Influence of context in contingent valuation : application to the monetary valuation of chronic obstructive pulmonary disease

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Influence of Context in Contingent Valuation - Application to the Monetary Valuation of Chronic Obstructive Pulmonary Disease

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Toutefois les propos qui suivent sont libres de tout contrôle et n'engagent que leur auteur et en aucune manière EIFER, ni ses membres (EDF, KIT).

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RÉSUMÉ

Influence du contexte dans les évaluation contingentes -
Application à l'évaluation monétaire de la bronchite pulmonaire chronique obstructive

Le recours de plus en plus fréquent à l'évaluation monétaire des impacts sanitaires permet de les intégrer aux processus de décision, souvent fondés sur des critères essentiellement économiques, et de prendre en compte les préférences des personnes concernées. Il conduit à s'interroger sur la fiabilité des méthodes et sur leur adaptation au contexte de la décision. Ce travail se propose de déterminer la robustesse des valeurs monétaires des impacts sanitaires estimées par évaluation contingente en traitant de la question suivante : la cause de l'impact sanitaire influence son évaluation ?

La théorie économique précise d'une part que l'évaluation d'un impact sanitaire ne devrait dépendre que de ses caractéristiques et non de ses causes, et d'autre part, qu'il faut fournir l'ensemble des informations nécessaires à l'évaluation. En pratique, les évaluations contingentes énoncent parfois des causes, avec des résultats variables.

Une évaluation contingente a été conduite pour analyser l'influence des causes de la bronchite pulmonaire chronique obstructive sur son évaluation, en comparant quatre versions du questionnaire : la cause n'est pas citée ; la cause est principalement imputable au tabac et à la pollution de l'air ; la cause n'est que la pollution de l'air ; ou que le tabac. Les résultats montrent que la mention des causes possibles et crédibles augmente l'acceptabilité du questionnaire. Lors de la détermination du consentement à payer, les divers contextes ont moins d'influence que les caractéristiques des personnes interrogées, en particulier leur santé et l'environnement (alimentation saine, activité physique, pollution du lieu de vie).

Par conséquent, fournir des informations sur les causes de l'impact sanitaire évalué permettrait d'améliorer la fiabilité de l'évaluation. Il faut noter que les incertitudes restent importantes, notamment parce que l'exercice reste inusité en France où la Sécurité Sociale couvre en grande partie les dépenses de santé.

Mots clés : Impact sanitaire, évaluation monétaire, méthode, pollution de l'air, aide à la décision

SUMMARY

Influence of Context in Contingent Valuation -
Application to the Monetary Valuation of Chronic Obstructive Pulmonary Disease

Monetary valuation of health impacts is increasingly used to support decision process, often relying mainly on economic criteria, and to take into account preferences of concerned people. This use leads to questioning the reliability of the methods and their adaptation to the context of decisions support. This work aims at determining the robustness of monetary values of health impacts estimated by contingent valuation via the following question: does the cause of the assessed health impact influence its monetary value?

Economic theory outlines that, on the one hand monetary value of an health impact should depend on its characteristics only and not on its causes, on the other hand all information useful to the valuation should be provided. In practice, contingent valuations sometimes state the causes, with inconsistent results.

A contingent valuation was conducted to analyze the effect of cause of chronic obstructive pulmonary disease, with four versions of the questionnaire: the cause is not indicated, the causes are said to be mainly smoking and air pollution, the cause is said to be air pollution only, and smoking only. Results show that stipulating the possible causes increases the acceptability of the questionnaire. The willingness to pay depends less on the causes but more on the personal characteristics of the respondents, especially their health and environment (healthy diet, sport practice, pollution in living area).

To conclude, providing information about the causes of the valued health impact would increase the reliability of the assessment. Uncertainties remain high in particular as this valuation stays unusual in France where the National Health Service covers most of health expenses.

Key words: Health impact, monetary valuation, method, air pollution, decision support

SYNTHÈSE

1. Introduction

1.1 Aide à la décision

La prise de décision, en particulier dans le cas de politiques publiques, nécessite d'appréhender les conséquences des différentes options de gestion. Si certains éléments tels que les coûts de mise en œuvre d'une mesure sont relativement facilement quantifiables, d'autres, tels que les conséquences sur l'environnement ou la santé, peuvent être plus délicats à inclure dans le processus de décision car ils sont multiples et exprimés dans des unités variées. La monétarisation de ces impacts permet de réaliser des analyses coûts-bénéfices facilitant ainsi l'évaluation et la comparaison des mesures.

1.2 Monétarisation et contexte

La théorie du bien-être a été développée dans le cadre de l'économie néo-classique pour intégrer les aspects environnementaux dans les décisions basées sur des critères économiques, tout en prenant en compte les préférences des personnes concernées (i.e. internalisation des externalités). La valeur monétaire d'un impact sanitaire est composée d'une partie directement observable sur les marchés : coûts de traitement ou d'absence au travail par exemple. Une autre partie, appelée *Pretium Doloris* dans le langage légal, et désutilité en termes économiques, fait référence à la souffrance consécutive à la maladie et ne peut être évaluée directement. Deux familles de méthodes ont donc été développées pour pallier ce manque : les méthodes basées sur les préférences révélées et celles fondées sur les préférences déclarées. La première famille de méthodes consiste à observer les comportements des personnes concernées sur des marchés existants pour en déduire une valeur pour la souffrance, tandis que les méthodes fondées sur les préférences déclarées visent à obtenir directement cette valeur à partir des déclarations des personnes concernées.

Parmi les méthodes à préférences déclarées, la méthode d'évaluation contingente repose sur une enquête dans laquelle un marché fictif est créé pour déterminer combien les personnes concernées seraient prêtes à payer pour éviter les conséquences néfastes de l'impact étudié.

Les personnes interrogées doivent avoir suffisamment d'informations pour prendre une décision éclairée, sans être submergées par ces informations. Il faut donc trouver un compromis entre fournir les informations nécessaires et ne pas influencer les personnes interrogées. Concernant le cas spécifique des causes, la valeur monétaire d'un impact sanitaire ne devrait pas dépendre du contexte car les effets n'en dépendent pas.

1.3 Méthode

Ce travail s'appuie sur l'étude conduite dans le lot 4 « monetary valuation » du projet européen HEIMTSA (Health and Environment Integrated Methodology and Toolbox for Scenario Assessment), auquel l'auteur a participé. Une évaluation monétaire d'une maladie liée à l'exposition à la pollution atmosphérique a été intégrée à ce lot afin de faciliter la révision de la directive européenne Clean Air for Europe. Une évaluation contingente a été conduite dans 6 pays (République tchèque, Royaume-Uni, France, Grèce, Allemagne, Norvège) pour en déduire une valeur de la souffrance liée à la bronchite chronique obstructive.

Cette étude terminée, une seconde vague d'enquêtes a été organisée dans plusieurs pays européens dans le but de tester certains aspects méthodologiques. Le travail présenté ici a été conduit en France.

L'objectif global de ce travail est d'étudier la cohérence entre le consentement à payer mesuré et la valeur monétaire recherchée, en se basant sur l'exemple de l'évaluation monétaire de la bronchite chronique obstructive. Cette question se décline en deux points :

- ✓ D'un point de vue théorique, mesure-t-on réellement la valeur souhaitée ?
- ✓ D'un point de vue pratique, l'enquête permet-elle d'évaluer le consentement à payer individuel de manière fiable ?

1.4 Structure

Une analyse de la littérature sur les spécificités de l'économie de l'environnement dans leur application aux impacts sanitaires liés à la pollution de l'air permet de donner des éléments de réponse à la première question.

Puis, une revue des pratiques passées et présentes de réalisation des évaluations contingentes, ainsi que les recommandations des guides méthodologiques, permettent d'en tirer des bonnes pratiques de réalisation de ces évaluations.

Enfin, une évaluation contingente a été réalisée pour tester ces principes en pratique sur le cas d'application de la valeur de la souffrance associée à la bronchite pulmonaire chronique obstructive liée à la pollution de l'air. Différentes variantes du questionnaire ont été analysées afin d'examiner si le fait de mentionner le contexte et les causes de cette maladie conduit à des évaluations différentes de la souffrance.

2. Économie de l'environnement et évaluation des impacts sanitaires

2.1 L'évaluation monétaire des impacts sanitaires

L'évaluation monétaire des impacts sanitaires permet de les prendre en compte dans le processus de décision au même titre que les autres éléments de décision tels que les coûts ou les investissements. Elle permet également de prendre en compte les préférences des personnes concernées sur les conséquences des maladies.

La santé peut être considérée comme un bien privé ou public, selon l'angle d'observation (Rozan and Willinger, 1999). L'état de santé d'un individu bénéficie principalement à lui-même, et la façon de le maintenir résulte considérablement de choix privés ; la santé est alors vue comme un bien privé. La santé peut être aussi envisagée comme un bien public quand il s'agit d'efforts communs pour maintenir la santé des populations, par exemple par des politiques publiques de vaccination, la subvention de la recherche médicale, ou quand il s'agit de conserver ou restaurer un environnement sain.

Les définitions des différentes composantes de la valeur monétaire d'un impact sanitaire sont variables selon les contextes et auteurs, ce qui rend leur comparaison difficile. Si les coûts liés à l'évitement ou au traitement de la maladie (traitements, vaccins etc.), à la valeur du temps perdu à cause de la maladie (travail, loisir, aide à la famille) peuvent être évalués en observant les marchés existants ; ceux liés à la souffrance ne le peuvent pas, pas directement du moins (Rozan, 2001).

Comme il n'existe pas de marché pour cette composante, sa valeur doit être déduite de l'observation d'un marché existant, en utilisant une méthode des préférences révélées, par exemple le prix des médicaments, des aides à domiciles. Une autre solution est de directement demander aux personnes concernées leurs préférences en créant un marché fictif pour ce bien, méthode appelée des préférences déclarées.

2.2 Évaluation contingente

Les évaluations contingentes (Pearce and Özdemiroglu, 2002) font partie des méthodes à préférences déclarées, elles consistent à demander à un échantillon représentatif des personnes concernées combien elles seraient prêtes à payer dans un scénario hypothétique. Les personnes interrogées ont le choix entre le statu quo sans augmentation des coûts, ou une amélioration de leur bien-être à un certain coût : il s'agit de leur consentement à payer. Une variante consiste à demander combien les personnes devraient être payées pour accepter une dégradation de leur qualité de vie définissant ainsi leur consentement à recevoir. Une bonne évaluation contingente doit être crédible, le scénario doit être accepté par les personnes interrogées, et il doit être compréhensible.

Des manquements à ces critères peuvent conduire à des biais (Pearce and Özdemiroglu, 2002), tels que le biais hypothétique (les personnes interrogées ne croient pas à la situation décrite et ne déclarent pas leurs réelles préférences) ou encore le biais d'information (les personnes interrogées ne comprennent pas les concepts traités). Les analyses des biais des méthodes à préférences déclarées montrent qu'un des enjeux principaux de l'évaluation contingente lors de la conception du questionnaire est l'équilibre concernant les informations fournies.

3. Évaluation monétaire des impacts sanitaires : l'importance du contexte

3.1 Les impacts sanitaires de la pollution de l'air

La pollution de l'air nuit à la santé humaine de diverses façons, notamment sur le système respiratoire, le système cardio-vasculaire ou la grossesse. Ces impacts sanitaires peuvent également être induits par d'autres causes : génétiques ou biologiques, économiques et culturelles, comportementales, liées aux services de santé disponibles. Les spécificités de ces co-impacts sont :

1. la pollution de l'air n'est le plus souvent qu'une cause secondaire (moins importante) des impacts considérés, le tabagisme est une autre cause souvent majoritaire de ces mêmes impacts ;
2. la pollution de l'air n'est en général pas observable à l'œil nu, donc parfois difficile à concevoir ;
3. les conséquences de la pollution de l'air sont quant à elles moins connues.

Lors de l'évaluation monétaire d'un impact sanitaire lié à la pollution de l'air, il faut s'interroger sur l'opportunité de contextualiser l'évaluation, et le cas échéant le type d'information : causes possibles de l'impact sanitaire, niveaux et origines de la pollution de l'air, niveaux de pollution néfastes. En effet, les informations que les personnes interrogées ont et celles qui leur sont apportées dans le questionnaire peuvent influencer leur évaluation.

3.2 En théorie

Pour évaluer correctement leurs préférences par évaluation contingente, les individus ont besoin d'un bien concret et spécifique. À travers le scénario, l'évaluation doit donc donner une description détaillée du bien et proposer une situation précise d'évaluation. La question est plutôt la qualité et la quantité d'information à fournir.

Les guides de réalisation (par exemple celui de la *National Oceanic and Atmospheric Administration* par Arrow et al. (1993)) d'évaluation contingente indiquent de la même façon qu'il faut donner des informations sur le contexte et le bien évalué de façon claire et compréhensible pour rendre le scenario hypothétique d'évaluation crédible, permettant aux personnes interrogées d'évaluer de façon pertinente de leurs préférences. Néanmoins, donner trop d'informations conduit à rendre confuses les personnes interrogées qui peuvent alors avoir des difficultés à comprendre et assimiler ces éléments, voire les influencer.

Indiquer les causes d'un impact est une spécification de la contextualisation : il s'agit de savoir s'il faut indiquer les différentes causes de l'impact sanitaire évalué et, le cas échéant, comment. Dans le cas de la pollution de l'air, les impacts évalués peuvent avoir des causes multiples qui interagissent de manière complexe.

Dans le cas d'un impact sanitaire lié à la pollution de l'air, ces considérations sur les quantités et types d'informations se reflètent dans le bien évalué : si les causes de l'impact ne sont pas décrites, on se rapproche d'un bien privé ; alors que dans le cas contraire il s'agit d'un bien public.

3.3 En pratique

Les pratiques actuelles d'évaluation contingente reflètent l'hétérogénéité et le flou des guides et théories.

Certaines évaluations fournissent un contexte détaillé et approfondi, exposant les symptômes et causes de la maladie évaluée, et faisant référence à l'état de santé des personnes interrogées, encourageant ainsi leur réflexion sur la maladie, ses conséquences sur leur vie quotidienne et ses causes. D'autres se limitent à une description succincte de l'impact évalué, laissant les personnes interrogées se référer à leur expérience. L'éventail des approches intermédiaires a également été utilisé, y compris ajouter les informations au cours du questionnaire.

Les différentes approches ont des avantages et des inconvénients. Donner beaucoup d'informations conduit à une évaluation plus consciente, permet de s'assurer que toutes les personnes interrogées se fondent sur les mêmes informations, et augmente la crédibilité et l'acceptabilité du scénario. Néanmoins, cette approche peut engendrer des biais : le biais d'information peut être prononcé et le rejet du scénario peut être important. Ne pas donner d'information évite ces biais mais risque de conduire les personnes interrogées à se baser sur des éléments fantaisistes, ou du moins pas ceux voulus, sans que l'évaluateur puisse le contrôler ni savoir ce à quoi elles ont pensé.

Les évaluations issues de ces questionnaires sont aussi diverses : certains auteurs observent une augmentation du consentement à payer alors que d'autres observent une diminution lorsque le contexte est donné. Certaines analyses montrent que, pour la mortalité, donner le contexte semble augmenter le consentement à payer.

Des analyses similaires dans le cadre de la méthode d'expérimentation des choix (Czajkowski et al., 2014, 2016), une autre méthode basée sur la révélation des préférences dans laquelle les personnes interrogées choisissent entre un ensemble de biens avec des propriétés différentes (dont leur coût), ont montré que donner des informations ne change pas les consentements à payer mais augmente la crédibilité et la fiabilité (baisse des intervalles de confiance).

En conclusion exposer le contexte, et surtout les causes, de l'impact évalué semble conduire à des évaluations plus robustes. Ce constat corrobore les recommandations des guides qui précisent la nécessité de donner l'ensemble des informations nécessaires à l'évaluation, sans préciser lesquelles ni de quelle façon. Néanmoins, la quantité d'informations, leur type et la façon de les présenter doivent être étudiés pour éviter de submerger ou d'influencer les personnes interrogées.

4. Étude de cas : évaluation contingente de la bronchite chronique obstructive due à la pollution de l'air

Afin de tester en pratique les hypothèses, une évaluation contingente a été réalisée. Elle est basée sur l'étude conduite dans le lot 4 « monetary valuation » du projet européen HEIMTSA (Health and Environment Integrated Methodology and Toolbox for Scenario Assessment), citée précédemment (Maca et al., 2012; Maca et al., 2011). Cette étude a évalué la valeur de la souffrance d'une maladie liée à l'exposition à la pollution atmosphérique, la bronchite pulmonaire chronique obstructive (BPCO).

4.1 La bronchite pulmonaire chronique obstructive

La BPCO est caractérisée par une détérioration progressive et irréversible des fonctions pulmonaires, provoquant des difficultés croissantes dans la vie quotidienne. Aucun traitement ne peut guérir la BPCO ni en stopper l'évolution, ils peuvent seulement en ralentir le développement et en atténuer les symptômes (toux, encombrement pulmonaire, difficultés respiratoires). La cause principale de la BPCO est le tabagisme, actif ou passif : environ 50 % des fumeurs vont développer une BPCO, et 90 % de BPCO sont dues au tabac. Les autres causes sont liées à une exposition professionnelle et à l'exposition à la pollution atmosphérique. La pollution atmosphérique affectant un grand nombre de personnes, il est pertinent de se concentrer sur la BPCO générée par cette pollution.

Des évaluations monétaires ont donc été conduites dans ce cadre, avec certaines lacunes, notamment en décrivant que peu ou pas l'impact. Une évaluation récente conclut à un coût annuel de la BPCO due à la pollution de l'air comprise entre 123,7 millions d'euros et 186 millions d'euros, et celui de la bronchite chronique à 113,4 millions d'euros (Rafenberg et al., 2015).

L'étude européenne HEIMTSA avait pour objectif une évaluation monétaire de la BPCO pour une utilisation dans le cadre de la réglementation sur la pollution de l'air. Or, elle ne mentionnait pas les causes de la maladie. Les campagnes d'information ces dernières années insistant sur les dangers du tabac, il est possible que les personnes interrogées aient fait l'association d'elles-mêmes.

La BPCO constitue donc un impact pertinent pour cette étude de par son importance pour la prise de décision sur la qualité de l'air ainsi que de ses causes multiples.

4.2 L'évaluation contingente

La méthode d'évaluation est une évaluation contingente des quatre stades de la BPCO, basée sur la méthode de la pilule magique : la personne interrogée détermine combien elle serait prête à payer un médicament (qui n'existe pas sur un marché réel) pour traiter intégralement et immédiatement la maladie évaluée.

Quatre variantes du questionnaire sont administrées :

- ✓ une ne donne aucun contexte, cette variante est très proche du questionnaire du projet européen HEIMTSA,
- ✓ la deuxième indique les deux causes majeures de la BPCO, le tabagisme et l'exposition à la pollution de l'air,
- ✓ la troisième ne précise que la pollution de l'air,
- ✓ la dernier ne mentionne que la tabagisme.

Le questionnaire est composé de cinq parties principales.

Après une introduction présentant les objectifs du questionnaire, la première partie s'intéresse à l'état de santé de la personne interrogée : maladies (dont respiratoires), visite aux urgences.

La deuxième partie présente d'abord l'impact étudié, les quatre stades de la BPCO : un jour de toux, une bronchite chronique (BC), la BPCO modérée (BPCOm), et la BPCO sévère (BPCOs) en en détaillant les symptômes, les traitements et les conséquences sur la vie quotidienne. Afin d'éviter que les personnes interrogées recherchent d'autres informations, les noms des différentes maladies n'ont pas été donnés, à la place des couleurs leur ont été attribuées (maladie jaune par exemple pour la bronchite chronique). Puis, selon la version du questionnaire, le contexte est détaillé.

La troisième partie est axée sur la détermination des consentements à payer pour les quatre impacts, en deux temps : une première question permet de déterminer si la personne interrogée est prête à payer pour acheter le médicament qui évite l'impact évalué (et si non pourquoi), puis le consentement à payer est évalué. Le consentement est déterminé en deux étapes :

1. Des montants sont d'abord proposés à la personne interrogée qui indique si elle accepterait de les payer pour acheter un traitement la guérissant complétement et immédiatement de la maladie évaluée. Cela permet de déterminer le montant maximal que la personne serait prête à payer et le montant minimal qu'elle ne serait pas prête à payer. Pour la toux, les montants correspondent à un paiement unique. Vu la gravité des autres maladies, les montants proposés correspondent à un paiement mensuel sur dix ans, comme une sorte de crédit. Si cette approche permet des montants plus réalistes compte tenu des maladies évaluées (notamment pour la BPCOs), il faut noter qu'elle est hautement inhabituelle en France et peut être donc difficile à comprendre pour les personnes interrogées.

2. Il est ensuite demandé à la personne interrogée d'indiquer quel montant précisément elle serait prête à payer, en une fois pour la toux et mensuellement sur dix ans pour les trois autres maladies. Il faut noter que si la personne donne un montant hors de l'intervalle déterminé précédemment, cet intervalle lui est rappelé et il lui est proposé de modifier sa réponse ou de la confirmer.

Il avait été observé dans l'étude européenne HEIMTSA qu'un certain nombre de personnes revoyaient leur consentement à payer à la baisse lors de la seconde étape. Couplé à la nouveauté de ce genre d'exercice pour la majorité des français, le choix a été fait de considérer la première étape comme une étape de réflexion et d'analyser uniquement les résultats de la seconde.

La quatrième partie est constituée de questions de débriefing cherchant à préciser les pensées et raisons des participants, notamment concernant leur style de vie : régime alimentaire, habitudes sportives, statut tabagique, don à des associations caritatives, mais aussi façon dont ils ont appréhendé le questionnaire.

La dernière partie se concentre entre autres sur la situation socio-économique des personnes interrogées : sexe, âge, revenus personnels et du foyer, composition du foyer, profession, études.

Le questionnaire a été administré par internet à un échantillon représentatif de la population française de plus de 1000 personnes, réparties entre les quatre variantes. L'échantillon a été nettoyé pour enlever principalement les réponses inadéquates (par exemple celles montrant l'absence de réflexion de la personne interrogée), et celles des personnes déclarant un consentement à payer trop important (supérieur à la moitié des revenus mensuels du foyer). Les réponses des 984 personnes restantes ont été analysées.

Deux axes ont été étudiés. Dans un premier temps, l'acceptabilité du questionnaire a été analysée en se basant sur les acceptions pour payer, et les raisons pour ne pas le faire. Puis, les niveaux de consentement à payer et les facteurs les influençant ont été étudiés. À chaque fois, deux types d'analyses ont été réalisées : des analyses non conditionnelles et des modélisations économétriques pour prendre en compte plus de paramètres ainsi que leurs interactions.

4.3 Accepter ou non de payer

Lors de la détermination de son consentement à payer, la personne interrogée commence par déclarer si elle accepte de payer, et dans le cas contraire pourquoi. En effet, deux types de raisons peuvent conduire à ne pas accepter de payer :

- soit il s'agit d'une raison qualifiée de légitime, car elle préfère ne pas sacrifier une partie de son revenu pour obtenir le bien (ici le médicament) : « Je n'ai pas les moyens financiers », « Cette maladie n'est pas assez grave pour payer pour l'éviter », « Mes dépenses de santé sont déjà trop élevées », « Je n'ai pas ou peu de risque d'avoir cette maladie (pour CB, BPCOm, BPCOs) » ;

- soit la réponse est qualifiée de protestation, c'est-à-dire que la personne interrogée refuse de payer non pas parce qu'elle n'accorde pas une valeur suffisante à l'évitement de la maladie mais parce qu'elle rejette le principe de l'évaluation contingente, soit directement le questionnaire qui présente selon elle une situation peu crédible, soit le fait d'avoir à payer un traitement (plus encore en France où la Sécurité Sociale prend en charge une grande part des dépenses de santé) : « Je n'ai pas confiance en ce traitement », « Je ne devrais pas avoir à payer mes médicaments. »

L'analyse montre que plus la maladie est grave, plus les personnes interrogées sont prêtes à payer le traitement, excepté pour la BPCOs. Il semble que cette maladie apparaît si grave que les personnes interrogées supposent que le traitement est cher, et donc cherchent des alternatives. Le bon côté est que cette attitude révèle qu'elles ont considéré leur capacité de paiement avant de répondre.

L'influence du contexte se dessine sur la différence entre les raisons, légitimes ou de protestation, pour lesquelles les personnes ne payent pas : il y a moins de protestations lorsque le contexte complet est donné, puis seulement la pollution de l'air, puis seulement le tabagisme, puis aucun contexte. Il ressort que lorsque les causes de la maladie apparaissent crédibles, les personnes interrogées acceptent mieux le questionnaire, ce qui peut être un indicateur qu'elles acceptent mieux l'ensemble de l'exercice.

L'incidence du statut tabagique apparaît également dans des raisons pour refuser d'acheter le traitement. Les fumeurs affichent moins de réponses de protestation, alors que les anciens fumeurs protestent le plus. Les non-fumeurs ont un comportement intermédiaire. Une explication pourrait être que les fumeurs acceptent implicitement les conséquences et risques liés à leur comportement ou les sous-estiment, alors même que les anciens fumeurs qui ont arrêté peuvent l'avoir fait par crainte pour leur santé, voire parce qu'ils ont déjà expérimenté des effets négatifs liés au tabagisme. Ces résultats sont d'autant plus clairs lorsque les maladies sont dites être dues au tabac et, dans une moindre mesure, lorsque que le contexte complet est indiqué.

Les résultats de l'analyse conditionnelle (modèle probit) concordent avec ceux de l'analyse non conditionnelle. Comme pour l'analyse non conditionnelle, deux éléments ont été étudiés : d'abord sur la probabilité de payer, puis sur les raisons pour ne pas payer.

Le contexte et le statut tabagique ont peu d'influence sur la probabilité d'accepter de payer pour le traitement. En revanche avoir un revenu, un régime alimentaire sain, une mutuelle et faire des dons à une association caritative augmentent la probabilité de payer. Il semble donc qu'être conscient des questions de santé et essayer de la préserver augmentent la probabilité d'accepter d'acheter le traitement.

Concernant les raisons poussant les personnes interrogées à ne pas payer, leurs caractéristiques personnelles ont une importance majeure, en particulier leur statut tabagique. Dans ce cas, le contexte a aussi une influence notable puisque le contexte complet augmente là aussi la probabilité de raisons légitimes pour ne pas payer.

4.4 Consentement à payer

Les personnes qui acceptent de payer doivent ensuite déterminer combien elles seraient prêtes à payer. Une fois encore, les approches non conditionnelles et économétriques (modèle log-normal et Heckman) donnent des résultats cohérents.

Les niveaux de consentement à payer augmentent avec la sévérité de l'impact, ce qui correspond à la gravité des symptômes et à l'impact de la maladie sur la vie quotidienne.

Peu de différences sont observées entre les différentes variantes du questionnaire, et celles observées ne sont le plus souvent pas statistiquement significatives. Le statut tabagique des personnes interrogées influence leur consentement à payer. En effet, les fumeurs sont prêts à payer moins que les non-fumeurs, qui payent eux même moins que les anciens fumeurs. Cela rejoint l'attitude observée pour la probabilité de protestation contre l'exercice en lui-même.

L'approche par modélisation log-normale montre que les revenus plus importants (et niveaux d'éducation, liés aux revenus) augmentent leur consentement à payer des personnes interrogées, sauf pour la toux, maladie bégnine. De même, avoir arrêté de fumer augmente aussi les consentements à payer, ainsi que d'avoir un proche qui fume ou a fumé ; et ceci quel que soit le contexte exposé dans la variante du questionnaire. Les personnes interrogées déclarent également avoir pensé au tabagisme comme une cause possible de la maladie et avoir considéré cet élément lors de la détermination de leur consentement à payer. De plus les personnes qui ont un régime alimentaire sain et qui sont conscientes de la pollution de l'air indiquent également des valeurs de consentement à payer supérieures. Cela peut expliquer l'absence d'influence du contexte donné dans les questionnaires : les personnes interrogées l'ont peut-être reconstitué quel que soit le cas.

Le modèle de Heckman permet de considérer l'influence de l'étape de choix de payer ou pas sur le montant du consentement à payer. Il montre peu d'influence de cette première étape (sauf pour la bronchite chronique), confirmant ainsi que l'importance des revenus et d'être conscient des questions d'environnement et de santé influent majoritairement les consentements à payer, contrairement au contexte donné dans les questionnaires.

4.5 Évaluation de la souffrance associée aux maladies

Les consentements à payer (CAP) totaux, sur dix ans, ont été déterminés à partir de l'évaluation non conditionnelle et de la modélisation log normale. Ils sont présentés dans le tableau suivant :

	CAP (moyenne non conditionnelle)	CAP Modèle log-normal	HEIMTSA valeurs recommandées
BPCOs	25 962 €	10 695 €	65 841 €
BPCOm	16 266 €	8 713 €	58 362 €
BC	9 964 €	3 955 €	38 254 €
Toux	30 €	11 €	36 €

Ces valeurs sont plus faibles que celles déterminées dans le projet européen HEIMTSA (Maca et al., 2012; Maca et al., 2011), possiblement car les valeurs pour la France étaient dans ce projet plus faibles que celles des autres pays (excepté la République Tchèque). Une autre raison possible est l'importance des facteurs sanitaires et environnementaux dans la présente étude, donner le contexte a peut-être conduit les personnes interrogées à mettre en perspective leurs risques.

5. Conclusion

L'objectif de ce travail était de déterminer l'influence de la mention des causes de la maladie lors de l'évaluation par la méthode contingente de la souffrance qu'elle engendre. La question sous-jacente est la nature du bien évalué : la maladie en tant que telle, ou la maladie due à l'exposition à la pollution de l'air.

5.1 Principaux résultats et leurs limites

La revue de la littérature a montré que la théorie économique indique que la valeur accordée à un impact sanitaire ne devrait dépendre que de ses conséquences et non de ses causes ; mais aussi que l'ensemble des informations nécessaires à l'évaluation du bien doivent être fournies aux personnes interrogées pour qu'elles puissent déterminer leurs préférences de façon pertinente. Lors de la conception d'une évaluation contingente, il est donc nécessaire de déterminer le bon niveau d'information à fournir pour éviter les biais, notamment pour éviter d'influencer les personnes interrogées. Cependant, ne pas donner les causes empêche de contrôler ce à quoi les personnes interrogées ont pensé lors de l'évaluation, si elles ont envisagé une ou plusieurs causes, réelles ou non, et si ces opinions ont influencé leurs préférences ou leur consentement à payer. La littérature appliquée montre que différentes valeurs ont été mesurées pour un même impact selon les causes indiquées aux personne interrogées. Ces différences peuvent être dues à la façon dont les personnes interrogées perçoivent les causes et les risques associés. Les consentements à payer peuvent être donc influencés par la façon dont le questionnaire présente les cofacteurs de l'impact étudié. Lors de la conception d'une évaluation contingente, un compromis doit donc être trouvé entre une présentation exhaustive du bien évalué et l'obtention d'un questionnaire compréhensible et qui n'influence pas les personnes interrogées.

L'évaluation contingente conduite dans le cadre de cette étude vise à évaluer la souffrance due à la bronchite pulmonaire chronique obstructive, une maladie causée principalement par le tabagisme mais aussi par l'exposition à la pollution de l'air. Quatre variantes du questionnaire ont été utilisées, variantes différant par les causes données : aucune, toutes (tabagisme et pollution de l'air), pollution de l'air uniquement, tabagisme uniquement.

Les résultats semblent conformes à la littérature : donner le contexte complet et crédible augmente l'acceptabilité du questionnaire sans influencer les valeurs du consentement à payer, conduisant ainsi à une évaluation plus robuste. Il faut noter que les informations fournies dans cette évaluation restent simples. De plus, bien que différant dans leur essence (fumer est un choix, être exposé à la pollution de l'air ne l'est pas), les causes de cet impact restent similaires dans leur mode d'action (maladie respiratoire se déclarant après un long moment d'exposition) et peuvent être déjà connues des personnes interrogées, notamment grâce aux campagnes de santé publique.

Les autres éléments qui influencent les préférences des personnes interrogées sont leur statut tabagique : les fumeurs sont prêts à payer plus que les non-fumeurs, qui eux-mêmes payent plus que les anciens fumeurs. Cela peut être dû au fait que les fumeurs sont soit conscients des conséquences de leur habitude et l'acceptent, soit le nient totalement ; alors que les anciens fumeurs ont fait l'effort d'arrêter soit par crainte des conséquences pour leur santé, soit parce qu'ils en ont déjà souffert. Dans le même esprit, les personnes qui font attention à leur santé par leur régime alimentaire ou la pratique d'une activité sportive ont également des consentements à payer plus élevés.

Certaines limites persistent dans cette évaluation.

Tout d'abord, les causes elles-mêmes sont quelque peu spécifiques. Les effets néfastes sur les fonctions respiratoires du tabagisme comme ceux de la pollution atmosphérique sont largement connus, il est donc possible que les personnes interrogées aient, consciemment ou inconsciemment, eu ces éléments en tête lors de la détermination de leur consentement à payer, brouillant ainsi l'influence des éléments apportés par le questionnaire.

Un autre aspect concerne la façon dont les valeurs extrêmes influencent l'évaluation des consentements à payer globaux. Ces valeurs sont dues aux personnes ayant les revenus les plus élevés, qui peuvent donc en sacrifier une partie importante pour rester en bonne santé. Si ce n'est pas un biais en soi, ce paramètre peut ajouter un bruit de fond à la détermination des consentements à payer et des paramètres l'influençant. Ce point peut également jouer un rôle lors de l'agrégation des contentements à payer en une valeur globale. En effet, la même utilité marginale est supposée pour toute la population, sans correction pour prendre en compte les différences de revenus.

Enfin, le contexte et les causes de l'impact étudié ne sont qu'une des sources possibles d'influence des préférences et des consentements à payer qui en découlent. Les différences de comportements entre les fumeurs, anciens fumeur et non-fumeurs pourraient être liées à des façons différentes d'appréhender les risques. Ces différences pourraient se retrouver entre d'autres catégories.

5.2 Recommandations

Nous interprétons la littérature comme recommandant de fournir le contexte complet et crédible, de façon suffisamment simple pour éviter d'influencer les personnes interrogées.

Lors de la détermination de la valeur de la souffrance associée à un impact sanitaire par évaluation contingente, nous suggérons de fournir un contexte simple et réaliste mais complet, incluant donc les causes de l'impact sanitaire, pour s'assurer que l'ensemble des personnes interrogées ait les mêmes informations. Cette pratique améliore l'acceptabilité de l'évaluation sans influencer notablement les valeurs des consentements à payer. Il faudrait également vérifier les caractéristiques des personnes interrogées concernant les aspects liés à la santé et à l'environnement, tels que leur régime alimentaire, leur pratique sportive, leur historique tabagique ; ces éléments influençant leurs préférences.

Enfin, lors de l'utilisation de ces valeurs dans des analyses coûts-bénéfices, il serait tout d'abord souhaitable de veiller à ce que l'impact évalué soit bien défini selon les mêmes critères lors des différentes étapes. De plus, il faut s'assurer que les caractéristiques de la population cible de l'analyse coûts-bénéfices soit cohérentes avec les caractéristiques de la population dans laquelle les valeurs monétaires ont été déterminées.

5.3 Perspectives

Il serait intéressant d'étudier plus en détails l'influence sur le biais cognitif des caractéristiques des personnes interrogées qui pourraient surpasser les éléments donnés dans le questionnaire lui-même. Dans notre cas, les personnes interrogées semblent avoir une illusion de contrôle sur la maladie.

Les déterminants des résultats des évaluations monétaires restent volatiles et difficiles à appréhender, notamment à cause des interactions entre les caractéristiques de l'impact évalué et des personnes interrogées, renforcé par la difficulté de l'exercice pour des personnes ayant le plus souvent leurs dépenses de santé couvertes par la Sécurité Sociale comme en France.

Dans le cadre d'une utilisation de ces valeurs dans les analyses coûts-bénéfices, il faut garder en tête que les incertitudes liées à ces évaluations sont importantes. Il est délicat de tirer des conclusions lorsque les différentes options ont des valeurs totales proches. De plus, les ressources financières disponibles étant limitées, il est parfois impossible de mettre en œuvre des actions qui auraient pourtant une balance coûts-bénéfices favorable. Il peut donc s'avérer pertinent de considérer également le budget disponible lors du processus de décision pour mettre en place des politiques à la fois efficaces et abordables.

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Air pollution: a major stake for public health

Impacts and sources

Impacts of air pollution on health are now fully recognized, as stated by the World Health Organization (2018a): “Updated estimations [in 2018] reveal an alarming death toll of 7 million people every year caused by ambient (outdoor) and household air pollution.” Air pollution, as specified in Appendix 1, can induce or worsen cardiac conditions (such as (Miller et al., 2007): arrhythmia, atherosclerosis, thrombosis, myocardial infarcts), lung cancer and other respiratory diseases such as asthma and bronchitis. Therefore, air pollution is now a major cause of environmental mortality and morbidity in the world, and is considered as being the first non-accidental cause of death in cities. These externalities (cf. box 1) induce costs: medical cost, but also lost of working time, and welfare. Health impacts have many forms and consequences, from consultations to doctors to pain and suffering, and potentially death. Moreover, impacts of air pollution extend beyond health: for example, biodiversity also suffers, or buildings would need cleaning.

Box 1: Definitions

Externalities or External effect (Faucheux and Noël, 1995; Kermagoret, 2014): consequences of one economical agent’s activities to another without compensation. It is named positive externalities when it gives an advantage to the receiving agent, a negative externalities if it give him a disadvantage such as health degradation.

External costs (European Commission, 2005): “an external cost arises, when the social or economic activities of one group of persons have an impact on another group and when that impact is not fully accounted, or compensated for, by the first group.”

Cost-Benefit Analysis - CBA (Pearce et al., 2006): “The essential theoretical foundations of CBA are: benefits are defined as increases in human wellbeing (utility) and costs are defined as reductions in human wellbeing. For a project or policy to qualify on cost-benefit grounds, its social benefits must exceed its social costs.”

Nearly all human activities cause air pollution such as transport, industry, or energy production, cooking and burning wastes. However, there are also natural emissions such as erosion of soils or volcanoes. Depending on the geographic area (rural vs. urban), the sources differ and mix together. For example, in Western cities, important in-cities sources of air pollution are traffic and energy production, those emissions mix with so-called background emissions coming from other areas of the world. Therefore, air pollution is a complex mix of local and worldwide pollutants.

Management of air pollution

Whereas natural sources of air pollution may be quite difficult, if not impossible to decrease, anthropogenic ones should be reduced or suppressed as far as possible. Target concentrations on various pollutants have been set to reach gradually acceptable air pollution concentrations. Indeed, air pollution is toxic at any level; the aim of environmental politics is to lower the exposure levels so that consequences of air pollution are only slightly higher than the ones of natural causes. These concentrations limits are of two kinds. On the one hand, maximal concentrations in atmospheric air are defined for main pollutants, so population exposed to these concentrations suffers as little as possible from negative effects. For example, the World Health Organization (2016) gives the following guidelines for fine particles ($PM_{2.5}$): 10 µg/m^3 annual mean; and 25 µg/m^3 24-hour mean. On the other hand, emissions of various sources are regulated; for example, the EURO-Norm restricts emissions of cars in Europe. Emissions of industries are also limited by national, European and international laws. For both emissions and concentrations in the environment, decreases are planned over time.

Health impacts due to exposure to air pollution

As previously stated, air pollution has a major impact on human health. Health Impact Assessment (HIA) method is used to determine the proportion of the exposed population affected by a definite air pollution situation (cf. box 2). The situation can be the current one, future, or hypothetical (what would happen if the pollution levels were lower?).

This method assesses how various air pollutants' concentrations affect exposed populations. When the concentrations are linked to emissions and ultimately to projects, the health impacts of these projects can be assessed, ex ante (for example to choose between different scenarios) or ex post.

Box 2: Health impact assessment, the example of air pollution

An impact assessment study can be conducted to determine the consequences of a situation (current or future) on human health, i.e. assessing the part of the exposed population who will be affected by exposure to air pollution.

The impact pathway approach (cf. Figure 1), as described in the ExternE methodology (European Commission, 2005), allows to assess the impact of the exposure to air pollution, and then to determine the associated monetary value.

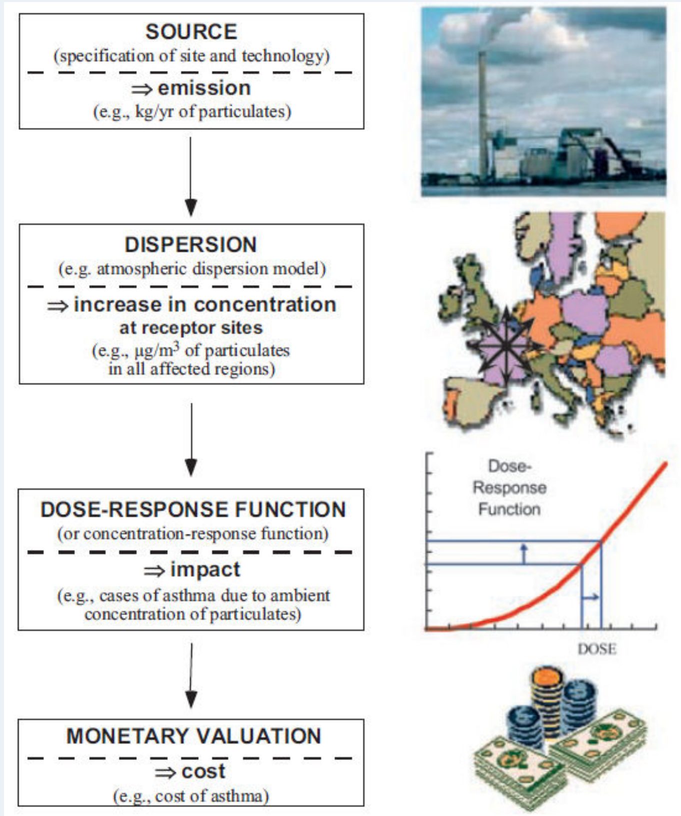


Figure 1: Health Impact Assessment followed by monetary valuation, example of air pollution (European Commission, 2005)

An example: air pollution in Strasbourg

A study was conducted in 2015-2016 on a district of the French city of Strasbourg by a consortium of partners with multidisciplinary competencies (Payre et al., 2017): European Institute for Energy Research (EIFER), Alsace Air Quality Agency (ASPA – Atmo Grand Est), Strasbourg Eurométropole (EMS), Medical Service of EDF, Group AIR - Atmosphere, Impact & Risk from Ecole Centrale de Lyon and Pascal de Giudici (consulting). The city of Strasbourg rehabilitates a former industrial neighborhood into a mix-use one (tertiary activities, services and residential buildings), with major changes into the transport network (including an increase in public transportation) and the energy production system (especially developing the district heating network). This district is next to the city center, and closed to densely populated residential areas.

An analysis method has been developed to support the needs of city, from the conception of its plan to its assessment. It is made of methods specific to each field, as shown in Figure 2. Emphasis is given to energy production (including district heating) and mobility, which are the two main sources of air pollution in cities, in order to determine the consequences of urban planning on air quality and health at city scale.

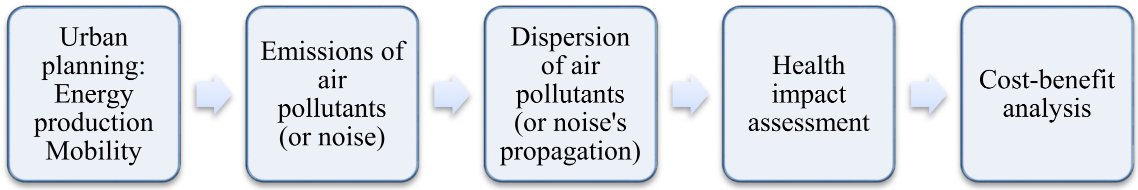


Figure 2: Study process to support the city from the conception of its plan to its assessment

The first step consists in an analysis of the current situation and of the urban development project, using urban planning reference documentation. The objective is to define, in collaboration with the city stakeholders, the evolution of the district. Indeed, many regulations from European to local ones applied, as well as some plans such as the urban mobility plan (*Plan de déplacement urbain*) or the energy, air and climate plan (*Plan climat-air-énergie territorial - PCAET).* For example, the PCAET is mandatory for large cities and its decisions apply to all projects in a territory. In this case, traffic's reduction was an objective, so development of public transport and reduction of parking places were planned, among other measures. The evolution of the car fleet according to European regulation was also taken into account. Regarding energy, the development of renewable energy, including the expansion of wood district heating and the use of geothermal energy were chosen to fulfill national and local objectives. Moreover, the refurbishment of buildings was also considered. This leads to three scenarios at 2030 horizon: 1) business as usual, 2) environmental - realist, 3) environmental - utopist (all the measures to the most environmental friendly possibility). After the scenarios have been defined, and their consequences modelled:

- ✓ Consequences on the traffic, by modelling the number of cars in each road, according to the three scenarios.
- ✓ Consequences on the energy production system, by modelling its evolution: stopping (virtually) older systems and establishing the evolution of the systems (i.e. new production profiles) to match the needs.

The second step is the determination of the pollutants' emissions of each scenario, using literature data and emissions registries, including emissions from other sources near or far from the city, with the support of ASPA and Centrale Lyon. Indeed, in France, emission registries are maintained by the Air Quality Agencies. Using them allows a better analysis of the actual emissions. Moreover, ASPA also developed an algorithm to better fit emissions from simulated traffic modelled to realistic data. Centrale Lyon also developed a program to re-construct the roads network as shown in Figure 3. EIFER worked with EMS on traffic and energy scenarios, and determined energy emissions values.

Figure 3: Roads and energy production - sources considered in the case study (© Centrale Lyon)

Then, the next step is modelling the dispersion of pollutants in the city, with two Gaussian air pollution dispersion models, as shown in Figure 4. ASPA used ADMS Urban[1], whereas Centrale Lyon and EIFER used SIRANE (Soulhac et al., 2011).

Figure 4: Particles concentration in Strasbourg – transport and energy production - 2030

The last step is assessing the resulting health effects, with a focus on vulnerable people (kids, elderlies and ill people) using human health risk assessment method and health impact

[1] Cambridge Environmental Research Consultants Limited. ADMS Urban Copyright©. Cambridge Environmental Research Consultants Limited, 2016.

assessment by the Medical Service of EDF and EIFER. The environmental - utopist scenario results in, in 2030:

- ✓ $\Delta PM_{2.5} = 0.65\ \mu g/m^3$ => 12.4 [4.2 – 22.1] avoided deaths per year (all causes >30 years old).

  Among which 6% due to the specific measures taken by the city, the rest is due for example to evolution of the car fleet.

- ✓ $\Delta NO_2 = 5.84\ \mu g/m^3$ => 45 [29 – 61] avoided hospitalizations for respiratory causes per year.

  About 4.5% due to the specific measures taken by the city, the rest is due for example to evolution of the car fleet.

In this case, traffic is responsible for a large part of air pollution and of the associated health impacts. Holistically, the evolution of one city district has a limited influence on the overall city.

The study also valued the cases of chronic bronchitis due to exposure to $PM_{2.5}$ on adults over 27 years old. The number of avoided cases, per year, is 1 for the scenario “environmental - realist”, and 10 for the “environmental - utopist”, this range highlights the influence of various possibilities.

From a methodological point of view, this approach allows choosing, between realistic scenarios, the one with the lowest impacts on air quality and health. However, the scenarios are only compared on these two aspects: it does not account for other consequences of air pollution such as impacts on crops or on buildings. Moreover, many indicators are determined for health only. Lastly, it does not take into account for the limits of decreasing air pollution’s emissions such as technological barriers (the only remaining technological solution to decrease emission is closing the sources, e.g. a factory); or economic ones (some technological solutions exist but are so costly that their implementation would not be economically sustainable). Regarding the second aspect, some examples are: i) increasing the prices of energy to a point that fuel poverty affect more people, ii) closing industries leading to unemployment; iii) forbidding craft woodstoves could lead to difficulties for cooking (assuming such regulation would be indeed applied). In short, air pollution has to be decreased with measures limiting unwanted side effects.

Identifying and quantifying the whole set of (or as many as possible) impacts and externalities due to air pollution gives the possibility to better consider them in the decision-making process and to contrast them with others such as impacts of climate change. However, these dimensions may be difficult to consider as comparing different outcomes from various impact assessments may not be straightforward. In this scheme, the monetary valuation of these impacts adds the possibility, first of valuing all impacts with the same metrics; second to compare their investments to conduct cost-benefit analyses.

It is worthy noticing that other methods also exist to take into account multiple indicators and dimensions in the decision process without monetary valuation. The Multi-Criteria Decision Analysis (MCDA) method is one of these. As explained in NEEDS (Makowski et al., 2006): *"MCDA is intended to assist decision-makers in several different ways, according to the main problems experienced in making decisions on complex systems. In particular, the goal is to help make the decision-making process structured, explicit, clear and correct, so that not only is the ranking of alternatives right for each decision-maker's preferences, but the entire process serves as a clear basis for debate with others."* The multi-criteria decision analysis method is based on preferences of the stakeholders and accounts for many the aspects of the question, even the non-monetarily valuated ones. This method can be an alternative to monetary valuation for impacts which are not usually quantified in monetary units. However, one advantage of monetary valuation is to take into consideration the opinion of the concerned population, and not only of stakeholders or experts, when taking a decision.

Monetary valuation of health impact

Advantages of monetary valuation

As previously mentioned, it is important to assess all the related benefits and costs and not only the commercial ones, for highlighting the best option from the society's point of view when designing public policies. In this context, accounting for the externalities is of importance: if they are not taken into account, policies could be conceived in a not optimal way regarding society's preferences, and could thus be implemented although they may have harmful consequences.

Weighting the different impacts (on health or else) may be easier when they are all expressed in the same monetary unit. First, it is something everyone is familiar with; second, it allows comparison with other elements such as the cost of a project or the cost to cure an illness with the method called Cost-Benefit Analyses (CBA). So CBA are also used to define environmental and health policies to avoid the implementation of inefficient or harmful policies. Moreover, it allows to choosing to implement first the most efficient measure: it means to be able to determine and order possible actions to assess the respective benefits and to keeping the measures within manageable limits for the cost-bearers. Incidentally, the local authorities usually conduct these studies.

Monetary value, pain and suffering

Consistency has to be kept all over the chain of impact assessment. In the context of this work, it means that the health impacts have to be the same all along the assessment process (cf. Figure 1). Epidemiology usually precisely defines the health state it assesses as these studies are usually conducted by medical doctors. However, this may be more difficult when it comes to monetary valuation.

The theoretical basis of the monetary valuation of health impacts is part of neoclassical environmental economics and, more precisely, the welfare theory, which was developed in order to integrate environmental issues into economic policy (see for example Mitchell and Carson (2005) or Gurjar et al. (2010)). It should be noted that the methods for monetary valuation of health impacts were developed in the scope of environmental economics and are therefore, from a theoretical point of view, specific to environmental-related health effects.

According to the theory, and as described in the first chapter (I), the value of a health state is linked to two parts. Some consequences of air pollution externalities have costs on a market: cost of the medical treatment, of missing work, possibility of help with kids or household tasks, etc. Other consequences do not have marketed costs, in the case of health mainly: pain and suffering. The former can be determined by observing the concerned markets. The later can be deduced from observation of an existing market (for example, value of safety for kids riding bicycles may be deduced from the prices of helmets), with so-called revealed preferences methods; or to be calculated by creating a fictitious market in a survey, called stated preference methods.

Among the various stated preference methods, contingent valuation is widely used, and is the focus of this work. Carson et al. (2003) define the contingent valuation as a survey approach designed to create the hypothetical market for public goods, by presenting consumers with a choice situation, in which they have the opportunity to pay for or sell the above-mentioned public goods. The survey seeks to reveal how much respondents would agree to pay for an improvement of the good being valued by asking them what is called their willingness to pay (WTP).

Contextualization in stated preference methods

In order to value the intended health state, the survey has to comply with economic theory, which, as it will be highlighted in the second chapter (II), may be a bit fuzzy when it comes to define the information to be given about the valued good. Moreover, it has to be done in an understandable way for the public. It raises a question regarding stated preferences methods including contingent valuation: how much information are needed for the respondents to determine an accurate (or as accurate as possible) value?

There are various environmental, behavioral, and genetic (among other) factors that have the same health impacts as air pollution, and that are called cofactors. The question of context in contingent valuations surveys can be described in the following way: when conducting the survey, should the context of what is being valued be given? The issue of contextualization and the issue of cofactors are two points that deserve attention, since they could be two means to make contingent valuation more robust; while being at the same time a potential source of bias. For example, it is well recognized that the values accorded to a death may vary depending of the causes of the death, especially between accidental death, which often concerns younger people, whereas illness-related death concerns mainly older people.

Concerning health impacts of air pollution, the question is whether to provide or not respondents with some information on the context of air pollution (such as the level of pollution or the sources of pollution). It is hereafter considered that "contextualization" is synonymous with providing a given type of information.

Approach

Background

Contextualization in contingent valuation may allude to information about the good valued, in the present case a health state. It may also refer to how the valued good, here health, is damaged. Last, it may mean how to improve the valued good. The focus of this work will be on the second option.

The review of literature shows that, to value pain and suffering due to health state, at least some context should be given to ensure the studied health state is valued, meaning the respondents made informed decision. Indeed, to properly value the health state, respondents have to know and understand it, even though most of them did not experiment it (at least not directly). Therefore, the survey's questionnaire has to give respondents enough information without overloading them, ensuring that what is measured is what is wanted and not some random construction of the respondents' mind.

Box 3: HEIMTSA

The HEIMTSA (Health and Environment Integrated Methodology and Toolbox for Scenario Assessment) project, funded by the European Union, aimed to develop and apply new integrated approaches for the assessment of environmental health risks in support of European policy in transport, energy, agriculture, industry, household and waste treatment and disposal.

The work stream 4 (called Monetary Valuation) was devoted to economic valuation and was part of the work to update the assessment of air pollution in Europe and the respective regulation of air pollutants emissions. A study has been conducted to monetary value impacts of air pollution on health via the use of the contingent valuation method. The four stages of Chronic Obstructive Pulmonary Disease (COPD) were described, with the effects and probable evolution (without any causes indicated in the survey), and valued with contingent valuation stating that a treatment will cure the illness ("magic pill" approach, developed by Krupnick and Alberini).

The official partners of this study were: Charles University Environment Centre (Czech Republic), Institute of Occupational Medicine (United Kingdom), Department of Economics & International Development (United Kingdom), Norwegian University of Life Sciences (Norway) and Sweco Norge (Norway). The author, as a researcher of EIFER, has taken part to this project. EIFER is not an official partner but was asked to participate on a non-contractual basis[2] (Maca et al., 2012).

[2] Maca, V., Payre C. and Scasny M. (2012). Valuation of chronic respiratory illnesses: 6-country study. European Association of Environmental and Resource Economists. 19th Annual Conference. Prague.

This work is a follow up study of the HEIMTSA project (cf. box 3). It is based on the observations done during the survey and uses the questionnaire developed then as a basis. It concerns the influence of providing the context and cofactors during the contingent valuation process, on monetary valuation of Chronic Obstructive Pulmonary Disease (COPD[3]). The main causes of COPD are smoking (90%) and air pollution, whereas 50% of smokers develop a COPD. The HEIMTSA survey studies COPD caused by air pollution, without providing this information to the interviewees. However, tobacco can be a confusion factor because it is by far the first cause of COPD. Therefore, COPD is a relevant health endpoint to study the influence of cofactor on monetary valuation.

The chosen valuation method is contingent valuation of COPD first because this study was a follow-up of the European project HEIMTSA, second and foremost because this allows testing our hypothesis:

- ✓ Contingent valuation is a stated preference method: respondents need to imagine a fictitious (i.e. contingent) situation and directly express their preferences in monetary unit. So the behaviors observed in the contingent valuation survey may represent reliably the reactions and preferences of the respondents to different valuation context. Consequently contingent valuation may allow to draw some broad conclusions on the influence of context in stated preferences methods overall, and generally monetary valuation.
- ✓ COPD is a multicausal illness, with two clear main causes: smoking and exposure to air pollution. It is consequently adapted to this study.

Research question

The main aim of this work was hence to study the influence of contextualization on monetary valuation of health impacts of pollution within the framework of contingent valuation, and to improve the robustness of the results through reducing bias.

Consequently the research question is the following: How to better align WTP measurement to health impact value? A focus on the influence of information given in the contingent valuation is performed.

The purpose is to determine whether giving additional information regarding the causes of the valued health state to the respondents influences their valuation, and consequently to check the level of information to reliably value the right health state. If the causes and some context are given, would the respondents better express their preferences? Including contextualization in the description of the health state should improve the reliability of the valuation. All respondents would have the same level of information, and a better knowledge of the good.

[3] This illness is characterized by an irreversible deterioration of lungs, which worsens over time. The symptoms begin with cough, sputum, and shortness of breath, which exacerbate until leading to incapacitation of daily life. Cf. Chapter 3-B-2.1 and Appendix 1.

The analysis will tackle two aspects:

- ✓ On the theoretical side, the first objective of this work is to determine what kind of good has to be valued: the health state per se or the health state due to an environmental exposure with its causes? The aim is to determine how to value at best the good (in our case a health problem).
- ✓ The consequence, on an applied side, is to determine whether the causes and cofactors of the illness should be given in the contingent valuation.

For the applied side, a contingent valuation survey based on the HEIMTSA questionnaire was conducted, with a description of the causes of the health state. Some respondents got no explanations about the causes, some have full explanation, some have only air pollution as cause, and some has only smoking as cause.

The analysis will focus on the impacts on the respondents' preferences, or more precisely their expressed preferences, depending on the variant of the questionnaire they got. These differences may obviously appear in the value of the expressed WTP, which would reflects a change of the preferences depending on the cause of the illness; but also on the precision of the WTP (with the analysis of confidence interval for example) or the acceptance of the overall contingent valuation, which would means contextualization leads to more accurate WTP.

Structure

During this work, these questions were addressed through (1) an analysis of the theoretical and applied literature and (2) an empirical approach.

Chapters I and II are about the analysis of the literature. The first chapter describes the main aspects of environmental economics to highlight the specificities of health impact monetary valuation, meaning especially its multi-dimensional aspects, from cost due to sick leaves to pain and suffering. The second chapter deals with the actual practice regarding context and causes in monetary valuation, focusing on contingent valuation study. It analyses the guidelines given by the main institutions, as well as some studies to summarize the main recommendations.

Lastly, chapter III deals with the survey. This contingent valuation aims to test in an actual survey the effects of the information provided in the survey. First, the health state (COPD) and its current monetary values will be reviewed. Then the method used and the questionnaires will be described. Finally, the results will be analyzed to assess potential discrepancies depending on the context and causes of the illness.

I. ENVIRONMENTAL ECONOMICS: MAIN DEFINITIONS AND STAKES

A. Introductory remarks

In this first chapter, the key aspects of the monetary valuation of health impacts will be reviewed as basis for the rest of this work. Indeed, the diversity of terminology used by the various actors, as well as the multitude of methods developed to answer specific questions, may lead to confusion. It allows tackling the specificities of health impact monetary valuation. Indeed, health related cost are multidimensional: linked to the sick leaves, medicines buying, pain, replacement for taking care of the family, etc. The cost associated to a health state may vary a lot between countries with the structure of the health care system, which might lead to confusion reading the vocabulary used to define its different components. Moreover, the pain and suffering part touches very personal conception of priorities and life conception.

This literature review begins with the more generic context of environmental economic to focus then on contingent valuation. First, the place of monetary valuation of health within environmental and welfare economics will be clarified. Then, several methods to assess health impact monetary valued will be reviewed. Finally, emphasis will be placed on the method studied here: contingent valuation.

B. Health and environmental economics

1. Welfare, utility and public good economics

The aim of this section is to give an overview of the economic theory that applies to our subject and to redefine the important notions. We will particularly focus on the application in the field of health impacts of air pollution.

Public goods economics is a tool for decision-making. Economists use it to see how people give importance on things in life and how they sort their preferences. Mitchell and Carson (1989) describe it as such: “welfare economics […] seeks to make judgments about the desirability of having government undertake particular policies, or, put in another way, how the world could work”. Bénicourt (2008) justifies the development of the notion of welfare by economists by the fact that human activities produce externalities which lead to market failure. Public authorities must therefore act in order to bring back the balance to (try to) restore welfare of the individuals.

1.1 The notion of welfare

1.1.1 A welfare theory?

Roos (1973) highlights that “there exists no generally accepted and coherent theory of welfare, only fragments and ‘overdeveloped’ areas” and cites welfare economics as one of them. In the literature, the theory of welfare actually often refers to welfare economics. However, it is a notion that has several definitions. Indeed, Roos (1973) outlined that “there is no single, unitary concept of welfare, rather it consists of a widely varying collection of aspects, components or dimensions”. Furthermore, many words refer to it: “in speaking of welfare, it is possible to utilize many different names to fulfill the same purpose. We can speak of the enjoyment of value; we can speak of the good life, health, well-being, the ends of man and society, of interest, and so on”. The term “well-being” deserves particular attention. Indeed, it appears that, in the literature, a distinction exists between “welfare” and “well-being”. According to Van Praag and Frijters (1999), “welfare is the evaluation assigned by the individual to income or, more generally, to the contribution to our well-being from those goods and services that we can buy with money”. For them, economists traditionally reveal welfare through income. As for well-being, they state: “next to material resources, we have other aspects which determine the quality of our life. We can think of our health, the relationship with our partner and family and friends, the quality of our work (job satisfaction), our political freedom, our physical environment, etc. We shall call this comprehensive concept well-being or quality of life”. Yet, in spite of this theoretical distinction, most of authors interchangeably use both appellations and it will be assumed in this work that they are synonymous.

1.1.2 The multidimensionality of welfare

In addition, welfare shows itself to be multidimensional. Indeed, Ross (1973) argues that “it seems untenable to assert that, for instance, education, power, freedom, justice, etc., would not, in actual fact, be aspects of welfare, but something external to it”. According to him, it is natural to consider freedom as one dimension of welfare, justice as another, and so on. To expand his statement, he cites several authors who previously presented their multifactorial view of welfare. First, Lasswel and Kaplan (1950) enumerated the following welfare values: “well-being, health and safety of the organism, wealth, skills, and enlightenment”. Then Russel (1952) declared that man’s happiness depended on “food and a place to live, health, love, successful work, and respect enjoyed in a man’s own sphere of life”. Eventually Lenski (1966) stated there are five main ends of man, namely “survival, health, status or prestige, creature comfort and affection”.

It is noticeable that health appears in each of these descriptions; Roos (1973) corroborates this as he views health like one of the most central conditions relevant to welfare, which he considers, in turn, as the ultimate end of health policies.

Welfare economics is therefore the part of economics that is used to analyze society and to evaluate the effects of changes for individuals or the society as a whole, despite the fact that welfare is rather an open notion - since there is no dominating definition for it. Yet, welfare economics is at the base of stated preference techniques, and methods like Contingent Valuation Method (CVM, cf. I 3) find their roots in it.

1.2 Utility

When it relates to welfare, utility refers to a measure of the satisfaction inferred by the consumption of a good in comparison to another (Bénicourt, 2008). Utility is not a measured function of a mathematical unit but is deduced from the observation of someone's preferences for a good compared to another one (Feldman and Serrano, 2006). These authors argue that doing so "[allows] you to construct a numerical measure to reflect tastes. The determination of best alternatives and the construction of a measure of satisfaction are both made possible by the completeness and transitivity assumptions on preferences". Bénicourt (2008) explains that the numerical measure reflecting preferences that is mentioned is called "utility function" and allows classifying (and thus comparing) the goods according to the consumer's preferences. Hence, when making a choice in order to get the maximum of satisfaction, the consumer classifies all the possible alternatives and then chooses the highest one in the classification, considering his own wealth (Bénicourt, 2008).

When it comes to the collective welfare, the utility function reaches its limits: it is not possible to create a utility function for collective preferences. Indeed, as reported by Mitchell and Carson (1989): "Arrow showed that there was no nondictatorial way to aggregate preference into a social welfare function that did not violate a few simple and quite desirable axioms of behavior and choice". This is known as Arrow's impossibility theorem. Consequently, other methods have been discussed and developed and the one that is now mainly used is the Pareto criterion. The approach of the Pareto criterion, based on utility functions, is that any policy changes which make at least one person better off without making anyone worse off are Pareto-improving (Mitchell and Carson, 1989). Bénicourt (2008) explains it in terms of exchanges between individuals: exchanges that make no one worse off and at least one person better off are performed until a state where no such trade can be conducted is reached. It is then said that a Pareto optimum is attained. A specificity of the Pareto criterion is that Pareto-optimal positions cannot be compared to one another since it would imply that mutually advantageous exchanges are still possible and therefore that another Pareto-optimal position could be reachable, a contradiction to the definition of a Pareto optimum (Bénicourt, 2008).

Economic theory says utility is based on the preferences for private goods. Indeed, public goods such as air are excluded at first: people do not have to reveal their preference for such goods since their characteristics are that they are non-competitors (the consumption of the good by an individual does not reduce the possibility for other to consume it too) and non-excludable (one cannot prevent an individual from consuming the good). The case of health appears to have its particularity: it is not *per se* a public good since people's health status only benefits them (as well as their close relatives and, in a way, to the society - as healthy people cost less and are more productive). Indeed, goods and services necessary to provide and sustain health status are mainly rival and excludable. However, in the context of public policy health becoming a public good, as stated by the California Association of Public Hospitals and Health Systems (2001): "The responsibility for delivering immunization services, preventing and controlling communicable disease outbreaks, and conducting important public outreach efforts is a critical public good that benefits all community residents".

Individuals do not need to choose between two public goods, they can freely benefit from each of them. However, because nobody pays for such goods, their use generates externalities - costs that are not supported by the user but by the society, which leads to non-optimal situations according to the Pareto criterion. For instance, the production of electricity generates air pollution and since nobody pays for "using" air, nobody pays directly its pollution. However, everyone (exposed) suffers from this pollution and pay to mitigate its consequences (such as paying for a medical treatment, or paying through taxes to restore public monuments). To better understand this situation, specific methods, permitting to reveal the values of externalities, were developed in the frame of the neoclassical economic theory.

1.3 Neoclassical economics of public goods

1.3.1 Welfare, utility and preferences

As previously mentioned; the value associated with environmental goods, health, or any non-marketed good, can be derived from the preferences and utility of individuals, which are an expression from their preferences. If a good has a utility for an individual, it has an economic value for him (Roy, 2013). As non-market goods do not have a value on a market by definition, a proxy of this value has to be determined by other means than direct market observation. Bonnieux and Desaigues (1998) stated that the more relevant actor to determine the value of a good, and behind that his preferences related to a good, is the individual. One underlying hypothesis is that individuals maximize their utility according to their preferences at all time. However, this hypothesis is not always, if only, verified because of lack of information, influence, or just seemingly inconsistent decisions of the individuals (Fischhoff, 1989).

There are different ways to determine preferences of the individuals. The first one is by observing the existing market. The second one is to question the concerned individuals' preference. The hypothesis here is that these observations, or the answer directly given by the individuals, are a real representation of their preferences. This is not the case because of many reasons among which: first, the individuals may not be clear with what their preferences are, because the actions on the market only represent part of the preferences of the individuals (for examples the prices have a major influence) or second, because they have difficulties to determined their preferences.

1.3.2 Welfare and stated preferences

According to Mitchell and Carson (1989), the Cost-Benefit Analysis (CBA) - the applied side of modern welfare economics - operationalizes a variant of the Pareto criterion by monetizing the gains and losses to those affected by a change in the level of provision of a public good. This is necessary since "in practice there are very few, if any, policy changes which make no one worse off, the only way such a criterion can be implemented is to allow those who gain from a policy change to compensate the losers. According to the compensation test of Kaldor-Hicks (Hicks, 1939; Kaldor, 1939) [4], the Pareto criterion is met if, after the gainers have compensated the losers, one agent is better off and no one is worse off" (Mitchell and Carson, 1989). Applying CBA to project having health impacts is not an easy task: one must first decide what is going to be analyzed. It is possible to make CBA for the measures to be undertaken (e.g. measures that would lead to a reduction of pollution) but one could also decide to make a CBA of the results (e.g. reduction of the health impact caused by pollution).

Bateman et al. (2002) directly mention the willingness to pay: after recalling that welfare is a preference-based concept which emanates from preference satisfaction and that preferences are regularly revealed in market places, they declare that "there is a logical link from preferences to *willingness to pay*. (…) willingness to pay can be shown to be a measure of preference satisfaction and hence a measure of well-being" (Bateman et al., 2002). Mitchell and Carson (1989) put it in another way as they assert that "in a CV survey, respondent is being asked to determine what change in his income, coupled with the change in the level of the public good, leaves his utility unchanged".

1.3.3 Willingness to pay and willingness to accept

Whatever the method used, the aim is to determine the utility function for the given good. For that, variations of the utility are measured (Bonnieux and Desaigues, 1998; Haab and McConnell, 2002; Pearce et al., 2006):

- ✓ The willingness to pay (WTP): the WTP is the maximal amount an individual is ready to pay to get an improvement of the situation or to avoid a deterioration of a situation and stay with the same overall utility.
- ✓ The willingness to accept (WTA): the WTA is the minimal amount an individual is ready to accept in order to consent to a deterioration of the situation or to stay with the same situation without the improvement happened and stay with the same overall utility.

WTP and WTA of each individual are the amounts of money, which makes this individual indifferent to the evolution (or non-evolution) of the situation, and that the related good does not worth more than the WTP for the individual. However, WTP and WTA are determined under some constraints, the main one being the income of the individuals. Indeed, one cannot pay more than one has - taking into account the compulsory expenses -; in case of observation of the market, other phenomena than the preferences play a role, such as the preferences of all the individuals in the same market and the availability of the good.

When WTP surveys are conducted with regards to air quality improvement, people implicitly state how much money they are ready to devote to secure their health-enhancing (i.e.

[4] Bateman, Carson et al. (2002) define the compensation test as a reallocation of resources so that the sum of the benefits to those who gain by that reallocation exceeds the sum of the cost to those who lose.

their welfare). The amount of money they state is the standard to measure welfare while the WTP is the measure of benefit (Bateman et al., 2002). Welfare is therefore at the core of the contingent valuation method.

The next part focuses on the determination of these monetary values. The different related definitions, concepts and valuation approaches will be presented. The global aim of this methodological review of the literature - related to economic valuation of morbidity - is to present the different approaches in a clear way, and to detect the numerous disturbing confusions that often appear in the several studies.

1.4 Definitions in the field of health impact valuation

The aim of this section is to clearly present definitions of some terms used in the field of monetary valuation of health impacts. This is particularly necessary because there are different stakeholders and institutions interested (economists and public health experts) in this field, who are not using the same definitions. In order to bring more transparency on the different approaches, the definitions used by important actors in Europe - in particular by "environmental economics" community and by the World Health Organization (WHO) - will be explained in the following paragraphs. Then they will be compared to find out the extent of these differences. Other terms, specific to monetary valuation of health impacts, which usually have clear definition, are also defined in Appendix 2.

1.4.1 Private, external and social costs

1.4.1.1 Definition used by the environmental economic community (in particular in ExternE)

In the European environmental economics community, the terms private, external and social costs are usually used according to the definition given by ExternE (European Commission, 2005):

- ✓ External costs: "converting external effects into monetary units results in external Costs […] an external cost arises, when the social or economic activities of one group of persons have an impact on another group and when that impact is not fully accounted, or compensated for, by the first group."
- ✓ Private costs (also sometimes called internal costs): costs borne by the company responsible for the pollution (for investment, production…).
- ✓ Social costs: "the sum of internal and external costs".

1.4.1.2 Definitions by the World Health Organization

The terms private, external and social costs are defined by the World Health Organization (WHO) in the same way as shown by Figure 5, whose source is a WHO report (Seethaler, 1999).

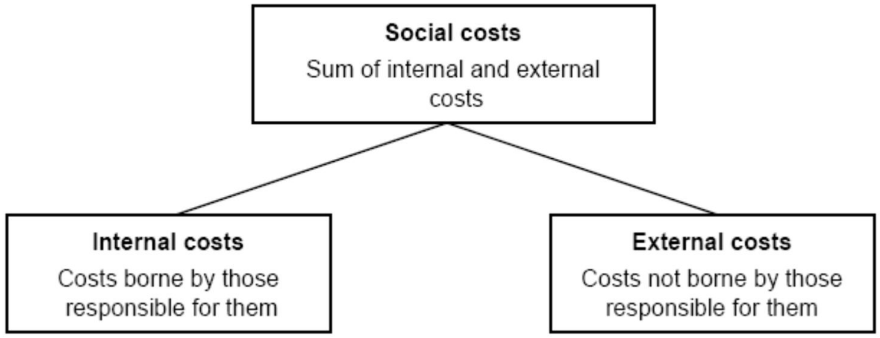
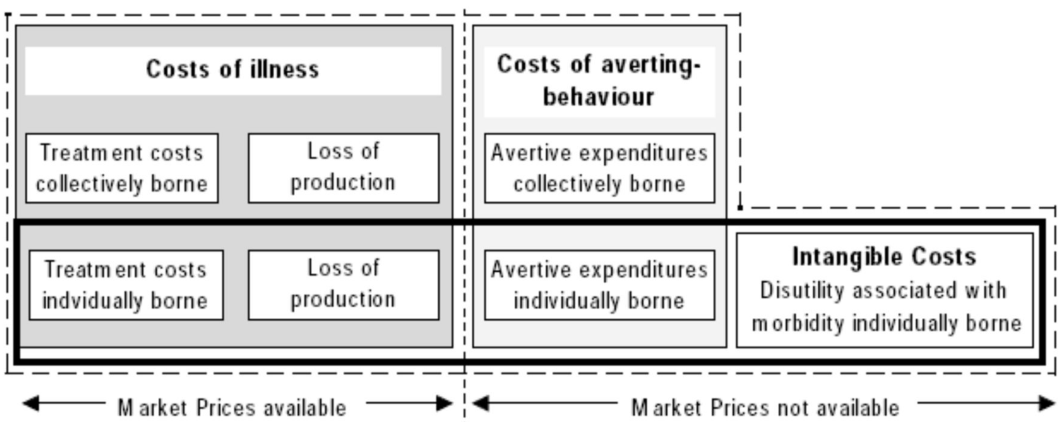


Figure 5: Social, internal and external costs (Seethaler, 1999)[5]

However, one should notice, that not all documents of the WHO are using the same definitions. As shown in Figure 6 for some authors (Sommer et al., 1999):

- ✓ "social costs" represent costs which are not borne by the polluter (i.e. "external costs" as defined previously);
- ✓ "private costs" represent here the part of external cost borne by individuals for his/her health (and not the cost borne by the polluters as previously defined).

These definitions can also be found for example in Rozan (2001) but with "variations". Her definition of "private costs" corresponds to the one displayed by Sommer et al. (1999). However, her definition of "social cost" corresponds to the component "cost of illness", as illustrated in Figure 6.



— **Private costs (= individual WTP)** - - - - - Social costs (individually and collectively borne)

Figure 6: Overview of the costs of morbidity (Sommer et al., 1999)

1.4.1.3 Trying to compare

Table 1 illustrates the differences in definitions. They may come from different "culture" of the authors: the "ExternE type" definitions are commonly used by experts with an economic background, whereas the definitions as illustrated in Figure 6 are more used by

[5] Sommer H., Neuenschwander R., Walter F., (1991) Soziale Kosten von Verkehrsunfällen in der Schweiz; Ecoplan. Auftrag GVF Nr. 186, Eidg. Verkehrs- und Energiewirtschaftsdepartement, Bern, 1991 cited in Seethaler R. Austria, France, Switzerland (1999): Health costs due to road traffic-related air pollution. An impact assessment project of Austria, France and Switzerland. Synthesis report. WHO Ministerial Conference on Environment and Health. London World Health Organization 1999.

experts with an epidemiologic background. What is called external costs in economic view is equivalent to social cost in epidemiology:

- ✓ economic view distinguishes cost depending on the responsibility of the cost (cost borne by the polluter or not);
- ✓ epidemiology distinguishes the cost depending on who pays for it (individual or the society).

	Economical view (ExternE type)	Epidemiology (WHO type)
Social cost	Costs borne by society (total costs)	Costs generated by a polluter but borne by someone else (For Rozan: individual, for WHO: individual or/and society)
External cost	Costs generated by a polluter but borne by someone else	
Private costs	Costs borne by the individual (or company) responsible for the pollution	Costs borne by a person for his/her health

Table 1: Comparison of definitions in the field of health impacts valuation

These differences (even within a recognized international organization such as the WHO) underline the necessity of being aware that, in the field on economic valuation of health impacts, one should always check the definitions used by each author. In the text of this thesis, the definitions according to ExternE will be used, except when specified otherwise.

1.4.2 Cost components related to morbidity

In the preamble of its constitution, the WHO (2005) defines health as follows: “Health is a state of complete physical, mental and social well-being and not merely the absence of disease or infirmity.” These different components of health are found in the way economic apprehends the value of an illness.

Here also exist different definitions according to various authors.

1.4.2.1 Definition used in ExternE

The valuation of morbidity impacts in ExternE (European Commission, 1999) integrates three costs components:

- ✓ Costs component 1: the “Value of the time lost because of the illness”. It consists in a value of lost working and leisure time. They are usually valued “at the post-tax wage rate (for the work time lost) and at opportunity cost of leisure, for the time lost”.
- ✓ Costs component 2: the “Value of the lost utility because of pain and suffering” for the person himself but also for other persons (e.g. a relative who helps the ill person). The mostly used method to determine this cost is contingent valuation (cf. I 3).
- ✓ Costs component 3: the “Expenditures on averting and/or mitigating the effects of the illness”. These costs are usually called “Cost of illness”; they are directly measured by the costs of treatment and service used in the case of the studied illness.

1.4.2.2 Definition used by the World Health Organization

The WHO mainly uses the definitions of health costs components by Sommer et al. (1999) (see Table 2). As previously underlined, Sommer et al. (1999) distinguishes between private costs (borne by individuals) and social costs (collectively borne costs). According to their definitions, private costs as well as social costs have several components:

- ✓ Costs components A: called "cost of illness" and representing "the "material part" of the health costs, i.e. the costs of morbidity which can be measured in an existing market, such as: cost of treatment, loss of production, for the society and the individual.
- ✓ Costs components B: called "costs of averting behaviour" representing the expenditures due to avertive behaviors. Sommer et al. (1999) specify that for these costs market prices are not available. However, this point could be subject to discussion.
- ✓ Costs components C: regarding costs borne by individuals, Sommer et al. (1999) also integrates so-called "intangible costs", which *"reflect the individual loss of utility and consists of the pain, grief and suffering due to an illness. According to the experience of several authors, the wish not to get ill is mainly determined by these inconveniences".*

1.4.2.3 Trying to compare

The different definitions presented above do not really match. Indeed:

- ✓ Components A seems to include the costs components 1 and 3 of the ExternE definitions, plus loss of production;
- ✓ Components C could correspond to the costs component 2 of the ExternE definitions. Nevertheless, as cost components B are considered to correspond to non-marketed goods, one could also argue that the component 2 corresponds to the sum of components B and C;
- ✓ Moreover, one could notice that the term "cost of illness" do not represent the same costs according ExternE and the WHO.

Here, once more, in each study one should be very careful on what is really included in the different cost components before comparing quantitative values.

1.4.3 Definitions related to valuation approaches

According to ExtenE (European Commission, 1999), three approaches to estimate the costs related to morbidity endpoints can be used:

- ✓ Previously to ExternE, the "costs of illness" (component 3) plus forgone earnings (component 1) was the only estimated costs. They were used as the approximation of the value of an illness. Nevertheless, as described above they are only parts of the total costs related to a specific morbidity endpoint. As the other component (component 2, i.e. pain and suffering) was considered difficult to measure, estimates have been made regarding the relationship between the total costs and the "cost of illness". This method is not reliable because the relationship between total cost and cost of illness is difficult to determine.
- ✓ In order to estimate cost component 2 (i.e. pain and suffering), direct measures of the willingness to pay can be obtained through contingent valuation (see part I-B-3 of the present work for more details.

✓ Avertive behavior is a revealed preference method which can be used to value component 2, it is based on the expenses made to prevent morbidity (or mortality), e.g. buying smoke detectors or seatbelts.

When reviewing the literature, a common confusion appears regarding the term "cost of illness". For some authors, it designates a cost component (3 or A depending on the authors). For some other authors as Rozan (2001), "cost of illness" designates economic valuation method and not a cost component as described above. This method can allow assessing components 1 and 3. In other word, the "cost of illness" method (definition by Rozan) can be used to determine "cost of illness" components. The term "cost of illness can thus lead to confusion because of its various meanings depending on the context (and on the person using it), as detailed in Table 2.

Rozan's definition	**Costs components Economical view (ExternE type)**	**Costs components Epidemiology (WHO type)**	**Methods[6] to determine this cost (according to Rozan)**
Treatment of the illness	Cost of illness (component 3)	Cost of illness (component A)	Cost of illness Production function of health Stated preference (including CV)
Lost of production	Value of working time lost (component 1)	Cost of illness (component A)	Cost of illness Production function of health Stated preference (including CV)
Prevention of activities	Cost of illness (component 3)	Costs of averting behaviour (component B)	Production function of health Stated preference (including CV)
Pain, disutility	Pain and suffering (component 2)	Intangible cost (component C)	Stated preference (including CV)
Restricted activities	Value of leisure time lost (component 1)	Cost of illness (component A)	Stated preference (including CV)

Table 2: Comparison of the different "cost of illness" meanings

1.4.4 Definitions related to the categories of values

In the scope of environmental valuation, the objective is to measure the Total Economic Value (TEV) of the change of provision of an environmental good. The notion of TEV is presented in Figure 7 from Pearce and Özdemiroglu (2002). This figure illustrates the different categories of values:

✓ use value, which is the value accorded to the good because of its use;

✓ non-use value, which represents the value accorded to the good because of only the fact it is there.

Each of these categories has sub-categories, which again depend on the characteristics of the value accorded to a good (they can be combined).

Regarding use value:

✓ for "present use", e.g. to sell the good;

[6] The various methods will be described in 2.2.

✓ "option value", i.e. a value given to a good not for its use at the time of the study, but for later use, for the usage of some else (altruism) or for the use of descendant of the person (bequest value).

For non-use value, the main category here is value given to the good because it exists.

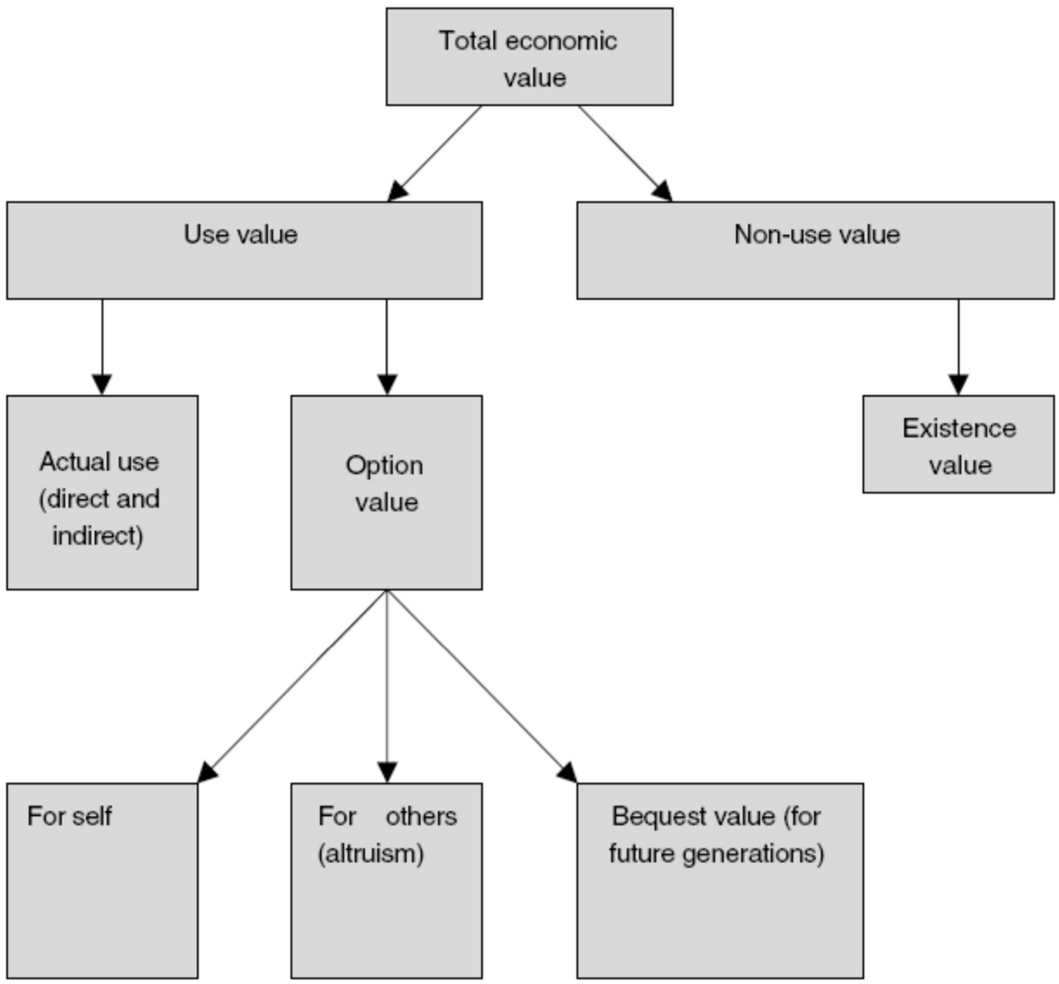


Figure 7: Components of total economic value (Pearce and Özdemiroglu, 2002)

However, depending on the authors, the classification of values can slightly be different, as illustrated in Figure 8 (from Terra (2005b)):

✓ use value can be divided in three categories: marketed use value, non-marketed use value and option value;

✓ bequest value is considered as non-use value.

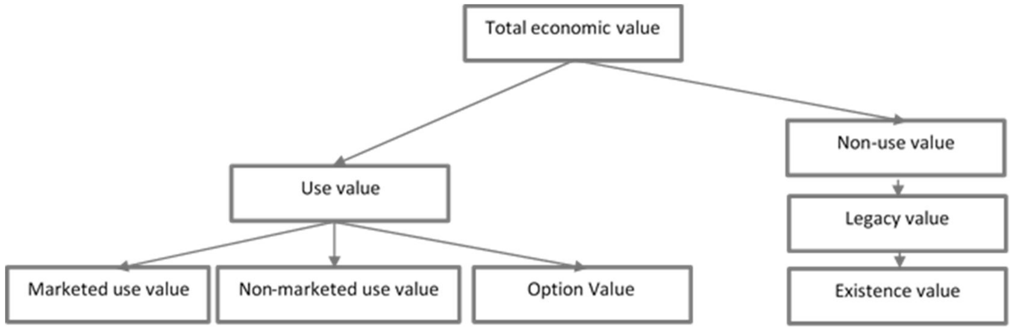


Figure 8: Decomposition of the total economical of an environmental good (Terra, 2005b)

Moreover, the classification of values is not as easy as suggested by these fairly simple figures. Indeed, even the same authors sometimes use different definitions. For example, some differences exist between the guide (Pearce and Özdemiroglu, 2002) and the manual by (Bateman et al., 2002) although among "et al." of the latest reference includes the two previous cited authors. More precisely, bequest value and altruism are considered as a use value in Pearce and Özdemiroglu (2002) whereas they are considered as non-use value in (Bateman et al., 2002).

1.4.5 Conclusion: health impact valuation

In the case of valuation of health impacts, it remains very difficult to use the sub-categories of TEV. This is mainly related to the question of the non-market good to be valued which is a change of health state or a change of environmental conditions, which induces a change in health state. In all cases, it is here difficult to define which are related use and/or non-use values. Therefore, the notion of use and non-use values are usually not used in the literature related to health impact valuation. Combined with the multiple variations of the definition presented before, this leads to a fact that the valued health impact has to be precisely defined to ensure that the valuation is correctly done and that the values determined by this way are correctly used.

In the next section, the principle of health impact valuation will be presented.

2. Monetary valuation of health impacts

2.1 Principles for economic valuation of health impacts

2.1.1 The indirect and the direct approaches

In the scope of environmental economics, the health impacts to be valued are implicitly related to environmental-related health risks. Nevertheless, two approaches can be distinguished in the literature (Rozan and Willinger, 1999) as illustrated in Figure 9:

- ✓ The first approach, called the "indirect valuation" is conducted in two steps. Firstly, the economic value of morbidity endpoint is assessed without taking into account its (environmental or non-environmental) causes. Secondly, the value of the environmental conditions affecting this endpoint is deduced.

✓ The second approach, called “direct valuation”, consists in valuing a change in health state resulting explicitly from a change of environmental conditions in a single step.

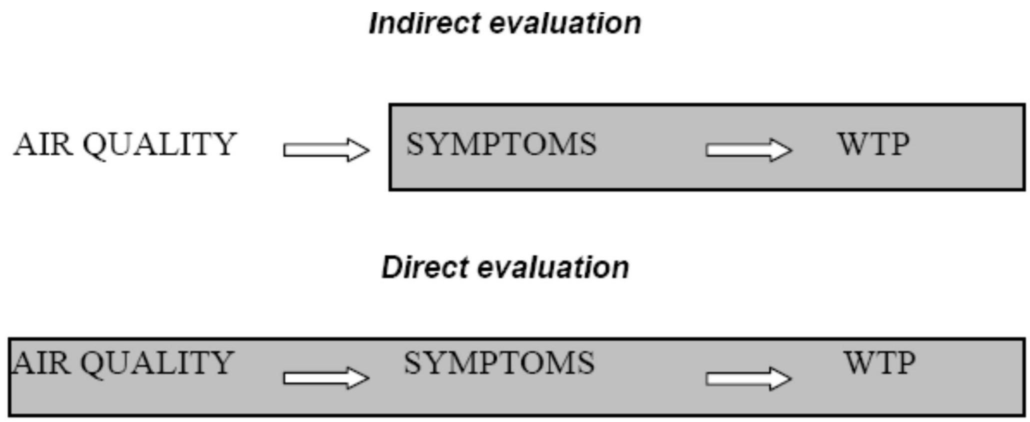


Figure 9: Two approaches for eliciting the health benefits of an improvement in Air Quality (Rozan and Willinger, 1999)

Rozan and Willinger stated that these two approaches lead to different results, probably because the cause of the health damage has an importance for the respondent when the method used is contingent valuation. The cause of the impacts could have an influence on the utility function, even if, according to the theory, the value of a change in health state does not depend on the cause. Rozan and Willinger consider that using the indirect approach can conduct to biases willingness to pay because each respondent will refer to his/her knowledge about the possible causes of the illness. However, the authors quotes also Navrud’s point of view: “*In the field of health damage evaluation, the current practice favours the use of indirect evaluation, i.e. without additional information about the cause. These studies try to avoid the embedding effect. According to Navrud [1998][7]: « by not giving the respondents any information about the “program” that would make it possible to buy yourself free from the symptoms, we avoid that respondents include their value of avoiding other impacts from air pollution in their symptoms values. » ”*.

2.1.2 Health: private or public good?

The monetary valuation of health endpoints also raises a question: is health a private or public good? This question has been extensively discussed in the literature and no satisfying responses could be found. Nevertheless, one should be aware of this issue when conducting valuations.

[7] Navrud S., 1998, “Valuing health impacts from air pollution in Europe, New empirical evidence on morbidity”, Mimeo, Agricultural University of Norway, 24 pages.

As stated by Bateman et al. (2002): *"A good is public to the extend that consumption of it is non-rival, that is, one person's consuming it does not reduce the amount available to others, and non-excludable, that is, it is not possible to supply the good only to those who choose to pay for it, and to exclude everyone else"*. A private good is a rival, excludable good. In the interest of a producer, a private resource should be sustainably managed, in order to ensure a long-lasting production. However, if there is a free public access to that resource, each producer's interest is to increase the natural resource exploitation, without consideration of its depletion. That fact referred to as the "Tragedy of the Commons", which was first used by Garrett Hardin and published in the journal Science in 1968 (Bontems and Rotillon, 2007).

When the good to value is air quality, it is referred to the quality of a public good. However, the related health impact concerns each person, i.e. it could be considered as a private good. The different methods value one or the other aspects of health impact of air pollution. This double aspect is reflected by different methods available:

- ✓ One approach is to determine what people are ready to pay to improve their health by breathing pure air, in a hypothetical market: here the direct approach is used and health is considered as public good.
- ✓ Another approach is to value the health without mentioning the cause of the variation of health (the value that people attribute to health is approximated thanks to a contingent medicament market for example). Here health (and its determinant, air quality) can be assimilated to the drug market (both of them have a positive effect on health): the indirect method is used and health is viewed as private good.

This issue of giving or not the context and, more particularly of explaining the different causes of the health endpoint, really matters because it could lead to very different values. It is transferred to the conception of health used in the valuation. This aspect, the very subject of this thesis, will be detailed from section II on.

2.2 Methods for economic valuation of morbidity

2.2.1 The different types of non-marketed valuation techniques

Different methods exit to assess the monetary value of non-marketed goods, as detailed in Figure 10. The two main categories are:

- ✓ Revealed preference methods, based on real markets: health costs are extrapolated from existing markets (for example: medicaments);
- ✓ Stated preference methods, based on a hypothetical market: the Willingness To Pay for the non-market good is directly measured (for example: a better air quality).

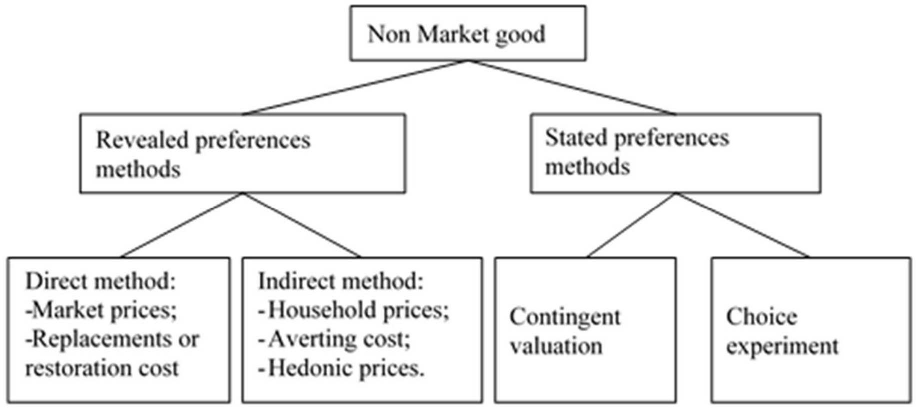


Figure 10: External Cost Valuation of non-market goods (own compilation from (European Commission, 2005))

The aim of the next sections is not to detail the different valuation methods. Comprehensive presentations of each method as well as related advantages and limitations can be found in MEDAD et al. (2009). Only important information in the specific case of health endpoints valuation will be given.

2.2.2 Revealed preference method

These methods are used to determine non-marketed external costs on the base of observations of real markets, of real choices made by the individuals. The underlying principle is that the choices made on real markets are revelatory of individuals preference about environment (MEDAD et al., 2009). Different revealed preference methods are applied to health valuation.

2.2.2.1 Hedonic price method

This method can be used to determine the value of morbidity impact by studying the price of marketed goods, such as medicaments or medical treatments. It is based on the comparison of two marketed situations, one with and the other without the impact to be valued. Hedonic price method cannot assess non-use values (Terra, 2005a).

In the case of health impacts valuation, the main limitation of the method is that one should be sure that people know the link between environmental conditions and health endpoints, which is not always the case (King et al., 2000).

2.2.2.2 Other methods

Some others revealed preference methods can be used:

- ✓ Opportunity costs i.e. the cost in terms of lost productivity (work time loss - or performing at less than full capacity) and the opportunity cost of leisure (leisure time loss) including non-paid work.
- ✓ The averting behavior method assessed the value of health by measuring the amount of money that people spend, in activities to protect their health (Markandya and Ortiz, 2010).

- ✓ Observing wage differential can also be a possibility (Stoeckel, 2006b). The preferences of workers toward risks are considered to be represented by the level of wage (and working conditions): the most dangerous work should be associated higher wage. But workers have to be informed about the risk and the job market should be perfect (Stoeckel, 2006b).

Other methods exist in the field of environmental economic, but they are not used to assess health impact but environment impact. For example:

- ✓ Travel cost method is based on the principle that the cost of transport from the living place to the places with particular environmental conditions give the possibility to determine the value attributed to the visitors to the site (Terra, 2005b).
- ✓ Restoration methods estimate the environment value according to the cost used to restore the damages.

2.2.3 Stated preference methods

These methods measure the value of non-market goods by creating a hypothetical situation. The willingness to pay (i.e. what people are ready to pay for the non-market good to be valued) of the affected people is directly measured: individuals make tradeoff between improving their health condition and buying other goods (Markandya and Ortiz, 2010). Two main stated preference methods are used:

- ✓ Contingent valuation (Pearce and Özdemiroglu, 2002), where people are asked how much they would pay in an hypothetical scenario; this method will be presented in a comprehensive way in Chapter 3 of this thesis because it is the one which is applied for this work.
- ✓ Choice experiment (Pearce and Özdemiroglu, 2002): "Choice experiments present respondents with a baseline scenario corresponding to the status quo and several alternative options in which specified attributes are changed in quantity. […] Chosen attributes should include a money value, which, as in contingent valuation, represents a payment vehicle. The number of attributes should be limited to ensure they can be handled by respondents." It remains unclear if non use value can be assessed with this method. The choice of the respondents give the possibility to know the willingness to pay for each characteristic, under the hypothesis that the total cost is the sum of the cost of each characteristic (Markandya and Ortiz, 2010).

Another method to determine the value attributed to good health is the "healthy equivalent income" which is defined by Fleurbaey (2007) as a measure of the tradeoff between health and income. According to the author, this healthy equivalent income is linked to the willingness to pay by the following relation: WTP= income in good health - healthy equivalent income ("income in good health" being the present income, with an increase due to an increase of productivity for example). Fleurbaey advocates for the use of healthy equivalent income mainly because it keeps the information of the standard of living. Nevertheless, it remains unclear whether this method is actually a new approach or is only a variant of the contingent valuation in which the payment vehicle would be defined in a very particular way.

2.2.4 Cost of Illness Approach

Cost of Illness (COI) aims at giving an overview of the whole cost of the illness (Jo, 2014). Three types of costs are valued in the Cost of illness approach: direct costs incurred for medical goods and services (medication, doctor visits, hospitalization…), indirect (or human capital) costs related to the absence of production due to an adverse health effect (Kuchler and Golan, 1999), and pain of suffering:

- ✓ Direct Costs of illness (also called “resources costs”): The direct costs of illness, including expenditures on medicines, health services, and defensive goods and services, provide an indication of individual welfare loss through the foregone utility resulting from the shift in expenditure patterns. Those expenditures do not induce a drop in income or consumption for the economy as a whole, but stimulate activity in a few sectors of the economy. Therefore, those amounts do not represent a simple drop in social welfare (Kuchler and Golan, 1999).
- ✓ Human Capital Approach: The human capital approach considers the value of an individual can be assessed by valuing what he/she products for the society, which is approximated by his or her earnings (Markandya and Ortiz, 2010). Thus, the value of preventing someone’s statistical death or injury is equal to the gain in the present value of his or her future earnings. Some disturbing consequences are here noteworthy: according to this approach the “life of retired people has no value”; discounting future earnings induces a statistical life value of children smaller than that of adults in their best period of earnings; people whose value for production is not reflected by wage payments, such as house makers, are also difficult to handle in the human capital framework (Johansson, 1995). Moreover, the human capital approach is based on two assertions: changes in health status are reflected in changes in national income, and national income is a valid measure of well-being. But earnings and national income do not always match health status, and national income is not a reliable indicator of social welfare. Therefore, the human capital approach is considered by some authors as not suitable for a measuring social welfare, and hence is not appropriate for use in cost-benefit analysis (Kuchler and Golan, 1999). It was one of the first methods used for economic valuation of health damage but it is usually not used anymore because of its limits.
- ✓ Pain and suffering can be valued by one of the methods above.

2.2.5 Benefit transfer (BT) methods

2.2.5.1 Principle

The principle of benefit transfer methods is to use economic values measured at a specific site, called study site, for another site, called the policy site. Databases gather the results of study sites (such as ‘EVRI’, the Environmental Valuation Resource Inventory (international data[8] (Pearce and Özdemiroglu, 2002). As benefit transfer applies values determined in one context to another context, some characteristics of the new situation have to be similar to these of the older one (Pearce and Özdemiroglu, 2002):

- ✓ "the socio-economic characteristics of the relevant populations;
- ✓ the physical characteristics of the study and policy site;
- ✓ the proposed change in provision between the sites of the good to be valued; and
- ✓ the market conditions applying to the sites (for example variation in the availability of substitutes)."

If these parameters are different between the two sites, the values can be adjusted. Various benefit transfer methods exist:

- ✓ Unitary transfer: in this case, the WTP measured in the study site is used in the policy site:
    - o Simple unitary transfer: the value is transferred as it exists, without adaptation to the new situation;
    - o Adjusted unitary transfer: the value measured at the study site is adjusted according to the characteristics to the policy site.
- ✓ Function transfer: in this case, the function found at the study site for modelling the WTP (based on the different statistical significant variable) is used with the information of the policy site:
    - o the function of a single study site can be used;
    - o a function obtained through a meta-analysis based on a range of studies can be used.

2.2.5.2 Validity of benefit transfer for morbidity valuation

Regarding valuation of environmental goods in general, the validity of BT remains an open question (King et al., 2000) because of the different limitations of the approach which will not be presented here in details (for a complete description see (Genty A, 2005)). Regarding valuation of health impacts, some authors (Barton D.N and Mourato S, 2003) suggest that benefit transfer should not be used because in this case such valuation relies on multiple psychological factors which cannot be taken into account through BT. Nevertheless, BT was used in numerous papers in order to transfer health impacts values measured in one country for other countries in which no values existed.

Ready et al. (2004) try to find out which are the best method for transfer, and the errors made when transfers values between five European countries for morbidity valuation due to air and water pollution. It was determined that transfers between countries conduct to an error of about 38%. The error does not depend on the method used (3 methods tested) and is similar

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[8] EVRI: www.evri.ec.gc.ca "Source documents for UK values (but not the values themselves) are listed in the Environmental Valuation Source List for the UK (www.defra.gov.uk/environment/evslist/index.htm" from: (Pearce and Özdemiroglu, 2002)

with other studies. According to the study of Ready et al. (2004), the transfer between countries is thus possible with error lower than 50%. The main problems for transferring results from one country to another are:

- ✓ the evaluation should affect the same good, and be considered in the same way in the two sites;
- ✓ exchange rates and differences in cost of living should be considered;
- ✓ differences between the characteristics of the populations (average wage rate) have to be reduced to minimal;
- ✓ differences in culture, experiences, and health status also have to be reduced.

A study conducted in Italy and in Czech Republic (Scasny et al., 2009a) about the willingness to pay of parents for their own children for mortality risk reduction shows that the predicted values based on benefit transfer of the value from Italy (2.46 million Euros) are very higher (up to 2 times) than measured values by conjoint choice experiment (1.09 million Euros).

In the NEEDS study about the mortality (Desaigues et al., 2006b), consistency was checked by means of benefit transfer. Transfer errors and validity of transfers were tested by using the pooled sample except one country, transferring the mean and median WTP estimates to this country, and comparing the transferred estimates with the original measured WTPs. Since the explanatory power of the WTP function was found to be low, unit value transfers were performed rather than benefit function transfers. The conclusion is that simple unit values transfers (based on power parity purchase-adjusted Euros) are valid, with a transfer error of about 20%, a percentage that the authors consider acceptable for most applications of cost-benefit analysis.

Moreover, Dekker et al. (2009) look at the possibility of benefit transfer between situations (e.g. from road accident to air pollution morbidity impact). As the willingness to pay results are very dependent on the situation (here: mortality from air pollution and from road accidents), it seems to be risky to transfer value from one case to another. The authors suggest it could partly come from the design of the study and from the representation of the risk of the respondent, as stated also by Fischhoff (1989): knowledge of the risk, severity of the consequences, voluntaries to run the risk and control of the person over the risk.

2.2.5.3 Example: comparison between France and Germany

A study about the value attributed to air pollution was conducted by Rozan (2000b) in Strasbourg (France) and in Kehl (Germany) (two cities on the sides of the Rhine river, in the same level on the both sides of the river): people were asked if they want to take part to a program to increase air quality and by this way decrease benign symptoms due to air pollution (morbidity). Rozan realized a comparison of WTP for air quality improvement between France and Germany. This study was designed to measure "private" benefits[9] but is limited to benign symptoms[10]. Respondents were not asked about more serious illnesses and were not made aware that air pollution can be a factor for asthma, cardio-vascular disease, emphysema or cancer. Therefore, it would not be relevant to compare the WTP measured by Rozan with the WTP for benefits in terms of mortality measured by the NEEDS study. Nevertheless, the study by Rozan is of interest here because it provides air pollution specific WTP values for France and Germany and analyses country-dependencies.

The main interesting point of this study is that the survey has been conducted at the same time on both sides of the French-German border (Strasbourg and Kehl). The conditions of the study were the same: geographical and climatic conditions as well as the levels of air pollution were equivalent in both cities. Moreover, the questionnaire and its administration were identical. The valued utilities were "*reductions of air pollution of a half and a third"* in the next five years and associated reduction of benign symptoms (in the same proportion). The payment vehicle was the same in both countries: payment during five years to an agency devoted to air quality. Finally, samples in both countries had the same characteristics, especially in terms of income, health status, but not the same culture nor education. It fit conditions for a reliable benefit transfer.

The similarities between contexts makes it possible to compare French and German WTPs and the different factors affecting them (Rozan, 2004). The main result is that Kehl's residents had a significantly higher WTP than the inhabitant's residents of Strasbourg[11]. As the context and the conditions of the study were the same in both cities, it can be deduced that the inhabitants of Kehl give a higher importance to health impacts in the context of air pollution than the inhabitants of Strasbourg. The two following questions then arise:

- ✓ Is air pollution perceived in the same way at both sides of the border?
- ✓ Do the inhabitants of both cities have the same behavior when policies to reduce air pollution are proposed?

Rozan found that the air pollution issue is rated the same in both cities: 65% of respondents stated that it is a really important issue and 30% stated that it is a quite important issue. The acceptability of the proposed program of air pollution reduction is also globally the same (55.3 % of French respondents and 50.4% of German respondents are willing to pay).

The statistical comparison test confirms that the "nationality" variable is significant. This could mean that there are strong cultural differences related to air pollution issues between both countries. The main conclusion of Rozan is that these WTP differences underline the difficulties to apply benefit transfer. Indeed, this study was offering the optimal conditions for such a transfer and shows nevertheless that nationality makes a big difference.

Ehmke et al. (2008) compare the willingness to buy water at a given price in a referendum way (if more than half of the persons want to buy a bottle, everyone has to buy one

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[9] Private benefits (vs. social benefits) are valued by Rozan through hospital admission avoided costs.
[10] Eye irritation, headaches/migraines, allergies, sinus problems and bronchitis.
[11] The mean WTP was 282 FF in Strasbourg and 466 FF in Kehl.

bottle) between USA; China, Niger and France. Their study includes two types of test (within subjects' comparison): first they would have to vote hypothetically (vote as if but without actually buying the bottle) to buy a bottle of water ,then for real (the groups would actually buy the bottle of water) to test the consistency of hypothetical bias between countries. They found significant differences in the behaviors in two aspects:

- ✓ they found strong differences between the countries in both steps;
- ✓ they found strong difference in the changes of behavior between the hypothetical and the real buying process.

This study concur with the previous one to state that benefit transfer is hazardous because many factors, including hypothetical braises influence the preferences' determination process.

2.2.5.4 Conclusion on benefit transfer

Benefit transfer, even if it is a useful method when no value can be measured, conducts to results with a high level of error. Therefore, this method has to be used with caution. Moreover, in addition to the differences between two areas as stated in the paragraph 2.2.5.3, the possible imprecision of the determination of a monetary value can make it difficult to use in another situation. Regarding context, it can be that, in the area of the study, people implicitly thought about one causes for the values health impacts whereas in other area anther causes can be imagined (e.g. work cause for respiratory illness in a mine area whereas air pollution in a big city).

2.3 An alternative method: QALYs and DALYs

Health impacts valuation, as described in the previous sections, can be measured through actual or hypothetical markets. But others methods also exist, such as those based on the assessment of quality of life. Quality-Adjusted Life-Years (QALYs) and Disability Adjusted Life Years (DALYs), gather under the umbrella term of Health Adjusted Life Years (HALY) are indicators to assess impacts on human health (Gold et al., 2002). They are expressed in life years that are corrected for health impairments. The concepts as such do not contain any element related to monetary valuation, and is therefore detailed in Appendix 3.

2.4 Discussion

2.4.1 Which valuation method for which values?

The different methods described in the previous sections do not give the same information about external costs. Regarding valuation of environmental goods in general, Pearce and Özdemiroglu suggest the following links between the costs components to be estimated and the valuation technique (Figure 11):

- ✓ Revealed preference methods are useful for assessing use value because they are based on market observation. They are not designed to assess non-use value. Main revealed preferences methods are: cost methods, hedonic prices, averting behavior, market price.

✓ Stated preference methods are appropriate for assessing total value including non-use value, because the hypothetical market can be designed according to value to be assessed. Main stated preference methods are contingent valuation and choice experiment.

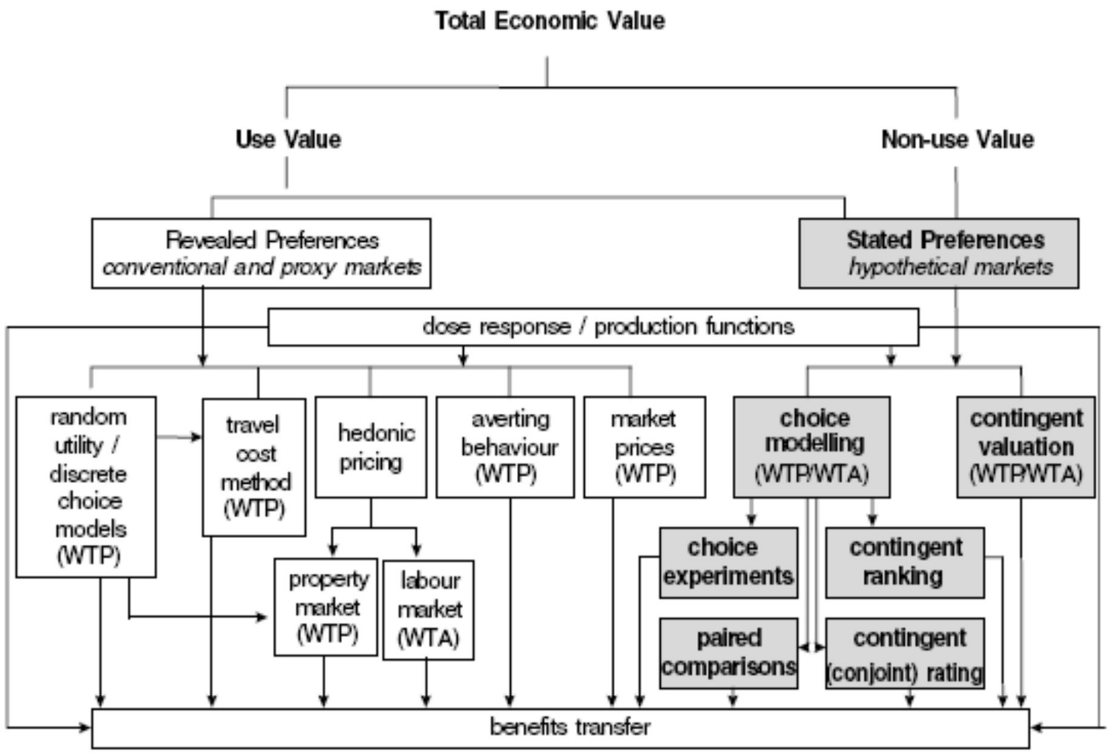

Figure 11: Total economic value and valuation techniques (Pearce and Özdemiroglu, 2002)

Rozan (2001) has given a classification of the different methods which is more useful for valuing the different costs components when valuing health impacts (see Table 3).

	Social cost		Private cost		
	Treatment of the illness	Lost of production	Prevention of activities	Pain, disutility	Restricted activities
Cost of illness method	X	X[a]			
Production function of health	X	X[a]	X[b]		
Contingent valuation method	X	X	X	X	X
Stated Preferences	X	X	X	X	X

[a] The production loss is valued through the human capital method.
[b] For prevention activities, the opportunity cost of time is taken into account with the human capital method.

Table 3: The various morbidity costs valuated by the various methods (Rozan, 2001)[12]

[12] In this table, the term "stated preferences" stands for choice experiment (cf. 2.2.3 for description of the two stated preferences methods).

From Rozan (2001):

"…It should be noted that morbidity could reduce the individual's welfare in different ways:

- ✓ the expenses associated with the medical treatment;
- ✓ the expenses made or the activities performed to avoid illness;
- ✓ the loss of wages resulting from sick leave;
- ✓ the disutility associated with the symptoms (the pain, the suffering) and the loss of opportunities to practice leisure activities due to the illness.

[Table 3] summarizes the various costs measured by the various valuation methods.

The cost of illness method (COI) and the method based on the production function of health (MFP) assess the health costs based on the monetary counterpart of these effects. The cost induced by the production loss is valued by the human capital method. COI and MFP both provide an assessment of the social cost. Moreover, the production function method taking into account prevention activities shows that COI underestimates the cost of illness (Cropper, 1981). Indeed, prevention expenses express a preference for a good health state, because the individual is able to work and to earn money. However, the pain induced by the illness is not taken into account explicitly, to the extent done by the contingent valuation method (CVM) or the stated preferences method (SP) is concerned. Moreover, MPF is difficult and takes a long time to be implemented, thus it is seldom used empirically.

Only, the direct approaches are able to take the private cost full into account. When medical expenses are borne by society, it could be difficult for an individual to estimate the total cost, and there is a risk of either double counting or underestimation. Indeed, it depends what the individual focuses on for his estimation. In introducing some explicit questions in the contingent questionnaire, we are able to validate the motivations of the individual and to focus him on private costs only."

Thus, Rozan (2001) recommends to combine two methods: cost of illness for the costs borne by the society, and contingent valuation for private cost. By this way, all aspects of external costs can be valued. This thesis focuses on contingent valuation to see how capture in a most possible reliable way private cost associated with a health impact.

2.4.2 Remark: the issue of double counting when valuing health impacts

Double counting can be a problem because, as previously explained, the different costs components of health impacts are difficult to value. Indeed, all these cost components are often linked in a complex way. For example, it can be difficult to distinguish cost attributed to the avoidance of pain and suffering from cost related to some medicaments (which can relieve part or all these symptoms). Another example: when stating his/her WTP in a contingent valuation study designed to value pain and suffering, the respondent may also add the value of his/her loss of wage.

Moreover, if in a study both mortality and morbidity impacts are assessed, there is also a risk of double counting especially for illnesses which conduct to death after a long time suffering. Indeed, the monetary factor for mortality, the Value Of Life Year (VOLY), could contain a fraction associated to morbidity. Likewise, the morbidity valuation of this kind of illnesses can also contain some mortality part as the ill-period is followed by death. This risk of double counting especially exists in the case of some cancers.

Once again, precisely defined the valued impact appears to be a good way to reduce the risk of doubling counting. Giving a detailed context and even the causes of the valuation, as discussed in this thesis, may appear as an important aspect of this specific definition of the valued good.

The next chapter focuses on contingent valuation, the method identified as a good one to assess private costs associated with a health impact, and the method used in the valuation analyzed in this thesis.

3. Contingent valuation

3.1 Principle

The aim of the contingent valuation method, an ex-ante study (the valuation is made before the start of the valuated program) is to determine the value of a non-marketed good. It is based on the principle of maximization of utility: people are supposed to use their money to maximize their well-being.

To assess what is the utility maximum, a fictitious trade is proposed. Respondents are asked to choose between two situations (Carson, 2000):

- ✓ the status quo, with no increase of charges;
- ✓ the setting up of a new policy which will improve the provision of the non-marketed good at a given cost.

The respondent chooses if he/she wants to participate to the program, and if yes, how much he/she is willing to pay for it: it is his/her willingness to pay. He may or give a direct answer (open-ended question, the respondent directly state the amount he is willing to pay). However, as it is an unusual exercise, he may also have to accept or refuse proposed amount (closed question) to mimic usual buying process (buyers have to choose between products with existing prices) or by accepting or refusing to pay amounts given on after the other (closed question), or by checking in a list the amount he would be ready to pay (payment card). A combination of these two methods is also used: first the respondent accept to pay or not given amount to have a range of amounts he would be ready to pay, then he precised his answer in an open question.

Another version is to ask how much the respondent would like to accept to reduce its provision of a non-marketed good: it is the willingness to accept.

This kind of study allows determining the value attributed by the affected population to the good, not only for its use but also for its possible use in the future (option value), for their children's use (bequest value), altruism (knowing that other people may use the good), or just knowing it exists (existence value) (King et al., 2000).

The steps of such a study are described in Figure 12: The first step is the definition of the scenario. Steps 2 to 4, construction of the questionnaire, are conducted simultaneously, with adaptation of one step in function of the result of the other steps (e.g.: changing the survey method - step 2 - because of the results of the test of the questionnaire - step 4). Step 5 is the phase of conduction of the questionnaire. The last steps are the analysis of the results.

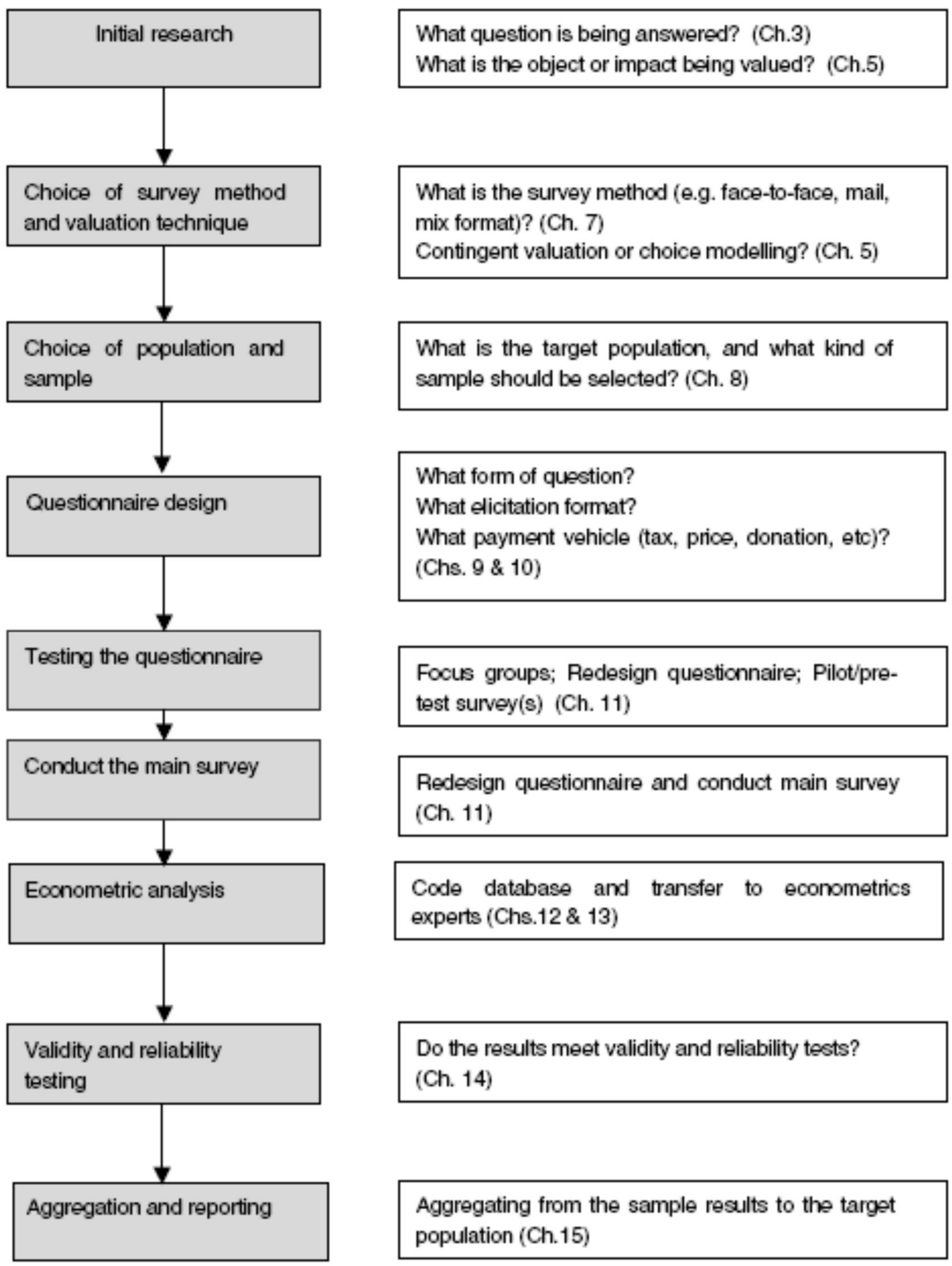

Figure 12: The stages of analysis in a stated preference study (Pearce and Özdemiroglu, 2002)

The willingness to pay has also to be as close as possible to real preferences to hold the respective gravity of different illnesses[13]. Hence, there are still controversies about the use of this method (King et al., 2000). This method has a main advantage: it makes it possible to determine the non-use values associated to the non-marketed good to be valued.

It has also drawbacks: the characteristics of respondents and biases (e.g. paying for someone else, such as children; or valuating other things than the one of the survey) influence the results but are neither always quantifiable nor avoidable. Therefore, these results have to be considered more as guidance, with its uncertainties, than as precise amounts.

3.2 Quality of a contingent valuation study

Two main elements may influence the results of a contingent valuation survey:

- ✓ Bias, which is the difference between the true unobserved WTP of a respondent, and the WTP elicited in a survey. For example for self-reported characteristics (e.g. illness, habits to pay), culture (e.g. between Protestants and Catholics) can conduct to major differences.
- ✓ Effect, which is the difference between the WTP elicited in a survey and the monetary values that would be obtained on a real market. Effects are linked to the quality of the survey.

3.2.1 Quality criteria of a contingent valuation study

3.2.1.1 Credibility

The fictitious scenario has to be credible and plausible: the respondent has to be convinced that he really will have to pay when he decides to accept or not to pay and when he determines the amount of the willingness to pay. At least, if he does not believe he will have to pay, he has to play the game.

A study about mortality conducted in Japan (Itaoka et al., 2007) highlights that if some questions are not credible, it could have an influence on the willingness to pay values, even if some debriefings questions could help to discriminate (to drop) most of these respondents. Moreover, respondents may not believe their baseline risk (Itaoka et al., 2007 ; Krupnick et al., 2002): this effect decreases when the period of interest for the health impact is far off. However, in this study, no difference was found between respondents who believe and those who do not: most of the respondent make “as if” (which clearly is a good point).

3.2.1.2 Acceptability

Some respondents do not accept to answer the willingness to pay question. They reject the scenario. They just do not want to play the game. These respondents are easy to find (people

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[13] The NOAA panel (Arrow et al., 1993), among others, recommends to try and have a conservative approach for the WTP so limit the predictable overestimation (due to an hypothetical exercise). For example, the panel recommends to give enough information (context consequences) so respondents have a better understanding of the situation, and so “the respondent to arrive at a realistic or even conservative value”. Another way to limit overstating WTP is to use the median in the analysis.

who have not given any answer in the willingness to pay questions) and are analyzed separately from the other respondents.

3.2.1.3 Comprehension

The contingent valuation is based on a fictitious scenario, generally constructed to value difficult subject. In the case of health and morbidity, it can be difficult for non-trained people to understand the description of the illnesses, the scenario and the probabilities presented in the study.

The first points can be minimized with a good level of explanation provided in the study. The last point was studied a lot. One study (Itaoka et al., 2007) highlights that some tests could allow to check that respondents understand simple probabilities, and then to drop into the analysis of the results those who do not. If the probabilities are not understood, insensitivity to risk can be found. Indeed, as explained by Krupnick et al. (2002), "one measure of the success of a contingent valuation survey" is the proportionality between willingness to pay and risk changes: willingness to pay should increase proportionally (minimally for small risk changes with no budgets constraints) with the risk changes for a respondent (internal test) and between different groups of respondent (external test). Krupnick et al. also underline difficulties of comprehension when dealing with health and money. Moreover, most of people in France may probably not be used to consider monetary aspect when being ill because of national health insurance.

However, other explanations to this insensitivity have been proposed. Desaigues et al. (2006a) suggest that willingness to pay may not be proportional to risk reduction because for a too small risk reduction, some people think it is of no more use for them but it still useful for the society. A study from DEFRA (Department for Food and Rural Affairs in United Kingdom) (Chilton et al., 2004) gives the following hypothesis: the insensitivity to the risk may come from the fact that respondents think about what they can afford to pay without too many constraints, to the contrary of the theory which wants that money has to be found in the main part of the budget (i.e. part of the budget used for daily life or leisure), and compare with other similar possible expenses (paying for better water, reduction of car crashes, etc.). Therefore, they do not have the possibility to adjust their answer to the risk.

Even if these studies were conducted to value mortality impact, the similarities with morbidity may suggest that the explanations proposed here are also valuable in morbidity context.

3.2.1.4 Formulation

The questionnaire has to be clear enough to be understood by all respondents. The sentences have to be clear and precise, but also written in a common style in order to be understood by as many people as possible. Moreover, the whole questionnaire (with the different parts and the logic between them) has to be easy to understand.

3.2.1.5 Design of the questionnaire

The structure of the questionnaire has an influence on the response. Stoeckel (2006a) studied the quality criterion for the questionnaire structure. The structure should be adapted to the subject, and be modified if tests underline some problems.

3.2.2 Mode of administration of the study

An issue is often to choose the mode of administration. The question is to discover (and if possible minimize) the biases caused by the administration of the questionnaire. Pearce et al. (2002) recommend face to face interviews (if budget allows it) because it allows visual aid and control of the sample. However, they admit that other modes of administration can also be used, as shown in Table 4.

Maguire (2009) suggests that, by comparing telephone, mail and in person surveys:

- ✓ People more often agree to pay in face to face than in the other modes.
- ✓ When they agree to pay, people with the higher per-capita income are paying more per mail or per telephone than in face to face.

Thus, these parameters have to be taken into account when choosing a survey mode. However, a questionnaire has to be designed for the chosen survey mode. So differences can be expected and specific effects avoided or at least reduced.

Even if some authors (Itaoka et al., 2007) tried to eliminate most of the biases (by dropping people on the base of their answers in the debriefing questions), some biases may still persist. The statistical treatment is designed to control and minimize the remaining biases.

Method	Advantages	Disadvantages
Mail surveys Printed questionnaires are posted to potential respondents	**Relatively inexpensive** Lack of interviewer bias Easier to answer sensitive questions Can be completed at respondent's own pace	**Low response rates 25-50%** Self-selection bias Time-consuming Little control over who fills the questionnaire Fixed question order No clarification or probing possible Restricts the use of visual aids Respondent can alter earlier responses
Telephone interviews Interviewers call potential respondents	Complex questionnaire structures are possible **Cheaper than face to face interviews** Permits probing and clarification Relatively quick to administer Easy to monitor **60-75% response rates**	No use of visual aids Restricts use of lengthy scales Respondent may get tired Respondents may not answer sensitive questions Non-telephone or non-listed respondents not sampled
Face-to-face interviews Interviews take place one-to-one between the interviewer and the respondent either at home or another location relevant to the study (intercept survey)	Highly flexible Complex questions and questionnaire structures are possible Permits probing and clarification Larger quantity of data can be collected Potential for extensive use of visual and demonstration aids **High response rates 70% +** Greatest sample control	**Relatively expensive** Possible interviewer bias Intercept surveys: samples normally not representative and self-selection bias Intercept surveys: questionnaires have to be short
Mixed methods: drop off survey The questionnaire is mailed prior to a visit by the interviewer	Initial personal contact gives survey a 'human face' Shares the advantages of mail and face-to-face methods	Survey form may be lost in interval before calling back **Expensive**
Mixed methods: mail + telephone surveys The questionnaire is mailed prior to a phone call by the interviewer	Gives personal touch to the survey Can complete mailed questionnaire in own time	Shares some of the limitations of mail surveys **Relatively expensive**
Computer assisted interviews Interviewer records responses directly to computer and/or respondent may respond to questions on computer screen	Subsequent analysis is quicker since data inputting stage is not necessary Permits more complex interviews Permits use of e-mail and internet	Possible rejection of 'computer technology' E-mail/internet may preclude random sample unless wide coverage of PCs

Table 4: Type of bias in stated preferences analysis (Pearce and Özdemiroglu, 2002)

3.2.3 Common biases and their effects

Biases influence the results of a survey but are only depending on the quality of the study: an ideal study does not have any biases while a good study limits them to the minimal. Pearce and Özdemiroglu (2002) list the main biases:

- ✓ Hypothetical effect: people are asked to state their preferences; they say what they would do (in contrary to revealed preferences, where the preferences of the people are determined on observations of what people really do on real markets); so the fictitious scenario must be credible enough to ensure the population participates really to the game (King et al., 2000).
- ✓ Information bias: the questionnaire should contain a part informing the respondent of the studied subject[14]. Indeed some understanding problem can appear with the concepts dealt with in the study (Pearce and Özdemiroglu, 2002): "While [Stated Preference] techniques can, in principle, be used to value any impact, in practice there may be cognitive limitations to stating preferences. People may not fully understand, for example, very small changes in risk, or highly complex goods such as biological diversity." In case of morbidity, some illnesses are well known by the public: they can be easily understood by the respondent, with a short description of their symptoms. Others are not so well known (because they do not affect many people): in this case, it can be difficult to explain the illness and its consequences in an easy to understand way without being too long.
- ✓ Strategic bias, also called free-rider bias (similar according to (Pearce and Özdemiroglu, 2002)): one respondent declares a willingness to pay lower than his/her own because he thinks he will have to pay, or declares a higher willingness to pay because he thinks he will have the benefits of the actions without paying for it.
- ✓ Anchoring bias, also called starting point bias when on the first payment value: it appears when the respondent stated his/her willingness to pay based on the payment value provided by the interviewer. A Canadian contingent valuation (Krupnick et al., 2002) shows that the first willingness to pay determined affects the others (in this study, willingness to pay was determine for two risk reductions: 5/1000 and 1/1000). To avoid this effect, the authors only analyze the first willingness to pay determined.
- ✓ Inclusion bias: the interviewer has to ensure that the respondent really answers the given question, and not another one: if the question is about bronchitis, the respondent may also broaden it to all the respiratory diseases (until potentially including asthma).
- ✓ Framing effect: the question suggests a positive or a negative aspect, instead of being neutral.
- ✓ Payment vehicle bias: the respondent may change his/her willingness to pay because of the payment vehicle, for example creating a new tax may induce a decrease of the willingness to pay because it is an unpopular measure.
- ✓ Embedding bias: the willingness to pay does not depend on the quality or the quantity of the good, the respondent included other characteristics than those prescribed in the study.
- ✓ Sensitivity to sequencing: the order of valuation influences the willingness to pay.

[14] In the European program HEIMTSA in general, and particularly in the study about the cost of health impact of air pollution (work stream 4), a methodological choice is to give as little information as possible to the respondents, to have the more representative of the global population sample as possible. This choice was not made in the NEEDS project, where the classical way with as many explanations as possible was chosen.

✓ Yes/no saying: the respondent always answers yes (to please the interviewer) or no (to counter the interviewer).

✓ Protest effect: the respondent does not want to pay anything, or declare a much lower (or higher) willingness to pay than his/her true one, to protest against something.

C. Concluding remarks

Monetary valuation of health impacts is one way to assess health impacts, so they first can be taken into account in the decision process, in a similar way than other elements such as cost of treatments or investments. Second, through this valuation concerned persons can give their own appreciation of the consequences of the illnesses. Indeed, individuals are used to make choices according to their preferences in markets: individuals aim to maximize their utility in order to reflect their preferences, even if they may fail at doing so, for example because of a lack of information.

It should however be mentioned that monetary valuation of health impacts is often subject to a range of critics. A review of these criticisms can be found in Gurjar et al. (2010), who emphasized that they are usually related to the different assumptions of the welfare theory. The main critics focus on the following question: how could someone put a monetary value on human health? Neither can monetary valuation attributes a price to human health (it is not a good to be sold) nor attribute a cap on the treatment costs that are acceptable per human being. Its aim is to measure the preferences of the whole population with a monetary unit, in order to be able to compare different scenarios of public actions, better represent the tradeoffs at stake and better take them into account in political and economic decisions. Indeed, most of decisions are taken using economic criteria.

However, health impacts and preferences of the population about health are often not integrated in the decision process, because they are not measured in the same economic unit. As said by Pearce and Özdemiroglu (2002): *"While some commentators object to putting money values on environmental or other unprized assets, the alternative is to risk that things which people care about will be not given adequate recognition when decisions are made. If these issues are omitted from decision making, there is a strong risk that non-marketed goods will be under-supplied in the economy, and that non-marketed bads will be over-supplied. Deciding how much of a good to supply, or how much of a bad to tolerate or abate, requires that the value of those goods and bads be brought into balance with the costs of providing the good (or the cost of reducing the bad). In this regard at least, 'money counts' because prices provide an indicator of preferences."*

This analysis has shown that the definition of the different components of monetary value associated with a given health state may sometime be difficult to compare, from one study to another, as the definition used may vary a lot. However, the part related to pain and suffering is quite stable in its definition. As no markets exist for pain or suffering, the value given by individuals can be deduced by observing existing markets (revealed preference methods), or by asking the individuals their preferences in monetary units by creating a fictitious market for the studied good (stated preference methods).

The analysis of the possible biases of this “stated preference” method shows that one of the main challenges of Contingent Valuation (CV) practitioners when designing questionnaire is to achieve the right balance in the information they provide. The questionnaire should allow affected and informed respondents to construct a WTP that expresses their preferences toward the good to be valued. A compromise should therefore be found between presenting necessary scientific and complex facts, (1) keeping the questionnaire comprehensible, and (2) not emphasizing the impact to be valued by giving too much related information.

The next chapter will detail the issue of context and causes in contingent valuation.

II. CONTEXTUALIZATION IN CONTINGENT VALUATION STUDIES

A. Introductory remarks

This second chapter will revolve around current practices and recommendations, regarding contextualization in contingent valuation.

First, the specificities of health impacts reading their causes will be specified. The second part details the theoretical background of environmental economics, and then focus on contingent valuation through an analysis of guidelines in the methodology. The last part investigates how surveys tackle this issue and in what manner its integration would enhance or not contingent valuations.

B. Contextualization and multifactor in the contingent valuation method

1. Contextualization in monetary valuation of health impacts

What we call the multifactor issue can be described in the following way: there are factors that have the same health impacts as air pollution (these are called cofactors). In other words, the consequences on health of a poor air quality can arise from other causes. Regarding the impact of air pollution on health, UK Parliament's Environmental Audit Committee (UK Environmental Audit Committee, 2010) recently recalled that "Poor air quality leads to poor human health. There are short-term effects on, for example, the respiratory system, and more serious impacts due to long-term exposure including permanent reductions in lung function. Air pollution has been linked to asthma, chronic bronchitis, heart and circulatory disease, and cancer". On the other hand, as for the cofactors themselves, the *Agence Française de Sécurité Sanitaire de l'Environnement et du Travail*[15] (AFSSET, 2007) declared that the health status was influenced by numerous interdependent factors such as:

- ✓ Genetic and biologic individual factors (heredity, ageing);
- ✓ Cultural and socio-economic factors (profession, wages, housing);
- ✓ Environmental factors (chemical physical, biological);
- ✓ Behavioral factors (nutrition, physical activities, smoking);
- ✓ Accessibility and quality of health services.

[15] The AFSSET is an administrative public establishment that aims to gather scientific expertise concerning dangers and risks for human health in order to provide French authorities with advice for them to better control these risks and to provide the French population with information on the link between health and environment quality. Since the 1st July 2010, the AFSSET became the « Anses » (Agence nationale de sécurité sanitaire de l'alimentation, de l'environnement et du travail - http://www.anses.fr/ - February 2011).

The AFSSET (2007) also clearly stated that the causal relation between an environmental risk factor and health is a complex notion due to the multifactor characteristic of the illness occurrence.

The relevance of this issue has been discussed by Brown and Slovic (1988) as they considered that the way the context is given may "affect how objects are perceived, the beliefs that become relevant, the utility experienced and the value assigned". The information respondents have and the information they are provided with play therefore a role in the valuation process, since the authors conclude that the results are contingent upon it. Moreover, they stress on the fact that when direct perception of the environmental commodity is not possible, and when an expert knowledge is required, the type and form of information supplied especially matter to get relevant responses. In the case of air pollution, this last point is particularly relevant, since the level of pollution cannot be observed naked eye and since people often do not know the connection between air pollution and its health impacts. The first objective of this chapter is to find out if specific guidelines concerning the integration of the context exist, whether surveys have incorporated it so far, and eventually in what manner. The second objective is then to assess if integrating information about the context in the survey questionnaire is (1) consistent with the theory and (2) leads to more robust valuations or not.

2. The economic theory of the contingent valuation: should context be given to respondents?

2.1 Contextualization: what does the theory say?

As seen in introduction, the relevance of this issue has been discussed in the literature. Bateman and Turner (1992) reviewed several surveys and even though most of the surveys found that more information increases mean WTP, some of them found few or even no statistical significance. Hanemann (1994) put it in another way: "a common temptation is to characterize the object of valuation in rather general terms: What would you pay for environmental safety? What would you pay for wilderness? The problem is that these are abstractions. People's preferences are not measured in the abstract but in terms of specific items." He therefore advocates that respondents should be confronted with something concrete. Bergstrom et al. (1990) found statistical significance between providing information - which they call service information - and an increase in the WTP, as well as Rozan and Willinger (1999) for whom the direction of change could nevertheless be both an increase or a decrease.

2.1.1 The problem of the amount of information to give

According to Mitchell and Carson (1989) the contingent valuation method is a method in which respondents are presented with material that consists of three parts, the first one being "A detailed description of the good(s) being valued and the hypothetical circumstance under which it is made available to the respondent. The researcher constructs a model market in considerable detail, which is communicated to the respondent in the form of a scenario that is read by the interviewer during the course of the interview" (Mitchell and Carson, 1989). The emphasis is hence put on the idea of giving details in the scenario presented to respondents. This idea is confirmed later in the book (ibid.): "CV scenarios must define and communicate to respondents the following: […] *The nature of the public good.* Unlike ordinary surveys' questions, which sometimes ask respondents whether they are willing to pay x dollars to improve "air quality", the nature of the good and the changes to be valued must be specified in detail in a CV survey.".

Notwithstanding, it appears that this first statement remains rather general and leaves room to a broad self-interpretation since it is not actually clear to what extent should the nature of the good and the changes be detailed. To use the same example as Mitchell and Carson: is saying "air quality depends on pollution level" sufficient or should air pollutants be also mentioned? One must however pay attention not to give too much information: being too comprehensive may highly increase the information bias which is defined by Ajzen et al. (1996) as the process through which "giving respondents detailed information about the public good and about the context relevant for valuation introduces unintended and unanticipated distortions". Boyle (2003) indicates furthermore that only specific information about the item being valued is required. According to him this specific information "enhances the personal relevance of the policy change to survey respondents".

2.1.2 The NOAA panel's point of view

The National Oceanic and Atmospheric Administration - NOAA, (Arrow et al., 1993) made another contribution to the CV theory when it commissioned a panel of economic experts (chaired by two Nobel Prize laureates, namely Kenneth Arrow and Robert Solow) to examine the contingent valuation surveys in order to respond to the criticisms made to stated preference techniques (such as CV). The view of the panel on contextualisation was that CV surveys recurrently provided only sketchy details in their scenario and one of the guideline emanating from the NOAA report tackled this issue. Indeed, in a paper in which he looked at the rationale for using CVM for environmental regulations, Portney (1994) reported that the NOAA panel recommended to begin the valuation with a scenario that "accurately and understandably describes the expected effects of the program under consideration" in order to give a larger amount and more accurate information as for what is being valued. In fact, a lack of information prevents respondents from giving out meaningful values. On top of that, providing information is not an end in itself: people do have limits in their ability to internalise the information given and especially when they have a limited time to do so. An overload of information makes it harder for them to then accept it and thus proceed it (Arrow et al., 1993). The problem brought up here is the one of trying to avoid overwhelming respondents with too much new knowledge. The risk is for them not to believe in what is said and to not integrate later it in their responses. The authors explicitly affirm: "even when CV surveys provide detailed and accurate information about the effects of the program being valued, respondents must accept that information in making their (hypothetical) choices”. If respondents do not accept what is presented to them they will not use it in their reflection which can lead to a decision making based on false point of view on the question.

2.1.3 A more pessimistic view

Hausman (2012) is critical about contingent valuation in any form, as claimed by the title of his article: *Contingent Valuation: From Dubious to Hopeless*. His position is that there is no such thing as a reliable contingent valuation. Hausman suggests there is no way to get real and consistent preferences, mainly because of tackling hypothetical bias (more people are willing to pay when they do not actually have to pay) and gap between willingness to pay and willingness to accept, he mentions the embedding effect (respondents do not pay more for large changes than for small ones). The lack of reliability is for him due to the fact that “Responses to contingent valuation surveys for a single environmental issue are typically based on little information, given the limited time involved for each survey respondent. Thus, the results of such surveys are unlikely to be accurate predictors of informed opinion.” This comes back to Cummings et al.’s idea (1986): “Subjects must understand, be familiar with, the commodity to be valued”. This would mean that contingent valuation with a proper level of information would be relevant.

The view of Hausman regarding hypothetical bias is somewhat supported by Ehmke et al. (2008). They tested for hypothetical bias (in four countries) and determined major hypothetical one in every country (with the exception of France actually) with up to half of the participants changing their mind between the hypothetical and real step of the experiment.

However, Hausman does not really provide any solution to improve contingent valuation, he suggests avoiding them overall (but we will not).

2.1.4 The example of air quality

A couple of authors go a little deeper in their explanation when talking about contextualization by presenting a few examples. First, Mitchell and Carson (1993) repeat that a means to improve understanding is to describe the context in which a good provides services, but they underline that context may involve many dimensions and therefore state that “the designer should focus on those context features that preliminary research shows are likely to influence the value respondents place on the good”. The example of an air quality good is then used and it is affirmed that this case would involve information about whether any human health improvements would occur if the good was provided.

Portney (1994) uses examples too: after recalling that a scenario is intended to give the respondent a clear picture of the good that the respondent is being asked to value, he argues that “in some cases, [scenarios] are quite detailed, providing information on the expected effects of the program as well as the likely course of events should the program not be adopted. For instance, the scenario might contain an estimate of the reduction in annual mortality risk that would be expected to accompany an improvement in air quality; or it might explain the rate at which an endangered species would be expected to recover if it was given additional protection".

One can derive of these two occurrences that when using CVM for air quality, providing information is recommended since it can help producing more robust values thanks to more informed decisions.

Lastly, Bateman et al. (2002) also tackle the context issue and state that CV questionnaires should be designed "to get respondents to think seriously about the topic of interest, to provide the necessary information for them to be able to make informed decisions and to encourage them to identify and reveal their monetary valuations". They even go further: "As all surveys, CV surveys are context dependent. That is, the values estimated are contingent on various aspects of the scenario presented and the questions asked". Indeed, the authors see two different groups of survey elements: those expected to be neutral on the elicited value and those thought to have a significant influence on respondents' valuation. The latter include the information provided about "the good, the wording and type of the valuation questions, the institutional arrangements and the payment mechanism". Thus, according to the authors, the design of the valuation scenario is of crucial importance for the elicitation of accurate and reliable responses.

2.1.5 The effect of information on WTP

When it is decided to include information in a CV scenario, it may have effects on the final result. In fact, it may lead respondents to state lower or higher WTP than those they would have stated if they had been told anything before the valuation. As information may have an influence on the final result it seems relevant to investigate to which extent information has an effect and what is the direction of the change.

2.1.5.1 Cases where providing information increased WTP

A couple of authors have studied this question, among them Bergstrom, Stoll et al. (1990) looked at the impact of information on the WTP as they hypothesized that additional information about the valued good (in their survey: wetlands) would increase WTP. Their test, between subjects, confirmed their hypothesis: "The additional [Service Information] apparently had a stronger positive impact on the post-payment utility level which (…) increases WTP". Protière et al. (2004) made the same kind of study as they looked at the difference in WTP of three groups valuing the same goods (health care programs) but with different level of information added during the questionnaire (within subjects). The authors have tested the effect of two types of additional information: one thought to be neutral ("in the sense that it simply describes what would happen, on average, to patients") and the other thought to be positive (and which concerned the process of treatment and quality of care).They came up with the conclusion that the presentation of more information to respondents induced differences in WTP values: "the value associated with some additional 'neutral' information on the process of care was positive; and when this information was complemented by unambiguously ‘positive’ information, the increase in the mean WTP became statistically significant”.

2.1.5.2 An unclear direction of the change

Rozan and Willinger (1999) showed that in the context of health improvements caused by reductions in air pollution, a significant difference between WTP when the origin of health improvement were provided or not was observed. The test within subjects as well as between subjects stated WTP was 50 % higher when respondents were aware that pollution was the origin of the bad health state. However, their global conclusion puts this statement in perspective. Indeed, they came up with the conclusion that even though additional information about the cause had an impact on WTP valuation, this impact was not predictable since in some cases information about the cause increased the respondent’s WTP, whereas in some other cases the authors observed the opposite effect. It is not clear what leads respondents to increase or decrease their initial WTP, however the information presented and the way it is done plays very probably a role. In the end, the authors stated that their results demonstrated that any additional information may significantly affect the respondents’ WTP, the change being between 20% and 50% increase or decrease. The fact that the influence of information on WTP is variable is corroborated by Alberini et al. (2005). In the survey, respondents were told about a hypothetical public program that would, if passed by a majority vote, restore beaches, implement erosion control, and improve infrastructure on the island. The survey aimed to elicit whether they would vote for or against the proposition on a ballot, if establishing the program would imply a cost of X€ to their household. In order to test the influence of information two groups were made (between subjects comparison): “the first group of respondents received the standard questionnaire, while respondents in the second group were given a reminder of possible reasons for voting in favor or against the proposed program before the referendum question”. The results of their analysis gave no significant correlation between reminding respondents of the advantages and disadvantages of the intervention and their WTP for the program. However, when including the education level into the regression the WTP was then significantly correlated to information: “reminding respondents of the reasons for voting for or against the public works increases WTP among less highly educated respondents, and decreases WTP among more highly educated respondents”. Hence, despite an existing correlation, it is not possible to make a definitive statement about the direction the change happens and it is therefore not possible to conclude that providing information tends to either increase or decrease respondents’ WTP.

2.1.5.3 Should information be given: CV designers’ point of view

Thus, even if WTP can differ with respect to the available information, it is unclear in which direction additional information does affect the stated amount. Some authors therefore consider that providing information should in fact be done, and others do not. Among those that advocate in favor of designing surveys with information, Rozan and Willinger (1999) believe that with additional information “informational differences and subjective references are reduced because respondents rely on the same cause" and they see it as a better control over individual responses. This control appears to be important for the authors since according to them, despite most individual characteristics are observable, it is usually difficult to determine accurately the respondent's level and quality of privately owned information about the situation. In addition, Vàzquez et al. (2006) stated that "non-contextual approach could be subject to higher preference imprecision, which makes estimated values unreliable for policy purposes" and therefore also advocate for survey with information. On the contrary, Alberini and Chiabai (2007) chose not to provide respondents with the context of air pollution or climate change: in the survey people were to value reductions in their own risk of dying for cardiorespiratory causes. They justified their approach as follows:

1. "First, an earlier study by Johannesson et al. (1991) suggests that people are capable of grasping such risks and willing to pay to reduce them.
2. Second, we wished to keep the risk reduction a private good, because it is difficult to identify the altruistic components of WTP, and to account for them appropriately to avoid double counting.
3. Third, linking risk changes to emissions reductions or adaptation to climate change would require that we educate respondents about them, quantify effects, and address the uncertainty associated with them. In our opinion, doing so would have resulted in an excessively heavy cognitive burden, which prompted us to choose a context-free risk reduction."

The aim is therefore to avert:

- ✓ having the respondents not giving a WTP for the goods in question;
- ✓ double-counting and;
- ✓ overwhelming respondents with too much new information to deal with.

One finds hence many assertions in the economic literature as for the concept of contextualizing the survey in a contingent valuation. Despite it is not always really detailed how the contextualization should be made, the authors of the CVM theory make it overall clear that CV designers cannot bypass the contextualization issue, that is to say they have to include information in the scenario. Moreover, there is room enough for the designers' self-interpretation that allows a better application of the method to each different subject. In addition, it emerges that there is no consensus on whether providing information has an influence (decreasing or increasing WTP) on the final result. Consequently, each approach becomes acceptable as long as it is justified. Every survey designer can in fact choose the solution that he believes to be the best, provided he had in the first place a reflection about why using this particular approach. Nonetheless, such a justification is seldom if ever provided.

A great effort also has to be done not to give too extensive and/or irrelevant information. Irrelevant information refers in our case to information unnecessary to bring up because it involves new elements that may lead respondents to think of something else than what is supposed to be evaluated.

It seems now of interest to have a look at the literature pertaining to the CVs applied to the health impacts of air pollution and to see if many surveys actually put some context in their scenario, and if so, in what manner.

2.2 Current practice concerning contextualization in contingent valuations of health impact of air pollution

As a result of what the theory says, it is rational to expect finding different levels of information in the various surveys hitherto conducted. This focuses on contingent valuations applied to health, and more particularly to health impacts of air pollution. These different levels of information given are illustrated in Rozan's two approaches. Indeed, Rozan (2000a) exposed the two approaches she found to valuing health effects induced by environmental pollution in Figure 13.

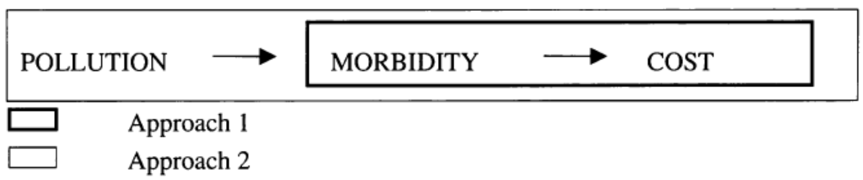

Figure 13: Two approaches in contingent valuation (Rozan, 2000a)

Rozan (2000a) justifies that "Approach 1 consists in valuing the willingness to pay for a reduction of morbidity without saying that this reduction is due to a decrease in environmental pollution". It is hence a way of doing with no information given and no context provided, this method has been largely used by Krupnick et al. (2002) as we will later see. In approach 2, "the individual knows when he reveals his WTP that the health effect is due to an environmental degradation". Thus, the difference between the two approaches is that in the second one the information about the cause is given to respondents while in the first one they all ignore it.

2.2.1 Cases of large information provided

Rozan (2000a) mentions a contingent valuation survey she implemented in Strasbourg in 1998 and for which she used the approach 2 ("When the individual had to elicit his WTP, he was told that the symptoms were due to air pollution"). Rozan (2001) further explained how was conducted the survey: in order to have the respondents become familiar with the good to be valued, the respondents were first asked to describe their own health and their close relatives' one, and were then presented with a list of ten symptoms. Respondents willing to take part into the air quality improvement policy were told that the symptoms were due to air pollution and their WTP was then elicited. This seems particularly appropriate since it simultaneously leads respondents to think about their own health (and hence possibly think about what influences it) and then gives them some clues about it. The amount of information that respondents end up with is thus quite large.

2.2.1.1 Norwegian survey

The earliest appearance of some kind of information-giving that was noticed in the literature review dates from when Halvorsen (1996) decided to analyze the ordering effect in CV surveys, that is to have a look at how the expressed value of a particular good valued in a sequence of several goods depends on where in the sequence the good is valued. He used for that data from a CV survey conducted in 1993 in Norway to value the public's willingness to pay for a governmental program reducing the emissions to air from car traffic by 50%. The survey was designed to give to respondents a scenario where the benefits from a 50% reduction in air pollution due to reduced emissions from traffic were described. Health benefits were the main ones but a few environmental benefits were mentioned too. The health benefits were a reduction in the risk of becoming ill from lung disease, asthma, bronchitis, allergy, and minor health effects such as a reduction in days with headache, tiredness, aching muscles, cold or flu while the environmental benefits were a reduction in damage due to acid rain: damage to forestry and agricultural production, and material damage. One must here underline that a great effort has been made to provide respondents with quite a large amount of information on what is at stake.

Besides, in order to have all the respondents reconsidering their total WTP after all the information was given they were separated in four sub-samples. Sub-samples B and D were told that the government would subsidize electric cars to achieve the 50% reduction in air pollution while sub-samples A and C were told that the government would use an unspecified package of tools to achieve the required reduction in emissions from car traffic. "Respondents in sub-samples A and B were given all the information, and then asked to value all the benefits from a 50% reduction in the air pollution from cars. The respondents in sub-samples C and D were first given information about health effects and then asked to value these effects. Subsequently, they were told about all other effects, and asked to state a new total value for all the benefits mentioned". Doing so makes it possible to bring out the potential differences that may result from the various ways information is given, and if one way of doing should possibly be preferred although respondents all end up with the same level of knowledge on the question.

The results of the survey showed that a sequential valuation procedure may create "considerable and significant ordering effects and/or part-whole biases". Halvorsen concluded that the main reason for the biases mentioned above seemed to be that the respondents were given imperfect information about the valuation problem during the valuation sequence. They therefore put the emphasis on the importance of perfect information on the validity of the results from a CV survey.

2.2.1.2 The DEFRA survey

Chilton et al. (2004) conducted a survey on the valuation of health benefits associated with reductions in air pollution on behalf of the Department for Environment, Food and Rural Affairs (DEFRA) of the British government. They started their survey by asking respondents to first consider various public health risks (one of them being air pollution) and then to state those they were seeing as the most important threats to their health. The authors explain their method as follows: “the reason for this approach was to see to what extent respondents identified air pollution as a high priority concern for them, and to put air pollution in some context: i.e. that there are a range of public health risks, of which air pollution is just one” (ibid.). Once done, respondents were then presented with various ways in which air pollution might affect their health. In the end, respondents were asked to value four possible benefits that “might be associated with reducing air pollution”.

2.2.1.3 The European Union project NEEDS

The strength of the questionnaire developed within NEEDS (Desaigues et al., 2006b) – see 2.1 – is that precise data are given to describe and explain the context, the impacts and the scenario. Indeed, the scenario is made clear right from the start: it is said before anything else that the study concerns the health consequences of air pollution and that reducing the latter leads to an increase in the life expectancy of individuals.

After inquiring for the respondents on their opinion on air pollution (through asking them whether air pollution physically bother them and if they feel concern with the effects of air pollution on their health) they were introduced to where actually air pollution comes from: “In your city air pollution can mainly be attributed to public and private transportation (cars, trucks, buses, etc.), heating systems, household waste incinerators, power plants and industry. In other words, through our lifestyle, transportation needs and the goods and services that we consume are all responsible for creating air pollution.” Thus, there is a real work to raise respondents’ awareness on the fact that they are all actors of the level of pollution and that they can have a real influence on it.

Respondents were also presented with the effect of air pollution: “What are the effects of air pollution on your life expectancy? The daily inhalation of air pollutants gradually damages the body and accelerates the aging process. Individuals (of all ages) who are already more vulnerable because they suffer from respiratory or cardiovascular illnesses are more sensitive to air pollution because it aggravates their symptoms. An improvement in air quality would lead to an increase in the life expectancy of the general population.” Hence, respondents were also said that given that they were responsible for air pollution and that air pollution had impacts on their health, they could act in such a way that they could live longer and in better health. To complete thoroughly it all, an example was given: “to put this information in an everyday life context understand that the level of air pollution in a big European city like Paris is like smoking 4 cigarettes a day”.

2.2.2 A case of few information provided

Carlsson and Johansson-Stenman (2000) produced a paper concerning contingent valuation survey to elicit the WTP for improved air quality, as part of the larger Household Market and Nonmarket Activities (HUS) survey which took place in 1996 in Sweden.

The CV scenario was designed so that it presented a program that could reduce the concentration of harmful substances in the region where the respondent lived and worked by 50% but left the concentration unaffected elsewhere. This way of doing is quite different than

Halvorsen (1996)'s one (cf. previous paragraph): the amount of information is rather small. Indeed, even though it is not just asked to value "air pollution" such as it is often found in other studies, it is only specified that it deals with the concentration of harmful substances. Another point that differentiates this survey from the others is that it detailed the reason for not providing information while, on the contrary, other similar studies did not. In fact, a paragraph mentions that in spite of the emphasizing of the CV literature on the importance of well-informed respondents, the authors chose to leave respondents with their own level of information (Carlsson and Johansson-Stenman, 2000). In their opinion, the fact that consequences of air pollution for health and environment are very difficult to predict and the divergence in scientists' views are reasonable grounds for avoiding providing information. This therefore shows up that some CV designers are advocates for no information providing when they do not just leave the question behind.

2.2.3 A no information providing method

This method was mainly used by Krupnick (who developed it) and Alberini (Alberini et al., 1997; Krupnick et al., 2002), who have both conducted many contingent valuation. For this reason, the method is sometimes referred to as "Alberini - Krupnick approach". The principle of this method is the following: a treatment is presented as a tool solving a particular problem that is not detailed a lot (not to say not detailed at all). In this approach, the hypothetical scenario is therefore very simple: "you have the illness x", and the payment vehicle is also very simple: "you can buy a treatment which will cure your illness". The main feature of this approach is the fact that it is decided not to give any information concerning the context: respondents are left with their own knowledge and points of view. This method sometimes called "the magic pill method" is widely used. For example, Alberini et al. (1997) designed the scenario of a survey aiming to value the health effects of air pollution in Taiwan so that it elicited respondents' WTP to avoid an episode of acute respiratory illness. Scasny et al. (2009b) designed a contingent valuation study where respondents were asked to consider how much they would value the opportunity to reduce their risk of dying. A last example is the survey HEIMTSA (see Appendix 4) in which a contingent valuation seeks to reveal the WTP for avoiding various illnesses thanks to a treatment not described. In all these surveys the authors never mentioned that the illness was related to air pollution. One drawback of this method is that respondents may indeed value avoiding the illness by decreasing air pollution but not paying here because they are afraid of the side effects of the magic pill.

Lindhjem et al. (2011) looked at the influence of using a questionnaire originally developed by Alberini and Krupnick compared to using other questionnaires. Indeed, they made a meta-analysis[16] in which the influence on the Value of a Statistical Life (VSL – which is based on the WTP stated by respondents) of different variables used in contingent valuations was examined. Given that it is difficult to compare surveys to one another since they all depend on

[16] A meta-analysis is an analysis across a number of separate surveys, in order to seek to explain differences in their findings, and to gain additional insights, by pooling several surveys together. (Braathen et al., 2009).

various criteria, the present meta-analysis looks at which variables affect the result and one of the variables included was about whether the survey was using a Krupnick-Alberini type questionnaire. The results of the meta-analysis showed that estimates coming from a Krupnick-Alberini type survey were significantly lower (cf. Table 5).

Variable	Model 1	Model 2	Model 3	Model 4
	Full model (max variables and obs)	No method variables	Model 1 + Income and age	Model 1 + risk change
krupalber	**-1.014**** (-1.9883 - -0.0401)	-0.312 (-1.3888 - 0.7638)	**-1.195***** (-1.6965 - -1.1945)	-0.205 (-0.9402 - 0.5299)
R^2: overall	0.691	0.485	0.898	0.778
N	739	800	330	541
# surveys	43	52	31	34

Note: Significance levels: *** p<0.01, ** p<0.05, * p<0.1. 95% confidence intervals in parentheses.

Table 5: The effect of the Krupnick-Alberini variable on VSL (Braathen et al., 2009)

Using a Krupnick-Alberini type questionnaire can be considered as a proxy for using a low information questionnaire. Therefore, according to this meta-analysis of Braathen et al. (2009) giving no or low information in the questionnaire leads to lower WTP values as using questionnaire giving more information. As the authors state: "estimates from surveys using the questionnaire developed by Krupnick and Alberini gave systematically lower VSL values than estimates from the average study in the dataset".

2.2.4 Step-by-step scenario

The approaches presented in the previous paragraphs (2.2.1, 2.2.2, and 2.2.3) were antinomic: either considering context or willfully avoiding it. However, a couple of authors look at both approaches.

One finds the idea of a two-step scenario survey in Chanel et al. (2004) who introduced the main results of a contingent valuation survey dealing with a change in air pollution exposition where individual's WTPs for both health and non-health effects were elicited. Their method is however slightly different from Rozan (2001)'s since here in both scenarios the baseline is air pollution. Indeed, the first step is as such: people are said that they are forced to move out and are given the choice of two cities in which to move in. The only difference between the two cities is the level of air pollution. The survey hence seeks to reveal the WTP to move into the city with less pollution, the WTP being a proxy for the higher cost of living in the less polluted city.

In the second step, respondents are provided with details on what actually are the impacts of air pollution, the latter being divided in 3 categories:

- ✓ Purely polluting impacts: they make buildings dirty and smelly.
- ✓ Irritating impacts: cause additional illnesses: irritated eyes, headache, sore throat, coughing, flu symptoms or even hospital admissions for respiratory and cardiac reasons.
- ✓ Fatal impacts: shorten the life span. Exposition during several years to a high level of air pollution leads to a deterioration of health status and hence to premature deaths.

As an example, one out of hundred persons living in the less polluted city will die before the age of 80 as a consequence of air pollution whereas two would die if they lived in the polluted city. Thus, one person out of hundred can live about 10 more years when living in the less polluted city compared to the polluted one. After being told this, respondents are once more asked their WTP to move into the less polluted city rather than in the more polluted one. The second scenario (the one with the information) is hence really detailed and leads respondents to a decision based on very good information concerning what are the pros and cons for their health to decide where to move in. The results for the mean WTP were 65€ in the scenario without information and 69.7€ in the scenario with information which equals to an increase of 7%. However, the authors argue that the data only imperfectly represent the impact of information at the individual level since the analysis of such an impact would require the use of a specific econometric model.

2.3 The example of choice experiment

Choice experiment is another declared preferences method. As for contingent valuation, respondents have to choose between various options of a virtual market. Each option represents a set of characteristics and a value (price). This method is supposed to be closer to real life choices than contingent valuation as it compares to choices made when buying goods. However, this exercise anyway implies that respondents do give a value to the studied good. As in contingent valuation, the amount of information to be handled by the respondents is important: too much may impair their thinking abilities, whereas too little may limit the possibility of making an informed decision.

Hanley, in a series of papers with various colleagues, studied the influence of context on the contextual information given during the study on the respondents' answers, on case lined to biodiversity and environment. An analyze by Ivcevic (2016) shows giving positive information increases the WTP. It highlights that study on information in choice experiment have various influences on respondents, including confusing them. Theoretical economy says that inconsistencies expressed by respondents when maximizing their utility is due to imperfect information. Tinch et al. (2015) conducted a study in which they tested the influence of adding information to respondents, by the mean of a visit of the valued nature park. Their main conclusion is: "We find that the timing and location (context) of identification of preference for a given environmental resource (given the same sample, experimental design, choice cards and methodology of application) does have an impact upon the resulting stated preferences for landscape characteristics, with higher differences for the valuation on site before the visit, called the "moment of consumption". The authors concluded that context matters with conducting a choice experiment.

The influence of the experience on the WTP determined by choice experiment studied in two articles (Czajkowski et al., 2014, 2016). These two papers show that a higher experience of the good to value lead to a higher confidence of the valuation and to a (yet marginally significant) decrease of the variance, i.e. of the uncertainty link to the valuation. However, the

WTP is not affected by the information, only its precision. They emphasis new studies may be necessary with higher statistical power as well as test with other types of studies or good would be necessary to confirm their findings.

In conclusion, it appears that theory almost consistently recommends for contingent valuations to be put in some context to help respondents understanding what they are asked to value. Nevertheless, most cases do not provide other precision than: i) enough information for the respondents to be familiar with the good to value and consequently eliciting a meaningful value, and increasing the acceptability of the questionnaire; ii) little enough for not overwhelming the respondents, or influencing them.

On the applied side, all options have been used. While most of CV designers leave the context's issue aside, those that decide to provide information do it in very detailed ways by a majority. Both choices have shown their own drawbacks: a no-context approach would tend to make respondents producing values resulting from under-informed decision, whereas the contextualized approach risks facing the embedding effect[17], influencing respondents' WTP, and cannot avoid the information bias.

When using the contextualization approach, the potential bias can be limited and controlled through proper and careful design and tests of the questionnaire: giving clear and succinct information may increase the acceptability and reliability of the WTP. On the contrary, when using the approach without context, the risk exists of letting uninformed respondents with incorrect or incomplete knowledge.

Regarding choice experiment studies, similar outcomes were found. It appears that information does influence the WTP even if is not clear how: positive information seems to increase WTP; too much information confuses the respondents. However, it appears that giving information leads to smaller confidence interval, meaning more accurate and reliable value.

Regarding this work, the outcomes of this review are i) providing information is recommended to conduct a reliable contingent valuation survey, ii) the consequences on WTP of information may not be always statistically significant, but it seems to improve consistency of the value.

3. How to deal with multifactors in contingent valuation?

"Poor air quality leads to poor human health. There are short-term effects on, for example, the respiratory system, and more serious impacts due to long-term exposure including permanent reductions in lung function. Air pollution has been linked to asthma, chronic bronchitis, heart and circulatory disease, and cancer" (UK Environmental Audit Committee, 2010). This statement about the health impacts of air pollution summarizes a huge amount of

[17] The embedding effect refers to the "tendency of many CV respondents to report much the same willingness to pay for a comprehensive bundle of safety or environmental "goods" as for a proper subset of that bundle." (Beattie et al., 1998)

research work and resulting knowledge collected all around the word in the last decades. An important outcome of this research work is that the consequences on health of poor air quality are strongly related to other factors. In other words, the illnesses linked with air pollution have cofactors. Indeed, as stated by the French agency responsible for health impacts of air pollution (*Agence Française de Sécurité Sanitaire de l'Environnement et du Travail* (AFSSET), now ANSES), the health status is influenced by numerous interdependent factors such as genetic and biologic individual factors (heredity, ageing); cultural and socio-economic factors (profession, wages, housing); environmental factors (chemical physical, biological); behavioral factors (nutrition, physical activities, smoking); or accessibility and quality of health services.

When coming to the economic valuation of health impacts, the complexity due to their multifactor characteristic induces different issues:

- ✓ Firstly, as it remains in some case difficult to measure the part of risk associated to a specific factor, it is not always possible to define precise relative risk or doses-response functions. This could lead to attribute too less or too much impacts to air pollution and, consequently, the resulting external costs could be under-or-over estimated. If such external costs are then used in the scope of the design of an environmental and/or health politics, this could lead to inefficient decisions (i.e. sub-optimal financial allocation to reduce the occurrence of an impact).
- ✓ Secondly, when using the contingent valuation method, a range of questions related to multifactor arises. For example: What should be valued? The impact as such or the impact due to a specific factor? Should information about cofactors be given in the CV questionnaire? Is there a risk of bias associated to giving or not this information? Can debriefing questions help to know if respondents considered cofactors when stating their WTP? Does the amount of the WTP depend of cofactors? …

The first issue described above will not be addressed in the present work that will focus on the questions related to CV. The main objective of this chapter is thus to give an overview on how the CV studies available in the literature deal with the complexity related to the multifactor characteristic of health impacts. Some elements of the CV theory related to this topic will be given and the main current practices will be described. In the end, some possible improvements will be proposed.

3.1 Should information be provided about multifactor in CV questionnaires?

The environmental economics theory literature does not seem to discuss directly the topic of multifactor. Nevertheless, this topic is closely linked with different points that were discussed extensively in the literature. Indeed, it is particularly linked with (1) the issue of contextualization discussed in the previous chapter, (2) the issue of providing the right level of information to respondents, and (3) the necessity of providing respondents with substitutes for the good to be valued.

3.1.1 Contextualization

Introducing some elements on cofactors means giving contextual information on the health impact to be valued. On the one hand, this leads to the difficult issue of providing the right level of information in order to reduce the risk of associated bias. This was already discussed in chapter A - 3.2.3 but further elements more specific to cofactors will be given in section 3.1.3. The present section focuses on the theoretical question whether information on cofactors should be given at all. Indeed, Rozan and Willinger (1999) recall that regarding economic theory the amount stated should not be dependent of the cause: "From a theoretical point of view, there is no reason to expect a difference between the expressed WTP by the two alternative methods" (where the first alternative provides respondents with information about the origin of the health improvement before the evaluation question while the second does not). Still from a theoretical point of view, a health improvement due to a better environment is equivalent to the same improvement achieved through a change in diet. Therefore, the value of this health improvement should be the same whatever the causes. Nevertheless, the authors also declared that "in the specific context of health improvements caused by reductions in air pollution, a significant difference [of the WTP expressed in the two alternatives] is observed" (Rozan and Willinger, 1999). This could be explained by:

(1) The different biases associated with the CV method (inclusion bias, information bias…). Nevertheless, these biases can be reduced or at least controlled by a proper implementation of the method.

(2) The different causes of a health impact have different characteristics which could have an influence on the preferences of the respondents and, hence, on their WTP. An illustration of this could be that contracting a sickness due to a bad environment has not the same value for the respondent than contracting the same sickness because of, for example, unhealthy diet. This is mainly related to the respondent's perception and behavior towards different type of risks (Fischhoff, 1989). Different authors described the risks attributes[18] and/or studied different kinds of parameters influencing the risk perception (Slovic (1987) for example). In the CV literature, there were also different attempts to consider risks and perception of risks. This literature mainly focuses on the difficulties for respondents to understand risk probability and small risk variations (Navrud et al., 2009). Moreover, a variant of the CV method was developed in order to overcome its limitations: the chained method (Carthy et al., 1999). It consists in combining a classical CV method with a standard gambling method aimed at determining the level of risk accepted by the respondents. Nevertheless, more research is needed in order to (1) achieve robust results on the economic valuation of health impacts

[18] Main attributes influencing risk perception: is the risk imposed to the respondents? Can the risk be controlled by the respondents? Is the risk natural or caused by human activities? Is the risk known? Feared? Considered as unfair? Uncertain? Accidental? Related to some immoral facts? Related to memorable facts?

related to different risks (2) better understand how perception and behavior towards different type of risks affect WTPs.

Finally, when considering the literature, it remains unclear whether the value of a health impacts depends on its causes or not. Here too, more research is needed in order to confront the theory to the applications and perhaps introduce more elements of the scientific field of risk.

3.1.2 Providing the right level of information on the factors

As seen in Chapter 3, the CV theory and best practices recommend providing clear information to respondents in order to help them expressing an informed WTP. Hence, in the case of CV studies giving contextual information the main challenge is to provide the right level of information. When valuing a health impact caused by different cofactors, the question is then: what is the right level of information to provide on this particular point? This question will be addressed in the next two subsections.

3.1.2.1 Health and multifactor: a common understanding?

Being in a good health status depends on many things. On the one hand getting ill can be due to our behavior (e.g. being out in the cold without wearing appropriate clothes) or because of factors we do not directly control for such as air pollution while on the other hand there are predisposition factors, that is internal factors we are not responsible for and which are not due to an external responsibility. This is known for ages: one finds in the text "De morbis et chronicis, de dolore dentium" written by Cælius Aurelianus and dating of the III^rd^ or IV^th^ century the following statement "Illnesses are the difficult ratio between the solid element and the liquid element of a tissue, and this in all the area of the body, including teeth. The cause of these troubles can be climatic, alimentary or due to hygiene mistakes".

As underlined in the introduction above, modern sciences confirm that illnesses do not depend on one single factor: they are multifactorial. The AFSSET states that "the health status is influenced by many interdependent determinants" (AFSSET, 2007). Likewise, according to Demars-Fremault (2001) the illness is either linked to industrial activities or to contemporary lifestyles. However, although it is well known and accepted that many factors play simultaneously a role in the development of an illness, the AFSSET (2007) recall that "the causal relation is a complex notion to determine due to the multifactorial feature of an illness occurrence".

As there seems to be a common understanding of the fact that health depends on a wide range of factors, one could assume that the respondents are aware that illnesses like asthma, chronic bronchitis, heart and circulatory disease, and cancer are multifactorial and that there is therefore no need to recall it. Nevertheless, in a questionnaire related to air pollution, respondents do not always have the time to remind such facts. They are sometimes also not aware of the actual risks related to each factor. As mentioned in the previous chapter (cf. I-3), CV questionnaires should be designed in such a way that respondents can make "informed" decision. It seems therefore important to provide the useful information.

3.1.2.2 How many cofactors should be mentioned in surveys?

Informing respondents of multifactor is one thing but it raises another issue: to which extent should they be informed? Apart from the information bias that has been discussed in 2.1.1, the problem is to determine how many cofactors should be given. In the present case, air pollution tends to have a multitude of cofactors as for the effect on health: a few were mentioned in the introduction but the list was far from exhaustive. When conducting a CV, adding as much cofactors as possible in the scenario is obviously not possible: listing too many cofactors would lead to providing too much information and would finally confuse respondents. The goal is first and foremost to raise their awareness on the fact that the health impacts of air pollution can be caused by other sources: air pollution is only a cause among others. Thus, respondents must avoid considering only air pollution when valuing an improvement or deterioration of their health but great care must be taken not to overwhelm them with too many confounding factors.

A selection among the cofactors needs therefore to be done, how this selection should be conducted is left to the discretion of CV designers, as different approaches would be acceptable: some could decide to put forward the significance of the cofactor while others could favor presenting respondents with the cofactors that they would better understand.

3.1.3 Should cofactors be mentioned because they are a way of providing substitutes of the good to be valued?

In environmental economics, a substitute is defined as something that can be used as a replacement for the good valued. For example, the NOAA panel stated in its guidelines, that "respondents must be reminded of substitute commodities, such as other comparable natural resources or the future state of the same natural resource. This reminder should be introduced forcefully and directly prior to the main valuation question to assure that respondents have the alternatives clearly in mind" (Arrow et al., 1993). Through this, the NOAA panel introduces a two-scale view: seeing substitutes either as a good which could replace the one being valued or as its state in the future. For example, in a survey concerning oil as energy, the scenario must mention the existence of wind, water, coal and so on, but also the reserve of oil and the expected reserve life span. Nonetheless, whatever the case, it is clearly recommended to mention it. Portney (1994) also provided some indications to help constructing a reliable CV questionnaire. One of them, based on the NOAA panel's guidelines, suggested reminding respondents of the availability of substitutes.

In some cases, it is easy to find substitutes. When valuing air quality it appears more complex: there is no substitute for air since one cannot live without breathing or choose to breath something else than air! Nevertheless, the concept of substitution can be slightly adapted. Instead of reminding respondents of the (nonexistent) substitutes for the air deteriorated, one could rather inform the respondents on how to obtain the same health quality or on how to reduce their risk of contracting a sickness by influencing other factors as the environmental one. To put it another way, changing the risks associated to cofactors would be substitutes of an environmental risk. In this way, cofactors could be mentioned in CV questionnaire in order to provide substitutes.

This approach has been used by Navrud (2001) in a survey designed for the valuation of the morbidity impacts of air pollution. The respondents are asked about their relation to tobacco before eliciting their WTP. This was done to "implicitly [remind them] of the opportunities for averting behaviour". To achieve it, he asked people about their smoking habits and if they had given up smoking due to health reasons prior to the valuation question. Hence, Navrud definitely presented tobacco as a health-deteriorating factor alongside air pollution and by doing this, as mentioned above, offered respondents a substitute to the health impact of air pollution: reducing their risk of contracting the illness through stopping smoking. It should nevertheless be noted that the proposed substitute is here only relevant for smokers.

3.2 Current practice concerning multifactor in the contingent valuation of the health impacts of air pollution

As described in chapter II 2.2, only few CV studies introduced the context to the respondents and give background information on the illness to be valued. Even less studies provide information about the causes of the sickness to the respondents. As described above, Navrud (2001) introduced the "smoking" cofactor as an opportunity for averting behavior in order to offer a substitute. Nevertheless, he did not explicitly address the possible cofactors. Rozan (2001) seems to be an advocate for the recognition of cofactors in surveys and is particularly interested in the influence of smoking on the WTP. Nevertheless, in the questionnaire of her study she did not explain to the respondents that the impacts of smoking on health could be the same as those of air pollution nor did she explain the reason why smoking is a confounding factor.

To our knowledge, the only survey that actually gives respondents a somewhat detailed list of the confounding factors of air pollution is the European survey NEEDS (Desaigues et al., 2011; Desaigues et al., 2006b). The aim of this study was to measure the value attributed to the gain of life expectancy due to a reduction of air pollution (the related parameter is called VOLY, Value Of a Life Year). The research team responsible for this survey made the choice to provide respondents with a range of information about health impacts of air pollution. Different complex notions were therefore introduced before the respondents elicited their WTP. For example, information on average life expectancy are given and the respondents were explained how air pollution affects it. Among other information on air pollution impacts on health, the different cofactors of air pollution were explicitly presented: "Your life expectancy actually depends on several factors, which are: biological (genetic), social (if you live in a city, in the mountains, your lifestyle, your standard of living), behavioural factors (you are a smoker, a non-smoker, you exercise, you eat healthy), medical (you have high blood pressure, diabetes, kidney failure), environmental (you live in a highly polluted neighbourhood or not very polluted neighbourhood)" (ibid). The respondents were also reminded of (in this questionnaire) "We will only focus on environmental factors, but remember the other factor also play a role on your life expectancy". It is therefore assured that respondents have in mind what interacts with their health when valuing the air pollution. This survey really stands out compared to the other reviewed ones given that not only does it mention the existence of multifactor but it also details them with the help of examples.

The idea of such a detailed questionnaire was originally developed and tested as a variant to the questionnaire of Krupnick et al. (Krupnick et al., 2002) in the UK, Italy and France (Alberini et al., 2004) in the scope of the NewExt phase of the ExternE projects series. This detailed approach was then developed further in the scope of NEEDS and the survey designer team have had comprehensive discussions about the place of multifactor in the NEEDS CV study. Indeed, the risk existed to provide too much information. As underlined by Chilton et al. (2007), for each CV study, "the survey designer must balance scientific detail with cognitive consideration in relation to what an average member of the public can realistically be expected to understand and assimilate. This is a very difficult trade-off and the temptation to sacrifice the former for the latter under the justification that it is pointless giving people detailed and possibly complicated information they do not and/or cannot understand". For the NEEDS survey, the choice of a protocol based on a carefully constructed description of how the pollution reductions actually affects an individual's life expectancy was done. This description was deliberately designed to be both comprehensive and, at the same time, intelligible to the average layperson. The results of the survey globally show that comprehension, credibility and acceptability are actually enhanced, compared to previous other studies. Even if this should be checked in further details through additional statistical treatment of the results, it seems that the information provided on cofactors did not induce an information bias in the study. In the case of the NEEDS CV survey, it is also clear that the measured WTP corresponds to an increase of life expectancy associated specifically to reduced air pollution and is not a WTP attributed to life expectancy outside of this context.

3.3 Detailed debriefing questions to get some evidence of the influence of cofactors on the WTP

As described above, there are currently only a few studies giving information on multifactor before asking respondents their WTP. Nevertheless, whether cofactors are mentioned or not before the WTP question, it would be interesting in all surveys to collect some information on cofactors in the debriefing parts, located at the end of the questionnaires. Indeed, one objective of the debriefing is to check whether the survey managed to reveal respondents' WTP for the good planned by the designers to be valued and how the respondents constructed their WTP. Thanks to debriefing questions, it could therefore be possible to determine to which extent cofactors are known by respondents and how this knowledge influences or not the WTP.

As an example, asking respondents if they smoke (smoking being the main confounding factor with air pollution for health effects) allows comparing the WTP of smokers to the one of non-smokers and to then infer the possible influence of smoking on the WTP. This was for example done by Rozan (2001): "We distinguished between smokers and non-smokers, as smoking appeared as a factor of confusion". In the treatment of the data, she accordingly distinguished two groups and the corresponding mean WTPs turned out to be actually different.

If cofactors are found to have an influence on WTPs, one further research work would be to try to determine the part of the WTP value to attribute to each factor. To our knowledge this has not be done until now but it stays an open question if the CV is the appropriate method to do so. Indeed, choice experiment, another stated preference method, could perhaps be more appropriate to value the different "characteristics" of a health impact (if "characteristics" are understood as "factors"). There is here place for further research work.

3.4 The case of health

There are different extends of context though.

In the smaller understanding, context may be information about the good valued, in the present case a health state. This would be a more detailed description of the health state: physical or psychological changes, symptoms, duration, consequences on daily life, etc. The limit of this description is what respondents may understand and remember, all without panicking. Most of the studies try and give an as accurate as possible description of the illness, compromising between an accurate description and an understandable one.

The second types may refer to how the valued good, meaning here health, is damaged: the causes of the health state. It may be environmental, behavioral or other causes (such as viruses). The causes can be given with different levels of precision. For example, it may be citing an environmental driver (such as air pollution), or explaining in details the mechanism, which conduct air pollution to impair health (such as the particles passing in the lungs). Here again a compromise has to be found between giving accurate information and what is possible for the respondents to understand in a limited time.

Lastly, it may be how to improve the valued health state, by medicaments or health care, changes in behavior or changes in policies improving environment. Ami et al. (2011) and Ami et al. (2013) studied the influence of the last type of context on the WTP: they proposed three ways to decrease the effects of the air pollution (moving, drugs, new regulation). They stated that respondents react differently to the various options, depending on the scenario and their personal characteristics.

The main focus of the rest of this work will be the second option, meaning: should the cases of the illness be given in a contingent valuation? Does it change the value?

3.5 Contextualization in contingent valuation: key elements

The review of both the theoretical literature and the empirical studies do not lead to strong conclusions about the question "how to deal with multifactor in CV of health impacts?" Firstly, it remains unclear whether the value of a health impacts depends on its causes or not. The applications do not match the economic theory. A perspective for further research would be to integrate into environmental economic more results coming from the research in the field of perception and behavior towards risks.

Secondly, the theory and recommendations regarding CV claim (1) to provide the right level of information to the respondents to help them to make an informed choice and (2) to provide substitutes for the good to be valued. As seen above, these recommendations induce to provide contextual information among which the cause of the health impacts, and the different causes if there are some. The CV practitioner is then confronted to the challenge of determining the right level of information. The risk of bias is particularly important in the case of providing information about cofactors. Indeed, due to the fact that it was empirically demonstrated that the preferences of respondents depend on the type of causes, the resulting WTP can be strongly influenced by the way cofactors are presented in the questionnaire. These issues require designing and testing the questionnaire in a very careful way. To our knowledge, the survey on mortality conducted in the scope of NEEDS in 2006 (Desaigues et al., 2006b) seems to be the only available study carefully introducing cofactors. It was intended to measure the value attributed to a life expectancy gain specifically in the context of a decrease of air pollution.

Regarding past and current practices of economic valuation of health impacts, most authors do not provide information or context and also ignore multifactor in their survey. This approach has the advantages of not confronting the CV practitioner with the information bias. Nevertheless, by using such an approach, the practitioner cannot know whether respondents did think about one/several causes and how this influenced the way he constructed its WTP. As already stated in Chapter 3, giving information in a careful way makes it possible to ensure that all respondents base their WTP on the same facts.

Of course, whatever the chosen approach (providing or not information on cofactors), debriefing questions about the cause(s) of the valued health status should be added at the end of the questionnaire in order to better understand how the respondents constructed their WTP. Did they consider one or several causes? Did those who considered a particular cause declared WTP amounts significantly different from those considering another or several others causes? Answers to such questions would not only help the practitioner to understand better the WTP results of its very study: it would also provide the research community with new results on how to deal with cofactors. Unfortunately, authors too often only publish their results in terms of WTP and do not provide quantitative nor qualitative outcomes from their debriefing questions.

C. Concluding remarks

The first issue, contextualization in CV, is whether and how to provide respondents with information on the context of air pollution (such as the level of pollution or the sources of pollution responsible for the health impacts to be valued). Indeed, the information respondents have and the information they are provided with, may play a role in the valuation process. The main conclusions are:

- ✓ The reviewed guidelines put forward the importance of adding context to the contingent valuation scenario but do not often give more details on what exactly should be presented to respondents or not.

✓ In the field of the health impact of air pollution, CV designers do not consistently follow the guidelines and two different approaches can be distinguished. In the first one, CV designers do not provide information on the context of the health status to be valued: the origin of the illness as well as the relationship between the illness and its causes are not described in the scenario. The second approach consists in providing comprehensive information about the relationship between the health impact to be valued and its cause(s). While most of CV designers use the first approach and do not provide information, the authors using the second one do it usually in very detailed ways.

✓ Some authors found an increase and others a decrease of the stated WTP when information on the context is given. According to the meta-analysis of Braathen et al. (2009) on surveys valuing mortality, giving no or low information in the questionnaire leads to lower WTP values than using questionnaire giving more information.

✓ From a qualitative point of view, both approaches have advantages and drawbacks. With the "no context" approach, the main risk is that respondents' WTP can result from under-informed decision, a bias that cannot be controlled for. With the "context provided" approach, the main risks are influencing respondents WTP, increasing the embedding effect and inducing information bias, which biases can be limited and controlled through proper and careful design and tests of the questionnaire. As a side effect, it will also increase the acceptability of the questionnaire.

✓ Work on choice experiment, while not showing many differences in WTP when providing well-though information, these information increase the reliability of the WTP (decreasing the confidence interval in the valuation).

The "context provided" approach seems to lead to more robust valuations, although great care should be put in the quantity and the presentation of this information to avoid overwhelming or influencing respondents.

The second point can be considered as a specific aspect of contextualization: how to deal in CV questionnaire with the specific information related to the fact that health impacts can have different causes? Indeed, the scientific literature clearly states that the consequences on health of poor air quality have cofactors, and that the interactions between these different factors are very complex.

The first chapter of the analysis revolved around the pure economic theory. It states that the value of health impact does not depend on its cause(s) whereas, in the literature, different values were measured for a single health impact - respectively to the causes that were presented to the respondents. These differences could be related to how respondents perceive each cause and the related risk. Here again, the CV practitioner is confronted to the challenge of determining the right level of information to avoid bias. As it was empirically demonstrated that the preferences of respondents depend on the type of causes, the resulting WTP may be strongly influenced by the way cofactors are presented in the questionnaire.

The second chapter of our analysis on cofactors consisted in an overview on the past and current practices on this topic. Just as for the contextualization, it appears that most authors did not integrate information on multifactor in their survey. Indeed, this approach has, *a priori*, the advantage of not confronting the CV practitioner with the information bias. Nevertheless, by using such an approach, the practitioner cannot know whether respondents did think about one/several causes and how these influenced the way they constructed their WTP.

Whatever the chosen approach (providing or not information on cofactors), CV questionnaires usually contain at the end questions on cofactors (in particular on smoking), which could help getting additional knowledge on how to deal with cofactors on CV studies. Nevertheless, publications often focus on quantitative results (WTP values) and do not contain the results regarding those specific questions.

III. CASE STUDY

A. Introductory remarks

The case study presented here aims to test the influence of the context given in a contingent valuation on the value of the good. It will focus on the effect of the causes of the illness on its monetary valuation.

The contingent valuation questionnaire is based on the one questionnaire that was used in the frame of the EU project HEIMTSA (Cf. Appendix 4). Its aim was to assess monetary value for Chronic Obstructive Pulmonary Bronchitis (COPD). Indeed, the illness is considered in the Clean Air For Europe (CAFE) program, and in European legislations such as the New Emission Ceiling (NEC) directive.

Section B gives some information about COPD: its link with air pollution, a short description of this illness, and previous monetary values associated with COPD.

Section C describes the questionnaire, as well as the technical aspects of this survey (administration, population).

The software used for the analysis IBM SPSS Advanced Statistics 25.0.

B. Air pollution and chronic bronchitis

1. The morbidity and mortality impacts of air pollution

The World Health Organization (2018b) stated that outdoor air pollution is a major threat for health as it leads to around 4.2 million deaths[19] in the world each year, and that around "In 2016, 91% of the world population was living in places where the WHO air quality guidelines levels were not met". Air pollution affects cardiac health causing (such as arrhythmia, atherosclerosis, thrombosis, myocardial infarcts (Miller et al., 2007)), respiratory health with lung cancer and other respiratory diseases (such as asthma and bronchitis). Appendix 1 describes more precisely health consequences of air pollution.

2. A specific impact: chronic bronchitis

2.1 Key elements about COPD

The survey aims at valuing COPD. A detailed description of this health endpoint can be found in Appendix 5, and is briefly summarized below.

COPD is an illness characterized by the deterioration of lungs function. It is an irreversible illness and its main symptom correspond to high difficulties to breath. It has disturbing consequences on daily life. The main symptoms of COPD are cough, sputum and

[19] Among which around 91% are in low- or middle- income countries.

shortness of breath. However, COPD is composed of four different stages, from mild to very severe. These stages differ by the seriousness, which implies differences in the pain and suffering, and in the cost of illness. There is no treatment to cure or to stop COPD. They only slow its development.

The main cause (90%) of the COPD is active or passive smoking (with a relative risk - RR[20] - of 13 for smokers, according to Andreas et al (2009)): up to about 50% of the smokers develop a COPD, and up to 90% of COPD are caused by smoking. Other causes are environmental factors, such as air pollution (indoor - e.g. from cooking and heating - or outdoor), chemicals, and genetics. Occupational causes, combined with smoking, can also be a source for COPD. The other identified factors are allergens, diseases such as schistosomiasis[21] or sickle cell disease[22] and living at high altitude (Bousquet and Khaltaev, 2007).

This work concerns the influence of indicating the causes of the studied illness in the contingent valuation questionnaire. The HEIMTSA survey studies COPD caused by air pollution. However, tobacco can be a confusion factor because it is by far the first cause of COPD. Therefore, COPD is a relevant health endpoint to study the influence of cofactor on monetary valuation.

2.2 Relationship between COPD and air pollution

Exposure risk functions are a link between an indicator of pollution (which could represent a mixture of pollutants) and a health impact, that is to say a number of ill people. It is different from a dose-response function, which is a link between the quantities of a substance to which people are exposed, and its consequences on an organ or physical function. The dose-response functions can be established for new cases (so concerning all the population) or for worsening of existing cases (that is to say, evolution of the illness, just already ill people are concerned). Often, dose-response functions are drawn from doctor’s consultations and/or from medication consumption.

The current dose-response function used by European projects (ExternE, NEEDS) for chronic bronchitis are based on a study which was carried out on a cohort of seventh-day Adventists, a population who have a healthy lifestyle and do not smoke according to religious principles (Abbey and Hwang, 1995). Therefore, they are a very relevant population to study the effects of atmospheric pollution on health without routine confounding factors, such as tobacco. A cohort of 3914 people was followed between 1977 and 1987. The air pollution was approximated by the concentrations of PM_{10} (particles of 10 micrometers or less in aerodynamic diameter) estimated by the place of residence and work (available for all studies’ members). Tests show that the precision of the extrapolation is good.

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[20] “RR is equal to the risk among exposed subjects divided by the risk among unexposed subjects” (Sistrom and Garvan, 2004).
[21] Bilharziose in French, i.e. a parasitic disease.
[22] Drépanocytose in French.

The survey of Abbey was conducted in United States. So some authors scaled down these functions by a factor of 0.5 to take into account the transfer of epidemiological studies from United States to Europe (European Commission, 2004). In the frame of the NEEDS project, Torfs et al. (2007) give the following dose-response function for new cases of chronic bronchitis caused by Particulate Matter (PM_{10}) for adults above 27 years old, also based on the same survey (after scaling):

26.5 cases per year, per 10 µg/m³, per 100,000 adults aged 27+ (CI[23]95% = (-1.9; 54.1))

The VIDAL[24] (VIDAL, 2018) indicates that, in France, around 3 million of persons have a COPD, i.e. around 7.5% of the population over 45 years old, among which 1 million have symptoms.

The currently mainly used dose-response functions for COPD are based on quite old United States' survey: they may not match to the current situation: the mixture of pollutants is different between the two continents, and has changed since the survey was conducted. However, the work package 4 of ESCAPE[25] about respiratory diseases is looking at "the effect of ambient air pollution on the prevalence and incidence of COPD". So new dose-response functions for COPD caused by air pollution are being prepared.

2.3 Previous valuation of COPD

2.3.1 Values

Direct costs for the French national health care (i.e. costs for the medical care of COPD) equal to more than 1 billion euros, and indirect costs equal to three times more (DGS et al., 2007). Rafenberg et al. (2015) conducted a thorough analysis of costs of some illnesses due to air pollution to French health systems. They were extra careful to differentiate COPD from chronic bronchitis. They suggest:

- ✓ For chronic bronchitis: 600€/year for medicaments and medical appoints, and 30 days of sick leave meaning 1452.9 €/year.
- ✓ For COPD:
    - o COPD mild: 600 €/year
    - o COPD moderate: 3 861 €/year
    - o CODP moderate/sever: 3 922 €/year
    - o COPD sever: 7 914 €/year

Overall, they estimate the cost for French health care system of all COPD due to air pollution between 123.7 million€/year to 186 million€/year; and the ones of chronic bronchitis to 113.4 millions€/year.

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[23] "A CI is the range of values that is believed to encompass the actual ("true") population value [...]. Wider CIs indicate lesser precision, while narrower ones indicate greater precision [...]." (Medina and Zurakowski, 2003)

[24] The VIDAL is a French medical dictionary of the illnesses and medicaments, often used as reference by medical doctors.

[25] ESCAPE - European Study of Cohorts for Air Pollution Effects. http://www.escapeproject.eu/index.php

Costs of COPD related to pain and suffering were already estimated in European context:

- ✓ In the frame of the ExternE project (European Commission, 2005). However, when reading the description of the endpoints in the ExternE update 2005 ("a truly debilitating permanent condition, making it impossible to work or lead a normal life."(European Commission, 2005)), the valuated illness looks like chronic obstructive pulmonary bronchitis, and not chronic bronchitis. Moreover, when reading how the original survey was constructed (Krupnick and Cropper, 1992), it appears that the respondents were asked to value "a case of chronic respiratory disease like your relative's" (the survey was administrated only to respondents who have a relative suffering from a chronic respiratory condition).

  That implies that the endpoint 1/ is imprecisely defined, 2/ can be anything the respondent associated to chronic respiratory condition when answering (the convergence with fixed health endpoints is made at the end of the questionnaire). So in that case, the value is probably obtained for a range of illnesses, from light diseases to very serious, more or less representative of the distribution of such illnesses in USA in 1992.
- ✓ The NEEDS project recommends to use the same value (Desaigues et al., 2006b). The calculation is based on DALY for chronic bronchitis and COPD (cf. Appendix 5) for COPD description) combined with VOLY, with the assumption that the DALY for COPD represents mostly chronic bronchitis. However, the description of the symptoms let suppose that the endpoints is COPD in its current acceptation.

As an example, a study has been conducted on the coal power plant in Cordemais (France) with the software Ecosenseweb (Institut für Energiewirtschaft und Rationelle Energieanwendung (IER), 2018). Many impacts are valued such as impacts on crops, human health, materials, ecosystems and climate change. This study has shown that COPD represents around 30% of the mortality impact and 10% of health impacts in 2008[26]. It is due in part to high prevalence of COPD as well as to high cost per case. Consequently, the valuation of pain and suffering induced by COPD matters.

2.3.2 The latest valuation: HEIMTSA project

The HEIMTSA project has valued the cost linked to pain and suffering for COPD, with a contingent valuation, at 75000€ per case. Attention was paid to the description of the endpoint to ensure respondents read and understand it. Moreover, the questionnaire was written to ease its understanding and was repeatedly tested on real population sample to improve it (Maca et al., 2012; Maca et al., 2011)[27]. The study is described in Appendix 4.

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[26] Personal communication from Jonathan Van der Kamp, author of: Van der Kamp, J., 2009. The External Costs Of Electricity Generation Of A Coal-Fired Power Plant In Cordemais, France. Karlsruhe (DE): EIFER2009 November. Report No.: HN-44/09/016, p. 67.

[27] Maca, V., C. Payre and M. Scasny (2012). Valuation of chronic respiratory illnesses: 6-country study. European Association of Environmental and Resource Economists. 19th Annual Conference. Prague.

The survey described in this work is based on this HEIMTSA questionnaire. The author has taken part to the conception, the test and the analysis of the HEIMTSA survey, even if her research institute, EIFER, was not officially partner of the EU project consortium (Maca et al., 2012).

C. The contingent valuation survey

In this work, the influence of the context on WTP in contingent valuation will be tested. A fictitious scenario is presented to the respondents: they are told that they are diagnosed with illnesses (the one the researcher attempts to value), and they are asked how much they would be ready to pay (their willingness to pay - WTP) to buy a medicament immediately curing the illnesses, so practically to avoid them.

However, contingent valuation has known limitations. Indeed, it may be difficult for the respondent to value a health state he did not know well or experiment himself. Moreover, addressing health-related issues in monetary terms is not a common exercise (at least in countries such as France where strong national health services exist). These aspects can induce some difficulties for the respondents to give their actual WTP. To prevent these limitations, the description of the illnesses was adapted to be easily understandable and interviewees were required to take an initial test (ranking according to severity) in order for us to ensure that they really read the descriptions.

The first part synthetizes the method. The second part describes the structure of the questionnaire and the different versions, and the third one focuses on the sample.

The questionnaire was administrated by IPSOS[28] to a representative sample to the French population, as described in Chapter 3. To ensure a representative sample of the French population, computer-assisted web interviewing (CAWI) was chosen. This gives the possibility to have a dynamic questionnaire, in which one question may depend from the previous one, and to ensure that respondents answer properly all questions. However, it also implies that the respondent was alone when responding to the questionnaire: the questionnaire has consequently to be very clear, unambiguous, and encouraging respondents to carefully read the entire provided information. These elements guided the construction of the questionnaire.

1. Method: hypothesis of the case study

1.1 Approach

The analysis of the theoretical as well as applied literature conducted in the chapters I and II has underlined that the good (including when it is a health state) valued by contingent valuation has to be described precisely enough so respondents can make an informed choice.

[28] http://www.ipsos.fr/

As respondents may not be familiar with the health state, the questionnaire must give them enough understandable information for them to get a clear and common representation of the valued good. Indeed, during the European project HEIMTSA, the four stages of COPD were described - with the effects and probable evolution and without any causes given - and valued with contingent valuation saying that a kind of magic treatment will cure the illness without any side effect. However, it appeared during the face-to-face tests (to prepare the actual web survey) that first respondents did have some ideas (right or wrong) of the possible causes of this illness, second that they did care, and overall that both aspects differed significantly between respondents. Some respondents seemed to think that they could not be affected as they were not smoking, and declare a null or very low WTP whereas they actually would be ready to pay if they were affected.

In this applied part, we will adapt the questionnaire used in the European project HEIMTSA to test the influence of information, focusing on the causes of the health state, in contingent valuation. COPD with its two main causes, smoking and exposure to air pollution, is adapted for this research. The focus on contingent valuation will allow some generalization on other stated preference methods and overall monetary valuation as it is a very used method, and the one where the respondents directly express the monetary value (so the plainer one where they expressed their preferences in monetary terms). As detailed below, four versions of the questionnaires will be administrated:

- ✓ around ¼ of respondents got no explanations about the causes;
- ✓ around ¼ have full explanation;
- ✓ around ¼ have only air pollution as cause;
- ✓ around ¼ has only smoking as cause.

The aim is to see if there are differences in the expressed WTP depending on the information provided in the contingent valuation's questionnaire:

- ✓ Differences in the WTP depending on the different information given: this would mean respondents change their valuation depending on the given information.
- ✓ Difference in the precision of the WTP: usually confidence intervals are quite wide. If giving contextualization induces smaller confidence interval, it would mean contextualization leads to more accurate WTP.
- ✓ Difference in the acceptance of the scenario: the part of protest answers may vary with the causes given. If there are less protest answers for the full context, it may mean a realistic scenario increases the acceptance of the contingent valuation process, and consequently the reliability of the WTP.

It has to be noted that, as smoking is one cause of the studied illness, smoking habits of the respondents are specifically watched out.

1.2 The four variants of the questionnaire

The aim of this survey was to test how the information about the causes of the illnesses may influence the WTP of the respondent. The two mains causes of COPD are smoking and air pollution. So four variations of the questionnaire were designed:

- ✓ **"Baseline questionnaire"= no context:** In this version, the respondent assesses his WTP without knowing the causes of the illnesses: he has no information about context and cofactors. This questionnaire is similar to the one used in the European survey HEIMTSA, just with an improved presentation in order to give only one "message" per Internet page - to avoid overloading the respondent with the information-, as well as a changed closed question process (described in section III – C - 2.1).
- ✓ **Variant 1 = full context: "Cause of illnesses: air pollution and smoking".** Additional information is given on the fact that the illnesses are usually caused by air pollution, but mainly by smoking.
- ✓ **Variant 2: "Cause of illnesses: air pollution".** Additional information is given on the fact that the illnesses are usually caused by air pollution.
- ✓ **Variant 3: "Cause of illnesses: smoking".** Additional information is given on the fact that the illnesses are usually caused by smoking.

Figure 14 below shows how the causes of the illness are presented to the respondents, here in the case of variant 1 (both causes detailed). Variant 2 stops after screen 3, variant 3 begins at screen 4.

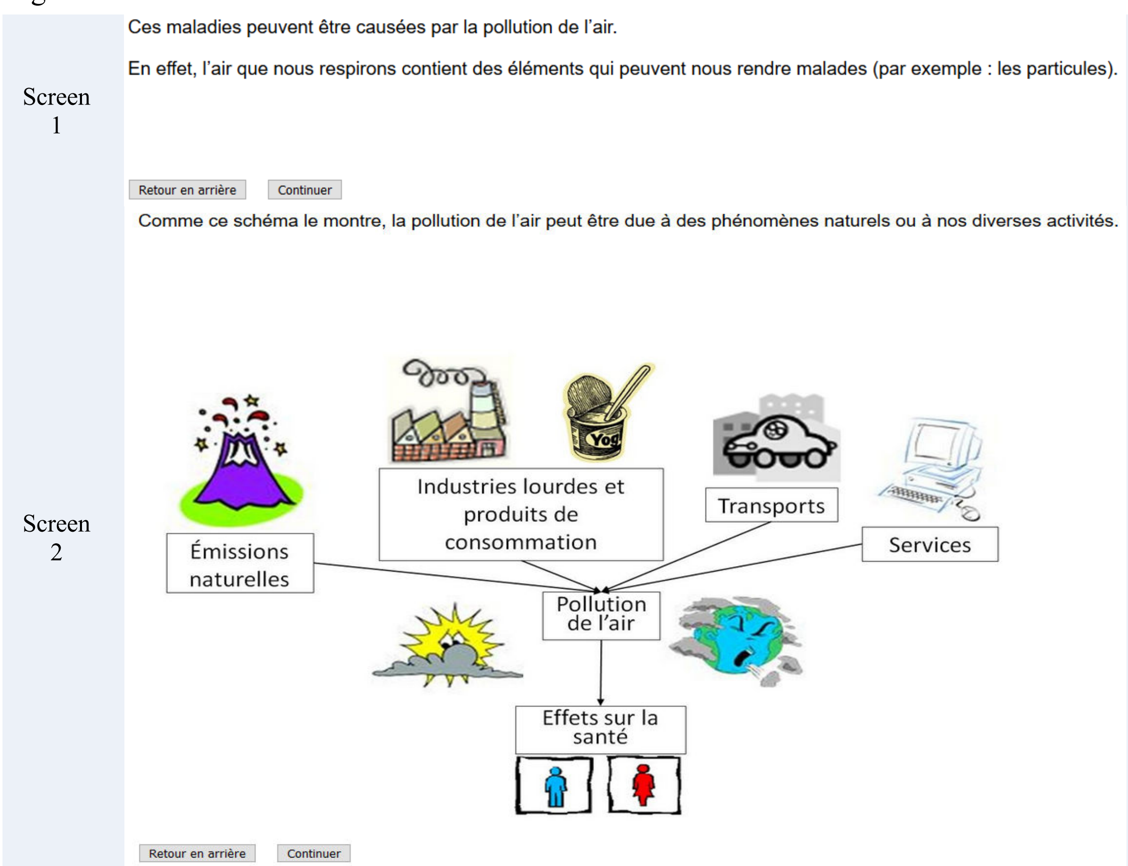


Figure 14: Screen copy of the causes' description process (screenshot)

The links below give access to the different variants of the questionnaire:

- ✓ Baseline: http://cawi2.ipsos.cz/heimtsa2012/fr/baseline/
- ✓ Variant 1: http://cawi2.ipsos.cz/heimtsa2012/fr/baseline_v1/
- ✓ Variant 2: http://cawi2.ipsos.cz/heimtsa2012/fr/baseline_v2/
- ✓ Variant 3: http://cawi2.ipsos.cz/heimtsa2012/fr/baseline_v3/

The questionnaire was coded by Eckart Haug, web administration and development.

One of the four variants was randomly administrated to each respondent.

2. Description of the questionnaire

2.1 Design of the questionnaire

Figure 15 describes the overall organization of the questionnaire.

Introduction	• Context of the study • Aim of the study • General information (such as no good or bad answers, anonymity, and duration)
Part 1: Health status	• Health status of the respondent: his general health status, illnesses he may have, hospitalization in the last year • Health status of his family: illnesses
Part 2 - 1: Presentation of illnesses	• Description of the illnesses (in a random order) • Ranking of the illnesses according to their severity • Criteria used by the respondent for the ranking

Part 2 - 2: Causes the illnesses	• Depending on the questionnaire (cf. below):
	  • question to know if the respondents know the causes of the illnesses
	  • description of the causes

Part 3 : WTP determination	• 1st for cough, then random order for the 3 others illnesses: 1. description of the treatment; 2. choice between buying or not the treatement; 3. if yes: determination of the amount the respondent would be ready to pay, if not why • Questions about the WTP determination's process
Part 4: Debriefing questions	• Familiarity with paying for a medical treatement, risk of having the illnesses, how to avoid them, causes • Complement of part 2-follow-up: giving the name of the illnesses and the rest of the causes, possibility to change the WTP, reasons for the WTP • Relationship to risk and fear: regarding illnesses, at work, in leisure time, and in life in general
Part 5: Socio-ecomomic	• Characteristics of the respondent and his household

Figure 15: Organization of the questionnaires

The questionnaire is made of five parts.

1. **Introduction**: Explanation of the aim and conditions of the study.

2. **Part one:** Assessment of the health status of the respondent and of his family.

3. Part two: Presentation of the studied illnesses, and ranking according to their seriousness by the respondent. To avoid that respondents look for information concerning the valued illnesses, the names of these illnesses were not given:

- ✓ On day of cough, called cough after, was called illness violet ("maladie violette");
- ✓ Chronic bronchitis, CB, was called illness yellow ("maladie jaune");
- ✓ Chronic Obstructive Pulmonary Disease stage moderate, COPDm was called illness brown ("maladie marron");
- ✓ and Chronic Obstructive Pulmonary Disease stage sever, COPDs was called illness azure ("maladie azur").

Moreover, the illnesses were presented in a random order (i.e. not in order of severity, cf. Figure 16) to encourage respondents to read them carefully.

	Maladie violette	Maladie marron	Maladie azur	Maladie jaune
Symptômes	Toux persistante avec crachats	- Essoufflement dès qu'une activité physique modérée est pratiquée, par exemple : marche rapide sur terrain plat ou en légère montée - Toux avec crachats presque chaque jour	- Essoufflement important, au point de ne pas pouvoir sortir - Toux importante - Sifflement lors de la respiration et poitrine compressée - Sensation de fatigue ou d'épuisement - Hospitalisation nécessaire dans certains cas	Toux forte avec crachats. Essoufflement pendant les périodes de toux
Fréquence	Plusieurs fois par jour	Presque chaque jour	Presque chaque jour	Chaque jour, au moins 3 mois par an
Durée	1 jour	Tout le reste de votre vie	Tout le reste de votre vie	2 ans ou plus
Conséquences	Qualité de vie normale	- Prise régulière de médicaments et rendez-vous réguliers chez le médecin - Impact significatif sur la qualité de vie, éventuellement impossibilité d'exercer certains emplois - Les activités quotidiennes restent possibles (faire les courses, cuisiner, faire le ménage, s'habiller)	- Très souvent, obligation de rester au domicile - Besoin d'aide pour les tâches quotidiennes (telles que s'habiller, faire sa toilette) - Régulièrement ou toujours besoin d'un appareil à oxygène pour respirer - Prise de médicaments plusieurs fois par jour - De temps à autre période d'aggravation des symptômes, nécessitant une hospitalisation	Difficulté à faire des efforts importants pendant les périodes de toux
Evolution	Retour à une santé normale	- De temps à autre période d'aggravation des symptômes, nécessitant plus de médicaments - Risque de complications	- Incapacité permanente nécessitant une surveillance médicale à vie - Mort prématurée presque inévitable	Possibilité que les symptômes durent plus de 2 ans

Figure 16: Description of the illnesses as presented to the respondent (screenshot)

Then, respondents were asked to order the illnesses according to their severity, as shown in Figure 17.

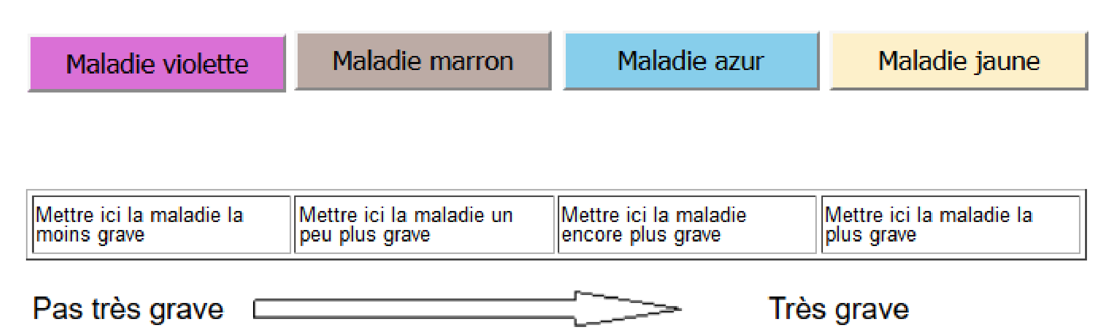


Figure 17: The respondents are asked to order the illnesses according to their severity (screenshot)

4. Part 2 – follow-up: depending on the questionnaire, causes of the illness, as described in the previous part (cf. part III C 1.2):

- ✓ in "Baseline questionnaire", the respondent has no information about context and cofactors.

✓ in Variant 1 ("Cause of illnesses: air pollution and smoking"), it is said that the illnesses are usually caused by air pollution, but mainly by smoking.

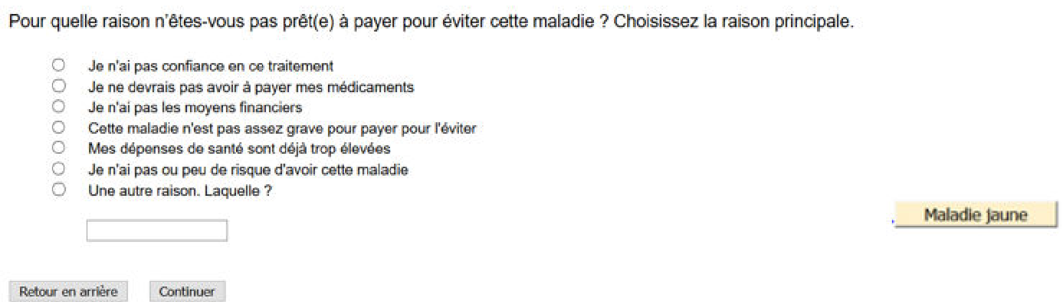
✓ in Variant 2 ("Cause of illnesses: air pollution"), the illnesses are said to be usually caused by air pollution.

✓ in Variant 3 ("Cause of illnesses: smoking") the illnesses are said to usually caused by smoking.

5. Part three: WTP determination for the four endpoints.

The chosen payment vehicle is the price of a medicament to fully and immediately cure the valued illness, diagnosed by a house doctor. The description of this situation is called the scenario.

First, the respondent is asked to determine if he wants to pay for or not the medicament. If he declined, he is asked why to determine if he really does not want to pay or if he does not agree with the scenario (this kind of answer is called "protest answer") as shown in Figure 18.


Pour quelle raison n'êtes-vous pas prêt(e) à payer pour éviter cette maladie ? Choisissez la raison principale.

- Je n'ai pas confiance en ce traitement
- Je ne devrais pas avoir à payer mes médicaments
- Je n'ai pas les moyens financiers
- Cette maladie n'est pas assez grave pour payer pour l'éviter
- Mes dépenses de santé sont déjà trop élevées
- Je n'ai pas ou peu de risque d'avoir cette maladie
- Une autre raison. Laquelle ?

Maladie jaune

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Figure 18: Determination of the reason why a respondent would not pay, example of CB - Maladie Jaune (screenshot)

if the respondent clicks on the name "maladie jaune", the description of the illness appears in a pop up window

If the respondent agrees to pay, his WTP is determined in two steps:

1. Close-ended question

When the respondent choses to pay for the medicament to avoid the valued illness, some amounts are suggested to the respondent to help him decide how much he would consider to pay for the treatment. The proposed payment is a single one for the treatment to avoid one day of cough ("maladie violette", which is a very mild illness) and monthly payments over ten years to purchase the treatments for the other illnesses which may require the more expensive treatments because they are more serious, as shown in Figure 19.

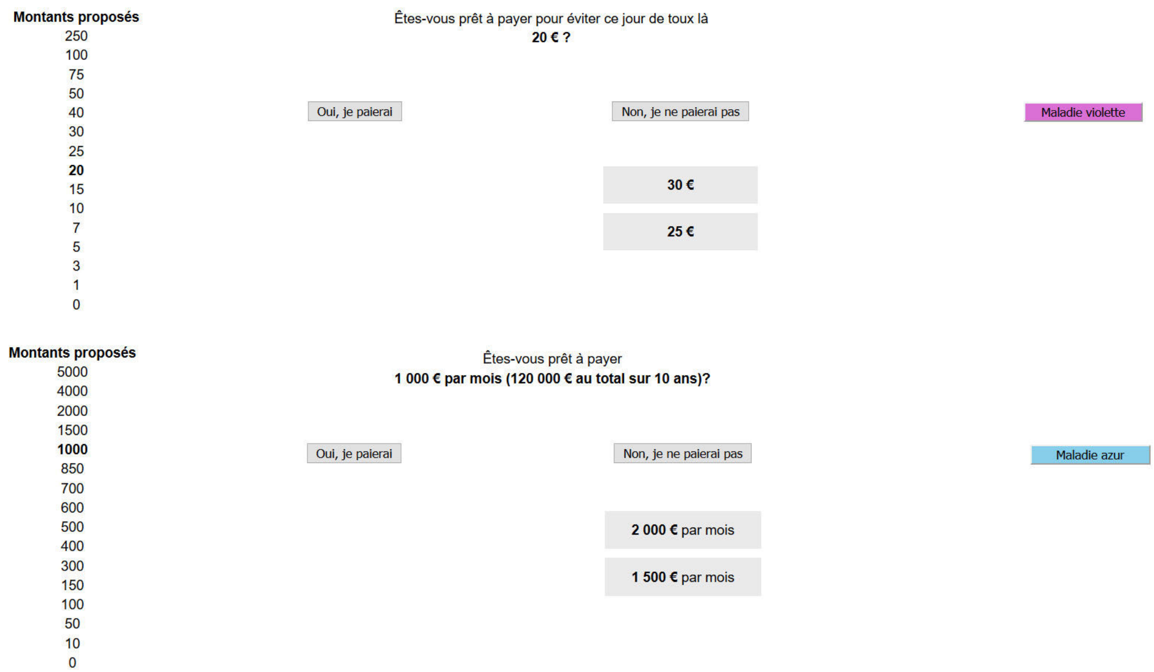


Figure 19: Process to support the respondent in his WTP determination, on the top for one day of cough, on the bottom for COPD severe (screenshot)

This approach, similar to payment cards on which the respondents check the amounts they would be ready to pay in a list, was chosen to ease the respondents' thinking process. Indeed it is analogous to daily life choices: respondents have to choose to buy, or not, the good at a given price, with clear visual support (Chanel et al., 2017). However, it also leads to biases such as starting value (the respondent unconsciously bases his answers on the first proposed amount), "Yea" saying (the respondent agrees to pay more than he would do in real life). In this case, the classical payment cards system has been adapted using the opportunities of computer administrated survey to try and reduce the biases. As shown in Figure 19, the whole range of suggested amounts is presented to the respondent, from the start of the experiment, to limit the anchoring effect (cf. 3.2.3). The respondent is hence aware that the first amount proposed is randomly picked up from a large list (Krupnick et al., 2002) and not purposely chosen (for example because it is the order of magnitude of the expected answer).

This list was determined from the answers made by the respondents in the first wave of the HEIMTSA questionnaire (cf. Appendix 4, (Maca et al., 2012)). In this first wave, the amounts proposed were determined by a complex algorithm, which had as consequences high and sometimes unusual amounts (2385€ for example). The amounts proposed in this version are based on the range of answers of the first wave, avoiding too high amounts (and biases such as anchoring effect due to presentation of very high amounts), and rounded to ease respondent's thinking process.

The respondent decides if he would pay or not the proposed amount for the treatment. According to his choice, he sorts the amounts in two categories: "would pay" or "would not pay" until he has determined the interval of his WTP: the highest amount he would pay and the lowest he wouldn't pay.

2. Determination of the precise amount the respondent is willing to pay: open-ended question

After the sorting phase described above, the respondent is remembered the highest amount he said he is willing to pay and the lowest he said he is not ready to pay. Then the respondent is asked which amount he is actually ready to pay: it is an open-ended question to get the exact WTP of the respondent. If the respondent chooses here an amount out of the determined range, a message asks him to confirm his choice, and the respondent has the possibility to change his mind.

As the respondent is allowed to change his mind between the interval determination (previous part, close-ended question) and the open question, the final open question is considered to be the best for revealing the actual WTP of the respondent and will thus be used for the analysis.

3. First feeling about the WTP determination

This part determines if the respondent found the WTP determination process credible, if he would be ready to pay more (and under which conditions as a proxy for assessment the sensitivity of the WTP determination), for which illnesses it was more difficult to determine an amount and why, which criteria respondent took into account to determine his WTP, and how he would pay.

6. Part four:

- ✓ Perception of the questionnaire: how people were thinking to pay for the illnesses, if the respondent had already thought about paying for medications in case of serious illness (for himself or a family member), or if he thought about the possible causes of theses illnesses (smoking, air pollution or others) during the questionnaire.
- ✓ Complement of part 2-follow-up: name of the illnesses and the rest of the causes, possibility of changing WTP after knowing these information, reasons for the WTP (Did you think how to avoid them? How much they cost to the society?).
- ✓ Relationship to risk and fear: regarding illnesses, at work, in leisure time, and in life.
- ✓ How the respondent takes care of his health: sport activities (duration), feeling of air pollution in living place, healthy diet or not, smoking habits.

7. Part five:

This part gathers debriefing questions to better know the characteristics of the respondent: sex, Birth year, postcode, number of people living in the household, number of people under 15 living in the household, highest diploma, marital status, work, own income, household income, donation to a charity, private health insurance.

2.2 Specificities of each variant

As said before, there are four variants of the questionnaire, depending on which context of the illness is explained to the respondent. Figure 20 represents the different organization of the questionnaire depending on the variant. In comparison to Figure 15, it is the content of Part 2 – follow-up and the information given in part 4 as complement which change depending on the variant. All the other elements remain the same, as shown in Figure 15.

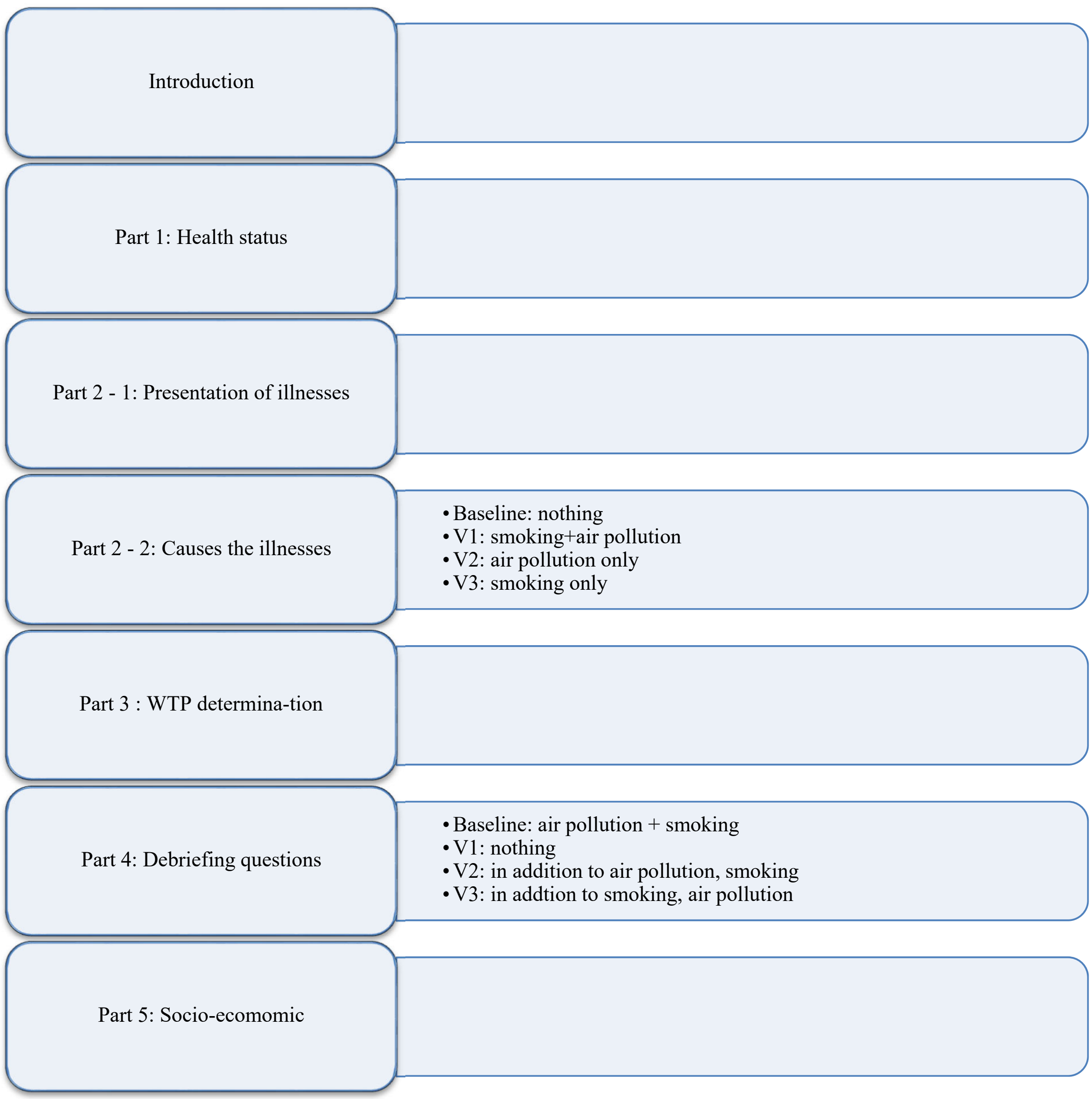


Figure 20: The four variants of the questionnaire: place where information about context is given

The good valued in the questionnaire baseline is the illnesses as such, as the respondent does only have information about the illnesses but not about their causes.

In variant 1, the respondent is aware of the two (main) possible causes of COPD, smoking and air pollution (including the causes of air pollution). In this case, the good valued is the illnesses in its full context.

In variant 2, the respondent is told that the illnesses are caused by air pollution only (and again with a description of the causes of air pollution). In this case, the good valued is "COPD caused by air pollution". Air pollution is an environmental risk it, and everyone endure it. So the risk valued here is endured, with no alternative.

In variant 3, the respondent is told that the cause of the illnesses is smoking. So the good is "COPD caused by smoking". In this case, the risk valued is due to the life style, it is a chosen risk. For this questionnaire, a difference may exist between smokers and non-smokers. Indeed, smokers feel concerned, but non-smokers may not. However, all the questionnaire is based on "as if" method: most of the respondents are not really affected by COPD, there is no magic pill to cure it (as clearly said in the description of the illnesses). Moreover, people who think they will not be affected by the illnesses would answer, at the first step of the WTP determination, that they will not pay as they have low or no risk to get this illness (cf. III – C – 2.1 and III – D – 1).

3. Description of the sample

The questionnaire was administrated to a sample of 2000 people representative of the adult (over 18) French population, part of the panel of IPSOS survey institute. Each respondent get only one questionnaire, as shown in Table 6.

	Frequency	Percent
Baseline – no context	341	24.15
V1 – Full context	291	20.61
V2 – Air pollution	351	24.86
V3 - smoking	429	30.38
Total	1412	100

Table 6: Repartition of the respondents according to the questionnaires

Note that the original sample included a fifth questionnaire that has a structure similar to baseline but using the algorithm of the first wave of HEIMTSA for the closed question of the WTP determination. Because the influence of the algorithm on WTP is found to be strong (cf. Appendix 4), the results of this questionnaire will not be studied in the present work (nor in the description of the sample) and the corresponding respondents (n=504) removed. The analysis of this sample can be found in Appendix 6.

3.1 Sample treatment

Some of the answers of the entire sample of respondents (1412 respondents) cannot be considered in the analysis. Possible reasons for not considering some answers include:

1. Uncompleted questionnaires: the questionnaires were coded to oblige respondents to answer to all the important questions. However, some glitches may always happened and some respondents may not have fill all the important questions.
2. Answers which are obviously not thought about, mainly: pattern when stating the WTP amount (example: 111111, 333333333, 1234567890). Indeed, these amounts are unusual, from experience, respondents prefer “rounded” amounts (e.g. 1000 €), and they match repletion on the keyboards.
3. Lack of consistency in WTP answers:
   - ✓ WTP for the worst illnesses should be equal or higher than the ones for the lightest illnesses: WTP cough ≤ WTP CB ≤ WTP COPDm ≤ WTP COPDs.

   However, this ranking may not be the one of some respondents. For example, some may be afraid by suffering from an illness which decreases sharply their quality of life, even if it does not lead to death. So they may value illnesses COPDm and COPDs in a similar way. So, even if the previously described ranking may seem rational, the respondents who did not follow it were not removed as it may reflect their thoughts.
   - ✓ WTP higher than the monthly income, with the restriction than some people may consider using saving to pay the monthly fees (= WTP amount) or asked for help to their relatives. This aspect could be partly controlled with the question “How did you foresee to pay the treatment? Personal income/household income/savings/other”.
4. Inconsistencies in other questions:
   - ✓ Respondents who did not think at anything when they stated their WTP.

   This answer is consistent with the variant providing no context; and says little for the other questionnaires as it is difficult to state that an information was or not taken into account as soon as it is known.
   - ✓ Not thinking at the causes of the illnesses or stating the wrong ones whenever asked.

   This answer is consistent with the variant providing no context. For the other versions, it has the same limits as the previous point.
   - ✓ People having difficulties to state their WTP.

   This type of exercise (stating how much you would pay for a medical treatment) is highly unusual for French respondents because of the national healthcare service, so having difficulties to state their WTP is altogether logic. Acknowledging it may just illustrated that respondents were conscious of the difficulty.

Figure 21 shows the process for treating the sample. Points 1 and 2 refer to some completely inadequate answers. and were removed from the original sample (cf. paragraph III – C –3.1.1). Then answers of questionnaires with the old algorithm (cf. III – C – 3) and answers of questionnaires with a coding biases (cf. III – C – 3.1.2) were removed. Points 3 and 4 refer to some possibly illogical answers from the respondents. Some of these aspects are dealt with in paragraph III – C –3.1.3 for the unrealistic WTP. As the other aspects may be difficult to control, answers from respondents showing these types of behaviors were not removed.

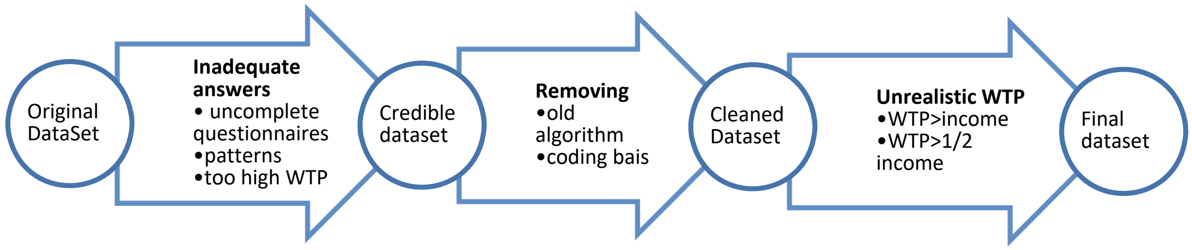


Figure 21: Sample treatment

3.1.1 Inadequate answers

First, the inadequate answers were removed. as shown in Figure 22.

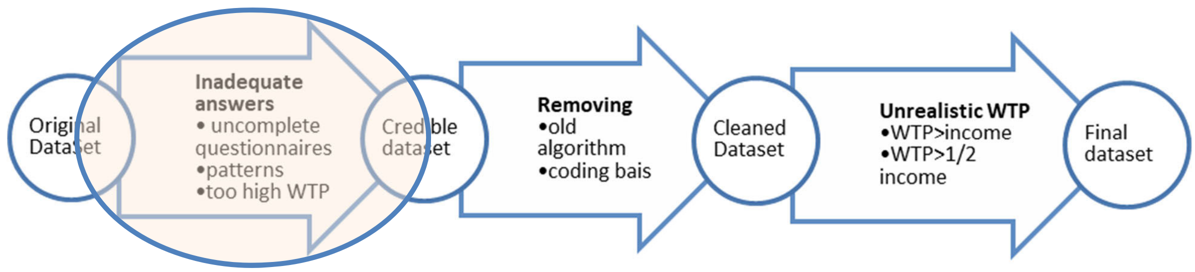


Figure 22: Sample treatment - removing inadequate answers

Four individuals were at first removed from the sample:

✓ 2 because of uncompleted questionnaires (i.e. not completed mandatory questions).

✓ 1 because of schemas in the answers (WTP COPDm = 77777€ and WTP CB = 888888€).

✓ 1 because of very high WTPs at WTP COPDm and WTP CB (25 000€ each time).

3.1.2 Coding bias

Figure 23 shows the step where the answers subject to coding bias are removed. The issue related to the old algorithm was addressed in III – B – 3.

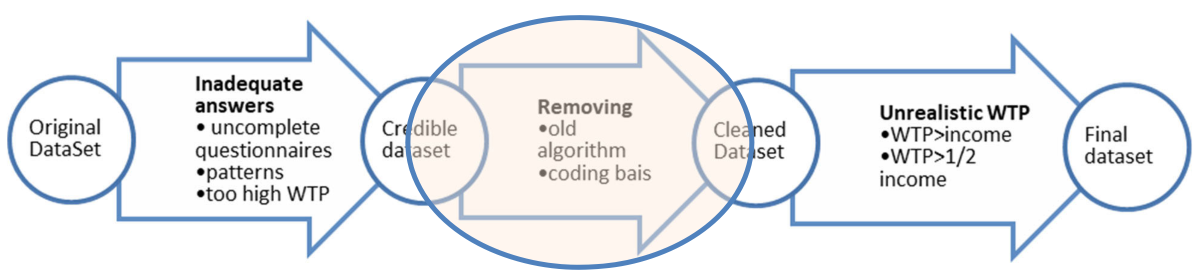
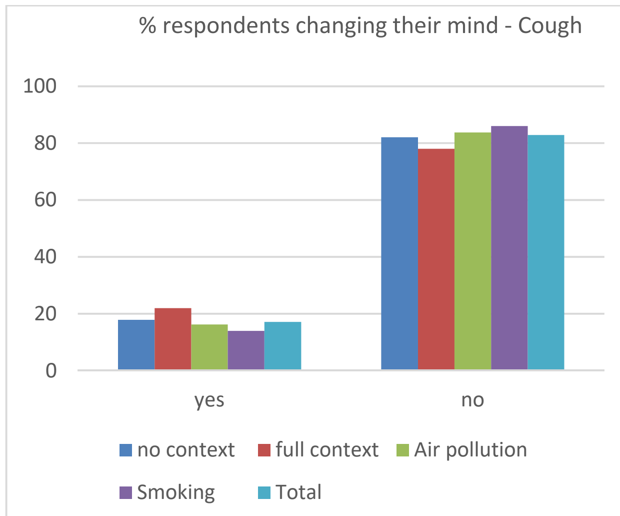


Figure 23: Sample treatment - removing coding bias

At some point in the questionnaire (cf. section III – C – 2 to see the structure of the questionnaires), the respondents had the possibility to correct their answers after having been given the causes of the illnesses. However, a mistake in the coding makes it overwrite their first answers. This means that the WTP of the respondents who changed their answers (who have been tracked) matched more with a full context WTP than with the one of their respective group, which is a serious flaw given that the main interest of the survey deals with context. Table 7 illustrates the number and characteristics of the 341 respondents who changed their mind, by illness and questionnaire.

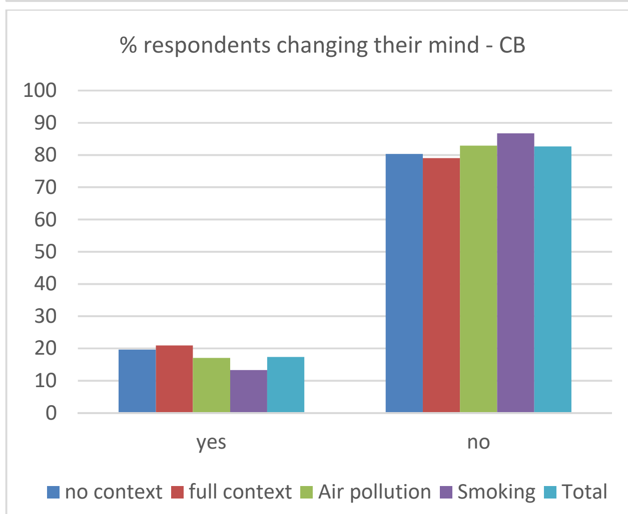
Number of respondents who changed their mind after getting more information about the illnesses for 1 day of cough

	Variant of the questionnaire				Total
	no context	full context	Air pollution	Smoking	
yes	61	64	57	60	242
no	280	227	294	369	1170
Total	341	291	351	429	1412



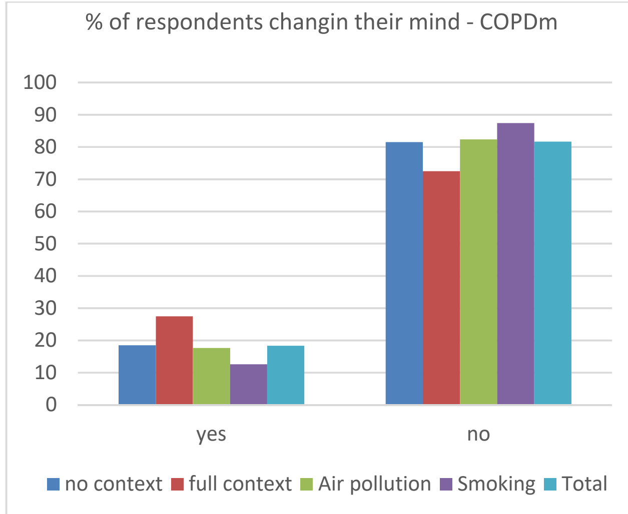
Number of respondents who changed their mind after getting more information about the illnesses for CB

	Variant of the questionnaire				Total
	no context	full context	Air pollution	Smoking	
yes	67	61	60	57	245
no	274	230	291	372	1167
Total	341	291	351	429	1412



Number of respondents who changed their mind after getting more information about the illnesses for COPDm

	Variant of the questionnaire				Total
	no context	full context	Air pollution	Smoking	
yes	63	80	62	54	259
no	278	211	289	375	1153
Total	341	291	351	429	1412



Number of respondents who changed their mind after getting more information about the illnesses for COPDs

	Variant of the questionnaire				Total
	no context	full context	Air pollution	Smoking	
yes	70	80	68	56	274
no	271	211	283	373	1138
Total	341	291	351	429	1412

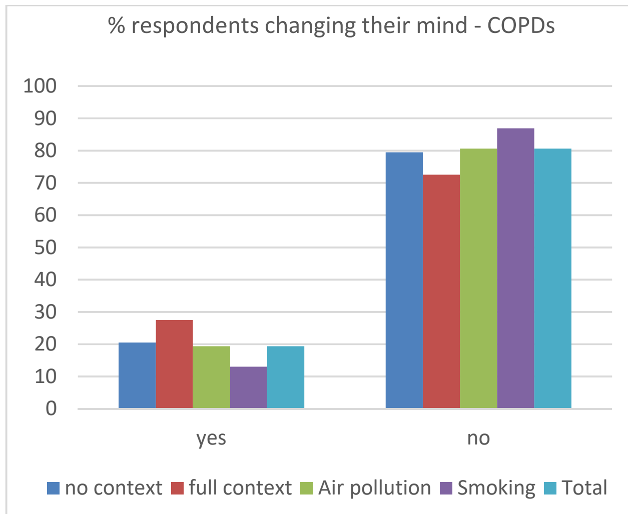


Table 7: Number and characteristics of respondents who changed their mind after getting more information about the illnesses

It highlights that a minority of respondents changed their mind.

It is worth noting that, for the four illnesses, respondents who most often changed their mind had the full context variant, then the no context one, then smoking and finally air pollution. For the no context variant, at least some respondents may have discovered the main causes of COPD in this second step, and consequently some of them wanted to adapt their WTP in light of this new information. In the same vein, respondents with smoking only context may not have thought at air pollution as a possible cause of COPD and revised their WTP when they got the information; while respondents with air pollution only context are more bound to have thought at smoking as a another possible cause of COPD from the beginning, maybe thanks to the numerous public health program about the risks of smoking. The fact that respondents with full context from the beginning changed their WTP the most is a bit more challenging to explain. One possible reason is they may not have consciously taken into account the causes of COPD in their valuation and, when reminded it, felt they should have.

Anyway, to avoid this bias, respondents who have changed their mind have been removed from the sample. The analysis will be conducted in the sample without the respondents who changed their answers, to keep the comparison possible across the variants.

In total, 386 respondents were removed, letting overall 1026 respondents.

3.1.3 Unrealistic WTP

Figure 24 illustrates the last step of the treatment process: removing unrealistic WTP. To have a better view of the possible links between WTP and other respondents' or questionnaires' characteristics, further work on the sample was conducted to identify and remove the answers of respondents having declared unrealistic WTP compared to their revenues.

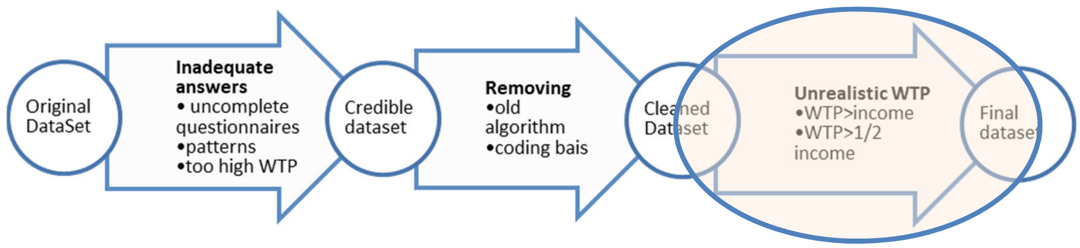


Figure 24: Sample treatment - removing unrealistic WTP

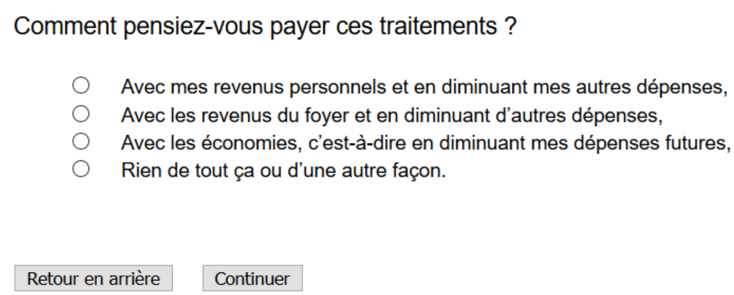
3.1.3.1 Criteria

The respondents whose WTP is too high in comparison to their revenues were also removed. These respondents did not apparently fit into the game seriously by forgetting to take into account their daily expenditures. However, some exceptions (i.e. respondents who stated justified high WTP) may arise:

- ✓ Some respondents may not have income themselves, but have spouses (for example) supporting themselves (e.g. housewife).
- ✓ Very rich people may have not stated their entire income stream including savings but just their monthly income. However, the probability these people do answer this kind of study (payed) is quite low.
- ✓ Some people may be ready to sacrifice a large part of their total income to be healthy.
- ✓ Some people may get help from their relatives.

The first aspect is taken into account by two specific questions:

1. The income of the respondent but also the income of the household were asked.
2. A question was asked how the respondent how he planned to pay, with their own income, household's or spare money (cf. Figure 25).


Comment pensiez-vous payer ces traitements ?

- ○ Avec mes revenus personnels et en diminuant mes autres dépenses,
- ○ Avec les revenus du foyer et en diminuant d'autres dépenses,
- ○ Avec les économies, c'est-à-dire en diminuant mes dépenses futures,
- ○ Rien de tout ça ou d'une autre façon.

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Figure 25: Question to determine how the respondent planned to pay for the medicine

(How do you think you will pay for this treatment?
- *With my own income and by spending less for my other expenses,*
- *With household's income and by spending less for other household's expenses,*
- *With spare money, and decreasing future expenses,*
- *None of those ways, or another way.)*

This would allow taking into account the point 1 before: people with no or low personal income but spouse's support. However, due to the usual lack of consistency of respondents and to ensure removing only respondents who really could not pay the stated amounts, the household's income was taken as reference for all the respondents.

For the second aspect, a check of the sample shows that respondents with very high income (the higher category) did not state WTP higher than their income. Indeed, a test conducted with 11 000 € as reference, as the upper category is open-ended (income higher than 10 001 €), shows that nobody in this category stated a WTP higher than this amount.

For the third aspect: at this point, the cleaning deleted respondents paying more than their household's income, i.e. respondents who would be ready to pay the entire income on this specific medicine.

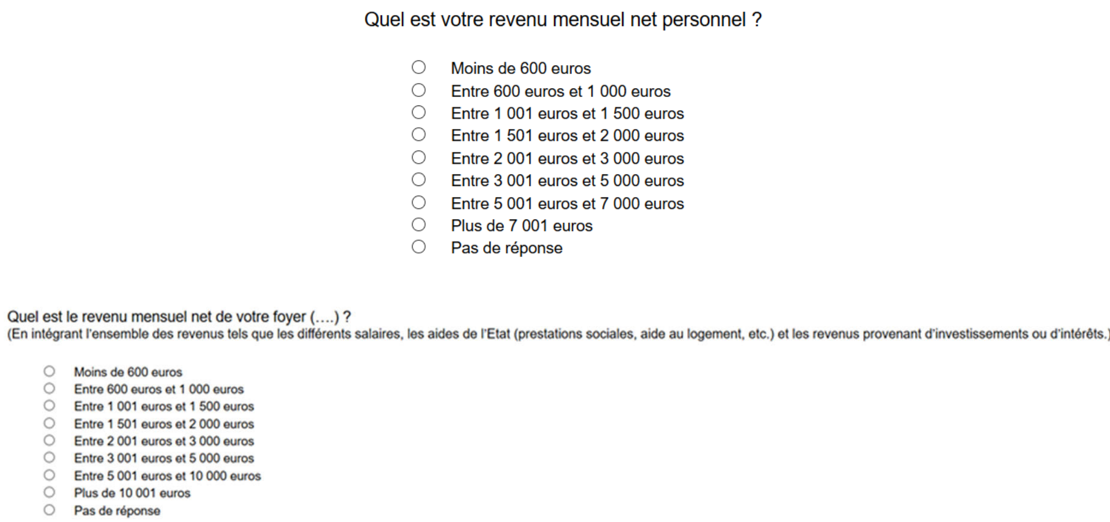
Regarding the last aspect, one respondent was excluded from the analysis because of a too high amount for cough (one-time payment, WTP cough=2 200 €). This respondent was ready to pay much less for the most serious illness (WTP COPDs=10 €) and nothing for the two others, so his answers are inconsistent. The others respondents who were paying more than their household's income did it for the more serious illnesses with a payment over ten years, which is quite a long time to be sure of the support of relatives. So it seems relevant to remove respondents who declare being willing to pay more than their household's income.

For respondents who did not state their household's income but give their personal income, the analysis was conducted with their personal income.

The dataset was treated in the following way:

1. The respondents whose WTP are higher than half of their household's income for one or more illness are removed. The income taken is the maximum of each category (cf. Figure 26): 22 respondents paid more than their households' income and 20 more than half of their household income and were consequently removed.

2. All the 111 respondents who did not give their income are kept except one whose WTP is 10 000 € per months for COPDs (azur), the higher WTP.


Quel est votre revenu mensuel net personnel ?

- Moins de 600 euros
- Entre 600 euros et 1 000 euros
- Entre 1 001 euros et 1 500 euros
- Entre 1 501 euros et 2 000 euros
- Entre 2 001 euros et 3 000 euros
- Entre 3 001 euros et 5 000 euros
- Entre 5 001 euros et 7 000 euros
- Plus de 7 001 euros
- Pas de réponse

Quel est le revenu mensuel net de votre foyer (….) ?
(En intégrant l'ensemble des revenus tels que les différents salaires, les aides de l'Etat (prestations sociales, aide au logement, etc.) et les revenus provenant d'investissements ou d'intérêts.)

- Moins de 600 euros
- Entre 600 euros et 1 000 euros
- Entre 1 001 euros et 1 500 euros
- Entre 1 501 euros et 2 000 euros
- Entre 2 001 euros et 3 000 euros
- Entre 3 001 euros et 5 000 euros
- Entre 5 001 euros et 10 000 euros
- Plus de 10 001 euros
- Pas de réponse

Figure 26: Income categories, on the top personal income, on the bottom household income

3.1.3.2 Description of the removed respondents because of their unrealistic WTP

20 respondents were ruled out in the process. A short analysis of these removed respondents is shown by Table 8, Table 9, and Figure 27.

Table 8 shows that slightly more women than men were removed, mirroring the sample composition.

		No Context	Full context	Air Pollution	Smoking	Total
men	Count	4	0	3	1	8
	%	50.0%	.0%	42.9%	50.0%	40.0%
women	Count	4	3	4	1	12
	%	50.0%	100.0%	57.1%	50.0%	60.0%
Total	Count	8	3	7	2	20
	%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 8: Analysis of the removed respondents because of their too high WTP compared to income – Sex reparation, by variant of the questionnaire (depending on the causes given)

Table 9 highlights that the repartition between the income's classes is roughly equal, except for the two higher categories that are not represented, probably because there are high enough to cover the payment respondents are willing to make.

			No context	Full context	Air pollution	Smoking	Total
household net monthly income (€)	<600	Count	1	0	2	0	3
		%	12.5%	.0%	28.6%	.0%	15.0%
	600-1000	Count	2	1	0	0	3
		%	25.0%	33.3%	.0%	.0%	15.0%
	1001-1500	Count	1	0	1	0	2
		%	12.5%	.0%	14.3%	.0%	10.0%
	1501-2000	Count	1	0	0	1	2
		%	12.5%	.0%	.0%	50.0%	10.0%
	2001-3000	Count	0	0	1	1	2
		%	.0%	.0%	14.3%	50.0%	10.0%
	3001-5000	Count	2	1	1	0	4
		%	25.0%	33.3%	14.3%	.0%	20.0%
	No answer	Count	1	1	2	0	4
		%	12.5%	33.3%	28.6%	.0%	20.0%
Total		Count	8	3	7	2	20
		%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 9: Analysis of the removed respondents because of their too high WTP compared to income – Income reparation, by variant of the questionnaire

Figure 27 shows that there is specific trend regarding age.

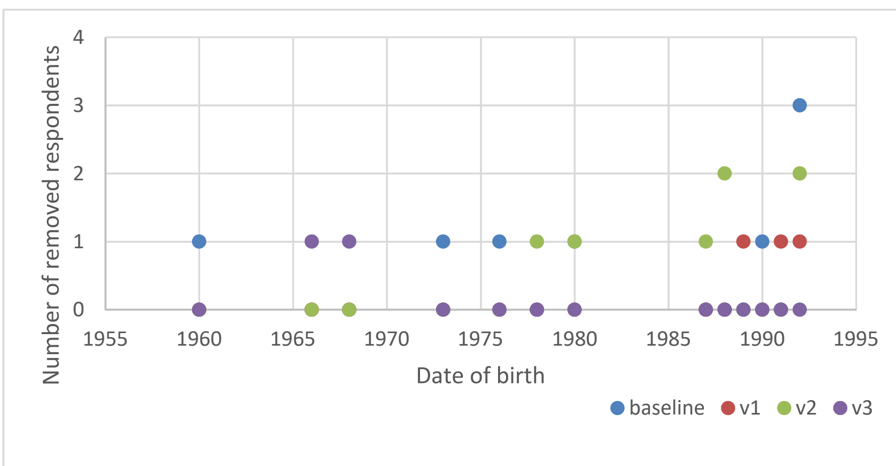


Figure 27: Number of the removed respondents because of their too high WTP compared to income – Age reparation, by variant of the questionnaire

These analyses show slightly more women than men gave inconsistent answers, mirroring the sample's composition. Regarding the income classes, the repartition is roughly equal except for the two higher categories that are not represented. It looks like that younger respondents stated more too high WTP than the older, probably because they have lower income, and are more used to borrowed money or being support by relatives (parents): they may even have used parents' income as reference.

3.2 Description of the remaining sample

The initial sample contains 1921 respondents. Table 10 sums up the treatment process described in the previous part to reach the sample used for the analysis.

Content	Number of respondents	Comments
Original dataset	1921	All respondents as obtained from IPSOS
Original dataset - inadequate answers = Credible dataset	1916	5 respondents with impossible answers removed
Credible dataset – old algorithm – coding bias = Cleaned dataset	1026	504 respondents having the old algorithm removed 386 respondents who changed their mind removed
Cleaned Data set - More than income - More than 1/2 income = Final dataset	984	22 respondents who paid more than their income removed 20 respondents who paid more the 1/2 income removed

Table 10: Data set description

This leaves overall 984 respondents, for the four variants of the questionnaire, as shown in Table 11. This table highlights that the smoking context variant has more respondents than the others.

	Frequency	Percent
no context	229	23.3%
full context	175	17.8%
Air pollution	247	25.1%
Smoking	333	33.8%
Total	984	100.0%

Table 11: Number of respondents per questionnaire after data treatment

3.2.1 Socioeconomic status

First, the sex ratio was considered, as shown in Table 12. A Chi 2 test shows the difference between the variant is statistically significant (p = 0.010), the proportion of women in the smoking context variant being lower than for the others.

		No Context	Full context	Air Pollution	Smoking	All
Men	**Counts**	83	70	108	166	427
	%	36.2%	40.0%	43.7%	49.8%	43.4%
Women	**Counts**	146	105	139	167	557
	%	63.8%	60.0%	56.3%	50.2%	56.6%
Total	**Counts**	229	175	247	333	984
	%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 12: Sex ratio, per variant

Next the marital status was examined, as shown in Table 13. Here again, the Chi 2 test shows the differences between the variants are statistically significant (p = 0.000034). In smoking context variant again, the promotion of single is lower than for the other variants, the proportion of widower higher.

		No Context	Full context	Air Pollution	Smoking	All
Single	**Counts**	69	39	78	56	242
	%	30.1%	22.3%	31.6%	16.8%	24.6%
Married	**Counts**	142	119	146	221	628
	%	62.0%	68.0%	59.1%	66.4%	63.8%
Divorced	**Counts**	17	12	17	50	96
	%	7.4%	6.9%	6.9%	15.0%	9.8%
Widower	**Counts**	1	5	6	6	18
	%	0.4%	2.9%	2.4%	1.8%	1.8%
Total	**Counts**	229	175	247	333	984
	%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 13: Marital status, per variant

Education levels are shown in Table 14. Here again, the Chi 2 test shows the differences between the variants are statistically significant (p = 2.4359E-14). The proportion of respondents having only "brevet des collèges" is much higher in the full context variant than in the others, and the proportion of higher education level is lower.

		No Context	Full context	Air Pollution	Smoking	All
Brevet des collèges	**Counts**	82	119	84	94	379
	%	35.8%	68.0%	34.0%	28.2%	38.5%
A-Level	**Counts**	59	29	59	84	231
	%	25.8%	16.6%	23.9%	25.2%	23.5%
A-Level+2	**Counts**	35	14	55	80	184
	%	15.3%	8.0%	22.3%	24.0%	18.7%
Bachelor	**Counts**	25	7	25	31	88
	%	10.9%	4.0%	10.1%	9.3%	8.9%
Master or +	**Counts**	28	6	24	44	102
	%	12.2%	3.4%	9.7%	13.2%	10.4%
Total	**Counts**	229	175	247	333	984
	%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 14: Education levels, per variant

Education levels are linked to occupation and income. Table 15 explores the proportion of the various occupations in the variants. As expected, the differences are statistically significant (Chi 2, p = 1.7651E-15), with a very high proportion of full time employees in the smoking variant, and high proportion of full time employees in the full context variant.

		No Context	Full context	Air Pollution	Smoking	All
No answer	**Counts**	0	0	0	2	2
	%	0.0%	0.0%	0.0%	0.6%	0,2%
Liberal profession	**Counts**	6	6	2	14	28
	%	2.6%	3.4%	0.8%	4.2%	2,8%
Full time employee	**Counts**	102	68	74	179	423
	%	44.5%	38.9%	30.0%	53.8%	43,0%
Parttime employee	**Counts**	23	18	18	35	94
	%	10.0%	10.3%	7.3%	10.5%	9,6%
Student	**Counts**	24	23	33	0	80
	%	10.5%	13.1%	13.4%	0.0%	8,1%
Housewife/man	**Counts**	17	5	4	9	35
	%	7.4%	2.9%	1.6%	2.7%	3,6%
Retired	**Counts**	18	28	72	60	178
	%	7.9%	16.0%	29.1%	18.0%	18,1%
No professional activity	**Counts**	27	15	31	17	90
	%	11.8%	8.6%	12.6%	5.1%	9,1%
Sick/disability leave	**Counts**	3	2	4	6	15
	%	1.3%	1.1%	1.6%	1.8%	1,5%
Other	**Counts**	9	10	9	11	39
	%	3.9%	5.7%	3.6%	3.3%	4,0%
Total	**Counts**	229	175	247	333	984
	%	100,0%	100.0%	100.0%	100.0%	100.0%

Table 15: Occupation, per variant

The last aspects considered are the personal and household incomes, presented in Table 16. They are linked to education level, occupation, and marital status. as anticipated, the differences between the categories are statically significant (Chi2 tests, own income: p = 9.7003E-9; household income: p = 0.000007), with particular composition for smoking variant, and to a lesser extend of the full context variant.

		Own Income					Household income				
		No Context	Full context	Air Pollution	Smoking	All	No Context	Full context	Air Pollution	Smoking	All
<600	**Counts**	32	14	41	15	102	9	4	20	4	37
	%	14.0%	8.0%	16.6%	4.5%	10,4%	3.9%	2.3%	8.1%	1.2%	3,8%
600-1000	**Counts**	25	23	30	34	112	13	5	13	20	51
	%	10.9%	13.1%	12.1%	10.2%	11,4%	5.7%	2.9%	5.3%	6.0%	5,2%
1001-1500	**Counts**	63	53	50	65	231	32	32	25	25	114
	%	27.5%	30.3%	20.2%	19.5%	23,5%	14.0%	18.3%	10.1%	7.5%	11,6%
1501-2000	**Counts**	29	33	54	84	200	28	30	44	47	149
	%	12.7%	18.9%	21.9%	25.2%	20,3%	12.2%	17.1%	17.8%	14.1%	15,1%
2001-3000	**Counts**	29	11	33	69	142	57	40	63	94	254
	%	12.7%	6.3%	13.4%	20.7%	14,4%	24.9%	22.9%	25.5%	28.2%	25,8%
3001-5000	**Counts**	11	8	10	27	56	40	32	45	92	209
	%	4.8%	4.6%	4.0%	8.1%	5,7%	17.5%	18.3%	18.2%	27.6%	21,2%
5001-7000 (10 000 for household)	**Counts**	5	0	0	3	8	16	4	5	14	39
	%	2.2%	0.0%	0.0%	0.9%	0,8%	7.0%	2.3%	2.0%	4.2%	4,0%
>7001 (10 001 for household	**Counts**	1	0	0	1	2	4	1	1	0	6
	%	0.4%	0.0%	0.0%	0.3%	0,2%	1.7%	0.6%	0.4%	0.0%	0,6%
No Answer	**Counts**	34	33	29	35	131	30	27	31	37	125
	%	14.8%	18.9%	11.7%	10.5%	13,3%	13.1%	15.4%	12.6%	11.1%	12,7%
Total	**Counts**	229	175	247	333	984	229	175	247	333	984
	%	100%	100%	100%	100%	100.0%	100%	100%	100%	100%	100%

Table 16: Personal and household income, per variant

3.2.2 Health status

As the questionnaire is related to health, the health status of the respondents is investigated. The answers to the question ": How would you describe your own health state compared to your own age group?" are represented in Table 17.

		No Context	Full context	Air Pollution	Smoking	All
well above average	Count	17	10	15	26	68
	%	7.4%	5.7%	6.1%	7.8%	6.9%
above average	Count	56	25	57	63	201
	%	24.5%	14.3%	23.1%	18.9%	20.4%
average	Count	135	116	140	205	596
	%	59.0%	66.3%	56.7%	61.6%	60.6%
below average	Count	20	21	27	34	102
	%	8.7%	12.0%	10.9%	10.2%	10.4%
well below average	Count	1	3	8	5	17
	%	0.4%	1.7%	3.2%	1.5%	1.7%
Total	Count	229	175	247	333	984
	%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 17: How would you describe your own health state

A chi² test confirm, with a p value of 0.202, that there is no statistically significant differences between the four variants of the questionnaire.

The illnesses considered are related to respiratory health, so respondents were asked if they have such illnesses. Table 18 features the respiratory illnesses the respondents have declared: asthma, chronic bronchitis, allergy to airborne allergens. Around 10% of the respondents have asthma, 1% to 5% have chronic bronchitis and 12% to 18% have allergies. The chi² tests shoes the differences between the contexts are snot statistically significant.

			No Context	Full context	Air Pollution	Smoking	p value (chi²)
Asthma	no	Counts	210	167	226	315	0.224
		%	91.7%	95.4%	91.5%	94.6%	
	yes	Counts	19	8	21	18	
		%	8.3%	4.6%	8.5%	5.4%	
Chronic Bronchitis	no	Counts	226	171	237	323	0.313
		%	98.7%	97.7%	96.0%	97.0%	
	yes	Counts	3	4	10	10	
		%	1.3%	2.3%	4.0%	3.0%	
Allergy to airborne allergens	no	Counts	198	153	203	286	0.409
		%	86.5%	87.4%	82.2%	85.9%	
	yes	Counts	31	22	44	47	
		%	13.5%	12.6%	17.8%	14.1%	

Table 18: Respiratory illnesses

The analysis of the entire sample is presented in Appendix 6. On this same too, disparities are observed between the variants, similar to the ones observed in the treated sample.

D.Analysis of the WTP: unconditional statistics

The aim of this part is to conduct a first analysis, in an unconditional way (descriptive statistics), of the reactions of the respondents to the questionnaire, depending on the variants they got (meaning which context was given to explain the illnesses), and their smoking status (non-smoker, former smoker, smoker).

First, the respondents who chose not to pay to buy a treatment to avoid each illness will be analyzed, with focus on the reasons for not wanting to pay, the influence of the context given and the respondents' smoking status. Then, the WTP will be determined for each illness and the influence of the context and the respondents' characteristics will be determined.

1. Respondents who choose not to pay and their reasons

After the introduction of the questionnaire and, depending on the variant, the description of the context, and before actually stating their WTP, respondents are asked for each illness if they are willing to pay to buy the pill to avoid it. If they choose not to buy the pill, they are asked why. It may be because they do not give any value to avoid the illness or because they are not ready to give up something else in their life (e.g. lack of money): this is called a "true 0" or legit (legitimate) 0. The second option is the respondents in fact value avoiding the illness but answer they do not want to pay because they do not agree with the questionnaire: these are protests answers. The proposed reasons for not paying are the following:

1. Legit 0: "I can't afford this treatment", "One day of cough / This health state is not severe enough to pay to avoid it", "My health expenses are already too high", and, except for one day of cough, "I have only a low risk or no risk at all to experience this illness".
2. Protests answers: "I don't trust this treatment", "The National Health Service should pay this treatment", "I don't trust the information I have been given".

The option "another reason" is also given for one day of cough only, and is replaced by "I have only a low risk or no risk at all to experience this illness" for the three other illnesses. The Appendix 7 gathers the direct information about respondents who chose not to pay.

This chapter will first analyze these answers to determine if there are differences between the illnesses, depending on the four variants of the questionnaire, and on the smoking status of the respondents.

1.1 Global analysis

1.1.1 Decision to pay or not

First, the differences between the illnesses will be analyzed, without considering any other factors. The more serious the illness is, the more the respondents are willing to pay to buy the treatment to avoid it. This is consistent with logic: one can survive one day of cough with low disagreement whereas COPDs means high disturbance to daily life conducting to death. The Mc Nemar test (cf. Table 19) confirm that the differences are statistically significant.

	Cough & CB	Cough & COPDm	Cough & COPDs	CB & COPDm	CB & COPDs	COPDm & COPDs
N	984	984	984	984	984	984
Chi-2[b]	179.095	218.822	242.338	15.238	32.752	6.793
Sig. asymptotic	.000	.000	.000	.000	.000	.009

Table 19: Mc Nemar test for proportions of respondents willing or not to pay, for each illness for the entire sample

1.1.2 Reason why not: legit vs protest

The next step is to determine why respondents do not pay. Figure 28 shows the reasons given by the respondents for not buying the treatment, in proportion, for each illness. It shows that, for one day of cough, the main reasons for not paying is by far “the illness is not serious enough”, meaning a legitimate reason, which seems relevant as one day of cough is a very benign and usual illness. This reason is very less given for the other illnesses, with decreasing propositions with the increase of the seriousness of the illness, which is still logic.

For the all the other illnesses “The National Health Service should pay this treatment”, a protest answer, is the first answer given; followed by “I can’t afford this treatment”, a legitimate one. This comes from the fact that these illnesses are the more serious one and consequently the amount needed to pay the treatment appears higher to the respondents. It is worth noting that, the more serious the illness is, the more the respondents trust the information given and the more they trust the treatment.

Overall, the part of protest answers seems to increase from cough to COPDm, to decrease for COPS: the effects of this illness seem to be more important than other considerations.

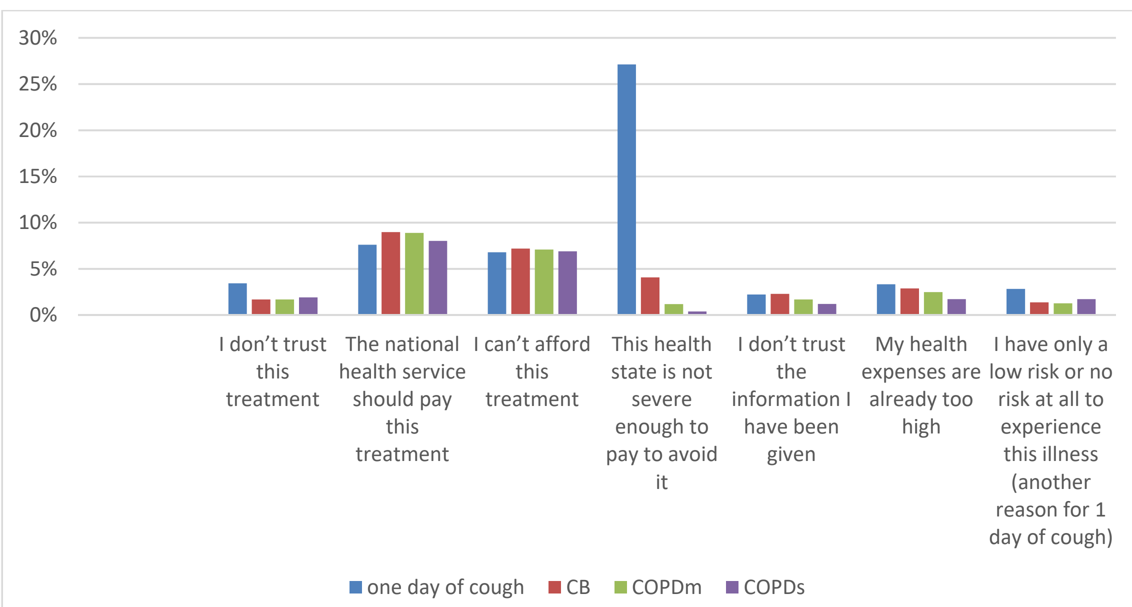


Figure 28: Reasons for respondents not to pay, in proportion per illness

A Mc Nemar test was conducted to determine if these differences are statistically significant, in Table 20, by comparing legit answer (true 0, as explained in the introduction of this part), and protest ones.

	Cough vs CB	Cough vs COPDm	Cough vs. COPDs	CB vs. COPDm	CB vs. COPDs	COPDm vs. COPDs
N	241	201	526	210	283	242
Chi-2	13.255	6.283	15.534		21.780	13.796
Sig. asymptotic	.000	.012	.000		.000	.000
Sig. exact (bilateral)				1.000c		

Table 20: Mc Nemar test for protest vs. legit reasons for not paying, for each illness

in grey: statistically significant

Table 20 highlights that the differences observed in Figure 28Figure 31 are actually statically significant. There is no answer for the comparison between CB and COPDm because of the specific structure of the answers shown in Table 21.

		COPDm	
		Protest	**Legit**
CB	**Protest**	95	10
	Legit	10	95

Table 21: CB and COPDm - protest vs. legit reasons for not paying

1.2 Influence of the context

1.2.1 Decision to pay or not

Figure 29 shows the proportion of respondents who are willing to pay to avoid each illness (in column) versus those who do not want to pay, depending on the context given in each variant of the questionnaire (in line). About half the respondents chose not to pay for the treatment avoiding on day of cough and around one third for the other illnesses.

Figure 29 highlights that respondents are more willing to pay for more serious illnesses than for one day of cough, but the differences between the three other illnesses are not visually obvious. Moreover, respondents are more willing to pay on the last variant (context: smoking). In the case of one day of cough, the difference between the variant of the questionnaire in which illness due to air pollution and the one with illness due to smoking is around 8%.

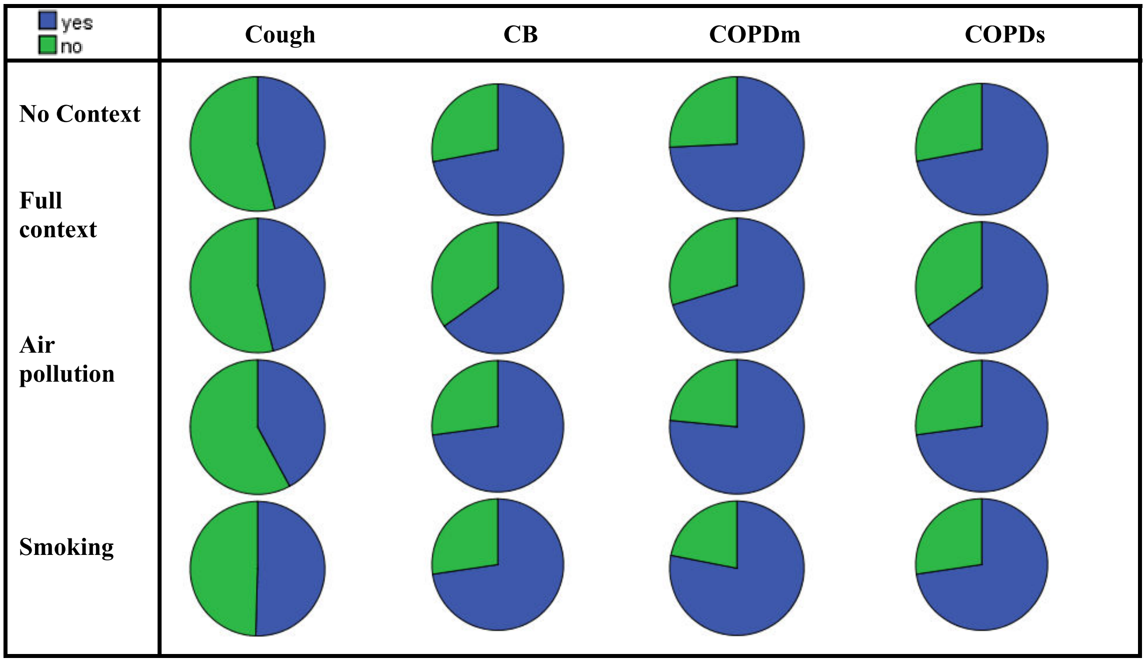


Figure 29: Proportions of respondents willing to pay or not, depending on the variant of the questionnaire per illness

Table 22 presents the results of the ANOVA test, showing no statistically significant difference between all variants of the questionnaire.

		Sum of squares	df	Mean square	F	Sig.
Cough	**Between groups**	1.007	3	.336	1.349	.257
	Among groups	243.818	980	.249		
	Total	244.825	983			
CB	**Between groups**	.800	3	.267	1.301	.273
	Among groups	200.809	980	.205		
	Total	201.609	983			
COPDm	**Between groups**	.758	3	.253	1.363	.253
	Among groups	181.725	980	.185		
	Total	182.484	983			
COPDs	**Between groups**	.783	3	.261	1.525	.206
	Among groups	167.802	980	.171		
	Total	168.585	983			

Table 22: ANOVA test for respondents willing to pay or not, between variants and per illness

in grey: statistically significant

Then post-hoc test were conducted to look for differences between two variants of the questionnaire. Two corrections were used: Bonferroni, which limits type 1 error by accounting for the number of tests; and LSD (Least Significant Difference), which does not have correction, and this being less strict but at risk of error. Table 23 presents these results.

	Context (I)	Context (J)	Bonferroni Mean difference (I-J)	Bonferroni Standard error	Bonferroni Sig.	LSD Mean Difference (I-J)	LSD Standard error	LSD Sig.
Pay or not – Cough	No context	Full context	.004	.050	1.000	.004	.050	.931
		Air pollution	-.037	.046	1.000	-.037	.046	.413
		Smoking	.046	.043	1.000	.046	.043	.283
	Full context	No context	-.004	.050	1.000	-.004	.050	.931
		Air pollution	-.042	.049	1.000	-.042	.049	.397
		Smoking	.042	.047	1.000	.042	.047	.371
	Air pollution	No context	.037	.046	1.000	.037	.046	.413
		Full context	.042	.049	1.000	.042	.049	.397
		Smoking	.083	.042	.280	.083*	.042	.047
	Smoking	No context	-.046	.043	1.000	-.046	.043	.283
		Full context	-.042	.047	1.000	-.042	.047	.371
		Air pollution	-.083	.042	.280	-.083*	.042	.047
Pay or not - CB	No context	Full context	-.069	.045	.773	-.069	.045	.129
		Air pollution	.008	.042	1.000	.008	.042	.843
		Smoking	.006	.039	1.000	.006	.039	.873
	Full context	No context	.069	.045	.773	.069	.045	.129
		Air pollution	.077	.045	.505	.077*	.045	.084
		Smoking	.075	.042	.451	.075*	.042	.075
	Air pollution	No context	-.008	.042	1.000	-.008	.042	.843
		Full context	-.077	.045	.505	-.077*	.045	.084
		Smoking	-.002	.038	1.000	-.002	.038	.958
	Smoking	No context	-.006	.039	1.000	-.006	.039	.873
		Full context	-.075	.042	.451	-.075*	.042	.075
		Air pollution	.002	.038	1.000	.002	.038	.958
Pay or not - COPDm	No context	Full context	-.040	.043	1.000	-.040	.043	.361
		Air pollution	.023	.040	1.000	.023	.040	.564
		Smoking	.038	.037	1.000	.038	.037	.299
	Full context	No context	.040	.043	1.000	.040	.043	.361
		Air pollution	.062	.043	.860	.062	.043	.143
		Smoking	.078	.040	.317	.078*	.040	.053
	Air pollution	No context	-.023	.040	1.000	-.023	.040	.564
		Full context	-.062	.043	.860	-.062	.043	.143
		Smoking	.016	.036	1.000	.016	.036	.666
	Smoking	No context	-.038	.037	1.000	-.038	.037	.299
		Full context	-.078	.040	.317	-.078*	.040	.053
		Air pollution	-.016	.036	1.000	-.016	.036	.666
Pay or not - COPDs	No context	Full context	.009	.042	1.000	.009	.042	.830
		Air pollution	.075	.038	.294	.075*	.038	.049
		Smoking	.027	.036	1.000	.027	.036	.453
	Full context	No context	-.009	.042	1.000	-.009	.042	.830
		Air pollution	.066	.041	.644	.066	.041	.107
		Smoking	.018	.039	1.000	.018	.039	.646
	Air pollution	No context	-.075	.038	.294	-.075*	.038	.049
		Full context	-.066	.041	.644	-.066	.041	.107
		Smoking	-.048	.035	.998	-.048	.035	.166
	Smoking	No context	-.027	.036	1.000	-.027	.036	.453
		Full context	-.018	.039	1.000	-.018	.039	.646
		Air pollution	.048	.035	.998	.048	.035	.166

Table 23: Post-hoc test for respondents willing to pay or not, between variants and per illness

in grey: statistically significant

Table 23 shows statistically significant differences between:

- ✓ for cough: air pollution context and smoking context;
- ✓ for CB: full context and air pollution context; and full context and smoking context;
- ✓ for COPDm: full context and smoking context (with the difference between : full context and air pollution context having a sig. =0.143);

- ✓ for COPDs: no context and air pollution context (with the difference between : full context and air pollution context having a sig. =0.107).

The differences being only significant with LSD test and not Bonferroni test, they may actually not be significant (risk of type 1 error). So the full context leads to more respondents wanting to pay compared to air pollution only or smoking for the two medium illness.

1.2.2 Reason why not: Legit vs protest

The next step is to compare the reasons why respondents do not want to pay, detailed in Figure 30.

The main reason by far for not paying for one day of cough treatment is that the illness is not serious enough, a legit reason. However, with the illnesses becoming more serious, respondents may really consider to pay, and the proportion of protest answers reaches the one of genuine non-payment. This may be justified by the fact, that respondents when facing the impossibility to pay the amount they think appropriate for the most serious illness, look for ways to have it paid another way: through the national health service.

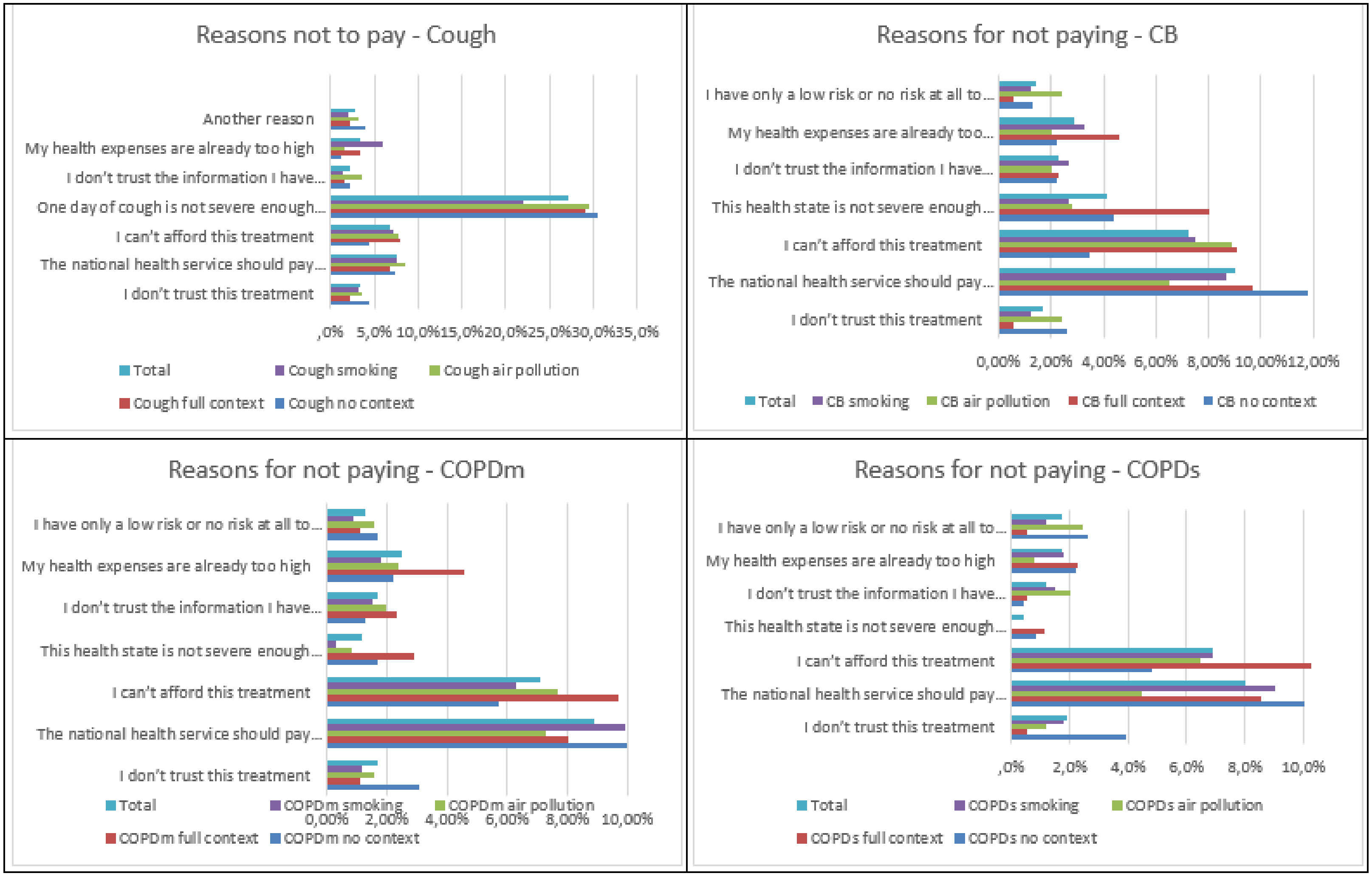


Figure 30: Reasons given by respondents for not paying, in proportions

Table 24 compares true, protest and positive WTP answers for each illness, depending on the context given in the variants of the questionnaire.

		Counts					%				
		No context	Full context	Air pollution	Smoking	Total	No context	Full context	Air pollution	Smoking	Total
Cough	WTP>0	105	81	104	168	458	64.0	60.9	64.2	69.7	65.4
	True	26	32	31	31	120	15.9	24.1	19.1	12.9	17.1
	Protest	33	20	27	42	122	20.1	15.0	16.7	17.4	17.4
CB	WTP>0	165	114	180	242	701	72.1	65.1	72.9	72.7	71.2
	True	26	39	40	49	154	11.4	22.3	16.2	14.7	15.7
	Protest	38	22	27	42	129	16.6	12.6	10.9	12.6	13.1
COPDm	WTP>0	170	123	189	260	742	74.2	70.3	76.5	78.1	75.4
	True	26	32	31	31	120	11.4	18.3	12.6	9.3	12.2
	Protest	33	20	27	42	122	14.4	11.4	10.9	12.6	12.4
COPDs	WTP>0	172	133	204	258	767	75.1	76.0	82.6	77.7	78.0
	True	24	25	24	33	106	10.5	14.3	9.7	9.9	10.8
	Protest	33	17	19	41	110	14.4	9.7	7.7	12.3	11.2

Table 24: True 0, protest answer and positive WTP for the four illnesses, depending on the context

Figure 31 illustrated the proportion of protest and true 0 for all illnesses, depending on the provided context.

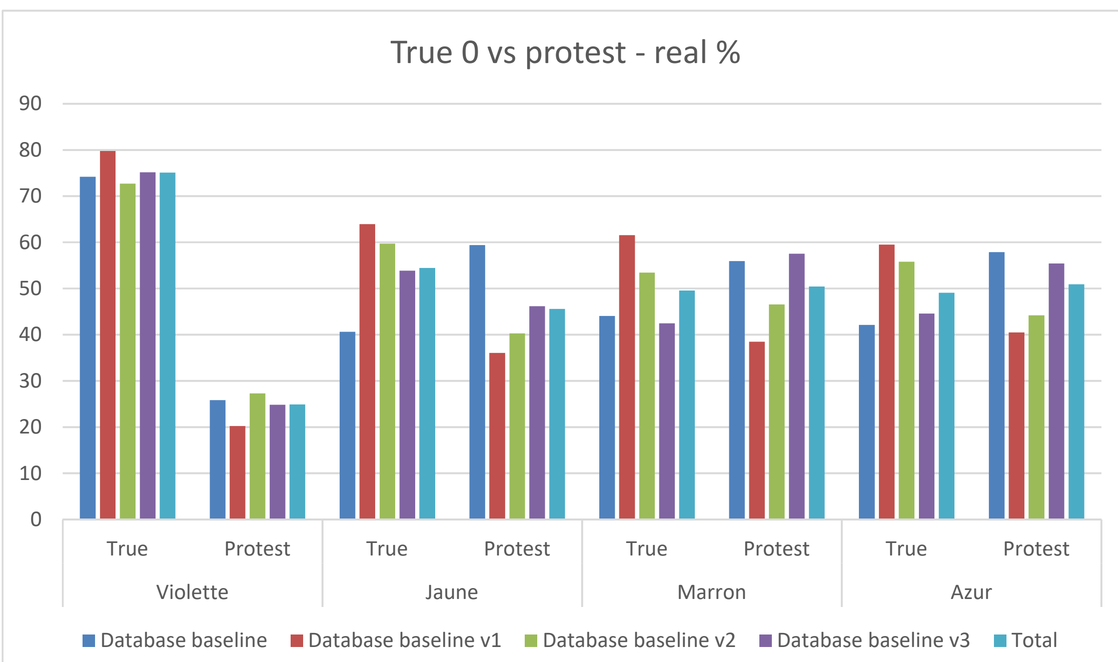


Figure 31: Protest vs. legit reasons for not paying, for each illness depending on the context

Figure 31 shows first the proportions of true 0 vs protest answers, clearly in favor of the first one for cough (around 80% of true 0), equals for COPDm and is very slightly inverse for COPDs (49% /51%). One plausible explanation is that respondents do not even consider paying for one day of cough because it is so benign. Table 25 presents the results of the Anova test, stating that statistically significant differences can be observed for CB and CODPs whereas there are far from significant for cough.

		Sum of squares	df	Mean square	F	Sig.
Cough Protest Legit	**Between groups**	.297	3	.099	.527	.664
	Among groups	98.077	522	.188		
	Total	98.375	525			
CB Protest Legit	**Between groups**	1.960	3	.653	2.671	.048
	Among groups	68.238	279	.245		
	Total	70.198	282			
COPDm Protest Legit	**Between groups**	1.379	3	.460	1.851	.139
	Among groups	59.117	238	.248		
	Total	60.496	241			
CODPs Protest Legit	**Between groups**	.620	3	.207	2.085	.101
	Among groups	97.084	980	.099		
	Total	97.703	983			

Table 25: Anova test for protest vs. legit reasons for not paying, for each illness, depending on the context

in grey: statistically significant

To figure out between with context the differences are significant, post hoc tests were conducted, their results are present in Table 26. This table shows that, for CB, the absence of context is statistically different from the three other versions, whereas the statistically significant differences are less consistent for COPDm and COPDs. It seems that for the less serious as well as the more serious one, the illnesses' characteristics themselves take precedence over other considerations. It worth noting that the differences only significant with LSD test and not Bonferroni test may be due to coincidences.

	(I) Database	(J) Database	LSD			Bonferroni		
			Mean difference (I-J)	Standard error	Sig.	Mean difference (I-J)	Standard error	Sig.
Cough Protest Legit	No context	Full context	-.056	.059	.346	-.056	.059	1.000
		Air pollution	.015	.053	.783	.015	.053	1.000
		Smoking	-.010	.052	.853	-.010	.052	1.000
	Full context	No context	.056	.059	.346	.056	.059	1.000
		Air pollution	.071	.058	.221	.071	.058	1.000
		Smoking	.046	.056	.408	.046	.056	1.000
	Air pollution	No context	-.015	.053	.783	-.015	.053	1.000
		Full context	-.071	.058	.221	-.071	.058	1.000
		Smoking	-.024	.050	.625	-.024	.050	1.000
	Smoking	No context	.010	.052	.853	.010	.052	1.000
		Full context	-.046	.056	.408	-.046	.056	1.000
		Air pollution	.024	.050	.625	.024	.050	1.000
CB Protest Legit	No context	Full context	-.233*	.088	.009	-.233*	.088	.053
		Air pollution	-.191*	.086	.028	-.191	.086	.169
		Smoking	-.132	.081	.102	-.132	.081	.614
	Full context	No context	.233*	.088	.009	.233*	.088	.053
		Air pollution	.042	.088	.629	.042	.088	1.000
		Smoking	.101	.082	.219	.101	.082	1.000
	Air pollution	No context	.191*	.086	.028	.191	.086	.169
		Full context	-.042	.088	.629	-.042	.088	1.000
		Smoking	.059	.080	.463	.059	.080	1.000
	Smoking	No context	.132	.081	.102	.132	.081	.614
		Full context	-.101	.082	.219	-.101	.082	1.000
		Air pollution	-.059	.080	.463	-.059	.080	1.000
COPDm Protest Legit	No context	Full context	-.175*	.095	.067	-.175	.095	.399
		Air pollution	-.094	.092	.310	-.094	.092	1.000
		Smoking	.016	.087	.854	.016	.087	1.000
	Full context	No context	.175*	.095	.067	.175	.095	.399
		Air pollution	.081	.095	.396	.081	.095	1.000
		Smoking	.191*	.090	.036	.191	.090	.216
	Air pollution	No context	.094	.092	.310	.094	.092	1.000
		Full context	-.081	.095	.396	-.081	.095	1.000
		Smoking	.110	.088	.212	.110	.088	1.000
	Smoking	No context	-.016	.087	.854	-.016	.087	1.000
		Full context	-.191*	.090	.036	-.191	.090	.216
		Air pollution	-.110	.088	.212	-.110	.088	1.000
COPDs Protest Legit	No context	Full context	-.04696	.03160	.138	-.04696	.03160	.826
		Air pollution	-.06718*	.02887	.020	-.06718	.02887	.121
		Smoking	-.02098	.02702	.438	-.02098	.02702	1.000
	Full context	No context	.04696	.03160	.138	.04696	.03160	.826
		Air pollution	-.02022	.03110	.516	-.02022	.03110	1.000
		Smoking	.02598	.02939	.377	.02598	.02939	1.000
	Air pollution	No context	.06718*	.02887	.020	.06718	.02887	.121
		Full context	.02022	.03110	.516	.02022	.03110	1.000
		Smoking	.04620*	.02643	.081	.04620	.02643	.485
	Smoking	No context	.02098	.02702	.438	.02098	.02702	1.000
		Full context	-.02598	.02939	.377	-.02598	.02939	1.000
		Air pollution	-.04620*	.02643	.081	-.04620	.02643	.485

Table 26: Post-hoc test protest vs. legit reasons for not paying, for each illness, depending on the context

in grey: statistically significant

In a nutshell, regarding the different variants of the questionnaire, always the same acceptance ranking is found (for cough the differences are very low and almost absent), based on the legit vs protest answers:

Full context >air pollution only > smoking only > no context.

This implies that giving full information about the context increases the acceptability of the questionnaire, and consequently of the WTP valuation process itself. The variant with no context (no context) has an equivalent proportion of rejection as the one with the context smoking. So respondents seem to associate no context with smoking context, maybe because (or thanks to) the public health campaigns insisting on the impacts of smoking on health, respondents do imagine smoking as a cause of the illness even without it being said.

1.3 Differences between smokers, non-smokers and former smokers

1.3.1 Decision to pay or not

As smoking is given as a possible cause of the studied illnesses for two variants (full context and smoking only), the next analysis will study if the respondents' smoking status influence their readiness to pay for the treatment. Figure 32 represents the proportion willing to pay depending on their smoking status.

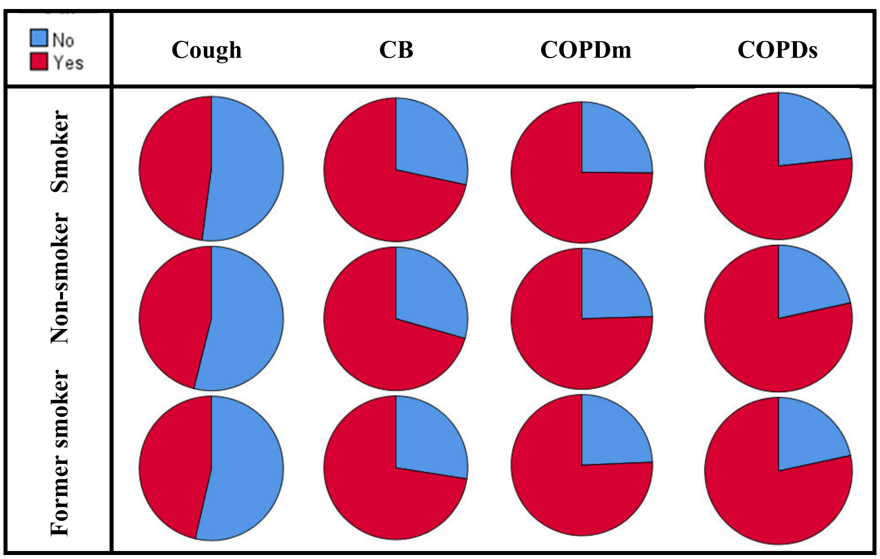


Figure 32: Proportion of respondents willing, depending on their smoking status, per illness

It seems in Figure 32 that former smokers and smokers have very similar behaviors whereas non-smokers are much more bound not to pay. The results of the Anova test presented in Table 27 though show that these differences are not statistically significant. Post hoc test confirm it (Table 79 in Appendix 8).

		Sum of squares	df	Mean square	F	Sig.
Cough	**Between groups**	.053	2	.026	.106	.900
	Among groups	244.772	981	.250		
	Total	244.825	983			
CB	**Between groups**	.065	2	.032	.157	.855
	Among groups	201.544	981	.205		
	Total	201.609	983			
COPDm	**Between groups**	.008	2	.004	.021	.979
	Among groups	182.476	981	.186		
	Total	182.484	983			
CODPs	**Between groups**	.047	2	.023	.136	.873
	Among groups	168.539	981	.172		
	Total	168.585	983			

Table 27: Anova test for respondents willing to pay or not, depending on their smoking status, per illness

in grey: statistically significant

As the variant of the questionnaire are also related to smoking, the cross-influence of smoking status and context was investigated. Figure 33 shows the proportions of respondents willing to pay for the treatment, depending of the context they got in the questionnaire and their smoking status (cf. Table 80 in Appendix 8). As observed before the more serious the illness is, the more respondents are willing to pay to avoid it. It seems in this figure that former smokers and non-smokers have similar behaviors. Somehow surprisingly, smokers seem less bound to pay when the illness is said to be related to smoking, maybe because they think they could just stop smoking to avoid it, or because they have previously implicitly accepted damaging their health due to their smoking habits. Similar behavior is observed when full context is provided. However, smokers are ready to pay more than former smokers and non-smokers when no context or only air pollution are given, maybe because they know they are already at risk because of smoking.

Non-smokers and former smokers are slightly less paying when context is described as smoking than air pollution only.

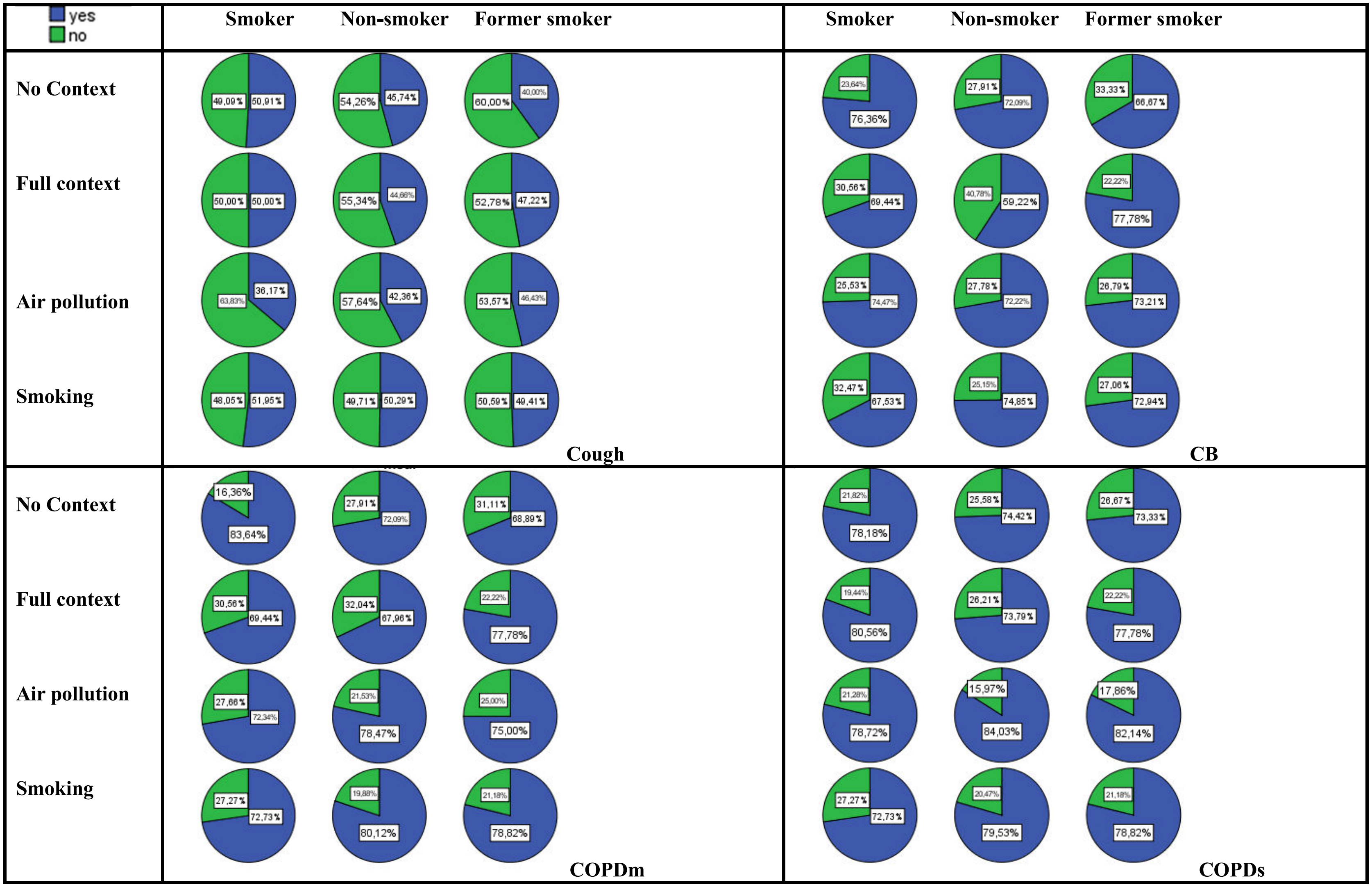


Figure 33: Proportion of respondents paying or not the treatment for illness, depending on the context and smoking status

The results of the Anova test (cf. Table 28) confirm these observations.

		No context	Full context	Air pollution	Smoking
		Sig.	Sig.	Sig.	Sig.
Cough	Between groups	.556	.854	.854	.948
CB	Between groups	.564	.111	.111	.490
COPDm	Between groups	.173	.541	.541	.423
CODPs	Between groups	.826	.692	.692	.476

Table 28: Anova test between respondents willing to pay or not, between variants, per illness, and per smoking status

The post hoc test (cf. Table 81 in Appendix 8) confirm that there is no real schema. Two differences only are significant for LSD correction (for CB – full context: former smokers and non-smoker; and for COPDm - no context: former smoker and smoker).

1.3.2 Reason why not: Legit vs protest

Then the reasons for not paying are investigated. Figure 34 illustrates the differences in proportion between legit and protest reasons for not paying, for each illness, depending on the smoking status of the respondents. This figure shows that for all smoking status the proportion of legit answer increases with the severity of the illness, to drastically decrease for COPDs: the seriousness of the illness seems to overcome other factors. Moreover, smokers and non-smokers have similar behaviors whereas former smokers are more bound to protest. To better state the difference, an Anova test was conducted.

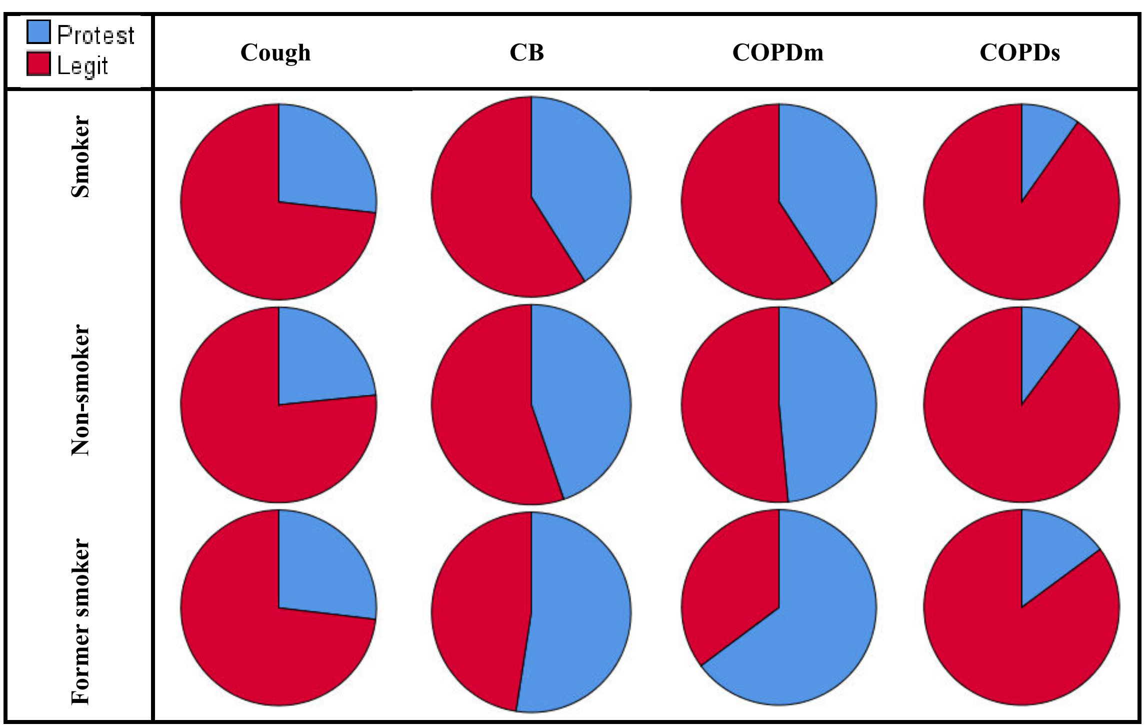


Figure 34: Proportion of protest vs legit non-payment, depending on their smoking status, per illness

Table 29 shows that the differences are only statistically significant for COPDm.

		Sum of squares	df	Mean square	F	Sig.
Cough Protest Legit	Between groups	.154	2	.077	.411	.663
	Among groups	98.220	523	.188		
	Total	98.375	525			
CB Protest Legit	Between groups	.429	2	.215	.862	.424
	Among groups	69.768	280	.249		
	Total	70.198	282			
COPDm Protest Legit	Between groups	1.674	2	.837	3.401	.035
	Among groups	58.822	239	.246		
	Total	60.496	241			
COPDs Protest Legit	Between groups	.393	2	.196	1.980	.139
	Among groups	97.310	981	.099		
	Total	97.703	983			

Table 29: Anova test reason for not paying, between variants, per illness, and per smoking status
Entire sample (984 respondents) - in grey: statistically significant

Table 30 presents the results of post hoc test. It highlights, for COPDm and CODPs, former smokers have statistically significant behaviors than non-smokers and former smokers. However, these differences are only significant with LSD test and not Bonferroni test, first explaining why they do not appear in Anova test (the difference between smokers and former smokers is significant with Bonferroni test), second that these differences may actually be due to coincidence.

	Smoking statu (I)	Smoking statu (J)	LSD			Bonferroni		
			Mean difference (I-J)	Standard error	Sig.	Mean difference (I-J)	Standard error	Sig.
Cough Protest Legit	smoker	non-smoker	-.034	.048	.480	-.034	.048	1.000
		former smoker	.001	.057	.985	.001	.057	1.000
	non-smoker	smoker	.034	.048	.480	.034	.048	1.000
		former smoker	.035	.047	.457	.035	.047	1.000
	former smoker	smoker	-.001	.057	.985	-.001	.057	1.000
		non-smoker	-.035	.047	.457	-.035	.047	1.000
CB Protest Legit	smoker	non-smoker	.037	.075	.619	.037	.075	1.000
		former smoker	.115	.090	.205	.115	.090	.616
	non-smoker	smoker	-.037	.075	.619	-.037	.075	1.000
		former smoker	.077	.075	.303	.077	.075	.910
	former smoker	smoker	-.115	.090	.205	-.115	.090	.616
		non-smoker	-.077	.075	.303	-.077	.075	.910
COPDm Protest Legit	smoker	non-smoker	.078	.080	.332	.078	.080	.997
		former smoker	.241*	.095	.012	.241*	.095	.037
	non-smoker	smoker	-.078	.080	.332	-.078	.080	.997
		former smoker	.163*	.080	.043	.163	.080	.128
	former smoker	smoker	-.241*	.095	.012	-.241*	.095	.037
		non-smoker	-.163*	.080	.043	-.163	.080	.128
COPDs Protest Legit	smoker	non-smoker	.00470	.02535	.853	.00470	.02535	1.000
		former smoker	.05097*	.03014	.091	.05097	.03014	.273
	non-smoker	smoker	-.00470	.02535	.853	-.00470	.02535	1.000
		former smoker	.04627*	.02506	.065	.04627	.02506	.195
	former smoker	smoker	-.05097*	.03014	.091	-.05097	.03014	.273
		non-smoker	-.04627*	.02506	.065	-.04627	.02506	.195

Table 30: Post hoc test reason for not paying, between variants, per illness, and per smoking status
Entire sample (984 respondents) - in grey: statistically significant

These results highlights that former smokers have behaviors which differ from non-smokers and smokers.

The influence of the context on these results was then looked upon. Figure 35 shows protest vs legit reasons for not paying, depending on context and on respondents' smoking status, for each illness.

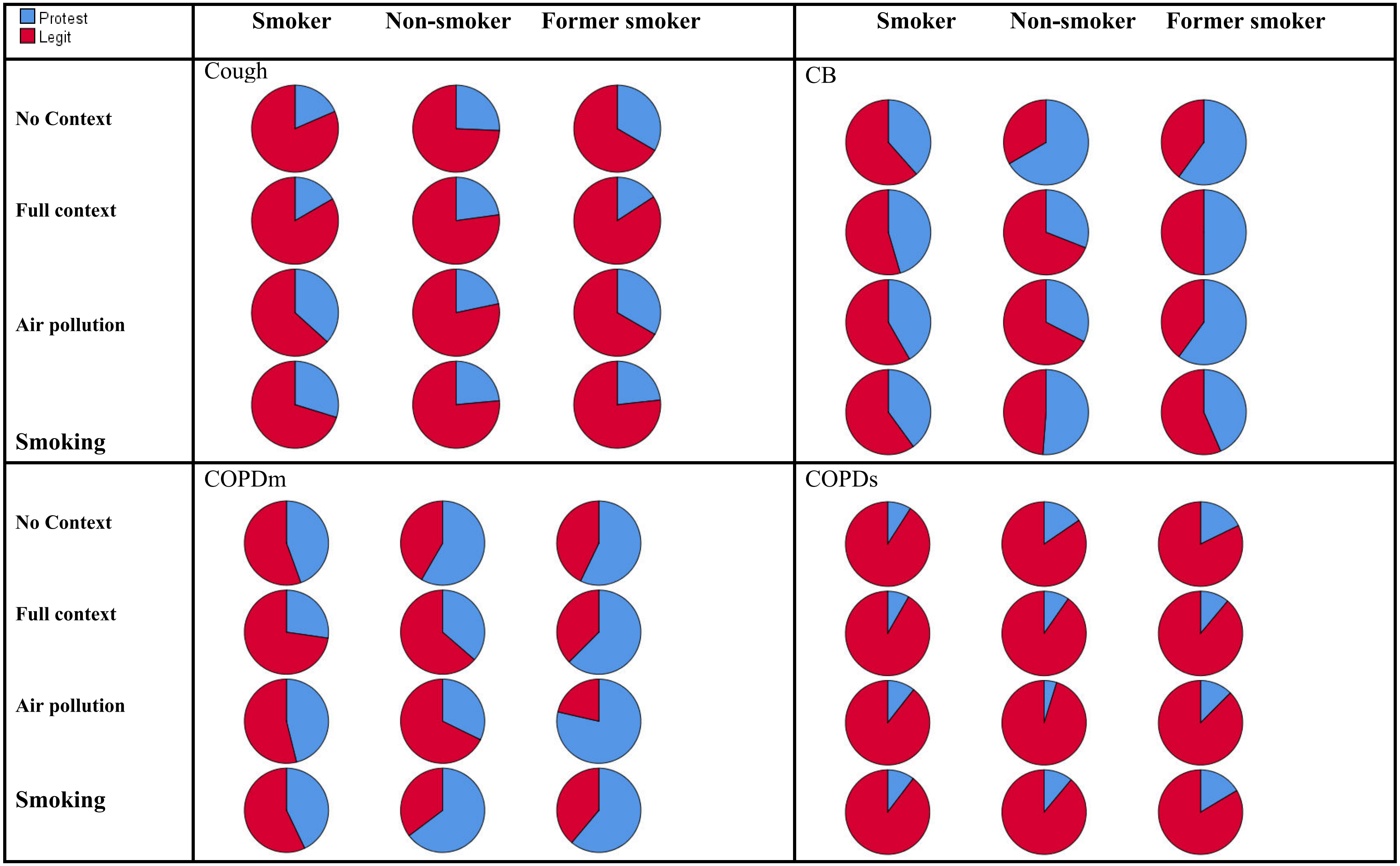


Figure 35: Proportion of protest vs legit non-payment, depending on their smoking status and context, per illness

Figure 35 shows the following protest rankings for all illnesses, and all contexts: former smokers > non-smokers >smokers. Table 31 shows the ranking for the cross influence between context and smoking status.

	More protest	**→**	**→**	**Less protest**
Smokers	Air pollution	No context	Smoking	Full context
Non-smokers	No context	Smoking	Air pollution	Full context
Former smokers	Air pollution	Smoking	No context	Full context

Table 31: Ranking for protest vs. legit answers, per context and smoking status

However, the differences seem more important for former smokers and non-smokers than for smokers. Former smokers have once again a more extreme behavior, rejecting even more the questionnaire, including the variant where smoking is said to be the cause of the illness. The differences for smokers are very low, as if smokers keep a consistent behavior for all questionnaires whereas non-smokers and former smokers had more different behaviors. Il could be because smokers admit their behaviors can be the causes of these illnesses so they are less sensible to context.

An Anova tests was conducted to assess if these differences are statistically significant, as shown in Table 32.

		No context	**Full context**	**Air pollution**	**Smoking**
		Sig.	**Sig.**	**Sig.**	**Sig.**
Cough	**Between groups**	.468	.744	.206	.741
CB	**Between groups**	.468	.469	.185	.652
COPDm	**Between groups**	.760	.285	.014	.273
CODPs	**Between groups**	.410	.925	.135	.398

Table 32: Anova test for reason for not paying, between variants, per illness, and per smoking status

Post hoc test (cf. Table 82 in Appendix 8) shows no statistically significant differences in full context and smoking context variant. For the no context variant, there are differences between smokers in non-smokers for cough only. In air pollution context, differences are observed for CB, COPDm and COPDs between non-smokers and former smokers, and for COPDm only between non-smokers and former smokers. It should be noted that the effectives in each category is quite low (sometime only 5 persons), so the relevance of these analyzes should be relativized.

Even if the tendencies are similar, the differences are not always significant. These can be due to the fact that there are no significant differences, or that the differences are a bit fuzzy, being related to people. Indeed, correlation coefficients are often low in this health economic field because of dealing with people (Maca et al., 2012; Maca et al., 2011).

To conclude, overall, the more serious the illness is, the more the respondents are willing to pay to buy the treatment to avoid it. Moreover, if the reasons for not paying for cough are mostly legitimate, the assumed price of the treatment for the others illnesses leads respondents to give first protest answer ("The National Health Service should pay this treatment"), and a legit one ("I can't afford this treatment"). It highlights that respondents actually took into account their income and expenses when stating their WTP. Moreover, they trust the information given for the worst illness.

Providing the context about the causes triggering the illnesses seems to increase the acceptability of the questionnaire (and consequently of the WTP determination exercise) the respondents seem to believe more in this situation and less protesting against the survey: Full context >air pollution only > smoking only > no context.

Smokers are more bound to accept that they have to pay for the treatments (less protest answers) even if limitation on available income limits anyway their capability. On the other hand, former smokers have more bound not to pay to protest against the scenario developed in this study (i.e. paying for their own treatment).

Context marginally influences the probability a respondent has to agree to pay the treatment, depending on his smoking status.

2. Amount payed for the treatment to avoid the different illnesses

The previous part studied whether the respondents agreed to pay for the treatment and for which reasons, depending on the context given (i.e. variant of questionnaire) and respondents' smoking status. This part addresses the following question: how much the respondents who agreed to pay are really paying?

First, the overall WTP for each illness (meaning all variants of the questionnaire together) will be analyzed. Then the WTP per variant of the questionnaire, meaning depending on the context, will be assessed. Last, the influence of the smoking status of the respondent on the WTP will be studied.

2.1 Overall WTP

2.1.1 WTP distribution

First, the distribution of the WTP, per illness, will be scrutinized. Figure 36 represents the distribution of WTP illness CB (answers of the 4 variants). The distribution is similar for the four illnesses. It highlights that respondents preferentially chose rounded amounts as WTP. Moreover, the repartition of the values follows a log-normal distribution with some extreme values, which is usual for WTP survey.

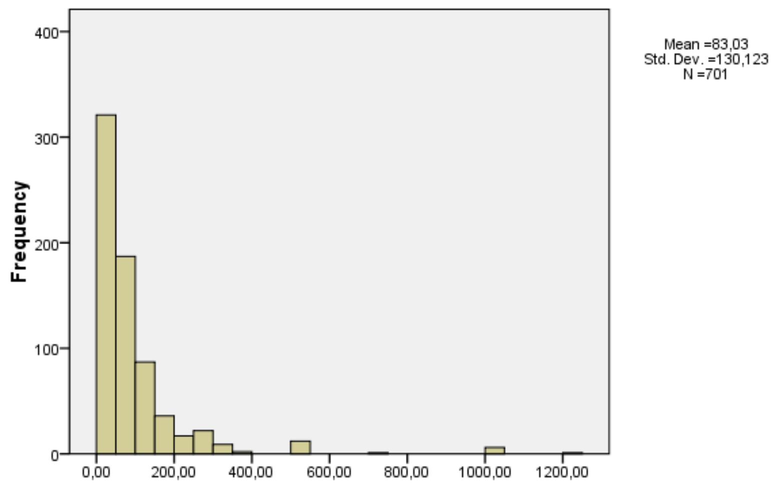


Figure 36: Distribution of the WTP for CB

The boxplot graph, Figure 37, illustrates the repartition of the WTP answers for illness CB. This graph illustrates the wide distribution of the answers: on the left hand side, high WTP can be seen; on the right hand side, a focus on the core of the distribution shows also a wide dispersion.

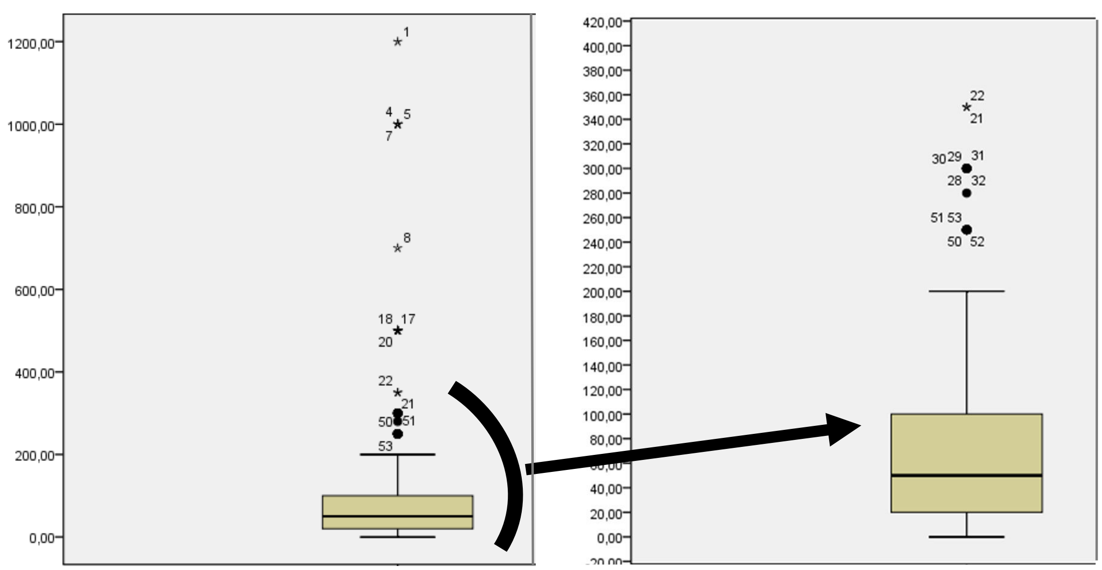


Figure 37: Boxplot graph, CB, all questionnaires – on the left entire distribution, on the right focus on the core of the distributions

Box: 25 to 75 percentiles (interquartile value); Bar in the box: median; Whiskers : from -1.5 to + 1.5 from respectively the min and max value in the box; Stars: extreme values. Tiny numbers identify the respondents

This figure confirms first that most of the answers are grouped, with a non-negligible number of high and extreme values. It highlights the influence of these high values as the median is shifted to the bottom of the distribution.

As shown in Figure 38, the behaviors of the WTP is similar for all illnesses. The medians increase with the severity of the illnesses. This is consistent with the theory (and intuition) saying that the more serious the illness is, the more respondents are willing to pay to avoid it.

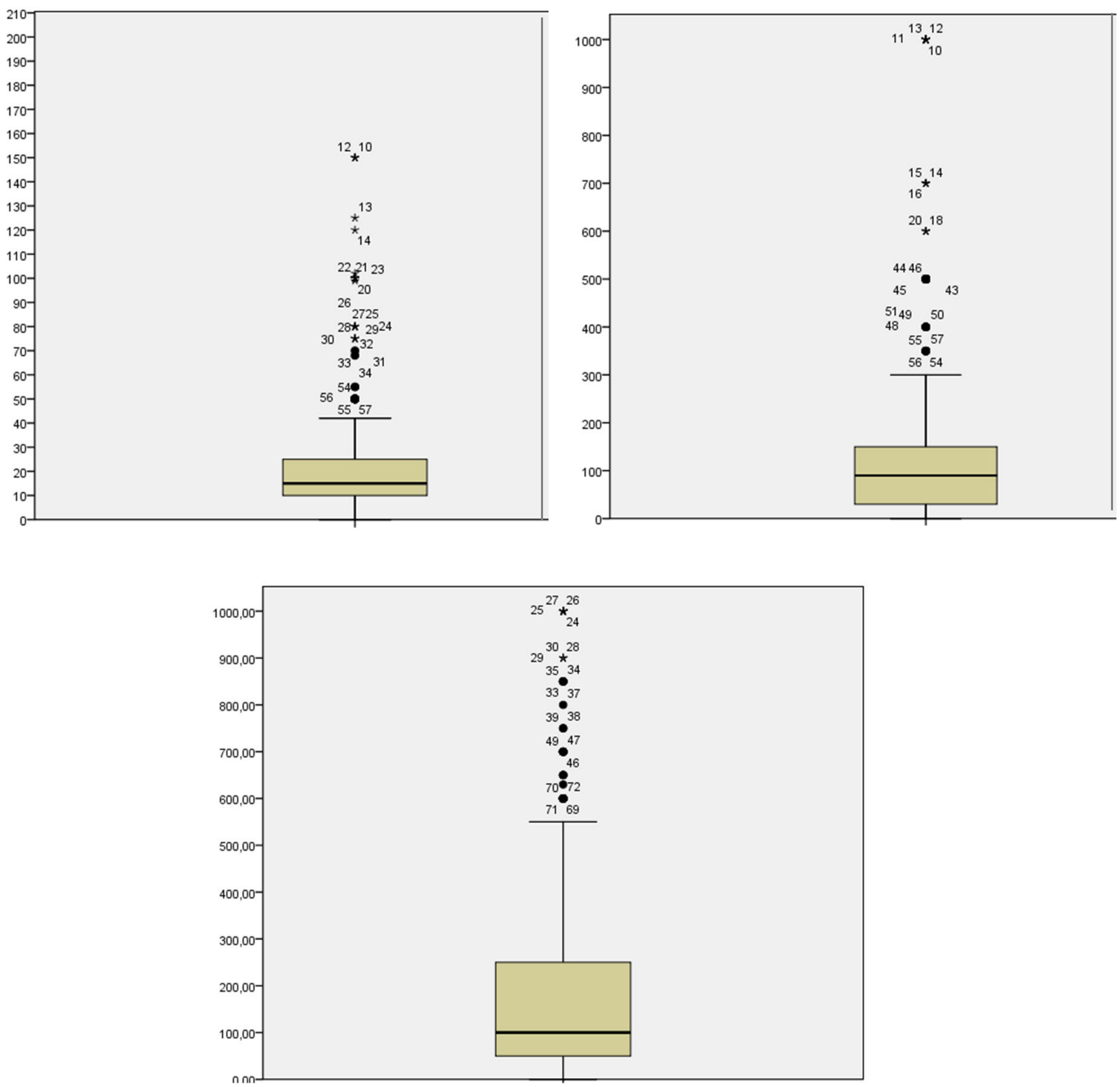


Figure 38: Boxplot distribution for all the illness, focus on the core of the distribution

Moreover, for the four illnesses, the distributions are spread out, with extreme values. Table 33 confirms that the distributions are not similar, and that the observed differences are statistically significant.

	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	**df**	**Sig.**	**Statistic**	**df**	**Sig.**
WTP cough	.338	395	.000	.295	395	.000
WTP CB	.298	395	.000	.505	395	.000
WTP COPDm	.255	395	.000	.574	395	.000
WTP COPDs	.274	395	.000	.508	395	.000

Table 33: Kolmogorov-Smirnov test to compare the distributions

2.1.2 Trend indicators for the overall WTP

Table 34 details the mean, median and other descriptive statistics for each illness. The means and medians increase with the severity of the illness, which makes sense. High standard deviations indicate a wide distribution of the sample. Moreover, median is much lower than mean for each illness: the impact of the high values is important. This is confirmed by the fact that the 5% Trimmed Mean is lower than the "standard" mean.

		WTP – Cough	WTP - CB	WTP - COPDm	WTP - COPDs
Mean		29.4	83.0	135.6	216.4
95% Confidence Interval for Mean	**Lower Bound**	23.3	73.4	121.9	191.7
	Upper Bound	35.5	92.7	149.2	241.0
5% Trimmed Mean		19.7	63.1	107.6	168.0
Median		15.0	50.0	90.0	100.0
Variance		4435.1	16932.1	35888.3	121380.3
Std. Deviation		66.6	130.1	189.4	348.4
Minimum		0.0	0.0	0.0	0.0
Maximum		1000.0	1200.0	2000.0	5000.0

Table 34: Mean and median WTP per illness, for the entire sample

However, Table 35 confirms that the differences between the means are statistically significant.

	Paired difference					
	Mean	**Standard error**	**Mean standard error**	**t**	**df**	**Sig. (bilatéral)**
WTP Cough - WTP CB	-57.83486	126.15954	6.18548	-9.350	415	.000
WTP Cough - WTP COPDm	-108.08777	184.49200	9.03461	-11.964	416	.000
WTP Cough - WTP COPDs	-189.52188	364.09661	17.85131	-10.617	415	.000
WTP CB – WTP COPDm	-53.80867	154.79651	5.98478	-8.991	668	.000
WTP CB – WTP COPDs	-146.76722	341.43977	13.21070	-11.110	667	.000
WTP COPDm –- WTP COPDs	-91.61283	292.89246	10.99981	-8.329	708	.000

Table 35: T-paired test to compare of the means WTP

2.1.3 Trend indicators for WTP, 5% trimmed sample

As said just above, the 5% trimmed means indicate that the extreme values have a high influence. To see how much the 5% extreme values are significant, the descriptive analysis procedure was again conducted, on the sample from which have been removed for each illness the 5% min and max values (only for this illness, the entire case was not removed). That means deleting the 23 maximal and the 23 minimal values (out of 458) for one day of cough, the 35 minimal and maximal values (out of 701) for CB, the 37 minimal and maximal values (out of 742) for COPBm, and the 38 minimal and maximal values (out of 768) for COPDs.

The distributions stay similar, with less low values (decrease of the pics near to 0) and maximal values being lower. Table 36 shows that the mean (of the 5% trimmed sample) and the 5% trimmed mean are much closer, for each illness, than it was for the entire sample. It shows that the 5% extreme values had indeed a very important influence over the mean and deleting them allows capturing the core of the distribution. Moreover, the 95% confidence intervals of the mean are much smaller. However, the medians lower than the means indicate that the high values still have an influence.

		WTP – Cough 5% trimmed	WTP – CB 5% trimmed	WTP – COPDm 5% trimmed	WTP – COPDs 5% trimmed
Mean		19.7	63.1	107.7	168.3
95% Confidence Interval for Mean	**Lower Bound**	18.3	58.7	100.5	155.8
	Upper Bound	21.1	67.4	114.9	180.7
5% Trimmed Mean		18.2	57.0	98.1	150.9
Median		15.0	50.0	90.0	100.0
Variance		218.4	3055.1	8992.7	27791.2
Std. Deviation		14.8	55.3	94.8	166.7

Table 36: Mean and median WTP per illness, for the 5% sample

Table 37 confirms that the observed differences are statistically significant.

	Paired difference					
	Mean	**Standard error**	**Mean standard error**	**t**	**Mean**	**Standard error**
WTP Cough 5% - WTP CB 5%	-41.66476	53.35141	2.85584	-14.589	348	.000
WTP Cough 5% - WTP COPDm 5%	-83.09659	91.32700	4.86775	-17.071	351	.000
WTP Cough 5% - WTP COPDs 5%	-136.52319	157.97744	8.50522	-16.052	344	.000
WTP CB 5%- WTP COPDm 5%	-43.94234	80.21575	3.32791	-13.204	580	.000
WTP CB 5% - WTP COPDs 5%	-106.27589	142.00403	6.00077	-17.710	559	.000
WTP COPDm 5%- WTP CPOPDs 5%	-62.19294	123.66654	5.01122	-12.411	608	.000

Table 37: T-paired test to compare of the 5% trimmed means WTP

2.2 Influence of the context

2.2.1 WTP distribution, depending on the context

The distribution of the WTP, for each illness and each variant (i.e. depending on which information were given to the respondents), is similar to the ones of the illnesses for all variants. Moreover, as also previously seen, the worst the illness is, the higher WTP is. The repartition of the WTP follows a log-normal distribution with some extreme values. There are few differences in this repartition between the variants of the questionnaire, so it is difficult to assess a possible influence of the information given from this analysis. Moreover, the differences in frequencies between the variants are also linked to the number of respondents. So the same analysis was conducted with the proportions of answer for each amount, as shown in Figure 39. This figure shows disparities in the distribution of the amount between the variants. For example, for COPDm (illness Marron), 30€ get the maximum of answer for variant providing full context, and 100€ for V4. However, it is not clear from this graph whether these differences are significant or not.

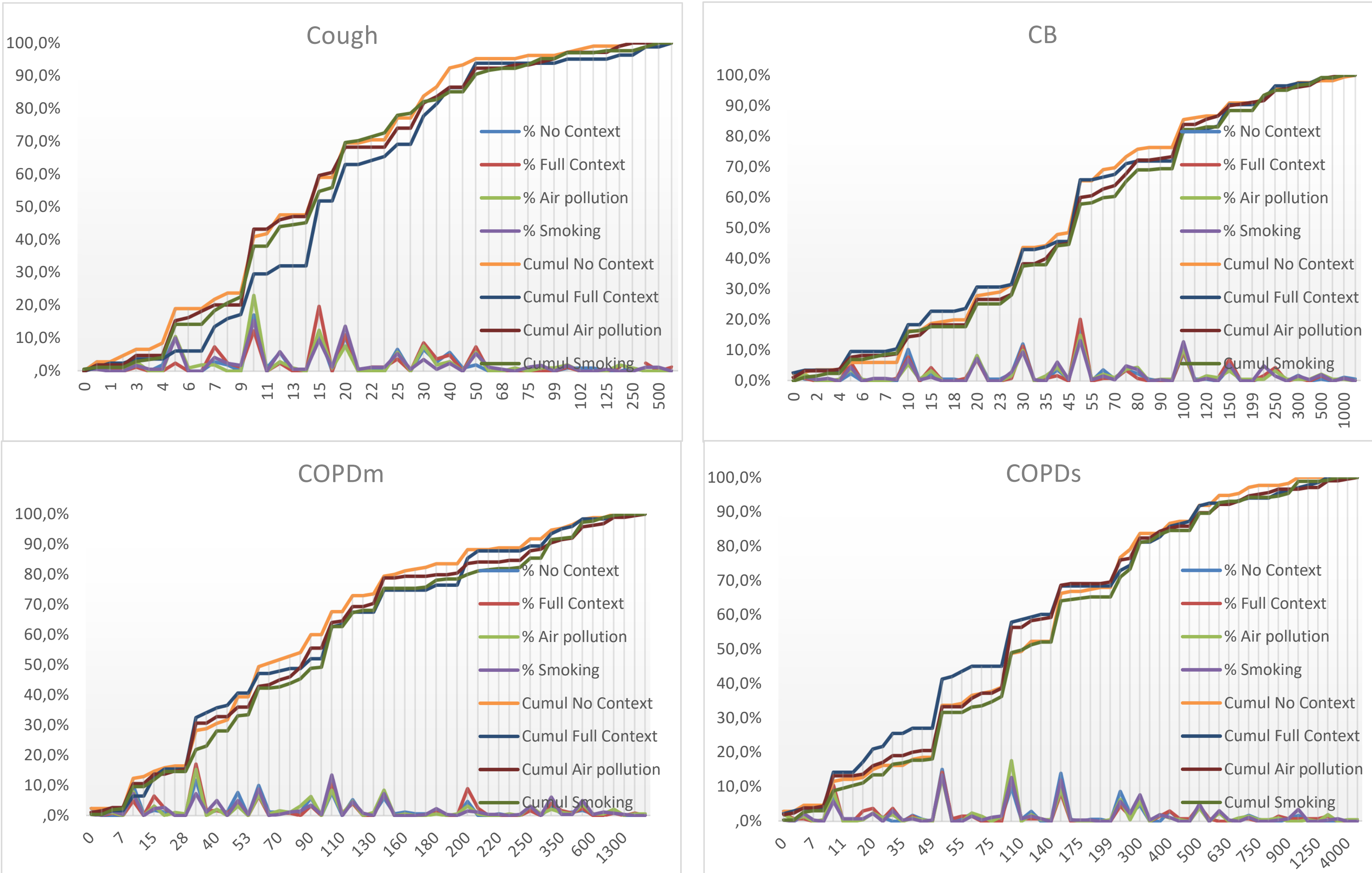


Figure 39: Proportion of each amount, depending of the variant

Kolmogorov-Smirnov tests were conducted to determine if the distributions are similar. Table 38 shows the observed differences are actually not statistically significant.

	No context – Full context	No context – Air pollution	No context – Smoking	Full context – Air pollution	Full context – Smoking	Air pollution – Smoking
Cough	.221	.969	.776	.256	.302	.995
CB	.999	.883	.356	.973	.713	.997
COPDm	.755	.742	.155	.997	.258	.370
COPDs	.534	.664	.889	.363	.163	.571

Table 38: Kolmogorov-Smirnov test to compare the distributions

In the analysis of the WTP for all variants, the influence of extreme values appeared to be very important. The 5% trimmed mean represented better the overall distribution when analyzing the WTP for each illness and all variants. The figure before shows there are also extreme values in the distribution of WTP per illness per variant (obviously), the detailed analyses of these samples will also be conducted for the entire sample and then for the 5% trimmed sample.

2.2.2 Trend indicators for WTP, per illness depending on the context

Figure 40 represents the median of the WTPs for each illness, depending on the variant i.e. depending on the information given to the respondents. As shown in

Figure 40, median WTP increased with the severity of the illnesses, and that whatever the context (i.e. the variant of the questionnaire). For all illnesses, the medians (represented by the line in the middle of each box) do not appear to be largely different. For all illnesses but cough, the median seems to be slightly lower for version 1, i.e. when both causes of the illnesses are given. Moreover, medians are all shifted to the bottom of each box: the distribution of the WTP is shifted with a large number of low values, as seen in Figure 39. The interquartile range (high of each box) is, for all illnesses but cough, less wide when full context is provided (V1) than for the others: having the entire context seems to lead less variability on the WTP, so to a more accurate WTP. WTP of cough do not follow the same scheme than others illnesses because, as it is a very mild illness, many respondents did not even want to pay to avoid it and, the one who paid, just paid very low amounts which represent a negligible part of their resources. In all cases, there are some extreme high values which be respondents who have large financial means, or who give an important value to health and are ready to pay a high amount to avoid an illness.

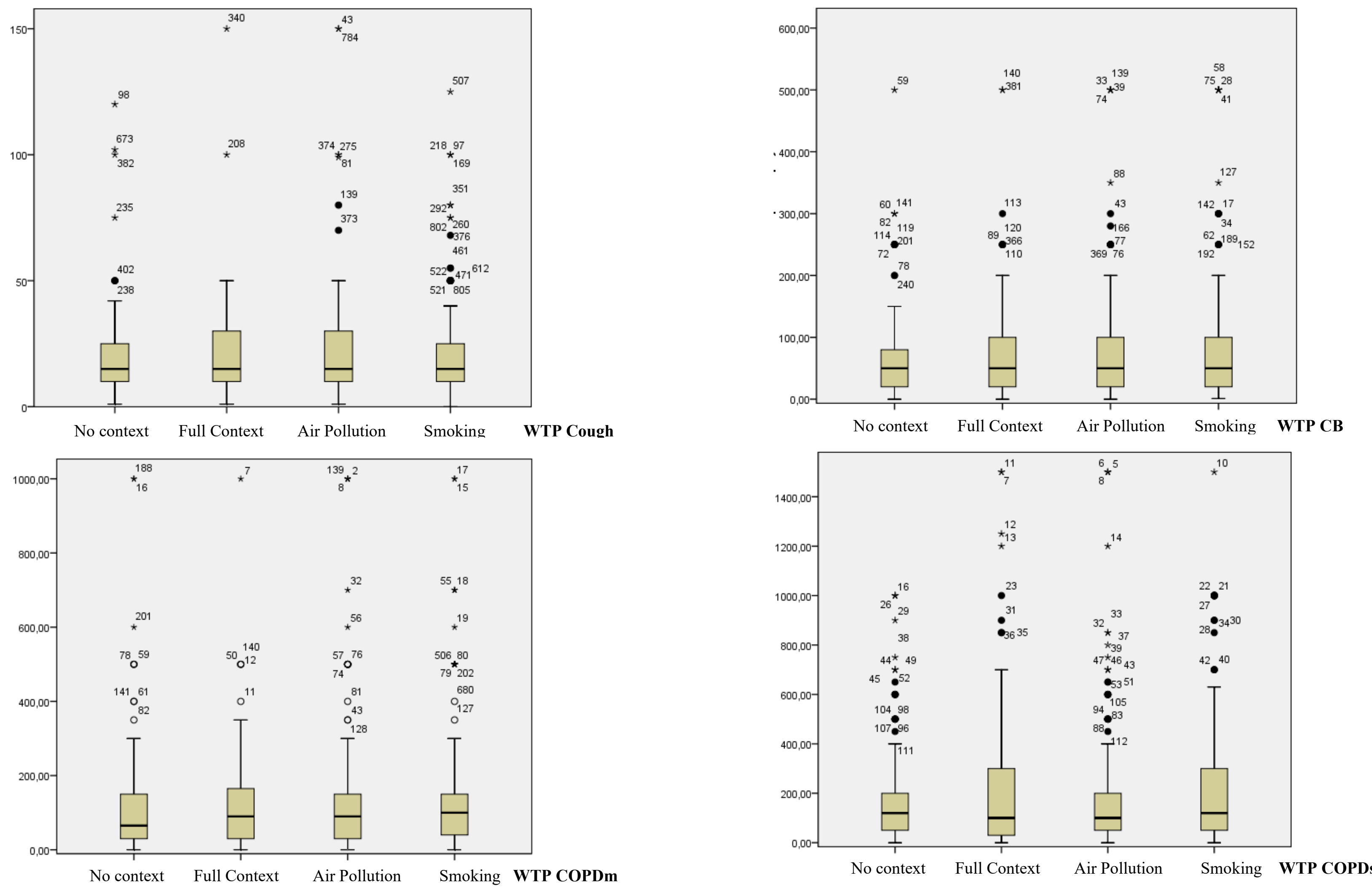


Figure 40: Median, extreme values and interquartile values of the WTP, depending on the context

Table 39 confirms that the means are slightly lower and that the confidence intervals are smaller for V1 (full context), with the same conclusions. However, the 95% confidence intervals are still very wide. The 5% trimmed means are nevertheless closer one to another between questionnaires than the standard means. The influence of extreme values is important, and separating the WTP per questionnaire increases this because extreme values are rare, so the questionnaire which “inherits” one or more extreme values is bound to see its means and the confidence interval increasing. This table does not show any clear pattern between the variants. For example, the mean WTP increases for one day of cough, COPDm and COPDs between no context variant and full context but decreases for CB. Mean WTP increases between air pollution context and smoking for one day of cough and CB but decreases for COPDm and COPDs. Moreover, here again, the 5% trimmed mean are much lower than the standard means, so extreme values have a high impact on the mean WTP. This is confirmed by the wide confidence intervals and high variance.

			WTP Cough	WTP CB	WTP CODPm	WTP COPDs
No context	Mean		22.1	82.3	113.5	186.9
	95% Confidence Interval for Mean	Lower Bound	16.3	58.8	91.9	155.1
		Upper Bound	27.9	105.8	135.1	218.7
	5% Trimmed Mean		17.5	58.3	92.6	161.4
	Median		15.0	50.0	65.0	120.0
	Variance		899.0	23400.0	20367.8	44648.0
	Std. Deviation		30.0	153.0	142.7	211.3
	Minimum		1.0	0.0	0.0	0.0
	Maximum		250.0	1200.0	1000.0	1000.0
Full context	Mean		41.6	79.6	129.7	203.5
	95% Confidence Interval for Mean	Lower Bound	15.5	56.9	97.1	154.0
		Upper Bound	67.7	102.4	162.4	252.9
	5% Trimmed Mean		22.0	61.8	103.5	159.9
	Median		15.0	50.0	90.0	100.0
	Variance		13943.7	15029.9	33430.5	83157.5
	Std. Deviation		118.1	122.6	182.8	288.4
	Minimum		1.0	0.0	0.0	0.0
	Maximum		1000.0	1000.0	1500.0	1500.0
Air pollution context	Mean		25.4	82.8	150.5	241.0
	95% Confidence Interval for Mean	Lower Bound	18.6	64.8	115.5	171.1
		Upper Bound	32.1	100.8	185.6	311.0
	5% Trimmed Mean		19.8	63.3	110.9	165.0
	Median		15.0	50.0	90.0	100.0
	Variance		1211.8	14989.1	59526.9	256662.9
	Std. Deviation		34.8	122.4	244.0	506.6
	Minimum		1.0	0.0	0.0	0.0
	Maximum		250.0	1000.0	2000.0	5000.0
Smoking context	Mean		30.6	85.3	141.9	223.1
	95% Confidence Interval for Mean	Lower Bound	20.9	69.8	120.7	187.3
		Upper Bound	40.2	100.8	163.0	258.9
	5% Trimmed Mean		20.2	66.7	118.7	181.6
	Median		15.0	50.0	100.0	120.0
	Variance		4032.1	15065.4	29890.4	85570.4
	Std. Deviation		63.5	122.7	172.9	292.5
	Minimum		0.0	1.0	0.0	0.0
	Maximum		500.0	1000.0	1300.0	2000.0

Table 39: Descriptive statistics WTP per illness depending on the context

Table 40 presents the result of the t test to compare, for each illness, the mean WTP between the different versions of the questionnaire. In grey are represented the tests that are statistically significant (p<0.1).

	No context vs Full context	No context vs Air Pollution context	No context vs Smoking context	Full context vs Air Pollution context	Full context vs Smoking context	Air Pollution vs Smoking context
Cough	0.149	0.463	0.138	0.185	0.338	0.445
CB	0.878	0.971	0.826	0.828	0.684	0.837
COPDm	0.394	0.076	0.065	0.418	0.529	0.659
COPDS	0.578	0.166	0.137	0.438	0.528	0.633

Table 40: Comparison between the WTP mean of the variants of the questionnaire for each illness
In grey: statistically significant results

Table 40 shows, for each illness, that there is few statistically significant differences between the mean from each version of the questionnaire. This result is consistent with the observations of

Figure 40 and Table 39: for all the illnesses, the mean WTPs from each variant of the questionnaire are very close to each other with large confidence intervals, so the difference between them is not significant. Moreover, there is no clear pattern of the statistically significant differences between the variants.

As previous analyses show the very high impact of extreme values on the WTP, the analysis of WTP will be conducted again without these extreme values, on a “5% trimmed sample” (cf. § 2.1.3).

2.2.3 Trend indicators for WTP per illness, per variant, 5% trimmed sample

It was previously stated that the extreme values have a high impact on the descriptive statistical indicators of the WTPs. So another analysis was conducted on the 5% trimmed sample as described in paragraph 2.1.3. First, boxplots were constructed to see the median, extreme values and 95% confidence intervals, for each illness and context, as shown in Figure 41. In comparison to

Figure 40, Figure 41 shows much tighter confidence intervals and obviously smaller extreme values. Moreover, the differences between the samples seem to be much smaller than for the overall sample.

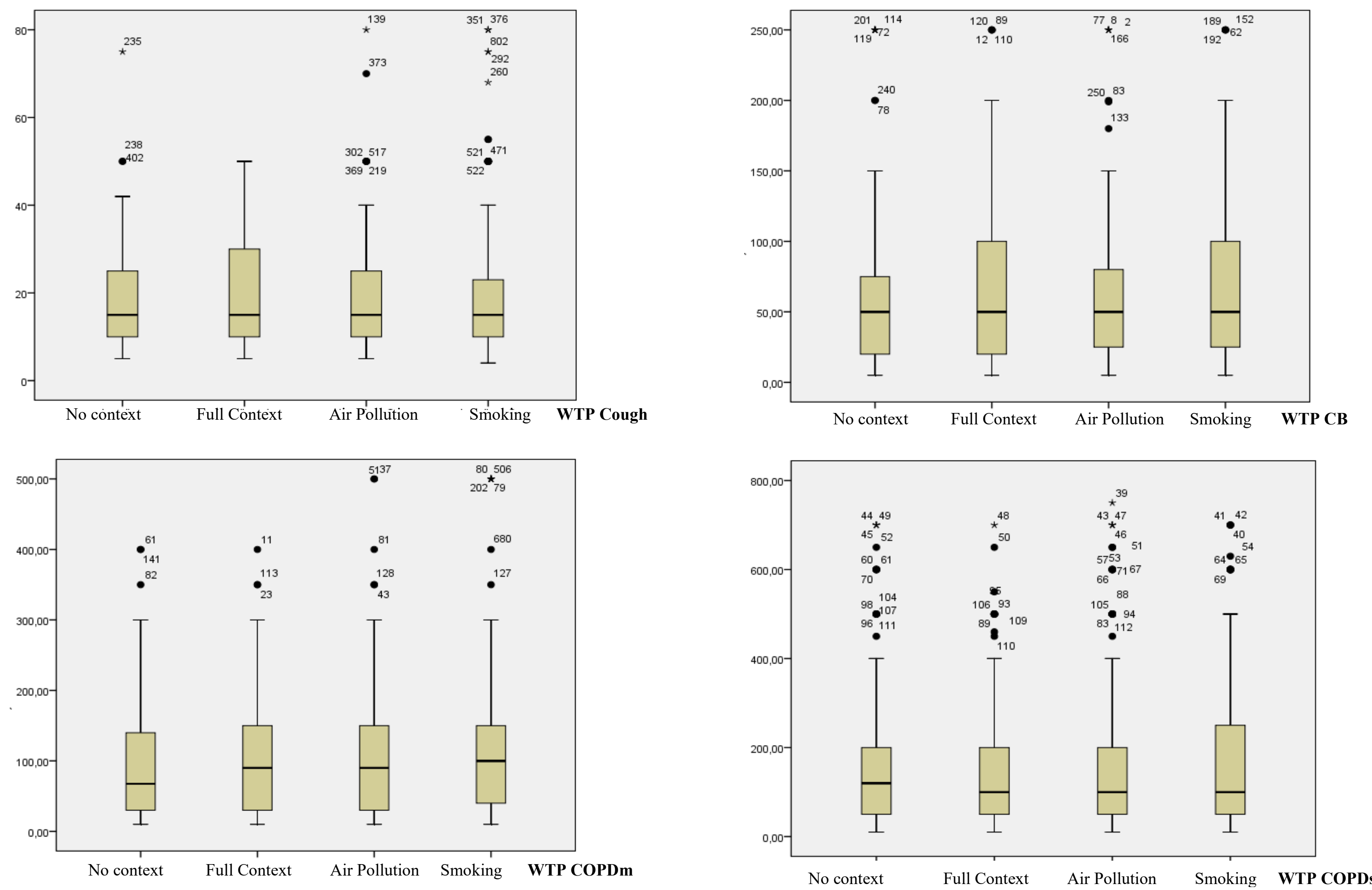


Figure 41: Median, extreme values and interquartile values of the WTP, depending on the context, 5% trimmed sample

Table 41 shows the descriptive analysis for the four illnesses, per variant, for the 5% trimmed sample. As for the overall sample, the 95% confidence intervals are smaller there than for the full sample. Moreover, the means and the 5% trimmed means are closer than for the entire sample, so this analysis is less influenced by extreme values. In first glance, no clear pattern appears between the different contexts (variants), whatever the illnesses.

			WTP Cough 5%	WTP CB 5%	WTP COPDm 5%	WTP COPDs 5%
No Context	**Mean**		18.7	59.4	97.1	172.8
	95% Confidence Interval for Mean	**Lower Bound**	16.1	50.5	84.1	146.3
		Upper Bound	21.4	68.3	110.1	199.3
	5% Trimmed Mean		17.6	52.2	88.9	155.7
	Median		15.0	50.0	67.5	120.0
	Variance		164.3	3080.1	6769.6	28610.5
	Std. Deviation		12.8	55.5	82.3	169.1
	Minimum		5.0	5.0	10.0	10.0
	Maximum		75.0	250.0	400.0	700.0
Full context	**Mean**		20.8	63.8	105.5	153.6
	95% Confidence Interval for Mean	**Lower Bound**	17.8	52.2	88.9	124.4
		Upper Bound	23.8	75.5	122.1	182.9
	5% Trimmed Mean		20.0	57.3	97.9	138.6
	Median		15.0	50.0	90.0	100.0
	Variance		164.2	3494.6	7950.0	25548.5
	Std. Deviation		12.8	59.1	89.2	159.8
	Minimum		5.0	5.0	10.0	10.0
	Maximum		50.0	250.0	400.0	700.0
Air pollution context	**Mean**		19.1	61.3	104.7	168.0
	95% Confidence Interval for Mean	**Lower Bound**	16.1	53.3	90.6	142.8
		Upper Bound	22.2	69.4	118.7	193.2
	5% Trimmed Mean		17.6	55.8	94.9	149.4
	Median		15.0	50.0	90.0	100.0
	Variance		221.9	2615.6	8258.7	29561.2
	Std. Deviation		14.9	51.1	90.9	171.9
	Minimum		5.0	5.0	10.0	10.0
	Maximum		80.0	250.0	500.0	750.0
Smoking context	**Mean**		20.1	66.5	117.8	172.7
	95% Confidence Interval for Mean	**Lower Bound**	17.5	59.0	104.1	151.5
		Upper Bound	22.8	74.0	131.5	193.9
	5% Trimmed Mean		18.1	61.4	106.4	156.4
	Median		15.0	50.0	100.0	100.0
	Variance		276.9	3171.5	11390.8	27203.9
	Std. Deviation		16.6	56.3	106.7	164.9
	Minimum		4.0	5.0	10.0	10.0
	Maximum		80.0	250.0	500.0	700.0

Table 41: Descriptive statistics WTP for the 5% trimmed sample per illness per variant

As the differences between the means and the 5% trimmed means are low, the 95% confidence intervals small, and the standard deviations quite small (in comparison to Table 39), the extreme values do not have an important effect on the statistics. As for the medians, means appear to be close, but as the confidence intervals are also small tests are conducted to see if they are statistically different.

	No context vs Full context	No context vs Air pollution context	No context vs Smoking context	Full context vs Air pollution context	Full context vs Smoking context	Air pollution context vs Smoking context
Cough	0.314	0.851	0.500	0.455	0.764	0.641
CB	0.543	0.748	0.233	0.718	0.702	0.365
COPDm	0.427	0.437	0.031	0.941	0.289	0.200
COPDS	0.341	0.795	0.993	0.470	0.304	0.779

Table 42: Comparison between the WTP mean of the versions of the questionnaire for each illness
In grey: statistically significant differences

Table 42 shows, as assumed through the observation of Figure 41 as well as of Table 41, that there is only one statistically significant differences between the contexts when extreme values are suppressed. It is worth noting that the differences reported are far from significant (p>>0.1). So providing the context does not statistically change the WTP, as the differences of means WTP between the different contexts are very low.

In the next chapter, the influence of characteristics of the respondents on the WTP will be studied.

2.3 Influence of the smoking status: differences between smokers, non-smokers and former smokers

2.3.1 WTP distribution, depending on the smoking status of the respondent

The differences between the variants of the questionnaire are based on the context:

1. No context for baseline;
2. Smoking and air pollution (including its causes) as causes of the illness for variant 1;
3. Air pollution (including its causes) as causes for variant 2;
4. Smoking as cause or variant 3.

When mentioned, smoking is highlighted to be the main cause of the illnesses. So this chapter will analysis how the smoking status of respondents influences their WTP. Respondents were asked if they were smokers, non-smokers or former smokers. Figure 42 shows the distribution of the WTP depending on the smoking status of the respondent.

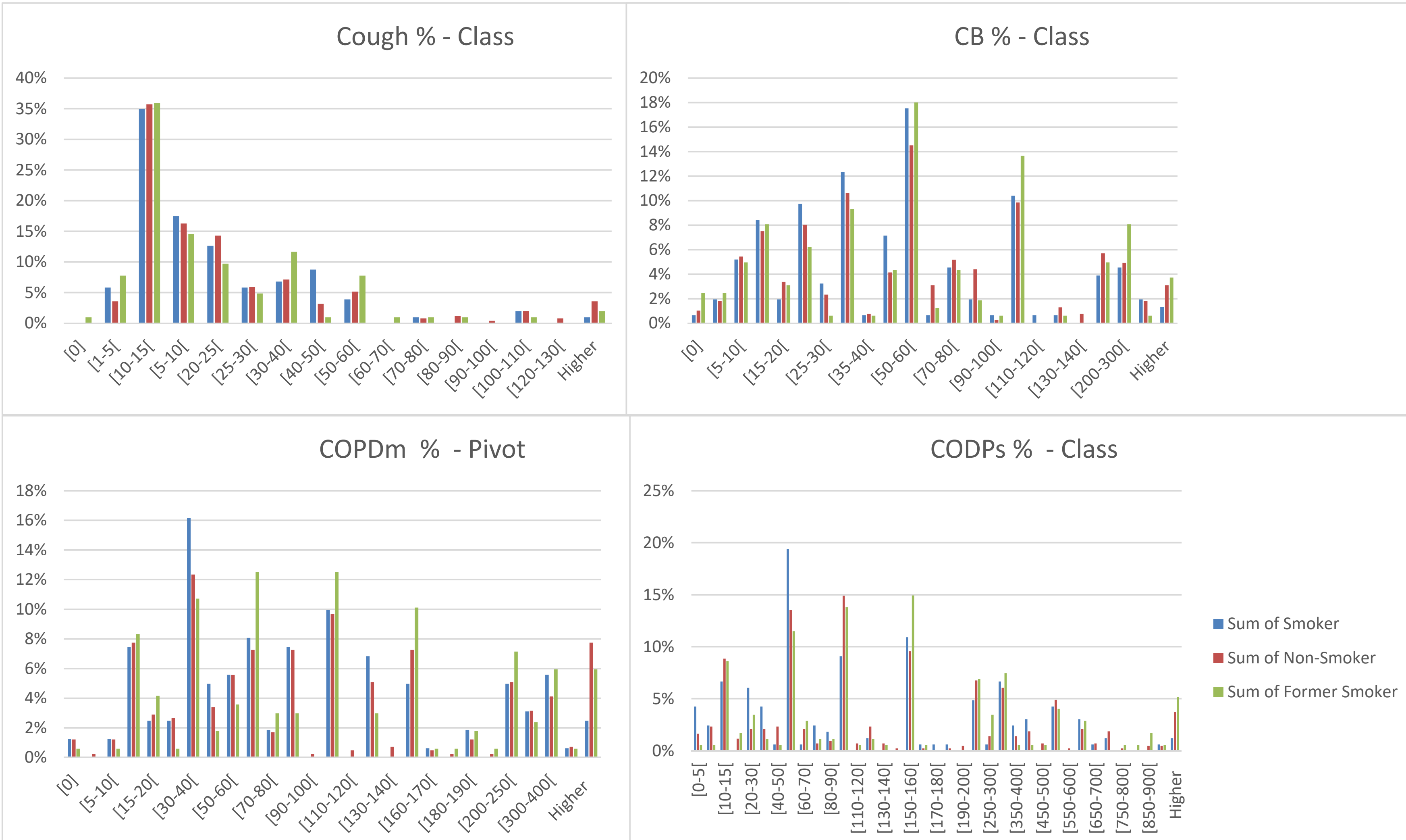


Figure 42: WTP distribution depending on the status of the respondents, for the four illnesses, in frequencies

Figure 42 shows differences in the repartition of the WTP for each illness, depending on the smoking status of the respondent (smoker, non-smoker, former smoker). Table 43 presents the result of Kolmogorov-Smirnov tests: the observed differences are actually not statistically significant, except between smokers and fore smokers for COPDs.

	Smoker – Non-smoker	Smoker – Former smoker	Non-smoker – Former smoker
Cough	.947	.995	.957
CB	.303	.538	.971
COPDm	.576	.228	.615
COPDs	.129	.035	.539

Table 43: Kolmogorov-Smirnov test to compare the distributions

Further analysis on the means and the medians will be conducted to determine if the smoking status really influences the WTP.

2.3.2 Trend indicators for WTP, per illness depending on the smoking status of the respondent

Table 44 shows the mean and median for each sample, depending on the smoking status of the respondents.

smoker / non-smoker / former smoker			WTP Cough	WTP CB	WTP COPDm	WTP COPDs
smoker	Mean		22.67	66.6	106.3	192.5
	95% Confidence Interval for Mean	Lower Bound	16.3	53.8	88.9	127.7
		Upper Bound	29.1	79.5	123.6	257.3
	5% Trimmed Mean		18.3	54.9	92.7	144.5
	Median		15.0	42.5	70.0	100.0
	Variance		1065.2	6516.5	12470.3	177577.5
	Std. Deviation		32.6	80.7	111.7	421.4
	Minimum		1.0	.0	.0	.0
	Maximum		300.0	500.0	700.0	5000.0
Non-smoker	Mean		33.5	85.8	142.6	217.8
	95% Confidence Interval for Mean	Lower Bound	23.5	72.2	123.2	186.7
		Upper Bound	43.5	99.4	162.0	248.9
	5% Trimmed Mean		21.1	64.6	112.6	171.2
	Median		15.0	50.0	90.0	100.0
	Variance		6498.5	18437.9	40194.6	107403.3
	Std. Deviation		80.6	135.8	200.5	327.7
	Minimum		1.0	.0	.0	.0
	Maximum		1000.0	1200.0	1500.0	4000.0
Former smoker	Mean		26.1	92.1	146.3	235.5
	95% Confidence Interval for Mean	Lower Bound	15.9	68.5	113.2	187.4
		Upper Bound	36.3	115.8	179.3	283.6
	5% Trimmed Mean		19.0	67.4	113.8	189.7
	Median		15.0	50.0	100.0	150.0
	Variance		2716.1	23120.0	47064.3	103172.6
	Std. Deviation		52.1	152.1	216.9	321.2
	Minimum		.0	.0	.0	1.0
	Maximum		500.0	1000.0	2000.0	2000.0

Table 44: Mean, median and descriptive for the four illnesses, depending on the smoking status of the respondent

Table 44 shows that, again, the WTP increases with the gravity of the illness for all smoking status. Moreover (except for cough), smokers pay less than non-smokers, who pay less than former smokers:

WTP smokers < WTP non-smokers < WTP former smokers

As observed for the probability of paying, it seems that smokers implicitly accept the risks associated with their smoking habit and consequently are willing to pay less to mitigate its consequences. On contrary, former smokers may have stop to precisely avoid health consequences, or may even already suffer from some health consequences: they are so willing to pay more to avoid the illnesses. Non-smokers exhibit an in-between behaviors.

The impact of extreme values is also important as the 5% trimmed mean is quite lower than the standard mean, and the confidence interval is quite wide. However, the WTP seem to be different depending on the smoking status of the respondents. To see if these differences are significant, T-test were conducted, and the corresponding p-values are shown in Table 45 with in grey statistically significant results.

	Smoker vs. non-smoker	Smoker vs. former smokers	Non-smokers vs former smokers
Cough	**0.073**	**0.574**	**0.389**
CB	**0.044**	**0.063**	**0.631**
COPDm	**0.006**	**0.035**	**0.847**
COPDS	**0.488**	**0.290**	**0.545**

Table 45: Comparison between the WTP mean depending on the respondents' smoking status for each illness
In grey: statistically significant differences

The results show a difference between smokers and non-smokers and, to a lesser extent, between smokers and former smokers; whereas no differences appear between former smokers and non-smokers. However, these differences do not appear for the worst illness COPDs. It may be because this illness is so bad that its seriousness goes beyond any other characteristics.

2.3.3 Trend indicators for WTP per illness, per smoking status of the respondent, 5% trimmed sample

The same tests performed on the 5% trimmed sample does not show the same differences, as underlined by Table 46.

	Smoker vs. non-smoker	Smoker vs. former smokers	Non-smokers vs former smokers
Cough	0.949	0.437	0.340
CB	0.549	0.096	0.146
COPDm	0.939	0.355	0.298
COPDS	0.757	0.786	0.521

Table 46: Comparison between the WTP mean 5% trimmed sample depending on the respondents' smoking status for each illness
In grey: statistically significant differences

The extreme values have hence a very high influence that determines most of the observed differences between the WTP according to the smoking status. However, we observed for all illnesses the same order as before:

WTP smokers < WTP non-smokers < WTP former smokers.

The analysis of the 5% trimmed sample WTP according to illness and respondent's smoking status is presented in Table 47.

smoker / non-smoker / former smoker			WTP Cough 5%	WTP CB 5%	WTP COPDm 5%	WTP COPDs 5%
Smoker	Mean		19.4	58.7	105.0	166.6
	95% Confidence Interval for Mean	Lower Bound	16.7	49.9	89.4	139.0
		Upper Bound	22.1	67.6	120.6	194.1
	5% Trimmed Mean		18.2	52.2	95.0	149.3
	Median		15.0	45.0	80.0	100.0
	Variance		174.6	2797.4	9384.6	29004.2
	Std. Deviation		13.2	52.9	96.9	170.3
	Minimum		5.0	5.0	10.0	10.0
	Maximum		70.0	250.0	500.0	700.0
Non-smoker	Mean		19.3	61.9	105.7	171.7
	95% Confidence Interval for Mean	Lower Bound	17.3	56.3	96.0	154.5
		Upper Bound	21.2	67.6	115.4	188.8
	5% Trimmed Mean		17.6	56.1	95.7	154.0
	Median		15.0	50.0	90.0	100.0
	Variance		219.3	2886.3	8879.1	29376.1
	Std. Deviation		14.8	53.7	94.2	171.4
	Minimum		4.0	5.0	10.0	10.0
	Maximum		80.0	250.0	500.0	700.0
Former smoker	Mean		21.1	70.0	115.2	161.5
	95% Confidence Interval for Mean	Lower Bound	17.7	60.0	100.0	137.6
		Upper Bound	24.5	80.1	130.4	185.5
	5% Trimmed Mean		19.5	64.4	107.1	145.8
	Median		15.0	50.0	100.0	105.0
	Variance		263.7	3693.2	8923.3	22967.6
	Std. Deviation		16.2	60.8	94.5	151.6
	Minimum		5.0	5.0	10.0	10.0
	Maximum		80.0	250.0	500.0	750.0

Table 47: Mean, median and descriptive for the four illnesses, depending on the smoking status of the respondent, 5% trimmed sample

The previous analysis highlights that the WTP are statistically different between the illnesses, with the higher WTP for the more serious illnesses. This is consistent with the fact that the more serious illnesses have an higher impact on daily life (even leading to death), and with the common though that treatment for serious illnesses are certainly expensive.

It appears that providing the context does not statistically change the WTP.

Smokers, former smokers and non-smokers seem to have different behaviors, for all illnesses: WTP smokers < WTP non-smokers < WTP former smokers These differences are however not always significant.

E. Analysis of the WTP: Econometric modelling

Previous analyses study the influence of illness, context and smoking status on the probability of paying (and the reasons for not paying) and the WTP valued in an unconditional way, i.e. taken one by one, with the following results:

- ✓ The more serious the illness is, the more the respondents agree to pay for the treatment and the higher their WTP are.
- ✓ Giving a realistic context increases the acceptability of the questionnaire, with the following ranking: Full context >air pollution only > smoking only > no context. However, it does not seem to influence the WTP value.
- ✓ Smokers are more bound to accept to pay for the treatments. On the other hand, former smokers have more bound not to pay to protest against the scenario developed in this study (i.e. paying for their own treatment). It influences their WTP value too, for all illnesses: WTP smokers < WTP non-smokers < WTP former smokers. These differences are however not always significant.

In this chapter, these influences will be analyzed in a conditional way, meaning taking into account the different interactions. First, the fact the respondents agree to buy the medicament, and why they do not want to, will be studied. Then, the WTP value and the parameters which influence it will be studied for all respondents who agree to pay. Lastly, WTP value will be studied taking into account the fact that the respondents pay or not.

1. Do respondents pay?

When answering the questionnaire, respondents are first asked if they agree to pay or not for the treatment. The unconditional statistics (cf. § III D 1) determined that context (i.e. the variant of the questionnaire) and smoking status influence the fact that respondents do agree to pay or not, and their acceptability of the questionnaire (more legit 0).

In this part, a probit model will be applied to figure out which aspects may lead respondents to agree to pay, and to protest.

1.1 Decision to pay or not

This first part addresses the decision to pay or not, as the respondents have to choose before stating their WTP (if they agree to do so). The probit model was first constructed with all the variables which could explain the respondents' behavior to test if they are significant, Then a scarce model was built with only the significant ones and some considered as mandatory (questionnaire variant for context, smoking status, income).

For COPDs, Table 48 highlights the significant variables: physical activity of the respondent, diet, their opinion regarding the fact they can avoid the illness, sex, profession and if the profession is at risk.

		Estimation	Standard Error	Wald	Sig.
	Constant	9.630	11.486	.703	.402
Parameters	**Birth year**	.005	.006	.645	.422
	Household size	-.009	.043	.039	.843
	Household Income	1.823E-5	2.564E-5	.505	.477
	Context = no context	-.153	.182	.706	.401
	Context = full context	-.029	.149	.039	.844
	Context =Air pollution	.254	.177	2.057	.152
	Context =smoking	0[a]	.	.	.
	Health = Well above average	.075	.402	.035	.852
	Health = Above average	-.266	.371	.513	.474
	Health = Average	-.115	.358	.104	.748
	Health = Below average	.025	.375	.004	.947
	Health = Well below average	0[a]	.	.	.
	Hospital last year = yes	.116	.362	.103	.748
	Hospital last year = no	0[a]	.	.	.
	Sport = Every day	-.156	.217	.519	.471
	Sport = Several times a week	.121	.166	.532	.466
	Sport = Several times a month	.455	.175	6.760	.009
	Sport = Only rarely	.140	.155	.815	.367
	Sport = Never	0[a]	.	.	.
	Dwelling = Heavily air polluted	.001	.224	.000	.998
	Dwelling = Somewhat air polluted	-.111	.159	.490	.484
	Dwelling = Slightly air polluted	-.109	.137	.626	.429
	Dwelling = Not air polluted	0[a]	.	.	.
	Diet = Better than average	.527	.213	6.116	.013
	Diet = About average	.423	.185	5.229	.022
	Diet = Below average	0[a]	.	.	.
	Smoker	-.159	.148	1.146	.284
	Non -Smoker	-.127	.125	1.039	.308
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	4.789	.000	.	.
	Think illness avoidable = Yes	.434	.106	16.663	.000
	Think illness avoidable = No	0[a]	.	.	.
	Risky leisure = Yes	.561	.360	2.420	.120
	Risky leisure = No	0[a]	.	.	.
	Risky occupation = Yes	.004	.131	.001	.975
	Risky occupation = No	0[a]	.	.	.
	Sex = Male	-.264	.108	6.017	.014
	Sex = Female	0[a]	.	.	.
	Marital status = single	.278	.355	.615	.433
	Marital status = Married	.319	.341	.877	.349
	Marital status = Divorced	.075	.360	.043	.835
	Marital status = Widower	0[a]	.	.	.
	Education = Brevet des Collèges	-.120	.196	.378	.539
	Education = A-level	-.110	.197	.313	.576
	Education = A-level+2	-.006	.207	.001	.977
	Education = Bachelor	-.194	.236	.677	.411
	Education = Master +	0[a]	.	.	.
	Main occupation = no answer	5.775	7696.990	.000	.999
	Main occupation = Liberal	.341	.363	.883	.347
	Main occupation = Fulltime employee	.495	.242	4.171	.041
	Main occupation = Parttime employee	.396	.278	2.027	.154
	Main occupation = Student	.725	.330	4.826	.028
	Main occupation = Housewife/husband	.970	.401	5.848	.016
	Main occupation = Retired	-.017	.269	.004	.950
	Main occupation = None	.253	.274	.851	.356

	Main occupation = Medical/disability leave	-.158	.430	.136	.713
	Main occupation = Other	0[a]	.	.	.
	Occupation related health = Yes	.325	.170	3.631	.057
	Occupation related health = No	0[a]	.	.	.
	Donation charity last year = Yes	.139	.129	1.151	.283
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	.054	.138	.152	.696
	Health insurance = No	0[a]	.	.	.

Table 48: COPDs – Pay or not – Probit full model

Pseudo R^2(McFadden) = 0.110, N = 984, In grey: Statistically significant parameters

Table 49 presents the results of the scarce model, gathering the previously significant variables and mandatory ones (questionnaire variant for context, smoking status, income). The same variables as before are significant. Pseudo R^2 is low, but it is not unusual for this kind of models: McFadden=0.095. Many of the parameters are not significant. However, respondents having air pollution as context, trying to be healthy (by doing sport and eating well), thinking the illness is avoidable, and having a job related to health increase the probability to pay whereas begin a male decreases it.

		Estimation	Std Error	Wald	Sig.
	Constant	.228	.326	.489	.484
Parameters	Household Income	3.151E-5	2.342E-5	1.810	.178
	Context = no context	-.088	.130	.456	.500
	Context = full context	-.048	.137	.123	.726
	Context =Air pollution	.321	.133	5.835	.016
	Context =smoking	0[a]	.	.	.
	Sport = Every day	-.138	.208	.438	.508
	Sport = Several times a week	.119	.159	.557	.455
	Sport = Several times a month	.440	.171	6.666	.010
	Sport = Only rarely	.120	.150	.643	.423
	Sport = Never	0[a]	.	.	.
	Diet = Better than average	.496	.206	5.807	.016
	Diet = About average	.392	.179	4.801	.028
	Diet = Below average	0[a]	.	.	.
	Smoker	-.140	.144	.949	.330
	Non -Smoker	-.119	.121	.961	.327
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	4.681	.000	.	.
	Think illness avoidable = Yes	.399	.103	15.070	.000
	Think illness avoidable = No	0[a]	.	.	.
	Sex = Male	-.252	.101	6.243	.012
	Sex = Female	0[a]	.	.	.
	Main occupation = no answer	5.744	7582.739	.000	.999
	Main occupation = Liberal	.291	.354	.674	.412
	Main occupation = Fulltime employee	.411	.237	3.011	.083
	Main occupation = Part-time employee	.309	.273	1.277	.258
	Main occupation = Student	.740	.300	6.079	.014
	Main occupation = Housewife/husband	.894	.390	5.250	.022
	Main occupation = Retired	-.187	.246	.577	.447
	Main occupation = None	.169	.268	.397	.529
	Main occupation = Medical/disability leave	-.168	.410	.167	.683
	Main occupation = Other	0[a]	.	.	.
	Occupation related health = Yes	.312	.165	3.592	.058
	Occupation related health = No	0[a]	.	.	.

Table 49: COPDs – Pay or not – Probit scarce model

Pseudo R^2(McFadden) = 0.095, N = 984, In grey: Statistically significant parameters

For COPDm, the full model (cf. Table 83, Appendix 9) indicates the following significant variables: physical activity of the respondent, their opinion they may avoid the illness, activities at risk, sex, profession, and if the respondent has a private health insurance and if he donates to charitable society.

Table 50 shows the results for the scarce model. The Pseudo R² is low: McFadden=0.084. As for COPDm, practicing sport and thinking the illness is avoidable increase the probability to pay and being a male decreases it. Having a risky leisure and having a health insurance also increase it.

		Estimation	Standard error	Wald	Sig.
	Constant	.352	.291	1.460	.227
Parameters	**Household Income**	2.724E-5	2.302E-5	1.401	.237
	Context = no context	-.101	.171	.344	.558
	Context = full context	-.204	.134	2.328	.127
	Context =Air pollution	.050	.168	.090	.765
	Context =smoking	0[a]	.	.	.
	Sport = Every day	-.122	.205	.352	.553
	Sport = Several times a week	.160	.156	1.052	.305
	Sport = Several times a month	.362	.164	4.842	.028
	Sport = Only rarely	.152	.147	1.063	.302
	Sport = Never	0[a]	.	.	.
	Smoker	-.098	.140	.490	.484
	Non -Smoker	-.097	.118	.679	.410
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	5.033	.000	.	.
	Think illness avoidable = Yes	.486	.099	23.856	.000
	Think illness avoidable = No	0[a]	.	.	.
	Risky leisure = Yes	.632	.339	3.480	.062
	Risky leisure = No	0[a]	.	.	.
	Sex = Male	-.203	.098	4.312	.038
	Sex = Female	0[a]	.	.	.
	Main occupation = no answer	5.755	7409.468	.000	.999
	Main occupation = Liberal	.598	.359	2.783	.095
	Main occupation = Fulltime employee	.462	.228	4.099	.043
	Main occupation = Part-time employee	.387	.263	2.167	.141
	Main occupation = Student	.600	.275	4.762	.029
	Main occupation = Housewife/husband	.836	.362	5.324	.021
	Main occupation = Retired	-.058	.240	.058	.810
	Main occupation = None	.407	.261	2.433	.119
	Main occupation = Medical/disability leave	.418	.426	.962	.327
	Main occupation = Other	0[a]	.	.	.
	Donation charity last year = Yes	.269	.124	4.672	.031
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	.265	.129	4.214	.040
	Health insurance = No	0[a]	.	.	.

Table 50: COPDm – Pay or not – Probit scarce model

Pseudo R²(McFadden) = 0.084, N = 984, In grey: Statistically significant parameters

For CB, the full model (cf. Table 84, Appendix 9) highlights the following significant variables: diet, their opinion they may avoid the illness, sex, profession, and if the respondent has a private health insurance and if he donates to charitable society.

Table 51 shows the results for the scarce model. The Pseudo R² is low: McFadden=0.087. As for the two previous illnesses, thinking the illness is avoidable, having an health insurance, and trying to be healthy (good diet) increase the probability to pay, being a male decreases it.

		Estimation	Standard Error	Wald	Sig.
	Constant	.653	.314	4.337	.037
Parameters	**Household Income**	2.301E-5	2.151E-5	1.145	.285
	Context = no context	.082	.164	.253	.615
	Context = full context	-.168	.128	1.724	.189
	Context =Air pollution	.138	.160	.741	.389
	Context =smoking	0[a]	.	.	.
	Diet = Better than average	.327	.195	2.814	.093
	Diet = About average	.227	.172	1.739	.187
	Diet = Below average	0[a]	.	.	.
	Smoker	-.045	.134	.113	.736
	Non -Smoker	-.134	.112	1.421	.233
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	5.299	.000	.	.
	Think illness avoidable = Yes	.342	.096	12.763	.000
	Think illness avoidable = No	0[a]	.	.	.
	Sex = Male	-.211	.093	5.127	.024
	Sex = Female	0[a]	.	.	.
	Main occupation = no answer	-.061	.927	.004	.947
	Main occupation = Liberal	.927	.351	6.984	.008
	Main occupation = Fulltime employee	.678	.219	9.589	.002
	Main occupation = Parttime employee	.502	.250	4.023	.045
	Main occupation = Student	.656	.258	6.444	.011
	Main occupation = Housewife/husband	.708	.324	4.764	.029
	Main occupation = Retired	.307	.231	1.761	.184
	Main occupation = None	.418	.249	2.817	.093
	Main occupation = Medical/disability leave	.458	.401	1.307	.253
	Main occupation = Other	0[a]	.	.	.
	Donation charity last year = Yes	.206	.117	3.103	.078
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	.269	.123	4.752	.029
	Health insurance = No	0[a]	.	.	.

Table 51: CB – Pay or not – Probit scarce model
Pseudo R²(McFadden) = 0.087, N = 984, In grey: Statistically significant parameters

For One day of cough, the significant variables are (cf. Table 85, Appendix 9): age, number of persons in the household, health state, diet, their opinion they may avoid the illness, activities at risk, profession, and if the respondent has a private health insurance and if he donates to charitable society.

Table 52 shows the results of the scarce model. The Pseudo R² is low: McFadden=0.047. As for the previous illnesses, thinking the illness is avoidable, having an health insurance, and trying to be healthy (good diet) increase the probability to pay, being a male decreases it.

		Estimation	Standard Error	Wald	Sig.
	Constant	-24.183	9.151	6.983	.008
Parameters	**Birth year**	-.013	.005	7.369	.007
	Household size	.096	.033	8.305	.004
	Household Income	-1.908E-5	2.001E-5	.909	.340
	Context = no context	.095	.154	.379	.538
	Context = full context	-.016	.122	.017	.897
	Context =Air pollution	-.049	.148	.107	.743
	Context =smoking	0[a]	.	.	.
	Health = Well above average	-.830	.363	5.241	.022
	Health = Above average	-.741	.341	4.735	.030
	Health = Average	-.644	.330	3.807	.051
	Health = Below average	-.736	.346	4.508	.034
	Health = Well below average	0[a]	.	.	.
	Diet = Better than average	.384	.198	3.761	.052
	Diet = About average	.323	.179	3.270	.071
	Diet = Below average	0[a]	.	.	.
	Smoker	.107	.126	.724	.395
	Non -Smoker	.035	.106	.110	.740
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	6.030	.000	.	.
	Think illness avoidable = Yes	.163	.094	3.012	.083
	Think illness avoidable = No	0[a]	.	.	.
	Risky leisure = Yes	.409	.250	2.690	.101
	Risky leisure = No	0[a]	.	.	.
	Main occupation = no answer	-6.226	.000	.	.
	Main occupation = Liberal	.250	.322	.600	.438
	Main occupation = Fulltime employee	.382	.223	2.940	.086
	Main occupation = Parttime employee	.246	.249	.976	.323
	Main occupation = Student	.199	.277	.514	.473
	Main occupation = Housewife/husband	.600	.311	3.732	.053
	Main occupation = Retired	.166	.247	.449	.503
	Main occupation = None	.189	.254	.555	.456
	Main occupation = Medical/disability leave	.075	.402	.035	.851
	Main occupation = Other	0[a]	.	.	.
	Donation charity last year = Yes	.193	.110	3.073	.080
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	.269	.117	5.318	.021
	Health insurance = No	0[a]	.	.	.

Table 52: Cough – Pay or not – Probit scarce model
Pseudo R²(McFadden) = 0.047, N = 984, In grey: Statistically significant parameters

Table 53 compares the results of the scarce probit model for the four illnesses. To sum up, trying to be healthy (with diet and sport), having an health insurance, donating to charities, and thinking the illnesses are avoidable increase the probability to pay. It seems that overall, being "healthy and socially conscious" seems to increase it. Overall male are less ready to pay than women, and respondents who have an income are more ready to pay (which is logic).

COPDs - Pay			COPDm - Pay			CB - Pay			Cough-Pay		
	Estimation	Sig.		Estimation	Sig.		Estimation	Sig.		Estimation	Sig.
Constant	.228	.484	Constant	.352	.227	Constant	.653	.037	Constant	-24.183	.008
									Birth year	-.013	.007
									Household size < 15 years old	.096	.004
Household Income	3.15E-02	.178	Household Income	2.72E-02	.237	Household Income	2.30E-02	.285	Household Income	-1.91E-02	.340
No Context	-.088	.500	No Context	-.101	.558	No Context	.082	.615	No Context	.095	.538
Full Context	-.048	.726	Full Context	-.204	.127	Full Context	-.168	.189	Full Context	-.016	.897
Air Pollution Context	.321	.016	Air Pollution Context	.050	.765	Air Pollution Context	.138	.389	Air Pollution Context	-.049	.743
Smoking Context	0[a]	.	Smoking Context	0[a]	.	Smoking Context	0[a]	.	Smoking Context	0[a]	.
Sport Every day	-.138	.508	Sport Every day	-.122	.553				Health Well above	-.830	.022
Sport several time week	.119	.455	Sport several time week	.160	.305				Health above	-.741	.030
Sport several time month	.440	.010	Sport several time month	.362	.028				Health average	-.644	.051
Sport rarely	.120	.423	Sport rarely	.152	.302				Health below	-.736	.034
Sport never	0[a]	.	Sport never	0[a]	.				Health well below	0[a]	.
Diet better	.496	.016				Diet better	.327	.093	Diet better	.384	.052
Diet average	.392	.028				Diet average	.227	.187	Diet average	.323	.071
Diet below	0[a]	.				Diet below	0[a]	.	Diet below	0[a]	.
Smoker	-.140	.330	Smoker	-.098	.484	Smoker	-.045	.736	Smoker	.107	.395
Non Smoker	-.119	.327	Non Smoker	-.097	.410	Non Smoker	-.134	.233	Non Smoker	.035	.740
Former smoker	0[a]	.	Former smoker	0[a]	.	Former smoker	0[a]	.	Former smoker	0[a]	.
Can avoid illness no answer	4.681	.	Can avoid illness no answer	5.033	.	Can avoid illness no answer	5.299	.	Can avoid illness no answer	6.030	.
Can avoid illness yes	.399	.000	Can avoid illness yes	.486	.000	Can avoid illness yes	.342	.000	Can avoid illness yes	.163	.083
Can avoid illness no	0[a]	.	Can avoid illness no	0[a]	.	Can avoid illness no	0[a]	.	Can avoid illness no	0[a]	.
			Activities at risk yes	.632	.062				Activities at risk yes	.409	.101

			Activities at risk no	0a	.				Activities at risk no	0a	.
Sex male	-.252	.012	Sex male	-.203	.038	Sex male	-.211	.024			
Sex female	0a	.	Sex female	0a	.	Sex female	0a	.			
Profession no answer	5.744	.999	Profession no answer	5.755	.999	Profession no answer	-.061	.947	Profession no answer	-6.226	.
Profession liberal	.291	.412	Profession liberal	.598	.095	Profession liberal	.927	.008	Profession liberal	.250	.438
Profession full time employee	.411	.083	Profession full time employee	.462	.043	Profession full time employee	.678	.002	Profession full time employee	.382	.086
Profession part time employee	.309	.258	Profession part time employee	.387	.141	Profession part time employee	.502	.045	Profession part time employee	.246	.323
Profession student	.740	.014	Profession student	.600	.029	Profession student	.656	.011	Profession student	.199	.473
Profession housewife	.894	.022	Profession housewife	.836	.021	Profession housewife	.708	.029	Profession housewife	.600	.053
Profession retired	-.187	.447	Profession retired	-.058	.810	Profession retired	.307	.184	Profession retired	.166	.503
Profession none	.169	.529	Profession none	.407	.119	Profession none	.418	.093	Profession none	.189	.456
Profession sick leave	-.168	.683	Profession sick leave	.418	.327	Profession sick leave	.458	.253	Profession sick leave	.075	.851
Profession other	0a	.	Profession other	0a	.	Profession other	0a	.	Profession other	0a	.
Profession Risk yes	.312	.058	charitable society yes	.269	.031	charitable society yes	.206	.078	charitable society yes	.193	.080
Profession Risk no	0a	.	charitable society no	0a	.	charitable society no	0a	.	charitable society no	0a	.
			private health insurance yes	.265	.040	private health insurance yes	.269	.029	private health insurance yes	.269	.021
			private health insurance no	0a	.	private health insurance no	0a	.	private health insurance no	0a	.

Table 53: Comparison of the significant variables for the four illnesses for the probit model

In grey: Statistically significant parameters

To conclude, context and smoking status have only low influence on the decision to pay or not: context is only significant once, smoking status never. This is consistent with the results of the unconditional statistics. Nevertheless, common significant factors can be found:

- that increase the probability of paying: having an income, a good diet, their opinion they may avoid the illness, and if the respondent has a private health insurance and donations to charitable society.

- that decrease the probability of paying: being a man.

It looks like that being "healthy and socially conscious" increases the probability to pay, even if it appears a bit counter-intuitive: respondents who are more careful and think they can avoid the illness, are more willing to pay.

The overall quality of the models is low as shown by the Pseudo R^2 (McFadden), which is common with this type of model.

1.2 Reason for deciding not to pay: legit vs protest

The unconditional statistics have shown some differences between protest and legit 0. This part aims to determine which characteristics of the respondents differentiate protesters from the ones who accept the scenario even if they do not pay. A first probit model including many possible explanatory variables will be run. Then, a second one with the most significant variables and the ones of interest (smoking status, variant of the questionnaire – context –, household income) will be designed. Both models were run only on the respondents who did not want to pay.

First, the analysis for COPDs has been conducted. Table 54 shows the results of the full probit model that tests all the variables which may influence the fact that respondents protest. Table 55 presents then the models keeping only the significant variables from the first full model and the mandatory variables (variant of the questionnaire, smoking status, income).

		Estimation	Sig.
	Constant	-68.650	.018
Parameters	**Birth year**	-.035	.018
	Household size	.142	.175
	Household Income	-9.669E-5	.114
	Context = no context	-.393	.352
	Context = full context	.542	.080
	Context =Air pollution	-.106	.779
	Context =smoking	0[a]	.
	Health = Well above average	-.653	.463
	Health = Above average	-.890	.262
	Health = Average	-.558	.470
	Health = Below average	-1.040	.192
	Health = Well below average	0[a]	.
	Hospital last year = yes	-1.138	.216
	Hospital last year = no	0[a]	.

	Sport = Every day	.478	.287
	Sport = Several times a week	-.045	.896
	Sport = Several times a month	-.344	.381
	Sport = Only rarely	-.303	.336
	Sport = Never	0[a]	.
	Dwelling = Heavily air polluted	-.171	.723
	Dwelling = Somewhat air polluted	.134	.701
	Dwelling = Slightly air polluted	.141	.645
	Dwelling = Not air polluted	0[a]	.
	Diet = Better than average	.236	.590
	Diet = About average	.341	.349
	Diet = Below average	0[a]	.
	Smoker	.842	.009
	Non -Smoker	.584	.036
	Former Smoker	0[a]	.
	Think illness avoidable = Yes	.135	.549
	Think illness avoidable = No	0[a]	.
	Risky leisure = Yes	-.064	.945
	Risky leisure = No	0[a]	.
	Risky occupation = Yes	.255	.393
	Risky occupation = No	0[a]	.
	Sex = Male	-.210	.391
	Sex = Female	0[a]	.
	Marital status = single	-.332	.659
	Marital status = Married	-1.000	.155
	Marital status = Divorced	-.366	.625
	Marital status = Widower	0[a]	.
	Education = Brevet des Collèges	.376	.427
	Education = A-level	.439	.381
	Education = A-level+2	.820	.112
	Education = Bachelor	.362	.541
	Education = Master +	0[a]	.
	Main occupation = Liberal	.094	.909
	Main occupation = Fulltime employee	.286	.579
	Main occupation = Parttime employee	-1.098	.091
	Main occupation = Student	.349	.629
	Main occupation = Housewife/husband	.252	.793
	Main occupation = Retired	-.286	.617
	Main occupation = None	1.093	.058
	Main occupation = Medical/disability leave	.724	.423
	Main occupation = Other	0[a]	.
	Occupation related health = Yes	.274	.530
	Occupation related health = No	0[a]	.
	Donation charity last year = Yes	.396	.177
	Donation charity last year = No	0[a]	.
	Health insurance = Yes	-.279	.349
	Health insurance = No	0[a]	.

Table 54: COPDs - Protest 0 vs legit 0 – Probit full model

Pseudo R²(McFadden) = 0.237, N = 216, In grey: Statistically significant parameters

Table 54 shows that the significant variables are birth year, the context, smoking status and occupation status. Table 55 highlights that these variables are still significant when the others parameters have been removed. The pseudo R^2 are also very low, but that is not unusual for this kind of model (McFadden=0.134). Respondents who have full context are increases the probability of legit reasons for not paying, as well as being smoker or non-smoker (former smokers are more bound to protest).

		Estimation	Sig.
	Constant	-49.132	.030
Parameters	**Household Income**	-.000124	.017
	Birth year	-.025	.028
	Context = no context	-.075	.770
	Context = full context	.469	.082
	Context =Air pollution	.322	.227
	Context =smoking	0[a]	.
	Smoker	.815	.004
	Non -Smoker	.634	.009
	Former Smoker	0[a]	.
	Main occupation = Liberal	.266	.698
	Main occupation = Fulltime employee	.501	.259
	Main occupation = Parttime employee	-.572	.283
	Main occupation = Student	1.020	.112
	Main occupation = Housewife/husband	.468	.592
	Main occupation = Retired	-.222	.650
	Main occupation = None	1.158	.022
	Main occupation = Medical/disability leave	.467	.487
	Main occupation = Other	0[a]	.

Table 55: COPDs - Protest 0 vs legit 0 – Probit scarce model
Pseudo R²(McFadden) = 0.134, N = 216, In grey: Statistically significant parameters

The same analysis was conducted for COPDm. Table 86 (Appendix 10) highlights few significant variables: income, context (variant of the questionnaire), smoking status and sex of the respondent. Table 56 shows the results of the model including only these variables (the mandatory ones are, in this case, significant). As for COPDs, R^2 are quite low (McFadden = 0.056). As for COPDs, respondents who have full context are increases the probability of legit reasons for not paying, as well as being smoker or non-smoker (former smokers are more bound to protest).

		Estimation	Sig.
	Constant	.201	.426
Parameters	**Household Income**	-7.698E-5	.053
	Context = no context	.014	.951
	Context = full context	.462	.050
	Context =Air pollution	.256	.259
	Context =smoking	0[a]	.
	Smoker	.649	.010
	Non -Smoker	.365	.082
	Former Smoker	0[a]	.
	Sex = Male	-.253	.131
	Sex = Female	0[a]	.

Table 56: COPDm - Protest 0 vs legit 0 – Probit scarce model
Pseudo R²(McFadden) = 0.056, N = 242, In grey: Statistically significant parameters

For CB, Table 87 (Appendix 10) shows the significant variables: health status, their opinion they may avoid the illness, sex of the respondent and their marital status. Table 57 shows the results of the modeling with these variables and mandatory ones (context, smoking status and household income). As for the two previous analyses, R^2 are quite low (McFadden = 0.079).

		Estimation	Standard Error	Wald	Sig.
	Constant	-6.888	.713	93.329	.000
Parameters	**Household Income**	-2.577E-5	3.698E-5	.486	.486
	Context = no context	-.343	.219	2.468	.116
	Context = full context	.184	.220	.702	.402
	Context =Air pollution	.100	.215	.215	.643
	Context =smoking	0[a]	.	.	.
	Health = Well above average	-.856	.719	1.419	.234
	Health = Above average	-1.047	.676	2.399	.121
	Health = Average	-.745	.662	1.267	.260
	Health = Below average	-1.287	.690	3.478	.062
	Health = Well below average	0[a]	.	.	.
	Smoker	.322	.245	1.730	.188
	Non -Smoker	.129	.204	.401	.527
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = Yes	.331	.165	4.007	.045
	Think illness avoidable = No	0[a]	.	.	.
	Sex = Male	-.330	.161	4.219	.040
	Sex = Female	0[a]	.	.	.
	Marital status = single	-5.986	.282	450.646	.000
	Marital status = Married	-6.023	.258	545.284	.000
	Marital status = Divorced	-6.109	.000	.	.
	Marital status = Widower	0[a]	.	.	.

Table 57: CB - Protest 0 vs legit 0 – Probit scarce model
Pseudo R^2(McFadden) = 0.079, N = 283, In grey: Statistically significant parameters

For one day of cough, Table 88 (Appendix 10) presents the results of the full Probit model. The significant variables are the age, the context, a visit to hospital or ER in the last 12 months, their opinion they may avoid the illness, sex of the respondent and their profession.

Table 58 presents the model with only these significant variables and the mandatory ones. As for the previous analyses, R^2 are quite low (McFadden = 0.085).

		Estimation	Standard Error	Wald	Sig.
	Constant	42.848	13.755	9.704	.002
Parameters	**Birth year**	.022	.007	9.700	.002
	Household Income	3.141E-5	3.065E-5	1.050	.305
	Context = no context	-.191	.183	1.095	.295
	Context = full context	.115	.193	.352	.553
	Context =Air pollution	-.216	.173	1.565	.211
	Context =smoking	0^a	.	.	.
	Hospital last year = yes	-1.236	.547	5.102	.024
	Hospital last year = no	0^a	.	.	.
	Smoker	-.020	.189	.011	.916
	Non -Smoker	-.009	.160	.003	.955
	Former Smoker	0^a	.	.	.
	Think illness avoidable = Yes	.377	.136	7.723	.005
	Think illness avoidable = No	0^a	.	.	.
	Sex = Male	-.371	.134	7.680	.006
	Sex = Female	0^a	.	.	.
	Main occupation = no answer	-.397	.954	.174	.677
	Main occupation = Liberal	.808	.507	2.541	.111
	Main occupation = Fulltime employee	.490	.292	2.813	.093
	Main occupation = Parttime employee	.469	.339	1.907	.167
	Main occupation = Student	.254	.374	.460	.498
	Main occupation = Housewife/husband	1.411	.657	4.613	.032
	Main occupation = Retired	.771	.337	5.240	.022
	Main occupation = None	.420	.334	1.578	.209
	Main occupation = Medical/disability leave	.434	.529	.672	.412
	Main occupation = Other	0^a	.	.	.
	Occupation related health = Yes	.371	.217	2.933	.087
	Occupation related health = No	0^a	.	.	.

Table 58: One day of cough - Protest 0 vs legit 0 – Probit scarce model
Pseudo R^2(McFadden) = 0.085, N = 526, In grey: Statistically significant parameters

The significant variables for the four illnesses are summarized in Table 59.

	COPDs	COPDm	CB	Cough
Household income	Sig+	Sig-		
Context	Full+	Full+		
Smoking status	Smokers / non smoker +	Smokers / non smoker +		
Profession	No activity+			Full time / housewife /retired
Health	Below average-			
Think illness avoidable = Yes			+	+
Sex			Male-	Male -
Birth year	-			+
Hospital last year = yes				-
Marital status	Singe / Married -			
Main occupation related to health				+

Table 59: Significant variables - Protest 0 vs legit 0 – Probit model

Overall, personal characteristics of the respondents are important to define their attitude towards the questionnaire: being a male increases the probability of protest answers. For the most serious illnesses, the type of questionnaire and the smoking status are also considered by the respondents: smokers, and a bit less non-smokers, are more bound to not pay for legit reasons for the two more serious illnesses, and former smokers are more bound to protest.

Providing the full context increases the probability of legit 0, i.e. increases the acceptance of the questionnaire and consequently the reliability of the valuation, even if it is not significant for the two less serious illnesses.

However, the important parameters vary depending on the illness.

2. How much do the respondents pay?

2.1 Modelling: lognormal model

The lognormal model has been applied to all respondents who do actually pay something (WTP>0). The analysis was first conducted on all significant variables on the questionnaire to see which ones were the most significant. Then, the “stepwise” method is used to choose the most significant variables independently from the order they were introduced in the model. However, some usually considered variables, such as personal characteristics of the respondents, were not considered. Therefore, a model was created with as mandatory variables the main respondents’ characteristics (age, sex, kids, marital status, and income) and the studied variables (smoking status, questionnaire version), and as chosen variables (stepwise method) all the others. Table 60 gives all coefficients and their significance for these three approaches, for COPDs.

COPDs	**Full – R^2 = 0.443**		**Stepwise R^2=0.445**		**Stepwise sign– Oblig R^2=.450**	
	B	Sig	B	Sig	B	Sig
(Constant)	-3.454	.309	-5.483	.025	-3.048	.315
Context = full context	-.074	.300			-.030*	.592
Context =Air pollution	-.061	.246			-.035*	.474
Context =smoking	-.085	.190			-.026*	.576
Health = Well above average	.020	.770				
Health = Above average	-.011	.813				
Health = Below average	.069	.239				
Health = Well below average	.241	.085				
Preexisting condition: Chronic bronchitis	-.024	.843				
Hospital last year	-.011	.937				
WTP: 1st proposed amount CODPs	2.109E-5	.098				
WTP: lowest proposed amount CODPs	.001	.000	.001	.000	.001	.000
WTP: highest proposed amount CODPs	-6.696E-6	.675				
WTP criteria: illness duration	-.005	.887				
WTP criteria: other	-.005	.786				
WTP criteria: comparison with usual health expenses	.083	.001	.100	.000	.090	.000
WTP criteria: pain	-.063	.112	-.065	.077	-.060	.110

WTP criteria: living standard	.040	.189				
WTP criteria: long term effects of the illness	-.094	.013	-.085	.016	-.088	.013
Planning to pay – personal income	.050	.220				
Planning to pay - savings	-.011	.855				
Planning to pay – other	-.283	.000	-.306	.000	-.302	.000
Sport = Every day	.092	.303				
Sport = Several times a week	.022	.736				
Sport = Several times a month	.067	.300			.058	.133
Sport = Only rarely	-.014	.818				
Dwelling = Heavily air polluted	-.038	.636				
Dwelling = Somewhat air polluted	-.037	.509				
Dwelling = Slightly air polluted	-.007	.885				
Diet = better than average	.013	.769				
Diet = below than average	.022	.781				
Smoker	-.049	.365			-.045*	.368
Non-Smoker	-.071	.111			-.078*	.060
Difficulties to assess WTP – I do not know my usual health expenses	-.083	.078				
Difficulties to assess WTP – I do not know how much costs medicaments	.017	.645				
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.061	.069	.075	.020	.067	.040
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.056	.143	.061	.092	.060	.103
Difficulties to assess WTP – illnesses are similar	-.097	.132	-.120	.042	-.114	.055
Difficulties to assess WTP – proposed amounts do not fit	-.008	.859				
Think you can avoid these illnesses	-.053	.219				
You think illnesses caused by air pollution and smoking	.031	.592				
You think illnesses caused by smoking	.094	.029				
You think illnesses caused by air pollution	.007	.899				
WTP – Thought about smoking but no influence	-.077	.080				
WTP – Thought about smoking and influence	-.023	.692				
WTP – Thought about air pollution but no influence	.070	.107				
WTP – Thought about air pollution and influence	.029	.647				
WTP – Thought about prevention program	.076	.082				
WTP – Thought about the costs of theses illnesses for society	-.006	.893				
Knowing that this kind of respiratory problems could become so serious	.037	.296				
1 Relative smoker	-.043	.256				
Risky occupation	.001	.986				
Risky leisure	.143	.149				
Sex	-.064	.081			-.054*	.112
Birth year	.002	.162	.003	.007	.002*	.130
Household size < 15 years old	.010	.659			.006*	.764
Marital status = Married	.072	.152			.062*	.184
Marital status = Divorced	-.021	.772			-.015*	.832
Marital status = Widower	-.003	.984			-.023*	.863
Education = A-level	.135	.005			.115*	.013
Education = A-level+2	.139	.010			.125*	.014
Education = Bachelor	.146	.037			.125*	.060
Education = Master +	.153	.020			.141*	.023

Occupation related to health	-.019	.715				
Donation charity last year	.039	.395				
Health insurance	-.043	.383				
Log Household Income	.105	.166	.234	.000	.121*	.085

Table 60: WTP COPDs – the three models tested – full
In grey: sigma <0.1; and *=mandatory variable, sample size 674

First, the money-related considerations are significant: household income, comparison with usual health budget, and difficulties to know what the proposed amounts represent, increase the WTP whereas not knowing how to pay (How would you pay – other, in contrast to household income, personal income and savings) decreases it importantly. Whereas the first two and the last one make sense, the difficulty to understand what proposed amount means highlights a flaw in the contingent valuation survey. One possible reason is the unfamiliarity of French respondents with paying for health treatment, and even less having to pay for a long term health outcome (like having a bank loan for a health treatment). This could lead to less robust WTP. The first amount given and the minimal amount chosen have a highly significant influence on the WTP: it is understandable for the later, while the former may reveal an the anchoring effect, common in contingent valuation studies. The characteristics of the illnesses are also significant, with somewhat contradictory effects:

- ✓ Pain from the illness, long term effect, illnesses looking alike decreasing the WTP;
- ✓ Difficulties to imagine the constraints of the illness increasing the WTP.

When forced into the model, being non-smoker decreases the WTP, whereas being older, married, and having studied increase it.

The other parameters significant in the first model have a very low influence.

Appendix 11 shows the full model for the four illnesses.

2.2 Analysis of the results

Table 61 summarizes the models for the four illnesses; with a mandatory part: respondents main characteristics (age, sex, kids, marital status, and income) and the studied variables (smoking status, questionnaire version); and as chosen variables (stepwise method) all the others.

COPDs (sample=674, R²adjusted=0.450)			COPDm (sample = 657, R adjusted ²=0.226)			CB (sample = 623, R² adjusted = 0.217)			Cough (sample = 401, R² adjusted =0.469)		
	B	Sig.		B	Sig.		B	Sig.		B	Sig.
(Constante)	-3.048	.315	(Constante)	-1.558	.619	(Constante)	2.191	.523	(Constante)	3.777	.222
Context = full context *	-.030	.592	Context = full context *	.026	.646	Context = full context *	.029	.644	Context = full context *	.083	.113
Context =Air pollution *	-.035	.474	Context =Air pollution *	.028	.581	Context =Air pollution *	-.018	.748	Context =Air pollution *	.023	.645
Context =smoking *	-.026	.576	Context =smoking *	.058	.236	Context =smoking *	-.004	.942	Context =smoking *	.037	.420
Smoker*	-.045	.368	Smoker*	-.071	.177	Smoker*	-.061	.273	Smoker*	-.005	.923
Non-Smoker*	-.078	.060	Non-Smoker*	-.053	.220	Non-Smoker*	-.059	.207	Non-Smoker*	.005	.898
Sex*	-.054	.112	Sex *	-.051	.149	Sex *	-.086	.025	Sex *	-.021	.535
Birth year*	.002	.130	Birth year*	.001	.417	Birth year*	-.001	.667	Birth year*	-.001	.359
Household size (<15 years)*	.006	.764	Household size (<15 years)*	-.007	.722	Household size (<15 years)*	.003	.880	Household size (<15 years)*	.006	.762
Marital status = Married *	.062	.184	Marital status = Married *	-.037	.448	Marital status = Married *	-.055	.292	Marital status = Married *	-.052	.263
Marital status = Divorced*	-.015	.832	Marital status = Divorced*	-.124	.083	Marital status = Divorced*	-.192	.013	Marital status = Divorced*	-.034	.609
Marital status = Widowed*	-.023	.863	Marital status = Widowed *	.069	.602	Marital status = Widowed *	-.062	.645	Marital status = Widowed *	-.146	.185
Education = A-level *	.115	.013	Education = A-level *	.085	.078	Education = A-level *	.109	.037	Education = A-level *	.055	.225
Education = A-level +2*	.125	.014	Education = A-level +2*	.048	.354	Education = A-level +2*	.070	.213	Education = A-level +2*	-.017	.726
Education = Bachelor*	.125	.060	Education = Bachelor *	.059	.391	Education = Bachelor *	.128	.081	Education = Bachelor *	-.042	.501
Education = Master *	.141	.023	Education = Master *	.109	.086	Education = Master *	.187	.009	Education = Master *	.018	.773
Log Household Income*	.121	.085	Log Household Income*	.239	.001	Log Household Income*	.146	.071	Log Household Income*	-.048	.522
Lowest amount presented	.001	.000	Lowest amount presented	.001	.000	Lowest amount presented	.001	.000	Lowest amount presented	.007	.000
						Highest Amount presented	5.35E-02	.005	Highest Amount presented	######	.069
Plan to pay = other	-.302	.000	Plan to pay = other	-.226	.004	Plan to pay = other	-.198	.013	Plan to pay = other	-.134	.029
WTP criteria: comparison with usual health expenses	.090	.000	WTP criteria: comparison with usual health expenses	.054	.027	WTP criteria: comparison with usual health expenses	.023	.389			

		WTP – Thought about smoking and influence	.078 .082			**WTP – Thought about smoking and influence**	.068 .082
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.067 .040	**Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses**	.081 .014				
Sport several time a month	.058 .133					**Sport several time a month**	.090 .023
WTP criteria: long term effects of the illness	-.088 .013			**Think you can avoid these illnesses**	-.093 .029	**Occupation related to health**	.104 .043
Difficulties to assess WTP – illnesses are similar	-.114 .055			**Risky occupation**	.271 .010	**Diet = better than average**	.082 .031
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.060 .103			**First amount presented**	0.04903 .001		
WTP criteria: pain	-.060 .110						

Table 61: Model for the four illnesses: lognormal, WTP>0,

=mandatory variable, in grey: significant variables

Table 61 highlights some common aspects between the four illnesses.

The fact of not knowing how they will pay always leads to significantly lower WTP, which is good because it could mean that respondents do consider their income when answering. For the worst illnesses, respondents acknowledge the difficulties to imagine the consequences of an unknown illness, which is good as it means they actually try to imagine it. For the same illnesses, they also compare the amounts to their usual health expenses, so they actually try to take a realistic decisions.

Education increase the WTP, probably linked to income (which also increases it), being divorced decreases it.

For the three most serious illnesses (COPDs, COPDm, CB), usual health budget and constraints linked to the illnesses are considered. Moreover, the increase of education level also increases the WTP slightly for A-Level, more for A-Level +3 (bachelor) and A-Level +5 (Master), probably because of its links with income, which also have a significant and important influence. The benign nature of one day of cough, and low reduction of quality of life and one-time payment justifies that these factors are not considered for it.

Respondents also declared, for COPBs (full model), COPDm and cough, that they thought about smoking as a possible causes of the illnesses and actually took it into account. That may explain why the causes given in the questionnaires do not influence the respondents.

Finally yet importantly, in all cases, having quit smoking increases the WTP. It may be because they quit smoking for health considerations, so former smokers are more cautious. As observed for the probability to pay, being “healthy and socially conscious” increases the WTP.

3. Cross influence of deciding to pay and amount: Heckman regression

In the two previous chapters, the facts that the respondents decide or not to pay and how much they will pay, were studied separately. However, some interactions exist between the two, as the first step is a selection for the second one. To combine these two aspects, an Heckman model was used. This model allows to control the influence of selection in the first step (when the respondent choose if he wants to pay or not) on the WTP value (second step).

For each illness, a model with all the possible meaningful variables was first tested (full model). Then, a scarce model based on significant and mandatory variables (variants of the questionnaire, smoking status, household income) was constructed.

These analyses have been conducted with the SPSS plug-in STATS HECKMAN REGR; version 1.1.6 by Jon Peck (JKP. IBM SPSS; 2015).

3.1 Results of the modelling

Table 93 in Appendix 12 presents the results of the full model for COPDs. Table 62 displays the results of the scarce model, with only significant variables and mandatory ones (variants of the questionnaire, smoking status, household income). The significance of the model slightly improves for the second one as shown by the increase of the adjusted R^2. The significant variables in this model are similar to the ones of the previous analysis (cf. section III – E – 1.1 and 2), with among other: income and education increase the probability of paying and the WTP, not knowing how to pay decreases it. Air pollution context increases the probability to pay but decreases the amount (not significantly).

Probit Selection Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
Constant	-27.507	7.607	-3.616	.000
Full Context	.080	.153	.522	.602
Air pollution context	.367	.146	2.507	.012
Smoking context	.159	.136	1.165	.244
Smoker	-.186	.146	-1.272	.204
Non-Smoker	-.139	.122	-1.137	.256
Think you can avoid these illnesses	-.424	.105	-4.037	.000
Sex	.261	.099	2.633	.009
Household Income	.000093	.000025	3.659	.000
Sport = Every day	-.107	.211	-.507	.612
Sport = Several times a week	.133	.164	.813	.417
Sport = Several times a month	.464	.175	2.647	.008
Sport = Only rarely	.145	.155	.935	.350
Diet = better than average	.038	.125	.301	.763
Diet = below than average	-.399	.184	-2.162	.031
Occupation related to health	-.323	.168	-1.923	.055
Birth year	.015	.004	3.757	.000

Outcome Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
Constant	.484	.342	1.418	.157
Full Context	.000	.067	.004	.997
Air pollution context	-.033	.060	-.548	.584
Smoking context	.000	.055	.006	.995
Health = Well above average	-.002	.080	-.020	.984
Health = Above average	.085	.052	1.639	.102
Health = Below average	.106	.065	1.628	.104
Health = Well below average	.304	.152	1.999	.046
WTP criteria: comparison with usual health expenses	.127	.028	4.469	.000
WTP criteria: long term effects of the illness	-.118	.040	-2.935	.003
Planning to pay – personal income	.020	.045	.448	.654
Planning to pay - savings	.135	.067	2.017	.044
Planning to pay – other	-.358	.084	-4.242	.000
Sport = Every day	.211	.102	2.061	.040
Sport = Several times a week	.029	.077	.374	.708
Sport = Several times a month	.057	.082	.692	.489
Sport = Only rarely	.029	.073	.391	.696
Smoker	-.071	.061	-1.166	.244
Non-Smoker	-.047	.051	-.921	.357
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.107	.038	2.839	.005
WTP – Thought about prevention program	.097	.046	2.101	.036
1 Relative smoker	-.075	.043	-1.739	.082
WTP – Thought about smoking but no influence	-.032	.045	-.719	.472
WTP – Thought about smoking and influence	.099	.058	1.697	.090
Education = A-level	.164	.054	3.051	.002
Education = A-level+2	.144	.060	2.408	.016
Education = Bachelor	.107	.078	1.384	.167
Education = Master+	.135	.074	1.840	.066
Log Household Income	.376	.080	4.707	.000
invMillsRatio	-.198	.144	-1.376	.169

Table 62: COPDs – Heckman scarce model adjusted

Adjusted R^2 =0.1889, Sample size = 890, in grey: significant variables

The results of the full model for COPDm are presented in Table 94 in Appendix 12, the ones of the scarce model in Table 63, with similar results as for COPDs. It is worth noting that, for the amount pay, living in a polluted area increases the WTP, supporting the idea that being "healthy and socially conscious" increase the WTP.

Probit Selection Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
Constant	-22.655	7.580	-2.989	.003
Full Context	-.059	.150	-.392	.695
Air pollution context	.146	.140	1.041	.298
Smoking context	.141	.137	1.033	.302
Smoker	-.144	.143	-1.011	.312
Non-Smoker	-.144	.120	-1.203	.229
Think you can avoid these illnesses	-.492	.102	-4.831	.000
Sex	.224	.097	2.305	.021
Household Income	.000101	.000025	4.007	.000
Sport = Every day	.004	.208	.021	.984
Sport = Several times a week	.232	.158	1.466	.143
Sport = Several times a month	.419	.167	2.513	.012
Sport = Only rarely	.174	.150	1.157	.247
Education = A-level	.051	.129	.393	.694
Education = A-level+2	.264	.149	1.768	.077
Education = Bachelor	-.189	.181	-1.043	.297
Education = Master+	.133	.186	.715	.475
Birth year	.012	.004	3.048	.002

Outcome Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
Constant	.523	.310	1.689	.092
Full Context	.080	.061	1.302	.193
Air pollution context	.072	.054	1.337	.182
Smoking context	.104	.050	2.104	.036
Health = Well above average	.012	.075	.158	.874
Health = Above average	.058	.046	1.263	.207
Health = Below average	.047	.061	.767	.444
Health = Well below average	.232	.132	1.757	.079
WTP criteria: comparison with usual health expenses	.070	.026	2.740	.006
1 Relative smoker	-.095	.039	-2.411	.016
Planning to pay – personal income	.005	.042	.120	.905
Planning to pay - savings	.144	.060	2.396	.017
Planning to pay – other	-.209	.086	-2.420	.016
Dwelling = Heavily air polluted	.160	.080	1.995	.046
Dwelling = Somewhat air polluted	.117	.058	2.009	.045
Dwelling = Slightly air polluted	.081	.051	1.604	.109
Smoker	-.055	.055	-1.003	.316
Non-Smoker	-.009	.046	-.196	.845
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.101	.034	2.940	.003
Education = A-level	.114	.051	2.264	.024
Education = A-level+2	.052	.058	.902	.368
Education = Bachelor	.029	.071	.404	.686
Education = Master+	.097	.070	1.401	.161
Log Household Income	.328	.075	4.361	.000
invMillsRatio	-.054	.125	-.436	.663

Table 63: COPDm – Heckman scarce model

Adjusted R^2 = 0.1018, Sample size = 899, in grey: significant variables

Table 95 in Appendix 12 shows the result of the full model for CB, Table 64 of the corresponding scarce model. Similar results as for COPDs and COPDm can be observed regarding income, with very few variables significant, and notwithstanding the fact CB is the only ones where accounting for the selection step influences the WTP values.

Probit Selection Estimates				
	Estimate	Std. Error	t Value	Sig.
Constant	-2.126	7.064	-.301	.764
Full Context	-.423	.162	-2.607	.009
Air pollution context	.009	.134	.065	.948
Smoking context	-.231	.149	-1.545	.123
Smoker	-.015	.137	-.107	.915
Non-Smoker	-.094	.114	-.827	.408
Health = Well above average	-.012	.181	-.066	.947
Health = Above average	-.152	.116	-1.306	.192
Health = Below average	-.268	.144	-1.857	.064
Health = Well below average	.166	.330	.505	.614
Think you can avoid these illnesses	-.354	.097	-3.638	.000
Household Income	.000089	.000023	3.913	.000
Health insurance	-.285	.125	-2.285	.023
Birth year	.002	.004	.490	.624
Household size	-.006	.035	-.162	.871

Outcome Estimates				
	Estimate	Std. Error	t Value	Sig.
Constant	1.233	.434	2.841	.005
Full Context	.064	.076	.848	.397
Air pollution context	.001	.064	.015	.988
Smoking context	.045	.059	.766	.444
Planning to pay – personal income	.062	.046	1.355	.176
Planning to pay - savings	.109	.067	1.623	.105
Planning to pay – other	-.188	.090	-2.089	.037
Smoker	-.066	.066	-1.006	.315
Non-Smoker	-.010	.055	-.189	.850
You think illnesses caused by air pollution and smoking	-.068	.067	-1.021	.308
You think illnesses caused by smoking	.041	.048	.846	.398
You think illnesses caused by air pollution	-.029	.063	-.466	.642
Log Household Income	.169	.103	1.637	.102
invMillsRatio	-.417	.201	-2.079	.038

Table 64: CB – Heckman scarce model

Adjusted R^2 = 0.0358, Sample size = 906, in grey: significant variables

The results for the full model for cough are presented in Table 96 in Appendix 12, of the scarce one in Table 65, with similar results as previously.

Probit Selection Estimates				
	Estimate	Std. Error	t Value	Sig.
Constant	24.368	6.754	3.608	.000
Full Context	-.200	.154	-1.301	.193
Air pollution context	-.136	.127	-1.068	.286
Smoking context	-.177	.139	-1.268	.205
Health = Well above average	-.136	.171	-.799	.425
Health = Above average	-.044	.110	-.402	.687
Health = Below average	-.103	.141	-.727	.468
Health = Well below average	.667	.325	2.055	.040
Smoker	.167	.129	1.291	.197
Non-Smoker	.064	.108	.589	.556
Think you can avoid these illnesses	-.155	.095	-1.642	.101
Household Income	.000053	.000020	2.602	.009
Health insurance	-.240	.119	-2.019	.044
Birth year	-.012	.003	-3.578	.000
Household size	.072	.033	2.148	.032

Outcome Estimates				
	Estimate	Std. Error	t Value	Sig.
Constant	1.519	.459	3.310	.001
Full Context	.159	.069	2.304	.021
Air pollution context	.080	.063	1.254	.210
Smoking context	.102	.058	1.759	.079
Planning to pay – personal income	.133	.047	2.807	.005
Planning to pay - savings	.051	.069	.736	.462
Planning to pay – other	-.138	.086	-1.615	.107
Smoker	-.038	.065	-.594	.553
Non-Smoker	.026	.053	.482	.630
You think illnesses caused by air pollution and smoking	-.036	.070	-.516	.606
You think illnesses caused by smoking	.038	.051	.744	.457
You think illnesses caused by air pollution	-.104	.066	-1.589	.112
Log Household Income	-.086	.103	-.837	.403
invMillsRatio	-.184	.148	-1.240	.215

Table 65: Cough – Heckman scarce model

Adjusted R^2 = 0.0344, Sample size = 927, in grey: significant variables

3.2 Analysis of the results

The results for the four illnesses show a slight increase of the adjusted R^2 between the full and the scarce models. So deleting the non-significant variables improves the model.

Regarding the selection step (do the respondents accept to pay or not, estimated with a probit model), Table 66 compares the significant variables between the four illnesses.

	COPDs	COPDm	CB	Cough
Variant of the questionnaire	Context =Air pollution		Context = full context	
			Health = Below average	Health = Well below average
Opinion they may avoid the illness	Think you can avoid these illnesses	Think you can avoid these illnesses	Think you can avoid these illnesses	Think you can avoid these illnesses
Sex	Sex	Sex		
	Household Income	Household Income	Household Income	Household Income
Health insurance			Health insurance	Health insurance
	Sport = Several times a month	Sport = Several times a month		
	Diet = below than average			
Profession	Occupation related to health	Education = A-level+2		
Birth year	Birth year	Birth year		Birth year
Number <15yo in the household				Household size

Table 66: Comparison of the significant variables for the four illnesses for the selection model (probit)

The sex of the respondents also matters: female are more bound to pay. In every case, the fact respondents think they may avoid the illness decreases their probability to pay. Moreover, trying to be healthy (with diet and sport habits) also increase the probability to pay. So overall, trying to be healthy increases the probability to pay. Household income (and education levels) also increases the WTP. These results are consistent with the ones found for the probit model only (cf. III – E - 1.1).

Regarding the second part of the model, Table 67 compares the significant parameters for the four illnesses.

Outcome Estimates COPDs			**Outcome Estimates COPDm**			**Outcome Estimates CB**			**Outcome Estimates Cough**		
	Estimate	**Sig.**		**Estimate**	**Sig.**		**Estimate**	**Sig.**		**Estimate**	**Sig.**
(Intercept)	0.484	0.157	**(Intercept)**	**0.523**	**0.092**	**(Intercept)**	**1.233**	**0.005**	**(Intercept)**	**1.519**	**0.001**
Full Context	0	0.997	Full Context	0.08	0.193	Full Context	0.064	0.397	Full Context	0.159	0.021
Air pollution context	-0.033	0.584	Air pollution context	0.072	0.182	Air pollution context	0.001	0.988	Air pollution context	0.08	0.21
Smoking context	0	0.995	Smoking context	0.104	0.036	Smoking context	0.045	0.444	Smoking context	0.102	0.079
Health = Well above average	-0.002	0.984	Health = Well above average	0.012	0.874						
Health = Above average	0.085	0.102	Health = Above average	0.058	0.207						
Health = Below average	0.106	0.104	Health = Below average	0.047	0.444						
Health = Well below average	0.304	0.046	Health = Well below average	0.232	0.079						
WTP criteria: comparison with usual health expenses	0.127	0	WTP criteria: comparison with usual health expenses	0.07	0.006						
WTP criteria: long term effects of the illness	-0.118	0.003	1 Relative smoker	-0.095	0.016						
Planning to pay – personal income	0.02	0.654	Planning to pay – personal income	0.005	0.905	Planning to pay – personal income	0.062	0.176	Planning to pay – personal income	0.133	0.005
Planning to pay - savings	0.135	0.044	Planning to pay - savings	0.144	0.017	Planning to pay - savings	0.109	0.105	Planning to pay - savings	0.051	0.462
Planning to pay – other	-0.358	0	Planning to pay – other	-0.209	0.016	Planning to pay – other	-0.188	0.037	Planning to pay – other	-0.138	0.107
Sport = Every day	0.211	0.04	Dwelling = Heavily air polluted	0.16	0.046						
Sport = Several times a week	0.029	0.708	Dwelling = Somewhat air polluted	0.117	0.045						
Sport = Several times a month	0.057	0.489	Dwelling = Slightly air polluted	0.081	0.109						
Sport = Only rarely	0.029	0.696									
Smoker	-0.071	0.244	Smoker	-0.055	0.316	Smoker	-0.066	0.315	Smoker	-0.038	0.553
Non-Smoker	-0.047	0.357	Non-Smoker	-0.009	0.845	Non-Smoker	-0.01	0.85	Non-Smoker	0.026	0.63
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	0.107	0.005	Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	0.101	0.003						
WTP – Thought about prevention program	0.097	0.036									
1 Relative smoker	-0.075	0.082									
WTP – Thought about smoking but no influence	-0.032	0.472				You think illnesses caused by air pollution and smoking	-0.068	0.308	You think illnesses caused by air pollution and smoking	-0.036	0.606
WTP – Thought about smoking and influence	0.099	0.09				You think illnesses caused by smoking	0.041	0.398	You think illnesses caused by smoking	0.038	0.457
Education = A-level	0.164	0.002	Education = A-level	0.114	0.024	You think illnesses caused by air pollution	-0.029	0.642	You think illnesses caused by air pollution	-0.104	0.112
Education = A-level+2	0.144	0.016	Education = A-level+2	0.052	0.368						
Education = Bachelor	0.107	0.167	Education = Bachelor	0.029	0.686						
Education = Master+	0.135	0.066	Education = Master+	0.097	0.161						
Log Household Income	0.376	0	Log Household Income	0.328	0	Log Household Income	0.169	0.102	Log Household Income	-0.086	0.403
invMillsRatio	-0.198	0.169	invMillsRatio	-0.054	0.663	invMillsRatio	-0.417	0.038	invMillsRatio	-0.184	0.215

Table 67: Comparison of the significant variables for the four illnesses for the second model (lognormal)

Regarding the influence of the selection process on the WTP values, which is the main advantage of the Heckman model, it seems significant only for CB; when the inverse of the Mills ratio is significant. The selection process does not seem to have any significant effects for the other illnesses.

As for the lognormal model only (cf. III – E – 2), education level and income increase the WTP. Knowing how to pay increases also the WTP. Smoking context increases the WTP but is significant for COPDm and cough only. Overall, giving any context increases the WTP compared to not providing one (but for air pollution for COPDs). For COPDs and COPDm, being healthy conscious (sport, living in a polluted area) increases the WTP. In contrary to the lognormal model, smoking status has no statistically significant influence.

Heckman regression allows to take into account the selection process for the WTP determination. The selection process, however, has little impact on the WTP values except for the CB. Globally , the results are consistent with the ones of the probit and log-normal model (cf. III – E – 1.1 and 2).

For the decision of paying and the amount, the more serious the illness is, the more parameters were taken into consideration by respondents, including those related to smoking (someone you care smoke or smoked), budget (comparison with current health budget) and the illness itself (not really understanding the two worse illnesses increases the WTP).

The household income and education level increase the probability to pay and the amount paid, as knowing how to pay increases the WTP whereas not knowing decreases it.

Being “healthy conscious” (diet, doing sport regularly, living in a polluted area) increases the probability to pay and the WTP.

Being former smoker, in comparison to being smoker or non-smoker, increases the WTP, without being significant.

So being aware of the risks of air pollution, smoking and overall of healthy lifestyle, and of health risk in general, increases the WTP. It may explain why context is seldom significant: the personal characteristics and behaviors (preferences) of the respondents override the information given.

F. Concluding remarks

The aim of this study is to assess the influence of providing the context when valuing the pain associated with an illness by stated preference method, here contingent valuation. The valued illness is chronic obstructive pulmonary bronchitis (COPD), a respiratory illness mainly caused by air pollution and smoking. This illness was valued with four stages, from a very mild and non-permanent one (one day of cough) to the most severe one which shortens life expectancy, COPB severe (COPDs), with in-between chronic bronchitis (CB) and COPD mild (COPDm).

Four variants of a questionnaire were constructed, with various information regarding context:

- ✓ one does not give any information;
- ✓ one gives the full context (illnesses caused by air pollution and smoking);
- ✓ one states the illness is caused by air pollution only;
- ✓ one states the illness is caused by smoking only.

1. Paying or not?

The first step was the analysis of respondents agreeing to pay or not, and the reason why they do not want to pay the treatment: respondents who really do not want to pay, called legit 0; or respondents who actually would pay for the treatment but do not because of other reasons, called protest answers. Two approaches were followed: unconditional statistics and modelling analysis (probit model). Both approaches lead to consistent results.

The main reason for agreeing to pay the treatment is the seriousness of the illness. The more serious the illness is, the more respondents agree to buy the treatment to avoid it. However, there is a limit: for COPDs, there are slightly less respondents willing to pay than for COPDm. COPDs appears so bad that the cost of the treatment is supposed to be high, thus more respondents seem to think they cannot afford it, and that it should be paid by the National Health Service, which is a protest answer, or that they do not have enough income. The positive aspect is that it shows respondents truly considered their income and expenses when choosing to buy the treatment or not.

Regarding the influence of context, some differences appeared. The more credible the context is, the more respondents do not pay for legitimate reasons, meaning the more they accept the questionnaire: Full context >air pollution only > smoking only > no context.

Respecting the smoking status, differences of behaviors can be noticed: Smokers and non-smokers accept more the questionnaire than former smokers. Indeed, smokers are more bound not to pay for legitimate reasons ("I cannot afford the treatment" and "My health expenses are too high"), whereas former smokers are more bound to give protest answers ("the national health service should pay"). Non-Smokers have an in-between behavior, closer to the former smokers' one. The explanation may be that smokers know their behavior affect their health and are feeling responsible for their possible illnesses, whereas former smokers (and to some extent non-smokers) rely on the national health system. This is even clearer for the variant of the questionnaire with the smoking context and, to a lesser extent, for full context. However, the overall difference between respondents depending on their smoking status is low (and not statistically significant).

Moreover, being broadly "healthy and socially conscious" (a good diet, their opinion they may avoid the illness, and if the respondent has a private health insurance and donations to charitable society) increase the probability of paying. Men are less bound to pay, and more bound to protest.

2. If paying, how much?

The next step is the analysis of the WTP value, for the respondents who do agree to buy the treatment. As for the previous part, two types of analyses were conducted: unconditional statistics and modelling analysis (lognormal model). Both approaches lead to consistent results.

The WTP increases with the seriousness of the illnesses, ascertaining the idea that the more serious the illness is, the more expensive the treatment is and the more detrimental consequences the respondents would otherwise experiment. Moreover, the WTP distribution fits a log-normal distribution with some very high values, which is also consistent with standard WTP distributions. Because of the significant influence of the extreme values, the 5% trimmed sample was analyzed too (unconditional statistics only), leading to similar conclusions.

Few differences between the WTP per context were observed, even less were statistically significant. Context was also not a significant variable in the modeling approach.

The smoking status of the respondents affects their reaction to the questionnaire, with: WTP smokers < WTP non-smokers < WTP former smokers.

These differences are statistically significant in the descriptive analysis for all but COPDs. It may be because this illness is so bad that its seriousness goes beyond any other characteristics. The differences disappear when studying the 5% trimmed sample: the extreme values come from people with high income, valuing their health to the point of decreasing the current living standard to pay for a medication (as respondents paying more than half of their income have been removed, high payment are still possible from respondents who have a high income).

In the modelling approach, smoking status of the respondents is significant only for COPDs (stepwise model) and COPDm (Full model), with the same direction (being non-smokers or smoker decrease the WTP in comparison to being former smoker).

Respondents also declared, for the COPBs (full model), COPDm, and cough, that they thought about smoking as a possible cause of the illnesses and actually took it into account. That may explain why the causes given in the questionnaires do not influence the WTP values.

For the most serious illnesses, other parameters related to smoking (someone you care smoke or smoked), also increase the WTP, reinforcing the idea that respondents do take smoking into account in all variants of the questionnaire.

The WTP amounts increase for the three worst illnesses with households' income, the knowledge on which budget the payment will be made, education, and the perception of illness itself. Moreover, usual health budget and constraints linked to the illnesses are considered, showing respondents do take into consideration their available budget and thus confirming the amounts they state are realistic.

Through the modelling approach with the lognormal model, being aware of health risk through diet, air pollution or smoking (precisely quitting smoking, which may occur because of health risk), increases the WTP.

Taking into account the selection process (respondents willing to pay or not) through an Heckman model suggests that this selection has little influence on the WTP value, except for CB. However, it confirms the results of the previous analyses: importance of the income and knowing how to pay, being aware of health and environmental issues, and the low influence of context.

Therefore, two calculations of the overall WTP value were made (over 10 years for CB, COPDm and COPDs), one based on the unconditional valuation, the other on the lognormal model; as shown in Table 68.

	WTP (mean descriptive)	**Lognormal model**
COPDs	25 962 €	10 695 €
COPDm	16 266 €	8 713 €
CB	9 964 €	3 955 €
Cough	30 €	11 €

Table 68: Overall WTP values

These values are lower than the ones found in the European project HEIMTSA, which are shown in Table 69.

	Cough	**CB**	**COPDm**	**COPDs**
Non-parametric analysis, closed question	26 €	38 990 €	58 852 €	89 995 €
Open question	29 €	21 506 €	34 698 €	54 316 €
Recommend valued 27- Europe Parametric analysis, closed-question	36 €	38 254 €	58 362 €	65 841 €

Table 69: Value for one case for each impact, for the Europe 27 countries

In HEIMTSA, interval data as well as open-ended data were analyzed. Open-ended data lead to lower WTP than the intervals ones; which make sense as a high proportion of respondents (10% to 15%) stated a lower WTP in the open-ended questions. That is the reason why in the present study only open-ended questions were analyzed, the determination of the interval data was thought as a way to help the respondents assess their WTP.

Even when considering only open-ended data, HEIMTSA values are higher than those of the present study. HEIMTSA values were determined for the Europe of 27 countries, while France had relatively lower WTP compared to the other countries of the study (WTP Czech Republic < WTP France < WTP Germany < WTP United Kingdom < WTP Norway) for COPDs, COPDm and CB, and the higher for cough. Being used to a quite performant national health service may lead French respondents to state lower WTP. That may be confirmed by the fact that the main parameters are significant in the modelling.

Indeed in HEIMSTA, lognormal as well Heckman model analyses were also conducted (cf. Appendix 13). Results were similar to the one found here in terms of income and education, which also increase the WTP (except for cough for the lognormal model). Moreover, age, and having being diagnosed with chronic respiratory illness increase the WTP for cough but decease it for the three other illnesses, as if the present moment was more valued than future (high discount rate). On a light note, male have a higher WTP than female to avoid cough, going in the direction of the popular belief that cough and cold are perceived by men as more uncomfortable / painful.

The main differences with this study is that the “healthy and socially conscious” aspects only slightly appear with the chronic respiratory diagnosis, but in no other way. The questionnaire of the European survey did not proved any context (it actually aimed at determining WTP for European countries and testing the differences between them). It seems that providing context enhances the respondents to think more about the illnesses and their consequences.

3. Influence of the context: perspective

When designing this questionnaire, attention was devoted to following the recommendations drawn from the first chapter (I - C): “A compromise should therefore be found between presenting necessary scientific and complex facts, (1) keeping the questionnaire comprehensible, and (2) not emphasizing the impact to be valued by giving too much related information.”

The analysis of the results of the survey shows that context increases the acceptability of the questionnaire but does not notably change the WTP values.

These results seem to concur with the criteria defined in the second chapter (II – C): “The “context provided” approach seems to lead to more robust valuations, although great care should be put in the quantity and the presentation of this information to avoid overwhelming or influencing respondents.”. It may actually provide answers to the paradox between the pure economic theory (the value of health impact does not depend on its causes) and observations in the literature (different values were measured for a single health impact depending on the causes presented to the respondents). Giving full context increases the credibility of the questionnaire, as respondents guess at least that smoking is a cause of the illnesses, but does not change the WTP values.

It is worth noting that the causes considered here are in a way quite different: smoking is a choice whereas exposure to air pollution is hardly avoidable. All the same, they do not fundamentally change the illnesses; in contrary for example to death caused by car accident (sudden death concerning mainly young people) or caused by illness (preceded by long period of illness concerning older persons). Moreover, these causes are, in the current French context, known by many respondents: the damages of smoking are widely explained since decades, and air pollution and its impacts on health appear regularly on the media (even at the time of this questionnaire was administrated). So giving some context in the questionnaire may have stimulate the respondents to think about all possible causes of the illnesses.

This interpretation may be strengthened by the fact that smoking status of the respondents do influence their WTP, as being “healthy conscious” (notable trough having a good diet, exercising, and in some cases the level of pollution of the living area): respondents actually thought about their own habits related to health.

A last aspect is the low significance of the statistical analysis, although standard in this type of models. This may be explained, in addition to the possible actual low significance of these aspects, by the fact that the questions asked in the questionnaire are unusual (at least in the French context with national health system) and complex, and that respondents do not have a lot of time to answer. So two types of uncertainties can be observed. First, a large variability between respondents, even if having similar opinions, may appear different in the questionnaire (uncertainties). Second, each respondent may have difficulties to express his/her actual opinion, at least for some questions especially accepting to pay and WTP value (error).

CONCLUSIONS AND PERSPECTIVES

Called *Pretium Doloris* in legal language (Braudo, 2018), disutility in economics (Rozan, 2001) among other terms, the more commonly called "pain and suffering" is an effect of health impairment. Whereas other effects of a health impairment are (quite) easily measurable (cost of the treatment, loss of wages, to take care of the relatives, etc.), pain and suffering cannot be directly assessed.

Objective and method

This work explored the effects of context and causes in the economic assessment of pain and suffering due to an illness, thanks to stated preference method. It aims to better align the willingness to pay measurement to health impact value, in particular by focusing on the influence of the type of information provided in the scenario during the survey.

The first objective was to identify what kind of good has to be valued: the health state per se or the health state due to an environmental exposure with its causes. The aim was to figure out how to value at best the good (in our case a health problem). Therefore, a review and analysis of the literature was conducted to try and investigate firstly the theoretical aspects of the monetary assessment of pain and disutility with stated preference method, secondly the current practice in contingent valuation.

The consequence, on an applied side, was to ascertain whether the causes and cofactors of the illness should be given in the contingent valuation. Therefore, a contingent valuation was conducted to empirically measure the influence of the information given: does giving information about the cause and context of the valued illness influence the respondent WTP? The survey valued pain and suffering due to chronic obstructive pulmonary disease (COPD), a respiratory illness caused mainly by smoking and exposure to air pollution and which represents a high share of costs linked to these two causes. The payment vehicle was a magic pill, and the respondents were asked if, and how much, they would be willing to pay for a treatment that would immediately cure this illness. Four variants of the same questionnaire have been tested, with different indications about the causes of the illness:

- ✓ the first variant indicates no context;
- ✓ the second one indicates air pollution (with illustration of its sources) and smoking;
- ✓ the third one, air pollution (with illustration of its sources);
- ✓ and the last one, smoking.

Main results

Monetary valuation is one way to assess the value attributed by respondents (actually a representative sample of the population) to pain and suffering from an illness, by asking them how much they value avoiding this pain and suffering. It also aims at avoiding paternalism by asking to the surveyed people their opinion, even if the ability of the population to take rational decisions has been questioned (Bureau, 2018). This assessment is necessary to inform public decision-makers, and monetary unit was chosen to be comparable to the other consequences of health impairments. Monetary valuation is currently widely used to value health impacts of environmental pollution in order to help policies decrease these impacts (Hunt and Ferguson, 2010). In addition to the direct costs of the illness, Hunt and Ferguson (2010) underline the necessity to also assess disutility costs (linked to pain and suffering) for the same health impact to be consistent with epidemiological data. Although the first are valued at aggregate scale, for example by analyzing the data of the health system, this work tackles the second aspect - disutility cost - at individual level. Schucht et al. (2017) present one use of these monetary values for policy decision by comparing various scenarios with cost-benefit analyses. These analyses, used in the United States for many years, are currently increasingly used in Europe and in France despite the ethical concerns which has not been studied here (Bureau, 2018).

The pain and suffering due to the illness cannot be observed. So methods have been developed to figure them out, among which stated preference methods in which individuals are asked their preferences by creating a fictitious market of the studied good. The contingent valuation method asked directly individuals how much they are willing to pay to avoid the illness.

A contingent valuation questionnaire aims at capturing the actual preferences of the respondents and at avoiding biasing their answers through the questionnaire. One potential source of bias may be due to the level of information given to the respondents: no information may lead the respondents to imagine everything; too much information may lead to an overload and misunderstanding. Whereas the theory of contingent valuation is quite clear upon the fact that information has to be given for the respondents to make conscious choice, the level of information and its nature are not accurately defined. Some studies tackled the question with no final answer: in some cases, it seems to influence the WTP - increasing or decreasing it; in other cases, it does not seem to have any effect.

The case study relies on a contingent valuation survey based on buying a “magic” treatment to assess pain and suffering due to COPD, an illness mainly caused by air pollution and smoking. Respondents received various levels of information on the causes of the illness. The results were analyzed with unconditional statistics as well as econometric models (probit for the probability of buying the treatment, lognormal for the value of the WTP and Heckman to combine both).

The main findings are that giving the context helps the respondents, as it increases the acceptance of the questionnaire and decreases the protest answers when respondents are asked if they agreed to pay. Therefore, respondents are able to deal with the added information and to make use of it. It does not impair their understanding of what it is asked and in fact, it helps them better understand the situation described in the questionnaire. Moreover, the more credible the scenario is, the more accepted it is, with the following acceptance ranking by scenario: full context >air pollution only > smoking only > no context. The characteristics of the respondents also influence their acceptance of the questionnaire, as smokers seem to more accept it than non-smokers, the more extreme behaviors being those of former smokers. These behaviors are clearer when the cause stated in the questionnaire is smoking, and to a lesser extent, full context. In the same vein, respondents who are conscious of their health (good diet, private health insurance) are more accepting to pay than those who are not. Therefore, giving context in the contingent valuation questionnaire, especially a credible context, increases its acceptability.

The WTP values increase with the seriousness of the illness. However, only minor differences in the WTP values were found between the variants of the questionnaire. Respondents facing unusual and difficult questions may be unsure of their preferences; which leads to a wide dispersion of the answers and consequently no statistically significant differences between the variants of the questionnaires. In addition to the uncertainty of the answers, it may also reflect the high variability of inherent preferences of the respondents regarding health and expenses: some are ready to pay more, even impairing their living standard, to be fit and healthy. Therefore, when respondents agreed to pay for the treatment, they then focus on the illness itself and not anymore on its causes.

The results could be explained by the fact that the causes and context given here are quite light: they are expressed very simply, with no numbers and only basic information, sticking to facts that respondents may even already know. This level of information is enough to make the respondents feel the situation described in the survey as plausible, but not enough to significantly affect their preferences. The absence of differences in the WTP between contexts may highlight that respondents accept the game as it is presented: once they agreed to pay, they state their WTP according to the seriousness of the illness and disregarding the probability to be sick. The fact that both causes refer to breathing may also concur. It may also rely on the fact that the explanation of the context of air pollution makes clear for the respondents that everyone, including themselves, are responsible from air pollution and hence, decreases the perceived differences between the two situations (but, even if it was an aim when designing the survey, that explanation is somehow unlikely).

The smoking status of the respondents influence their WTP, in a similar way than it affects their acceptability, depending on the illness, with the following ranking: WTP smokers < WTP non-smokers < WTP former smokers. Besides, other characteristics of the respondents influence their WTP: high household income, knowing how the payment will be made, or knowing the constraint linked to the illness, for example, increase the WTP. More notably, "healthy and socially conscious" increases the probability to pay as well as the WTP: having an healthy diet, working out regularly, giving to charities, having a private health insurance.

So, first it seems that former smokers, having quit smoking probably because of health reasons, have an extreme behavior, more than non-smokers. Second, it appears that the differences of behaviors between smokers, non-smokers and former smokers match overall health and social related behavior and have an actual influence on individuals' preferences.

Despite the fuzziness of the literature, we would figure out that giving full credible context fits all the requirements: giving all the information needed for the assessment, sticking to the principle that the causes of an impact should not influence its monetary value, and ensuring consistency between impact assessment and monetary valuation.

Thus, when assessing monetary value of a health impact, we would suggest providing contingent valuation's respondents with a simple realist context that ensures they all have the same minimum set of information. This increases the acceptance of the contingent valuation process without influencing notably the willingness to pay, and stays in line with the recommendations of the literature. Controlling for respondents' "health and social behaviors" (including smoking status) would enable to check if they influence the WTP.

Furthermore, when using these values in cost-benefit analysis, we would recommend to control for the "health and social behaviors" of the concerned populations, in order to improve the relevance of the recommended decisions.

Limits

Despite the fact that this study has given some findings for the contingent valuation into the issue of the air quality impacts on health debate, some limitations remain. Below some points are provided that would worth being investigated further on.

First, due to a flaw in questionnaire coding, there is no track on people who changed their mind when given more information after the first WTP determination, though they are the ones who are bound to be the more impacted by the information given.

Second, the influence of extreme values is significant, even in the cleaned up sample (where no respondents are willing to pay more than half their income). As said before, these variations may reflect the differences of the importance associated with health between respondents, and of what they are ready to give up to stay healthy. If it is more a statement than a flaw, and it reduces the sensitivity of the analysis. Combined with the (relatively) small size of the samples associated with each variant of the questionnaire - once people who do not pay or have erratic behavior are deleted -, this does not help to get clear and final results.

The last point is related to the context itself. Indeed, smoking and air pollution are known to have disastrous consequences on health. Many prevention campaigns advertise the dangers of smoking, sometimes in graphic ways. Air pollution is also widely known to endanger life, and especially respiratory health, even if this aspect was slightly less publicly promoted at the time of the survey than now. It is thus possible that respondents, consciously or unconsciously, have these facts in mind while responding to the survey. On the good side, giving information allows to focus the attention of the respondents on the topics of interest. On the dark side, it is nearly impossible to control totally what the respondents actually thought when answering.

Moreover, the aspect studied here is only one possible question in contingent valuation. Other parameters that may influence the risk perception and acceptance are personal, related to culture, predisposition or education (Finkel, 2008). The fact smokers are more willing to pay the treatment than non-smokers may suggest that the former are taking responsibility for their behavior and support this hypothesis. It may be linked to another observation: on average, this category has riskier jobs, more work-related and non-work-related accidents, but has a smaller risk-premium in its wage (smokers do not have higher wages than other workers for risky jobs) than non-smokers (Viscusi and Aldy, 2003). So being a smoker highlights a different attitude towards risk: it seems that smokers are more inclined to take risks than non-smokers do. Regarding the use of the contingent valuation results, Champonnois and Chanel (2018) studied the constraints linked to income and basic needs for subsistence, and the marginal effects on WTP. Because WTP are aggregated over all the respondents, the same marginal utility is supposed for everyone, and there are consequently no proper accounting for the basic subsistence needs that limit the realm of possible WTP. Thus, in absence of distributional weights aimed at correcting this inequity, CBA based on elicited WTP would give a higher weight to high incomes compared to low incomes.

Perspectives

Context in stated preference survey is now widely studied as shown for example by the sequel of articles by Ami et al. (2011, 2013, 2018). They analyze the influence of three ways to decrease the effects of air pollution (moving, drugs, new regulation), an approach based on variety of treatment instead of variety of causes of the illness as in this work. In the last publication, they also tested the impact on WTP of what they called social cue, i.e. the mean WTP of all respondents, and of scientific cue, i.e. a description of the effect of air pollution on health. They conclude first that respondents react differently to the various options, depending on the scenario and their personal characteristics, and second, that social cues do not have a significant effect on the WTP whereas scientific information has, especially for respondents with first WTP below the mean. However, they notice that scientific cue has an effect only after a social cue. This might mean that the context described in our survey may not have influenced the respondents because they were not back up by their peers. Another lead which would worth being followed is that some personal characteristics lead to a cognitive bias, which overrides other elements such as context. Indeed, smokers seem either to accept the consequences of their actions, or to ignore them by thinking that respiratory illnesses do not concern them. The second option is collaborated by the fact that respondents think they can avoid the illness, even when it is said to be caused by air pollution, and they are less willing to pay because of that: in both cases, respondents seem to (have the illusion of) being able to control the situation.

All the same, the main outcome is that the influence of the different elements given in stated preference method questionnaire seems to be volatile, or at least very difficult to capture, with interactions between the elements given and the characteristics of the respondents. This may explain why they are difficult to observe. Combined with the variability inherent to human responses (reflected, at least partly, by the low significance of the statistical analyses in this field of research), more researches are needed in order to accurately identify which elements influence the respondents when stating their WTP value for pain and suffering, and to ensure more reliable results.

The stakeholders have to compare the positive and negative impacts (with their respective uncertainties) of a project over its expected duration as well as the different options before making a decision. Cost-benefit analyses have been proven useful for decision support by using monetary units (Champonnois and Chanel, 2018). However, although taking into account market goods is relatively straightforward, the economic assessment of non-market goods such as environment and health can be challenging: the preferences of individuals are assessed with the WTP, which is a proxy of the preferences, valued by the income the respondents are ready to give up for the non-market good. When using these values for example in cost-benefit analyses, caution should be exercised: 1. when choosing which health state to value, to ensure consistency along the assessment method, 2. when parsing the results, keeping in mind the uncertainties. Regarding the first aspect, it means that the epidemiological data used, the monetary value for pain and suffering, the one for cost of treatment and the one for not working should be consistent. The second aspect refers to avoiding drawing conclusions when two options are close one to the other. In the example of planning of the district presented in the introduction of this work, assessing the costs and benefits of the different possible actions allows prioritizing the most effective first. However, as explained by Bilinski et al. (2017) in a world of scarce resources, even (very) effective actions in terms of cost-benefit analysis, may not be feasible; budget-impact analysis may be necessary to design affordable and effective policies.

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APPENDIXES

1 Appendix 1: Health effects of air pollution

1.1 Important facts about air pollution on health

The World Health Organization (2008) resumed some important facts about the health impacts of health:

"Key facts

- Air pollution is a major environmental risk to health and is estimated to cause approximately 2 million premature deaths worldwide per year.
- Exposure to air pollutants is largely beyond the control of individuals and requires action by public authorities at the national, regional and even international levels.

[…]

- By reducing particulate matter (PM10) pollution from 70 to 20 micrograms per cubic meter, we can cut air quality related deaths by around 15%.
- By reducing air pollution levels, we can help countries reduce the global burden of disease from respiratory infections, heart disease, and lung cancer.

[…]

- More than half of the burden from air pollution on human health is borne by people in developing countries. In many cities, the average annual levels of PM10 (the main source of which is the burning of fossil fuels) exceed 70 micrograms per cubic meter. The guidelines say that, to prevent ill health, those levels should be lower than 20 micrograms per cubic meter.

Background

Air pollution, both indoors and outdoors, is a major environmental health problem affecting everyone in developed and developing countries alike.

[…]

Key findings in 2005 Air Quality Guidelines:

- There are serious risks to health from exposure to PM and O3 in many cities of developed and developing countries. It is possible to derive a quantitative relationship between the pollution levels and specific health outcomes (increased mortality or morbidity). This allows invaluable insights into the health improvements that could be expected if air pollution is reduced.
- Even relatively low concentrations of air pollutants have been related to a range of adverse health effects.
- Poor indoor air quality may pose a risk to the health of over half of the world's population. In homes where biomass fuels and coal are used for cooking and heating, PM levels may be 10–50 times higher than the guideline values.
- Significant reduction of exposure to air pollution can be achieved through lowering the concentrations of several of the most common air pollutants emitted during the

> combustion of fossil fuels. Such measures will also reduce greenhouse gases and contribute to the mitigation of global warming."

1.2. Air pollution and mortality

One major impact of air pollution is mortality, due to:

- ✓ A short term exposition to unusually high air pollution levels: it is acute mortality;
- ✓ a long-term exposition to air pollution, which causes a worsening of their health condition because of the daily exposure to harmful pollutants. This is the impact valuated in NEEDS.

Weakest people, like already ill people, new born or elderly, are more sensible to its effects.

This section aims to detail the mortality induced by air pollution. Indeed, a meta-analysis of 109 daily time-series studies of air pollution and mortality conducted by Stieb et al. (2002) revealed that "PM_{10}, CO, NO_2, O_3, and SO_2 were all positively and significantly associated with all-cause mortality, leaving little doubt that acute exposure to air pollution is a significant contributor to mortality". In fact, they ended up with the following estimates of increased mortality associated with a change in pollutant concentration (Daily maximum concentration for O_3, daily average concentration for others):

- ✓ 2.0% per 31.3 $\mu g/m^3$ PM_{10};
- ✓ 1.7% per 1.1 ppm CO;
- ✓ 2.8% per 24.0 ppb NO_2;
- ✓ 1.6% per 31.2 ppb O_3;
- ✓ 0.9% per 9.4 ppb SO_2.

1.2.1 Particulate matter

Cohen et al. (2005) recall that outdoor air pollution is a complex mixture with many toxic components and that this mixture is indexed in terms of particulate matter (PM). For the authors "Exposure to PM has been associated with a wide range of health effects, but its effects on mortality are arguably the most important" while they assert that PM has been consistently linked with serious health effects. Besides, they claim that current scientific evidence indicates that air pollution from the combustion of fossil fuels causes a spectrum of health effects from eye irritation to death. Lehmijoki and Rovenskaya (2009) corroborate the relation between pollution and mortality as they state that there is emerging evidence that environmental degradation adds human mortality. They also state that there seems to be a consensus that of the several environmental hazards, outdoor air pollution currently causes the greatest risk to human health.

1.2.2.1 PM_{10} (particles of 10 micrometers or less) and mortality

Lambrozo and Guillossou (2007) explain that this relation is already established since time-series ecological studies have showed an association between mortality and an increase in the concentration of PM_{10} while recommended limit values were not even exceeded. In the USA, the National Mortality Morbidity and Air Pollution Study (conducted in 1987 and 1994) exposed that an increase of 10 µg/m^3 of the mean daily concentration of PM_{10} was associated with an increase of 0.21 % of the global mortality. In the other hand, the European study APHEA 2 exposed that an increase of 10 µg/m^3 of the mean daily concentration in PM_{10} or in black smoke was related to an increase of 0.4 % of the total daily mortality (ibid). This percentage is higher when high level of NO_2 were associated and the climate seemed to have an influence since with equal pollution level the mortality was higher in the southern Europe countries where mean temperatures are higher.

1.2.2.2 $PM_{2.5}$ (particles of 2.5 micrometers or less) and mortality

Ostro et al. (2006) focused on fine particles and found that each increase of 10 µg/m^3 of the concentration of $PM_{2,5}$ increased mortality by 0.6%, this estimation being the lower of all the previous studies. According to Medina et al. (2005) if annual $PM_{2.5}$ levels were reduced to 10 mg/m^3 the average reduction in the total burden of mortality among people aged 30 and over in all the cities of the program (26 cities, representing more than 40 million inhabitants) would be 3.0%. It would be 1.6% for $PM_{2.5}$ reductions to 15 µg/m^3. The benefits clearly decrease when the reduction scenarios are less ambitious, and fall to 0.8 % and 0.4 % for $PM_{2.5}$ reductions to 20 µg/m^3 and 25 µg/m^3, respectively (Ballester et al., 2007).

1.2.2.3 Does a decrease of air pollution really lead to a decrease of mortality?

Lambrozo and Guillossou (2007) claim that the question is whether a significant decrease of air pollution is followed by a significant decrease of mortality. A couple of examples tend to support that it is actually the case. In the Utah valley (an industrial site), following the interruption of the pollutant activity of a steelworks because of a 13-month strike, the reduction of the PM_{10} concentration was associated with the reduction of 3.2 % of the global mortality (beside a reduction of the number of hospitalisation). In Dublin, on the 1st September 1990, the Irish government banned the marketing, sale, and distribution of bituminous coals leading to an immediate and permanent reduction in average monthly particulate concentration (Sinclair and Clancy, 1995). This ban made possible the comparison between the global and cardiovascular mortality before and 72 months after the ban. Clancy et al. (2002) reported that the black smoke concentration was reduced by 70 % while global mortality encountered a 5.7 % decrease, the mortality due to respiratory cause a 15.5 % decrease and the mortality for cardiovascular cause a 10.3% decrease (all at the 0.1 % degree of significance). The authors mentioned that between the two analyses (before and after the ban) other risk factors (such as tobacco consumption or arterial pressure) were also reduced, but asserted that their results indicate an impact at least partial of the reducing pollution measures.

1.2.2 Effect of other pollutants than particulate matter

The effects of ozone on health have also been studied, notably with three meta-analyses (Bell et al., 2005; Ito et al., 2005; Levy et al., 2005) among which Levy et al.'s came up with the conclusion that an increase of 10 parts per billion (ppb) in the tropospheric ozone[29] leads to an increase of 0.86 % in global mortality. This result can be compared to Gryparis et al. (2004)'s as they found that ozone was a summer pollutant responsible for an increase mortality. Their analysis showed that an increase of 5 ppb (that is 10 $\mu g/m^3$) increased by 4.5% the cardiovascular mortality and by 1.13% the mortality due to pulmonary cause.

Bell et al. (2006)'s study brings another aspect: they showed that mortality occurred below current regulatory standards and guidelines for everyday of the study period. They also found that daily increases in ambient O_3 exposure are linked to premature mortality under compliance with other O_3 regulations, including some more stringent than the U.S. standard. They conclude as such: "these results indicate that current regulations, even California's new, more stringent standards, are not sufficiently low to provide complete protection against the risk of premature mortality from O_3" which raises the question of whether a threshold of innocuousness exists.

[29] The ozone found in the troposphere (the lowest portion of Earth's atmosphere) is mostly generated by humans' activity and act as a pollutant. On the other hand, the ozone found in the stratosphere (the second portion of Earth's atmosphere, i.e. just above the troposphere) and which is known as the ozone layer is what protect Earth from the sun's high frequency ultraviolet light which is potentially damaging to life on earth.

2 Appendix 2: Other terms of economic valuation

Some other terms used in economic health impact assessment are:

- ✓ damage costs: "Damage cost is the cost incurred by repercussions (effects) of direct environmental impacts (for example, from the emission of pollutants) such as the degradation of land or human—made structures and health effects. In environmental accounting, it is part of the costs borne by economic agents."(OECD, 2001);
- ✓ avoidance costs: "Avoidance costs are actual or imputed costs for preventing environmental deterioration by alternative production and consumption processes, or by the reduction of or abstention from economic activities." (OECD, 2001);
- ✓ discount rate: "The discount rate is an interest rate used to convert a future income stream to its present value" (OECD, 2001).

"Individuals and society prefer to pay costs in the future rather than now, so from today's perspective, a cost of $100 payable after 10 years is not seen to be as high as a cost of $100 payable today. The present value of $100 payable in 10 years is, therefore, less than $100. Discounting is the process of converting future costs to their present value, to reflect the fact that, in general, individuals and society have a positive rate of time preference for consumption now over consumption in the future." (World Health Organization, 2003)

3 Appendix 3: QALYs

3.1 Presentation and discussion of QALYs

QALYs were developed in the 60's by economist for cost-effectiveness analysis (Gold et al., 2002). QALYs "*attempt to combine expected survival with expected quality of life in a single metric*" (La Puma and Lawlor, 1990). A QALY equal to 1 corresponds to one year living in perfect health; a QALY equal to 0 corresponds to death. The use of QALY is based on six ethical principles (La Puma and Lawlor, 1990):

- ✓ "quality of life can be accurately measured and used;
- ✓ Utilitarianism is acceptable;
- ✓ Equity and efficiency are compatible;
- ✓ Projection of community preferences can be substitute for individual preferences;
- ✓ The old have less capacity of benefit than the young;
- ✓ Physicians will not use quality-adjusted life-years as clinical maxims."

The concept of QALY is also based on theoretical principle (Freeman, 2006):

- ✓ "''risk neutrality'' over longevity, which means that an individual is indifferent regarding patterns of mortality risks that have the same life expectancy;
- ✓ ''constant proportional trade off'' of longevity for health, which implies that the fraction of remaining longevity an individual would trade to improve his health from one state to another (for the rest of his life) does not depend on his longevity;
- ✓ an individual's preferences for health and longevity are ''utility independent'' of his wealth and future income, which means that his preferences for risks that affect health or longevity do not depend on income."

If these principles are not followed during the elaboration of QALYs (which can be difficult to know when surveying a population), QALYs are not consistent with utility theory[30] (Freeman, 2006).

The main ways of quantifying/determining QALYs are based on surveys that use the following approaches (Blomqvist, 2002):

- ✓ gambles about different health states;
- ✓ willingness to pay for different health states;
- ✓ trading off years of life for different quality of life.

The value for a QALY of a given health state differs with the survey: description of health states, of outcomes, of scales and of administration of the survey (La Puma and Lawlor, 1990). QALY can be approximated by the "capacity to benefit" of the patient and/or of his family. It could help policy deciders to allocate resources in policy elaboration because they are a measurement of cost effectiveness. They could also give the priority of the physicians and of

[30] Utility theory is based on the principle of maximizing utility: people are supposed to use their money to get the best of it.

the patients. It can be a "rationing tool" (La Puma and Lawlor, 1990) in a money limited world. But there are some issues. For example, using QALYs supposes that everybody considered that life does not worse living anymore at the same level of disability, which is clearly wrong.

3.2 Presentation and discussion of DALYs

DALYs were developed in the 90's by medical experts to compare health between populations (Gold et al., 2002). DALYs are an aggregated indicator which takes into account morbidity and mortality (Essink-Bot, 1999), with 1 being death (or extreme disability) and 0 being perfect health. The same principles as for QALYs applied for DALYs, with some differences (Sassi, 2006):

- ✓ Some authors use "age-weighting" for DALY, most of the time not for QALYs, to take into account the "normal" impairments of each age (which don't lead to a decrease of the DALY);
- ✓ DALYs are often based on expert valuation, when DALYs are most of the time based on general population or patients surveys;
- ✓ Discounting is often made in different ways: discrete for QALYs, continuous for DALYs.

Although some discussions were conducted about the reliability of this indicator, especially because of the parameters used for determining them (Anand and Hanson, 1997 ; Murray and Acharya, 1997), DALYs were used to compare some diseases, such as in the "The global burden of disease: 2004 update" from the World Health Organization (Vallier et al., 2006).

3.3 Comparing QALYs with DALYs

Differences between DALYs and QALYs can be summarized as follows (Sassi, 2006):

- ✓ QALYs "represent levels of quality of life enjoyed by individuals in particular health states", and "are normally measured on a scale in which 1 represents full health and 0 represents death, therefore higher values correspond to more desirable states and states deemed worse than death can take negative values."
- ✓ DALYs "represent levels of loss of functioning caused by diseases", and "are measured on a scale in which 0 represents no disability, therefore lower scores correspond to more desirable states."

3.4 Assessing monetary values for QALYs in the NEEDS project

QALYs and DALYs are not monetary valuations of health impacts. However, they are sometimes used in this scope because they have a large coverage in terms of diseases and in terms of space. Some studies try thus to give them a monetary value, e.g. in Pinto-Prades et al. (2009). Willingness to pay is considered by Freeman (2006) as superior to both of these indicators because the former gives real cost, used in the policy decision, what the latest do not.

3.5 Monetary values for QALYs assessed in the NEEDS project

Desaigues et al. (2006b) detailed the way of the determination of value of QALY by NEEDS team.

- ✓ Principle/Motivation: The NEEDS team acknowledges the large uncertainties of valuing mortality, i.e., the Value Of Life Year (VOLY) estimation based on contingent valuation method. The NEEDS team therefore investigates other sources of information for estimating what an appropriate VOLY could be. The main idea was to infer the implicit valuation by society by comparing a) the benefits from decisions related to public health and medical interventions made by policy makers with b) the implied costs. Medical guidelines were prioritised for the analysis. Rather than finding just one monetary value, it was sought to find upper bound and lower bound threshold values: a lower threshold below which an intervention should certainly be performed and an upper threshold beyond which interventions are certainly not considered cost-effective.
- ✓ Approach: The practical goal was thus to gather information about cost per QALY gain. The situation and data of the United Kingdom and Sweden were analysed.
- ✓ Results/Discussion/Conclusion: The conclusion is that until now none of these two governments has explicitly defined a maximal admissible value over which a treatment is not to be provided or reimbursement by public health insurance is to be refused. Nevertheless, it is generally accepted that, in the "EU16", interventions having a cost of QALY of less than 30 000 Euros are generally recommended whereas those whose costs exceed 100 000$ per QALY are in many cases rejected. In the New Member Countries (NMCs), less information is available but a lower threshold around 10 000 to 15 000 Euros/QALY is recognized as acceptable. The NEEDS team deduced from these investigations that it is reasonable to recommend a VOLY between 30 000 and 100 000 Euros for policy makers in the "EU16" although values in the NMCs could be substantially lower in the short run.

It shall be underlined that this conclusion could be globally correct. However, it is not clearly justified by the investigations. Indeed, the relationship between VOLY and cost per QALY gain is not known exactly and can probably not be deduced in a simple way, as shown by Pinto-Prades et al. (2009). Moreover, as stated by Hofsetter and Hammitt (2002), willingness to pay is the most appropriate way to monetizing health impacts (for example for cost-benefit analysis, whatever the method used -stated or revealed preferences).

4 Appendix 4: European project HEIMTSA

This section presents the results of the contingent valuation conducted within the European HEIMTSA, in the Work Stream 4 of the project[31]. The work carried out consisted on a monetary evaluation of a morbidity impact of air pollution: the chronic obstructive pulmonary disease.

It should be noted that EIFER was not an official partner of this project and that its participation relied on its own funds. Indeed, it has been contacted after the beginning of the work, following its participation in the European NEEDS project[32]*. The official results of this European project can be found in:*

- Maca V, Scasny M, Hunt A, Anneboina L, Navrud S. Presentation of the unit values for health endpoints: country specific and pooled. GOCE-CT-2006-036913-2, HEIMTSA (Health and Environment Integrated Methodology and Toolbox for Scenario Development), sixth Framework Programme, Thematic Priority 6.3; 2011. Contract No.: D 4.1.3.

- Maca V, Payre C, Scasny M. Valuation of chronic respiratory illnesses: 6-country study. European Association of Environmental and Resource Economists 19th Annual Conference; 27 - 30 June; Prague 2012.

This work was carried out within an EDF R&D project led by EIFER. This synthesis is a slightly adapted translation of the one written for this EDF project.

4.1 Data collection: creation, optimization and administration of the questionnaire

4.1.1 Method

4.1.1.1 Valued impact

The chronic obstructive pulmonary disease (COPD) -the morbidity impact assessed- , is composed of four stages: one day of cough (namely cough), chronic bronchitis (CB), moderate COPD (COPDm) and severe COPD (COPDs). The COPD, that only affects adults, is progressive and irreversible. 90% of this disease cases are caused by smoking and 10% are due to other causes, including air pollution and occupational exposure. It was interesting to assess this impact because its monetary valuation is currently poor and its impact on external cost assessment is high. It is planned to consider this value in the context of the revision of the

[31] European project HEIMTSA (FP6, 2007-2011, http://www.heimtsa.eu/ - 11 oct. 2011): aims at developing interdisciplinary tools for decision support in some key sectors (transport, agriculture, industry, waste) on environment and human health. EIFER took part to the Work Stream 4, which objective was to assess the value attributed by European population to the decrease of morbidity due to exposure to air pollution.

[32] European project NEEDS (http://www.needs-project.org/ -11 oct. 2011): aims at assessing costs and benefits of current and future energetic policies, at European level and for each country. EIFER took part to the contingent valuation of mortality due to exposure to air pollution (Desaigues et al., 2011; Desaigues et al., 2006b)

Ambient Air Quality and Cleaner Air for Europe (commonly known as the CAFE Directive) and National Emissions Ceilings ("NEC") directives.

4.1.1.2 Method

The method used is the chained contingent valuation, an adaptation of the contingent valuation method. Currently, contingent valuation method is commonly used for monetary evaluation of health impacts. It consists on directly asking a representative sample of potentially affected population how much they would be willing to pay (their willingness to pay - WTP) to avoid being affected by the studied impact. A limitation of this method relies on the fact that few people have any experience of the studied impact. The chained approach method was developed to overcome this disadvantage; it consists on three steps:

1. Valuation of a well-known impact (usually not too serious) by contingent valuation.
2. Determination of respondents' preferences between the different impacts studied without reference to a monetary evaluation.
3. Combination of the results of the two previous steps to deduct WTP, for the most serious diseases.

First, the four health stages are assessed thanks to the contingent valuation method. Then the two most serious (COPDm and COPDs) stages are assessed via the chained approach, in view to compare the results of both assessments.

4.1.2 Optimization of the questionnaire

In order to get comparable results, the questionnaire remained the same for all European countries in which it was conducted, except it has been marginally adapted for each country. Indeed, determining a WTP is an unusual and difficult exercise for respondents; realistic assessments of WTP can be expected only when the questionnaire reveals to be credible. Based on NEEDS' feedback, the questionnaire was tested beforehand, particularly in France where three series of tests were carried out over one year. Each successive iteration led to improvements in both content (e.g. description of the assessed impacts) and understandability of the questionnaire.

4.1.3 Administration of the questionnaire

The questionnaire was administered by the IPSOS Internet survey institute to a representative sample of the adult population of each country (United Kingdom, Czech Republic, Norway, France, Germany, and Greece); about with 2000 respondents in each country.

4.2 Analysis of the results

This section is based on two documents written in the frame of the European project by Maca et al. (2011) as well as an article Maca et al. (2012) to which the author participates.

4.2.1 Principle

The questionnaire allows to measure the individual WTPs of the respondents. However, the expected result of the study is a WTP representative of the country-specific populations, as well as a WTP representative of the European population (Europe of 27). To obtain this result, the "raw" measured data must be processed, involving thus different methodological choices and assumptions. This treatment was carried out by the European project team.

4.2.1.1 Processing refusals to pay

Firstly, the calculation of the mean WTP involves to know if and how many people will refuse to pay. Indeed, this refusal can have two reasons:

- ✓ Either these people really have a null WTP, e.g. because they consider that the studied impact is not serious enough so they would pay to avoid it: these are the "true 0", or legit 0.
- ✓ Or they would actually pay to avoid the studied impact, but they wish to express disagreement (e.g. considering that there are not in charge on the payment): these are the protest responses, also called "false 0", or protest 0.

These responses can be processed in three ways:

- ✓ The value 0 is assigned to the WTP of respondents that do not give a WTP, considering thus they do not have preferences for the good ("true zero"): this leads to underestimate the sample WTP.
- ✓ Or the mean sample is calculated only on the basis of the non-zero WTP expressed (we then consider that all the others are protest responses): this leads to overestimate the sample WTP.
- ✓ Or questioning why there is no WTP:
  - o people who really do not have preferences for the good, who are assigned a 0 WTP,
  - o those expressing a protest, which are then not taken into account in the analysis.

According to the authors of the European report, this final method best reflects the actual WTP but requires the ability to differentiate between the two categories of non-response. Though not explicitly specified in the report, it seems the latter method was used in the analysis of the results.

4.2.1.2 Parametric and non-parametric analyzes

The country-specific WTP representative of the surveyed population can be calculated by unconditional methods (mean and median). However, such results are limited; WTP must be depicted via characteristics (namely variables) of a person or sample. Several dedicated models are available, with various data processing and number of used variables. For our study requirements, several models were tested and compared.

4.2.2 Analysis of the results of the contingent valuation

The determination of the WTP by contingent valuation is performed in two steps:

- ✓ Closed questions: the respondent indicates whether he would be willing to pay pre-determined amounts. The interval containing his WTP is composed by the highest amount that the person is willing to pay to avoid this impact and the lowest amount that he or she is not willing to pay.
- ✓ Open-ended question to give the exact WTP.

4.2.2.1 Analysis of the results of the closed-ended questions

Table 70 presents the closed questions results, analyzed by both parametric and non-parametric method.

Impact		**Parametric analysis**		**Non-parametric analysis**	
		Mean	**Standard deviation**	**Mean**	**IC 95% (mean)**
Cough	**€/case**	36	50	26	23,8 ; 26,5
CB	**€/month**	305	742	318	304 ; 339
COPDm	**€/month**	464	919	480	459 ; 505
COPDs	**€/month**	544	838	734	698 ; 767

Table 70: Estimated WTP per impact for closed-ended questions, for all countries

The results presented in Table 70 seem logical: the highest the severity of the impact, the more the WTP increases. WTP differ between non-parametric and parametric analyses, particularly for the most severe impacts, but remain of the same order of magnitude.

The WTP measured in the different countries (except for Greece) seem consistent. They are of the same order of magnitude, though different according to the country. For CB, COPDm and COPDs impacts, the Czech Republic presents the lowest values, followed by France, Germany and the United Kingdom, while the highest values can be encountered in Norway. For cough impact, WTP are the lowest in the United Kingdom, followed by the Czech Republic, Norway and Germany, while the France presents the highest values.

4.2.2.2 Parametric analysis of open-ended questions

The results obtained in the second step of the contingent valuation (open-ended question) are analyzed in Table 71.

Impact		**Model 1 full**		**Model 2 full**	
		Mean	**Standard deviation**	**Mean**	**Standard deviation**
Cough	**€/case**	35	21	30	16
CB	**€/month**	190	98	178	74
COPDm	**€/month**	292	166	284	136
COPDs	**€/month**	416	235	443	223

Table 71: Parametric WTP estimation per illness, open question for all the countries

As for the previous analysis, the results shown in Table 71 are logical as the highest the severity of the impact, the more the WTP increases. The two models give similar results except the values obtained with the open-ended questionnaire are systematically lower than the values obtained by the closed-ended questions. As some respondents revised their WTP downwards for the second part of the contingent valuation, these results make sense. Indeed, the amounts given in response to the open-ended question are for 10% to 15% of cases below the interval defined by the interval questions (depending on the impact assessed); and higher in only 2% to 4% of cases. We can assume that the first step (determining an interval) was used for reflection, and that the open question gives a more thoughtful answer. Another possible reason is that the algorithm used to help determine WTP induces a bias in responses.

4.2.2.3 Value of a case of COPD

For each impact, a value was recommended for the EU-27. Considered in the European report as the most reliable one, the applied method consists in a parametric model based on intervals and taking into account both the probability of agreeing to pay and the amount paid. Results are presented in Table 72.

	Cough	CB	COPDm	COPDs
Non-parametric analysis, closed question	26 €	38 990 €	58 852 €	89 995 €
Open question	29 €	21 506 €	34 698 €	54 316 €
Recommend valued 27- Europe Parametric analysis, closed-question	36 €	38 254 €	58 362 €	65 841 €

Table 72: Value for one case for each impact, for the Europe 27 countries

The values for one case of each impact presented in Table 72. It differs according to the approach used, especially for the more severe impacts. The results of open-ended and closed questions reveal significant differences. It underlines the need to test the potential biases due to the algorithm, which would lead respondents to give WTP greater than their actual WTP. These results clearly demonstrate that each data processing step choices greatly influence the obtained value.

4.2.3 Results of the chained approach

4.2.3.1 Principle

With the chained method, it is possible to deduce WTP for respondents' not well-known impacts from WTP of a known impact. For the well-known impact, the WTP is determined by contingent valuation, then the respondent's preferences for other impacts are determined without requiring a monetary valuation. Thereby this study compares the WTP measured by the contingent valuation method to those obtained by the chained method. In addition, in this study, several "chains" -i.e. sequences between the different impacts studied- were tested to better understand this experimental method.

4.2.3.2 Results

Table 73 presents the results of the chained approach.

Impact			Value derived from the one of	All countries	Results of contingent valuation
COPDm	€/case	Simple chain 1	CB	89 732	58 362
COPDs	€/case	Simple chain 2	COPDm	138 771	65 841
		Simple chain 3	COPDm	87 870	65 841
		Double chain	COPDm (from chain 1)	215 961	65 841

Table 73: Results of the chained approach

The results for severe COPD, in Table 73, show a high variability depending on the chosen chain. In one case, the value obtained for severe COPD is slightly lower than that obtained for moderate COPD, which is not logic. Finally, these values are much higher than those obtained by contingent valuation. This raises questions about the reliability of the results obtained by this method.

4.3 Conclusion and perspectives

4.3.1 Evolution of the monetary value of a COPD case

The value previously associated with a COPD case was €200,000. It was determined in a methodological study, which did not precisely defined the studied impact. Therefore, this value was questionable.

4.3.2 Limitations of the study

4.3.2.1 Analysis of the results

The values derived from the contingent valuation method seem consistent, as they increase with the severity of the impact. On the one hand, chained method results present inconsistencies; their reliability may be questioned. On the other hand, the values obtained in Greece are included in this result. The obtained results seem inconsistent: the WTP measured in Greece are the highest, whereas Greek wages are the lowest European ones. The questionnaire for this country did not benefit from the same preparatory work as for the other countries. It would therefore be interesting to conduct further analyses of the results, to determine the influence of Greek WTP on the total values.

4.2.3.2 Influence of the cause of the disease on WTP

COPD is mainly caused by smoking (active or passive) and to a lesser extent by air pollution. However, the causes of the disease are not mentioned in the questionnaire. Some studies -such as the one conducted by Rozan and Willinger (1999)- show that the cause of the impact could influence the WTP reported by respondents. Therefore, the influence of this information on the causes of the impact studied on WTP should be investigated.

4.3.2.3 Influence of the WTP determination assistance algorithm

The assistance algorithm for the determination of WTP seems to induce a bias in respondents' responses, which is difficult to quantify within the results of this first wave of surveys. It would be interesting to study the influence of this assistance in determining WTP on the obtained responses.

4.3.2.4 Presentation of the questionnaire

Despite the efforts made to facilitate reading of the questionnaire (and thus ensure that respondents fully understand the given information), some parts remain very dense. In addition, the need to keep questionnaires quite similar in the six countries of the study required keeping some sentences not well adapted to the case of France, which could lead to misunderstanding for part of the French respondents.

4.3.3 Perspectives

These last three aspects are being studied as part of a second wave of research, planned for 2012, to better determine whether and to what extent, they have an influence on WTP.

All the results obtained should be subject to further analysis, in order to better target policy and methodological recommendations:

- ✓ Results of the first wave: analysis of the results without Greece answers, to determine the possible repercussions of poorly measured values for a country on European values; on both the country-specific survey values and the EU-27 ones.
- ✓ Results of the second wave: extensive statistical analysis to determine the sensitivity of the results, regarding the various factors mentioned above.

In general, a better understanding of the choices made during the European team's results analysis would allow a better understanding of the recommendations and their regulatory consequences.

5 Appendix 5: COPD

5.1 What is COPD?

The American Thoracic Society and the European Respiratory Society give the following definition in their guide about COPD (ERS and ATS, 2009): "Chronic obstructive lung disease (COPD) describes a group of lung conditions (diseases) that make it difficult to empty the air out of the lungs. This difficulty can lead to shortness of breath (also called breathlessness) or the feeling of being tired. COPD is a word that can be used to describe a person with chronic bronchitis, emphysema or a combination of these. COPD is a different condition from asthma, but it can be difficult to distinguish between COPD and chronic asthma." Another definition is given by the World Health Organization (2009): "Chronic Obstructive Pulmonary Disease (COPD) is not one single disease but an umbrella term used to describe chronic lung diseases that cause limitations in lung airflow. The more familiar terms 'chronic bronchitis' and 'emphysema' are no longer used, but are now included within the COPD diagnosis."

COPD can also be referred to as (but actually belongs to) Chronic Obstructive Lung Diseases (COLD[33]), Chronic Obstructive Airway Diseases (COAD), Chronic Airway Limitations (CAL) and Chronic Obstructive Respiratory Diseases.

A normal chronic bronchitis (CB) exists when people regularly cough up sputum (more than three months per year within two consecutive years). It is a reversible chronic illness. The obstruction part of the COPD appears when the airways in the lungs become narrowed, which leads to a limitation of the flow of air to and from the lungs causing shortness of breath. COPD is irreversible. The confusion is often made with chronic bronchitis, which was also a former name of COPD.

In France, a plan to fight COPD is running from 2005 to 2010 to decrease morbidity and mortality rate caused by COPD, and to increase the quality of life of ill people (Biron et al., 2005).

COPD is an illness characterized by the destruction of alveoli in lungs. It is an irreversible illness with as main symptom high difficulties to breath. It has disturbing consequences on daily life.

For the survey descried here, the main problem may be the lack of precision of the definition of COPD: some illnesses which are COPD are called chronic bronchitis, and the wording COPD may be used for other diseases. So it will be needed to be very precise on the definitions used in the survey.

[33] COLD, listed in the International Classification of Diseases (ICD-10) under the code J40-44, includes in reality COPD (Bousquet and Khaltaev, 2007)

5.2 Symptoms

The main symptoms of COPD are coughing, sputum and shortness of breath (World Health Organization, 2009). The diagnosis is confirmed by a spirometry test, which estimates the level of obstruction by measuring the quantity of air in the lung. The degradation of the lung and alveoli is irreversible.

COPD also has consequences on cardiac, muscular, bone diseases, and also on patients' social life because of the activity restriction (Andreas et al., 2009). Obstructive chronic bronchitis and emphysema can also cause high blood pressure and lead to heart diseases. The risk of dying of dyspnoea, cough or sputum is also well known (Frostad et al., 2006). A co-morbidity of COPD is asthma in 9.4% of cases, more than half of the patients fell depressed, 40% have difficulties in everyday life, 45% have problem to walk. However, COPD is often associated with other diseases caused by air pollution, such as cardiac conditions, lung cancer and other respiratory diseases (Frostad et al., 2006). People do not really know COPD, as shown in a phone study in France where only 8% of the surveyed people knew COPD, whereas 63% knew emphysema and 93% chronic bronchitis (Biron et al., 2005). Therefore COPD is associated with a degradation of life quality.

COPD has several stages (Bousquet and Khaltaev, 2007) which are shown on the Figure 43.

Stage	Characteristics
I: Mild	$FEV_1/FVC < 70\%$ $FEV_1 \geq 80\%$ predicted
II: Moderate	$FEV_1/FVC < 70\%$ $50\% \leq FEV_1 < 80\%$ predicted
III: Severe	$FEV_1/FVC < 70\%$ $30\% \leq FEV_1 < 50\%$ predicted
IV: Very severe	$FEV_1/FVC < 70\%$ $FEV_1 < 30\%$ predicted Or $FEV_1 < 50\%$ predicted plus chronic respiratory failure

FEV_1, forced expiratory volume in one second; FVC, forced vital capacity.

Figure 43: Classification of the severity of chronic obstructive pulmonary disease, based on post-bronchodilator FEV1 (Bousquet and Khaltaev, 2007)

One question for our work is that although there are international definitions, each doctor or institution has a personal view of the disease, with his own definitions of every stage. These differences lead to confusion when comparing different health stages and when speaking with partners or interviewees. Moreover, it can lead to double counting when counting the number of cases of the disease, because of the same cases counted many times under different names.

The main symptoms of COPD are cough, sputum and shortness of breath. However, COPD is composed of four different stages, from mild to very severe. These stages differ by the seriousness; which implies differences in the pain and suffering and in the cost of illness. Therefore, these stages have to be valued separately.

5.3 Treatment and outcomes

Treatments do not stop the disease nor cure it. They can only slow its evolution. Smokers are strongly advised to quit smoking. The use of bronchodilators, anti-inflammatory drugs and antibiotics can help to ease the airflow and prevent possible infections. Corticoids can also reduce irritation, swelling and mucus production. Vaccination against pneumonia may reduce the risk of inflammation and hence the risk of COPD. Intermittent or permanent oxygen therapy can be used as a treatment of last resort. The lung use can also be improved: patients should keep having regular activities in order to avoid losing any more lung power (ERS and ATS ; Warren, 2004).

The risk of dying from COPD depends on the age of the patient, stage of the disease, smoking habits, health status (diabetes), lifestyle and treatment.

When considering the economic valuation of COPD due to air pollution, morbidity and mortality costs could be mixed up. Indeed, several COPDs lead to long-term suffering (morbidity) followed by death (mortality). Furthermore, these two parts interact with each other: in the case of better air quality, the drop in morbidity implies a fall in the mortality because the number of ill people decreases. So confusion between the costs of morbidity (studied here) and mortality could arise.

There is no treatment to cure or to stop COPD. They only slow its development.

5.4 Prevalence and mortality

In Europe and Northern America, 8% to 13% of inhabitants suffer from COPD. The prevalence of COPD in France has been estimated in 2003 at the level 7.5%, far below the rates in other countries (Fuhrman et al., 2008): 20% in United States of America and Canada, 15% in Germany. This tendency is corroborated by the mortality rates for lower respiratory symptoms, which COPD belongs to. But two thirds of the ill people are probably not diagnosed, an issue which exists in all countries according to “la Direction Générale De La Santé” (2007).

A point for the HEIMTSA chained contingent valuation study is that only adults can be affected by COPD, not children. So this survey will only assess the health impact of air pollution among adults. For children, other health endpoints have to be chosen (such as those used in NEEDS, cf. (Desaigues et al., 2011; Desaigues et al., 2006b)). Adults over 40 years old, and particularly over 65 years old, are more at risk (Warren, 2004). The COPD prevalence sex ratio female/male is 0.6 (Biron et al., 2005), but female cases are rising because of the increasing smoking habit of women. In almost all countries, the poorest people's risk of developing chronic respiratory diseases is the greatest (greater exposure to risks and more difficult access to health service). From a global health perspective, more than 50% of the people affected by avoidable chronic respiratory diseases are deprived populations (or live in low or average income countries) (Biron et al., 2005).

COPD is the world's fifth cause of death and is becoming more and more prevalent (Bousquet and Khaltaev, 2007). Chronic Respiratory Disease account for 7% of deaths and 4% of DALY[34] worldwide (Bousquet and Khaltaev, 2007) as represented on the Figure 44.

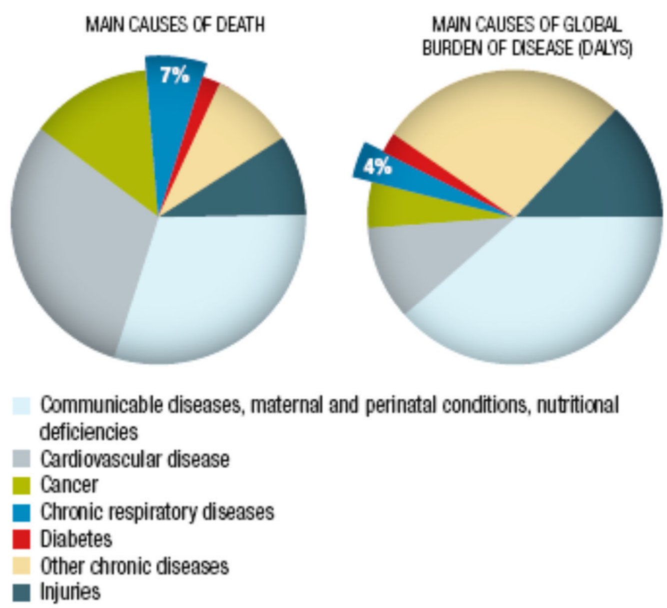

Figure 44: Projected global deaths and disability–adjusted life years (DALYs) in 2005 (Bousquet and Khaltaev, 2007)

In France COPD is the main cause of death in 1.4% of all deaths, and is mentioned as a cause in 3% of all deaths (DGS et al., 2007). This rate is lower than in other countries, as confirmed in the Eurostat figures presented in Table 74. These figures concerned all lower respiratory symptoms, which COPD belongs to (classification: J40-J44), which explains why they are so high. However, they give an indication of the impacts of all lower respiratory symptoms in Europe.

[34] "DALYs, disability adjusted life years, are an aggregated indicator which takes into account morbidity and mortality (Essink-Bot, 1999), with 1 being death (or extreme disability) and 0 being perfect health."
"One DALY can be thought of as one lost year of "healthy" life, and the burden of disease can be thought of as a measurement of the gap between current health status and an ideal situation where everyone lives into old age, free of disease and disability." (World Health Organization, 2004)

All ages	Men	Women	All (2001-2003)	All (1999-2001)
France	16.1	5.5	9.5	12.9
Ireland	48.9	25.2	34.1	41.1
Netherlands	47.9	19	29.1	31.1
Norway	33.5	20	24.9	25.6
Spain	46.1	9.5	23.8	26.6
Germany	31.6	12.2	19.3	19.7
Austria	34.6	14	21.5	17.9
Italy (2000-2002)	30.1	9.1	16.9	17.9
Sweden	20.9	14.5	16.8	16.4
Finland	29.8	7.2	15.3	16.5
Swiss	25.4	9.5	15.4	17.2
Total (E.U. 27)	33.4	12.6	20.4	22.3

Table 74: Eurostat – Standard mortality rates for 100 000 inhabitants (mean 3 years) for lower respiratory symptoms (classification J40 –J47) (own translation) (DGS et al., 2007)

COPD is of high interests because of its high prevalence and mortality rates:

- The prevalence of COPD is about 10% in developed countries, with a high number of non-diagnosed people.

- It is the world's fifth cause of death, which represents around 3% of death in France.

The number of non-diagnosed people may be a problem for our work, as respondents may consider this illness as negligible because they do not know it.

6 Appendix 6: Description of the non-treated sample

6.1 Socioeconomic status

Figure 45 shows on the left side the proportion of men and women in the four variants of the questionnaire and overall, and on right side the number of respondents in each category.

Sex		Variant of the questionnaire				Total
		No context	full context	Air pollution	Smoking	
men	%	39.3%	39.5%	43.3%	49.4%	43,4%
women	%	60.7%	60.5%	56.7%	50.6%	56,6%
Total	%	100.0%	100.0%	100.0%	100.0%	100.0%

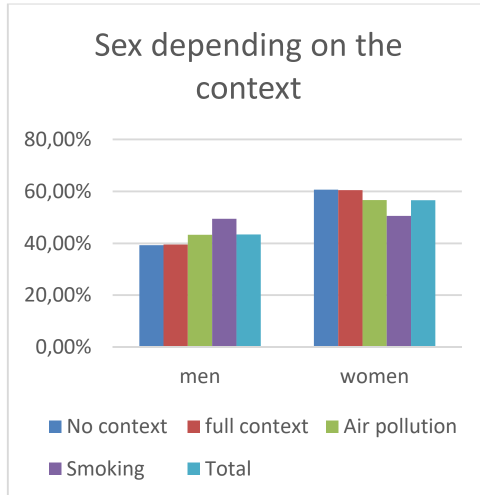

Figure 45: Repartition by sex over the four variants and overall

Figure 45 underlines that the proportions of men and women among the respondents is quite stable except for smoking is provided as context, where men are overrepresented.

Figure 46 shows the marital status of the respondents for each variant and overall.

Marital status	Variant of the questionnaire				Total
	No context	Full context	Air pollution	Smoking	
single	35.2%	25.1%	32.5%	17.0%	26,9%
married	57.5%	66.3%	58.1%	66.4%	62,2%
divorced	6.7%	6.2%	6.8%	14.5%	9,0%
widower	.6%	2.4%	2.6%	2.1%	1,9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

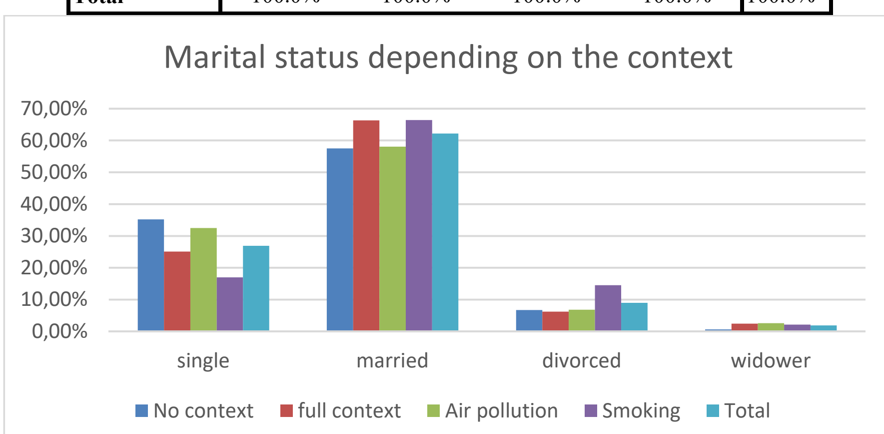

Figure 46: Marital status of the respondents

As shown by the previous figure, there are differences between the marital statuses of the respondents answering the different variants.

Figure 47 represents the level of education of the respondents.

Education	Variant of the questionnaire				Total
	No context	Full context	Air pollution	Smoking	
brevet	38.7%	64.6%	34.5%	29.4%	40.2%
A-level	24.6%	17.9%	24.5%	26.3%	23.7%
A-level+2	15.2%	8.6%	21.7%	23.8%	18.1%
bachelor	9.7%	5.2%	9.7%	8.9%	8.5%
master or +	11.7%	3.8%	9.7%	11.7%	9.6%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

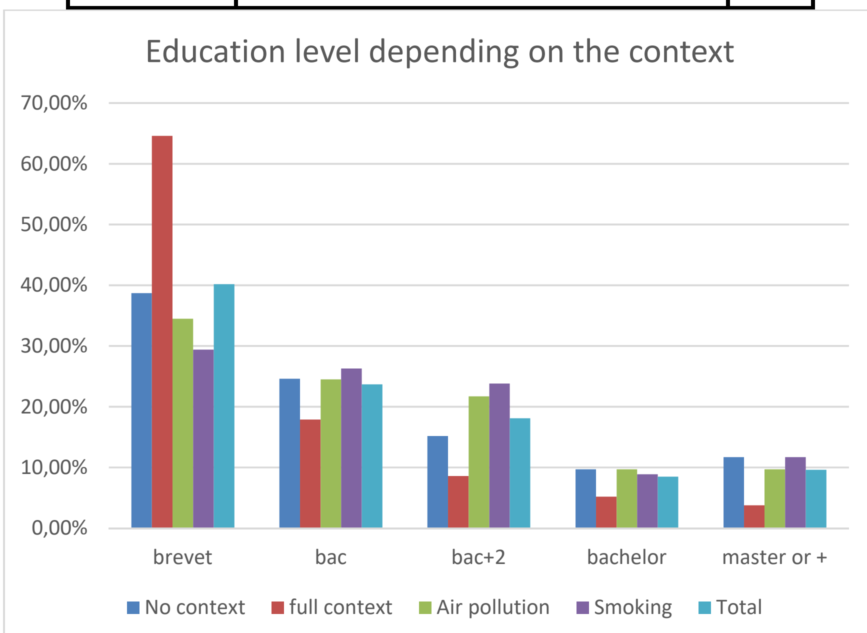

Figure 47: Education of the respondents

As for the others parameters, there are important differences between variants of the questionnaire regarding the level of education of the respondents.

Figure 48 represents the occupation of the respondents. As before, there are important differences between the variants. However. as activity is usually linked with education. it is consistent.

main occupation	Variant of the questionnaire				
	No context	full context	Air pollution	Smoking	Total
No answer	.0%	.0%	.0%	.5%	.1%
liberal profession	2.9%	3.8%	1.1%	4.9%	3.3%
full-time employee	43.4%	37.8%	31.3%	53.1%	42.2%
part-time employee	11.1%	9.6%	7.1%	10.5%	9.6%
student or pupil	12.3%	15.8%	14.8%	.0%	9.9%
housewife/man	6.7%	3.8%	1.4%	3.0%	3.7%
retired person	6.5%	13.4%	28.8%	17.0%	16.6%
without professional activity	10.6%	10.0%	10.8%	5.8%	9.1%
sick/disability leave	1.5%	1.4%	1.1%	2.3%	1.6%
other	5.0%	4.5%	3.4%	2.8%	3.8%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

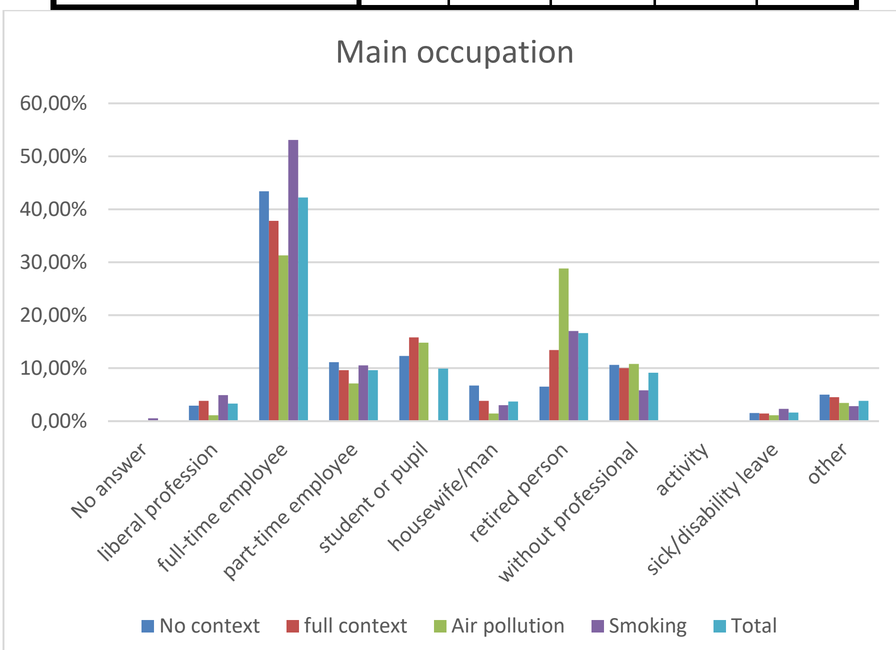

Figure 48: Occupation of the respondents

Figure 49 gives the income of the respondents. with as before differences across variants. However, there are no large differences between the proportions of respondents who do not indicate their income. So no variant of the questionnaire makes respondents more uneasy than the others so they do not want to give their income.

own net monthly income (€)	Variant of the questionnaire				Total
	No context	Full context	Air pollution	Smoking	
<600	15.0%	13.1%	17.7%	5.1%	12.3%
600-1000	11.4%	13.1%	10.0%	10.5%	11.1%
1001-1500	27.0%	27.5%	18.8%	18.6%	22.5%
1501-2000	15.0%	17.2%	21.1%	26.3%	20.4%
2001-3000	12.0%	7.9%	14.5%	20.5%	14.4%
3001-5000	4.4%	3.8%	4.8%	7.9%	5.5%
5001-7000	1.8%	.7%	.0%	.9%	.8%
>7001	.3%	.0%	.0%	.2%	.1%
No answer	13.2%	16.8%	13.1%	9.8%	12.9%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

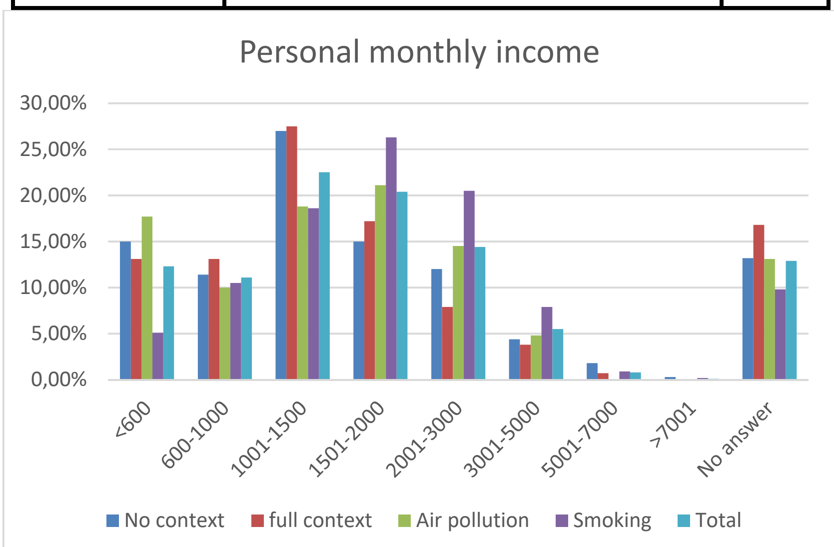

Figure 49: Income of the respondents

Figure 50 shows the household income of the respondents, with the same conclusions as before.

household net monthly income (€)	Variant of the questionnaire				Total
	No context	full context	Air pollution	Smoking	
<600	3.2%	3.4%	8.3%	1.2%	3.9%
600-1000	6.2%	5.2%	3.7%	5.8%	5.2%
1001-1500	15.0%	16.5%	11.7%	8.6%	12.5%
1501-2000	14.1%	14.8%	16.8%	14.7%	15.1%
2001-3000	24.6%	24.7%	24.5%	29.4%	26.1%
3001-5000	19.4%	17.9%	18.2%	26.3%	20.9%
5001-10000	5.9%	2.4%	2.6%	4.0%	3.8%
>10001	1.2%	.7%	.3%	.2%	.6%
No answer	10.6%	14.4%	14.0%	9.8%	12.0%
Total	100.0%	100.0%	100.0%	100.0%	100.0%

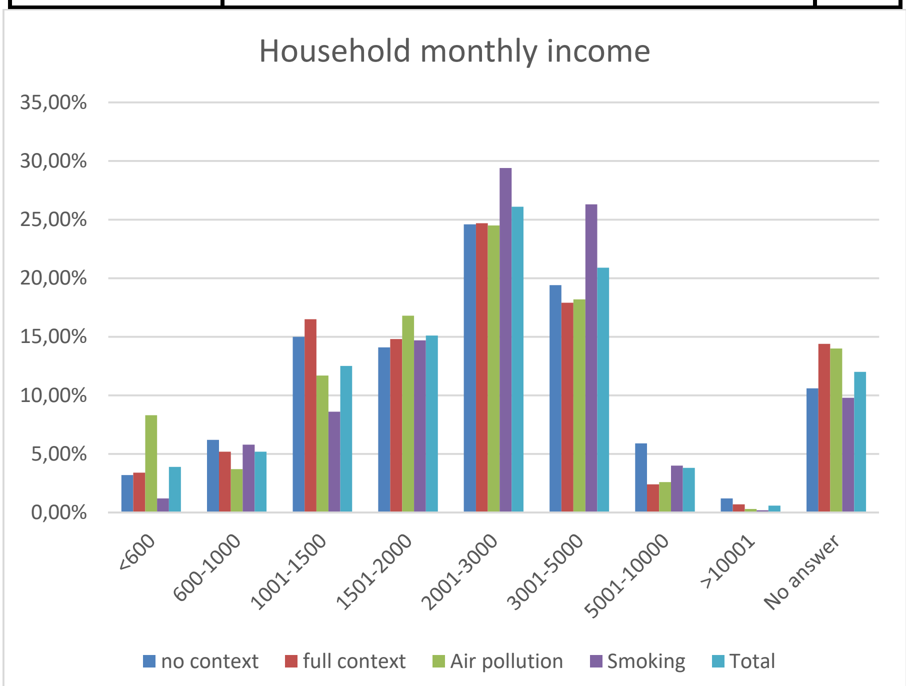

Figure 50: Household income of the respondents

Depending on the variant, the respondents do not have the same socio-economic profile. The main impacts on the WTP may be on the link between income and WTP, as the income as a high influence on the WTP.

6.2 Health Status

Figure 51 shows how respondents assess their own health status.

your health condition compared others your own age	no context	full context	Air pollution	Smoking	Total
well above average	8.80%	7.60%	6.60%	7.70%	7.60%
above average	22.30%	16.50%	24.80%	19.10%	20.80%
average	58.10%	61.90%	56.10%	60.10%	59.00%
below average	9.70%	11.30%	10.30%	11.00%	10.60%
well below average	1.20%	2.70%	2.30%	2.10%	2.10%
Total	100.00%	100.00%	100.00%	100.00%	

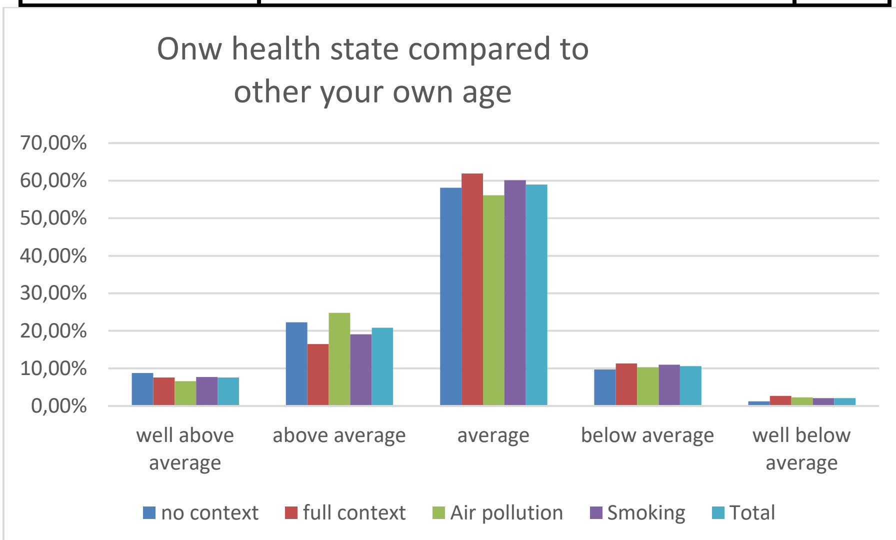

Figure 51: Health state of the respondents

Figure 51 highlights some slight differences between self-assessed health states of the respondents between the variants. However, a Chi2 test shows that these differences are not statistically significant. So there are no important differences between health status of the respondents in the different variants of the questionnaire.

Moreover, 2.6% of the respondents have a Chronic Bronchitis, and around 7.7% have a relative who have one; with no statistically significant differences between the variants. So, the respondents of the four variants have comparable health status.

7 Appendix 7: Reasons for not paying depending on the context

Table 75: Cough – reason for not paying

Cough		Variant				Total
		No context	Full context	Air pollution	Smoking	
I don't trust this treatment	Count	10	4	9	11	34
		4.4%	2.3%	3.6%	3.3%	3.5%
The national health service should pay this treatment	Count	17	12	21	25	75
	%	7.4%	6.9%	8.5%	7.5%	7.6%
I can't afford this treatment	Count	10	14	19	24	67
	%	4.4%	8.0%	7.7%	7.2%	6.8%
One day of cough is not severe enough to pay to avoid it	Count	70	51	73	73	267
	%	30.6%	29.1%	29.6%	21.9%	27.1%
I don't trust the information I have been given	Count	5	3	9	5	22
	%	2.2%	1.7%	3.6%	1.5%	2.2%
My health expenses are already too high	Count	3	6	4	20	33
	%	1.3%	3.4%	1.6%	6.0%	3.4%
Another reason	Count	9	4	8	7	28
	%	3.9%	2.3%	3.2%	2.1%	2.8%
Total	Count	229	175	247	333	984
	%	100.0%	100.0%	100.0%	100.0%	100.0%

Table 76 CB: – reason for not paying

CB		Variant				Total
		No context	Full context	Air pollution	Smoking	
I don't trust this treatment	Count	6	1	6	4	17
	%	2.60%	0.60%	2.40%	1.20%	1.70%
The national health service should pay this treatment	Count	27	17	16	29	89
	%	11.80%	9.70%	6.50%	8.70%	9.00%
I can't afford this treatment	Count	8	16	22	25	71
	%	3.50%	9.10%	8.90%	7.50%	7.20%
This health state is not severe enough to pay to avoid it	Count	10	14	7	9	40
	%	4.40%	8.00%	2.80%	2.70%	4.10%
I don't trust the information I have been given	Count	5	4	5	9	23
	%	2.20%	2.30%	2.00%	2.70%	2.30%
My health expenses are already too high	Count	5	8	5	11	29
	%	2.20%	4.60%	2.00%	3.30%	2.90%
I have only a low risk or no risk at all to experience this illness	Count	3	1	6	4	14
	%	1.30%	0.60%	2.40%	1.20%	1.40%
Total	Count	229	175	247	333	984
	%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 77 COPDm – reason for not paying

COPDm		Variant				Total
		No context	Full context	Air pollution	Smoking	
I don't trust this treatment	Count	7	2	4	4	17
	%	3.10%	1.10%	1.60%	1.20%	1.70%
The national health service should pay this treatment	Count	23	14	18	33	88
	%	10.00%	8.00%	7.30%	9.90%	8.90%
I can't afford this treatment	Count	13	17	19	21	70
	%	5.70%	9.70%	7.70%	6.30%	7.10%
This health state is not severe enough to pay to avoid it	Count	4	5	2	1	12
	%	1.70%	2.90%	0.80%	0.30%	1.20%
I don't trust the information I have been given	Count	3	4	5	5	17
	%	1.30%	2.30%	2.00%	1.50%	1.70%
My health expenses are already too high	Count	5	8	6	6	25
	%	2.20%	4.60%	2.40%	1.80%	2.50%
I have only a low risk or no risk at all to experience this illness	Count	4	2	4	3	13
	%	1.70%	1.10%	1.60%	0.90%	1.30%
Total	Count	229	175	247	333	984
	%	100.00%	100.00%	100.00%	100.00%	100.00%

Table 78 COPDS – reason for not paying

COPDs		Variant				Total
		No context	Full context	Air pollution	Smoking	
I don't trust this treatment	Count	9	1	3	6	19
	%	3.9%	.6%	1.2%	1.8%	1.9%
The national health service should pay this treatment	Count	23	15	11	30	79
	%	10.0%	8.6%	4.5%	9.0%	8.0%
I can't afford this treatment	Count	11	18	16	23	68
	%	4.8%	10.3%	6.5%	6.9%	6.9%
This health state is not severe enough to pay to avoid it	Count	2	2	0	0	4
	%	.9%	1.1%	.0%	.0%	.4%
I don't trust the information I have been given	Count	1	1	5	5	12
	%	.4%	.6%	2.0%	1.5%	1.2%
My health expenses are already too high	Count	5	4	2	6	17
	%	2.2%	2.3%	.8%	1.8%	1.7%
I have only a low risk or no risk at all to experience this illness	Count	6	1	6	4	17
	%	2.6%	.6%	2.4%	1.2%	1.7%
Total	Count	229	175	247	333	984
	%	100.0%	100.0%	100.0%	100.0%	100.0%

8 Appendix 8: Respondent who pay or not, smoking status and context

Table 79: Post hoc test willing to pay or not, per illness, and per smoking status

Entire sample (984 respondents) - in grey: statistically significant

			LSD			Bonferroni		
	Smoking status (I)	Smoking status (J)	Mean difference (I-J)	Standard error	Sig.	Mean difference (I-J)	Standard error	Sig.
Cough	smoker	non-smoker	.018	.040	.648	.018	.040	1.000
		former smoker	.015	.048	.752	.015	.048	1.000
	non-smoker	smoker	-.018	.040	.648	-.018	.040	1.000
		former smoker	-.003	.040	.934	-.003	.040	1.000
	former smoker	smoker	-.015	.048	.752	-.015	.048	1.000
		non-smoker	.003	.040	.934	.003	.040	1.000
CB	smoker	non-smoker	.011	.036	.771	.011	.036	1.000
		former smoker	-.009	.043	.837	-.009	.043	1.000
	non-smoker	smoker	-.011	.036	.771	-.011	.036	1.000
		former smoker	-.020	.036	.588	-.020	.036	1.000
	former smoker	smoker	.009	.043	.837	.009	.043	1.000
		non-smoker	.020	.036	.588	.020	.036	1.000
COPDm	smoker	non-smoker	-.006	.035	.859	-.006	.035	1.000
		former smoker	-.008	.041	.848	-.008	.041	1.000
	non-smoker	smoker	.006	.035	.859	.006	.035	1.000
		former smoker	-.002	.034	.960	-.002	.034	1.000
	former smoker	smoker	.008	.041	.848	.008	.041	1.000
		non-smoker	.002	.034	.960	.002	.034	1.000
COPDs	smoker	non-smoker	-.017	.033	.614	-.017	.033	1.000
		former smoker	-.016	.040	.680	-.016	.040	1.000
	non-smoker	smoker	.017	.033	.614	.017	.033	1.000
		former smoker	.000	.033	.988	.000	.033	1.000
	former smoker	smoker	.016	.040	.680	.016	.040	1.000
		non-smoker	.000	.033	.988	.000	.033	1.000

Table 80: Respondent who pay or not, smoking status and context

Variant			Cough				CB				COPDm				COPDs			
			Smoker	Non-Smoker	Former smoker	Total	Smoker	Non-smoker	Former smoker	Total	Smoker	Non-smoker	Former smoker	Total	Smoker	Non-smoker	Former smoker	Total
no context	yes	Count	28	59	18	105	42	93	30	165	46	93	31	170	43	96	33	172
		%	50.90%	45.70%	40.00%	45.90%	76.40%	72.10%	66.70%	72.10%	83.60%	72.10%	68.90%	74.20%	78.20%	74.40%	73.30%	75.10%
	no	Count	27	70	27	124	13	36	15	64	9	36	14	59	12	33	12	57
		%	49.10%	54.30%	60.00%	54.10%	23.60%	27.90%	33.30%	27.90%	16.40%	27.90%	31.10%	25.80%	21.80%	25.60%	26.70%	24.90%
	Total	Count	55	129	45	229	55	129	45	229	55	129	45	229	55	129	45	229
		%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
full context	yes	Count	18	46	17	81	25	61	28	114	25	70	28	123	29	76	28	133
		%	50.00%	44.70%	47.20%	46.30%	69.40%	59.20%	77.80%	65.10%	69.40%	68.00%	77.80%	70.30%	80.60%	73.80%	77.80%	76.00%
	no	Count	18	57	19	94	11	42	8	61	11	33	8	52	7	27	8	42
		%	50.00%	55.30%	52.80%	53.70%	30.60%	40.80%	22.20%	34.90%	30.60%	32.00%	22.20%	29.70%	19.40%	26.20%	22.20%	24.00%
	Total	Count	36	103	36	175	36	103	36	175	36	103	36	175	36	103	36	175
		%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Air pollution	yes	Count	17	61	26	104	35	104	41	180	34	113	42	189	37	121	46	204
		%	36.20%	42.40%	46.40%	42.10%	74.50%	72.20%	73.20%	72.90%	72.30%	78.50%	75.00%	76.50%	78.70%	84.00%	82.10%	82.60%
	no	Count	30	83	30	143	12	40	15	67	13	31	14	58	10	23	10	43
		%	63.80%	57.60%	53.60%	57.90%	25.50%	27.80%	26.80%	27.10%	27.70%	21.50%	25.00%	23.50%	21.30%	16.00%	17.90%	17.40%
	Total	Count	47	144	56	247	47	144	56	247	47	144	56	247	47	144	56	247
		%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Smoking	yes	Count	40	86	42	168	52	128	62	242	56	137	67	260	56	136	67	259
		%	51.90%	50.30%	49.40%	50.50%	67.50%	74.90%	72.90%	72.70%	72.70%	80.10%	78.80%	78.10%	72.70%	79.50%	78.80%	77.80%
	no	Count	37	85	43	165	25	43	23	91	21	34	18	73	21	35	18	74
		%	48.10%	49.70%	50.60%	49.50%	32.50%	25.10%	27.10%	27.30%	27.30%	19.90%	21.20%	21.90%	27.30%	20.50%	21.20%	22.20%
	Total	Count	77	171	85	333	77	171	85	333	77	171	85	333	77	171	85	333
		%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Table 81: Post hoc test willing to pay or not, between variants, per illness, and per smoking status

Entire sample (984 respondents) - in grey: statistically significant

				No context			Full context			Air pollution			Smoking		
				Mean difference (I-J)	Standard error	Sig.	Mean difference (I-J)	Standard error	Sig.	Mean difference (I-J)	Standard error	Sig.	Mean difference (I-J)	Standard error	Sig.
Cough - pay or not	**LSD**	**smoker**	**non-smoker**	0.052	0.081	0.521	0.053	0.097	0.584	-0.062	0.083	0.458	0.017	0.069	0.810
			former smoker	0.109	0.101	0.279	0.028	0.118	0.815	-0.103	0.098	0.296	0.025	0.079	0.748
		non-smoker	**smoker**	-0.052	0.081	0.521	-0.053	0.097	0.584	0.062	0.083	0.458	-0.017	0.069	0.810
			former smoker	0.057	0.087	0.508	-0.026	0.097	0.793	-0.041	0.078	0.603	0.009	0.067	0.895
		former smoker	**smoker**	-0.109	0.101	0.279	-0.028	0.118	0.815	0.103	0.098	0.296	-0.025	0.079	0.748
			non-smoker	-0.057	0.087	0.508	0.026	0.097	0.793	0.041	0.078	0.603	-0.009	0.067	0.895
	Bonferroni	**smoker**	**non-smoker**	0.052	0.081	1.000	0.053	0.097	1.000	-0.062	0.083	1.000	0.017	0.069	1.000
			former smoker	0.109	0.101	0.837	0.028	0.118	1.000	-0.103	0.098	0.889	0.025	0.079	1.000
		non-smoker	**smoker**	-0.052	0.081	1.000	-0.053	0.097	1.000	0.062	0.083	1.000	-0.017	0.069	1.000
			former smoker	0.057	0.087	1.000	-0.026	0.097	1.000	-0.041	0.078	1.000	0.009	0.067	1.000
		former smoker	**smoker**	-0.109	0.101	0.837	-0.028	0.118	1.000	0.103	0.098	0.889	-0.025	0.079	1.000
			non-smoker	-0.057	0.087	1.000	0.026	0.097	1.000	0.041	0.078	1.000	-0.009	0.067	1.000
CB - pay or not	**LSD**	**smoker**	**non-smoker**	0.043	0.073	0.557	0.102	0.092	0.268	0.022	0.075	0.765	-0.073	0.061	0.233
			former smoker	0.097	0.091	0.285	-0.083	0.112	0.457	0.013	0.088	0.887	-0.054	0.070	0.442
		non-smoker	**smoker**	-0.043	0.073	0.557	-0.102	0.092	0.268	-0.022	0.075	0.765	0.073	0.061	0.233
			former smoker	0.05426357	0.078	0.487	-.186*	0.092	0.045	-0.010	0.070	0.888	0.019	0.059	0.747
		former smoker	**smoker**	-0.097	0.091	0.285	0.083	0.112	0.457	-0.013	0.088	0.887	0.054	0.070	0.442
			non-smoker	-0.05426357	0.078	0.487	.186*	0.092	0.045	0.010	0.070	0.888	-0.019	0.059	0.747
	Bonferroni	**smoker**	**non-smoker**	0.043	0.073	1.000	0.102	0.092	0.803	0.022	0.075	1.000	-0.073	0.061	0.700
			former smoker	0.097	0.091	0.856	-0.083	0.112	1.000	0.013	0.088	1.000	-0.054	0.070	1.000
		non-smoker	**smoker**	-0.043	0.073	1.000	-0.102	0.092	0.803	-0.022	0.075	1.000	0.073	0.061	0.700
			former smoker	0.054	0.078	1.000	-0.186	0.092	0.135	-0.010	0.070	1.000	0.019	0.059	1.000
		former smoker	**smoker**	-0.097	0.091	0.856	0.083	0.112	1.000	-0.013	0.088	1.000	0.054	0.070	1.000
			non-smoker	-0.054	0.078	1.000	0.186	0.092	0.135	0.010	0.070	1.000	-0.019	0.059	1.000
COPDm - pay or not	**LSD**	**smoker**	**non-smoker**	0.115	0.070	0.102	0.015	0.089	0.868	-0.061	0.072	0.392	-0.074	0.057	0.195
			former smoker	.147*	0.088	0.094	-0.083	0.108	0.443	-0.027	0.084	0.752	-0.061	0.065	0.351
			smoker	-0.115	0.070	0.102	-0.015	0.089	0.868	0.061	0.072	0.392	0.074	0.057	0.195

		non-smoker	**former smoker**	0.032	0.076	0.672	-0.098	0.089	0.271	0.035	0.067	0.605	0.013	0.055	0.814
		former smoker	**smoker**	-.147*	0.088	0.094	0.083	0.108	0.443	0.027	0.084	0.752	0.061	0.065	0.351
			non-smoker	-0.032	0.076	0.672	0.098	0.089	0.271	-0.035	0.067	0.605	-0.013	0.055	0.814
	Bonferroni	**smoker**	**non-smoker**	0.115	0.070	0.307	0.015	0.089	1.000	-0.061	0.072	1.000	-0.074	0.057	0.585
			former smoker	0.147	0.088	0.283	-0.083	0.108	1.000	-0.027	0.084	1.000	-0.061	0.065	1.000
		non-smoker	**smoker**	-0.115	0.070	0.307	-0.015	0.089	1.000	0.061	0.072	1.000	0.074	0.057	0.585
			former smoker	0.032	0.076	1.000	-0.098	0.089	0.814	0.035	0.067	1.000	0.013	0.055	1.000
		former smoker	**smoker**	-0.147	0.088	0.283	0.083	0.108	1.000	0.027	0.084	1.000	0.061	0.065	1.000
			non-smoker	-0.032	0.076	1.000	0.098	0.089	0.814	-0.035	0.067	1.000	-0.013	0.055	1.000
COPDs - pay or not	**LSD**	**smoker**	**non-smoker**	0.038	0.070	0.592	0.068	0.083	0.417	-0.053	0.064	0.408	-0.068	0.057	0.235
			former smoker	0.048	0.087	0.580	0.028	0.101	0.784	-0.034	0.075	0.650	-0.061	0.066	0.353
		non-smoker	**smoker**	-0.038	0.070	0.592	-0.068	0.083	0.417	0.053	0.064	0.408	0.068	0.057	0.235
			former smoker	0.011	0.075	0.886	-0.040	0.083	0.632	0.019	0.060	0.754	0.007	0.055	0.898
		former smoker	**smoker**	-0.048	0.087	0.580	-0.028	0.101	0.784	0.034	0.075	0.650	0.061	0.066	0.353
			non-smoker	-0.011	0.075	0.886	0.040	0.083	0.632	-0.019	0.060	0.754	-0.007	0.055	0.898
	Bonferroni	**smoker**	**non-smoker**	0.038	0.070	1.000	0.068	0.083	1.000	-0.053	0.064	1.000	-0.068	0.057	0.705
			former smoker	0.048	0.087	1.000	0.028	0.101	1.000	-0.034	0.075	1.000	-0.061	0.066	1.000
		non-smoker	**smoker**	-0.038	0.070	1.000	-0.068	0.083	1.000	0.053	0.064	1.000	0.068	0.057	0.705
			former smoker	0.011	0.075	1.000	-0.040	0.083	1.000	0.019	0.060	1.000	0.007	0.055	1.000
		former smoker	**smoker**	-0.048	0.087	1.000	-0.028	0.101	1.000	0.034	0.075	1.000	0.061	0.066	1.000
			non-smoker	-0.011	0.075	1.000	0.040	0.083	1.000	-0.019	0.060	1.000	-0.007	0.055	1.000

Table 82: Post hoc test for reason for not paying, between variants, per illness, and per smoking status

Entire sample (984 respondents) - in grey: statistically significant

				No context			Full context			Air pollution			Smoking		
				Mean difference (I-J)	**Standard error**	**Sig.**	**Mean difference (I-J)**	**Standard error**	**Sig.**	**Mean difference (I-J)**	**Standard error**	**Sig.**	**Mean difference (I-J)**	**Standard error**	**Sig.**
Cough - pay or not	**LSD**	**smoker**	**non-smoker**	.072	.100	.472	.061	.110	.578	-.150	.095	.116	-.062	.086	.471
			former smoker	.148	.120	.219	-.009	.134	.948	-.033	.115	.772	-.065	.098	.508
		non-smoker	**smoker**	-.072	.100	.472	-.061	.110	.578	.150	.095	.116	.062	.086	.471
			former smoker	.076	.100	.446	-.070	.108	.517	.116	.095	.221	-.003	.081	.973
		former smoker	**smoker**	-.148	.120	.219	.009	.134	.948	.033	.115	.772	.065	.098	.508
			non-smoker	-.076	.100	.446	.070	.108	.517	-.116	.095	.221	.003	.081	.973
	Bonferroni	**smoker**	**non-smoker**	.072	.100	1.000	.061	.110	1.000	-.150	.095	.349	-.062	.086	1.000
			former smoker	.148	.120	.656	-.009	.134	1.000	-.033	.115	1.000	-.065	.098	1.000
		non-smoker	**smoker**	-.072	.100	1.000	-.061	.110	1.000	.150	.095	.349	.062	.086	1.000
			former smoker	.076	.100	1.000	-.070	.108	1.000	.116	.095	.664	-.003	.081	1.000
		former smoker	**smoker**	-.148	.120	.656	.009	.134	1.000	.033	.115	1.000	.065	.098	1.000
			non-smoker	-.076	.100	1.000	.070	.108	1.000	-.116	.095	.664	.003	.081	1.000
CB - pay or not	**LSD**	**smoker**	**non-smoker**	.282*	.159	.081	-.145	.165	.382	-.092	.161	.571	.112	.127	.381
			former smoker	.215	.186	.251	.045	.226	.841	.183	.189	.336	.035	.146	.812
		non-smoker	**smoker**	-.282*	.159	.081	.145	.165	.382	.092	.161	.571	-.112	.127	.381
			former smoker	-.067	.151	.660	.190	.188	.314	.275*	.148	.068	-.077	.130	.557
		former smoker	**smoker**	-.215	.186	.251	-.045	.226	.841	-.183	.189	.336	-.035	.146	.812
			non-smoker	.067	.151	.660	-.190	.188	.314	-.275*	.148	.068	.077	.130	.557
	Bonferroni	**smoker**	**non-smoker**	.282	.159	.242	-.145	.165	1.000	-.092	.161	1.000	.112	.127	1.000
			former smoker	.215	.186	.753	.045	.226	1.000	.183	.189	1.000	.035	.146	1.000
		non-smoker	**smoker**	-.282	.159	.242	.145	.165	1.000	.092	.161	1.000	-.112	.127	1.000
			former smoker	-.067	.151	1.000	.190	.188	.942	.275	.148	.203	-.077	.130	1.000
		former smoker	**smoker**	-.215	.186	.753	-.045	.226	1.000	-.183	.189	1.000	-.035	.146	1.000
			non-smoker	.067	.151	1.000	-.190	.188	.942	-.275	.148	.203	.077	.130	1.000

COPDm - pay or not	**LSD**	**smoker**	**non-smoker**	.139	.189	.465	.091	.170	.595	-.139	.157	.379	.218	.138	.117
			former smoker	.127	.217	.560	.352	.227	.127	.324*	.183	.081	.183	.159	.255
		non-smoker	**smoker**	-.139	.189	.465	-.091	.170	.595	.139	.157	.379	-.218	.138	.117
			former smoker	-.012	.160	.941	.261	.193	.181	.463*	.153	.004	-.036	.144	.804
		former smoker	**smoker**	-.127	.217	.560	-.352	.227	.127	-.324*	.183	.081	-.183	.159	.255
			non-smoker	.012	.160	.941	-.261	.193	.181	-.463*	.153	.004	.036	.144	.804
	Bonferroni	**smoker**	**non-smoker**	.139	.189	1.000	.091	.170	1.000	-.139	.157	1.000	.218	.138	.350
			former smoker	.127	.217	1.000	.352	.227	.381	.324	.183	.244	.183	.159	.766
		non-smoker	**smoker**	-.139	.189	1.000	-.091	.170	1.000	.139	.157	1.000	-.218	.138	.350
			former smoker	-.012	.160	1.000	.261	.193	.542	.463*	.153	.011	-.036	.144	1.000
		former smoker	**smoker**	-.127	.217	1.000	-.352	.227	.381	-.324	.183	.244	-.183	.159	.766
			non-smoker	.012	.160	1.000	-.261	.193	.542	-.463*	.153	.011	.036	.144	1.000
COPDs - pay or not	**LSD**	**smoker**	**non-smoker**	.06413	.05671	.259	.01375	.05781	.812	-.05777	.04467	.197	.00722	.04517	.873
			former smoker	.08687	.07078	.221	.02778	.07038	.694	.01862	.05260	.724	.06081	.05178	.241
		non-smoker	**smoker**	-.06413	.05671	.259	-.01375	.05781	.812	.05777	.04467	.197	-.00722	.04517	.873
			former smoker	.02274	.06096	.710	.01402	.05781	.809	.07639*	.04188	.069	.05359	.04368	.221
		former smoker	**smoker**	-.08687	.07078	.221	-.02778	.07038	.694	-.01862	.05260	.724	-.06081	.05178	.241
			non-smoker	-.02274	.06096	.710	-.01402	.05781	.809	-.07639*	.04188	.069	-.05359	.04368	.221
	Bonferroni	**smoker**	**non-smoker**	.06413	.05671	.778	.01375	.05781	1.000	-.05777	.04467	.591	.00722	.04517	1.000
			former smoker	.08687	.07078	.663	.02778	.07038	1.000	.01862	.05260	1.000	.06081	.05178	.723
		non-smoker	**smoker**	-.06413	.05671	.778	-.01375	.05781	1.000	.05777	.04467	.591	-.00722	.04517	1.000
			former smoker	.02274	.06096	1.000	.01402	.05781	1.000	.07639	.04188	.208	.05359	.04368	.662
		former smoker	**smoker**	-.08687	.07078	.663	-.02778	.07038	1.000	-.01862	.05260	1.000	-.06081	.05178	.723
			non-smoker	-.02274	.06096	1.000	-.01402	.05781	1.000	-.07639	.04188	.208	-.05359	.04368	.662

9 Appendix 9: Pay or not - Probit model

Table 83: COPDm – Pay or not – Probit full model
Pseudo R²(McFadden) = 0.103, Sample size = 984, In grey: significant variable

COPDm Pay or not – Probit full model		Estimation	Standard Error	Wald	Sig.
	Constant	16.010	11.094	2.083	.149
Emplacement	Birth year	.008	.006	2.019	.155
	Household size	.038	.042	.800	.371
	Household Income	1.300E-5	2.481E-5	.274	.600
	Context = no context	-.117	.180	.418	.518
	Context = full context	-.129	.145	.788	.375
	Context =Air pollution	.052	.172	.092	.761
	Context =smoking	0[a]	.	.	.
	Health = Well above average	-.366	.403	.824	.364
	Health = Above average	-.463	.380	1.489	.222
	Health = Average	-.388	.367	1.119	.290
	Health = Below average	-.398	.381	1.092	.296
	Health = Well below average	0[a]	.	.	.
	Hospital last year = yes	.200	.363	.304	.581
	Hospital last year = no	0[a]	.	.	.
	Sport = Every day	-.138	.213	.419	.517
	Sport = Several times a week	.150	.163	.847	.357
	Sport = Several times a month	.377	.169	4.981	.026
	Sport = Only rarely	.161	.152	1.123	.289
	Sport = Never	0[a]	.	.	.
	Dwelling = Heavily air polluted	.241	.225	1.156	.282
	Dwelling = Somewhat air polluted	.008	.154	.003	.959
	Dwelling = Slightly air polluted	-.040	.132	.092	.761
	Dwelling = Not air polluted	0[a]	.	.	.
	Diet = Better than average	.229	.213	1.161	.281
	Diet = About average	.190	.187	1.037	.309
	Diet = Below average	0[a]	.	.	.
	Smoker	-.134	.144	.856	.355
	Non -Smoker	-.126	.121	1.077	.299
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	5.259	.000	.	.
	Think illness avoidable = Yes	.522	.103	25.592	.000
	Think illness avoidable = No	0[a]	.	.	.
	Risky leisure = Yes	.638	.355	3.241	.072
	Risky leisure = No	0[a]	.	.	.
	Risky occupation = Yes	.005	.126	.001	.970
	Risky occupation = No	0[a]	.	.	.
	Sex = Male	-.191	.104	3.343	.067
	Sex = Female	0[a]	.	.	.
	Marital status = single	-.007	.353	.000	.984
	Marital status = Married	.129	.340	.144	.704
	Marital status = Divorced	.054	.361	.022	.882
	Marital status = Widower	0[a]	.	.	.
	Education = Brevet des Collèges	-.218	.190	1.314	.252
	Education = A-level	-.123	.192	.415	.519
	Education = A-level+2	.130	.204	.407	.523

	Education = Bachelor	-.298	.225	1.758	.185
	Education = Master +	0[a]	.	.	.
	Main occupation = no answer	5.717	7477.574	.000	.999
	Main occupation = Liberal	.610	.368	2.751	.097
	Main occupation = Fulltime employee	.516	.234	4.861	.027
	Main occupation = Parttime employee	.413	.269	2.358	.125
	Main occupation = Student	.482	.306	2.491	.115
	Main occupation = Housewife/husband	.859	.372	5.344	.021
	Main occupation = Retired	.192	.261	.543	.461
	Main occupation = None	.480	.268	3.194	.074
	Main occupation = Medical/disability leave	.524	.445	1.387	.239
	Main occupation = Other	0[a]	.	.	.
	Occupation related health = Yes	.183	.157	1.354	.245
	Occupation related health = No	0[a]	.	.	.
	Donation charity last year = Yes	.252	.127	3.917	.048
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	.236	.133	3.129	.077
	Health insurance = No	0[a]	.	.	.

Table 84: CB – Pay or not – Probit full model
Pseudo R²(McFadden) = 0.062, Sample size = 984, In grey: significant variable

CB Pay or not – Probit full model		**Estimation**	**Standard Error**	**Wald**	**Sig.**
	Constant	-8.479	10.415	.663	.416
Emplacement	**Birth year**	-.005	.005	.748	.387
	Household size	.000	.040	.000	.993
	Household Income	2.542E-5	2.316E-5	1.205	.272
	Context = no context	.143	.171	.700	.403
	Context = full context	-.159	.138	1.318	.251
	Context =Air pollution	.161	.163	.969	.325
	Context =smoking	0[a]	.	.	.
	Health = Well above average	-.246	.388	.400	.527
	Health = Above average	-.369	.364	1.025	.311
	Health = Average	-.211	.352	.357	.550
	Health = Below average	-.447	.365	1.495	.221
	Health = Well below average	0[a]	.	.	.
	Hospital last year = yes	.156	.344	.205	.651
	Hospital last year = no	0[a]	.	.	.
	Sport = Every day	-.109	.210	.268	.605
	Sport = Several times a week	-.055	.158	.122	.727
	Sport = Several times a month	.002	.161	.000	.989
	Sport = Only rarely	.042	.149	.080	.777
	Sport = Never	0[a]	.	.	.
	Dwelling = Heavily air polluted	-.066	.207	.101	.750
	Dwelling = Somewhat air polluted	-.032	.147	.047	.828
	Dwelling = Slightly air polluted	-.080	.127	.396	.529
	Dwelling = Not air polluted	0[a]	.	.	.
	Diet = Better than average	.334	.203	2.706	.100
	Diet = About average	.200	.178	1.267	.260

	Diet = Below average	0[a]	.	.	.
	Smoker	-.053	.138	.145	.703
	Non -Smoker	-.110	.116	.900	.343
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	5.327	.000	.	.
	Think illness avoidable = Yes	.373	.099	14.092	.000
	Think illness avoidable = No	0[a]	.	.	.
	Risky leisure = Yes	.442	.301	2.159	.142
	Risky leisure = No	0[a]	.	.	.
	Risky occupation = Yes	.007	.120	.004	.951
	Risky occupation = No	0[a]	.	.	.
	Sex = Male	-.210	.100	4.420	.036
	Sex = Female	0[a]	.	.	.
	Marital status = single	-.046	.351	.017	.896
	Marital status = Married	-.029	.340	.007	.932
	Marital status = Divorced	-.111	.360	.095	.758
	Marital status = Widower	0[a]	.	.	.
	Education = Brevet des Collèges	.111	.174	.410	.522
	Education = A-level	.125	.174	.518	.472
	Education = A-level+2	.254	.181	1.959	.162
	Education = Bachelor	.091	.208	.193	.660
	Education = Master +	0[a]	.	.	.
	Main occupation = no answer	-.037	.952	.002	.969
	Main occupation = Liberal	.952	.359	7.040	.008
	Main occupation = Fulltime employee	.737	.225	10.699	.001
	Main occupation = Parttime employee	.568	.256	4.923	.027
	Main occupation = Student	.807	.289	7.777	.005
	Main occupation = Housewife/husband	.771	.332	5.399	.020
	Main occupation = Retired	.312	.252	1.537	.215
	Main occupation = None	.514	.257	3.990	.046
	Main occupation = Medical/disability leave	.537	.420	1.631	.202
	Main occupation = Other	0[a]	.	.	.
	Occupation related health = Yes	.105	.146	.520	.471
	Occupation related health = No	0[a]	.	.	.
	Donation charity last year = Yes	.198	.119	2.756	.097
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	.285	.128	5.004	.025
	Health insurance = No	0[a]	.	.	.

Table 85: Cough – Pay or not – Probit full model
Pseudo R²(McFadden) = 0.56, Sample size = 984, In grey: significant variable

Cough Pay or not – Probit full model		Estimation	Standard Error	Wald	Sig.
	Constant	-25.561	9.850	6.734	.009
Emplacement	Birth year	-.013	.005	6.923	.009
	Household size	.104	.038	7.760	.005
	Household Income	-1.427E-5	2.139E-5	.445	.505
	Context = no context	.067	.159	.179	.672
	Context = full context	-.028	.132	.044	.833
	Context =Air pollution	-.066	.151	.192	.661
	Context =smoking	0[a]	.	.	.
	Health = Well above average	-.855	.371	5.324	.021
	Health = Above average	-.771	.348	4.898	.027
	Health = Average	-.637	.337	3.577	.059
	Health = Below average	-.728	.351	4.315	.038
	Health = Well below average	0[a]	.	.	.
	Hospital last year = yes	.400	.326	1.503	.220
	Hospital last year = no	0[a]	.	.	.
	Sport = Every day	.047	.203	.053	.817
	Sport = Several times a week	.133	.152	.776	.378
	Sport = Several times a month	-.047	.154	.092	.762
	Sport = Only rarely	.004	.144	.001	.978
	Sport = Never	0[a]	.	.	.
	Dwelling = Heavily air polluted	.101	.194	.271	.603
	Dwelling = Somewhat air polluted	-.008	.138	.003	.956
	Dwelling = Slightly air polluted	-.045	.118	.144	.705
	Dwelling = Not air polluted	0[a]	.	.	.
	Diet = Better than average	.367	.203	3.281	.070
	Diet = About average	.313	.182	2.958	.085
	Diet = Below average	0[a]	.	.	.
	Smoker	.099	.129	.593	.441
	Non -Smoker	.018	.107	.029	.866
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = no answer	6.072	.000	.	.
	Think illness avoidable = Yes	.176	.096	3.352	.067
	Think illness avoidable = No	0[a]	.	.	.
	Risky leisure = Yes	.462	.257	3.240	.072
	Risky leisure = No	0[a]	.	.	.
	Risky occupation = Yes	-.118	.114	1.077	.299
	Risky occupation = No	0[a]	.	.	.
	Sex = Male	-.106	.094	1.267	.260
	Sex = Female	0[a]	.	.	.
	Marital status = single	-.187	.327	.325	.568
	Marital status = Married	-.269	.317	.722	.395
	Marital status = Divorced	-.350	.337	1.080	.299
	Marital status = Widower	0[a]	.	.	.
	Education = Brevet des Collèges	.086	.163	.281	.596
	Education = A-level	-.033	.163	.041	.840
	Education = A-level+2	.143	.167	.734	.392
	Education = Bachelor	.090	.194	.218	.640
	Education = Master +	0[a]	.	.	.

	Main occupation = no answer	-5.980	.000	.	.
	Main occupation = Liberal	.253	.327	.597	.440
	Main occupation = Fulltime employee	.386	.225	2.941	.086
	Main occupation = Parttime employee	.229	.253	.819	.365
	Main occupation = Student	.130	.286	.206	.650
	Main occupation = Housewife/husband	.508	.314	2.618	.106
	Main occupation = Retired	.139	.250	.310	.578
	Main occupation = None	.140	.258	.295	.587
	Main occupation = Medical/disability leave	-.064	.418	.023	.879
	Main occupation = Other	0[a]	.	.	.
	Occupation related health = Yes	-.143	.133	1.158	.282
	Occupation related health = No	0[a]	.	.	.
	Donation charity last year = Yes	.186	.113	2.735	.098
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	.257	.120	4.604	.032
	Health insurance = No	0[a]	.	.	.

10 Appendix 10: Pay or not; legit vs protest answer - probit model

Table 86: COPDm - Protest 0 vs legit 0 – Probit full model

Pseudo R²(McFadden) = 0.155, Sample size = 242, In grey: Statistically significant parameters

COPDm Protest 0 vs legit 0 – Probit full model		Estimation	Sig.
	Constant	-1.160	.962
Parameters	Birth year	-.001	.930
	Household size	.093	.309
	Household Income	.000	.050
	Context = no context	-.192	.608
	Context = full context	.487	.084
	Context =Air pollution	.053	.878
	Context =smoking	0a	.
	Health = Well above average	.305	.701
	Health = Above average	.183	.804
	Health = Average	.107	.883
	Health = Below average	-.475	.534
	Health = Well below average	0a	.
	Hospital last year = yes	-.135	.865
	Hospital last year = no	0a	.
	Sport = Every day	.574	.168
	Sport = Several times a week	-.276	.376
	Sport = Several times a month	-.090	.792
	Sport = Only rarely	-.405	.157
	Sport = Never	0a	.
	Dwelling = Heavily air polluted	-.780	.104
	Dwelling = Somewhat air polluted	-.147	.632
	Dwelling = Slightly air polluted	.081	.761
	Dwelling = Not air polluted	0a	.
	Diet = Better than average	-.104	.798
	Diet = About average	.109	.760
	Diet = Below average	0a	.
	Smoker	.712	.015
	Non -Smoker	.308	.205
	Former Smoker	0a	.
	Think illness avoidable = Yes	.212	.294
	Think illness avoidable = No	0a	.
	Risky leisure = Yes	-.373	.681
	Risky leisure = No	0a	.
	Risky occupation = Yes	.128	.633
	Risky occupation = No	0a	.
	Sex = Male	-.412	.062
	Sex = Female	0a	.
	Marital status = single	.452	.477

	Marital status = Married	.319	.587
	Marital status = Divorced	.611	.336
	Marital status = Widower	0a	.
	Education = Brevet des Collèges	.303	.460
	Education = A-level	.148	.733
	Education = A-level+2	.016	.972
	Education = Bachelor	.255	.585
	Education = Master +	0a	.
	Main occupation = Liberal	.905	.277
	Main occupation = Fulltime employee	.345	.460
	Main occupation = Parttime employee	-.286	.585
	Main occupation = Student	-.177	.771
	Main occupation = Housewife/husband	-.433	.618
	Main occupation = Retired	.380	.459
	Main occupation = None	.485	.359
	Main occupation = Medical/disability leave	.251	.755
	Main occupation = Other	0a	.
	Occupation related health = Yes	-.030	.933
	Occupation related health = No	0a	.
	Donation charity last year = Yes	.132	.623
	Donation charity last year = No	0a	.
	Health insurance = Yes	-.293	.259
	Health insurance = No	0a	.

Table 87: CB - Protest 0 vs legit 0 – Probit full model

Pseudo R²(McFadden) = 0.161, Sample size = 283, In grey: Statistically significant parameters

CB - Protest 0 vs legit 0 Probit full model		**Estimation**	**Sig.**
	Constant	-2.967	.889
Parameters	**Birth year**	.002	.832
	Household size	-.065	.407
	Household Income	-3.153E-5	.467
	Context = no context	-.256	.455
	Context = full context	.155	.543
	Context =Air pollution	.145	.653
	Context =smoking	0[a]	.
	Health = Well above average	-1.163	.158
	Health = Above average	-1.188	.125
	Health = Average	-.934	.216
	Health = Below average	-1.330	.085
	Health = Well below average	0[a]	.
	Hospital last year = yes	-6.237	.999
	Hospital last year = no	0[a]	.
	Sport = Every day	.558	.185
	Sport = Several times a week	.071	.808
	Sport = Several times a month	.091	.778

	Sport = Only rarely	-.395	.155
	Sport = Never	0[a]	.
	Dwelling = Heavily air polluted	-.270	.501
	Dwelling = Somewhat air polluted	.058	.838
	Dwelling = Slightly air polluted	.150	.541
	Dwelling = Not air polluted	0[a]	.
	Diet = Better than average	.225	.569
	Diet = About average	.294	.392
	Diet = Below average	0[a]	.
	Smoker	.308	.255
	Non -Smoker	.007	.975
	Former Smoker	0[a]	.
	Think illness avoidable = Yes	.315	.088
	Think illness avoidable = No	0[a]	.
	Risky leisure = Yes	-.365	.593
	Risky leisure = No	0[a]	.
	Risky occupation = Yes	.228	.339
	Risky occupation = No	0[a]	.
	Sex = Male	-.463	.017
	Sex = Female	0[a]	.
	Marital status = single	-6.899	.000
	Marital status = Married	-6.671	.000
	Marital status = Divorced	-6.891	.
	Marital status = Widower	0[a]	.
	Education = Brevet des Collèges	.126	.706
	Education = A-level	.057	.868
	Education = A-level+2	.238	.509
	Education = Bachelor	-.282	.487
	Education = Master +	0[a]	.
	Main occupation = no answer	-5.958	.999
	Main occupation = Liberal	.840	.263
	Main occupation = Fulltime employee	.348	.344
	Main occupation = Parttime employee	-.195	.650
	Main occupation = Student	.638	.217
	Main occupation = Housewife/husband	-.195	.762
	Main occupation = Retired	-.024	.953
	Main occupation = None	.524	.222
	Main occupation = Medical/disability leave	.062	.933
	Main occupation = Other	0[a]	.
	Occupation related health = Yes	-.096	.752
	Occupation related health = No	0[a]	.
	Donation charity last year = Yes	-.020	.932
	Donation charity last year = No	0[a]	.
	Health insurance = Yes	-.019	.938
	Health insurance = No	0[a]	.

Table 88: One day of cough - Protest 0 vs legit 0 – Probit full model
Pseudo R²(McFadden) = 0.129, Sample size = 526, In grey: Statistically significant parameters

One day of cough Protest 0 vs legit 0 – Probit full model		Estimation	Standard Error	Wald	Sig.
	Constant	40.893	16.040	6.499	.011
Parameters	Birth year	.021	.008	6.780	.009
	Household size	-.081	.060	1.833	.176
	Household Income	4.124E-5	3.525E-5	1.368	.242
	Context = no context	-.384	.256	2.253	.133
	Context = full context	.122	.210	.338	.561
	Context =Air pollution	-.440	.243	3.274	.070
	Context =smoking	0[a]	.	.	.
	Health = Well above average	.114	.627	.033	.856
	Health = Above average	.267	.597	.200	.654
	Health = Average	.089	.587	.023	.880
	Health = Below average	-.511	.597	.733	.392
	Health = Well below average	0[a]	.	.	.
	Hospital last year = yes	-1.024	.572	3.207	.073
	Hospital last year = no	0[a]	.	.	.
	Sport = Every day	-.019	.306	.004	.950
	Sport = Several times a week	.062	.234	.071	.790
	Sport = Several times a month	.303	.240	1.601	.206
	Sport = Only rarely	-.001	.214	.000	.997
	Sport = Never	0[a]	.	.	.
	Dwelling = Heavily air polluted	.372	.313	1.414	.234
	Dwelling = Somewhat air polluted	.270	.211	1.631	.202
	Dwelling = Slightly air polluted	.251	.178	1.982	.159
	Dwelling = Not air polluted	0[a]	.	.	.
	Diet = Better than average	-.144	.285	.257	.612
	Diet = About average	-.036	.249	.021	.884
	Diet = Below average	0[a]	.	.	.
	Smoker	.024	.201	.014	.905
	Non -Smoker	-.078	.171	.207	.649
	Former Smoker	0[a]	.	.	.
	Think illness avoidable = Yes	.385	.146	6.975	.008
	Think illness avoidable = No	0[a]	.	.	.
	Risky leisure = Yes	-.481	.425	1.278	.258
	Risky leisure = No	0[a]	.	.	.
	Risky occupation = Yes	-.034	.176	.036	.849
	Risky occupation = No	0[a]	.	.	.
	Sex = Male	-.354	.148	5.771	.016
	Sex = Female	0[a]	.	.	.
	Marital status = single	-.542	.680	.637	.425
	Marital status = Married	-.648	.663	.955	.328
	Marital status = Divorced	-.649	.687	.892	.345
	Marital status = Widower	0[a]	.	.	.

	Education = Brevet des Collèges	-.100	.256	.153	.696
	Education = A-level	.003	.260	.000	.990
	Education = A-level+2	-.059	.271	.047	.829
	Education = Bachelor	.028	.325	.007	.931
	Education = Master +	0[a]	.	.	.
	Main occupation = no answer	-.453	.989	.210	.647
	Main occupation = Liberal	.721	.541	1.777	.183
	Main occupation = Fulltime employee	.397	.318	1.557	.212
	Main occupation = Parttime employee	.475	.369	1.664	.197
	Main occupation = Student	.097	.403	.058	.810
	Main occupation = Housewife/husband	1.621	.715	5.138	.023
	Main occupation = Retired	.727	.365	3.974	.046
	Main occupation = None	.401	.358	1.258	.262
	Main occupation = Medical/disability leave	.677	.562	1.450	.228
	Main occupation = Other	0[a]	.	.	.
	Occupation related health = Yes	.399	.229	3.046	.081
	Occupation related health = No	0[a]	.	.	.
	Donation charity last year = Yes	.071	.189	.140	.708
	Donation charity last year = No	0[a]	.	.	.
	Health insurance = Yes	-.210	.178	1.397	.237
	Health insurance = No	0[a]	.	.	.

11 Appendix 11: WTP - Lognormal model

Table 89: COPDs WTP – Lognormal model

R²adjusted = 0.443, sample size 674, In grey: sigma <0.1

	COPDs				
	Coefficients non standard		Coefficients standard	t	Sig.
	B	Standard error	Bêta		
(Constant)	-3.454	3.393		-1.018	.309
Context = full context	-.074	.071	-.049	-1.038	.300
Context =Air pollution	-.061	.053	-.048	-1.161	.246
Context =smoking	-.085	.065	-.072	-1.312	.190
Health = Well above average	.020	.070	.009	.293	.770
Health = Above average	-.011	.046	-.008	-.237	.813
Health = Below average	.069	.058	.038	1.180	.239
Health = Well below average	.241	.140	.056	1.723	.085
Preexisting condition: Chronic bronchitis	-.024	.123	-.006	-.198	.843
Hospital last year	-.011	.137	-.002	-.079	.937
WTP: 1st proposed amount CODPs	2.109E-5	.000	.051	1.659	.098
WTP: lowest proposed amount CODPs	.001	.000	.537	15.755	.000
WTP: highest proposed amount CODPs	-6.696E-6	.000	-.014	-.420	.675
WTP criteria: illness duration	-.005	.035	-.004	-.142	.887
WTP criteria: other	-.005	.020	-.008	-.271	.786
WTP criteria: comparison with usual health expenses	.083	.026	.108	3.238	.001
WTP criteria: pain	-.063	.039	-.051	-1.590	.112
WTP criteria: living standard	.040	.030	.043	1.314	.189
WTP criteria: long term effects of the illness	-.094	.038	-.081	-2.494	.013
Planning to pay – personal income	.050	.041	.044	1.227	.220
Planning to pay - savings	-.011	.060	-.006	-.183	.855
Planning to pay – other	-.283	.075	-.125	-3.759	.000
Sport = Every day	.092	.089	.040	1.030	.303
Sport = Several times a week	.022	.065	.017	.338	.736
Sport = Several times a month	.067	.065	.051	1.038	.300
Sport = Only rarely	-.014	.062	-.012	-.231	.818
Dwelling = Heavily air polluted	-.038	.080	-.017	-.473	.636
Dwelling = Somewhat air polluted	-.037	.056	-.027	-.661	.509
Dwelling = Slightly air polluted	-.007	.048	-.006	-.145	.885
Diet = better than average	.013	.043	.009	.294	.769
Diet = below than average	.022	.079	.009	.278	.781
Smoker	-.049	.054	-.035	-.907	.365
Non-Smoker	-.071	.045	-.063	-1.596	.111
Difficulties to assess WTP – I do not know my usual health expenses	-.083	.047	-.057	-1.765	.078
Difficulties to assess WTP – I do not know how much costs medicaments	.017	.037	.015	.461	.645
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.061	.034	.057	1.823	.069
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.056	.038	.046	1.465	.143

Difficulties to assess WTP – illnesses are similar	-.097	.064	-.049	-1.506	.132
Difficulties to assess WTP – proposed amounts do not fit	-.008	.047	-.006	-.178	.859
Think you can avoid these illnesses	-.053	.043	-.040	-1.230	.219
You think illnesses caused by air pollution and smoking	.031	.059	.017	.536	.592
You think illnesses caused by smoking	.094	.043	.073	2.186	.029
You think illnesses caused by air pollution	.007	.056	.004	.126	.899
WTP – Thought about smoking but no influence	-.077	.044	-.067	-1.753	.080
WTP – Thought about smoking and influence	-.023	.059	-.016	-.396	.692
WTP – Thought about air pollution but no influence	.070	.043	.059	1.613	.107
WTP – Thought about air pollution and influence	.029	.063	.017	.458	.647
WTP – Thought about prevention program	.076	.044	.060	1.740	.082
WTP – Thought about the costs of theses illnesses for society	-.006	.044	-.005	-.135	.893
Knowing that this kind of respiratory problems could become so serious	.037	.035	.032	1.046	.296
1 Relative smoker	-.043	.038	-.037	-1.138	.256
Risky occupation	.001	.044	.001	.018	.986
Risky leisure	.143	.099	.044	1.446	.149
Sex	-.064	.037	-.056	-1.747	.081
Birth year	.002	.002	.057	1.399	.162
Household size < 15 years old	.010	.022	.015	.441	.659
Marital status = Married	.072	.050	.061	1.436	.152
Marital status = Divorced	-.021	.073	-.011	-.291	.772
Marital status = Widower	-.003	.135	-.001	-.020	.984
Education = A-level	.135	.048	.102	2.800	.005
Education = A-level+2	.139	.054	.097	2.599	.010
Education = Bachelor	.146	.070	.073	2.094	.037
Education = Master +	.153	.066	.086	2.329	.020
Occupation related to health	-.019	.052	-.011	-.366	.715
Donation charity last year	.039	.046	.033	.851	.395
Health insurance	-.043	.049	-.036	-.872	.383
Log Household Income	.105	.076	.052	1.387	.166

Table 90: COPDm WTP – Lognormal model

R^2adjusted = 0.214, sample size 657, In grey: sigma <0.1

CODPm					
	Coefficients non standard		Coefficients standard	t	Sig.
	B	Standard error	Bêta		
(Constant)	-1.893	3.506		-.540	.589
Context = full context	.004	.075	.003	.049	.961
Context =Air pollution	.037	.055	.034	.681	.496
Context =smoking	.053	.067	.052	.789	.430
Health = Well above average	-.012	.075	-.006	-.159	.874
Health = Above average	.002	.047	.002	.049	.961
Health = Below average	.068	.062	.042	1.099	.272
Health = Well below average	.147	.138	.042	1.061	.289
Preexisting condition: Chronic bronchitis	-.062	.125	-.019	-.499	.618
Hospital last year	-.139	.142	-.037	-.977	.329
WTP: 1st proposed amount CODPm	2.104E-5	.000	.057	1.553	.121
WTP: lowest proposed amount CODPm	.001	.000	.346	8.826	.000
WTP: highest proposed amount CODPm	-4.422E-6	.000	-.011	-.280	.780
WTP criteria: illness duration	.014	.037	.014	.377	.707
WTP criteria: other	.023	.022	.037	1.023	.307
WTP criteria: comparison with usual health expenses	.038	.026	.057	1.429	.154
WTP criteria: pain	.005	.039	.005	.120	.905
WTP criteria: living standard	.036	.031	.045	1.154	.249
WTP criteria: long term effects of the illness	-.034	.038	-.034	-.893	.372
Planning to pay – personal income	.010	.043	.010	.222	.825
Planning to pay - savings	.090	.060	.061	1.483	.138
Planning to pay – other	-.214	.086	-.096	-2.486	.013
Sport = Every day	.137	.092	.069	1.492	.136
Sport = Several times a week	.039	.067	.037	.589	.556
Sport = Several times a month	.053	.067	.046	.782	.435
Sport = Only rarely	.026	.065	.025	.401	.688
Dwelling = Heavily air polluted	.133	.082	.072	1.627	.104
Dwelling = Somewhat air polluted	.097	.058	.084	1.670	.096
Dwelling = Slightly air polluted	.047	.050	.049	.941	.347
Diet = better than average	.011	.046	.009	.243	.808
Diet = below than average	-.024	.079	-.012	-.306	.760
Smoker	-.096	.056	-.081	-1.721	.086
Non-Smoker	-.044	.047	-.044	-.930	.353
Difficulties to assess WTP – I do not know my usual health expenses	-.031	.049	-.024	-.634	.527
Difficulties to assess WTP – I do not know how much costs medicaments	-.046	.038	-.046	-1.202	.230
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.063	.035	.069	1.826	.068
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.030	.040	.029	.765	.445
Difficulties to assess WTP – illnesses are similar	.038	.070	.022	.552	.581
Difficulties to assess WTP – proposed amounts do not fit	-.026	.050	-.020	-.527	.598
Think you can avoid these illnesses	-.049	.043	-.044	-1.139	.255

You think illnesses caused by air pollution and smoking	.043	.062	.027	.686	.493
You think illnesses caused by smoking	-.005	.044	-.005	-.117	.907
You think illnesses caused by air pollution	-.004	.057	-.003	-.077	.938
WTP – Thought about smoking but no influence	-.017	.047	-.018	-.374	.709
WTP – Thought about smoking and influence	.083	.061	.066	1.371	.171
WTP – Thought about air pollution but no influence	.042	.045	.041	.938	.349
WTP – Thought about air pollution and influence	-.016	.067	-.011	-.235	.814
WTP – Thought about prevention program	.041	.046	.037	.896	.371
WTP – Thought about the costs of theses illnesses for society	.020	.045	.018	.444	.657
Knowing that this kind of respiratory problems could become so serious	.008	.037	.008	.225	.822
1 Relative smoker	-.075	.039	-.075	-1.930	.054
Risky occupation	-.011	.046	-.009	-.226	.821
Risky leisure	.190	.102	.069	1.868	.062
Sex	-.056	.039	-.057	-1.462	.144
Birth year	.001	.002	.036	.735	.462
Household size < 15 years old	-.005	.022	-.008	-.208	.836
Marital status = Married	-.025	.052	-.024	-.482	.630
Marital status = Divorced	-.103	.075	-.061	-1.369	.172
Marital status = Widower	.098	.137	.027	.719	.472
Education = A-level	.097	.051	.085	1.910	.057
Education = A-level+2	.066	.055	.055	1.212	.226
Education = Bachelor	.078	.074	.045	1.059	.290
Education = Master +	.119	.068	.078	1.752	.080
Occupation related to health	.032	.054	.022	.580	.562
Donation charity last year	.036	.048	.035	.758	.449
Health insurance	-.004	.051	-.004	-.085	.932
Log Household Income	.254	.079	.142	3.216	.001

Table 91 CB WTP – Lognormal model

R²adjusted = 0.201, sample size 623, In grey: sigma <0.1

CB					
	Coefficients non standard		Coefficients standard	t	Sig.
	B	Standard error	Bêta		
(Constant)	.779	3.822		.204	.839
Context = full context	-.071	.082	-.050	-.862	.389
Context =Air pollution	-.008	.059	-.007	-.134	.894
Context =smoking	-.101	.073	-.095	-1.390	.165
Health = Well above average	-.005	.079	-.003	-.067	.947
Health = Above average	-.062	.052	-.049	-1.204	.229
Health = Below average	.049	.068	.028	.720	.472
Health = Well below average	.115	.152	.031	.755	.450
Preexisting condition: Chronic bronchitis	-.107	.124	-.034	-.864	.388
Hospital last year	-.041	.150	-.011	-.274	.784
WTP: 1st proposed amount CB	4.856E-5	.000	.120	3.152	.002
WTP: lowest proposed amount CB	.001	.000	.326	8.352	.000
WTP: highest proposed amount CB	5.705E-5	.000	.110	2.852	.005
WTP criteria: illness duration	.019	.039	.019	.475	.635
WTP criteria: other	.023	.025	.036	.932	.352
WTP criteria: comparison with usual health expenses	.021	.029	.030	.721	.471
WTP criteria: pain	-.016	.043	-.014	-.361	.719
WTP criteria: living standard	.015	.034	.018	.447	.655
WTP criteria: long term effects of the illness	-.065	.042	-.062	-1.545	.123
Planning to pay – personal income	.052	.046	.051	1.124	.261
Planning to pay - savings	.061	.066	.039	.925	.355
Planning to pay – other	-.166	.088	-.076	-1.886	.060
Sport = Every day	.132	.097	.065	1.356	.176
Sport = Several times a week	.017	.072	.015	.236	.813
Sport = Several times a month	.096	.072	.078	1.336	.182
Sport = Only rarely	.055	.069	.050	.802	.423
Dwelling = Heavily air polluted	.026	.091	.013	.283	.777
Dwelling = Somewhat air polluted	.014	.062	.012	.224	.823
Dwelling = Slightly air polluted	.005	.054	.005	.090	.928
Diet = better than average	.028	.048	.023	.583	.560
Diet = below than average	-.052	.086	-.024	-.600	.548
Smoker	-.080	.060	-.065	-1.335	.182
Non-Smoker	-.055	.050	-.054	-1.097	.273
Difficulties to assess WTP – I do not know my usual health expenses	-.058	.052	-.045	-1.124	.261
Difficulties to assess WTP – I do not know how much costs medicaments	-.047	.043	-.044	-1.096	.274
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.030	.038	.031	.799	.425
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	-.008	.044	-.007	-.186	.852
Difficulties to assess WTP – illnesses are similar	-.004	.072	-.002	-.054	.957
Difficulties to assess WTP – proposed amounts do not fit	.029	.052	.022	.562	.574

Think you can avoid these illnesses	-.090	.046	-.077	-1.933	.054
You think illnesses caused by air pollution and smoking	-.037	.066	-.023	-.562	.575
You think illnesses caused by smoking	.066	.048	.057	1.370	.171
You think illnesses caused by air pollution	.011	.063	.007	.168	.866
WTP – Thought about smoking but no influence	.008	.051	.008	.162	.871
WTP – Thought about smoking and influence	.100	.065	.076	1.533	.126
WTP – Thought about air pollution but no influence	.007	.049	.007	.144	.885
WTP – Thought about air pollution and influence	-.009	.072	-.006	-.126	.900
WTP – Thought about prevention program	-.012	.051	-.010	-.228	.820
WTP – Thought about the costs of theses illnesses for society	.061	.049	.053	1.235	.217
Knowing that this kind of respiratory problems could become so serious	-.012	.040	-.012	-.296	.767
1 Relative smoker	-.025	.043	-.024	-.584	.559
Risky occupation	-.021	.051	-.016	-.404	.687
Risky leisure	.249	.111	.086	2.239	.026
Sex	-.072	.042	-.070	-1.723	.085
Birth year	.000	.002	-.003	-.057	.954
Household size < 15 years old	.002	.024	.004	.097	.923
Marital status = Married	-.035	.056	-.033	-.622	.534
Marital status = Divorced	-.177	.081	-.100	-2.168	.031
Marital status = Widower	-.020	.140	-.006	-.141	.888
Education = A-level	.109	.055	.091	1.990	.047
Education = A-level+2	.087	.060	.067	1.442	.150
Education = Bachelor	.161	.078	.091	2.056	.040
Education = Master +	.186	.077	.113	2.426	.016
Occupation related to health	.090	.060	.059	1.507	.132
Donation charity last year	.093	.053	.086	1.766	.078
Health insurance	-.069	.056	-.064	-1.236	.217
Log Household Income	.167	.087	.089	1.922	.055

Table 92: Cough WTP – Lognormal model

R²adjusted = 0.393, sample size 401, In grey: sigma <0.1

Cough					
	Coefficients non standard		Coefficients standard	t	Sig.
	B	Standard error	Bêta		
(Constant)	3.888	3.465		1.122	.263
Context = full context	.121	.072	.108	1.677	.094
Context =Air pollution	.022	.056	.022	.396	.692
Context =smoking	.041	.066	.046	.613	.541
Health = Well above average	.043	.076	.024	.561	.575
Health = Above average	.009	.046	.008	.189	.850
Health = Below average	.046	.060	.032	.764	.445
Health = Well below average	-.062	.116	-.024	-.539	.590
Preexisting condition: Chronic bronchitis	-.019	.101	-.008	-.191	.849
Hospital last year	.024	.115	.009	.208	.836
WTP: 1st proposed amount Cough	3.177E-5	.000	.005	.118	.906
WTP: lowest proposed amount Cough	.007	.000	.621	13.240	.000
WTP: highest proposed amount Cough	1.946E-5	.000	.057	1.201	.230
WTP criteria: illness duration	.008	.036	.010	.233	.816
WTP criteria: other	.017	.020	.036	.846	.398
WTP criteria: comparison with usual health expenses	-.029	.027	-.048	-1.076	.283
WTP criteria: pain	-.052	.038	-.059	-1.357	.176
WTP criteria: living standard	.039	.031	.055	1.253	.211
WTP criteria: long term effects of the illness	.012	.038	.014	.323	.747
Planning to pay – personal income	.081	.041	.095	1.966	.050
Planning to pay - savings	.058	.058	.045	.987	.324
1 Planning to pay – other	-.123	.073	-.075	-1.698	.090
Sport = Every day	.025	.086	.015	.296	.768
Sport = Several times a week	.036	.064	.039	.563	.574
Sport = Several times a month	.107	.065	.102	1.639	.102
Sport = Only rarely	.039	.062	.041	.619	.536
Dwelling = Heavily air polluted	.026	.081	.016	.320	.749
Dwelling = Somewhat air polluted	-.090	.055	-.088	-1.621	.106
Dwelling = Slightly air polluted	-.068	.048	-.080	-1.424	.155
Diet = better than average	.046	.043	.046	1.069	.286
Diet = below than average	-.122	.087	-.059	-1.402	.162
Smoker	.006	.054	.006	.115	.909
Non-Smoker	-.001	.045	-.001	-.019	.985
Difficulties to assess WTP – I do not know my usual health expenses	.003	.045	.002	.058	.954
Difficulties to assess WTP – I do not know how much costs medicaments	-.008	.037	-.009	-.228	.820
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	-.010	.033	-.012	-.300	.764
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	-.001	.038	-.001	-.029	.977
Difficulties to assess WTP – illnesses are similar	-.026	.064	-.018	-.410	.682

Difficulties to assess WTP – proposed amounts do not fit	-.013	.048	-.011	-.263	.793
Think you can avoid these illnesses	-.041	.041	-.044	-1.013	.312
You think illnesses caused by air pollution and smoking	-.023	.061	-.017	-.371	.711
You think illnesses caused by smoking	.038	.044	.040	.873	.383
You think illnesses caused by air pollution	-.046	.057	-.036	-.797	.426
WTP – Thought about smoking but no influence	-.034	.045	-.039	-.762	.447
WTP – Thought about smoking and influence	.013	.058	.012	.220	.826
WTP – Thought about air pollution but no influence	.019	.045	.022	.438	.662
WTP – Thought about air pollution and influence	.048	.063	.041	.774	.439
WTP – Thought about prevention program	.028	.044	.030	.642	.521
WTP – Thought about the costs of theses illnesses for society	-.031	.043	-.033	-.720	.472
Knowing that this kind of respiratory problems could become so serious	.011	.036	.013	.307	.759
1 Relative smoker	-.016	.038	-.019	-.426	.671
Risky occupation	.025	.047	.023	.525	.600
Risky leisure	-.058	.098	-.024	-.587	.558
Sex	-.013	.037	-.016	-.364	.716
Birth year	-.001	.002	-.042	-.795	.427
Household size < 15 years old	.004	.020	.009	.198	.843
Marital status = Married	-.062	.052	-.068	-1.189	.235
Marital status = Divorced	-.056	.073	-.038	-.761	.447
Marital status = Widower	-.161	.119	-.059	-1.351	.178
Education = A-level	.053	.050	.052	1.056	.292
Education = A-level+2	-.025	.052	-.023	-.479	.632
Education = Bachelor	-.008	.068	-.005	-.114	.909
Education = Master +	.021	.069	.015	.306	.760
Occupation related to health	.108	.055	.080	1.955	.051
Donation charity last year	-.001	.046	-.001	-.028	.978
Health insurance	-.021	.053	-.023	-.404	.687
Log Household Income	-.065	.087	-.039	-.739	.460

12 Appendix 12: Heckman model - Full models

Table 93: COPDs – Heckman full model

Adjusted R² = 0.1893, Sample size = 890, In grey significant variables

Probit Selection Estimates				
	Estimate	Std. Error	t Value	Sig.
(Intercept)	-25.872	9.394	-2.754	.006
Context = Full context	.102	.197	.516	.606
Context = Air pollution	.359	.153	2.350	.019
Context = Smoking	.171	.184	.929	.353
Health = Well above average	.148	.205	.720	.472
Health = Above average	-.146	.130	-1.120	.263
Health = Below average	.123	.167	.738	.461
Health = Well Below average	.141	.349	.403	.687
Dwelling = Heavily air polluted	.050	.228	.217	.828
Dwelling = Somewhat air polluted	-.134	.161	-.835	.404
Dwelling = Slightly air polluted	-.118	.139	-.851	.395
Smoker	-.203	.149	-1.363	.173
Non-Smoker	-.132	.125	-1.057	.291
Think you can avoid these illnesses	-.453	.109	-4.163	.000
Risky leisure	-.511	.369	-1.384	.167
Sex	.284	.105	2.698	.007
Household Income	.000	.000	3.228	.001
Donation charity last year	-.099	.130	-.756	.450
Health insurance	-.048	.140	-.347	.729
Hospital last year	.015	.361	.041	.967
Sport = Every day	-.111	.217	-.511	.610
Sport = Several times a week	.144	.169	.847	.397
Sport = Several times a month	.492	.180	2.734	.006
Sport = Only rarely	.164	.159	1.030	.303
Diet = better than average	.037	.129	.285	.776
Diet = below than average	-.436	.191	-2.280	.023
Risky occupation	-.083	.130	-.639	.523
Marital status = Married	-.053	.081	-.656	.512
Education = A-level	-.007	.136	-.052	.959
Education = A-level+2	.069	.153	.450	.653
Education = Bachelor	-.184	.199	-.924	.356
Education = Master+	.090	.198	.453	.651
Occupation related to health	-.320	.173	-1.847	.065
Birth year	.014	.005	3.047	.002
Household size	.002	.039	.048	.961

Outcome Estimates				
	Estimate	Std. Error	t Value	Sig.
(Intercept)	-6.912	6.510	-1.062	.289
Context = Full context	-.015	.083	-.176	.861
Context = Air pollution	-.006	.084	-.072	.943
Context = Smoking	.009	.080	.112	.911
Health = Well above average	.011	.084	.130	.897
Health = Above average	.059	.059	1.006	.315
Health = Below average	.124	.071	1.741	.082
Health = Well below average	.336	.163	2.066	.039
Preexisting condition: Chronic bronchitis	-.156	.140	-1.112	.267
Hospital last year	.001	.157	.003	.997
WTP criteria: illness duration	-.015	.040	-.379	.705
WTP criteria: comparison with usual health expenses	.112	.029	3.809	.000
WTP criteria: pain	-.054	.045	-1.198	.231
WTP criteria: living standard	.043	.034	1.250	.212
WTP criteria: long term effects of the illness	-.104	.043	-2.423	.016
Planning to pay – personal income	.041	.047	.877	.381
Planning to pay - savings	.129	.068	1.885	.060
Planning to pay – other	-.347	.086	-4.025	.000
Sport = Every day	.184	.104	1.771	.077
Sport = Several times a week	.029	.082	.348	.728
Sport = Several times a month	.077	.118	.655	.513
Sport = Only rarely	.050	.080	.635	.526
Dwelling = Heavily air polluted	.132	.092	1.432	.153
Dwelling = Somewhat air polluted	.049	.067	.720	.472
Dwelling = Slightly air polluted	-.010	.058	-.166	.868
Diet = better than average	.076	.050	1.523	.128
Diet = below than average	-.021	.126	-.164	.870
Smoker	-.087	.069	-1.248	.212

Non-Smoker	-.079	.055	-1.420	.156
Difficulties to assess WTP – I do not know my usual health expenses	-.057	.054	-1.050	.294
Difficulties to assess WTP – I do not know how much costs medicaments	-.028	.043	-.661	.509
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.100	.038	2.611	.009
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.043	.044	.980	.328
Difficulties to assess WTP – illnesses are similar	-.083	.074	-1.125	.261
Difficulties to assess WTP – proposed amounts do not fit	-.035	.054	-.655	.513
Think you can avoid these illnesses	-.103	.104	-.991	.322
You think illnesses caused by air pollution and smoking	-.018	.067	-.270	.787
You think illnesses caused by smoking	.064	.049	1.308	.191
You think illnesses caused by air pollution	-.033	.064	-.513	.608
WTP – Thought about smoking but no influence	-.092	.051	-1.813	.070
WTP – Thought about smoking and influence	.049	.067	.730	.465
WTP – Thought about air pollution but no influence	.063	.049	1.287	.198
WTP – Thought about air pollution and influence	.054	.072	.743	.457
WTP – Thought about prevention program	.106	.050	2.105	.036
WTP – Thought about the costs of theses illnesses for society	-.029	.051	-.560	.575
Knowing that this kind of respiratory problems could become so serious	.034	.041	.831	.406
1 Relative smoker	-.085	.043	-1.972	.049
Risky occupation	.018	.053	.345	.731
Risky leisure	.132	.138	.958	.338
Sex	-.079	.065	-1.223	.222

Birth year	.004	.003	1.167	.244
Household size < 15 years old	-.024	.025	-.967	.334
Marital status = Married	.072	.058	1.244	.214
Marital status = Divorced	-.046	.087	-.532	.595
Marital status = Widower	.124	.159	.782	.434
Education = A-level	.175	.055	3.156	.002
Education = A-level+2	.136	.062	2.181	.029
Education = Bachelor	.121	.084	1.439	.150
Education = Master+	.120	.078	1.539	.124
Occupation related to health	-.004	.077	-.046	.963
Donation charity last year	-.003	.055	-.049	.961
Health insurance	-.053	.056	-.943	.346
Log Household Income	.376	.137	2.743	.006
invMillsRatio	.034	.446	.075	.940

Table 94: COPDm – Heckman full model

Adjusted R² = 0.0981, Sample size = 899, in grey significant variables

Probit Selection Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
(Intercept)	-22.125	8.944	-2.474	.014
Full Context	-.051	.191	-.267	.790
Air pollution context	.174	.146	1.196	.232
Smoking context	.130	.182	.714	.475
Health = Well above average	-.002	.191	-.013	.990
Health = Above average	-.069	.130	-.536	.592
Health = Below average	-.018	.162	-.113	.910
Health = Well below average	.427	.357	1.196	.232
Dwelling = Heavily air polluted	.257	.227	1.133	.258
Dwelling = Somewhat air polluted	.002	.157	.010	.992
Dwelling = Slightly air polluted	-.062	.135	-.461	.645
Smoker	-.157	.146	-1.078	.281
Non-Smoker	-.154	.123	-1.251	.211
Think you can avoid these illnesses	-.532	.106	-5.036	.000

Outcome Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
(Intercept)	-7.594	6.392	-1.188	.235
Full Context	.019	.089	.211	.833
Air pollution context	.093	.070	1.336	.182
Smoking context	.104	.083	1.259	.208
Health = Well above average	-.018	.089	-.207	.836
Health = Above average	.018	.057	.322	.748
Health = Below average	.082	.073	1.119	.263
Health = Well below average	.347	.183	1.893	.059
Preexisting condition: Chronic bronchitis	-.067	.126	-.532	.595
Hospital last year	-.131	.173	-.760	.448
WTP criteria: illness duration	.023	.038	.594	.553
WTP criteria: comparison with usual health expenses	.058	.027	2.158	.031
WTP criteria: pain	.009	.040	.229	.819
WTP criteria: living standard	.033	.032	1.059	.290
WTP criteria: long term effects of the illness	-.049	.038	-1.273	.203
Planning to pay – personal income	.001	.044	.025	.980
Planning to pay - savings	.133	.061	2.176	.030
Planning to pay – other	-.201	.087	-2.314	.021
Sport = Every day	.150	.107	1.409	.159
Sport = Several times a week	.098	.090	1.085	.278
Sport = Several times a month	.174	.111	1.563	.118
Sport = Only rarely	.123	.084	1.456	.146
Dwelling = Heavily air polluted	.246	.106	2.307	.021
Dwelling = Somewhat air polluted	.129	.069	1.866	.062

Risky leisure	-.531	.358	-1.484	.138
Sex	.208	.102	2.036	.042
Household Income	.000	.000	3.075	.002
Donation charity last year	-.182	.129	-1.419	.156
Health insurance	-.211	.135	-1.565	.118
Hospital last year	-.228	.383	-.595	.552
Sport = Every day	-.055	.217	-.254	.799
Sport = Several times a week	.211	.167	1.262	.207
Sport = Several times a month	.427	.174	2.449	.015
Sport = Only rarely	.187	.157	1.186	.236
Diet = better than average	-.021	.124	-.166	.869
Diet = below than average	-.169	.192	-.880	.379
Risky occupation	-.056	.126	-.449	.654
Marital status = Married	.051	.080	.641	.521
Education = A-level	.073	.131	.557	.577
Education = A-level+2	.263	.153	1.721	.086
Education = Bachelor	-.199	.188	-1.059	.290
Education = Master+	.148	.192	.772	.441
Occupation related to health	-.181	.161	-1.127	.260
Birth year	.013	.005	2.817	.005
Household size	.050	.039	1.281	.201

Dwelling = Slightly air polluted	.047	.061	.772	.440
Diet = better than average	.047	.054	.857	.392
Diet = below than average	-.070	.096	-.728	.467
Smoker	-.097	.070	-1.393	.164
Non-Smoker	-.053	.060	-.885	.377
Difficulties to assess WTP – I do not know my usual health expenses	-.027	.049	-.543	.587
Difficulties to assess WTP – I do not know how much costs medicaments	-.060	.039	-1.533	.126
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.097	.035	2.758	.006
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.027	.041	.668	.505
Difficulties to assess WTP – illnesses are similar	.020	.070	.290	.772
Difficulties to assess WTP – proposed amounts do not fit	-.042	.049	-.840	.401
Think you can avoid these illnesses	-.185	.113	-1.639	.102
You think illnesses caused by air pollution and smoking	-.005	.065	-.075	.940
You think illnesses caused by smoking	-.029	.045	-.653	.514
You think illnesses caused by air pollution	-.031	.058	-.537	.592
WTP – Thought about smoking but no influence	.006	.047	.130	.897
WTP – Thought about smoking and influence	.101	.062	1.646	.100
WTP – Thought about air pollution but no influence	.034	.045	.744	.457
WTP – Thought about air pollution and influence	.052	.068	.774	.439
WTP – Thought about prevention program	.044	.047	.933	.351
WTP – Thought about the costs of theses illnesses for society	.015	.046	.333	.739
Knowing that this kind of respiratory problems could become so serious	.021	.037	.567	.571
1 Relative smoker	-.095	.039	-2.404	.016
Risky occupation	-.008	.056	-.137	.891
Risky leisure	.101	.149	.677	.498
Sex	-.016	.058	-.285	.776
Birth year	.004	.003	1.225	.221
Household size < 15 years old	-.005	.025	-.211	.833
Marital status = Married	-.005	.058	-.079	.937
Marital status = Divorced	-.099	.086	-1.153	.249
Marital status = Widower	.135	.149	.903	.367
Education = A-level	.142	.061	2.310	.021
Education = A-level+2	.119	.078	1.514	.130
Education = Bachelor	.013	.092	.141	.888
Education = Master+	.137	.086	1.593	.112

Occupation related to health	-.005	.071	-.075	.940
Donation charity last year	-.030	.065	-.456	.648
Health insurance	-.068	.070	-.970	.332
Log Household Income	.457	.132	3.456	.001
invMillsRatio	.539	.403	1.337	.182

Table 95: CB – Heckman full model

Adjusted R² = 0.0358, Sample size = 906, In grey significant variables

Probit Selection Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
(Intercept)	22.626	7.998	2.829	.005
Full Context	-.085	.174	-.485	.628
Air pollution context	-.131	.132	-.994	.321
Smoking context	-.032	.162	-.196	.844
Health = Well above average	-.179	.176	-1.016	.310
Health = Above average	-.102	.115	-.892	.373
Health = Below average	-.088	.146	-.603	.547
Health = Well below average	.689	.337	2.045	.041
Dwelling = Heavily air polluted	.086	.196	.442	.659
Dwelling = Somewhat air polluted	-.008	.140	-.054	.957
Dwelling = Slightly air polluted	-.076	.120	-.632	.528
Smoker	.161	.132	1.226	.221
Non-Smoker	.048	.111	.432	.666
Think you can avoid these illnesses	-.162	.098	-1.657	.098
Risky leisure	-.394	.269	-1.463	.144
Sex	.110	.093	1.188	.235
Household Income	.000	.000	2.528	.012
Donation charity last year	-.162	.115	-1.403	.161
Health insurance	-.210	.123	-1.714	.087
Hospital last year	-.332	.327	-1.017	.309
Sport = Every day	.079	.207	.380	.704
Sport = Several times a week	.196	.156	1.253	.211
Sport = Several times a month	.002	.159	.014	.989
Sport = Only rarely	.031	.149	.210	.833
Diet = better than average	.025	.109	.231	.817
Diet = below than average	-.282	.186	-1.512	.131
Risky occupation	.075	.114	.657	.511
Marital status = Married	-.006	.074	-.080	.937

Outcome Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
(Intercept)	1.113	7.526	.148	.882
Full Context	.136	.111	1.226	.221
Air pollution context	.074	.097	.761	.447
Smoking context	.034	.100	.334	.738
Health = Well above average	.207	.128	1.616	.106
Health = Above average	.102	.078	1.303	.193
Health = Below average	.091	.093	.982	.326
Health = Well below average	-.305	.281	-1.088	.277
Preexisting condition: Chronic bronchitis	-.043	.126	-.340	.734
Hospital last year	.210	.208	1.008	.314
WTP criteria: illness duration	.043	.044	.973	.331
WTP criteria: comparison with usual health expenses	-.046	.032	-1.428	.154
WTP criteria: pain	-.069	.046	-1.510	.132
WTP criteria: living standard	.034	.037	.926	.355
WTP criteria: long term effects of the illness	.020	.046	.426	.670
Planning to pay – personal income	.128	.049	2.597	.010
Planning to pay - savings	.054	.070	.767	.444
Planning to pay – other	-.120	.086	-1.402	.161
Sport = Every day	-.014	.129	-.106	.916
Sport = Several times a week	-.038	.113	-.335	.738
Sport = Several times a month	.159	.097	1.639	.102
Sport = Only rarely	.075	.093	.813	.417
Dwelling = Heavily air polluted	-.015	.121	-.124	.901
Dwelling = Somewhat air polluted	-.010	.083	-.116	.908
Dwelling = Slightly air polluted	-.042	.076	-.556	.578

Education = A-level	-.115	.121	-.952	.342
Education = A-level+2	-.012	.133	-.093	.926
Education = Bachelor	-.035	.171	-.204	.838
Education = Master+	-.188	.168	-1.116	.265
Occupation related to health	.146	.136	1.075	.283
Birth year	-.011	.004	-2.716	.007
Household size	.070	.034	2.028	.043

Diet = better than average	.016	.066	.236	.813
Diet = below than average	.073	.153	.475	.635
Smoker	-.056	.097	-.583	.560
Non-Smoker	.010	.069	.140	.889
Difficulties to assess WTP – I do not know my usual health expenses	.069	.052	1.321	.187
Difficulties to assess WTP – I do not know how much costs medicaments	-.061	.044	-1.366	.172
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.007	.040	.178	.858
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.017	.045	.367	.714
Difficulties to assess WTP – illnesses are similar	.021	.077	.272	.785
Difficulties to assess WTP – proposed amounts do not fit	-.004	.058	-.060	.952
Think you can avoid these illnesses	.025	.082	.304	.761
You think illnesses caused by air pollution and smoking	-.065	.074	-.875	.382
You think illnesses caused by smoking	.011	.052	.219	.827
You think illnesses caused by air pollution	-.133	.068	-1.954	.051
WTP – Thought about smoking but no influence	.058	.054	1.081	.280
WTP – Thought about smoking and influence	.037	.069	.541	.588
WTP – Thought about air pollution but no influence	.045	.053	.838	.402
WTP – Thought about air pollution and influence	.143	.075	1.917	.056
WTP – Thought about prevention program	-.010	.053	-.181	.856
WTP – Thought about the costs of theses illnesses for society	-.041	.052	-.796	.426
Knowing that this kind of respiratory problems could become so serious	.011	.043	.248	.804
1 Relative smoker	-.025	.045	-.552	.581
Risky occupation	.092	.075	1.237	.216
Risky leisure	.069	.198	.351	.726

Sex	-.096	.067	-1.433	.152
Birth year	.000	.004	.040	.968
Household size < 15 years old	-.014	.032	-.448	.654
Marital status = Married	-.073	.067	-1.086	.278
Marital status = Divorced	-.016	.103	-.156	.876
Marital status = Widower	.058	.161	.363	.717
Education = A-level	.096	.084	1.145	.253
Education = A-level+2	.002	.079	.026	.979
Education = Bachelor	-.063	.103	-.609	.543
Education = Master+	.127	.116	1.101	.271
Occupation related to health	.024	.094	.256	.798
Donation charity last year	.087	.087	1.009	.313
Health insurance	.039	.106	.366	.714
Log Household Income	-.170	.183	-.928	.354
invMillsRatio	-.564	.488	-1.156	.248

Table 96: Cough – Heckman full model

Adjusted R² = 0.035, Smaple size = 927, In grey significant variables

Probit Selection Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
(Intercept)	22.626	7.998	2.829	.005
Full Context	-.085	.174	-.485	.628
Air pollution context	-.131	.132	-.994	.321
Smoking context	-.032	.162	-.196	.844
Health = Well above average	-.179	.176	-1.016	.310
Health = Above average	-.102	.115	-.892	.373
Health = Below average	-.088	.146	-.603	.547
Health = Well below average	.689	.337	2.045	.041
Dwelling = Heavily air polluted	.086	.196	.442	.659
Dwelling = Somewhat air polluted	-.008	.140	-.054	.957
Dwelling = Slightly air polluted	-.076	.120	-.632	.528
Smoker	.161	.132	1.226	.221
Non-Smoker	.048	.111	.432	.666
Think you can avoid these illnesses	-.162	.098	-1.657	.098
Risky leisure	-.394	.269	-1.463	.144
Sex	.110	.093	1.188	.235
Household Income	.000	.000	2.528	.012
Donation charity last year	-.162	.115	-1.403	.161
Health insurance	-.210	.123	-1.714	.087
Hospital last year	-.332	.327	-1.017	.309

Outcome Estimates				
	Estimate	**Std. Error**	**t Value**	**Sig.**
(Intercept)	1.113	7.526	.148	.882
Full Context	.136	.111	1.226	.221
Air pollution context	.074	.097	.761	.447
Smoking context	.034	.100	.334	.738
Health = Well above average	.207	.128	1.616	.106
Health = Above average	.102	.078	1.303	.193
Health = Below average	.091	.093	.982	.326
Health = Well below average	-.305	.281	-1.088	.277
Preexisting condition: Chronic bronchitis	-.043	.126	-.340	.734
Hospital last year	.210	.208	1.008	.314
WTP criteria: illness duration	.043	.044	.973	.331
WTP criteria: comparison with usual health expenses	-.046	.032	-1.428	.154
WTP criteria: pain	-.069	.046	-1.510	.132
WTP criteria: living standard	.034	.037	.926	.355
WTP criteria: long term effects of the illness	.020	.046	.426	.670
Planning to pay – personal income	.128	.049	2.597	.010
Planning to pay - savings	.054	.070	.767	.444
Planning to pay – other	-.120	.086	-1.402	.161
Sport = Every day	-.014	.129	-.106	.916
Sport = Several times a week	-.038	.113	-.335	.738

Sport = Every day	.079	.207	.380	.704
Sport = Several times a week	.196	.156	1.253	.211
Sport = Several times a month	.002	.159	.014	.989
Sport = Only rarely	.031	.149	.210	.833
Diet = better than average	.025	.109	.231	.817
Diet = below than average	-.282	.186	-1.512	.131
Risky occupation	.075	.114	.657	.511
Marital status = Married	-.006	.074	-.080	.937
Education = A-level	-.115	.121	-.952	.342
Education = A-level+2	-.012	.133	-.093	.926
Education = Bachelor	-.035	.171	-.204	.838
Education = Master+	-.188	.168	-1.116	.265
Occupation related to health	.146	.136	1.075	.283
Birth year	-.011	.004	-2.716	.007
Household size	.070	.034	2.028	.043

Sport = Several times a month	.159	.097	1.639	.102
Sport = Only rarely	.075	.093	.813	.417
Dwelling = Heavily air polluted	-.015	.121	-.124	.901
Dwelling = Somewhat air polluted	-.010	.083	-.116	.908
Dwelling = Slightly air polluted	-.042	.076	-.556	.578
Diet = better than average	.016	.066	.236	.813
Diet = below than average	.073	.153	.475	.635
Smoker	-.056	.097	-.583	.560
Non-Smoker	.010	.069	.140	.889
Difficulties to assess WTP – I do not know my usual health expenses	.069	.052	1.321	.187
Difficulties to assess WTP – I do not know how much costs medicaments	-.061	.044	-1.366	.172
Difficulties to assess WTP – I have difficulties to imagine constraints due to these illnesses	.007	.040	.178	.858
Difficulties to assess WTP – I have difficulties to imagine what proposed amounts represent	.017	.045	.367	.714
Difficulties to assess WTP – illnesses are similar	.021	.077	.272	.785
Difficulties to assess WTP – proposed amounts do not fit	-.004	.058	-.060	.952
Think you can avoid these illnesses	.025	.082	.304	.761
You think illnesses caused by air pollution and smoking	-.065	.074	-.875	.382
You think illnesses caused by smoking	.011	.052	.219	.827
You think illnesses caused by air pollution	-.133	.068	-1.954	.051
WTP – Thought about smoking but no influence	.058	.054	1.081	.280
WTP – Thought about smoking and influence	.037	.069	.541	.588
WTP – Thought about air pollution but no influence	.045	.053	.838	.402
WTP – Thought about air pollution and influence	.143	.075	1.917	.056
WTP – Thought about prevention program	-.010	.053	-.181	.856
WTP – Thought about the costs of theses illnesses for society	-.041	.052	-.796	.426
Knowing that this kind of respiratory problems could become so serious	.011	.043	.248	.804

1 Relative smoker	-.025	.045	-.552	.581
Risky occupation	.092	.075	1.237	.216
Risky leisure	.069	.198	.351	.726
Sex	-.096	.067	-1.433	.152
Birth year	.000	.004	.040	.968
Household size < 15 years old	-.014	.032	-.448	.654
Marital status = Married	-.073	.067	-1.086	.278
Marital status = Divorced	-.016	.103	-.156	.876
Marital status = Widower	.058	.161	.363	.717
Education = A-level	.096	.084	1.145	.253
Education = A-level+2	.002	.079	.026	.979
Education = Bachelor	-.063	.103	-.609	.543
Education = Master+	.127	.116	1.101	.271
Occupation related to health	.024	.094	.256	.798
Donation charity last year	.087	.087	1.009	.313
Health insurance	.039	.106	.366	.714
Log Household Income	-.170	.183	-.928	.354
invMillsRatio	-.564	.488	-1.156	.248

13 Appendix 13: HEIMTSA 1st wave, parametric model

Extract form the EU report from the 1st wave of HEIMTSA (Maca et al., 2011)

Parametric models for open-ended data

Next, we report results from modelling open-ended data elicited in WTP questions following multiple-bounded dichotomous choice questions. As discussed in section […] above, between 10 to 16% of respondents revised their maximum WTP stated in open-ended question below the interval obtained in multiple-bounded dichotomous choice for avoiding respective health endpoints.

As with the interval data, four models were estimated for each of the endpoints with the same properties, i.e. simple model with countries as the only explanatory variables and full model with additional variables. Two distinct models were then estimated, the first one being log-normal regression on full data set (Model 1,. while the second a two-step model (Model 2) consisting of modelling of participation in WTP exercise (probit model) and log-normal regression on data for participating respondents only. The variables used in the regressions are the same that were used for interval data and are reported in Table 97, Table 98, Table 99, and Table 100.

The results from regression models for open-ended data are not much different from those obtained using interval data. Accordingly, the income is a positive and significant explanatory variable in all the regressions except for Model 1 for one-day cough and all models for asthma medication discomfort. Country variables (Germany taken as status-quo) again suggest that on average Czech, UK and French respondents would be willing to pay lower amounts, while Greek and Norwegian respondents higher amounts to avoid the endpoint(s). Interestingly, Model 2 also suggests that for chronic endpoints (chronic bronchitis, mild and severe COPD) Czech and French respondents will on average express positive WTP more frequently, though giving on average lower WTP amounts. Age again turns out to be a significant predictor with reversed influence on WTP, positively correlated with WTP for avoiding one-day cough and negatively with the chronic endpoints. The same effect is observed for a variable of having diagnosed chronic respiratory illness. Education variable is significant and positive predictor of WTP for avoidance of the three chronic endpoints. Having regularly experienced asthma attacks is positive predictor of WTP for avoiding asthma medication discomfort (but in Model 2 only with respect to probability to be willing to pay). In addition (and unlike in models using interval data), children presence in the household seems to indicate lower WTP for avoidance of the three chronic endpoints. As in the interval data models, male respondents tend to have significantly higher WTP for avoiding one-day cough.

Table 97: Parametric models for WTP to avoid one-day cough – open-ended data

	Model 1 (log-normal)				Model 2 (probit)				Model 2 (lognormal – positive)			
	full model		simple model		full model		simple model		full model		simple model	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
constant	0.765 ***	0.165	1.717 ***	0.043	-0.560 ***	0.118	-0.065 *	0.030	2.982 ***	0.152	3.616 ***	0.040
cz	-0.613 ***	0.067	-0.581 ***	0.057	-0.199 ***	0.047	-0.199 ***	0.040	-0.788 ***	0.063	-0.750 ***	0.056
en	-0.912 ***	0.073	-0.856 ***	0.061	-0.478 ***	0.052	-0.450 ***	0.043	-0.805 ***	0.076	-0.777 ***	0.065
fr	0.624 ***	0.072	0.658 ***	0.062	0.592 ***	0.052	0.583 ***	0.044	-0.269 ***	0.061	-0.213 ***	0.053
gr	0.582 ***	0.081	0.415 ***	0.063	0.351 ***	0.057	0.252 ***	0.044	0.173 *	0.072	0.097	0.056
no	-0.239 **	0.080	-0.279 ***	0.060	-0.214 ***	0.057	-0.239 ***	0.042	0.152 *	0.077	0.165 **	0.060
hhsize	0.008	0.028			0.004	0.020			0.012	0.026		
male	0.121 **	0.039			0.039	0.028			0.143 ***	0.037		
age	0.020 ***	0.002			0.014 ***	0.001			0.003	0.002		
children	0.044	0.034			0.027	0.024			0.013	0.032		
college	-0.099	0.052			-0.041	0.037			-0.078	0.048		
married	-0.016	0.056			0.023	0.040			-0.050	0.052		
single	-0.090	0.088			-0.030	0.063			-0.064	0.084		
empl	-0.017	0.051			-0.025	0.037			0.043	0.048		
retired	-0.182 *	0.089			-0.194 **	0.064			0.117	0.080		
logincref	0.016	0.017			-0.017	0.012			0.063 ***	0.014		
chronicresp	0.140 **	0.044			0.116 ***	0.031			-0.002	0.040		
N	8548		10945		8546		10942		4049		5059	
Pr[WTP>0]					0.474		0.462					
Log-likelihood	-17149.2		-22017.4		-5535.67		-7187.92		-7965.59		-7965.59	
Adj R^2/Pseudo R^2	0.0966		0.0761		0.0636		0.0484		0.1015		0.0868	

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05.

Table 98: Parametric models for WTP to avoid chronic bronchitis – open-ended data

	Model 1 (log-normal)						Model 2 (probit)						Model 2 (lognormal – positive)					
	full model			simple model			full model			simple model			full model			simple model		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
constant	0.017		0.155	3.588	***	0.051	0.017		0.155	0.858	***	0.038	3.952	***	0.134	-0.505	***	0.048
cz	0.218	***	0.060	-0.142	*	0.065	0.218	***	0.060	0.272	***	0.051	-0.472	***	0.051	-0.212	***	0.055
en	-0.210	**	0.064	-0.362	***	0.073	-0.210	**	0.064	-0.155	**	0.053	-0.249	***	0.059	-0.087		0.052
fr	0.345	***	0.068	0.354	***	0.072	0.345	***	0.068	0.428	***	0.059	-0.095		0.055	0.317	***	0.053
gr	0.623	***	0.086	0.877	***	0.074	0.623	***	0.086	0.649	***	0.066	0.251	***	0.062	0.432	***	0.052
no	0.043		0.076	0.640	***	0.071	0.043		0.076	0.242	***	0.055	0.199	**	0.061	4.463	***	0.038
hhsize	0.079	**	0.028				0.079	**	0.028				0.010		0.021			
male	0.036		0.038				0.036		0.038				0.093	**	0.030			
age	0.004	*	0.002				0.004	*	0.002				-0.010	***	0.002			
children	-0.070	*	0.034				-0.070	*	0.034				-0.054	*	0.026			
college	0.207	***	0.052				0.207	***	0.052				0.187	***	0.039			
married	0.010		0.053				0.010		0.053				-0.009		0.043			
single	0.153		0.085				0.153		0.085				-0.079		0.067			
empl	0.084		0.047				0.084		0.047				-0.031		0.039			
retired	-0.045		0.083				-0.045		0.083				-0.023		0.069			
logincref	0.073	***	0.015				0.073	***	0.015				0.129	***	0.014			
chronicresp	-0.058		0.041				-0.058		0.041				-0.105	**	0.033			
N	8095			9380			8094			9378			7153			8034		
Pr[WTP>0]							0.884			0.857								
Log-likelihood	-16324.8			-19501.2			-2795.19			-3740.5			-11762.2			-13447.2		
Adj R^2/Pseudo R^2	0.0674			0.0454			0.0391			0.0294			0.0885			0.0639		

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05

Table 99: Parametric models for WTP to avoid mild COPD – open-ended data

	Model 1 (log-normal)						Model 2 (probit)						Model 2 (lognormal – positive)					
	full model			simple model			full model			simple model			full model			simple model		
	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.	Coef.		Std. Err.
constant	3.325	***	0.171	4.085	***	0.049	0.710	***	0.180	1.006	***	0.040	4.223	***	0.132	4.848	***	0.038
cz	-0.136	*	0.064	-0.066		0.062	0.464	***	0.068	0.492	***	0.056	-0.499	***	0.050	-0.539	***	0.047
en	-0.316	***	0.071	-0.191	**	0.069	-0.090		0.069	-0.028		0.056	-0.280	***	0.056	-0.190	***	0.054
fr	0.114		0.070	0.299	***	0.069	0.296	***	0.074	0.437	***	0.064	-0.121	*	0.055	-0.110	*	0.053
gr	0.466	***	0.080	0.782	***	0.072	0.460	***	0.094	0.675	***	0.073	0.162	**	0.062	0.256	***	0.054
no	0.392	***	0.078	0.947	***	0.068	0.310	**	0.093	0.573	***	0.065	0.190	**	0.060	0.493	***	0.051
hhsize	0.034		0.027				0.029		0.031				0.014		0.020			
male	0.060		0.038				-0.013		0.044				0.078	**	0.029			
age	-0.019	***	0.002				-0.007	**	0.002				-0.016	***	0.001			
children	-0.102	**	0.033				-0.068		0.038				-0.061	*	0.025			
college	0.440	***	0.051				0.343	***	0.061				0.255	***	0.039			
married	0.082		0.054				0.152	*	0.061				-0.013		0.042			
single	0.023		0.086				0.205	*	0.098				-0.119		0.066			
empl	0.088		0.050				0.124	*	0.055				0.010		0.039			
retired	0.126		0.086				0.100		0.092				0.059		0.067			
logincref	0.209	***	0.018				0.066	***	0.018				0.171	***	0.014			
chronicresp	-0.140	**	0.042				-0.085		0.048				-0.096	**	0.033			
N	8207			9377			8205			9375			7627			8508		
Pr[WTP>0]							0.930			0.908								
Log-likelihood	-16021.4			-19107.7			-1985.5			-2778.71			-12635.1			-14453.4		
Adj R^2/Pseudo R^2	0.0919			0.0494			0.0502			0.0384			0.1132			0.0675		

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05

Table 100: Parametric models for WTP to avoid severe COPD – open-ended data

	Model 1 (log-normal)				Model 2 (probit)				Model 2 (lognormal – positive)			
	full model		simple model		full model		simple model		full model		simple model	
	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.	Coef.	Std. Err.
constant	3.711 ***	0.171	4.471 ***	0.049	1.126 ***	0.212	1.137 ***	0.042	4.301 ***	0.138	5.125 ***	0.040
cz	-0.116	0.062	-0.055	0.062	0.481 ***	0.074	0.499 ***	0.061	-0.426 ***	0.051	-0.472 ***	0.050
en	0.040	0.070	0.172 *	0.069	0.201 *	0.080	0.203 **	0.063	-0.109	0.057	-0.023	0.056
fr	0.073	0.069	0.231 **	0.070	0.333 ***	0.081	0.416 ***	0.068	-0.148 **	0.056	-0.123 *	0.056
gr	0.411 ***	0.082	0.742 ***	0.075	0.472 ***	0.111	0.684 ***	0.085	0.145 *	0.066	0.273 ***	0.059
no	0.327 ***	0.077	0.941 ***	0.068	0.309 **	0.105	0.647 ***	0.073	0.143 *	0.062	0.503 ***	0.054
hhsize	0.035	0.026			-0.018	0.035			0.039	0.021		
male	0.057	0.038			0.041	0.050			0.044	0.031		
age	-0.021 ***	0.002			-0.007 **	0.002			-0.018 ***	0.002		
children	-0.078 *	0.033			-0.004	0.044			-0.069 **	0.027		
college	0.498 ***	0.050			0.363 ***	0.073			0.354 ***	0.041		
married	0.073	0.054			0.183 **	0.069			-0.027	0.044		
single	-0.031	0.085			0.184	0.112			-0.144 *	0.069		
empl	0.076	0.049			0.091	0.064			0.036	0.040		
retired	0.056	0.084			-0.072	0.101			0.106	0.069		
logincref	0.223 ***	0.018			0.043	0.022			0.205 ***	0.015		
chronicresp	-0.085 *	0.042			-0.050	0.055			-0.067 *	0.034		
N	8031		9148		8028		9145		7645		8539	
Pr[WTP>0]					0.953		0.935					
Log-likelihood	-15504		-18602.9		-1468.53		-2161.52		-12962		-15017.5	
Adj R^2/Pseudo R^2	0.0975		0.0387		0.0458		0.0308		0.1193		0.0529	

Signif. codes: '***' 0.001 '**' 0.01 '*' 0.05

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