EXPORT INSTABILITY, CORRUPTION, AND HOW THE FORMER INFLUENCES THE LATTER

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Résumé

Cette thèse a pour objectif d'approfondir l'analyse des conditions d'émergence et d'incidence de la corruption dans le monde. Nous y soulignons une dimension importante mais jusque-là peu documentée des activités de corruption, à savoir, leur contribution aux stratégies informelles d'adaptation et de gestion du risque mises en place par les agents économiques pour se protéger contre l'instabilité de leur revenu. Le premier chapitre propose un état des lieux de la recherche sur les définitions, les mesures, les typologies et les déterminants de la corruption. Dans le deuxième chapitre, les méthodes usuelles de calcul de l'instabilité macroéconomique sont expliquées, sont appliquées aux données sur les recettes d'exportation d'un échantillon de pays développés et en développement, et sont comparées entre elles. Le troisième chapitre présente et analyse une base de données rétrospectives sur l'Indice de Vulnérabilité Economique, reflétant le risque pour un pays de voir son développement entravé par des chocs naturels et des chocs d'exportations, que nous avons calculée pour un échantillon de 128 pays en développement et couvrant la période 1975-2008. Dans le quatrième chapitre, nous analysons les effets de l'instabilité des exportations sur la corruption dans les pays développés et en développement. Ces effets sont décomposés en un effet *ex post*, résultant de l'expérience des agents économiques de l'instabilité des exportations, et un effet *ex ante*, résultant de leur perception de cette dernière. Nous testons empiriquement ces effets sur les perceptions de la corruption et sur les pots-de-vin payés par les entreprises. Nous mettons en évidence des effets robustes, significatifs et non linéaires, dont le signe dépend de la fréquence et de la taille des chocs d'exportations. Nos résultats suggèrent également que la contrainte de liquidité est un canal transmission clé de ces effets: lorsque la contrainte de liquidité est forte l'instabilité des exportations aggrave l'incidence la corruption, alors qu'elle la réduit lorsque cette contrainte se relâche. Ainsi, en l'absence d'Etat et de marchés financiers capables d'atténuer les effets de l'instabilité sur les performances économiques et le bien-être, il est probable que les agents économiques aient recours à la corruption pour se protéger contre les fluctuations économiques.

Mots-clés: corruption, instabilité des exportations, vulnérabilité économique, contrainte de liquidité, adaptation au risque, gestion du risque.

Summary

This thesis is an attempt to improve the understanding of the causes of corruption emergence and incidence around the world. It highlights an undocumented feature of corrupt transactions, that is, their contribution to informal risk-coping and risk-management mechanisms used by economic agents to protect against income fluctuations. We propose in a first introductory chapter a general state of art of researches on corruption definitions, measurements, typologies and determinants. In chapter two, we explain, apply and compare standard methods of computing instability indicators, using export revenue data from sample of developed and developing countries. In chapter three, we build a retrospective Economic Vulnerability Index – i.e. an index reflecting the risk for a country of seeing its development hampered by natural and trade shocks – for a sample of 128 developing countries over 1975-2008. In chapter 4, we analyse the effect of export instability on corruption in developed and developing countries. This effect is decomposed into an *ex post* effect, resulting from agents' experience of export instability, and an *ex ante* effect, resulting from their perception of export instability. We test empirically these effects using data on corruption perceptions and on firms' bribe payments. We find robust, significant and nonlinear *ex post* and *ex ante* effects of instability on corruption, and stress that their direction strongly depends on the frequency and size of export fluctuations. We show that the liquidity constraint is a key channel for these effects: when the liquidity constraint hardens, instability is found to foster corruption; while when it softens, instability is found to reduce it. Thus, corrupt strategies may act as a substitute for financial market imperfections and a low state capacity for mitigating the consequences of economic fluctuations on welfare.

Keywords: corruption, export instability, economic vulnerability, liquidity constraint, risk-coping, risk-management.

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General introduction

"The monopolization of theft and the protection of the tax-generating subjects thereby eliminate anarchy. Since the warlord takes a part of total production in the form of tax theft, it will also pay him to provide other public goods whenever the provision of these goods increases taxable income sufficiently. […] Thus we have 'the first blessing of the invisible hand': the rational, self-interested leader of a band of roving bandits is led, as though by an invisible hand, to settle down, wear a crown, and replace anarchy with a government. The gigantic increase in output that normally arises from the provision of a peaceful order and other public goods gives the stationary bandit a far larger take than he could obtain without providing government."

Mancur Olson in "Dictatorship, Democracy, and Development", *The American Political Science Review*, Vol.87, No.3, September 1993, p.568.

Research context

Efforts to combat corruption at international, regional, national, and sector levels have intensified since the last decade. The increasing number of countries ratifying anti-corruption international conventions (e.g. United Nations Convention Against Corruption), the development of anti-corruption international networks (e.g. the U4), as well as international initiatives in sectors vulnerable to corruption (e.g. the Extractive Industry Transparency Initiative or the Kimberley process in the diamond sector) witness the increasing attention and resources mobilized to tackle this issue. Unfortunately, anti-corruption efforts at both local and global levels have encountered significant difficulties to concretize into observable progresses on the ground. In fact, standardized formulas that have been supported to combat corruption often abutted on the endogenous and contextual nature of the corruption phenomenon.

Policy levers against bribery and other corruption offences are indeed usually confined to address superficial rather than deeply rooted causes of malpractices. In this regard, empirical research uses to distinguish distant causes from proximate causes of corruption. The former refers to the importance of social norms, legal culture, human capital, and other structural factors shaping countries' institutional profiles. The later refers to temporary conditions under which corruption emerges, such as low salaries in the public administration, lack of oversight and enforcement mechanisms, or poor incentives in the public sector.

What make corruption such a singular and challenging economic issue are its various nested facets. First, the literature sometimes analyses corruption as an *institutional arrangement*, that is, a set of informal practices, norms, customs, codes of conduct and sanctions contributing to the stability and predictability of exchanges between economic agents, when other formal arrangements are dysfunctional (Andvig, 2006; Graeff, 2005; Blundo et al., 2006). Second, it is also common to consider corruption as an economic and social cost arising from *market imperfections* and state resource scarcity (Acemoglu and Verdier, 2000; Lambsdorff, 2002; Krueger, 1974). Last but not least, corrupt transactions are often seen as an *expenditure* or an *investment* made by private agents to obtain undue preferential treatments from the public administration/the legislature/the government, hence yielding important private payoffs (Martin et al., 2007; Lambsdorff, 2002; Bhagwati, 1982).

This thesis is an attempt to improve the understanding of the complex motives underlying corrupt acts, by addressing an undocumented feature of corrupt transactions: we highlight how corruption may help economic agents protect against the hazards of economic activity. During economic upheavals, imperfect formal/informal financial markets may not enable agents to fully mitigate the consequences of economic fluctuations. In this context, engaging in corrupt deals may be an appealing strategy when it allows economic agents to relax their liquidity constraint and/or secure resource inflows over time. In what follows, we review the three major lenses of corruption analysis described above, and stress how the question of the effects of economic instability on corrupt transactions naturally arises from this literature.

Corruption as an institutional arrangement

Leaving aside the damaging effects of corruption on welfare, corruption can be holistically viewed as a system of informal practices, rules, constraints, and enforcement mechanisms governing market and non-market exchanges between individuals, and prevailing outside the realm of formal or legal institutions (Williamson, 2009). Some authors argue that corruption is an institutional arrangement arising from the lack, the inappropriateness, or the ineffectiveness of formal institutions reducing the uncertainty upon (or ensuring the predictability of) interactions between agents (Graeff, 2005; Andvig, 2006; Blundo et al., 2006; Williamson, 2009). This structuring role of institutional arrangements has been clearly pointed out by North (1991, p.97), who stresses that

> "[…] throughout history, institutions have been devised by human being to create order and reduce uncertainty in exchange."

This analytical lens may apply to various situations of corruption, when for instance the rule of law is undermined and bribe payments (or other corrupt arrangements) are made to enforce contracts. It may also apply to countries with weak democratic institutions, which do not reach political consensus upon resources allocation. In this context, parochial corruption may for instance be an accepted (but

non democratic) norm of redistributing resources among relatives at all levels of the government and the society. Another illustration is when new market-based coordination mechanisms are not fully integrated by economic agents after a rapid privatization process. Older but illegal kinship-based or hierarchy-based coordination mechanisms may instead be carried out to facilitate exchanges between economic agents (Andvig, 2006). The dubious repurchase by oligarchs of various state-owned enterprises at very obliging prices (far below market prices) in former centrally-planned economies illustrates this institutional configuration (Nellis, 2009).

Olson's (1993) analysis of the rise of autocratic and democratic systems gives interesting insights into the prevalence of systemic corruption patterns. The author suggests that selfish "warlords" are incited to replace anarchy by a social order, and to exert a monopoly power on theft. In this setting, stationary banditry ensures by authoritarian means the stability and the predictability of economic exchanges, thereby fostering saving and investment. Situations of systemic corruption may fall within this framework for the analysis of political regimes, when, for instance, private companies' interests influence the law and rule the administration of public resources (referred to as contexts of "state capture", illustrated by so-called "banana republics" in the developing world), and/or when patrimonial forms of corruption govern interactions between individuals at all levels of the society.

Thus, in a context of institutional failure, widespread corruption norms and practices may hence contribute to the predictability of economic behaviours and ensure the reciprocity in market and non-market exchanges (Graeff, 2005).

Corruption as a corollary of market regulations

New Institutional Economics look at corruption through a more normative analytical framework, the principal-agent theory. According to principal-agent models, corrupt transactions result from market failures and represent a source of economic distortion (Shleifer and Vishny, 1993; Banerjee, 1997; Acemoglu and Verdier, 2000). This approach considers that a government (the principal) intervenes to correct market failures by charging potential self-interested bureaucrats (the agents) with the duty of achieving collective goals. By giving bureaucrats discretionary powers over citizens and various opportunities to require extra-payments, state interventions are often presented as a "burden" that public agents can unduly exploit for their personal gain.

Corruption occurs when agents deviate from the laws, rules, procedures and codes established by the government to achieve an optimal allocation of public goods (Shleifer and Vishny, 1993; Banerjee, 1997). According to Acemoglu and Verdier (2000), when market failures justify state interventions (in forms of taxes and subsidies) and when public agents are corruptible, a certain amount of corruption may be a second-best optimum, since preventing all corruption would be too costly for governments (see also Banerjee, 1997). According to these studies, corruption is a problem of optimal control that

generates an overwhelming bureaucracy, excessive public wages, and a misallocation of the most productive economic agents.

Limits of the analysis of corruption proposed by the agency theory have been pointed out by Lambsdorff (2002). The author stresses that the principal is not necessarily a welfare-maximiser, and does not have an absolute control over rules, incentives, and penalties governing agents' behaviours. As an illustration, this framework may fail to explain political corruption and the capture of the state by private entities, that is, when the regulatory framework set and enforced by the government reflects the private interests of influential groups.

The rent-seeking theory addresses this issue by providing a framework for the analysis of corruption from a welfare perspective. According to this approach, corruption refers to a set of expenditures aimed at influencing the distribution of resources through rent appropriation (Bhagwati, 1982; Lambsdorff, 2002). In this regard, Krueger (1974, p.291), cited in Drazen (2000, p.335), stresses that

> "[…] in many market-oriented economies, government restrictions upon economic activity are pervasive facts of life. These restrictions give rise to rents of a variety of forms, and people often compete for the rents. Sometimes, such competition is perfectly legal. In other instances, rent seeking takes other forms, such as bribery, corruption, smuggling and black markets."

According to Lambsdorff (2002), corruption is an illegal rent-seeking activity undertaken by economic agents to i) influence public regulations and thereby increasing the number and size of public rents (e.g. by supporting regulations restraining domestic competition in the telecom sector), and to ii) take control over them (e.g. to be awarded a telecom license). In this setting, corruption is likely to induce huge amounts of unproductive spending and foster inefficient political actions. It therefore represents a deviation from socially optimal solutions (Lambsdorff, 2002).

Corruption as an investment

From a welfare perspective, the rent-seeking theory presents corruption as an unproductive, even counterproductive, investment aimed at siphoning public resources into the pockets of a handful of private interests. However, some business studies see corruption as a productive investment. Speaking of firms' inclination to bribery and other corruption offences, Martin et al. (2007, p.1403-1404) state that

> "[…] beyond the dismantling of individual normative controls in the face of institutional barriers, normlessness may permeate the social structure of firms, exerting pressure on them to engage in nonconforming rather than conforming behaviour to achieve performance goals […] In anomic organizational contexts, pressure exists to take any path that leads to the achievement of performance goals, regardless of its acceptability or legitimacy. For these firms, bribery can be a path to the achievement of important goals."

When the body of formal laws, rules and codes that are supposed to govern economics exchanges are failing, bribe payments made by firms represent key productive decisions with noticeable consequences on firms' performances. This dimension of corrupt transactions is also outlined by studies on the effects of cultural orientations on corrupt schemes, which stress that business corruption may increase when other resources get scarce (Robertson and Watson, 2004), or that corrupt strategies find a fertile ground in cultures where the fear of uncertainty is stronger (Husted, 1999; Søreide, 2009).

These three nested dimensions of corruption – corruption as an institutional arrangement, a corollary of market regulations, and an investment – can all be inferred from Olson's analysis of political regimes, when he points that,

> "the gigantic increase in output that normally arises from the provision of a peaceful order and other public goods gives the stationary bandit a far larger take than he could obtain without providing government."

Interestingly, when legal formal and informal safety net mechanisms are failing, corruption payments may be considered as key productive decisions, in so far as they can provide a stable or "peaceful" economic order. In a context of financial market imperfections, bribes can indeed be paid to alleviate the tax burden during adverse shocks, or to win long-term public contracts when future revenues are uncertain. Thus, in Olson's words, we examine in this thesis the circumstances under which corrupt agents may move from simple 'roving bandits', who take advantage of any opportunity to unduly enrich, to 'stationary bandits', who engage in corrupt transactions to protect against economic fluctuations and to maintain their income stable.

Thesis outline

Building on the literature of the macro and micro consequences of economic fluctuations on households' production and consumption decisions, we investigate the effects of export instability on corruption incidence. We emphasise the effects of instability in the constant value of export earnings, because exports are a major cause of a country's economic vulnerability: on the one hand, it is an important and mostly-external source of output fluctuations, and on the other hand, it has severe destabilizing effects on trade, tax, and redistribution policy (Guillaumont, 2009; Jones and Olken, 2010; Easterly et al., 1993; Bevan et al., 1993). This thesis, which includes four chapters, addresses the following three arrays of questions:

1. Where do we stand in the understanding of corruption incidence? What are the different typologies of corrupt acts? How do we measure corruption levels? (Chapter 1)
2. What are the causes and consequences of output instability? How and to what extent does export instability contribute to economic vulnerability? What are the methods available for the measurement of export instability? (Chapters 2, and 3)
3. How does corruption respond to export fluctuations? What are the mechanisms involved? (Chapter 4)

Chapter 1: Insights into the emergence and incidence of corruption around the world

Chapter 1 provides updated background knowledge on the conditions of emergence and prevalence of corruption. An extensive literature review is proposed, illustrated by a simple empirical analysis and some explicatory operational highlights. Many inputs of this chapter have been drawn from contributions made to a background paper prepared with Muzong Wanda Kodi for the European Commission (Europeaid, 2011). Thus, while arguments expounded are based upon a wide range of theoretical and empirical research materials, we sometimes illustrate them by providing operational highlights on specific corruption problems (e.g. risks of corruption in the procurement process) and anti-corruption strategies (e.g. anti-corruption virtues of public finance management reforms).

First, different approaches to defining corruption and various typologies of public sector corruption are emphasised. We stress that the diversity of corruption definitions is reflected into the various approaches of measuring and assessing it. In this regard, the main organizations combating corruption and a number of academic scholars have developed over the last few years a wide range of measurement tools, which allow them to assess the extent of corruption at a given time, to identify areas that need remedial action and also to draw international comparisons.

In a second stage, we provide an overview of corruption incidence in the public sector. We present the principal-agent framework, which is a very popular analytical framework explaining the mechanisms underlying corruption in the public sector. According to this framework, agent's incentives for corruption are encouraged by opportunities for corrupt acts and discouraged by the presence of effective accountability mechanisms, so that corrupt deals result from a rational reasoning based upon the expected benefits and costs of corrupt acts. Based on this framework, we highlight country characteristics expected to influence corruption incidence, and provide illustrative empirical evidence of key corruption determinants.

In a third stage, we address the private side of corruption by identifying its specific forms, causes and contexts of emergence. We stress the importance of norms of honesty and ethics in supporting good corporate governance within a given society.

This leads us to emphasise in a final stage cultural and anthropological factors explaining the pervasiveness and persistence of corruption in certain countries. We addressed how social capital, cultural orientations and the organization of powers that prevail in some societies may maintain them in a long-lasting state of impunity and widespread corruption.

Chapter 2: Measuring export instability, applications to export revenue data, 1970-2008.

Since 40 years, macro and microeconomic analyses of the causes and consequences of macroeconomic instability has greatly deepened our understanding of the handicaps faced by developing countries. This concern for economic instability is evidenced by the broad spectrum of indicators used by the literature. This second chapter provides an extensive review and a comparative analysis of usual macroeconomic instability measurements.

The literature on economic instability uses a great range of instability indicators, based on the deviation of observed values of a given economic aggregate from a reference or trend value. Computational methods therefore vary according to the choice of said reference value and the ways in which deviations from it are summed. In general, there is little discussion on the choice of indicators, in particular on the trend computation method, advocating that the resulting instability indicators are closely correlated. Using export revenue data for 134 countries from 1970 to 2005, we find that this assertion may be true for variance-based indicators, measuring the average magnitude of deviations from the trend. However, we stress that great discrepancies arise between trend computation methods when one pays attention to the asymmetry or the occurrence of extreme deviations in a variable's distribution around its trend. Thus, our purpose is to invite further discussions regarding the use of these indicators, and to consider other aspects of instability, namely the asymmetry of fluctuations and the occurrence of abrupt shocks.

Chapter 3: Building a retrospective Economic Vulnerability Index, construction and analysis of annual series

Following up on the previous chapter, the third chapter exposes the building and the analysis of a retrospective economic vulnerability index (EVI). The Economic Vulnerability Index (EVI) is a composite index set up and applied by the United Nations Committee for Development Policy (UNCDP) since 2000 as a criterion for identifying the Least-Developed Countries (LDCs). This index reflects the risk for a country of seeing its development hampered by natural and trade shocks. Because a retrospective assessment of economic vulnerability was needed for research and policy purposes, we calculate a retrospective EVI on a yearly basis, covering 128 developing countries from 1975 to 2008.

EVI scores proposed by the CDP 2009 and former reviews cannot be used to make intertemporal comparison of vulnerability levels. In fact, these reviews provide a "snapshot" of economic vulnerability around the world based on past available data on countries' history of shocks and exposure to them. For a EVI retrospective calculation, one requirement was to meet with accuracy the method followed by the CDP in its 2009 review, while providing vulnerability scores comparable over time and across countries.

We find a strong 94% rank correlation between scores of the UNCDP 2009 review and scores of the retrospective EVI in 2006. Calculation periods of components of the retrospective EVI in 2006 are indeed the closest to those of the 2009 review. According to this new retrospective index, vulnerability in developing countries slightly declined over the 1987-2008 period, but less rapidly in Low-Income and Least-Developed Countries (LICs and LDCs). A further analysis of trends in EVI components stresses that the export instability component is the greatest driver of time variations in vulnerability scores.

Chapter 4: When corruption is a response to export instability

The fourth chapter builds on previous chapters to examine empirically the effects of export instability on corruption. Considering that corruption strategies can be undertaken by economic agents to protect against fluctuations in their income, we assume that export instability may have *ex ante* and *ex post* effects on corruption. Regarding the *ex post* effects of instability on corruption, i.e. the effect of instability through agents' *experience* of shocks, we invoke two main corruption responses, acting in opposite ways:

- "opportunistic corruption", which feeds on the mechanical ups and downs in opportunities for corruption following ups and downs in economic activity; and
- "survival corruption", which spreads when resources become scarcer and when formal and informal risk coping mechanisms cannot fully absorb economic shocks.

As for the *ex ante* effect of instability on corruption, i.e. the effect of instability through agents' *perception* of shocks, we draw a parallel between corruption strategies and risk-management strategies aimed at reducing the risk in the income process. In this regard, we posit that agents perceiving their economic environment as unstable may engage in "resource-locking" corrupt transactions**,** which consist in reducing *ex ante* the variance of their income by securing future resource inflows through bribery.

We conduct empirical estimations of the *ex ante* and *ex post* effects of export instability by respectively using measures based on the 16-year rolling standard deviation and the 6-year rolling skewness of the distribution of exports around a 16-year rolling mixed trend. We expect the long-run standard deviation of exports to reflect perceptions of export instability, and the short-run skewness of

exports to reflect a country experience of shocks. *Ex ante* and *ex post* effects of instability are tested on two corruption datasets: i) panel data on corruption perceptions from the International Country Risk Guide, covering 68 countries over the period 1985 to 2005; and ii) cross-sectional data on firms' informal payments from the World Bank Enterprise Surveys, covering more than 9000 firms clustered in 23 countries.

Despite dissimilarities between perception-based and experienced-based indicators of corruption, and in spite of sample differences between macro and micro corruption datasets, we find robust, nonlinear but opposite *ex post* and *ex ante* effects of export instability on corruption, both depending on the frequency and size of export fluctuations. On the one hand, export instability is found to have a deterrent *ex post* effect on corruption when fluctuations are moderate and frequent, and a boosting *ex post* effect when fluctuations are large and infrequent. On the other hand, we find evidence of a strong, significant and robust boosting *ex ante* effect of instability on corruption when export instability is perceived as "normal" (resulting from moderate and frequent fluctuations). Evidence of a deterrent *ex ante* effect of perceptions of "abnormal" instability (resulting from large and infrequent fluctuations) is also found but should be taken with caution. Finally, we highlighted that the liquidity constraint is a key channel for the direction of both *ex post* and *ex ante* effects of instability on corruption: when it hardens export instability is found to increase corruption; while when it softens, export instability is found to decrease it.

Thus, by addressing the modalities by which export fluctuations affect corruption levels, this chapter hopefully opens new rooms for anti-corruption policies. First, our findings point out the damaging institutional effects of export instability in fragile states, since corrupt strategies may spread as a substitute for imperfect financial markets and/or a low state resilience to external fluctuations. We provide an additional argument in support to the reinforcement of state capacity for mitigating the consequences of shocks and policies lowering country's exposure to them. Moreover, improving access to formal and informal financial markets should yield important anti-corruption outcomes, since the liquidity constraint appears in our estimations as a key determinant of the direction of the *ex post* and *ex ante* effects of export instability upon corrupt transactions. Finally, evidence of boosting *ex post* and *ex ante* effects of export instability on corruption strategies highlights the role played by external factors of output stability, such as aid and remittances (Guillaumont and Le Goff, 2010; Guillaumont, 2005), in improving the quality of governance.

Chapter 1

Insights into the emergence and incidence of corruption around the world[1]

1. Introduction

It is widely believed that corruption is a major obstacle to the achievement of the 2015 Millennium Development Goals, and that more intensified anti-corruption efforts are needed for various developing countries to move out of a low-level development trap. The body of evidence collected over the last two decades by various researchers, institutions, and non-state actors reveals that not only corruption hinders the growth process, but it also represents a critical impediment to the democracy, the rule of law and the respect of human rights.

Corruption is a symptom of dysfunctional governance and weak institutions. In fact, resources that are meant to address the basic needs of millions of poor people around the world are diverted for the private gains of a handful of politicians, corrupt officials, and private companies. A great deal of work has been undertaken by researchers, governments and donor agencies with the purpose of building up state capacities for combating public and private malpractices worldwide. International efforts against corruption have therefore been devoted to support key sectors expected to yield anti-corruption outcomes, such as the justice and the democratization process, the public administration and the management of public finances, the decentralization process, or the capacity of non-state actors.

[1] Many components of this chapter have been drawn and adapted from my contributions to a background paper prepared with Muzong Kodi for the European Commission, DG Europeaid. This paper has been used as a major input to the European Commission anti-corruption concept paper: Europeaid (2011) "Supporting Anti-Corruption Reform in Partner Countries" *Europeaid Tools and Methods Series*, Concept Paper N°2, European Commission.

This introductory chapter is a modest contribution to these efforts, as it examines crucial dimensions of corruption and provides analytical tools for the understanding of corruption prevalence and persistence. It reviews some key aspects of corruption which have been widely documented by the literature – e.g. its many forms, its theoretical foundations, and country characteristics explaining the extent of public sector corruption – and relates them to other significant issues which are far less documented – notably, the private side of corruption and the anthropological foundations of corruption prevalence. Arguments developed along this chapter are supported by an extensive and updated literature review, illustrated by various empirical evidence and highlights on operational corruption issues.

In the next section, we propose a critical analysis of the definitions and measurements of corruption. We emphasise in section 3 how corruption manifests in some key areas of public action and how it flourishes within the scope of private transactions. We then highlight in section 4 the contribution of social capital to corrupt exchanges, and underline cultural orientations and institutional schemes that are expected to foster pervasive and systemic corruption. Section 5 concludes.

2. Definitions and measurements of corruption

Defining corruption is a complex task because of its multidimensional nature. The legal approach to defining corruption places the emphasis on individual responsibility in corruption affairs, with the explicit goal of punishing corrupt acts. Before prosecuting and condemning individuals involved in corrupt transactions, legal systems must provide precise definitions of corruption offences – by stating the nature, scope and meaning of corrupt acts – so that individuals are aware of and able to foresee prohibited acts.[2]

The socio-economic approach to defining corruption, presented along this section, differs from the legal approach in that it develops tools and concepts for the analysis of corruption prevalence, and delimits scopes for anti-corruption policies. It also provides a basis for the measurement and assessment of corruption at international, national, and sector levels.

2.1. The socio-economic approach to defining corruption

The socio-economic approach of corruption, illustrated by the principal-agent theory, considers corrupt acts as the result of individual rational decisions. Socio-economic definitions of corruption usually refer to the motivation for engaging in corruption, the nature of powers giving individual opportunities for corrupt transactions, and sometimes the *modus operandi* of corrupt actors.

[2] National legal frameworks must follow the principle, incorporated into international criminal law, stating that "no crime, no punishment without a previous law".

Let us begin with an interesting socio-economic definition of corruption, proposed by Tanzi (1998, p.564). According to him, corruption is

> "the intentional non-compliance with the arm's-length principle aimed at deriving some advantage for oneself or for related individuals from this behaviour".

This definition of corruption considers three necessary conditions for corrupt acts to be treated as such. The first refers to the *arm's length principle,* which states that personal or other relationships should play no part in economic decisions involving more than one party. Any bias towards particular economic agents would violate this principle. The second condition requires that this bias must be intentional. And the third condition implies that there must be some advantages for at least one party in violating intentionally the *arm's length principle*.

Another set of narrower definitions focuses on public sector corruption. For instance, Shleifer and Vishny (1993, p.599) provide a very popular definition of corruption, which is

> "the sale by government officials of government property for personal gain".

This definition refers to the *modus operandi* – a pecuniary transaction –, the location of power – an agent of the public sector –, and the motivation underlying corrupt acts – a personal gain. In the same vein, the World Bank's definition of corruption extends public sector corruption to non-pecuniary transactions by referring to

> "the abuse of public office for private gain".

This definition is very similar to that proposed by Shleifer and Vishny, the only difference being that it also refers to non-pecuniary abuses of public office – such as favouritism or influence peddling – or illegal acts which do not necessarily involve more than one party – such as theft, fraud, forgery or embezzlement (annex 1.A proposes definitions of these corrupt offences).

The United Nations Development Program further specifies the *modus operandi* of public agents, by defining corruption as

> "the misuse of public power, office or authority for private benefit – through bribery, extortion, influence peddling, nepotism, fraud, speed money or embezzlement".

By ignoring the private side of corruption, previous definitions do not consider private corrupt transactions like, for instance, corporate fraud, tax evasion, or the bribery of foreign officials by domestic private companies. Transparency International's (2009b, p.24) definition of corruption,

> "the misuse of entrusted power for private gain",

circumvents this drawback by referring to any legitimate formal authority, either public or private.

The above definitions present two main weaknesses. First, they only focus on acts of corruption committed by individuals motivated by "private gain", and ignore holistic causes of corruption. Second, socio-economic definitions of corruption generally limit their scope to formal manifestations of authority, whereas corruption can also be considered as a deviation from deep-rooted customs or social norms (Andvig, 2006).

This issue has been considered by the Norwegian development agency, the Norad (2008, p.11), which defines corruption as:

> "the abuse of entrusted authority for illicit gain".

The term "entrusted authority" refers to formal and informal manifestations of power, thus encompassing individual as well as systemic corruption under neo-patrimonial states and state capture (see section 4). The term "illicit" indicates that all corrupt acts are not necessarily illegal, and that corruption may also arise when transactions are in contradiction with morals, customs or other informal rules. For instance, in former soviet countries, newly introduced but formerly prohibited Market Economy's mechanisms were perceived by the population as corrupt, while persistent old practices, inherited from the soviet system, were not (Andvig, 2006). Another example is when private groups or political elites manipulate formal laws and rules for rent appropriation motives. Thus, in a context of 'state capture' by private interests, corruption may flourish within the framework of the law (Kodi, 2008).

As for the term "abuse", it refers to a personal outcome, thereby ignoring that corruption is not necessarily individually-driven but may depend on how well-accepted or legitimized are coordination modes within a community. Andvig (2006, p.329) takes into account this limit and defines corruption as a deviation from norms of behaviours prevailing in a group of individuals:

> "[Corruption is] a set of transactions that involve a member of a body or an organization and a non-member that for some reason is considered illegitimate"

According to this definition, corruption is an exchange between one "insider" and one "outsider" which is perceived by other "insiders" as illegitimate. This definition makes corruption a relative and inconstant notion, since individuals may belong to different groups based on different ties (friendship, ethnicity, citizenship, etc.).

Finally, Baker et al. (2008) propose a definition of corruption, which embraces many aspects addressed before:

> "Corruption is the abuse of public interest and the undermining of public confidence in the integrity of rules, systems and institutions that promote the public interest."

Baker et al. (2008) not only focus on individual aspects driving corruption, but also emphasises systems, processes, and consequences of corrupt acts. This definition does not strictly restrain the consequences of corruption to pure monetary losses, but also refers to its negative effects on public confidence and institution building.

Now that we grasp the very blurring of frontiers between honesty and corruption, we logically address in the next sub-section a related challenging issue, that is, the measurement of corruption.

2.2. Measuring corruption[3]

Measuring corruption is a complicated task, first, because of the secretive nature, the many definitions and the various forms of corrupt acts; and second, because of the multiple existing approaches to measure it, reflecting a variety of scopes for anti-corruption interventions and academic research.

Corruption measurement tools' overall objective is to inform efforts to analyse and combat corruption, by documenting the following areas of analysis:

- *Transnational benchmarking*: identifying relative changes in corruption prevalence over time and between countries.
- *Diagnosis*: understanding country most important drivers of corruption and identifying sources of bottlenecks for anti-corruption reforms;
- *Capacity gaps*: identifying capacity gaps in the areas of institution building, institutional development and strengthening, human resource development, and public resources management/administration;
- *Monitoring*: assessing the effectiveness of anti-corruption mechanisms and monitoring the implementation of anti-corruption strategies, as well as anti-corruption international legal frameworks;
- *Costs assessment*: understanding and, when possible, quantifying the impact of corruption on service delivery, businesses, and social welfare.

To achieve these sub-objectives, several measurement tools are available to analysts, who can combine them to draw a global and comprehensive picture of corruption in a given country.

It is first important to understand the distinction made between *corruption indicators* and *corruption assessment tools*:

[3] This sub-section is based on the UNDP (2008)'s user guide to measuring corruption, as well as inputs provided by the European Commission.

> "[While indicators of corruption] point out something about the state of governance or a about a particular aspect of corruption in a country, [an assessment tool] is a broader contextual analysis of the state and drivers of corruption, often relying on multiple indicators of corruption".[4]

Some assessment tools also propose a global or partial evaluation of a country anti-corruption framework, by focusing on aspects of country systems which are expected to be strong corruption deterrents.

Second, as corruption flourishes in the secrecy, it cannot be measured accurately by simply looking at *objective measures*, such as court verdicts, unpaid parking tickets (Fisman and Miguel, 2007), or leakages in public service delivery (Gauthier and Reinikka, 2007) and in infrastructure projects (Olken, 2007, 2009); nor by only using *subjective measures*, based on perceptions or experiences of corruption. Another difficulty in measuring corruption is the fact that acts as different as excessive hospitality between representatives of private firms, petty bribery of health officials or nepotism among the highest levels of government fall together under the (many) definitions of corruption. Thus, given the complexity of this phenomenon, one should be aware that a single and definitive measurement of corruption does not exist.

2.2.1. Subjective versus objective indicators of corruption

The most well-known method of measuring corruption is to enquire about subjective *opinions and perceptions of corruption* in a given country. Some of enquiries have targeted the wider public (e.g. the Global Corruption Barometer[5]) and different kinds of experts and surveys (Bribe Payer Index[6], Worldwide Governance Indicators…). Another similar approach is to enquire about the *experience of corruption*. These surveys, also be called 'victim studies', often provide a quantitative assessment of the burden of corruption, by for instance enquiring about the annual amount or share of informal payment paid by a standard enterprise or a household (e.g. the World Bank Enterprise Surveys[7], Business Environment and Enterprise Performance Surveys[8], or the UNODC International Crime Victim Surveys[9]).

These indicators are pretty convenient to make international comparisons of national corruption scores, but they cannot be considered as an objective measure of actual corruption levels. First,

[4] The United Nations Development Program, "A User Guide to Measuring Corruption", the United Nations Development Program and Global Integrity, September 2008, p.5.

[5] http://www.transparency.org/research/gcb/

[6] http://bpi.transparency.org/bpi2011/

[7] http://www.enterprisesurveys.org/

[8] http://www.ebrd.com/pages/research/analysis/surveys/beeps.shtml

[9] http://www.unodc.org/unodc/en/data-and-analysis/Crime-Victims-Survey.html

given the secret and illicit nature of corrupt acts, respondents are usually reticent to openly discuss it. As a consequence, they are likely to underreport it, or even provide false responses (Olken, 2009; Jensen et al. 2010). In a comparison between Indonesian villagers' perceptions of corruption and actual amounts of missing expenditure in a road-building project, Olken (2009) stresses that perceptions of villagers were somewhat underreported as local officials were inflating project inputs to hide dubious leakages of expenditure. The author also shows that high perceptions of corruption may lead to increased monitoring of behaviours which may reduce objective corruption levels. Second, there is a tendency for perceptions of corruption to persist over time, or conversely, to be influenced by transitory events not directly related to corruption prevalence, such as the business climate (Kaplan and Pathania, 2010). For these reasons, perception-based corruption indicators do not properly capture actual changes in the incidence of corruption.

Some studies provide objective measures of corruption prevalence based on estimations of public resource leakages in specific areas of public interventions (e.g. extractive industries, infrastructure projects, and health or education sectors). One well-known contribution is that made by Olken (2007, 2009) who resorts to a team of engineers and surveyors to estimate actual road projects' cost and compare it to official projects' cost reported in Indonesian villages. The gap between the two costs therefore corresponds to stolen funds. Another study conducted by Gauthier and Zeufack (2009) estimates the oil rent captured by the Cameroon's government between 1977 and 2006 and the proportion of this oil revenue "saved" abroad, the latter being an estimation of the share of oil revenue stolen by the government. Survey instruments have also been developed by the World Bank to gather information on public service delivery systems and performances (Gauthier and Reinikka, 2007). One of these surveys, the Public Expenditure Tracking Survey (PETS), is a useful tool which tracks the flow of public resources in a given sector (such as health or education) through all the layers of the bureaucracy, with the purpose of establishing how much of the original earmarked amount reaches each of these levels and their intended final beneficiaries.[10] Another tool, the Quantitative Service Delivery Survey (QSDS), is also used to assess the efficiency of public spending, incentives and various qualitative aspects of service delivery. Because PETS and QSDS can bring together data on inputs, outputs, user charges, quality, and other characteristics directly from the service-providing unit, more can be learned about the way public spending is transformed into public goods and services. Obviously, it is worth keeping in mind that evidence-based data on corruption are i) partial as they reflect the extent of corruption in particular areas of public interventions, ii) are subject to measurement errors, and iii) are not free from subjective interpretation from surveyors and researchers.

[10] See Gauthier and Reinikka (2007) for an overview of the methodological approaches of assessing public service delivery efficiency.

2.2.2. Composite versus single-source indicators of corruption

Limitations of the above corruption indicators also reflect a lack of consensus on corruption definitions. In this regard, using *composite indexes* of perceptions and experiences of corruption, made up of various data sources encompassing distinct dimensions of corruption, is convenient because it encapsulate many facets of corrupt deals. According to the UNDP, a composite indicator

> "…or aggregate indicator is one which combines different measures of a similar thing into a single measure".[11]

These tools are often a combination of corruption-related concepts, such as 'bribery', 'governance', 'democracy', 'transparency' or 'accountability'. It is worth noting that composite indexes with similar labels may measure distinct aspects of corruption, reflecting different scopes, units of analysis, or methodologies. For instance, in 2007, fourteen sources were used to compute the Corruption Perception Index (Transparency International), while twenty-five sources were used to create the Control of Corruption indicator (World Bank). The same confusion arises when comparing composite indexes with *single-source* and/or *country specific indicators* since, contrary to the former, the latter usually provide more contextualized information. Thus, the logical drawback of composite indicators is their lack of precision regarding what is actually measured, which is less the case of single-source database (e.g. the International Country Risk Guide, which provides a measure of country perceived risks of corruption for investors).

2.2.3. Disaggregated and targeted indicators of corruption

Disaggregated indicators reflect a heterogeneous picture of the experience/perception/impact of corruption among the population, considering that marginalized groups may experience or perceive corruption differently. For instance, '*pro-poor indicators'* differentiate experiences and perceptions of corruption according to different income levels, while '*gender sensitive indicators*' distinguish corruption perceptions and experiences by gender.

As disaggregated indicators do not take into account elements of anti-corruption frameworks which are of importance for specific social groups, it may by insightful to combine disaggregated indicators with *targeted indicators*. *Targeted indicators* indeed address specific corruption issues in a given category of the population. They may explicitly refer to the social group – by for instance specifying the number of cases implying female victims of corruption prosecuted in courts –, or may be implicitly relevant for these groups – by for instance looking at the incidence of corruption in

[11] The United Nations Development Program, "A User Guide to Measuring Corruption", The United Nations Development Program and Global Integrity, September 2008, p.6.

public agencies of particular relevance to women, such as public free school or public water utilities in rural areas.[12]

2.2.4. Anti-corruption framework assessments

Apart from the survey-type of studies on corruption building on perceptions or experiences, a complementary approach is to assess the ability of a state, institutions and sectors to prevent or curb corruption. These measurement tools are not aimed at measuring the level of corruption, but rather at assessing State/institutions/sectors' ability to prevent or combat corruption. These measures include *integrity indicators*, as opposed to corruption indicators, which reveal country resistance to corruption and/or capacity to combat it. Some integrity indicators look at these issues holistically within a country (National Integrity Survey[13]), others look at the quality of the administrative/legal anti-corruption frameworks (UNCAC gap analyses[14]), or focus on specific corruption deterrents, such as financial accountability in public finances (Public Expenditure Financial Accountability methodology[15] or Country Financial Accountability Assessment[16]) or the quality of national procurement systems (Country Procurement Assessment Reviews[17] or OECD-MAPS[18]). In addition, *Political economy analytical tools* are indispensable to conduct an in-depth analysis of how concrete positive changes in corruption prevalence can be reached, by examining country structural features, political systems and institutions that could drive improvements in governance quality[19] (see DFID's Drivers of Change, SIDA's Power Analysis).

2.2.5. Input/*de jure* versus output/*de facto* indicators

Finally, it can also be useful to combine *input/de jure corruption indicators* with *output/de facto indicators*. Such an approach allows the identification of gaps between the quality of formal institutions and actual governance's deliverables. Indeed, improvements in anti-corruption institutions may not materialize systematically into lesser corruption, because of possible bottlenecks or delays in the concretization of anti-corruption outcomes. As an illustration, improvements in the anti-corruption legal framework – 'the input' measured by, for example, the degree of implementation of the

[12] See the UNDP Framework for Selecting Pro-poor and Gender Sensitive Governance Indicators, available at: http://gaportal.org/sites/default/files/Framework%20paper%20-%20entire%20paper.pdf

[13] Available at: http://gaportal.org/country-initiatives

[14] Examples of UNCAC gap analyses undertaken in East Asia and Pacific countries can be found at: http://go.worldbank.org/0SJ5N0NBL0

[15] http://www.pefa.org/

[16] http://go.worldbank.org/M3MCU5ZHT0

[17] http://go.worldbank.org/RZ7CHIRF60

[18] See the OECD, *Methodology for assessing procurement systems (MAPS)*, February 2010. Available at: http://www.oecd.org/dataoecd/50/33/45181522.pdf

[19] The EC reference document on analysing and addressing governance in sector operations is available at: http://capacity4dev.ec.europa.eu/analysing-and-addressing-governance-sector-operations

UNCAC – may not result in actual positive change if corrupt behaviours are not investigated, prosecuted and sanctioned – 'the output' measured by, for example, the number of corruption brought to trial. Similarly, perceptions of corruption, which may be seen as an output of the anti-corruption framework, may lag behind anti-corruption reforms.

2.3. Concluding remarks

In this section, we provided a general overview of corruption definitions as well as a typology of corruption measurement tools. It appeared that the wide array of measurement tools reflects the multifaceted nature of corruption and the difficulty to give precise definitions of it. In fact, corruption is a global long-lasting phenomenon but inconstant in its appreciation, so that measures aimed at making international and inter-temporal comparisons are necessarily imprecise and/or incomplete. It is nevertheless possible for researchers and analysts wishing to measure accurately the level of corruption in a specific country at a particular point in time, to combine corruption measurement tools in a way that allows a precise representation of corruption prevalence. Notably, the incidence of corruption at country or sector levels can be reliably approximated by complementing "numbers" produced by global indicators with contextual tools (using for isntance political economy analysis tools and holistic assessment tools) and tools focusing on certain determinants of corruption (procurement systems, accountability mechanisms, rules of transparency, etc.).

Box No.1. Corruption indicators: UNDP definitions.

Corruption indicator: refers to discrete, often quantitative, measurements of a particular aspect of corruption (including the level of corruption).

Objective indicator: indicator constructed from undisputed facts, e.g. the existence of anti-corruption laws or the funding received by the national anti-corruption agency.

Composite indicator: indicator combining different measures of a similar thing into a single measure.

Perception-based indicator: indicator based on the opinions and perceptions of corruption in a given country among experts and citizens.

Experience-based indicators: indicators measuring citizens' and firms' actual experience with corruption.

Proxy indicators: indicators assessing corruption indirectly by aggregating symptoms and signals of corruption, or by measuring its opposite, that is, anti-corruption, good governance, political competition, public accountability mechanisms, etc.

Pro-poor and gender sensitive indicators: pro-poor indicators focus on population living in poverty while gender sensitive indicators reveal women's experience of corruption.

Input-based/*de jure* indicator: Indicators measuring the existence and the quality of *de jure* anti-corruption institutions, rules and procedures.

Output-based/*de facto* indicators: Indicators measuring the impact of corruption on the quality of life and public service delivery. Such indicators measure *de facto* outcomes of the governance system, often through proxy measures.

Source: The United Nations Development Program, "A User Guide to Measuring Corruption", The United Nations Development Program and Global Integrity, September 2008, p.7, 9, 14.

3. Main patterns of corruption

Although corruption is perceived differently from a place to another and feeds on heterogeneous environments, regular patterns of public and private sector corruption emergence and incidence have been highlighted. The purpose of this section is to improve the economic understanding of corruption prevalence in both public and private sectors.

3.1. The demand side of corruption: public sector issues

It is common to analyse corruption in the public sector within the framework of the *principal-agent theory*, provided by the New Institutional Economics. From this framework, it is possible to represent public agents' decisions to engage in corruption as the result of a cost-benefit analysis. We then emphasise some regular features of developed and developing countries expected to affect these costs and benefits, and thereby the incidence of public sector corruption in these countries.

3.1.1. A theoretical explanation of public sector corruption: the principal-agent theory

Public sector corruption has been widely explained through the lens of the principal-agent models. According to the principal-agent theory, public sector corruption results from the interaction of three types of actors, persons or abstract entities:

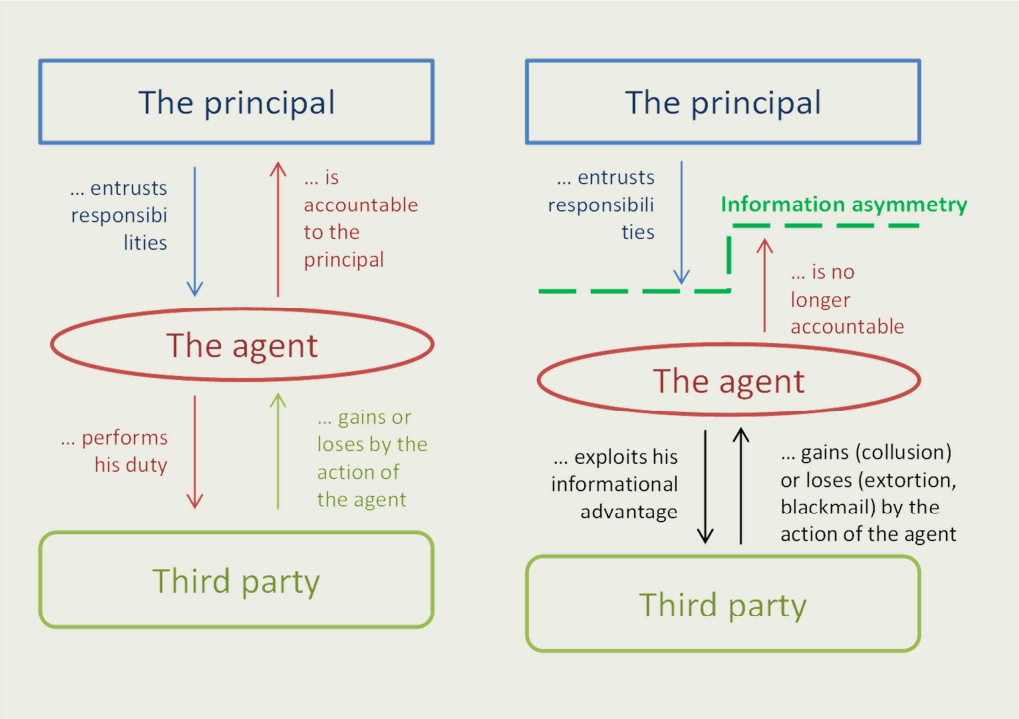
- the one who governs, called the *principal*;
- another who is governed, i.e. who acts on behalf of the principal, called the *agent*; and
- a *third party* who stands "to gain or lose by the action of the agent".[20]

Agency problems arise in a context of incomplete information and when the agent and the principal pursue diverging or antagonist goals (Banerjee, 1997; Drazen, 2000). In fact, agent's private interests may be in contradiction with the task he has been contracted for. In a context of perfect information, the agent has no incentives to misbehave, since in this case, he would inevitably be detected and sanctioned by the principal. In a context of imperfect information, agent's characteristics or actions cannot be perfectly observed, so that the principal has to hold him accountable in some manner (see figure 1.1). The literature on agency problems identifies two main sources of imperfect information; the *adverse selection* (Akerloff, 1970) and the *moral hazard* (Shapiro and Stiglitz, 1984). The *adverse selection* occurs when the principal ignores agent's inner characteristics. An example of adverse selection is when a minister (the principal) does not know if the public official (the agent) he is about to hire is honest or dishonest, because honesty is individual's private information. And when bureaucrats' remunerations are set according to average

[20] Banfield, E.C. (1975), "Corruption as feature of governmental organization", *The Journal of Law and Economics*, Vol.18,No.3, p.587.

staff performance, the presence of dishonest officials may lower the salaries, which in turn incites honest and performing employees not to apply for positions. As a result, only dishonest officials may join the public administration. The *moral hazard* occurs when the principal cannot perfectly observe the way agents behave. For instance, a fraudulent enterprise may lie to the central administration by not declaring workers, or public officials may accept undue informal payments not to do what they have been contracted for.

Figure 1.1. Principal-agent relationship



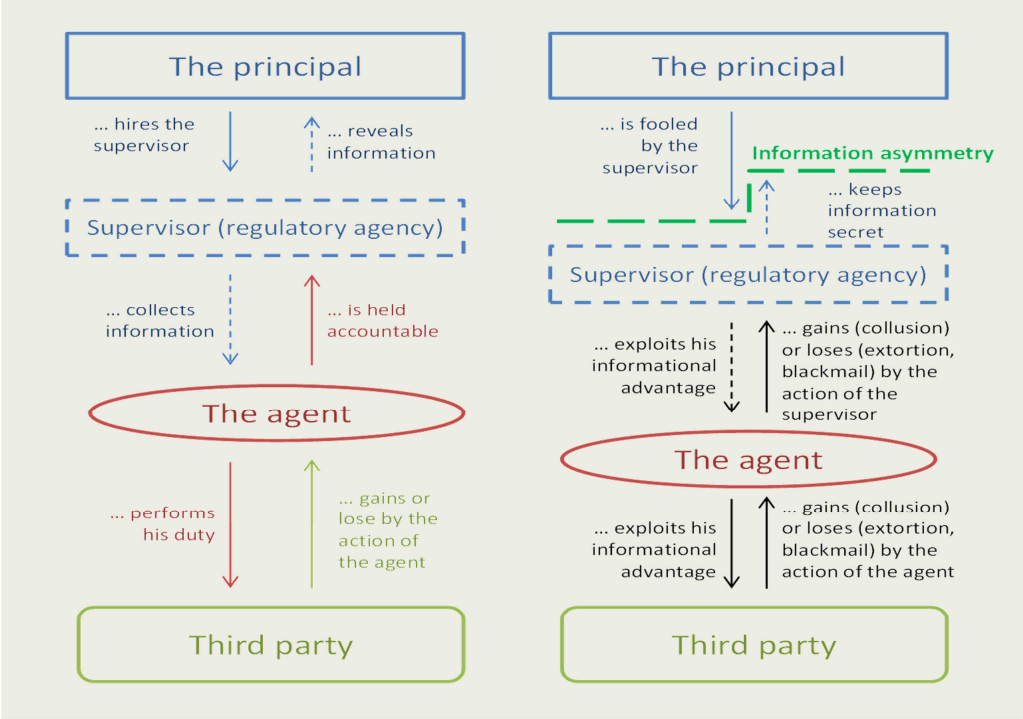
Source: author.

The agency problem may apply to several contexts. The most popular one is when a benevolent government agency (the principal), which objective is to correct market failures, charges potentially money-maker or bribe-maker bureaucrats (the agent) with the duty of achieving collective goals (Banerjee, 1997, Acemoglu and Verdier, 2000). In Banerjee's (1997) theory of misgovernance, corruption arises from the government's efforts to reduce wasteful red tape. In this setting, corruption occurs when agents deviate from the laws, rules, procedures and codes established by the government to achieve an optimal allocation of public goods (see also Shleifer and Vishny, 1993). In a complementary approach, Acemoglu and Verdier (2000) stress that when market failures justify state interventions, a certain amount of corruption resulting from those interventions may be a 'second-best', since preventing all corruption would be too costly for governments.

Other theoretical models have refined the analysis by considering the opportunity for the principal to hire a supervisor or a regulatory agency charged with collecting information on the agent. These models, called 'hierarchical agency models' or 'principal-agent-supervisor' models (Tirole, 1986), examine interactions between three parties that are hierarchically tied. The supervisor is expected to reduce agent opportunities to misbehave by revealing to the principal hidden information on the agent's type and/or actions. However, when supervisor's interests diverge from those of the principal, there are additional opportunities for corruption between the agent and the supervisor. In this case, the latter may misreport information on the agent's type/actions in exchange of extra-payments (see figure 2). This model may be relevant, for instance, for explaining corruption in customs (Dequiedt et al., 2012; Yang, 2008). A government (the principal) seeking to use customs duties to fund public expenditures needs information on imports volume, value, and classification. Importers (the agent) benefit from an informational advantage since the government cannot perfectly check the veracity of their declarations. The government may hence delegate the task of controlling what enterprises have actually imported to the customs administration (the supervisor). However, the supervisor's interests may not match with those of the principal, which leaves additional rooms for corrupt transactions, as illustrated in figure 1.2. Indeed, an enterprise may bribe a customs officer so that the latter underreports the value of its imports. Alternatively, a customs officer may extort money from an enterprise by threatening it to over-report the value its imports (Dutt and Traca, 2010). In this context, "supervisor of supervisor" structures charged with the supervision, inspection or gathering of information on supervisor' acts, as it exists in the police and the custom sectors (Dequiedt et al., 2012, Yang, 2008), can be very conducive to reduce corruption.

Agency models have been widely used to explain corruption in the public administration, but political corruption has also been explained in the light of the agency paradigm (Kunicova and Rose-Ackerman, 2005), when voters (the principal) entrust politicans (the agent) monopoly and discretionary powers over public resources. In these models, political corruption arises when politicians abuse their public positions to enrich, inasmuch such a misconduct does not jeopardize their chance of being re-elected.

Figure 1.2. The hierarchical agency model



Source: author.

The Cost-Benefit analysis

The economic approach of corruption higlights a range of country characteristics that are likely to shape the incentives for agents entrusted with public responsibilities to engage in corrupt transactions: the price and scarcity of goods/services delivered by the government, the amount of maximum red tape afforded, the level of public sector salaries, the existence of democratic institutions, the degree of domestic and foreign competition, the degree of competition between and within government agencies, or the establishment of effective dissuasive detection/prosecution/sanction mechanisms. By asserting that the likelihood of engaging in corrupt activities depends on the effectiveness of incentive mechanisms implemented by the principal to get the agent act in the public interest, the principal-agent framework presupposes that corruption will take place if public officials expect to derive a net benefit from a corrupt transaction. Following Huther and Shah (2000), agents accept or refuse to engage in corruption if, and only if, the expected utility of engaging in corruption outweighs the utility of staying honest, i.e. when:

$$(1-p)\times(w+n\times b)+p\times(w-s)>w+\theta \qquad (1.1)$$

where p is the probability of being caught and sanction, w is the wage rate in the public sector, s is the average penalty, b is the average bribe, n is the number of corrupt transactions, and Θ the agent

preference for honesty or the moral cost for corruption. From the regulator's point of view, corruption increases if the expected benefit of corrupt transactions is positive, i.e. if the expected gain exceeds the expected cost of corruption. Thus, the dilemma in (1) can be rewritten as:

$$Expected\ benefit = n \times [(1 - p) \times b] - [(p \times s) - \theta] > 0 \qquad (1.2)$$

From this corruption equation can be derived four mechanisms by which corruption is expected to increase or decrease:

- the number of opportunities for corruption transactions, *n*;
- the average scope for gain from corrupt transactions, *b*;
- the probability of getting caught, *p*; and
- the moral and economic costs associated to corruption transactions, θ and *s* respectively.

For instance, complex administrative rules/procedures give corrupt public officials opportunities to requiring third parties extra-payments to get things going faster/easier. Similarly, higher tax rates allow tax officers to ask for higher amount of money when a third entity wants to evade taxation, which hence raise the expected gain obtained from corrupt transactions. Conversely, strong check and balances on corrupt acts are likely to increase the probability for corrupt officials of getting caught and punished; while, the intolerance of the public toward corruption, combined with severe legal/administrative sanctions and high public salaries, are likely to raise the moral and economic costs of engaging in corruption.

From this rational microeconomic framework can be derived a general economic background for the analysis of the drivers underlying public agents' decisions to engage in corruption. Drivers or deterrents of public sector corruption have been put in a simple equation by Klitgaard (1988), which assumes that factors influencing corruption are those reducing the number of corrupt transactions, limiting the scope for gains from each transaction, and increasing the penalty and the probability of paying it:

$$Corruption\ (C) = Monopoly\ power\ (M) + Discretionary\ power\ (D) - Accountability\ (A) \qquad (1.3)$$

From this formula, one can deduce that country characteristics and policies curbing corruption are those reducing the *monopoly* and *discretionary powers* of officials, and supporting *accountability* mechanisms. According to this schematic framework, enlarged state interventions and the lack of competition between and within public sector agencies may increase public agents' *monopoly power* over public rents, hence shaping the size and number of opportunities for corrupt transactions. For instance, a heavy tax burden is likely to increase officials and taxpayers inclination to bypass taxation in exchange of illegal extra-payments or arrangements, while an increased competition

between agencies charged with granting business licenses may decrease the amount of extra payments expected by officials for this service.

The number, complexity and blurriness of state regulations and procedures, as well as the delegation of strong responsibilities at different layers of the public administration may foster corrupt activities by increasing public official's *discretionary powers* (Banerjee, 1997; UNODC, 2002). Indeed, complex or unclearly set laws and regulations create rooms for their misinterpretation in exchange of dubious extra payments. For instance, when laws do not explicitly and clearly define corruption offences, a judge may be prone to bribery or extortion for obliging judgments of legal cases.

Finally, the moral, social, economic and legal costs for public officials to engage in corruption will strongly determine the *accountability* of politicians and public officials by encouraging an honest use of their position. These costs and constraints are supposed to be positively related to the transparency in political decisions and administration proceeding, adequate working conditions in the public sector, and the effectiveness and capacity of law enforcement institutions and watchdog entities (e.g. Supreme Audit Institutions, non-state actors, etc.). Potential factors or drivers of corruption in the public sector are more formally addressed in sub-section 3.1.2.

Typologies of public sector corruption

When monopoly and discretionary powers prevail over accountability mechanisms in the public sector, corrupt acts are likely to occur and may materialize in various forms and contexts. The UNODC (2002) and the European Commission (Europeaid, 2011) identify a range of corrupt practices that encompass acts of bribery, extortion, fraud, favouritism, embezzlement, or illegal political contributions (see Annex 1.A). Such corrupt acts may be classified into specific categories, sharing common features or feeding on similar contexts. Those typologies of public sector corruption have been widely addressed by the literature on corruption and anti-corruption practices and generally refer to:

- the **scale of corrupt transactions,** by opposing *petty* to *grand corruption* (Europeaid, 2011). Petty corruption involves small sums and low-level officials, while grand corruption refers to substantial amounts of money and usually involves high-level officials or politicians.
- the **institutional location of actors,** by opposing *upper level* to *lower/street level corruption* (Morris, 2011), *centralized* to *decentralized corruption* (Bardhan, 1997), or by distinguishing *administrative/bureaucratic corruption* from *political corruption* and *state capture* (Rose-Ackerman, 2004). Administrative/bureaucratic corruption often results from the interaction with a bureaucrat or low-level public official (e.g. police or custom officer), altering the implementation of

regulations and policies. Political corruption and State capture are however less documented. The U4 Anti-Corruption Centre defines the former as

> "the misuse of entrusted power by political leaders",

and the latter as

> "the phenomenon in which outside interests (often the private sector, mafia networks, etc.) are able to bend state laws, policies and regulations to their (mainly financial) benefit through corrupt transactions with public officers and politicians".[21]

The rent-seeking literature[22] analyses political corruption and State capture as long-lasting phenomena contributing to the persistence of inefficient states and social injustice (Acemoglu et al., 2011), driven by rent appropriation by the ruler (politician or decision-maker) or outside groups. In this context, political corruption and State capture occur

> "when [high level officials and other] groups are able to influence [and/or exploit] the rules and regulations set by the State in ways that allow them to extract undue economic and/or political benefits".[23]

- the **costs of corruption,** by opposing *corruption with theft* and *corruption without theft* (Shelifer and Vishny, 1993), or distinguishing *corruption to do what officials are supposed to do* from *corruption to do what officials are not supposed to do* (Bardhan, 2006). While the former case corresponds to a situation where officials charge private agents an additional fee to accomplish or to fasten their professional duty ('speed money'), the second case represents a loss for the State implying greater collusion between corrupters and corruptees (Bardhan, 2006). For instance, extorting bribes from exporters is different from accepting bribes to let exporters evading trade barriers, as in the latter situation the government loses control over exchanges (Dutt and Traca, 2010). This point has been addressed by the recent literature focusing on the respective costs of bribery and extortion (Khalil et al. 2010; Dutt and Traca, 2010).

- the **motivation behind corrupt acts,** by distinguishing *corruption driven by need* from *corruption driven by greed***.** This distinction has been suggested by Tanzi (1998) and emphasised during the Warioba "Presidential Commission of Enquiry into Corruption" of Tanzania. According to the Warioba Commission, corruption motivated by need refers to street-level petty corruption, and

[21] http://www.u4.no/glossary/

[22] Unlike the principal-agent models who emphasise the mechanisms underlying corrupt acts, the rent-seeking literature on corruption is rather aimed at measuring the social costs induced by corrupt activities. See Drazen (2000) for a review of the main features of rent-seeking models.

[23] Norad (2008), "Anti-Corruption approaches", Evaluation Department, study 2/2008, p.10.

is viewed by public agents as a complement of insufficient resources. Conversely, corruption by greed usually refers to large scale transactions, motivated by wealth accumulation, and spreads in contexts of political and economic uncertainty, where agents' time-horizon is low (Mauro, 2004; Olson, 1993).

- the **frequency and scope within of corrupt transactions**, by distinguishing *incidental corrupt transactions* – which are occasional and individually driven –, *institutional corrupt transactions* – which are systematized within a given institution (e.g. the justice) –, and *systemic corrupt transactions* – which are widespread coordination mode throughout the whole society (Morris, 2011; Europeaid, 2011). In the latter context, administrative corruption and political corruption/state capture coexist and feed each other, petty corruption stokes large networks of corruption (Cadot, 1987), while cupid politicians and high-level public officials expose to everyone their dubious affairs and fuel a global climate of impunity (see section 4).

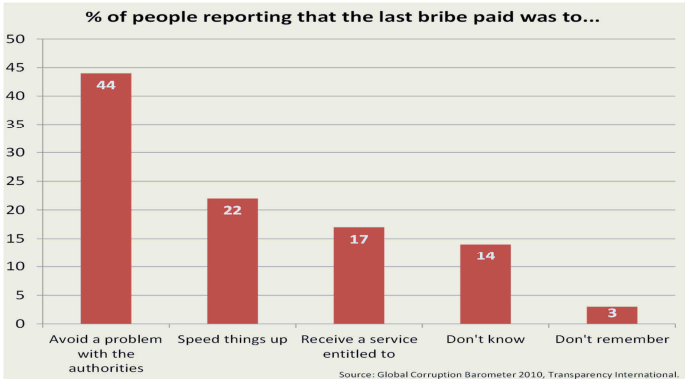
How and where bribes are paid

Typologies of public sector corruption are non-exclusive. Indeed, grand corruption is usually associated with high-level or political corruption, when for instance private interests illegally fuel with huge amount of money networks of politicians or legislators to unduly influence laws and rules satisfying their interest in trade protections or favourable economic regulations. In contrast, petty corruption generally involves low-level public officials and results from small and frequent transactions.

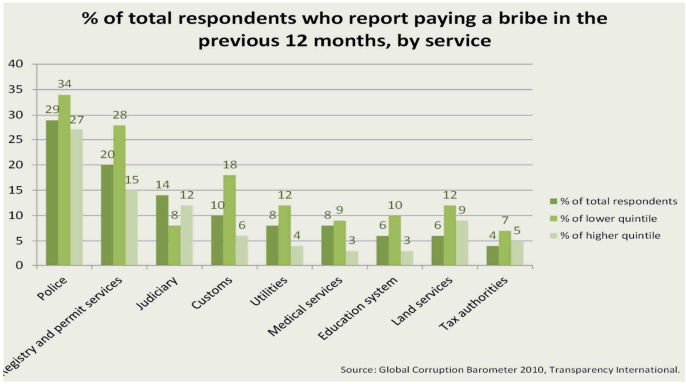
Grand corruption is often attributed to poor accountability and transparency, generally feeds on large-size and complex transactions, and is positively influenced by the immediacy of rewards, since the possibility of receiving the bribe within two or three years is not very enticing. Applying these criteria, grand corruption is expected to occur in the following sectors: public and private construction, telecommunications equipment, extractive industries, arms and defence contracts, large infrastructure contracts in health and water sectors, and technical expertise (see sub-section 3.2). Public or State enterprises may be an important vector of grand corruption, especially political corruption, when these companies are used to finance activities of a political party or to provide jobs to the "clientele" of political groups. Private monopoles may also be a source of grand corruption when for instance the government is bribed by a private group to sell a public enterprise below its market value, or when private groups bribe legislators or illegally fund political parties to obtain/maintain a monopolistic position. The 2010 Global Corruption Barometer survey published by Transparency International shows that political parties are perceived by 79% of respondents as the most corrupt institution (see figure 1.3iii)), thereby highlighting the extent and the prejudices caused by grand/political corruption around the world.

Figure 1.3. Some insights into bribe payments – the 2010 Global Corruption Barometer.

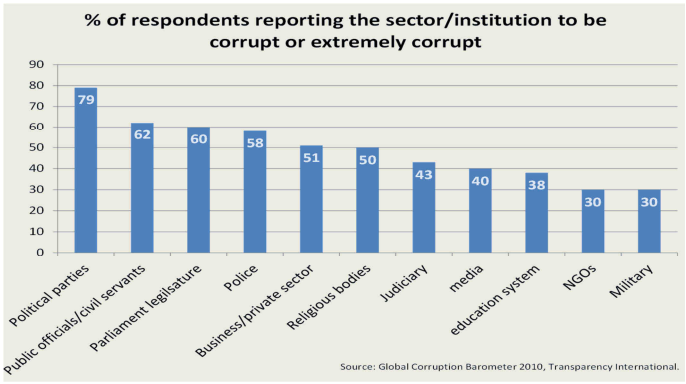
i) motivations for bribe-payments



ii) sector location of bribe payments



iii) institutional location of bribe-payments



If scandals of political corruption monopolize media attention, petty corruption is more discrete and alters the daily life of the ordinary (poorest) citizen. Petty corruption can be as damaging as grand or political corruption by impacting directly the welfare of citizens and the business environment. As a striking illustration, the 2009 Global Corruption Barometer survey finds that 40% of interviewed people reported to have spent in average between 1% and 10% of their annual income into bribes (Transparency International, 2009b, p.12). Notably, figure 1.3i) stresses that petty corruption mostly occurred when citizens and companies seek to get rid of the state burden, that is, either to avoid problems with public officials (44% of bribes paid) or to speed things up (22% of bribes paid). It also shows that at least 40% of the respondent paid bribes to get things done (17% of bribes paid), or done faster (22% of bribes paid), suggesting that public agents frequently charge additional fees to do (or do better) what they were expected to do. Finally, petty corruption uses to prevail in sectors most solicited by the population, such as customs, taxation, police, judiciary, land services, registry and permit services, health, education, and utilities (water and electricity). This fact is salient in figure 1.3ii), which shows that during 2010, 30% and 20% of respondents reported paying a bribe when interacting with the police and the registry and permit services, respectively. Figure 1.3ii) also supports that bribery in the most corrupt sectors – i.e. the police, the registry and permit services, and customs – hurts the poorest segments of the population. It can be indeed observed that corruption in these sectors displays the strongest disparities between the lowest and the highest income quintile of the respondents.

3.1.2. Expected drivers of public sector corruption

As stressed in the previous sub-section, the economic approach of corruption considers that corrupt acts flourish wihtin systems where there are weak incentives for behaving honestly, and where the frequency of and the scope for corrupt transactions are high. Therefore, various characteristics of country economic, political and social environments are likely to influence the likelihood of engaging in corruption. Notably, societies where public sector corruption finds a fertile ground are usually those with badly designed and poorly enforced anti-corruption regulations, and an inappropriate distribution of powers, responsibilities, and constraints among bureaucrats and politicians. Following the corruption framework established by Klitgaard (1988), we propose below a (non-exhaustive) review of some key drivers and deterrents of corruption in the public sector, supported by a very illustrative empirical analysis.

The development process

Treisman (2000) highlighted the deterrent effect of the economic development process on corruption levels. According to him, differences in the logarithm of the *per capita* GDP explain at least 73% of the country variation in the 1990 Transparency International's (TI) Corruption Perception Index (CPI).

Figure 1.4i) illustrates a strong negative cross-country correlation between the log GDP *per capita* and corruption perceptions in 2005, as measured by the Transparency International's "Corruption Perceptions Index" (CPI), the World Bank's "Control of corruption" indicator (CoC), and the International Country Risk Guide's corruption perception indicator (ICRG).[24] It is commonly argued that wealthier countries undergo lesser corruption, because corruption driven by need decreases with improved life standards; and also because of the many institutional, sociological, and demographic changes which usually accompany the development process and which are usually associated with lower corruption levels. Figure 1.4ii) plots the evolution of the average world *per capita* GDP against the evolution of the world average ICRG corruption score from 1984 to 2005. It depicts a negative time correlation starting 1990 (short-dashed line), and clearly illustrates the important decline in the world average corruption perception which followed the surge in the world average GDP *per capita* income since 1994 (long-dashed line).

However, the same figure shows that below a *per capita* income threshold of around 3000 dollars a year (corresponding to a logarithmic value of 8), income exhibits very little correlation with corruption perceptions. It even shows a positive correlation between the average world income and the average world corruption perception levels before 1990, suggesting that the worldwide enrichment of nations may have been associated with increased corrupt practices.

In table 1.1, we further illustrate the link between economic development and corruption by running Ordinary Least Square (OLS) cross-section estimations of the relationship between corruption perceptions (the dependent variable) and explanatory variables approximating the level of economic development: the logarithm of *per capita* income as a measure of wealth per habitant, and the growth of the population as a measure of human capital level (higher demographic growth rate corresponding to lower human capital levels). Each variable is averaged over the period 1995-2005, and corruption is proxied by our three measures of corruption perceptions (CPI, ICRG, and CoC indicators).

First, a robust and significant negative partial correlation between *per capita* income and corruption is evidenced in all regressions. Second, to check whether the relationship between wealth and corruption is non-monotonic, we add the quadratic value of the GDP/*capita* in corruption regressions (columns (4), (5), and (6)). We observe a 1%-significant hump-shaped relationship between GDP/*capita* and corruption, as well as an important rise in the explanatory power of regressions. These empirical evidence therefore suggest that an increase in *per capita* income in the poorest countries may translate into higher corruption levels, and that the negative association between the development process and corruption operates beyond a certain level of *per capita* income (between 150$ and 600$, depending on the corruption indicator). Third, concerning the

[24] An increase in corruption scores correspond to a decrease in corruption perceptions.

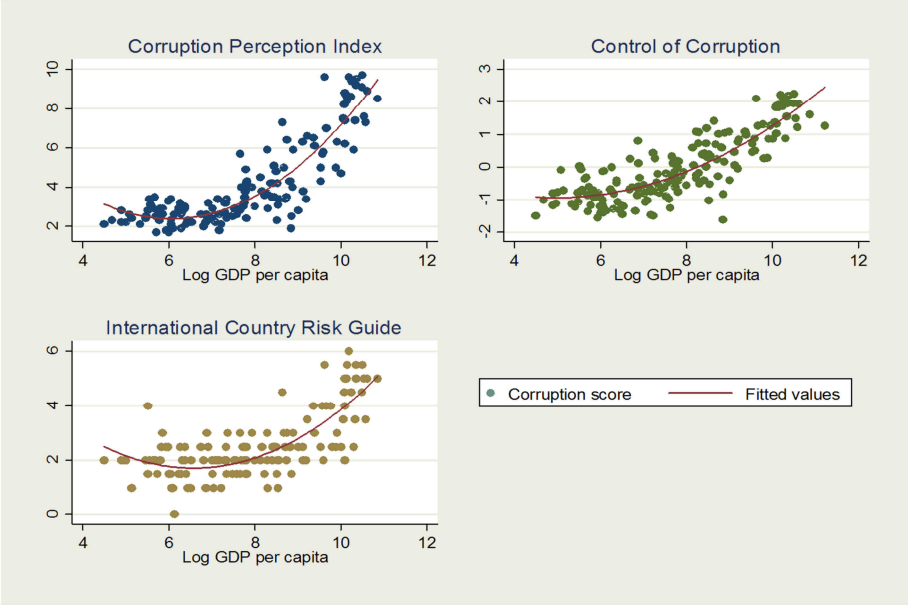
correlation between human capital (proxied by the demographic growth rate) and corruption, we find in columns (7), (8) and (9) a 1%-significant positive partial correlation, suggesting that lower human capital is associated with higher corruption levels.

Thus, the correlation between wealth and corruption is not as straightforward as surmised. It is likely that the growth process creates new opportunities for corrupt transactions at early stages of development, when institutional safeguards against malpractices are dysfunctional. But it is worth considering that the positive association between corruption perceptions and income, which is apparent at low income levels, may reflect the emergence of new coordination/interaction modes associated with the modernization process but still perceived as illegitimate by the public (see Andvig (2006) and sub-section 4.3). Last but not least, the strong negative correlation between income and corruption perceptions observable beyond a certain level of income may also reflect a global optimism, arising from improved standards of living, rather than a *de facto* reduction of corrupt practices. In fact, it can be noted that the GDP per capita explains much more variations in CPI and CoC scores than in ICRG scores, as shown by the important difference between the latter and the formers' R-squared. It is plausible that because they encompass a broad spectrum of governance-related concepts, perceptions of corruption reflected by composite indicators such as CPI and CoC are less precise and maybe more sensitive to improvements or declines in global living conditions than perceptions reflected by single source indicators such as the ICRG indicator.

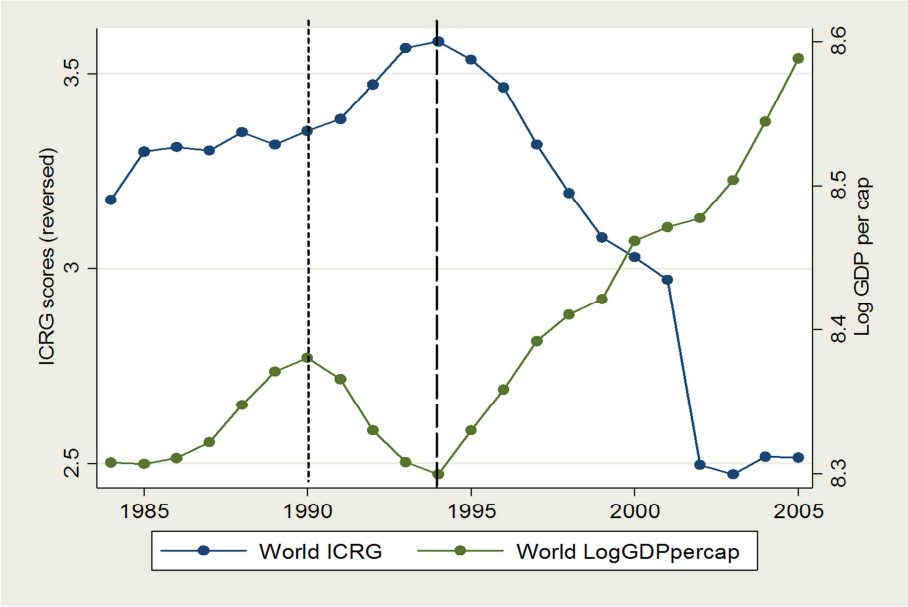
Thus, the correlation between economic development and the incidence of corruption is observable but difficult to explain, because of the simultaneity bias between the two variables, and also because of the many economic and socio-political unobserved changes inherent to the development process. A better understanding of factors shaping the incentives, disincentives, and opportunities for corruption is therefore necessary to explain cross-country differences in corruption levels.

Figure 1.4. Cross-country and time correlations between the log GDP per capita and corruption levels

i) Cross-country comparisons, 2005.



*ii) World time trend**



*ICRG scores have been reversed, so that a decrease reflects lower corruption perceptions.

Table 1.1. Corruption and *per capita* income, OLS estimations

Dependent variables :	CPI (1)	ICRG (2)	CoC (3)	CPI (4)	ICRG (5)	CoC (6)	CPI (7)	ICRG (8)	CoC (9)
Log GDP per capita	*-1.08***	*-0.44***	*-0.50***	*3.26***	*1.36***	*1.00***	*3.63***	*1.92***	*1.18***
	(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.01)*	*(0.00)*	*(0.00)*	*(0.01)*	*(0.00)*
Log GDP per capita^2				*-0.28***	*-0.11***	*-0.10***	*-0.30***	*-0.15***	*-0.11***
				(0.00)	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*	*(0.00)*
Population growth							*0.15***	*0.22***	*0.08***
							(0.04)	*(0.001)*	*(0.01)*
Constant	4.14***	0.53	3.86***	-11.88***	-6.23***	-1.71*	-13.63***	-8.87***	-2.59**
	(0.00)	(0.16)	(0.00)	(0.00)	(0.00)	(0.07)	(0.00)	(0.00)	(0.02)
Observations	151	131	177	151	131	177	151	131	177
R^2	0.68	0.44	0.69	0.79	0.51	0.75	0.80	0.56	0.76
Annual GDP/cap threshold:				**337$/cap**	**483$/cap**	**148$/cap**	**424$/cap**	**602$/cap**	**221$/cap**
Nb of countries < income threshold				26	26	5	33	30	12

Standard errors are robust to heteroskedasticity. P-value are between parentheses. ***significant at 1% **significant at 5% *significant at 10% †significant at 15%. Variables are averaged over the period 1995-2005. Corruption scores have been reversed, so that a negative coefficient reflects a negative association with corruption perceptions.

Features of the public sector affecting the costs and benefits of corruption

Public sector corruption is expected to be lower in countries where the public administration and the political arena provide incentives to stay away from corruption. Two main features of the public sector are generally found to affect corruption, namely, public sector's working conditions and public sector's size.

Public sector working conditions

Motives for public agents to engage in corruption may arise from poor working conditions, generated by low salaries (Tanzi, 1998; Van Rijckeghem and Weder, 2001; Cadot, 1987), or the uncertainty prevailing upon public offices in unstable political environments (Campante et al., 2009; Mauro, 2004; Cadot, 1987). Good working conditions increase the opportunity cost of engaging in corruption, by inducing substantial loss of benefit for the corrupt official detected and dismissed. In the same way, political stability lengthens public officials' time-horizon, improves career opportunities, and increases the value of public office, which should prevent them from stealing or embezzling public funds.

On the contrary, it has been contended that public office stability may allow corrupt public agents building trustworthy and constant relationship with their clients (Campante et al., 2009; Treisman, 2000). Or, as stressed by Tanzi (1998), high public salaries may increase the value of public office, which may in turn intensify bribery to get positions in the public administration. A non-monotonic relationship between public sector working conditions and corruption has also been suggested by Macchiavello (2008). The author hypothesizes the existence of agents heterogeneous in terms of public sector motivation, and argues that setting public salaries at a lower level than those of the private sector allows the screening of motivated public servants, while not providing sufficient monetary incentives against opportunistic behaviours. By contrast, he shows that when public sector salaries are higher, non-motivated public servants who would have worked in the private sector otherwise are hired and are likely to divert public resources. In these settings, public sector wages should not be too high, so that only true public servants apply to public sector positions, but should be sufficiently high to prevent from opportunistic behaviours of motivated agents. Thus, a qualitative working environment in the public sector, while being an incentive to behave honestly, may in certain situations represent a rent for public agents and get the expected gain from corrupt transactions bigger.

In table 1.2, we conduct OLS cross-section estimations of the relationship between public sector working conditions and corruption perceptions, by inserting into the previous regressions measures of bureaucratic salary and career opportunities proposed by Rauch and Evans (2000).[25] It appears

[25] drawn from Teorell, J., Samanni, M., Holmberg, S., and B. Rothstein, *The Quality of Government Dataset*, University of Gothenburg: The Quality of Government Institute, 2011.

that better relative salary or career opportunities in the bureaucracy tend to be negatively associated with corruption perceptions, but not at the usual confidence levels (except for the 5%-significant correlation between career opportunities and the CoC indicator). This relationship may however suffer from multicolinearity with GDP per capita (and important data losses), which certainly inflates estimated standard errors.

Table 1.2. Corruption and public sector working conditions, OLS estimations

Dependent variables :	CPI	ICRG	CoC	CPI	ICRG	CoC
	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP per capita	1.54*	1.35*	0.15	1.66*	1.41**	0.19
	(0.10)	(0.08)	(0.72)	(0.09)	(0.04)	(0.65)
Log GDP per capita^2	-0.17***	-0.11**	-0.04	-0.18***	-0.11***	-0.05*
	(0.00)	(0.03)	(0.12)	(0.01)	(0.01)	(0.10)
Population growth	-0.25	0.04	0.02	-0.32	0.05	-0.04
	(0.35)	(0.82)	(0.84)	(0.23)	(0.76)	(0.75)
Bureaucratic relative salary	*-1.20*	*-0.29*	*-0.58*			
	(0.31)	*(0.65)*	*(0.35)*			
Public sector career opportunities				*-1.10*	*0.25*	*-0.94***
				(0.30)	*(0.65)*	*(0.05)*
Constant	-4.49	-6.62**	1.79	-4.55	-6.96**	-1.71*
	(0.19)	(0.04)	(0.30)	(0.18)	(0.02)	(0.07)
Observations	33	33	33	33	33	33
R^2	0.72	0.48	0.75	0.71	0.48	0.77

Standard errors are robust to heteroskedasticity. P-value are between parentheses. ***significant at 1% **significant at 5% *significant at 10% †significant at 15%. Variables are averaged over the period 1995-2005. Corruption scores have been reversed, so that a negative coefficient reflects a negative association with corruption perceptions.

Public sector size

Excessive size of the state has been considered over the last decades as an important source of monopoly powers for public officials and politicians. By contrast, increased domestic and foreign competition, through trade openness, deregulation, and the privatization of state-owned enterprises, has been viewed as a lever for dragging firms' profits down and therefore discouraging bribe payments (Lambsdorff, 2005; Sandholtz and Koetzle, 2000; Ades and Di Tella, 1999).

Public sector corruption may arise from the strong monopoly and discretionary powers state interventions give to individuals entrusted with public responsibilities. Indeed, state interventions are seen by many authors, and in different ways, as a burden inciting private and public agents to exploit it or to get rid of it through sometimes questionable practices. Notably, *red tape*[26] may foster the bribery of bureaucrats to 'get things done' or 'to make things going faster', thereby feeding a vicious

[26] red tape refers to excessive and/or poorly-designed bureaucratic rules that imply non-pecuniary costs for agents dealing with bureaucracy (Banerjee, 1997).

circle where additional red tape is created by public agents to increase opportunities to demand extra payments (Guriev, 2004; Lambsdorff, 2002; Tanzi, 1998). In the same way, excessive taxation or trade barriers are often seen as opportunities for corruption and state capture. Indeed, higher tax rate may increase the amount of bribes required by bureaucrats for tax exemption (La Porta et al., 1999; Tanzi, 1998), while high tariff and non-tariff trade barriers may create opportunities for politicians and custom officers to extort money or to sell favourable treatments to domestic and international private companies (Dutt and Traca, 2010; Dutt, 2009; Gatti, 2004; Hellman, et al., 2003).

However, several arguments in support to a negative association between public sector size and corruption can be invoked. Indeed, it has been contended that increased state intervention often tracks the long run growth process (Peacock and Scott, 2000), generally accompanies the openness of economies (Rodrik, 1998), and sometimes results from improved economic and democratic institutions (Rodrik, 2000). Moreover, red tape does not systematically create opportunities for corruption since it may also be associated with better screening and higher internal administrative controls (Wilson, 1989). Last but not least, as further addressed in the next section, it is argued that the growth of the private sector worldwide has created new forms and opportunities of corruption (Transparency International, 2009a ; Rose-Ackerman, 2007; Pope, 2000), which makes the link between public sector size and corruption ambiguous.

To illustrate the empirical link between government size, protectionism and corruption, we re-estimate the corruption equation by adding government size and trade openness variables to economic and human development variables (see table 1.1). Results are presented in table 1.3. We first insert the share government expenditures in the GDP (columns (1), (2), and (3)), and find little evidence of a negative partial correlation between this variable and corruption levels. Suspecting that standard errors are inflated by a high correlation between public spending and GDP *per capita*, we replace the variable of government expenses by a variable of government revenue in the corruption equation. We find strong empirical evidence of a significant negative partial correlation between government revenue and corruption perceptions in columns (4), (5), and (6), which does not support the hypothesis that increased state interventions translate into higher corruption levels. In a third set of regressions (columns (7), (8), and (9)), we test the relationship between trade openness and corruption by adding a variable of total trade in GDP to economic and human development variables. The resulting estimates show a negative but not significant partial correlation between openness and corruption perceptions. In a fourth set of regressions (columns (10), (11), and (12)), we introduce government revenue and trade openness variables together and do not find any significant changes in estimated coefficients and standard errors.

Table 1.3. Corruption, government size and trade openness, OLS estimations

Dependent variables :	CPI (1)	ICRG (2)	CoC (3)	CPI (4)	ICRG (5)	CoC (6)	CPI (7)	ICRG (8)	CoC (9)	CPI (10)	ICRG (11)	CoC (12)
Log GDP per capita	3.49*** (0.00)	2.13*** (0.00)	1.28*** (0.00)	3.46*** (0.00)	1.96*** (0.00)	1.30*** (0.00)	3.69*** (0.00)	1.89*** (0.00)	1.37*** (0.00)	3.50*** (0.00)	1.94** (0.04)	1.32*** (0.00)
Log GDP per capita^2	-0.29*** (0.00)	-0.16*** (0.00)	-0.11*** (0.00)	-0.29*** (0.00)	-0.15*** (0.00)	-0.11*** (0.00)	-0.30** (0.00)	-0.15*** 0.00)	-0.12*** (0.00)	-0.29*** (0.01)	-0.15*** (0.00)	-0.12*** (0.00)
Population growth	0.11 (0.24)	0.21** (0.03)	0.04 (0.39)	0.08 (0.34)	0.17* (0.06)	0.04 (0.29)	0.15** (0.04)	0.21*** (0.01)	0.08** (0.02)	0.08 (0.33)	0.17* (0.06)	0.04 (0.28)
Gov expenses (% of GDP)	*-0.11 (0.37)*	*-0.01 (0.45)*	*-0.01** (0.05)*									
Tax revenue (% of GDP)				*-0.05*** (0.00)*	*-0.04*** (0.00)*	*-0.02*** (0.00)*				*-0.05*** (0.00)*	*-0.04** (0.00)*	*-0.02*** (0.00)*
Total trade (% of GDP)							*-0.003† (0.14)*	*-2e-04 (0.81)*	*-0.001 (0.16)*	*-0.001 (0.51)*	*0.001 (0.38)*	*-4e-04 (0.64)*
Constant	-12.83*** (0.00)	-9.47** (0.00)	-2.70*** (0.01)	-12.29*** (0.00)	-8.51** (0.00)	-2.71** (0.01)	-13.71*** (0.00)	-8.73*** (0.00)	-3.19*** (0.00)	-12.36*** (0.00)	-8.47*** (0.00)	-1.71* (0.07)
Observations	120	107	129	121	108	130	150	130	172	121	108	130
R^2	0.81	0.60	0.81	0.83	0.63	0.82	0.80	0.55	0.77	0.83	0.63	0.82

Standard errors are robust to heteroskedasticity. P-value are between parentheses. ***significant at 1% **significant at 5% *significant at 10% †significant at 15%.Variables are averaged over the period 1995-2005. Corruption scores have been reversed, so that a negative coefficient reflects a negative association with corruption perceptions.

Thus, state regulation of the economy, proxied by the government size and trade openness, is not necessarily positively associated with corruption levels. On the contrary, long term relationships estimated in cross-country regressions tend to support a negative correlation between the extent of public intervention and perceptions of corruption, which advocates the views according to which an increased involvement of the state in the economy goes hand-in-hand with improved governance outcomes. In this regard, introducing public sector size variables in regressions strongly lowers the significance of demographic growth rate coefficients, suggesting that the negative correlation between public sector size and corruption might be partly attributable to improvements in human capital levels. Nevertheless, one should abstain from drawing clear-cut conclusions based on this evidence, as it probably reflect omitted structural and institutional country characteristics underlying the effectiveness/ineffectiveness of state interventions.

Country structural characteristics influencing the monopoly and discretionary powers of public officials and politicians

There actually exist structural country characteristics which strongly influence the extensiveness of corruption by giving numerous opportunities for corrupt acts. Amongst these characteristics, endowments in natural resources and the size of country have often been considered by analysts as critical factors of corruption.

Natural resource endowments

Large endowment in natural resources without adequate accountability and control mechanisms[27] is considered by numerous analysts to be a "curse", by generating large inflows of money prone to rent-seeking and state capture (van der Ploeg, 2011; Kodi, 2008; Robinson et al., 2005; Sachs and Warner, 2001; Treisman, 2000). A large body of researches and international initiatives emphasise the potential risks of abuses in the management of natural resources, and support a range of norms of transparency in various sectors prone to bribery, such as extractive industries (Extractive Industry Transparency Initiative[28]), the forest industry (Forest Law Enforcement, Governance and Trade[29]), or the diamond sector (The Kimberley Process Certification Scheme[30]). It is worth noting that corruption vulnerabilities in natural resource sectors are related to the exploitation of natural resources on the one hand, and the management of the public revenues arising from this exploitation on the other hand (see Gauthier and

[27] As an example, Nygren (2005) addresses the issue of forest resource management in context of decentralization and community appropriation in Honduras. The author stresses that community-based resource management strongly improved social and economic outcomes in a context of decentralization.

[28] http://eiti.org/

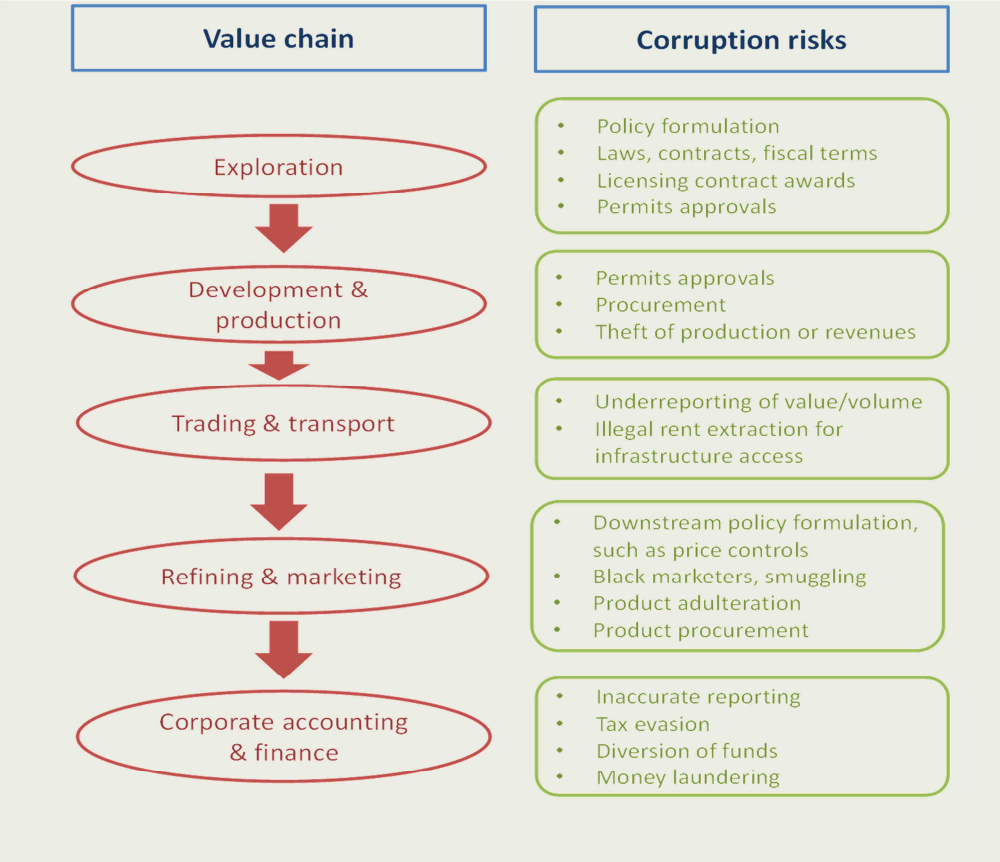
[29] http://www.euflegt.efi.int/portal/

[30] http://www.kimberleyprocess.com/

Zeufack, 2009). Figure 1.5 illustrates the risks of corruption prevailing along the value chain of the petroleum sector.

In table 1.4, we regress corruption indicators over a measure of natural resource endowments (in % of the GDP) drawn from the 2010 World Development Indicators, along with variables of GDP *per capita*, demographic growth rate, government tax revenue, and trade openness (columns (1), (2), and (3)). A significant positive partial correlation is evidenced, supporting that natural resource endowments may lead to pervasive corruption by lining the pockets of avid public and private agents.

Figure 1.5. Corruption vulnerabilities in the petroleum sector value chain



Source: McPherson, C., and S. MacSerraigh, "Corruption in the petroleum sector", in eds. Edgardo Campos, J., and S. Pradhan, *The Many Faces of Corruption: Tracking the Vulnerabilities at the Sector Level*, The World Bank, 2007, p. 214.

Country size

Another structural determinant of corruption often emphasised by the literature is the courty size. As stressed in Banerjee (1997), a low quantity of public goods and services *per capita* gives discretionary power to officials. For this reason, larger countries (in terms of population) may produce lower quantities of public *per capita*, which may tempts citizens to bribe public agents to "*jump the queue"* (Fisman and Gatti, 2002). The importance of country size has also been pointed in analyses of the effect of natural openness on corruption. According to Wei (2000), small domestic population increases trade openness, which in turn may incite policy-makers to invest in good institutions, since corruption is likely to discourage foreign companies from investing in their country.

On the contrary, it has been argued that larger country can benefit from scale economies in the provision of public goods and services (Alesina and Wacziarg, 1998), so that officials can extract lower rents *per-capita*. Finally, some empirical researches show that the positive link between country size and corruption disappears if the sample country coverage is widened, suggesting that this relationship is not straightforward (Knack and Azfar, 2003). OLS estimates in table 1.4 (columns (4), (5), and (6)) do not provide clear-cut evidence of a significant relationship between the logarithm of the population and corruption perceptions.

Country institutional features affecting the accountability and the transparency of public decisions and policy-making

Third, the lack of accountability mechanisms – such as financial/economic regulations and administrative rules, transparent procedures, effective law-enforcement institutions and poorly empowered watchdog and oversight bodies[31] – are seen as common features of corrupt countries. Because it is often associated with effective transparency and accountability mechanisms, democracy is considered as a strong corruption deterrent. Democratic institutions indeed reduce opportunities for corrupt transactions, by allowing an improved scrutiny of voters upon political decisions, fostering political competition and supporting the freedom of media (Lambsdorff, 2002; Treisman, 2000, 2007; Sandholtz and Koetzle, 2000). According to Sandholtz and Koetzle (2000), this virtuous effect of democracy on governance depends on how well institutionally established norms of democracy are. This idea is also supported by Treisman (2000), who shows that only democracy older than 40 consecutive years are significantly associated with lower corruption levels.

[31] the parliament, civil society organizations, the media, or supreme audit institutions.

Table 1.4. Corruption and structural country characteristics, OLS estimations

Dependent variables :	CPI	ICRG	CoC	CPI	ICRG	CoC
	(1)	(2)	(3)	(4)	(5)	(6)
Log GDP per capita	3.37***	1.49***	1.36***	3.36***	1.49***	1.36***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Log GDP per capita^2	-0.28***	-0.12***	-0.12***	-0.28***	-0.12***	-0.12***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Population growth	0.03	0.10	0.01	0.02	0.10	0.01
	(0.67)	(0.16)	(0.78)	(0.70)	(0.16)	(0.78)
Tax revenue (% of GDP)	-0.04***	-0.03***	-0.01*	-0.04***	-0.03**	-0.01*
	(0.01)	(0.01)	(0.07)	(0.01)	(0.02)	(0.09)
Total trade (% of GDP)	-0.001	0.001	-4e-04	-0.002	0.001	-4e-04
	(0.54)	(0.51)	(0.66)	(0.47)	(0.51)	(0.69)
Natural resources (% of GDP)	*0.02**	*0.02****	*0.01****	*0.02**	*0.02****	*0.01****
	(0.06)	*(0.01)*	*(0.00)*	*(0.06)*	*(0.01)*	*(0.00)*
Log population				*-0.03*	*0.01*	*-1e-04*
				(0.66)	*(0.86)*	*(0.99)*
Constant	-11.99***	-6.71***	-3.02***	-11.44***	-6.88***	-3.02***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Observations	114	100	121	114	100	121
R^2	0.84	0.67	0.84	0.84	0.67	0.84

Standard errors are robust to heteroskedasticity. P-value are between parentheses. ***significant at 1% **significant at 5% *significant at 10% †significant at 15%.Variables are averaged over the period 1995-2005. Corruption scores have been reversed, so that a negative coefficient reflects a negative association with corruption perceptions.

Democracy and polity durability

Therefore, it can be advanced that both democracy and/or the stability of the polity may reduce the incidence of corruption. We address separately these issues in table 1.5, using measures of democracy and polity durability provided by the polity IV.[32] Cross-country estimates presented in columns (1), (2), (3) display little evidence of a relationship between democracy and corruption, as a 5%-significant negative correlation is found with the ICRG indicator only. Adding the durability variable in the corruption equation yields interesting results (columns (4), (5), and (6) of table 1.5). First, 1%-significant and negative partial correlations between the polity stability and corruption perception indicators are evidenced. Second, it seems that the stability of political institutions is a significant channel for the hump-shaped relationship between *per capita* wealth and corruption. Estimates in table 1.5 show that, once inserting the durability variable in regressions, the strength of the relationship between GDP *per capita* and corruption is

[32] The democracy variable ranges from +10 (strongly democratic) to -10 (strongly autocratic). The polity durability variable is the number of years since the most recent regime change (defined by a three point change in the democracy variable score over a period of three years or less) or the end of transition period defined by the lack of stable political institutions.

considerably lowered. The positive correlation between wealth and corruption at an early stage of the economic development process evidenced previously even becomes non-significant when using the ICRG indicator.[33] According to our estimations, it is hence likely that the deterrent effect of the development process on corruption pass through the emergence of durable political institutions (whether democratic or not).

Table 1.5. Corruption and country institutional features

Dependent variables :	CPI (1)	ICRG (2)	CoC (3)	CPI (4)	ICRG (5)	CoC (6)
Log GDP per capita	3.33***	1.47***	1.36***	2.44***	0.844	0.982***
	(0.00)	(0.01)	(0.00)	(0.00)	(0.19)	(0.00)
Log GDP per capita^2	-0.28***	-0.12***	-0.12***	-0.21***	-0.07*	-0.09***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.10)	(0.00)
Population growth	0.01	0.07	-0.005	0.001	0.06	-0.01 (0.75)
	(0.89)	(0.31)	(0.89)	(0.98)	(0.34)	
Tax revenue (% of GDP)	-0.04***	-0.03**	-0.01*	-0.04***	-0.03**	-0.01*
	(0.01)	(0.03)	(0.08)	(0.01)	(0.02)	(0.08)
Total trade (% of GDP)	-0.003	4e-05	-9e-04	-0.003†	-3e-04	-0.001†
	(0.21)	(0.97)	(0.36)	(0.13)	(0.81)	(0.15)
Natural resources (% of GDP)	0.02**	0.01†	0.01***	0.02**	0.01*	0.01***
	(0.04)	(0.14)	(0.01)	(0.04)	(0.10)	(0.01)
Log population	-0.005	-0.008	0.02	0.06	0.03	0.04 (0.25)
	(0.94)	(0.87)	(0.63)	(0.35)	(0.49)	
Democracy	*-1e-04*	*-0.03**	*-0.005*	*-4e-04*	*-0.02**	*-0.01 (0.38)*
	(0.99)	*(0.06)*	*(0.64)*	*(0.98)*	*(0.06)*	
Polity durability				*-0.01****	*-0.01***	*-0.01****
				(0.01)	*(0.02)*	*(0.01)*
Constant	-11.58***	-6.43***	-3.27***	-11.44***	-6.88***	-3.02***
	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)
Observations	105	94	108	105	94	108
R^2	0.83	0.64	0.83	0.85	0.66	0.85

Standard errors are robust to heteroskedasticity. P-value are between parentheses. ***significant at 1% **significant at 5% *significant at 10% †significant at 15%.Variables are averaged over the period 1995-2005. Corruption scores have been reversed, so that a negative coefficient reflects a negative association with corruption perceptions.

[33] It seems that the ICRG indicator is more sensitive to the polity, while CPI and CoC indicators appear much more sensitive to the *per capita* wealth.

Patterns of democracy

Other studies show that many institutional features lie behind the umbrella concept of democracy, and that these features vary according to their ability to deter corruption and to promote transparency and accountability. As Persson and Tabellini (2004) point out about the relationship between democratic institutions and corruption, "*the evil is in the details*". They stress the many ways country constitutional rules can affect systems of checks and balances over the executive, and how such systems affect political rents and corruption.

Notably, the effects of electoral rules and forms of government on political corruption are an on-going debate among economists and political scientists.[34] Concerning electoral rules, the plurality (or majoritarian) rule of representation has often been opposed to the proportional rule of representation in terms of anti-corruption outcomes, the former being theoretically and empirically associated with higher accountability of incumbents and hence higher incentives to perform well and behave honestly (Kunicova and Rose-Ackerman, 2005; Persson and Tabellini, 2004; Persson et al., 2003; Persson, 2002). Regarding the forms of government, the same literature opposes theoretically presidential to parliamentary regimes, the former being associated with stronger checks and balances and hence less incentives to misbehave.[35] However, empirical findings tend support the inverse relationship. Parliamentary forms of government are indeed associated with better policy outcomes, while the empirical literature is not unanimous concerning the effect of presidentialism on corruption (Kunicova and Rose-Ackerman, 2005). If Persson and Tabellini (2004) find a positive effect of presidential systems on corruption in countries with weaker democratic institutions, Kunicova and Rose-Ackerman (2005) stress the role of electoral rules in this relationship by showing that corruption finds a fertile ground in presidential systems with rules of proportionality and low district size. These findings are partly corroborated by Gerring and Thacker (2004), who emphasise the effects of parliamentarism and unitarism on political corruption.[36] These authors find both institutional features to lower political corruption through multiple channels: the availability and transparency of information about the functioning of the polity, competition between political parties, competition between government units, local accountability, rules of decision-making,

[34] Political scientists generally address two categories of electoral rules, those determining the electoral formula – namely the plurality and proportional rules – and those determining the district size – i.e. the number of legislators acquiring a seat by voting district. While under the plurality rule seats are granted to candidates with the highest share of districts vote, proportional representation grants seat according to incumbents' share of vote.

[35] In presidential regimes, the executive is directly elected by the voters, and the powers of the legislature and the executive are clearly separated. In parliamentary regimes, the executive is appointed by the parliament, which makes their respective power more nested. See for instance Persson and Tabellini (2004), Persson et al. (2003) for further details on these forms of governments.

[36] In this study, unitarism refers to the relative sovereignty of the central government with respect to local governments. The degree of unitarism depends on the degree of independence between central and local governments (federalism) and the balance of legislative powers between central and local governments (bicameralism).

and the bureaucratic quality. The effect of federalism on corruption is however more controversial, as Kunicova and Rose-Ackerman (2005) and other empirical works suggest that federalism may give local politicians and bureaucrats higher monopoly and discretionary powers.

One highly controversial aspect of the unitarism/federalism paradigm which received a wide attention from researchers and development practitioners is the political and fiscal decentralization process. Theoretically, decentralization is expected to yield anti-corruption outcomes by i) creating competition in the provision of public services between sub-jurisdictions and between levels of government, and thereby reducing the bribes officials could demand (Bardhan, 1997; Shleifer and Vishny, 1993); and by ii) facilitating the grass-rooted scrutiny of the general public and non-state actors upon local political and administrative elites (Lessmann and Markwardt, 2010; Olken, 2007). In certain circumstances, it has nonetheless been observed that decentralization can increase low-level bribery or local elite capture by giving more power to local government and allowing for greater intimacy and frequency of interactions between individuals and corrupt officials (Lessmann and Markwardt, 2010; Bardhan and Mookherjee, 2006; Reinikka and Svensson 2004; Tanzi, 1998). Lessmann and Markwardt (2010) investigate this issue and test whether the devolution of power to lower levels of the government makes them more accountable to the public. They emphasise the role of free press in monitoring public agents' behaviours, and find decentralization to be an effective corruption deterrent only when and where there is an effective downstream monitoring of bureaucrats. Fisman and Gatti (2002) as well as Bardhan and Mookherjee (2006) emphasise that the decentralization of expenditure or public good provision is significantly associated with lower levels of corruption. But Bardhan and Mookherjee further demonstrate how and to what extent local provision of public goods under different financing arrangements may suffer from local elite capture. As underlined by Lessmann and Markwardt (2010), 'one size does not fit all' and the role of institutional checks and balances in curbing corruption may vary according to the many other accountability and transparency arrangements available to rulers and policy-makers, such as performance-based funding, budget information management systems, internal audits, or yardstick competition in the provision of public services between local administrations and between different layers of government (see box No.2).[37]

To conclude, though it is possible to identify regular patterns of administrative and political corruption in developed and developing countries, traditional frameworks for the analysis of corruption incidence may become inappropriate or incomplete as they stubbornly focus on public sector corruption, and tend to overlook the incentives and motivations driving the

[37] Those issues have been extensively addressed in Yilmaz et al. (2008) or Shah (2007).

private counterpart of many corrupt transactions. The next sub-section further addresses this issue.

3.2. The supply side of corruption: business sector issues

The donor community, institutions and organisations combating corruption have often concentrated their strategies on the demand side of corruption, that is, corruption in the public sector (Kaufmann, 2005; Vogl, 1998). But corruption is also the consequence of bribe suppliers – individuals, companies or other non-state actors (NGOs, lobbies, etc.) – who may have strong motives for surrounding laws, rules and procedures by illicit means. As an example, an individual dealing with the administration may bribe public officials to speed things up. Or, a bidder is likely to offer public procurement officers kickbacks, in order to win a contract or to have a subsequent advantage over its competitors.

The increasing role of private companies and other non-state actors in the delivery of essential goods and services raises the concern for the complex issue of the supply side of corruption (Transparency International, 2009a; Rose-Ackerman, 2007; Pope, 2000). This concern became global in 1999, with the entry into force of the ratification by OECD members of the OECD convention on combating the bribery of foreign public officials in international business transactions.[38] However, addressing the supply side of corruption is a difficult task because it is far less understood and documented than the demand side of corruption, emerging mostly from the public sector (Kaufmann, 2005). Indeed, more attention needs to be paid to the proper risks, motivations, incentives and mechanisms underpinning decisions of private agents to engage in corruption.

[38] See http://www.oecd.org/daf/briberyininternationalbusiness/ .

Box No.2. Institutional checks and balances in Public Finance Management (PFM) systems

Assessing the quality of public finance management (PFM) systems generally consists in looking at the achievement of three hierarchical levels of public sector outcomes:

1. Aggregate fiscal discipline;
2. Resource allocation compliance with government policy priorities;
3. Efficiency and effectiveness in public service delivery and revenue administration;

These outcomes address "fiduciary risks", or risks of public resources mismanagement. Indeed, a weak PFM system creates rooms for the diversion of public resources for private use, jeopardizes the ability of governments to achieve their agenda, and undermines the delivery of service in priority sectors such as education or health. In a well-functioning PFM system, authority delegation and reporting requirements must be clearly set, which requires to defining a balanced mix of restraints and flexibilities:

- **Restraints:** The absence of restraints over public policy often results in weak control over expenditures management and revenue collection, and hence gives opportunities for corrupt transactions. Restraints often concretize in a *hard budget constraint*, adapted to sector policy demands and involving a significant degree of predictability. However, too many constraints imposed at aggregate level (aggregate fiscal discipline) may not translate into improvements at intermediate (resource allocation compliance) and local (efficiency and effectiveness in public services delivery) levels of budgetary outcomes. In the same way, too many restraints upon resources allocation compliance may hamper progress in service delivery effectiveness.
- **Flexibility:** A certain degree of flexibility at each level may improve budgetary outcomes. However, too much flexibility without appropriate controls may foster corruption by increasing public agents' discretionary powers, diminishing his probability of getting caught, or increasing the relative benefits of corrupt acts.

It is therefore recommended to set effective monitoring and enforcement mechanisms improving:

- **Accountability:** lack of accountability in public finance management may significantly deter budgetary outcomes and to increase corruption, by reducing the commitment and discipline of all parties involved in PFM. Key institutions supporting accountability in public finance management are the following: the legislature (notably through the public account committee), the media, the judiciary, Supreme Audit Institutions (SAIs), the private sectors, taxpayers associations, and trade unions. These institutions can fully play their role of budgetary watchdogs, inasmuch they have easy access to information about revenue collection and public spending, and demonstrate a capacity to analyse fiscal information. This issue brings us to the next bullet point.
- **Transparency:** on the one hand, increased transparency supports accountability of policy-makers by informing public expenses stakeholders and taxpayers about the quality of the PFM system. On the other hand, it allows improving and maintaining public trust and confidence in the performance of fiscal administration. These principles are fundamental to enhancing compliance with tax and spending regulations, enlarging the tax base, and thus reaching better expenditure outcomes. Supporting increased transparency through enhanced access to budget information for citizens and non-state organisations (see for instance the Open Budget Index[39]) often yields significant anti-corruption outcomes by increasing downstream scrutiny and participation in PFM.

Sources: The World Bank, *Public Expenditure Management Handbook*, Washington D.C, 1998.*;* Shah, A. (2007) "Performance Accountability and Corruption", *Public Sector governance and Accountability Series*, the World Bank.; Schiavo-Campo, S. "Strenghtening Public Expenditure Management in Africa: Criteria, Priorities and Sequencing", in ed. A. Shah *Budgeting and Budgetary Institutions*, The World Bank, 2007.

[39] http://www.openbudgetindex.org/index.cfm?fa=about

3.2.1. General overview of private sector corruption

Without underestimating the important role played by the non-business private sector in the supply side of corruption, the recent but growing concern of the international community for business sector corruption (Transparency International, 2009a), in a context of globalization of trade flows (Hellman et al., 2000), underlines the need for understanding the motives of private companies to engage in corruption. It is possible to identify two types of business corruption (Hess, 2009; Pope, 2000):

- **Private-to-public corruption.** Private-to-public sector corruption has been addressed in the previous sub-section, as it involves both private and public agents. Its main forms and incentives are consequently similar to those of public sector corruption.
- **Private-to-private corruption**. Private-to-private sector corruption refers to private corrupt transactions involving private agents only. The growth of the private sector in developing countries has created opportunities for corrupt acts between private firms, which are both bribe payers and payees, or between private firms and other non-state actors (e.g. NGOs).

Studies in business ethics give some elements of analysis of the mechanisms underlying corrupt behaviours in a private organisation. These studies consider private sector corruption as the result of a tension between firm profitability and societal values of ethics (Nguyen and Cragg, 2012; Rose-Ackerman, 2007; Banfield, 1975). Results of experimental research on corrupt business practices suggest that profitability may in certain circumstances be preferred to morality, depending on cultural orientations of societies (see section 4). Indeed, it has been suggested that hiring staff with high ethical values does not necessarily lead to creating robust enough conditions to prevent business sector corruption (Nguyen and Cragg, 2012; Rose-Ackerman, 2007; Vitell et al. 2000, Banfield, 1975). According to these studies, integer staff members may i) add more premium to company goals than to honesty, ii) be forced by top manager to adopt unethical behaviours, or iii) find justification to make questionable practices circumstantial and 'acceptable'. It has even been objected that the precedence of ethical values over company's interest may also foster corruption. As underlined by Rose-Ackerman (2007), an agent with strong familial or loyalty values may unduly influence company's decisions in favour of kinship or friendship networks. Similarly, corruption within an organisation can arise when norms of friendship and solidarity among workers are antagonists to corporate objectives.

As expected, schemes of private corrupt transactions strongly vary and are not easily identifiable, due to the multitude of legal and contractual rights, responsibilities and codified procedures, and diverging interests between owners, managers, investors, and staff. Following TI's analysis of corruption within enterprises (Hess, 2009), we illustrate below how corruption may flourish within corporate governance:

- A corporate ownership concentrated in the hands of a few majority stakeholders may facilitate the undue expropriation of minority shareholders.
- Loyalty or friendship favours collusion between executives, by for instance facilitating the creation of networks of interconnected directorships where CEOs sit on each other's boards. Such a configuration creates a fertile ground for excessive rewards/bonuses, massive compensation packages or favourable nominations to lucrative board positions.
- Collusion between workers may arise and deter anti-corruption policies. For instance, combating corruption by rewarding whistle-blowers may fail because of empathy and solidarity between workers.
- Collusion between worker's representatives and executives may also arise within an enterprise, notably when "labour representatives [are] tempted to collude with management in exchange for generous expense allowances rather than representing employees' interests".[40]
- An enterprise may collude with supplier and clients in order to evade taxation, by manipulating financial accounts, underreporting commercial or financial transactions, etc.

If the above-listed examples of corruption schemes in private companies illustrate how corruption may prevail in the private sector, corrupt private practices *a fortiori* vary according to the following key factors (Johnston, 2007):

- the competition environment;
- firm's exposure to risk and the regulatory pressure;
- the link between firm's headquarters and local operations;
- the number and type of customers/suppliers;
- the nature, size, and time horizon of firm's operations and investments; and
- the sector's probability of being nationalized or privatized;

To conclude, it is nevertheless important to note that the private sector may act as a strong counter-power and is a significant driver of institutional change. Indeed, firms may resist corruption via the adoption of internal codes of conduct, network building or mutual support using structures such as chamber of commerce and business associations, and via improved coordination of anti-corruption efforts with the civil society, the media, and the public (Sullivan and Shkolnikov, 2008; Pope, 2000).

[40] Mendes Aldrighi, D. "Corruption inside the enterprise: corporate fraud and conflict of interest", in *Corruption in the Private Sector*, Global Corruption Report, Transparency International, 2009, p.14.

3.2.2.Private sector corruption and the deregulation process

The internationalization of trade and financial flows over the last decades, combined with the privatization of public services worldwide and the deregulation of markets, created a fertile ground for private corrupt practices, notably in countries with weak and/or non-democratic institutions (TI, 2009a; Nellis, 2009; Hellman et al., 2003; Hellman et al., 2000).

The international concern for the responsibility of private companies in public sector corruption started with the creation and ratification of the 1999 OECD Convention on Combating Bribery of Foreign Public Officials in International Business Transactions.[41] This convention calls signatory states to enact legislation criminalizing the bribery of foreign public officials and ending with the tax deductibility of bribes for companies headquartered in industrialized countries (TI, 2008). Since then, bribery is considered as a common and widespread mean for international companies to win contracts abroad, to avoid regulations, or to unduly influence policy-making, especially in the developing and transition world (TI, 2008; Hellman et al., 2003).

Private sector corruption and the financial globalization process

The globalization of financial flows went hand-in-hand with the development of private banking and offshore financial centres, allowing corrupt multinationals and officials to hide corruption-related proceeds through money laundering techniques (Vogl, 1998; Pope, 2000). Indeed, offshore financial services and private banking constitute major channels for corrupt companies and transnational crime to launder money, by guaranteeing bank secrecy over companies' operations and very low tax rates (Fenner, 2009; Hawley, 2000 Rose-Ackerman, 1996). In addition to facilitate corrupt transactions, the laundering of dubious proceeds generally lead to bribery in countries hosting these funds, which makes corruption and money laundering feeding each other. To illustrate this problem, the OECD Financial Action Task Force's 1998 report on money laundering in Mexico states that

> "one of the most favoured techniques continues to be outbound currency smuggling, along with electronic transfers, Mexican bank drafts and the parallel peso exchange market. Corruption remains the chief impediment to Mexico's anti-laundering efforts".[42]

Box No.3 proposes a general panorama of money laundering techniques.

[41] http://www.oecd.org/document/21/0,3746,en_2649_34859_2017813_1_1_1_1,00.html

[42] Cited in Vogl, F. (1998), "The Supply Side of Global Bribery", Finance & Development, vol.35, no.2.

Private sector corruption and the privatization process

In parallel to the financial liberalization processes, private sector growth and the wave of privatizations of state-owned enterprises in the 80-90's has been recognized as an important contributor to business corruption and the emergence of private corrupt networks, especially in former communist economies (Nellis, 2009; Hellman et al., 2003; Hawley, 2000). As stressed by John Nellis in the 2009 Global Corruption Barometer (p.77),

> "the idea that private ownership could occur in an efficient and equitable manner in the absence of the legal and policy frameworks that underpin the functioning of markets was naive or worse."

The privatization process may lead to higher corruption levels in developing countries because of various overlapping factors. The intensified competition environment combined with the overwhelming focus on shareholders values put pressure on managers to reach short-term performance objectives, leading them to follow risky strategies and to undertake complex financing transactions prone to abuses, fraud and embezzlement. The absence of effective regulatory frameworks fostering transparent, open and competitive market transactions often enabled politicians and staff of ex state-owned companies to benefit from the lack of controls over privatization to strip enterprises' assets. In eastern, Asian, and Latin-American countries which underwent a forthright and rapid transition to the market economy, many oligarchs bribed government officials to repurchase various state-owned enterprises far below market prices (Nellis, 2009). Buen and Michaelowa in the TI 2009 Global Corruption Barometer stress how insufficient regulations over market transactions may be conducive to corruption through the experience of the new carbon credit market introduced by the Kyoto Protocol (see box No.4).

Box No.3. Corruption and money laundering

As corruption operates in secrecy, its corresponding proceeds generally need to be hidden. Conversely, Money Laundering (ML) activities may involve corrupt third parties helping in concealing the origin of ill-gotten money. The Financial Action Task Force (FATF) defines ML as the "processing of criminal proceeds to disguise their illegal origin in order to legitimize the ill-gotten gains of crime". It often consists of the following steps:

Step 1. **Placement of (corruption) proceeds** into the domestic or foreign financial systems through cash deposit, split up cash amounts transportation abroad, cash switch into other valuables (diamonds, gold bars, trade goods, etc.), or foreign currency purchase.

Step 2. **Layering**, or concealment of the origin of criminal proceeds by transferring and splitting them between bank accounts, countries, individuals and/or corporations, often via offshore centres.

Step 3. **Justification** of the pseudo legal origin of criminal proceeds by creating transactions based on false and/or artificial documents (invoices, contracts, agreements, etc.).

Step 4. **Investment** is the use of criminal proceeds for personal gains, i.e. safekeeping, consumption or investment.

Sources: Financial Action Task Force webpage: www.fatf-gafi.org/

Box No.4. Market economy, regulation and corruption: lessons drawn from the market for carbon credits

The Kyoto Protocol, whose ratification started in March 1998, involves more than 190 countries. This agreement requires industrialized countries to cut their gas emission by 5 per cents below their 1990 levels.

To reach this objective, the Protocol introduced market mechanisms that are intended to reduce CO2 emissions effectively and efficiently. Among these mechanisms figure the Clean Development Mechanisms (CDM) and the Joint Implementation (JI) scheme, whereby countries earn emission reduction credit by implementing emission reduction projects in developing countries.

One important challenge encountered by the protocol is that this market involves carbon emissions, an intangible good difficult to quantify. To address eventual problems of under-reporting, mechanisms have been implemented for the tracking of carbon emission certificates through registries, and for independent checks of emissions reduction. Another challenge concerns the eligibility of projects falling under the CDM and JI mechanisms. Indeed, the *additionality* criterion states that offsets are considered to be valid "only if they are awarded for projects that would not otherwise have taken place" (TI, 2009, p.42). In other words, for carbon credits to be awarded, it must be proven that the project implementation faced prohibitive barriers or there exist more profitable ways of producing the product/service which would have emitted more carbon than the project actually do. In this system, the *additionality* criterion is prone to manipulation, and corruption is likely to arise when project developers, regulators and lobbies try to modify rules and regulation so that projects fall under the mechanisms.

A solution was to include a degree of transparency in project design by imposing project developers to make detailed documentation available for stakeholder's criticisms. However, this safeguard does not prevent from corrupt practices since project developers are still likely to bribe stakeholders to obtain obliging reports, and to falsify project documentation or expectancies (for instance to prove that project's rate of return is below that of higher emitting-carbon methods). To establish the legal liability of project developers in case of fraud or falsification, the latter are hence required to signing a declaration certifying that their information is correct. Again, this precaution is not yet fully free from bribery, fraud or conflict of interest, since project developers and buyers are still prone to offer bribes or other undue advantages to authorities and expert consultants charged with the project review and approval.

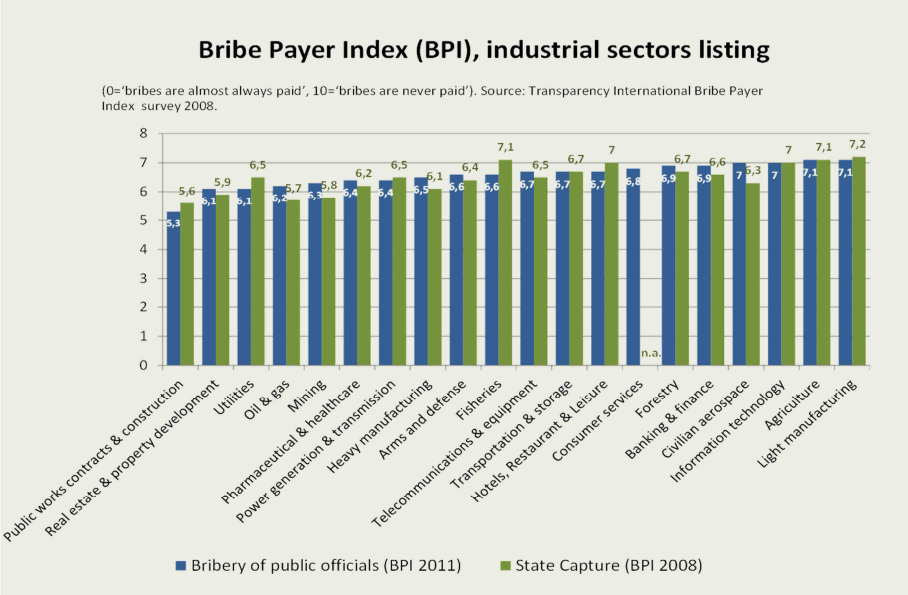
Source*:* Buen, J., and A. Michaelowa, "View from the inside – Markets for carbon credits to fight climate change: addressing corruption risks proactively", in ed. Transparency International, *Corruption in the Private Sector*, Global Corruption Report, 2009.

3.2.3. Where does private-to-public corruption occur?

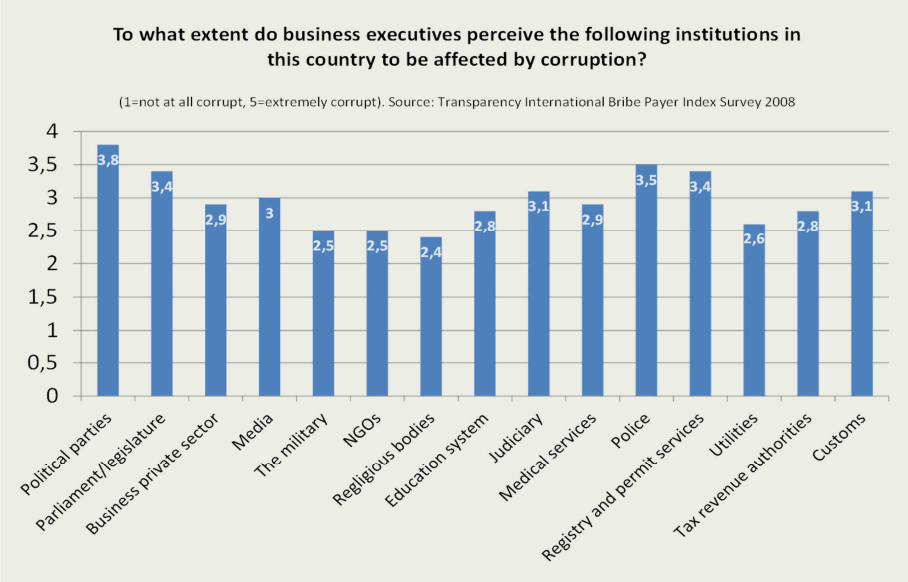
As stressed in sub-section 3.1, corrupt transactions involving private agents and public officials are usually made in sectors and institutions where large amounts of money are involved, where public officials have strong discretionary powers, and where laws and regulations are complex and applied in a non-transparent manner. Figure 1.6i) displays a listing of industrial sectors most prone to bribery and state capture, drawn from the Bribe Payer Index (2011, 2008), and shows that public works, real estate, utilities, and natural resource extraction are industries where bribery and state capture are most prevalent.

Figure 1.6. Sector and institutional locations of private sector corruption

i) In which industries are bribes most paid?



ii) CEO's perceptions of most corrupt institutions



A further analysis of risks of corruption at the sector level indicates that the following processes are particularly vulnerable to private-to-public corruption:

- **Public procurement**. The most evident example is when a company bribes public officials to influence a public tender in its favour. For instance, a corrupt firm may corrupt to influence procurement's terms and conditions, to be included in the list of qualified bidders, or to be awarded a public contract (see Box No.5 and annex 1.C).
- **Privatization**. As emphasised earlier, private sector corruption may occur when a government privatizes state-owned enterprises (Nellis, 2009). Companies may bribe to be included in the list of qualified bidders, to limit the number of competitors, or to be favoured in the selection process. They may also bribe so that the government underestimates the public property to be leased or sold off. Private agents may also offer informal payments to officials handling valuable information on bidding specifications, conditions for soon-to-be-privatized firms, and future capital projects. More complex schemes of corruption may occur when a state-owned enterprise manager creates an offshore company to buy it back far below from its market value.
- **Laws and regulations enactment/enforcement**. Foreign and domestic companies may also bribe politicians, legislators, or high-level public officials so that they enact/modify/enforce laws and regulations in their favour. For instance, foreign companies may bribe a government to get a privileged access to domestic markets or large public procurements (e.g. in natural resource sectors), or to obtain the liberalization of specific sectors (e.g. the electricity sector or telecommunications). Likewise, domestic firms may be willing to pay government officials to have a privileged access to foreign markets (e.g. when soliciting subsidies) or to maintain and secure its position on the domestic market (e.g. when soliciting maintained or higher trade barriers). Opportunities for such misconducts are even higher when laws and regulations are not clearly set or when agencies entrusted with their application are inexperienced. The strong vulnerability of this area of public action to malpractices is illustrated by Figure 1.6ii), which shows that political parties, the legislature and the registry and permit services are perceived by businesses as the most corrupt institutions worldwide.
- **Taxation and customs**. Private companies may also be inclined to evade taxation and customs duties through bribery of tax and custom officers. Conversely, tax or customs officers may extort private firms by threatening to charge them extra taxes or extra custom duties.
- **Administrative procedures**. In countries where the administrative burden is heavy and delays are important, individuals and private firms have great incentives to escape red tape (see sub-section 3.1) to make things going faster or jump the queue.
- **Illegal goods and services markets**. Smuggling is also an area of business feeding corruption

through bribery and extortion. Law enforcement officers may demand bribes to overlook criminal activities or to limit their penalties. Conversely, people engaged in illegal businesses may try to corrupt the police or judicial officers to get immunity from prosecution or to confirm a monopoly over an illegal market (e.g. gambling or drugs).

Not surprisingly, figure 1.6ii) shows that institutions perceived by CEOs as the most prone to corruption are those which are most concerned by the above-mentioned vulnerabilities. It can be observed that corruption in political parties and the legislature ranks among businesses' top most corrupt public institutions. Political parties and the parliament are indeed key institutions for businesses because of their strong regulatory power and their direct influence on economic policy. Other public institutions with important discretionary powers over businesses, such as the police, the registry and permit services, customs or the judiciary, are also ranked by CEOs amongst the most corrupt areas of public interventions.

Box No.5. Corruption in the procurement process

Procurement refers to the acquisition of goods and services through contracting. Efficient public procurement practices thus rely on the State ability to purchase and/or deliver goods and services in the right quantity, quality, time, price, place, and for the direct benefit of citizens. If corruption opportunities are inherent to the procurement process (see annex 1.C), the following key features of public tenders are expected to trigger corrupt and rent-seeking behaviours (Ware et al., 2007; Søreide, 2002):

- **Overlapping procurement procedures**. Donors' procurement procedures may sometimes take precedence over national procedures, even if the latter impose harder conditions for transparency than the former.
- **Contract size and frequency**. Since bribes are set proportionally to the total amount of money involved, the huger/more frequent the contract the larger/more frequent the bribes demanded.
- **Complexity of the technology.** Procurement in projects with high technological content is particularly prone to corruption since technology argument may be advanced to hide dubious practices and to announce unrealistic costs.
- **Emergency and immediacy**. In emergency contexts, the procurement process gives strong opportunities for corrupt acts since controls are weak, funding levels and media pressure are high, and staff turnover is rapid.
- **High discretionary powers.** Procurement officers' discretionary powers include the power of deciding which enterprise is invited to tender, the power of short-listing and pre-qualifying, the power of choosing the technology, the power of misusing confidential information, the power of changing the contract's terms, and the power of negotiating governmental contracts.

During the procurement process, contracting is the most critical phase because it operates at different levels of government and gives strong and repeated opportunities for bidders and public officers to collude. In this regard, two common corruption schemes are:

- **Bid rigging**, which occurs when a competitive and transparent public tender is manipulated in a way that favours a specific bidder. For instance, bid rigging arises when specific requirements regarding the product/service purchased are included in the bidding documents and favour a particular bidder, when the contract specifies qualifications that are met by only one bidder, or when a favoured bidder has access to bidding information before it is formally disseminated, giving him a substantial advantage over its competitors.
- **Front or shell companies**, which are used by corrupt officials to hide their illegal influence over the contract awarding process they have been entrusted for. They may use their positions to ensure that a front or shell company wins the contract, benefiting from the resulting illegal gain without necessarily fulfilling the contract. In some cases, the front/shell company acts as an intermediary, contracted by a prime contractor, which is expected to deliver certain goods or services. This mechanism hence serves corrupt public officials to hide the kickbacks paid by the prime contractor, and to launder money or move it offshore.

Sources: U4 web page on corruption in public procurement at: http://www.u4.no/themes/procurement/procurementintro.cfm ; Tina Søreide (2002), "Corruption in Public Procurement, Causes, Consequences and Cures", *Development Studies and Human Rights*, Chr. Michelsen Institute ; Ware, G. T., Moss, S., Campos, J. E., and G. P. Noone, "Corruption in Public Procurement, a Perennial Challenge", in Eds. J. E. Campos and S. Pradhan, *The Many Faces of Corruption*, The World Bank, 2007.

3.2.4. Where does private-to-private corruption occur?

In the same way as public sector corruption, private-to-private sector corruption is a pervasive phenomenon occurring in areas where private agents (payees) have strong monopoly and discretionary powers over other private agents (payers). According to Pope (2000), private-to-private corruption is commonly found in the following activities[43]:

- **Private procurement**. Corruption in private procurement is a very common practice which occurs when, for instance, a private supplier offers kickbacks to a purchasing agent in exchange for a contract. This form of private corruption is usually found in sectors like mass-market retailing, or in the manufacturing sector. For instance, a paint manufacturer may corrupt a purchasing agent of automobile companies so that the latter uses its products.
- **Distributorship, licence and franchises**. Huge bribes are paid to company officials to be granted distributorships.
- **Retail display space**. Sales representatives of consumer good manufacturers may bribe store managers so that their products benefit from favourable display space. This pattern of private corruption similarly occurs when a company bribes a private TV channel to get an advertising space at privileged audience hours.
- **Proprietary technical and commercial data**. A company may pay a competitor's marketing employees to get commercial private information such as pricing information.
- **Financial and banking sector**. A company may bribe bank officials to obtain loans or interest rates in privileged conditions. In the securities industry there have been cases of bribes paid by brokers to obtain special allocations of shares in attractive Initial Public Offerings. Recent studies based on enterprise surveys pointed out that corruption in the banking sector may be widespread, particularly in developing countries (Houston et al., 2011; Barth et al., 2009; Beck et al., 2006). These studies find that corruption in lending is lower when the monitoring of banking activities by private and independent entities is effective, and when transparency and competition within the banking system is improved.
- **Scrap disposal**. This area includes the bribery of quality control inspectors to reject good products, which can then be purchased as scrap and resold as quality products.
- **Sports**. Sports benefiting from large media coverage are vulnerable to corruption. An example of corruption in sports is when players are bribed by bookmakers to under-perform during a competition, or when referees receive bribes to unduly favour a team (Garicano et al., 2005).

Corruption may also occur *within* an enterprise, notably in the area of financial management.

[43] Analysis based on the views expressed by the author in TI 2000 *Source Book - Confronting Corruption: the Elements of a National Integrity System*, Berlin: Transparency International, 2000, p. 137- 152.

Indeed, recent financial scandals put the spotlight on cases of embezzlement of large amounts of money by high-level representatives of private enterprises or private pension funds.

3.3. Concluding remarks

In this section, we provided a panorama of the conditions, forms, and contexts of emergence of corruption the public and private sectors.

We built our analysis of public sector corruption on the framework proposed by Klitgaard (1988), adapted from the socio-economic analysis of the costs and benefits of engaging in corruption. We addressed a wide range of country characteristics which are expected to affect the monopoly and discretionary powers of public agents, as well as accountability and transparency mechanisms supporting their integrity. Among these characteristics, the role of economic development appeared prominent but non monotonic. Empirical evidence suggested that at early stages of the development process, an increase in *per capita* wealth may translate into higher corruption levels, notably if institutional rules are unclearly set and poorly entrenched. In this regard, our (illustrative) empirical analysis showed that around one-third of the (nonlinear) correlation between the GDP *per capita* and corruption perceptions is ascribable to the stability of political institutions.

We stressed that natural resource endowments are also an important corruption catalyst, as they provide tremendous monopoly and discretionary powers to public agents for the exploitation of natural resources, and for the collection and distribution of the resulting incomes. However, we did not evidence a positive association between the size of the state and corruption levels, although public sector size is otherwise considered by many studies as a key driver of corruption. We even found robust and significant negative correlations between public sector size and corruption perceptions, in particular when we approximated the former by the share of tax revenue in GDP. Such findings tends to support the idea that public sector growth goes hand in hand with the development of stable institutions, the gradual satisfaction of citizens' basic needs, and the openness of economies; and does not necessarily foster corrupt practices.

We then analysed the supply of bribes by private firms. We distinguished private-to-public from private-to-private corruption, identified activities and sectors most susceptible to business malpractices, and stressed the key processes by which they may expand. We showed that private corruption is prevalent in public works, real estate, utilities, and natural resource extraction sectors, which are sectors involving large amounts of money and being subject to complex laws and opaque regulations. As a result, it appeared that bribe payments are mostly intended to public institutions which are directly related to economic policy and regulations – i.e. political parties, the parliament, customs, and registry and permit services. Finally, we pointed out that, contrary to public sector corruption, business corruption arises from a tension between firms' pecuniary objectives and

norms of ethics and honesty which may prevail within a given society or a group of individuals. In this regard, the next section further addresses the importance of local contexts in shaping corruption levels and perceptions, and emphasises anthropological and cultural foundations of corrupt practices.

4. The anthropological and cultural contexts of corruption

It has been investigated how attitudes toward corruption or standards of behaviours may stick countries into high-corruption equilibrium, characterized by systemic corrupt transactions, a low probability of detection and punishment of corrupt activities, and a high probability that the next transaction partner is corrupt (Bardhan, 1997; Tirole, 1996; Andvig and Moene, 1990; Cadot, 1987). However, the literature which looks more closely at the cultural or anthropological mechanisms underlying corruption prevalence is recent and still hesitant, culture being often treated as a 'black box'. In what follows, we try to highlight key anthropological settings explaining the corruption differential in countries equal in other things.

4.1. Social capital, trust, and reciprocity in corrupt deals

The cultural foundations of institutional quality have been addressed by several studies. In these studies, a particular attention has been paid to the effects of social capital and its manifestations – such social norms of honesty or dishonesty, kinship, and trust – on corrupt exchanges (Graeff, 2005; Knack and Keefer, 1997). In this regard, the importance of reciprocity as a key principle guiding corrupt deals has been investigated. Following the agency problem presented in the earlier section, the illegal nature of corrupt arrangements between the agent (the corruptee) and the client (the corrupter) makes them very difficult to enforce, so that corrupt exchanges occur if and only if the corrupter expects the corruptee to deliver the favour he has been paying for (Kingston, 2007). In these setting, a number of surveys advance that in societies with strong social norms of corruption and/or high interpersonal trust, reciprocity in corrupt deals is likely to be guaranteed.

4.1.1. When corruption reciprocity is a social norm

According to Graeff (2005), certain social norms foster corruption by systematizing the reciprocity in corrupt deals. Those 'corruption norms' are defined by the author as

> "the expectation that one can usually offer or accept a corrupt deal in a certain situation".[44]

By specifying how corrupt agents should behave in particular situations, corruption norms structure corrupt exchanges, especially when agents and clients do not know each other, and so, may not

[44] Graeff, P. "Why should one trust in corruption ?" in eds. Lambsdorff, G, Taube, M. and M. Schramm, *The New Institutional Economics of Corruption*, Chapter 3, Routledge, 2005, p.44.

trust each other. Blundo et al. (2006) endeavoured to analyse the 'real' rules and procedures that govern informal and formal daily behaviours in developing countries. In their study of petty and institutional forms of corruption in West Africa, they note that

> "corruption must be understood as a practice embedded in everyday forms of sociability that transcend normative concepts of illegality and illegitimacy".[45]

They find that corruption is pervasive in everyday life in the countries where they carried out their research. They observed that the communal complicity of the different actors who commit corrupt acts was a way of dealing with dysfunctional public services. As a consequence, in many countries the public tolerates corruption in public administration and pay bribes even when civil servants do not ask for them. Talking about corrupt practices in Democratic Republic of Congo, Kodi (2008, p.17) stresses that,

> "for the majority of the people, a fight for survival became the order of the day. One had to be 'resourceful' to survive and provide for one's family. It was in this context of utter destitution that the moral values of the society were challenged and turned upside down. Corruption became an accepted and tolerated reality. Corrupt individuals, who flaunted their ill-acquired riches, were admired and became role models".

In these settings, an individual who does not engage in corruption is dismissed as a fool. Honesty may even sometimes be considered as selfishness, when for instance a public agent does not take advantage of his position to enrich and redistribute corruption proceeds among his kin or colleagues (Blundo et al., 2006). In certain countries people are even recruited on condition that they actively seek bribes and share the proceeds with the individuals who recruited them (Kodi, 2008).

4.1.2. When corruption reciprocity relies on interpersonal trust

According to Graeff (2005), when previous norms of corruption do not fully operate, trust can ensure the reciprocity in corrupt exchanges. Frequent and prolonged interactions between corrupt actors allow them to increase their knowledge about each other and, hence, to lift the uncertainty prevailing on the reciprocity in corrupt deals. Kingston (2007) stresses the limits of such enforcement mechanism in situations requiring secrecy of corrupt transactions and lowering the frequency of transactions. He rather underlines the role of informal shared activities between bribers and bribees, collateral to corrupt exchanges, to enforce corrupt arrangements. Trust may therefore be encouraged through various types of network membership – such as kinship or friendship, age, ethnic group, gender, social/religious cast or religion – so that corruption may be persistent even in societies with broad civic and ethical norms.

[45] Blundo, G., and J-P. O. de Sardan, *Everyday Corruption and the State: Citizens and Public Officials in Africa*. London: Zed Books, 2006.

Other studies consider that trust and norms of honesty may be self-reinforcing features of a society. Uslaner (2005) points out that trust – when defined as a "value expressing the belief that others are part of your moral community"[46] – discourages corrupt behaviours by enhancing the coexistence of citizens and contributing to the respect of laws, values of ethics and morality. Letki (2006) nuances slightly this assertion. She distinguishes interpersonal trust from citizen's trust in public institutions, and finds that the sole trust in institutional actors – such as the police, the justice, the parliament, or the army – contributes to people's adhesion to moral and civic values. Notably, she says that trust results from good institutions, fostering the stability and the predictability of formal rules governing people's interactions, and consequently favouring their compliance. In the same vein, in their attempt to identify UN diplomats' inclination to break the law, Fisman and Miguel (2007, 2008) suggest that corruption prevalence in a given country depends on people's "sentiments towards their own country's laws"[47]. Thus, according to these studies, the frontier between trust and adherence to social norms of ethics and civic-mindedness is porous.

Kingston (2008) proposes a model of corruption where informal social ties among corrupt actors can be used to circumvent norms of corruption, in so far as government officials and clients belong to an integrated and cohesive group and discipline each other. However, in less cohesive societies, trust and other informal ties can be used to ensure reciprocity in corrupt exchanges. As Litch et al. (2007, p.92) point out,

> "the strong informal ties within disjoint groups that characterize a collectivist social structure may facilitate parochial corruption but cannot be used to enforce broader social norms against bribery when individuals from different groups are involved. Conversely, the broader 'civic' social ties prevalent in an integrated social structure can more readily be used to enforce broader anti-bribery norms."

4.2. The cultural foundations of corrupt exchanges

Using surveys on well-being in Afghanistan, Graham and Chattopadhyay (2009) analyse public opinions about democracy and political freedom, trust in others and in public institutions, and concerns about crime and corruption. Regarding people's attitudes toward corruption, they found out that even in the challenging environments of armed conflict, people may surprisingly show a high level of tolerance to the vice. Their reported that well-being has not decreased because they consider corruption and crime as normal events, contending that,

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46 Uslaner, E.M. "Trust and corruption" in eds. Lambsdorff, G, Taube, M. and M. Schramm, *The New Institutional Economics of Corruption*, Chapter 5, Routledge, 2005, p.76.

47 Fisman, R., and E. Miguel "Nature or Nurture? Understanding the Culture of Corruption" in eds. Fisman, R., and E. Miguel, *Economic Gangsters*, Chapter 4, Princeton University Press, 2008, p.100.

> "while adaptation may be a good thing – or perhaps even a survival strategy – from an individual happiness perspective, it may be bad for welfare in the aggregate, as it results in a collective tolerance for bad equilibrium, such as high levels of crime and corruption."[48]

4.2.1. Culture as the rationale behind corrupt acts

Following Graeff (2005), the influence of culture on corruption can be resumed to the influence of norms and trust underlying reciprocity in corrupt deals, and can be transposed into a cost-benefit analysis:

$$E(G) = [1 - prob^F] \times G - prob^F \times F > 0 \qquad (1.4)$$

E(G) is the expected gain related to the corrupt deal. $Prob^F$ is the corrupter's probability of being fooled by the corruptee, i.e. the corruptee probability of not meeting his commitments. F is the client's loss if he is fooled by the agent, corresponding to the resources he places at the disposal of the agent to perform a certain task (e.g. the bribe). G is the gain associated with the proceeds of corrupt exchange. The probability $[1 - prob^F]$, the reciprocity in corrupt exchanges, increases as corruption norms or trust get stronger. On the one hand, in societies displaying strong norms of corruption, the probability $prob^F$ approaches zero, corruption becomes persistent and systemic. This argument has been invoked to explain how societies get stuck into a high equilibrium of corruption, where the probability that the next transaction involves corrupt agents is high and the incentive to behave honestly is low (Cadot, 1987; Andvig and Moene, 1990; Tirole, 1996). On the other hand, when corruption norms do not exist but there are informal ties between the agent and the client, the probability of being fooled remains low as their mutual sense of reciprocity is high. In this situation, trust supersedes corruption norms to structure corrupt exchanges.

4.2.2. Cultural orientations and corruption

The literature which emphasises cultural orientations facilitating the acceptance and the dissemination of norms of corruption/integrity is extensive. To grasp the popularity of the argument of a society's cultural inclination towards bad governance, it is worth reminding the many studies using the country predominant religion or the colonial heritage to proxy cultural emphases on values hostile or favourable to institutional development – such as hierarchy, trust, tolerance (Treisman, 2000; La Porta et al. 1999). Sandholtz and Koetzle (2000) study how well-entrenched cultural orientations favouring norms of democracy act as a constraint on corrupt behaviours. Licht et al. (2007) establish a framework setting schematic cultural stances, and identified those supporting norms of good governance and institutional quality. They find that cultures promoting the autonomy of individuals within the society tend to demonstrate higher values of transparency

[48] C. Graham and Soumya Chattopadhyay, "Well-being and Public Attitudes in Afghanistan: Some Insights from the Economics of Happiness", Foreign Policy at Brookings, Working Paper , no. 2, May 2009, p.15.

and compromise than do societies embedding individuals' actions into the social fabric. In the same vein, a study conducted by Mazar and Aggarwal (2011) stresses that collectivism reduces the sense of responsibility of individuals who compound it and fosters bribery. By contrast, they support that individualism encourages one's self-determination and awareness of interdependences between individuals, which in turn promotes value of honesty and morality.

Other stress that societies which value respect for one's kin, clan or ethnic group are more prone to corruption than those that value secular-rational attitudes toward authority or hierarchy. In this regard, it is argued that a high level of respect toward one's kin gives rise to a nepotistic or parochial type of corruption (Sandholtz and Taagepera, 2005). Banerjee and Pande (2007) document that increased levels of voter ethnicisation – defined as a greater preference for the party representing one's own ethnic group – has an impact on the quality of political leaders, including their integrity. Looking at voting patterns, they find out that ethnicisation reduces the average winner quality for the pro-majority party. In contrast, they observe that the quality of candidates from minority parties increases as they has to show a high level of integrity to stand a chance to win. They conclude that ethnicisation of voting behaviours may open a political space for corrupt politicians, especially when there is a dominant ethnic group. They advised, furthermore, that it is misleading to relate the perceived rise in corruption to the rise in tolerance toward corruption, as other factors are at play, such as ethnicisation of voting behaviours. Kingston (2007) also addresses the problem caused by parochial corruption and explains it by an "unequal access to the bribe-paying market".[49] He stresses that, for a given amount of bribe, an official or politician may prefer contracting with an inefficient bribe-payer instead of an efficient one if the former has an 'inside track', i.e. presents any informal social or economic tie with him.

The association between gender and corruption prevalence has also been investigated through the prism of cultural settings. Some authors opposed male-dominated corrupt societies, promoting particularistic and selfish interests, to female-dominated societies, more conducive to altruism, generosity, and integrity (Dollar et al., 2001; Swamy et al., 2001). As a consequence, it is commonly argued that improving women's participation in political decisions lowers levels of corruption and *vice versa*. The direction of the causality is not however clearly established since low levels of corruption may hamper male-dominated networks and, therefore, improve women's access to higher positions. There is however an on-going debate on whether women are naturally less corrupt than men (Sung, 2003). Indeed, empirical results derived from experimentations led by Lambsdorff and Frank (2011) nuance the former view according to which 'selfish/aggressive' male-dominated societies are more prone to corruption than 'caring/integer/protective' female-dominated societies. These authors find that women are less likely to carry out corrupt deals not because of a higher

[49] Kingston, C. (2008) "Parochial corruption", *Journal of Economic Behaviors and Organization*, Vol.63, p.74.

sense of ethics, but because they would demonstrate a less pronounced sense of reciprocity than men would do.

To sum up, where power is unequally distributed between groups of individuals or when hierarchy is generally accepted, corruption levels tend to be higher (Acemoglu et al., 2011; Knack and Keefer, 1997). Conversely, in societies where individuals are more autonomous and have an equal access to power and resources, higher levels of interpersonal trust and little acceptance of hierarchy are found, individuals are expected to transcend their own interest in favour of the social well-being, and corruption tend to be lower (Licht et al., 2007).

4.3. The organisation of power and systemic corruption

The recent literature emphasizing the anthropological nature of corruption exchanges represents corrupt societies as dynamic hybrid systems where new and ancient coordination modes may sometimes confront each other. From this overlap of coordination modes may emerge persistent inefficient states, characterized by state capture by private interest and/or patrimonial forms of corruption (Acemoglu et al., 2011; Hellman et al., 2003). Following Max Weber's theory of modernization, Andvig (2006) proposes a conceptual framework according to which corruption arises from the persistence of former coordination norms in areas or sector governed by new norms of coordination. Following Andvig (2006), four coordination modes (or transaction modes) governing exchanges between individuals can be identified:

- **Bureaucratic or hierarchical coordination modes**: the organisation of power is vertical, involving a personal tie between a superior and his subordinate, which legitimacy arises from the subordinate's obedience to the organisation's hierarchy and/or empathy towards organisation' objectives.
- **Family-friendship coordination modes**: the organisation of power is either vertical (e.g. family) or horizontal (e.g. ethnic group), involving personal (e.g. family) or impersonal (e.g. ethnic group) ties, governed by the respect, the altruism or the sympathy toward one's kin.
- **Political coordination modes**: the organisation of power is vertical, involving impersonal ties between those who govern and the governed, which legitimacy arises from the democratic or non-democratic delegation of power from the latter to the former.
- **Market coordination modes**: the organisation of power is horizontal, involving impersonal pecuniary ties between individuals, which legitimacy arises from the mutual gains resulting from a monetary transaction.

Andvig studies corruption in two cases of institutional change – the rapid modernization of an economy and the transition from a centrally planned economy to a market economy. He considers

modernization as the transition from a traditional society mainly governed by friendship-based and market-based transactions, to a society where the area of market-based transactions expands, and where new hierarchical and political transactions emerge. From the regulator point of view[50], patrimonial forms of corruption arise from the overlap of the persistent informal family-friendship coordination mode within the new bureaucratic/political spheres. Considering commercial corruption, it arises from the persistence of former family-friendship transactions in the extended area of market-based transactions. As for the situation of transition economies, Andvig stresses that the expansion of market-based transactions in areas where formal political and bureaucratic transactions used to prevail fosters another form of commercial corruption, arising from the persistence of former political and hierarchical coordination modes into the area of newly legalised market-based coordination mode. Finally, this analytical framework can be applied to the phenomenon of state capture by private interests, when political favours are sold or bestowed to private entities. In this context, state capture stems from the illegitimate intrusion of market or kinship/friendship transactions in the area of political transactions.

Neo-patrimonial states are interesting cases of institutional failure, illustrating how overlapping norms of coordination may lead to widespread corruption, inefficient state organisation and limited provision of public goods. Bratton and van de Walle (1997) defines patrimonial states as

> "Hybrid political systems in which the customs and patterns of neo-patrimonialism co-exist with, and suffuse, rational legal institutions […] Patrimonial logic is internalized in the formal institutions of neo-patrimonial regimes, it provides essential operating codes for politics".[51]

(Neo-)patrimonial states are characterized by a weak separation of the public and the private spheres, encouraging the capture of state resources by private or group interests; and by personalism, when these resources are accumulated in the hands of an individual, the "big man" or "strong man" (Acemoglu et al., 2011; Carmack et al., 2007; Hellman et al., 2003). In these settings, clientelism and patronage based on kinship, friendship, ethnicity or religion supersedes legal/formal political, bureaucratic, or market-based coordination modes.

In neo-patrimonial systems, the political competition for power is a zero-sum game: in accordance with the political logic of the patrimonial state, the "big man" uses formal institutions and informal customs and rules to take advantage over other politicians in a "winner-takes-all" competition for the control of state resources. The control of power and state resources is the driving force for alliances between political actors, rather than ideologies and principles. In such a socio-political

[50] Considering that new formal/legal coordination mode may be perceived as illegitimate by populations, and therefore corrupt.

[51] cited in Carmack et al. (2007) "Neopatrimonial Politics, Decentralisation and Local Government: Uganda and Malawi in 2006", Overseas Development Institute, p.3.

system, politicians' primary motive for seeking power is to provide for their own kin, ethnic group and other clients. They have no interest in national economic development and they would actively oppose to any changes or reforms that are perceived as a threat to the *status quo*. At best, they would manipulate the proposed reforms to suit their aim of maintaining themselves in power, weakening their competitors and serving the particularistic interests of their clients (Kodi, 2008).

4.4. Concluding remarks

Cultural arguments have often been invoked to explain the pervasiveness of corruption. In this section, we emphasised key interconnected anthropological features underlying country differences in the incidence and persistence of corruption: social norms and trust, cultural orientations, and the way formal and informal forms of powers are articulated within a society.

We stressed that widely accepted norms of corruption ensure the necessary reciprocity condition underlying corrupt transactions. And when these norms do not exist, interpersonal trust may replace them to ensure reciprocity between corrupt agents. We also outlined the importance of citizens' trust towards key national institutions, such as the political system, the police or the army, in shaping their degree of integrity.

This last issue naturally raised the question of whether there exist cultural settings more conducive to corruption or honesty. Following the literature on the effects of cultural orientations on corruption, we highlighted some cultural features that are considered as key determinants of corruption prevalence in a given country context. First, societies promoting individual autonomy seem to be less inclined to corruption than societies where individuals' attitudes are determined holistically. Second, it has also been suggested that societies promoting the respect of hierarchy and kinship are found to foster patrimonial or parochial forms of corruption; while societies promoting values of equality and universality are found to facilitate individual coexistence and to exhibit lower corruption incidence. Third, it has been advanced that male-dominated societies are more inclined to corruption than female-dominated ones, since the former are considered as driven by more individualistic and less public-spirited attitudes than the latter.

In a last stage, we explained the prevalence and systemic nature of corrupt exchanges in the light of Andvig's dynamic anthropological framework. From the regulator point of view, systemic corruption results from the confrontation between older (illegal) and newer (legal) coordination modes: patrimonial corruption stems from the persistence of family/friendship transactions where political, bureaucratic or commercial transactions should prevail; commercial corruption emerges when family/friendship transactions or political and hierarchical transactions are carried out whereas market transactions should normally operate; and the phenomenon of state capture arises

from the illegitimate intrusion of market-based or kinship/friendship transactions in the area of political transactions.

5. Conclusion

This first chapter was aimed at providing updated background knowledge on the conditions of emergence and prevalence of corruption. For this purpose, we proposed an extensive literature review, supported by some empirical evidence and operational highlights.

Different approaches to defining corruption and various typologies of public sector corruption have been emphasised. We outlined that definitions and forms of corruption vary according to the approaches, aims and needs of analysts. We noted that the diversity of corruption definitions is reflected in the various approaches of measuring and assessing it. In their efforts to grasp corruption incidence within and across countries, international organisations combating corruption and academic scholars developed a number of measurement tools over the last few years, which allow them to assess the situation of corruption at a given time, to identify areas that need remedial action and also to draw international comparisons.

The logical next step was therefore to provide an overview of public and private sector corruption. First, an analytical framework for understanding the mechanisms underlying corruption in the public sector – the principal-agent framework – was presented. According to this theory, agent's incentives for corruption are encouraged by opportunities for corrupt acts and discouraged by the presence of effective legal mechanisms, so that rational decisions based upon the expected benefits and costs of corrupt acts underlie corrupt transactions. Using this general framework, we reviewed a number of selected theoretical arguments, illustrated by a simple empirical analysis, highlighting country characteristics expected to affect the monopoly and discretionary powers and the accountability of public officials. We then focused on the private side of corruption by identifying its motivations, forms, causes and contexts of emergence. In this regard, the importance of norms of honesty and ethics in supporting good corporate governance was pointed out.

This led us to underline in a final section the role of cultural and anthropological factors in explaining the pervasiveness and persistence of corruption in certain countries. We addressed how social capital, cultural orientations and the organisation of powers prevailing in some societies may maintain them in a long-lasting state of impunity and widespread corruption.

Chapter 2

Measuring macroeconomic instability

Applications to export revenue data, 1970-2005

1. Introduction

The global economic crises of the 20th century have made macroeconomic instability a key issue for the analysis of the determinants of economic growth. The multiplicity of ways in which it affects the long-term growth path of economies, its diverse causes and the array of methods by which it is measured, make economic instability a complex and multidimensional phenomenon.

Economic instability refers to the notion of economic disequilibrium, and its measurement is generally based on the extent to which observed values of a given economic variable deviate from their trend or reference values. In other words, the greater and/or the more frequent is the deviation from the trend, the greater the instability. Therefore, measuring instability requires, in a first stage, to choose the appropriate trend computation method. The second stage consists in summing deviations from this trend. Traditionally, indicators of instability measure the average amplitude of economic fluctuations around their trend, by simply computing instability indicators based on the second moment of the distribution around a reference value, such as the standard deviation or the coefficient of variation. However, this approach does not account for other important features of instability, such as the asymmetry of deviations (predominance of positive or negative shocks) or the occurrence of extreme deviations, which are expected to have specific economic consequences (Rancière et al., 2008; Hnatkovska and Loayza, 2005; Dercon, 2002; Alderman, 1996).

The choice of instability indicator is also generally little discussed by authors, on the grounds that the different methods generate instability scores that are strongly correlated. A common approach of measuring instability is to look at the distribution of a variable growth rates, assuming, sometimes without any prior testing, that the variable is stationary in first difference. Other measures focus on the residuals of a regression of a variable on a mixed (deterministic and stochastic) trend. Or, cyclical economic fluctuations around filtered values are sometimes taken as a basis for instability measurement. The aim of this chapter is to discuss these techniques by computing indicators of instability using export revenue data of 134 developed and developing countries over the period 1970-2005, and examining their characteristics, similarities and dissimilarities.

In what follows, we present standard parametric and non-parametric approaches of calculating the trend component of exports. Then, on the basis of these trend calculations, we compute indicators of instability for the magnitude, the asymmetry and the occurrence of extreme deviations, respectively. Results show that, i) in line with the empirical literature, indicators of the magnitude of instability are strongly correlated with each other; ii) correlations between indicators of the asymmetry of fluctuations, and between indicators of the occurrence of extreme deviations, are low; iii) whatever the trend calculation method, the average magnitude of instability is found to be unrelated to its asymmetry and to the occurrence of extreme deviations; and iv) whatever the trend calculation method, the asymmetry of instability is found to be strongly driven by the occurrence of extreme events. Thus, attention should be paid to the proper characteristic of the different methods applied for the measurement of instability.

In the next section, we propose a brief overview of the literature in economics addressing the main causes and consequences of economic instability, and a non-exhaustive review of common approaches to measure it. The third section compares parametric and non-parametric approaches of calculating the trend component of exports. The fourth section outlines the various ways of characterizing the fluctuations in a variable around its trend value. We show that it is possible to quantify instability not only by the average magnitude of economic fluctuations, but also in terms of their asymmetry and the occurrence of extreme variations. Correlations between these different indicators are then discussed. The fifth section concludes.

2. Literature review

Macroeconomic instability is considered by many studies as an impediment to economic development. It depresses investment, productivity, the quality of policy, and consumption, especially in countries with imperfect financial markets, a high exposure to shocks and a low state capacity for reacting to them. Studies addressing the causes and consequences of macroeconomic instability however use a wide range of instability indicators. We review below the main findings of the literature and the main approaches of measuring macroeconomic instability.

2.1. Macroeconomic instability and development

The literature provides an extensive analysis of the costs and consequences of macroeconomic instability. Although the positive relationship between risk and capital returns may, under certain conditions, explain a positive relationship between economic instability and growth, most research agrees that this phenomenon has a negative impact on long-term growth and well-being. Indeed, over the long term, instability contributes to a reduction in levels of consumption, investment and factor productivity, to an increase in the instability and unpredictability of economic policy, and to a deterioration in the institutional environment. These effects on economic performances are even more marked in developing countries, which are often subjected to more significant external shocks but which do not enjoy the internal conditions that would allow them to absorb them more easily.

2.1.1. The costs of instability

Macroeconomic instability is a major obstacle to growth. According to estimates of Hnatkovska and Loayza (2005) based on a sample of 79 countries, increasing the average value of instability by one standard deviation results in an average loss of 1.3 points for GDP growth over the period 1960-2000, and 2.2 points for the decade 1990-2000. Instability is, indeed, a strong impediment to economic development.

An early series of research articles examined the impact of macroeconomic instability on growth from the point of view of investment or factor productivity (Guillaumont and Demeoq, 1989; Dawe, 1996; Dehn, 2000; Combes and Guillaumont, 2002; Koren and Tenreyro, 2006). Dawe (1996) analyses these two channels and finds a positive effect of instability on investment through an increase in precautionary savings, and a negative effect on growth through an allocation of capital to sectors with lower yields. Guillaumont and Demeocq (1989) study the effects of exports instability on the different sources of economic growth, namely, savings, capital inflows, and capital productivity. They distinguish the *risk effect* of export instability – resulting from the uncertainty in export fluctuations – from the *ratchet effect* of export instability – resulting from asymmetric responses to positive and negative export shocks. They find that export instability lowers growth

mainly through a negative effect of uncertainty on resource allocation and investment planning, and through a negative effect of export booms on capital productivity which is not compensated by a symmetric positive effect of export busts. In the same vein, Dehn (2000) distinguishes between the effects of commodity price uncertainty from those of discrete commodity price shocks on investment. He finds evidence of asymmetric investment responses to commodity price variations: while a positive effect of positive price shocks is found, negative shocks do not affect investment rates. The author explains this evidence by the irreversibility of some investments which cannot be reduced in the same extent during hardships. Koren and Tenreyro (2006) empirically test a theoretical model where the development process comes with an increased diversification of inputs into the production system, thereby reducing the effect of instability in world prices on factor productivity. In general, macroeconomic instability therefore seems to be an obstacle to economic growth as it discourages investment decisions, has a negative effect on factor productivity and diverts capital from the most productive sectors.

Other studies analyse the impact of macroeconomic instability on growth and well-being through its effect on the quality of economic policy. Easterly et al. (1993) show that positive shocks in relation to terms of trade influence the long-term growth path of economies, in part through an improvement in economic policy. Ramey and Ramey (1995) find that the unpredictability of economic policy caused by instability in growth rates has a negative effect on the average growth rate of the economy. To take two other examples, both Fatas and Mihov (2005, 2007) and Afonso and Furceri (2010) have emphasised the negative impact of variability in budget policy on growth in both OECD countries and developing nations.

The negative effect of macroeconomic instability on growth and well-being, based on instabilities in public and private consumptions, has also been examined in a number of studies. Aizenman and Pinto (2005) and Wolf (2005) point out that when financial markets are imperfect, the government and individual households are unable to fully protect themselves against risks on their revenue and adjust their consumption to the hazards of economic activity. As a result, instability driven by external factors, such as world agricultural prices or world interest rates, contributes to intermediate or policy-related instability in relation to consumption, real effective exchange rates, or investment rates, particularly in the poorest countries (Guillaumont, 2010; Aguiar and Gopinath, 2007; Loayza et al., 2007).

Poor economic policy and unstable consumption levels are very important economic consequences of instability. They also represent key channels through which sector instability is transmitted to the entire economy, with a concomitant negative effect on growth and development.

2.1.2. A typology of instabilities and their contribution to economic vulnerability

There exist different types of instability. The literature on economic vulnerability[52] (Combes and Guillaumont, 2002; Guillaumont, 2009ab, 2010) draws a distinction between:

- external sources of economic instability (exports, international prices, terms of trade, or international interest rates) and domestic ones (such as economic policy, agricultural production and natural or climatic shocks);
- primary instabilities (related to climatic events, terms of trade movements or political factors) and intermediate ones (related to changes in investment or real exchange rates); or between
- exogenous sources of instability (related to international trade, agricultural production and natural shocks) and endogenous sources of instability (linked to economic policy or domestic socio-political conditions).

Hnatkovska and Loayza (2005) also make a distinction between "normal" fluctuations in GDP (positive or negative, repeated and on an average scale) and "crisis" fluctuations, the latter being identified when GDP falls exceed a certain proportion of its trend values. They highlight an important and significant effect of "crisis" fluctuations on growth, but no significant effect of "normal" fluctuations. A similar distinction is made by Rancière et al. (2008) and applied to the study of the effect of financial "systemic risk" on growth.

The literature addressing the contribution of external trade-related and internal natural shocks to economic vulnerability is particularly vast (Guillaumont, 2007, 2009ab, 2010). A study carried out by Becker and Mauro (2006) identifies terms of trade deteriorations or sudden stops in capital movements as important external sources of growth collapses. Raddatz (2007) analyses the sources of instability in GDP in Least Developed Countries by examining the total and relative contribution of external shocks to instability in GDP. The author finds that external shocks (terms of trade, price of primary products, LIBOR and development aid) have only a marginal effect on growth instability, while internal factors related to economic policy (level of public deficit, inflation and overvaluation of exchange rates) are found to be important contributors. These findings support those of Fatas and Mihov (2005, 2007) and Acemoglu et al. (2003), who show that distorting economic policies are the main cause of output instability.

2.1.3. Domestic factors of a higher or lower vulnerability to shocks

One positive effect of instability on growth, explained, primarily, by the positive correlation between risk and return on investment projects, has already been highlighted (Imbs, 2007; Rancière et al., 2008; Hnatkovska and Loayza, 2005). Hnatkovska and Loayza (2005) suggest that this positive effect relies on the existence of risk-sharing mechanisms and respect for ownership, which

[52] Defined as the risk for countries to see their development process hampered by shocks (Guillaumont, 2009ab, 2010).

are, in turn, guaranteed by domestic factors such as a well-developed financial system or high-quality institutions. On the other hand, the literature on economic vulnerability identifies a range of domestic handicaps explaining a greater vulnerability to shocks, particularly in developing countries. Many developing countries are indeed structurally more exposed to shocks while demonstrating a low resilience to them (Guillaumont, 2009ab). Structural factors that affect exposure to shocks – such as the size of the population, the degree of economic diversification, the distance from global markets and the geographical remoteness – increase the likelihood of economies to face adverse shocks and heighten their negative impact on GDP growth. As for country resilience to shocks, it is primarily linked to policy outcomes, notably the government capacity for operating counter-cyclical fiscal policy, the degree of trade openness, the regulatory framework or the existence of democratic economic governance (Guillaumont, 2009a; Rodrik, 1998 2000).

Among these factors of vulnerability to shocks, the contribution of the degree of trade openness to the stability or instability of economies is widely documented. A recent study of Malik and Temple (2009) on the structural determinants of growth instability stresses the negative relationship between access to foreign markets and macroeconomic instability. According to the authors, countries which are isolated from foreign markets tend to lack diversity in terms of exports and experience greater instability in the GDP. Di Giovanni and Levchenko (2010) also study the extent to which trade openness results in a specialisation of export sectors highly exposed to external shocks, and how it may translate into increased economic instability. They show that countries with a low or moderate comparative advantage in high-risk export sectors diversify their economy in order to attenuate the risk on their export revenues. Conversely, countries with a very high comparative advantage in these sectors tend to specialise into them, which in turn increases the exposure to terms of trade, export earnings, and GDP growth rates instabilities. Koren and Tenreyro (2006, 2007) show that poor countries specialise in a limited number of sectors, with relatively simple production technologies using a limited range of inputs, and are more vulnerable to movements in international prices. Development is hence supported by an economic diversification or a specialisation into export sectors based on more complex technologies or using a wider variety of inputs, thereby lessening countries' exposure to trade-related shocks.

Other studies have examined the role played by the quality of governance and the financial development in absorbing the adverse effects of economic instability. Mobarak (2005) finds that democratic institutions reduce economic instability through an increased public scrutiny of the management of economic policy. These results support those of Rodrik (2000), who shows that democratic institutions encourage political consensus around political responses to external shocks. Other papers also examine the role of the development of financial markets in transmitting macroeconomic instability (Beck et al., 2001; Aghion et al., 2005; Aghion et al., 2004). In general, financial development is found to attenuate shocks, although it may magnify the effects of

monetary shocks on GDP instability (Beck et al., 2001). The quality of governance and the development of financial markets are therefore key internal factors of country resilience to shocks.

Thus, the decisive contribution of macroeconomic instability to country economic counter-performances is widely documented and debated. In what follows, we illustrate the large array of instability indicators used in the literature and try to point out the main features of these indicators.

2.2. Measures of economic instability: a variety of indicators.

Measuring instability generally consists in quantifying the gap between observed values of an economic variable and its equilibrium value. This equilibrium value, or reference value, is a permanent state or trend around which a variable's fluctuations are transitory. In statistical terms, economic instability is traditionally measured by the second moment (the variance or standard deviation) of the distribution of a variable around its mean or a trend.

Measuring instability thus relies on two key steps: the *trend computation* – i.e. the choice of a stationarisation method – and the *indicator computation* – i.e. the characterization or quantification of fluctuations around this trend. We set out below a review of the main indicators of economic instability used in the literature, noting how reference values and indicators have been calculated by various authors. A summary table of different approaches of measuring instability is presented in annex 2.A.

2.2.1. Instability indicators based on the growth rate of a variable

Many studies use instability indicators based on the standard deviation of a variable's growth rate. If the simplicity of this approach is a desirable feature, it nevertheless assumes that assumes that this variable is stationary after first-differencing, which implies restrictive hypotheses upon time series behaviours, without any prior hypothesis testing.

Ramey and Ramey (1995), for example, propose studying the effect of economic instability on long run growth using the standard deviation of the growth rate of GDP *per capita*. Servén (1997) examines the effects of instability on investment in sub-Saharan Africa and uses two indicators of macroeconomic instability, based on the standard deviation and the coefficient of variation of several economic aggregates (terms of trade, black-market premium, inflation, etc.).[53] In their study of the effect of institutional quality on macroeconomic instability, Acemoglu et al. (2003) use the standard deviations of GDP growth rates and terms of trade. Similarly, Di Giovanni and Levchenko (2010), and Van der Ploeg and Poelhekke (2009) examine the effects of a high level of exposure to external shocks using indicators of instability based on the standard deviation of the

[53] See section 4.2 for standard deviation and coefficient of variation formulae.

growth rates of terms of trade, GDP per inhabitant and exports. Raddatz (2007) also computes the standard deviation of the growth rates of several macroeconomic variables (price of primary products, terms of trade, aid per inhabitant, GDP per inhabitant and LIBOR) to examine the contribution of external shocks to the instability of GDP in African countries.

2.2.2. Instability indicators based on the residuals of an econometric regression

Other indicators of instability are based on the residuals or explanatory power of econometric regressions. Pritchett (2000) computes three indicators of instability. The first indicator is based on the coefficient of determination of a growth-rate regression on a linear time trend. The lower is this coefficient of determination, the less the trend's explanatory power and the greater the instability. The second measure is based on the difference in growth rates before and after a break year identified by minimising the sum of squared residuals of a regression on a simple linear trend. As a third measure, the author proposes an indicator based on the standard deviation of the residual of a regression of GDP on a mixed (deterministic and stochastic) trend. The same approach is followed by Servén (1998), Combes and Guillaumont (2002), and Chauvet and Guillaumont (2009). In the same vein, Lensink and Morrissey (2006) measure the instability of Foreign Direct Investments (FDI) by the standard deviation of residuals of a regression of FDI on its lagged levels and a time trend.

Finally, other authors propose indicators of economic uncertainty. Ramey and Ramey (1995) compute a measure of economic uncertainty based on the standard deviation of the unpredicted component of the residual of a growth regression. Similarly, Servén (1998) and Dehn (2000) examine the effect of economic uncertainty on investment using an array of measures based on the standard deviation of residuals of a GARCH process (1,1).

2.2.3. Instability indicators based on the cycle isolated by a statistical filter

Finally, other studies use filtered value of a statistical series as a reference value. Filter techniques decompose a time series into trend (long term) variations and cyclical (short term) variations. It differs from the previous parametric methods insofar as it does not formulate *a priori* the behaviour of a series (order of integration, difference-stationarity or trend-stationarity) and often smoothes time series on the basis of their past and future values. Section 3.3 examines this technique in more detail.

Dawe (1996) smoothes export series using a five-years moving average filter calculated over [t-2;t+2], and measures instability as the average cyclical deviation, that is, the average difference between observed and smoothed time series. Other authors apply the Hodrick-Prescott filters (Hodrick and Prescott, 1997) to smooth GDP series (Becker and Mauro, 2006) or aid (Chauvet and Guillaumont, 2009), and compute a measure instability based on the standard deviation of isolated

cyclical GDP or aid fluctuations. Hnatkovska and Loayza (2005) isolate cyclical fluctuations in GDP series using the Baxter and King (1999) filter and calculate their standard deviation. Finally, Afonso and Furceri (2010) compute the standard deviation of the cyclical component of public spending and tax revenues isolated using both HP and Baxter-King filters.

The usual indicators of economic instability can therefore be distinguished according to the method chosen to calculate the reference value. In general, these indicators are either based on the variance of a series' growth rates, of the residuals of a regression, or of the cycle isolated by statistical filters. However, divergences between methods of summing deviations from a reference value are less salient, since the literature on the causes and consequences of economic instability is often confined to use variance-based indicators, reflecting the average magnitude of fluctuations.

In the following section, we present various computation methods of the reference value, using export revenue data for the period 1970-2005, and stress analytical differences between these methods. In section four, we outline different ways of characterising a variable's fluctuations around reference values. We show that it is possible to go beyond variance-based instability indicators, reflecting the average magnitude of economic fluctuations, by computing indicators reflecting the asymmetry of fluctuations and/or the occurrence of extreme shocks.

3. Methods of computing the reference value

Instability measurements generally rely on the extent to which observed values of time series deviate periodically from their permanent state. However, most economic aggregates are not "naturally" stationary, meaning that some variations around their average values are not temporary. As a consequence, it is often necessary to compute a more complex reference or trend value around which fluctuations are transitory only (Dehn, 2000; Hnatkovska, 2005).

Consider $y_t = \mu_t + \varepsilon_t$, a non-stationary process with μ_t a non-constant term and ε_t the residual. Stationarising y_t consists in calculating or estimating the trend component μ_t so that the residual (or cycle) ε_t meets the following conditions[54]:

(1) $E(\varepsilon_t) = 0$;

(2) $V(\varepsilon_t) = \sigma_\varepsilon^2 < \infty$ for all of t; and

(3) $Cov(\varepsilon_t ; \varepsilon_{t-k}) = \rho_k$.

These three conditions require the residual ε_t to have a zero mean (1), a variance and autocovariance finite and independent of time (2, 3). Instability indicators based on this residual are

[54] We are referring here to conditions of "weak" stationarity.

expected to reflect a history of transitory fluctuations. If the series is poorly stationarised, variations which are attributable to a long-term (or permanent) change in μ_t may be included in the residual, thus breaching conditions (1), (2), and (3).

In this section, we present the principles and properties of usual methods for calculating reference values. We illustrate our analysis using the annual series of export earnings for 134 (developed and developing) countries over the period 1970-2005, from the *2008 World Development Indicators*. The instability of exports is an important component of macroeconomic instability, which is addressed in depth in the literature on economic instability (Guillaumont 2010, 2009a; Jones and Olken, 2010; Easterly et al., 1993; Bevan et al., 1993, Guillaumont and Déméocq, 1989). In what follows, we proceed to the decomposition of export series' evolution, we present standard techniques for trend computation, and we propose different indicators of export instability around their trend.

3.1. Decomposition of economic series

We first look at how exports vary for a sample of selected countries. We then decompose theoretically time series variations into permanent components and transitory components. This lead us to distinguish two main families of indicators: indicators of *economic variability*, which are indicators reflecting all transitory variations in a time series; and indicators of *economic uncertainty*, which are indicators reflecting only unpredictable variations in a time series.

3.1.1. Examination of a series' pattern of evolution

As an illustration, figure 2.1 displays the evolution of export revenues in constant dollars (2000) in six different countries (South Korea, Argentina, Venezuela, Kenya, Ivory Coast and Burundi) and their associated spectrum densities. The spectrum of a series is a representation of the contributions of each frequency of variation to the total variation of the series.[55] Observing the spectrum density of a series then makes it possible to identify whether the evolution of a series is dominated by longer-periodicity or shorter-periodicity variations. Examining the spectrum is therefore a helping diagnostic tool to model correctly the dynamics of change in a series. A peak at a given frequency (or periodicity) indicates that a significant proportion of the total variance in a series can be explained by the variations of this frequency (or periodicity).

The evolution of export proceeds in a selected sample of developing countries and their respective spectrum densities are represented in figure 2.1. Except for South Korea[56], a large proportion of the

[55] The calculation for switching from frequency to periodicity is as follows: T=1/F, where F = frequency and T = periodicity.

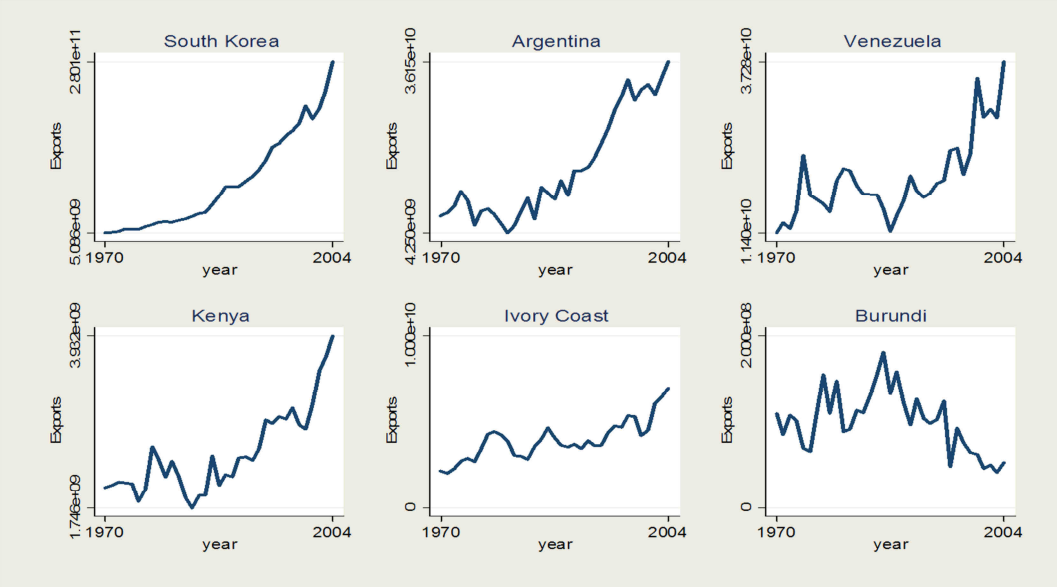
[56] Like many western countries, South Korea's export series exhibits a "Granger profile" (Granger, 1966), with most of the power of the spectrum located at zero frequency. This pattern suggests that a strictly decreasing or increasing trend in exports represent the principal source of total export variance.

series spectrum is located at long periodicities of around 20 years (with a peak in density at a frequency of around 0.05). Variations of 5 and 7-years periodicity (with a frequency between 0.1 and 0.3) also represent an important part of total variability in exports from Venezuela, Ivory Coast and Burundi. The spectrum of export series also points to the existence of density peaks at high-frequency variations, corresponding to periodicities of around 2-3 years. Thus, while export series are dominated by low frequency variations, short or medium-run export movements also contribute substantially to the total variance of the series in this sample of developing countries. These observations are consistent with the conclusions reached by Rand and Tarp (2002) and Aguiar and Gopinath (2007), who find that developing economies experience shorter business cycles and greater instability in their growth trend than their developed counterparts.

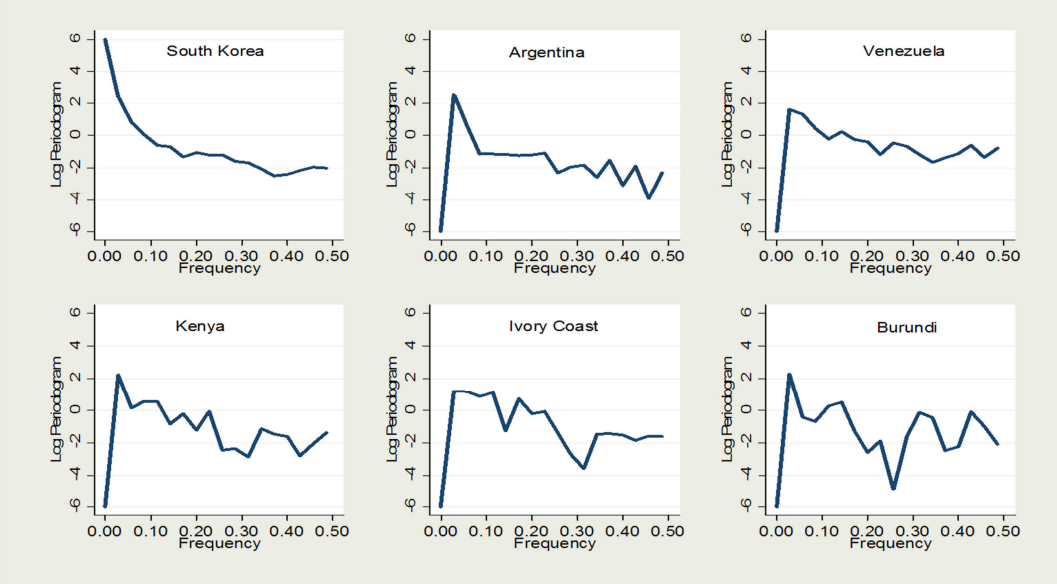
This illustrate how challenging is the choice of the reference value, as it determines which frequencies of variation are considered as transitory components of a series' evolution, and which frequencies of variations are considered as a trend components of a series' evolution. In what follows, we represent the theoretical dynamics of trend and transitory components of a time series.

Figure 2.1. Export series and spectrum densities for South Korea, Argentina, Venezuela, Kenya, Ivory Coast and Burundi.

i) Export raw data (USD, 2000)



ii) Spectrum densities



3.1.2. Theoretical breakdown of series

Following Dehn (2000) and Hnatkovska (2005), movements in economic series exhibit a *trend* or *permanent* (y^P_t) component and a *cyclical* or *transitory* (y^C_t) component:

$$y_t = y^P_t + y^C_t \qquad (2.1)$$

The *permanent* component is made up of a *deterministic* part ($y_0+a.t$), with a temporal trend t[57], and a *stochastic* (ε^P_t) part:

$$y^P_t = y_0 + a.t + \varepsilon^P_t \qquad (2.2)$$

ε^P_t represents stochastic shocks affecting the series trend on a *permanent* or *prolonged* basis. By way of example, variations in the productivity or in the preferences of economic agents can affect the path of an economic series over the long term.

The *cyclical* or *transitory* component comprises a *predictable* (y^{CP}_t component – influenced by country characteristics such as the level of development, the foreign exchange system, or the country size, etc.) and an *unpredictable* (ε^C_t) component:

$$y^C_t = y^{CP}_t + \varepsilon^C_t \qquad (2.3)$$

ε^C_t represents unpredictable shocks with a temporary effect on the series, like sudden changes in international prices of raw materials or unforeseen climatic events.

3.1.3. Variability, risk or uncertainty?

As Azeinman and Pinto (2005) suggest, the literature generally links economic instability to economic risk or uncertainty.[58] According to the authors, instability indicators based on the moments of the observed distribution of a variable around its reference value (average, filter, estimates) inform on its possible realisations, and could represent an approximation of its associated risk. The authors emphasise, however, that such a measure can overestimate risk by also including predictable transitory fluctuations. Pure risk or uncertainty would be better measured by the residual obtained from conditional variance models like GARCH models (Dehn et al., 2005; Dehn, 2000; Serven, 1998). Techniques for measuring instability may therefore be divided into two main families: those which provide *measures of series variability*, reflecting transient variation, and those which provide *measures of uncertainty or risk* (Wolf, 2005).

Uncertainty indicators, such as those based on GARCH models, generally apply to high-frequency economic data (daily, monthly or quarterly price changes, for example). Since in this chapter is focused on the measurement of instability in export proceeds, which are reported annually[59], we do not address *uncertainty* indicators. Instead, we review reference values underlying indicators of instability reflecting *economic variability*, i.e. based on variations in y^C (see equation (2.3)).

[57] Here we are examining the case of a linear deterministic trend, accepting that this may take diverse forms (quadratic and exponential trends, etc.)

[58] Leaving aside the distinction made by Knight between risk and uncertainty.

[59] As in the majority of researches on macroeconomic instability.

3.2. Parametric approaches

Many measures of macroeconomic instability are based on a parametric approach which models the trend component of economic series on the basis of their past evolution. The most common techniques are presented below.

3.2.1. Fluctuations around a linear deterministic trend

A usual approach consists in building an instability indicator reflecting the average magnitude of deviations from a linear time trend. Export series evolution, as for many macroeconomic variables (GDP, exports, interest rates, etc.), is dominated by low frequencies variations (see figure 2.1). This feature often justifies expressing export evolution as a function of a deterministic trend (linear, polynomial or exponential). For instance, in a study of world cereal price series behaviour, Sarris (2000) stresses that cereal price trends are generally deterministic, since the variance of residuals after deterministic detrending is not found to increase over time. In its simplified (linear) form, this deterministic detrending consists of estimating the following model:

$$y_t = \alpha + \beta.t + \varepsilon_t \qquad (2.4)$$

Where y_t is the variable whose instability is being measured, α a constant, t a linear trend, and ε_t a zero-mean error term. In this case, the reference value is the trend:

$$\hat{y}_t = \alpha + \hat{\beta} t \qquad (2.5)$$

In principle, deviations from the trend (ε_t) have no permanent effects on y_t. In other terms, these deviations are assumed to be stationary around the trend and can therefore be a basis for the measurement of instability in y_t. A measure of instability based on ε_t implies that i) trend values increase at a constant rate, ii) the long-term evolution of the series is perfectly predictable and iii) all deviations from the trend are transitory.

Beveridge and Nelson (1981) highlighted the limitations of an approach of this kind. To illustrate these limitations, figure 2.2 shows the evolution of export series and their corresponding deterministic trends in Belize between 1980 and 2004, and in Argentina between 1970 and 2005 (figure 2.3 displays their related residuals). Although the actual trend in Belize's export revenues seems linear, the observed values may durably deviate (between 1994 and 1999, as shown in figure 2.3) from trend values. This becomes problematic for Argentina, where the trend in export revenues is not apparently linear. Thus, this specification is likely to exacerbate the importance of shocks by unduly including a part of the trend component in the residual.

Figure 2.2. Linear trends of export series in Belize and Argentina.

i) Belize *ii) Argentina*

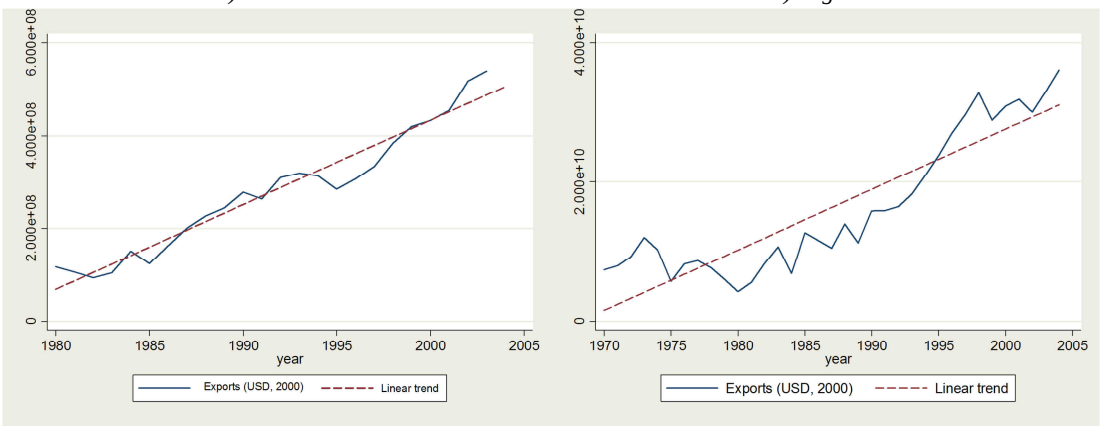
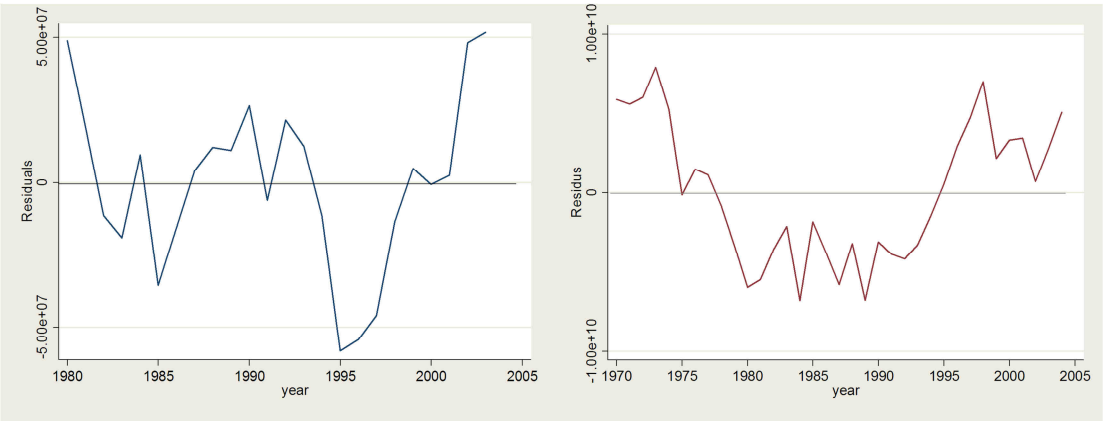


Figure 2.3. Residuals of linear trends in Belize and Argentina

i) Belize *ii) Argentina*



3.2.2. Fluctuations around a global mixed trend

Equation (2.2) suggests that it is possible that residual variations may have a permanent effect on the trend followed by a series. It is hence possible to estimate a reference value based on a stochastic trend, represented by the following first-order autoregressive process AR(1),

$$y_t = y_{t-1} + \varepsilon_t \qquad (2.6.a)$$

which can rewritten as follows:

$$y_t = y_0 + \sum_1^t \varepsilon_t \qquad (2.6.b)$$

Changes in y_t are determined by a successive history of random shocks, implying that a shock occurring in the past, even a distant past, has the same effect on the series as a shock in the present

(long-memory process). A time series with such a variation pattern is said *difference-stationary*, that is, its trend component follows a random walk process. In equations (2.6), the series exhibits a unit root process. After differencing, the series can be rewritten as follows:

$$\Delta y_t = \varepsilon_t \quad with \ \varepsilon_t \sim N(0, \sigma^2) \tag{2.7}$$

This is the hypothesis retained by studies using indicators of instability based on the standard deviation of a variable growth rate. This is a strong assumption given that spectrum densities of macroeconomic variables like GDP, exports or public spending are located at low-frequency variations (Nelson and Kang, 1981).

White and Granger (2011) reconcile the two previous approaches of modelling the trend by stressing that trends commonly observed in macroeconomic variable display both stochastic and deterministic movements. As a result, a more flexible approach may consist in estimating a trend based on both a deterministic and stochastic process, after transforming data in log:

$$Log\ y_t = \alpha + \beta.t + \delta.\log y_{t-1} + \varepsilon_t \quad with \ \varepsilon_t \sim N(0, \sigma^2) \tag{2.8}$$

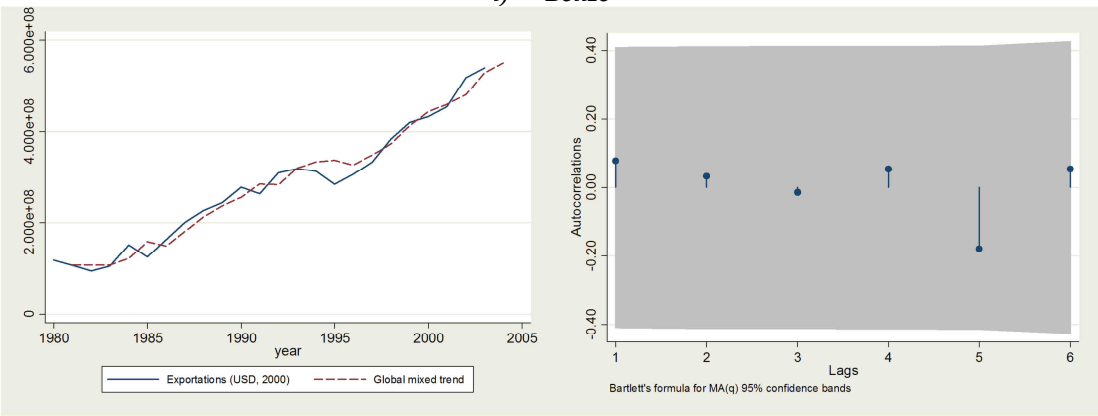
The resulting predictions of $log\ y_t$ are then rescaled with an exponential transformation. Using panel data on exports series from 134 countries, we perform the Maddala-Wu panel unit root test (based on the Phillips-Perron's unit root test) on ε_t (p-value are shown in table 2.1). We also compute Fisher statistics for the joint null hypothesis on α, β and δ (displayed in table 2.1, second column). The non-stationarity hypothesis is rejected once the series is differenced two times, and F-test statistics reject the joint null hypothesis on the coefficients. Modelling export series by the process in equation (2.8) hence seems an appropriate approach. We should nevertheless take our unit root analysis with careful consideration given their low power with roots approaching unity, with trend regime shifts, and with a limited data time-length (Sarris, 2000).

As illustrated in figure 2.4 and annex 2.B this method produces a trend that is a slightly smoothed version of the observed change in real export values. Correlograms of residuals of Belize and Argentina in figure 2.4 suggest that deviations from the trend are transitory for these countries, since residuals are not significantly autocorrelated (correlograms of other examples of countries displayed in Annex 2.B).

In a comprehensive review of statistical methods for trend calculation, White and Granger (2011) stress that one desirable property of trend values is to be pointedly smoother than the gross series. Yet, this trend seems to reproduce in *t* the change in exports observed in *t-1*.

Figure 2.4. Export revenue, global mixed trend and the correlogram of residuals in Belize and Argentina

i) Belize



ii) Argentina

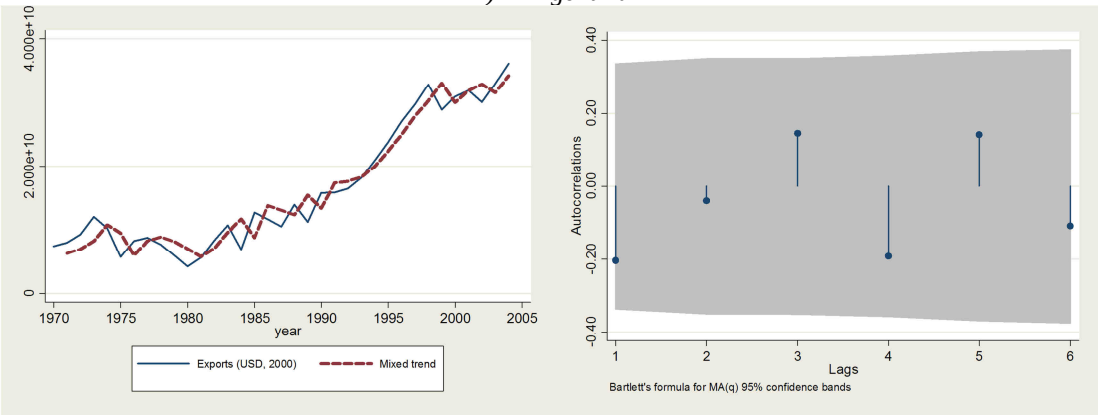


Table 2.1. Specification and unit root test on panel data

H_0: the series is non-stationary	**Prob>Chi^2**	**F-test**
$\Delta y_{it} = \alpha_i + \beta_i t + \phi_1 y_{it-1} + \varepsilon_{it}$	1.000	47.47
$\Delta\Delta y_{it} = \alpha_i + \beta_i t + \phi_2 \Delta y_{it-1} + \varepsilon_{it}$	0.000	36.61

Countries (Observations): 134(3693).

3.2.3. Fluctuations around a rolling mixed trend

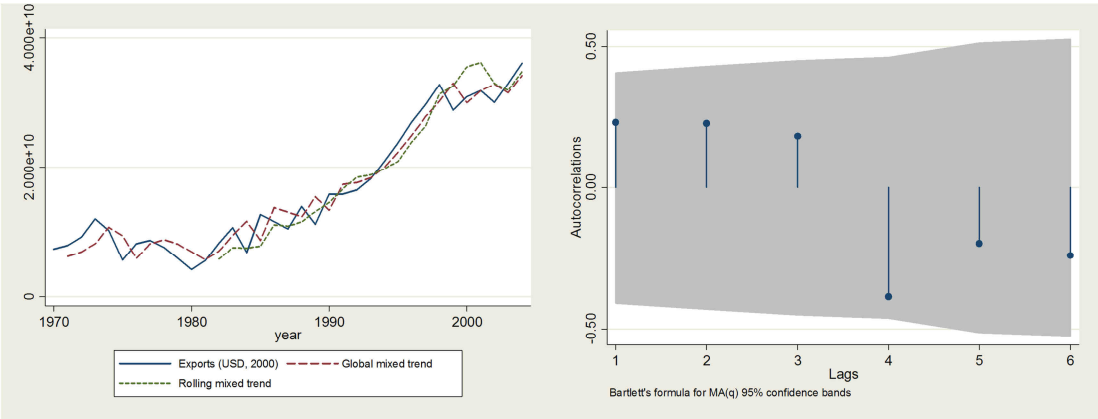
By computing the above mixed trend, we hypothesized that estimated coefficients of the stochastic and deterministic components are constant over time. Effectively, this so-called "global" trend is predicted each year for each country, based on coefficients estimated for the whole period of data availability. It therefore excludes the possibility for regime changes in the deterministic and stochastic components of the trend. Although tests of structural breaks in time series do exist (e.g.

CUSUM, Max Chow tests)[60], an alternative and more practical solution (applied to panel data with limited time length) may consist in estimating a mixed trend on a "rolling" basis (Guillaumont, 2007), allowing the estimated coefficients to change from year to year and thus reflecting recent changes in time series trend components. This "rolling" mixed trend is estimated each year for each country over the period $T = [t; t\text{-}k]$, rather than the whole of the period of data availability:

$$Log\ \hat{y}_t^T = \hat{\alpha}^T + \hat{\beta}^T t + \hat{\delta}^T \log y_{t-1} \qquad (2.9)$$

Predictions of $log\ y_t$ are rescaled using exponential transformation. Figure 2.5 plots the estimated "rolling" trend when k = 12 against the "global" mixed trend in Argentina. Annex 2.B plots the "global" and "rolling" mixed trends for a sample of different countries, and exposes correlograms of their corresponding residuals. It can be observed that the "rolling" mixed trend is smoother than the "global" mixed trend, and, contrary to the later, it does not exhibit a "saw-tooth" profile (resulting from time-constant parameters). Similarly, an examination of correlograms in figure 2.5, figure 2.6, and in annex 2.B, suggests that the residuals resulting from this approach are stationary, for this sample of countries.

Figure 2.5. Export revenue, global and rolling mixed trends, and the correlogram of residuals in Argentina



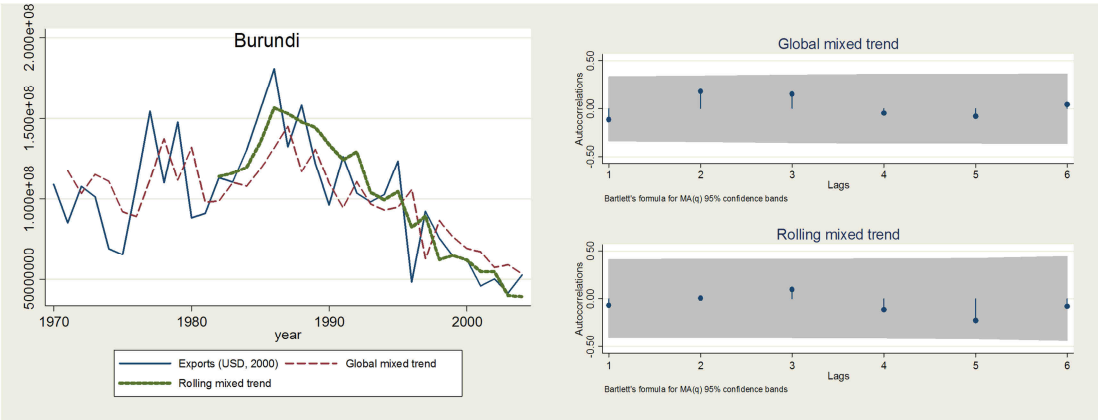
Nonetheless, this technique presents some drawbacks. First, it reduces the time coverage of instability indicators, since the first trend value is only available from $t = 1+k$. Second, estimates based on a rolling mixed trend are not necessarily an ideal solution when there is a regime shift in the trend of export series, since the prior trend regime may still exhibit inertia after the shift operates. Moreover, by estimating the trend over a shorter period than the global mixed trend, it is more sensitive to medium-periodicity than long-periodicity fluctuations, with the risk of including

[60]Sarris (2000) performs these tests to ensure that structural breaks are not included in the estimated variance of detrended cereal price series. These tests were inconclusive because of insufficient degrees of freedom.

the latter in the residual. This point may be illustrated by the relative behaviour of the two mixed trends in exports from Burundi between 1985 and 1995, in figure 2.6. In this example, the rolling mixed trend tends to underestimate the trend downfall relative to the "global" trend after the 1985 economic reversal.

Choosing an appropriate timeframe for trend estimation is a critical step because it has serious implications regarding components included into the residuals. Here, we have chosen a 12-years estimation period, so as to make the comparison between this technique and the global mixed trend more salient (in chapter 4, we compute indicators of instability based on a 16-year rolling mixed trend). It can be considered that a rolling trend calculated over a period of between 15 and 20 years is a reasonable basis. As suggested by spectrum densities presented previously in figure 2.1, variations of this periodicity strongly contribute to the long-run path of the series. Thus, the timeframe over which trend is estimated is an arbitrary choice which is intended to reflect at best the evolution of a series for a given sample of countries. Such a choice possibly induces misspecification problems when looking at export series in specific countries.

Figure 2.6. Export revenue, global and rolling mixed trends, and correlograms of residuals in Burundi.



3.3. The filter approach

Other researches on economic instability use statistical filters to isolate the cyclical component and removing the trend components of a time series (Hnatkovska and Loayza, 2005; Becker and Mauro, 2006; Chauvet and Guillaumont, 2009). The standard deviation of the resulting cycle is a popular measure of economic instability.

Unlike the parametric approach, the filter approach does not make *a priori* assumptions on the trend of time series. Moreover, statistical filters are sensitive to regime shifts in the trend component of

time series. The Hodrick-Prescott (HP) filter (Hodrick-Prescott, 1997) and the band-pass (BP) filter put forward by Baxter and King (1999) are amongst the most popular filter approaches. When applied to our export data, both techniques give extremely similar results. Although the BP filter maintains the properties of the series more accurately, this advantage comes at the price of a loss of observations at the end of the sample (Baxter and King, 1999).[61] In what follows, we only present the results obtained with the Hodrick-Prescott (HP) filter. Hodrick and Prescott break down the change in a series into a non-stationary trend component (y^P_t), and a stationary cyclical component (y^C_t):

$$y_t = y^P_t + y^C_t \qquad (2.10)$$

with T = 1, 2, 3,…, t. The HP filter isolates the cyclical component by optimising the following programme in relation to HP:

$$\min_{\{HP_t^*\}} \left[\sum_{t-1}^{T} (y_t - HP_t)^2 + \lambda \left(\sum_{t=2}^{T-1} \Delta^2 HP_t \right)^2 \right] \qquad (2.11)$$

with the deviation $\widehat{\epsilon_t} = y_t - HP_t^*$. This method is close to a symmetrical moving average filter with infinite time horizon. λ is a smoothing parameter which can be either estimated or determined *ad hoc*. The first term of the equation (2.11) minimises variance in the cyclical component while the second term smoothes the change in the trend component. When λ tends towards infinity, the variance in the trend growth converges towards 0, which implies that the trend component – or smoothed series – is close to a simple linear trend. Conversely, when λ tends toward 0, the filtered series is close to the original series. As a result, the lower is the value of the smoothing parameter, the shorter the periodicity of isolated cyclical fluctuations, and *vice versa*.

The choice of the value of λ is still debated in the literature. If Hodrick and Prescott advocate a parameter λ equal to 100 for annual data, Baxter and King suggest a value up to 400, while Maravall and Del Rio (2001) choose a value down to 6.

We hereafter compare results obtained with λ set at 100 (long-periodicity trend, or HP100) and 6.5 (medium-periodicity trend, or HP65). As expected, figure 2.7 shows that the trend HP65 fluctuates more than the trend HP100. Annex 2.C reports correlograms of the isolated cycles of countries represented in figure 2.7. Figures 2.7 and annex 2.C both suggest that extracted cycles are stationary and not significantly autocorrelated, for this sample of countries.

[61] The BP filter is a bilateral filter, which requires a minimum number of observations before and after each filtered observation point in order to increase the precision of the filtering. Baxter and King (1999) recommend to exclude the first 12 and last 12 quarters when filtering quarterly series. For annual series, they recommend to exclude the first three and last three years from the sample.

The filtering approach nonetheless presents some drawbacks. First, it relies on the hypothesis that the cyclical and trend components are independent. In light of the significant amount of research on the effects of macroeconomic fluctuations on long-term growth (Ramey and Ramey, 1995), this hypothesis seems restrictive. Moreover, the HP filter may suffer from *compression effects* when the smoothing parameter is set at a low value: part of short-periodicity cyclical variations can be attributed to trend variations. The resulting trend may become more volatile while the cyclical component – upon which instability measures are based – may be understated. Conversely, choosing a high smoothing parameter may cause *leakage effects*: some of the long-periodicity variations may be included into the cyclical component. The resulting trend may appear less volatile while the cyclical component may be overstated. Given the contribution of medium-periodicity fluctuations in the total variance of countries represented in figure 2.1, and given the predominance in our sample of developing countries with shorter business cycles and more variable trend components (Aguiar and Gopinath, 2007; Rand and Tarp, 2002), a lower smoothing parameter seems more appropriate.

Parametric and filter approaches of computing the trend are conceptually different. While the former approach models the process followed by trends in time series on the basis of their past evolution, two-sided filter methods such as the HP or BK filters use both past and future data to smooth time series. These differences imply that the choice of the reference value affects measurements of instability and their use in empirical analyses.

On the one hand, the filter approach is probably much more efficient in making series stationary, by computing a trend which is more sensitive to regime changes in the trend evolution of time series, and more flexible when time series variations exhibit very diverging patterns between countries. According to King and Rebelo (1993), the HP filter can stationarise series with an order of integration up to four. On the other hand, because series are modelled according to their past realisations, instability indicators based on the parametric approach better reflects the effects of unusual economic events such as economic crisis or booms, which is a key feature for the study of the consequences of instability on economic outcomes.

Conversely, since the two-sided filter approach uses both past and future information to compute the trend, it should be more sensitive to outliers and may hence produce cycles that are less sensitive to extreme events. In fact, filter approaches were originally aimed at identifying business cycles and relating them to macroeconomic policy outcomes and long-run properties of developed and developing economies. This approach of computing the trend is generally used to test business cycle models, with the underlying assumption of rational expectations of economic agents. By contrast, parametric approaches of computing the trend are popular among macro and

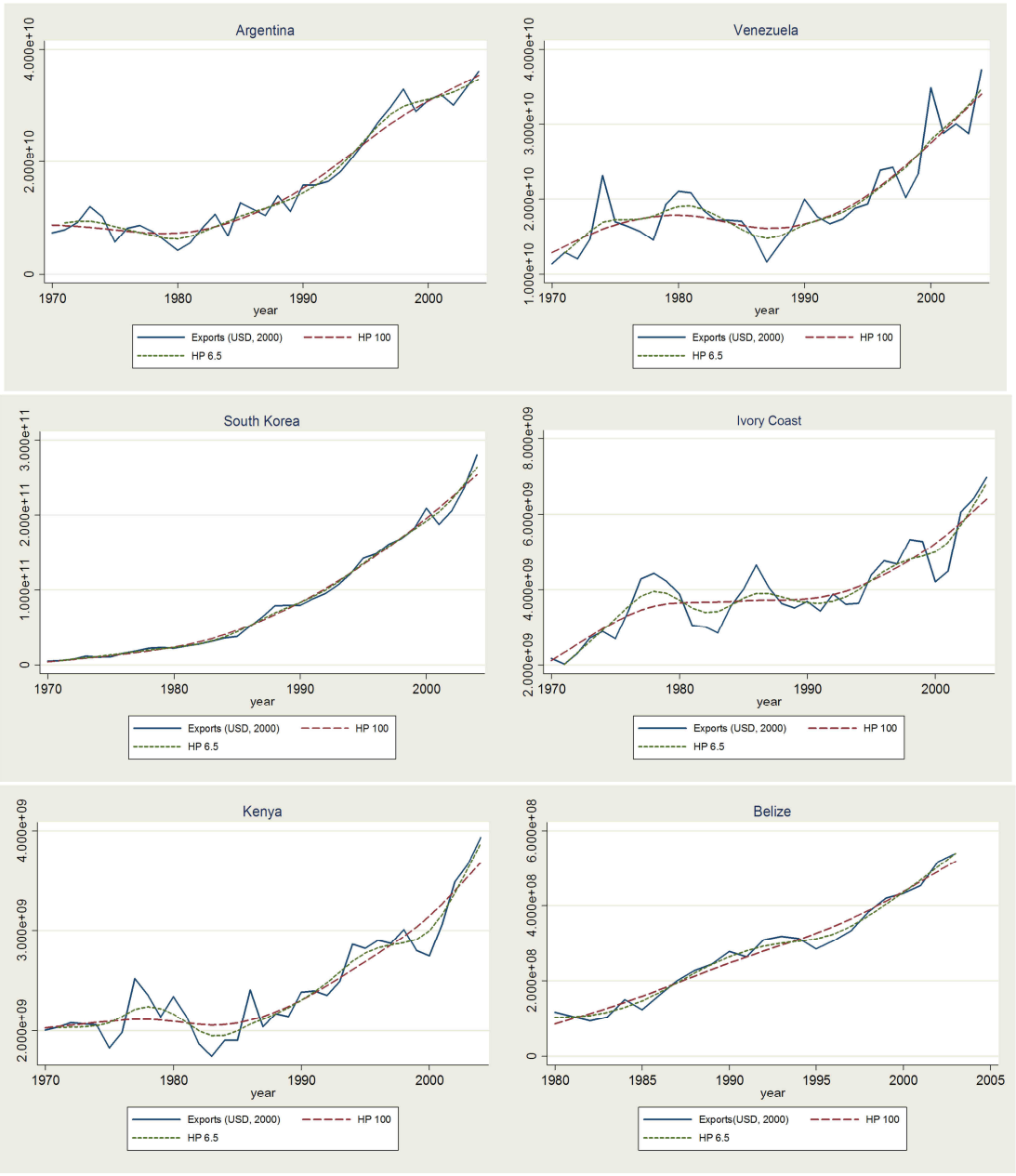
microeconomic studies on the effects of shocks on economic agents' production and consumption decisions, and rather rely on the hypothesis of extrapolative or adaptive expectations.

As a final word, whatever the approach chosen, both imply arbitrary choices: regarding the period of trend estimation for the parametric approach, and regarding the value of the smoothing parameter for the filter approach. These choices should at best reflect trend movements in economic time series, but both inevitably induce some misspecification problems when applied to wide panel datasets. Respective pros and cons of trend computation methods are synthetized in table 2.2 below.

Table 2.2. Pros and cons of trend computation methods

	Filter approach	Parametric approach
Pros	More efficient and more flexible in making series stationary Seems more appropriate for the study of macroeconomic responses to instability	Better reflects outliers in the distribution around trend values. Seems more appropriate for the study microeconomic responses to instability
Cons	More sensitive to outliers in the distribution around trend value	Arbitrary modelling of the trend component in time series Weaker results whtih structural breaks

Figure 2.7. Export revenue data smoothed by the HP filter



4. Quantifying instability: ways of summing deviations from the trend

While shock variables inform on the asymmetry and/or the size of an economic fluctuation at a given point of time, instability indicators reflect a history of past shocks, by summing deviations from their trend over a finite timeframe. Amongst available measures of instability, variance-based indicators are the most common ones. However, confining the analysis of instability to the analysis of a variable's variance may mask other important dimensions of economic instability. In fact, other important dimensions of economic instability are the asymmetry of fluctuations and the likelihood of crisis or booms. We hereafter show that it is possible to quantify these dimensions of instability by exploiting moments two, three and four of the distributions of exports around our different reference values.

4.1. Calculation period

As indicators of instability are intended to reflect a past history of shocks, it is first necessary to set the period over which deviations are summed. When the evolution of a time a series presents distinct episodes of instability over time, it may be relevant to align the period over which deviations are summed to the approximate duration of the episodes of instability (Wolf, 2005). Moreover, in an econometric analysis of the consequences of instability, the period of summing deviations should also fit with time variations of the dependent variable. For instance, studying the short-term effects of instability by summing deviations over a five-year period is indeed a relevant approach inasmuch the outcome variable varies over a similar timing (see chapter 4).

4.2. The average magnitude of export fluctuations

Numerous research articles examine the consequences and determinants of the average magnitude of fluctuations. A very common indicator is the standard deviation of a variable around its reference value (here expressed in % of the trend):

$$INS_1 = 100 \times \sqrt{\frac{1}{T}\sum_t \left(\frac{y_t - \hat{y}_t}{\hat{y}_t}\right)^2} \qquad (2.12a)$$

with T=1, …, t. We compute the standard deviations as a share of the reference value so as to rescale instability measurement when fluctuations' order of magnitude differs from one country to another. It is also possible to calculate the average absolute deviation of deviations from the trend:

$$INS_2 = 100 \times \frac{1}{T}\sum_t \left|\frac{y_t - \hat{y}_t}{\hat{y}_t}\right| \qquad (2.12.b)$$

with T=1, …, t, y_t is the observed value of the series, and $\hat{y}_t$ is the reference value. The question of the respective advantages of the standard deviation and the average absolute deviation as a measure of the average magnitude of deviations in a distribution is an old debate (see Gorard, 2005). The standard deviation is the most familiar indicator and provides a more efficient estimate of 'average deviation' in the case of a normal/Gaussian distribution. It also increases exponentially with the size of deviations, which can be a desirable property when the effects of instability are more than proportional than the size of fluctuations (Guillaumont and Demeocq, 1989). However, the average absolute deviation is a more efficient measure in presence of measurement errors, or when the distribution is not normal (Gorard, 2005).

We illustrate differences between these two indicators of the magnitude of fluctuations calculated for Venezuela and Kenya (see figure 2.8). Both measures are calculated on a rolling annual basis over a six-year period (t; t-5). Figure 2.8 suggests that peaks of instability which correspond to the end of the 1970s, 1980s and the early 1990s and 2000s are more heavily weighted when we use the standard deviation as instability indicator (INS_1).

We privilege the use of the standard deviation (INS_1) as a measure of the average magnitude of deviations, because this measure presents a greater time and country variability. We then compare standard deviations of export distributions around the different reference values presented in the previous section. In what follows, indicators of the average magnitude of export fluctuations, based on the standard deviation of exports, are computed over the period 1982-2005 for each reference values. Results are shown in tables 2.3 and 2.4, and in figure 2.9.

Standard deviations of export around mixed trends and HP-filtered values display high correlations, between 80% and 96%. Standard deviations of exports around the global mixed trend and the HP100 filter tend to be in average higher than other indicators, while standard deviations around HP65 filtered values are lower in average and display lower variability than with other reference values. The standard deviation around the HP100 filter is the one that correlates the less closely with other indicators, but still at a high 80% level.

Figure 2.8. Indicators of the magnitude of instability (% of trend)

i) Venezuela *ii) Kenya*

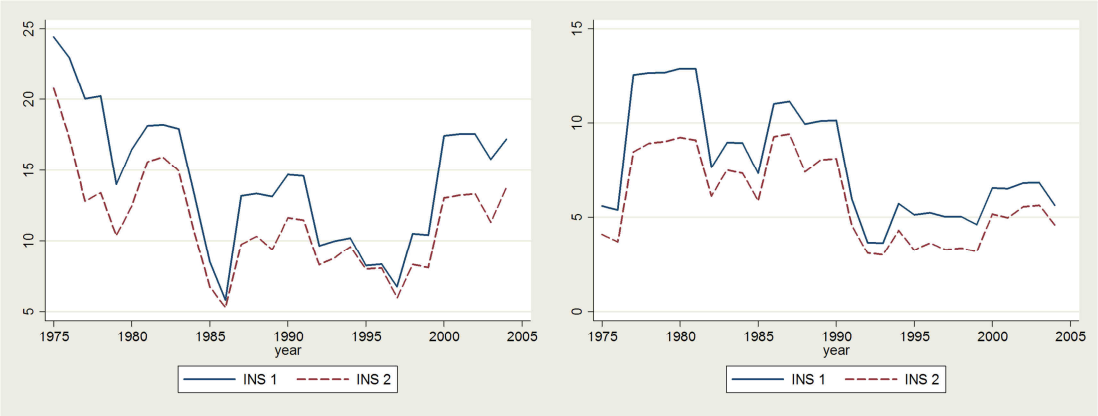


Table 2.3. Correlations between standard deviations of exports around different reference values.

	(1)	(2)	(3)	(4)
	Global mixed trend	**Rolling mixed trend**	**HP 6.5**	**HP 100**
	Standard deviations calculated over 1982-2005			
(1)	1.00			
(2)	0.92*	1.00		
(3)	0.96*	0.95*	1.00	
(4)	0.87*	0.80*	0.87*	1.00

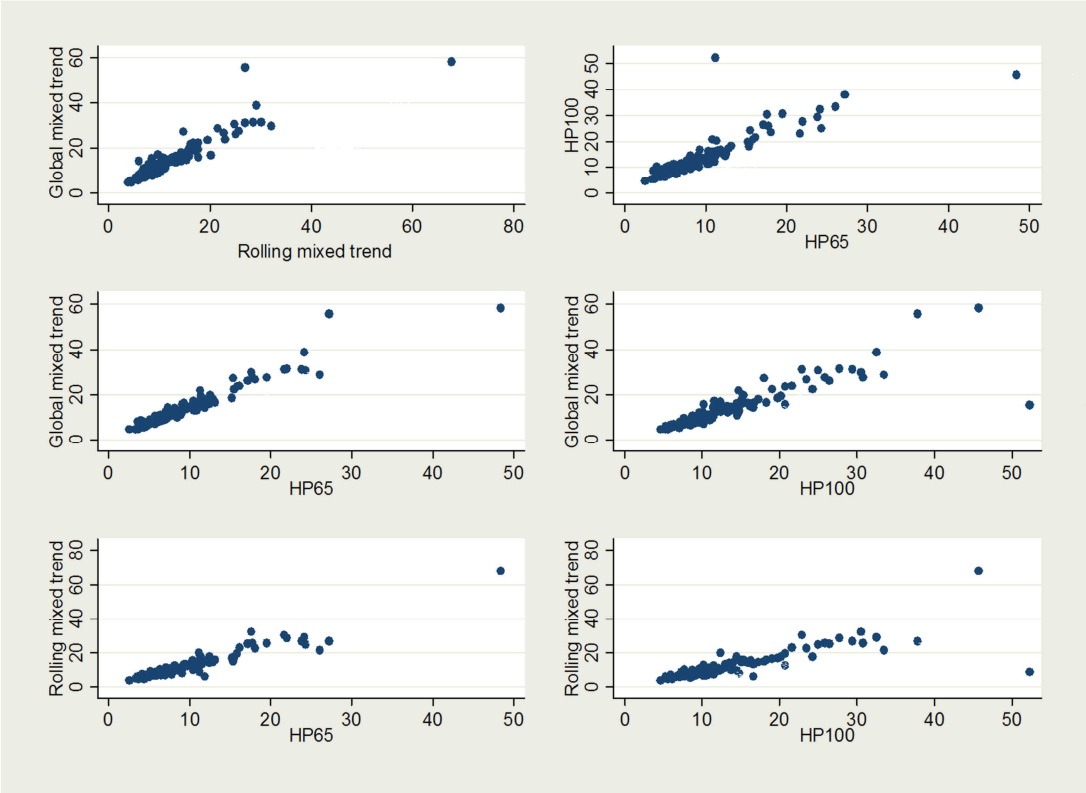
* Significant at 5%. Observations: 134.

Table 2.4. Descriptive statistics of standard deviations of exports around reference values.

	Global mixed trend	Rolling mixed trend	HP 6.5	HP 100
Mean	13.6	11.5	9.2	13.3
Standard deviation	8.7	7.8	6.1	7.8

Observations: 134.

Figure 2.9. Graphical illustrations of correlations between standard deviations of exports around different reference values



4.3. The asymmetry of export fluctuations

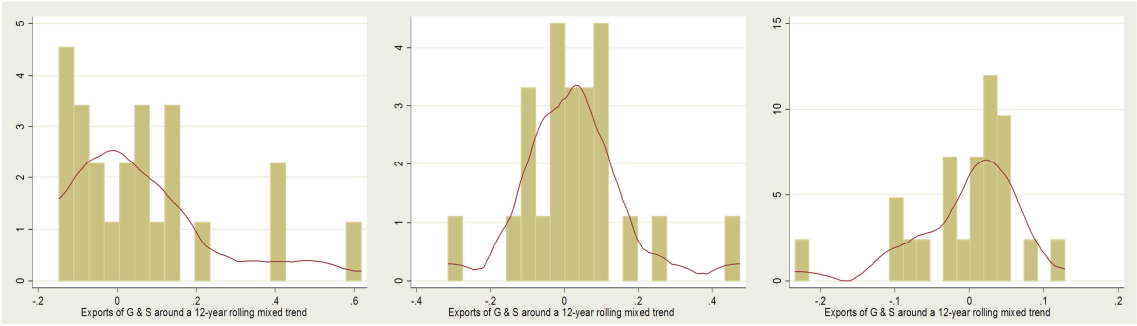
Variance-based indicators of instability do not reflect the effects of the asymmetry of shocks, which is a very important dimension of instability (Wolf, 2005). Considering the asymmetry in fluctuations is justified by the distinction made between agents' responses to adverse and favourable income shocks (Dercon, 2002; Elbers et al., 2007). In this regard, the coefficient of asymmetry in a statistical distribution – or skewness – is an indicator of the relative predominance of adverse or favourable shocks over a given period. A skewness-based indicator of the asymmetry of instability can be calculated as follow (in % of the trend):

$$Skewness = 100 \times \frac{\frac{1}{T}\sum^{T}\left(\frac{y_t - \hat{y}_t}{\hat{y}_t}\right)^3}{\left(\frac{1}{T}\sum^{T}\left(\frac{y_t - \hat{y}_t}{\hat{y}_t}\right)^2\right)^{3/2}} \qquad (2.13)$$

with T= 1, …, t. A symmetrical distribution displays a coefficient of skewness close to 0%. As a result, a distribution with a positive (negative) skewness indicates that export instability is dominated by positive (negative) shocks. We provide a graphical illustration of a positively skewed, a centred, and a negatively skewed distribution of export in figure 2.10. This figure exposes kernel

densities of the distribution of export around a 12-year rolling mixed trend in Argentina, Algeria and Mexico, respectively. Kernel densities show that a positive (negative) skewness increases with the size and/or the frequency of positive (negative) shocks. It can also be noted that the distribution of shocks of two different countries with close standard deviation may exhibit a contrasting asymmetry (see also figure 2.11).

Figure 2.10. Kernel densities of the distribution of exports around a 12-year rolling mixed trend and its corresponding moments in Argentina, Algeria and Mexico.



ARGENTINA
Std. Dev. = 20%
Skewness = 136%
Kurtosis = 433%

ALGERIA
Std. Dev. = 15%
Skewness = 71%
Kurtosis = 502%

MEXICO
Std. Dev. = 7%
Skewness = −125%
Kurtosis = 520%

Table 2.5 and annex 2.E suggest that the coefficients of skewness display important discrepancies between reference values. Indeed, correlations between the skewness based on different trends are weak, except between HP-based measures of skewness. Figure 2.11 plots the standard deviations of exports against the skewness of exports around each reference value. The straight-line correlations obtained for each reference value suggest a fairly weak positive correlation, particularly once certain outliers are excluded.

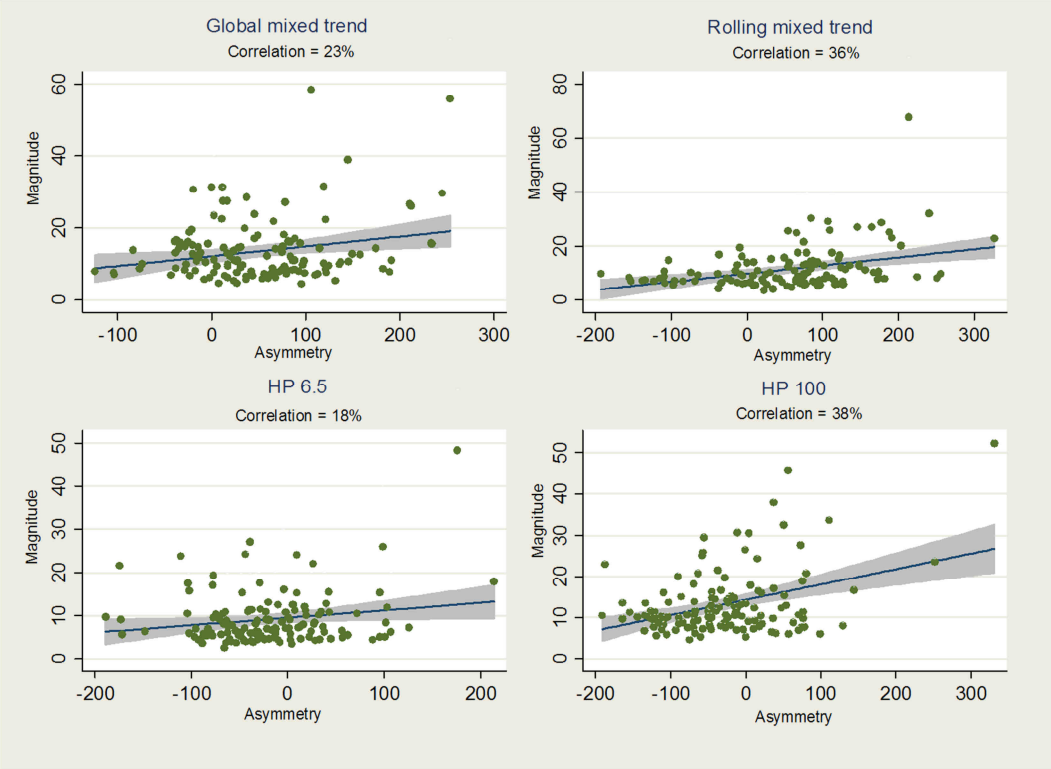
Thus, graphs in figures 2.10 and 2.11, and annex 2.F, stress that for a similar average magnitude of export fluctuations, the asymmetry of shocks may strongly differ. The choice of the reference value is therefore likely to reflect a strikingly different history of shocks.

Table 2.5. Correlations between coefficients of skewness calculated over 1982-2005.

	(1) Global mixed trend	(2) Rolling mixed trend	(3) HP(6.5)	(4) HP(100)
	Skewness calculated over the period 1982-2005			
(1)	1			
(2)	0.23*	1		
(3)	0.08*	0.14*	1	
(4)	0.29*	0.02	0.65*	1

* Significant at 10%. Sample = 134 countries.

Figure 2.11. Correlations between the standard deviation and the skewness of exports, by reference value.



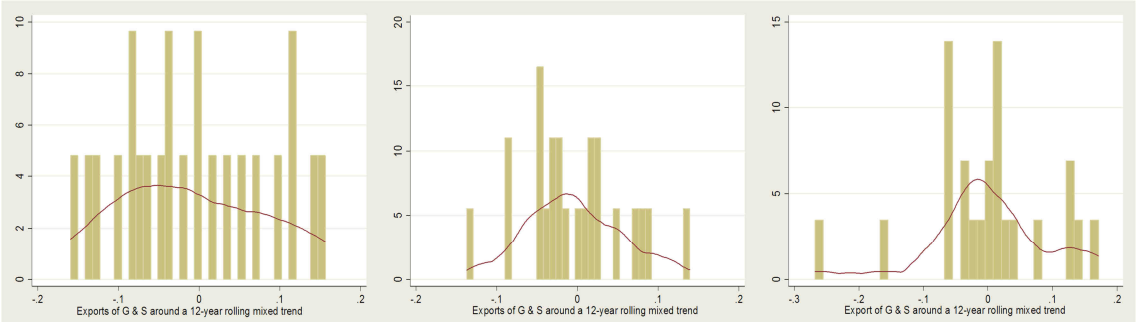
4.4. The occurrence of abrupt export fluctuations

A final dimension of the instability is the likelihood of abrupt deviations in a given statistical distribution. This dimension is measured by the fourth moment of the distribution of observations around their reference value, or the kurtosis. This value is calculated as a percentage of the reference value, as follows:

$$Kurtosis \quad = 100 \times \frac{\frac{1}{T}\sum_{t}\left(\frac{y_t - \hat{y}_t}{\hat{y}_t}\right)^4}{\left(\frac{1}{T}\sum_{t}\left(\frac{y_t - \hat{y}_t}{\hat{y}_t}\right)^2\right)^2} \qquad (2.14)$$

with T= 1, …, t. The kurtosis is a measure of the relative peakedness or tails' fatness of a statistical distribution. It indicates the extent to which the number of observations away from the mean is high compared with observations close to the mean. A low value indicates that the distribution tends to be uniformly distributed around the mean, while a high value indicates a distribution pointed around the mean with thick tails. Figure 2.12 illustrates three types of flattening of distributions of exports around their trend – platykurtic (kurtosis < 300%), mesokurtic (kurtosis = 300%), and leptokurtic (kurtosis > 300%). As shown in this figure, the kurtosis gives an indication of the propensity of a variable to take high values in comparison to values around the trend.

Figure 2.12. Graphical illustrations of a platykurtic, mesokurtic, and leptokurtic distributions of exports around a rolling mixed trend.



INDONESIA
Std. Dev. = 9%
Skewness = 21%
Kurtosis = 195%

FINLAND
Std. Dev. = 6%
Skewness = 23%
Kurtosis = 299%

GAMBIA
Std. Dev. = 9%
Skewness = -58%
Kurtosis = 420%

The risk of kurtosis is seen as a major risk in finance, and on this basis, can be used as a measure of economic instability in its own right. As underlined by Rancière et al. (2008), a high value of kurtosis should be interpreted with caution since it may both "be generated either by extreme events or by a cluster of observations around the mean that affect the peakedness of the distribution" (p.386). They find that about one-fifth of their sample of countries exhibiting high kurtosis was affected by observations in the neighbourhood of the distribution centre. One should hence look carefully at country data or may combine an indicator of kurtosis with an indicator of skewness, to ensure that countries actually experienced sharp asymmetric fluctuations (this approach is carried out in chapter 4).

Table 2.6 shows descriptive statistics for kurtosis-based indicators of instability. Distributions around reference values are on average slightly leptokurtic (higher than 300%). Distributions around the HP filter display in average a similar degree of flattening, but lower than those displayed by distributions around mixed trends. Table 2.7 and annex 2.G show correlations between indicators of kurtosis of distributions around the four reference values. These correlations are slightly stronger than the previous correlations between asymmetry coefficients. The occurrence of large-scale infrequent positive or negative deviations is logically less influenced by the choice of reference value than the asymmetry of fluctuations. However, correlations between rolling mixed trend-based and HP-based kurtoses are weak, suggesting again that the different trend computation methods reflect a pretty different history of shocks, even if these shocks are sharp and infrequent.

Table 2.6. Descriptive statistics of coefficients of kurtosis calculated over 1982-2005.

	Kurt. (global mixed trend)	Kurt. (rolling mixed trend)	Kurt. (HP(6.5))	Kurt. (HP(100))
Mean (%)	352.7	367.9	320.0	312.2
Standard deviation	155.7	173.0	139.0	146.2

Total sample: 134 countries.

Table 2.7. Correlations between coefficients of kurtosis calculated over 1982-2005

	(1) Kurt. (global mixed trend)	(2) Kurt. (rolling mixed trend)	(3) Kurt. (HP(6.5))	(4) Kurt. (HP(100))
(1)	1			
(2)	0.39*	1		
(3)	0.38*	0.28*	1	
(4)	0.49*	0.22*	0.62*	1

*Significant at 5%. Sample = 134 countries.

As suggested by figure 2.13, which illustrates the correlation between standard deviations and kurtoses of distributions around different reference values, the average magnitude of deviations seems quite unrelated to the occurrence of extreme ones. In figure 2.14, we compare scores of asymmetry with scores of kurtosis. A U-shaped relationship can be observed between the two indicators, with a turning point located close to a null skewness. Table 2.8 shows a strong positive correlation between these two indicators when the sample is limited to countries with a positive asymmetry, and a strong negative correlation for countries with a negative asymmetry. Moreover, it appears that high values of kurtosis are often associated with high positive values of skewness. This observation is consistent with a recent work of Bekaert and Popov (2012), who stress that the cross-sectional distribution of volatility is right-skewed, and is particularly true for distributions around mixed trends and the HP(100) filter. For an asymmetry between 0 and 100% in absolute value, these two dimensions of instability are however less related. Therefore, a low coefficient of asymmetry in absolute values refers to small-magnitude high-frequency deviations, while a high value refers to large-magnitude low-frequency deviations. Combining indicators of skewness with indicators of kurtosis may also help sizing country's propensity to experience huge negative or positive external shocks. Chapter 4 gives an illustration of such an empirical approach.

Table 2.8. Correlations between the skewness and the kurtosis of export distributions, by reference value, 1982-2005

	Global mixed trend	Rolling mixed trend	HP (6.5)	HP (100)
Total sample	+0.65*	+0.51*	+0.12*	+0.35*
Positive asymmetry (skewness>0%)	+0.85*	+0.83*	+0.84*	+0.91*
Negative asymmetry (skewness<0%)	-0.58*	-0.48*	-0.70*	-0.45*
Weak asymmetry skewness =[-100%; 100%]	+0.24*	+0.16*	+0.33*	+0.35*

*Significant at 5%. Sample = 134 countries.

Figure 2.13. Graphical illustrations of the correlation between the standard deviation and the kurtosis of export distributions, by reference value

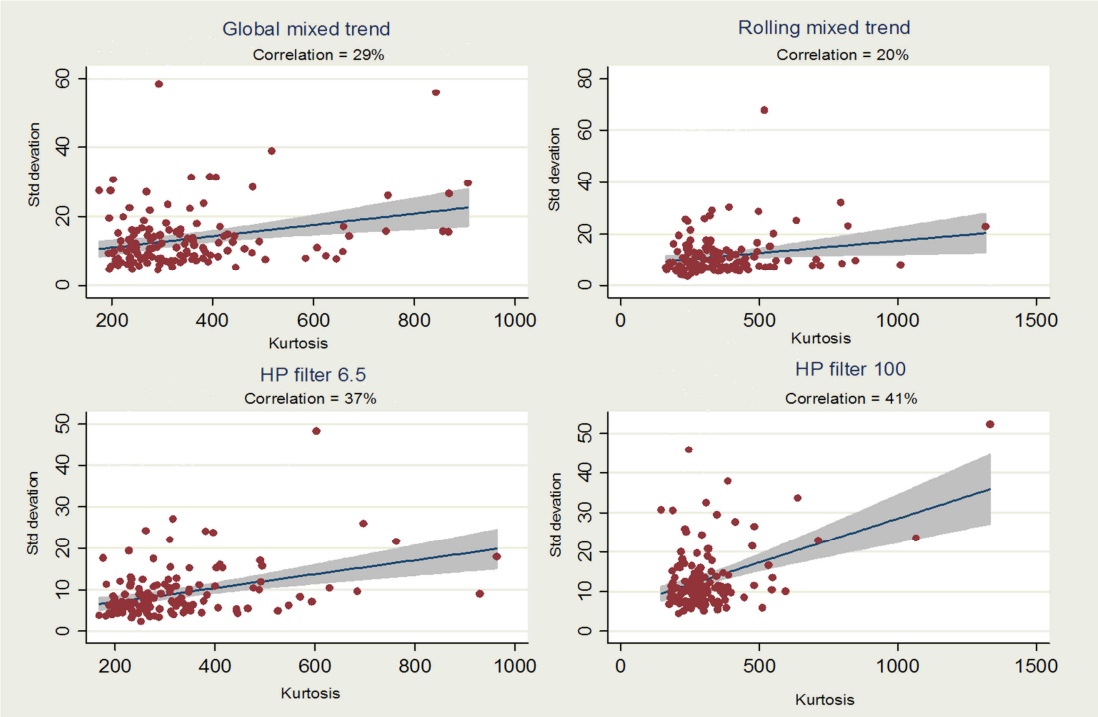
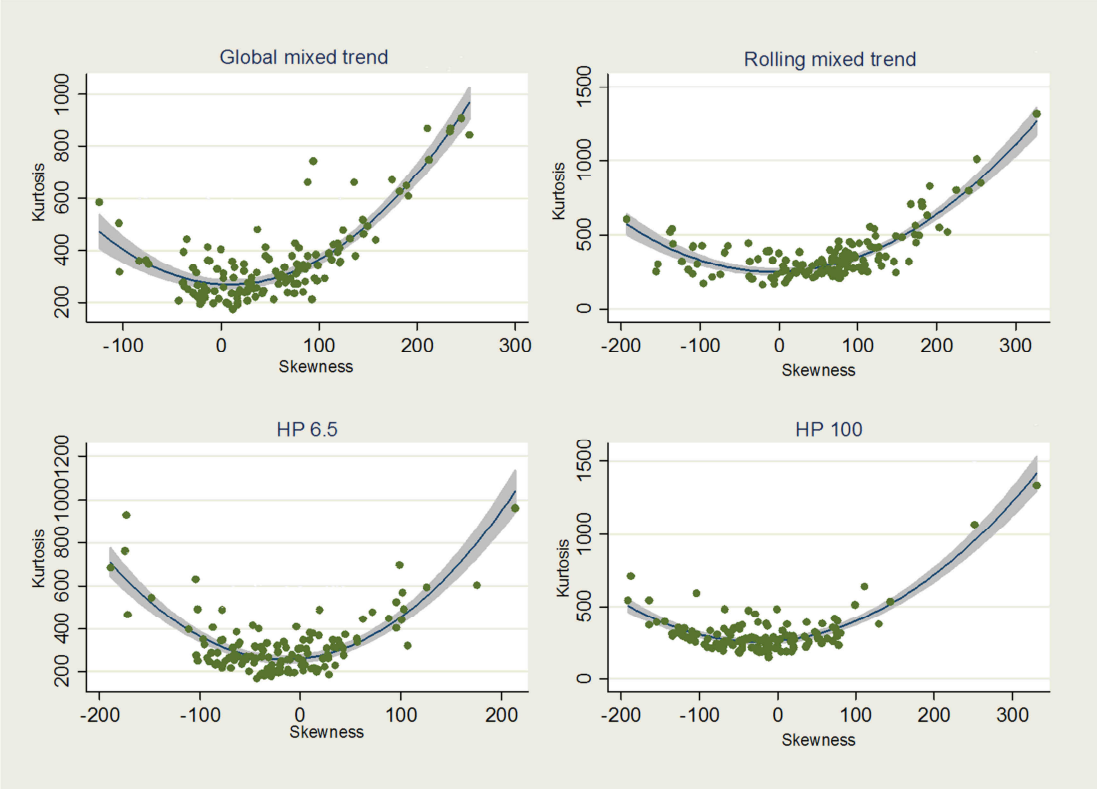


Figure 2.14. Graphical illustrations of the correlation between the skewness and the kurtosis of export distributions, by reference value



5. Conclusion

The literature on macroeconomic instability issues is extensive and uses a great range of instability indicators. Approaches of measuring instability vary according to the choice of the reference value and the way deviations around it are summed. Although, in general, the literature is confined to the study of the causes and consequences of the average magnitude of economic fluctuations, it is worth extending the analysis to the effects of the asymmetry of fluctuations and the occurrence of extreme shocks. In fact, these aspects are separate dimensions of instability but largely overlooked by the economic literature on the subject.

We present four popular trend calculation methods. The parametric approach of computing the trend is reliant on selecting an appropriate functional form. Applied to export revenue data, we set a mixed trend, including a deterministic and a random component, declined in two versions: a "global" mixed trend and a "rolling" mixed trend. In our view and when the data coverage is long enough, we opt for a "rolling" estimated trend rather than a "global" mixed trend, since the former enables estimated coefficients to better account for structural breaks. In another approach, we produced trend values by smoothing time series with statistical filter methods, with a low and a high smoothing parameter. Using filters does not require an *a priori* formalisation of the change in the series. It also offers the advantage of being more sensitive to structural breaks than parametric approaches presented in this chapter.

Each trend computation method is not exempt from misspecification problems. Whether it be the period over which trends are estimated or the value of the smoothing parameter, trade-offs have to be made in accordance with the average trend evolution of the sample of countries. As developing countries are a significant part of our sample, a rolling trend estimated over a 15-20 year period or a smoothing parameter set between 6 and 10 initially seemed appropriate, since the trend component in these countries is found to be more volatile than in developed countries.

The parametric and the filter approaches are however conceptually different and are designed for different purposes. On the one hand, the HP filter is a two-sided filter often used for identifying business cycles and relating them to macroeconomic policy outcomes and long-run properties of developed and developing economies, with the underlying assumption of rational expectations of economic agents. On the other hand, parametric approaches of computing the trend are popular among macro and microeconomic studies on the effects of risk on economic agents' production and consumption decisions, and rather rely on the hypothesis of extrapolative or adaptive expectations.

As indicators of instability intend to reflect a history of current and past shocks, we set out various options for summing deviations from the trend. On the basis of previous trend calculation methods, we compute indicators of instability for the magnitude, the asymmetry and the occurrence of extreme fluctuations. First, results show that indicators of the magnitude of export instability, measured by the standard deviation of exports, are strongly correlated with each other. Second, we find low correlations between indicators of the asymmetry of fluctuations, measured by the skewness of exports around their trend, and between indicators of the occurrence of extreme deviations, measured by the kurtosis of exports around their trend. Third, whatever the trend calculation method, the average magnitude of instability is found to be unrelated to its asymmetry and to the occurrence of extreme deviations. And fourth, whatever the trend calculation method, the asymmetry of instability is found to be strongly driven by the occurrence of extreme events. Thus, the coefficient of asymmetry seems particularly interesting because of its bi-dimensional nature. Not only does it express the degree of asymmetry of fluctuations around a trend over a given period, but it also reflects the frequency and size of fluctuations.

Chapter 3

Building a Retrospective Economic Vulnerability Index[62]

Construction and analysis of annual series

1. Introduction

The dramatic financial collapses that occurred in Asian countries at the end of the 90's, along with the many socio-political conflicts that undermine growth rates in low-income countries, or the occurrence of huge climatic phenomenon affecting recurrently small island developing states in the Caribe and in the Pacific, raise the global concern for the vulnerability of developing states and citizens to economic, socio-political and climatic shocks (Guillaumont and Simonet, 2011; Guillaumont, 2009ab). The need for international specific support to vulnerable countries has been expressed by the 1971 UN general assembly, which lead to the creation of criteria for the identification of two groups of vulnerable countries, namely the Least-Developed Countries (LDCs) and the Small Island Developing States (SIDS). In 2000, an index of structural economic vulnerability, the Economic Vulnerability Index (EVI), has been calculated and considered by the United Nations Committee for Development Policy (UNCDP) as an additional criterion along with the GNI per capita and the human capital level (measured by the Human Asset Index) for the identification of least developed countries (Guillaumont, 2009a). The structural economic vulnerability of countries, defined as the country likelihood of seeing its economic development process hindered by external trade-related shocks or domestic environmental/natural shocks, is indeed of interest as it results from factors independent of political will and policy (Guillaumont,

[62] This chapter is based on a 2011 research working paper of the Foundation for Researches and Studies on International Development. It uses definitions of the Economic Vulnerability Index which are prior to the revisions made for the 2012 review of the United Nations Committee for Development Policy.

2009ab). Since then, the EVI has been revised for the 2003, 2006, 2009, and 2012 triennial reviews of the UNCDP.

Economic vulnerability results from three main determinants: the size and likelihood of shocks, the exposure to these shocks, and the resilience or the capacity for reacting to them (Guillaumont, 2009). While the two former determinants mostly depend on country structural features (geographic localization, human capital, economic diversification, and so on), resilience rather relies on country policy responses to shocks. Therefore, structural economic vulnerability differs from policy-related vulnerability arising from state or financial fragility, in that it results from exogenous factors that are independent from the quality of governance. The emphasis placed on developing countries' structural vulnerability is justified by the need for long run aid allocation criteria, which should not depend on transitory features such as economic policy. As stressed by Guillaumont (2009b, p.195),

> "if a vulnerability index is to be used in selecting certain countries for the allocation of long-term support by the international community, what needs to be measured is, naturally, the structural vulnerability, which essentially results from the size of the shocks that can arise from a country's exposure to them".

The EVI is a country-level synthetic index of *the magnitude* of shocks and *exposure* to them (UNCDP, 2008). An index of the magnitude of shocks is computed, considering two main categories of shocks. First, the shock index intends to capture the effects of *domestic natural shocks*, including natural disasters – such as earthquakes or tsunamis – and climatic shocks – such as droughts, floods, or typhoons. Other domestic shocks like civil wars, political and social instabilities are not taken into account since they are at least partly endogenous. Second, the shock index also accounts for the effects of *external shocks*, which are related to trade and exchange, such as international commodity price instability, slumps in external demand, or fluctuations in world interest rates. As for the exposure to shocks, we compute an index which is negatively related to country size, positively related to country degree of specialisation in primary commodities, and positively related to country remoteness from world markets (Guillaumont, 2009ab).

The EVI is an index between 0 and 100, a high score corresponding to a high level of vulnerability, and *vice versa*. UNCDP triennial reviews, available at the United Nations Department of Social and Economic Affairs (UNDESA) website[63], provide vulnerability scores for 130 developing countries (in the 2009 review). However, these triennial reviews proposed by the CDP since 2000 do not allow intertemporal comparisons. In fact, three major changes in the calculation method have been

[63] In the UNCDP 2012 review, definitions and components of the EVI have been refined. As the work carried out in this chapter was prior to this review, recent adjustments in the EVI calculation have not been yet taken into account. Annex 3.E reports the new EVI definitions published on the UNDESA-CDP website.

made: i) between the 2000 and 2006/09 reviews, the EVI switched from a simple arithmetic average of five components to a weighted average of seven components; ii) two additional components have been included since the 2000 review, namely the share of homeless due to natural disaster in the population and remoteness from world markets; and iii) the share of manufacturing goods and modern services in GDP has been replaced by the share of agriculture, forestry and fisheries in GDP. Last but not least, components have not been revised in a way that enables comparisons of scores over time.

As a consequence, triennial reviews do not allow an assessment of progresses made by countries regarding their structural vulnerability. The CERDI/FERDI, in collaboration with the UN Department of Economic and Social Affairs, already attempted to calculate five-year and ten-year retrospective series of the EVI. The retrospective EVI database presented in this chapter goes further by providing annual scores from 1975 to 2008, consistent with the purpose of giving researchers and policy makers the opportunity to make cross-section and/or intertemporal comparisons. When calculating this retrospective data, we tried to follow as close as possible the method of the UNCDP 2009 review, detailed in the UNCDP (2008) Handbook on the least Developed Country Category. This chapter presents the method employed to construct the annual retrospective EVI, compares retrospective scores with scores of the UNCDP 2009 review, and exposes the main findings and trends of the retrospective series by country category.

2. Definitions and general principles of calculation

The retrospective EVI is a weighted average of seven indicators (or components), gathered into five sub-indexes (size, specialisation, location, trade shocks and natural shocks) among which are two shock sub-indexes (natural and trade shocks) and three exposure sub-indexes (size, specialization, location). The EVI, as calculated by the UNCDP 2009 review (UNCDP, 2008), results from the simple arithmetic average of:

- *The size and likelihood of shocks*, which is a weighted average of the annual mean share of homeless due to natural disasters in the population (25%), the instability in the agricultural production (25%), and the instability in exports of goods and services (50%).
- *The exposure index*, which is a weighted average of the population size (50%), the remoteness from world markets (25%), export concentration (12.5%), and the share of agriculture, forestry and fishery in GDP (12.5%).

Table 3.1 below connects components, sub-indexes and indexes to their related data sources.

Table 3.1. Indexes, sub-indexes, and components of the retrospective EVI

Components	Data sources	Sub-indexes	Indexes
Population (in log)	World Bank (except Afghanistan, for which the United Nations data has been used)	Size	EXPOSURE
Share of agriculture, forestry and fisheries in GDP. Export concentration	United Nations Statistics Division, United Nations National Accounts Main Aggregates Database UN Conference on Trade and development	Specialisation	
Remoteness from main world markets, adjusted for landlockness	CERDI (exports of goods in current dollars, World Development Indicators)	Location	
Instability of exports receipts	CERDI (deflated exports of goods and services, United Nations).	Trade shocks	SHOCKS
Instability of agricultural production Homeless due to natural disasters	Food and Agriculture Organization, United Nations Emergency Disasters Database (EM-DAT) – WHO in collaboration with the Centre for Research on the Epidemiology of Disasters (CRED) –, and the World Bank – World Development Indicators database.	Natural shocks	

2.1. The exposure to shocks

The country exposure to shocks is an important dimension of economic vulnerability because, first, the impact of shocks is all the more important when country exposure to shocks is strong, and, second, the exposure to shocks also reflects the likelihood for a country to be harmed by future shocks. Following the UNCDP 2009 review, the exposure index comprises the following indicators:

- *Population size*: because countries with small population size are more likely to be open to international trade, which in turn increases their exposure to trade shocks.
- *Merchandise export concentration*: because when countries export a limited number of goods, the impact and likelihood of trade shocks are expected to be higher.
- The *share of agriculture, forestry and fisheries in GDP*: because countries depending on those sectors are more vulnerable to climatic shocks and international commodity price fluctuations.
- *Remoteness from main world markets*: while being a structural handicap to growth and poverty reduction, remoteness from world markets particularly explains a greater exposure to trade and natural shocks.

2.2. The size of internal and external shocks

The shock index reflects the average magnitude of domestic (internal) and trade-related (external) shocks experienced by developing countries. It consists of one sub-index reflecting the importance of climatic and other natural shocks – *the climatic or natural shock index* – and another sub-index reflecting the importance of trade or export fluctuations – *the trade shock index*.

Climatic shocks and other natural shocks – earthquakes, hurricanes, tsunamis, droughts, floods, etc. – represent an important source of vulnerability in many developing countries. Natural or climatic shocks are proxied by two variables: the annual mean share of homeless due to natural disasters in the population, and the instability in the agricultural production.

Trade shocks are proxied by the instability in exports of goods and services, which reflects exogenous trade-related events such as slumps in external demand, or domestic events independent from economic policy, such as climatic shocks (Guillaumont, 2009ab).

2.3. Normalization of components

EVI scores, as well as those of its components, are normalized through the *min-max* procedure. It ranges original data from 0 to 100, where 0 and 100 are the normalized values for minimum and maximum values actually observed in our sample of countries. However, upper and lower time-invariant boundaries have been imposed to the distributions, in order to prevent from possible distortions produced by distributions containing outliers or presenting excess kurtosis. Applying this procedure yields index values that are comparable over time. Each normalized component contributes positively to vulnerability (the closer to 100 the index, the more vulnerable the country).

2.3.1. The min-max procedure

Except for the *population size*, all other variables behind the calculation of EVI components contribute positively to structural vulnerability. For these variables, the *min-max* procedure consists in applying the following formula:

$$I = [(\mathbf{Value}\text{-}Min)/(Max\text{-}Min)] \times 100.$$

Population size, which is negatively related to vulnerability, is normalized through the following operation:

$$II = [(Max\text{-}\mathbf{Value})/(Max\text{-}Min)] \times 100 \quad \text{or} \quad II = 100 - I$$

2.3.2. Lower and upper boundaries

Table 3.2 exposes lower and upper boundaries used to normalize values of each component. These limits are the same as those used by the UNCDP in its 2009 review, except for the *homeless*

component. Indeed, the *homeless* component has been computed on a yearly basis in our retrospective series, while homeless in the UNCDP 2009 review is based on the cumulative sum of homelessness over 1990-2004.[64] Thus, we had to modify boundaries used by the UNCDP so that they fit with annual retrospective data, dividing them by the number of years from 1990 to 2004, i.e. 15 years. Section 3 provides further details on the way components have been computed.

Table 3.2. Boundaries used for normalization

Variables/components	Lower boundary	Upper boundary
Population	150 000	100 000 000
Remoteness	0.100	0.900
Export concentration	0.100	0.950
Share of agriculture, forestry, and fisheries in GDP (%)	0	60.00
Homeless due to natural disasters (annual mean % of the population)	0.0001	1.3
Instability in the agricultural production	1.50	20.00
Export instability	3.00	35.00

2.4. Averaging of EVI components

Following the UNCDP 2009 review, the EVI is a simple arithmetic average of exposure and shock indexes:

$$EVI = 0,5 \text{ x } Exposure + 0,5 \text{ x } Shock.$$

Exposure Index is the weighted average of the following sub-indexes:

$$Exposure = 0,5 \text{ x } Size + 0,25 \text{ x } Location + 0,25 \text{ x } Specialization.$$

… and the specialization sub-index the simple arithmetic average of the following components:

$$Specialization = 0,5 \text{ x } Export\ concentration + 0,5 \text{ x } Share\ of\ agriculture,\ forestry,\ fisheries\ in\ GDP.$$

The shock index is the arithmetic average of natural shock and trade shock sub-indexes…

$$Shock = 0,5 \text{ x } Natural\ shock + 0,5 \text{ x } Trade\ shock$$

[64] See United Nations, *Handbook on the Least Developed Country Category : Inclusion, Graduation and Special Support Measures*, Committee for Policy Development and United Nations Department of Economic and Social Affairs, Novembre 2008, p. 53.

… and the natural shock sub-index the arithmetic average of homeless and instability in the agricultural production components:

Natural shock = 0,5 x *Homeless* + *0,5* x *Instability in the agricultural production*

The EVI's architecture is represented in figure 3.1 below. When aggregating weights of each component, export instability represents 25% of the EVI, the homeless and instability in the agricultural production components both represent 12.5%, the size of population 25%, remoteness from world markets 12.5%, export concentration and the share of agriculture in GDP 6.25% (see box No.6 for a discussion of an alternative averaging method). Given that component scores are between 0 and 100 and that the sum of their weight equals 1, the EVI is between 0 and 100, a high score corresponding to a high level of vulnerability.

Box No.6. An alternative averaging method, reflecting the interaction between shocks and the exposure to them

The traditional arithmetic averaging, followed by the UNCDP, presupposes that indexes, sub-indexes, and components of the EVI are substitutes. Guillaumont (2009a) proposes alternative approaches of averaging EVI's components, reflecting different interactions between and within shock and exposure indexes and their components.

It is possible to perform a semi-geometric averaging, combining the geometric average of the two shock and exposure index with the arithmetic average of their respective components. The geometric averaging of the shock and exposure indexes supposes that they have multiplicative effects. In fact, the impact of increased size/frequency of shocks is higher in more exposed countries, while the effect of an increased exposure is higher the more important/frequent shocks are. By contrast, the arithmetic averaging of sub-indexes and their sub-components suggest they remain substitutable between each other. The geometric average consists in giving more weight to whichever of the two indexes is the lower, i.e.

$$\text{EVI} = \sqrt{\text{Exposure} \times \text{shock}},$$

or giving more weight to whichever of the two indexes is the higher, i.e.

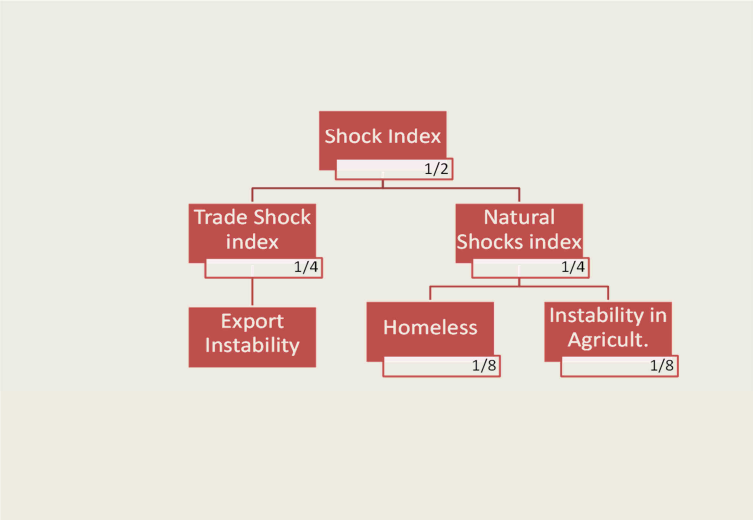
$$\text{EVI} = 1 - \sqrt{(1 - \text{Exposure}) \times (1 - \text{shock})}$$

The second solution is interesting when one wants to capture the huge impact of infrequent and abrupt shocks, such as Tsunami, in countries which are usually not exposed to these events. Other alternative averaging methods are further presented and discussed in Guillaumont (2009a).

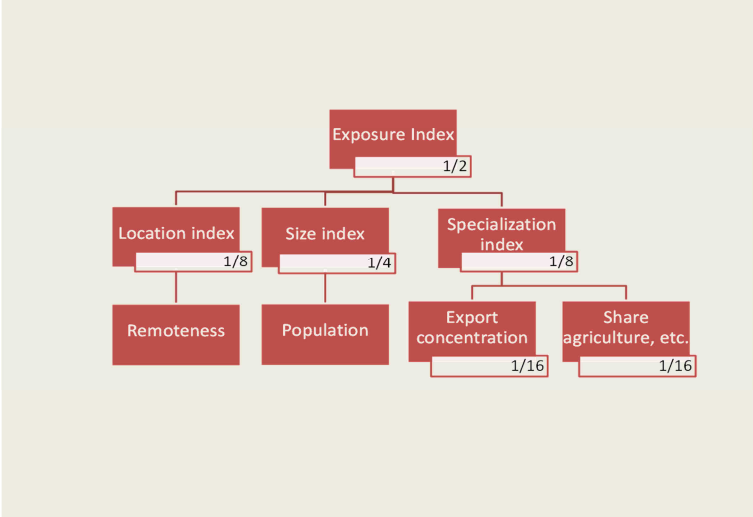
Source: Guillaumont, P, *Caught in a Trap*, Economica, 2009, p.201-205.

Figure 3.1. EVI averaging method

i) shock index's components (and their corresponding weights)



ii) exposure index's components (and their corresponding weights)



3. Calculation of the retrospective EVI

The calculation of the retrospective EVI consists in combining contemporaneous values (at time *t*) of each component following the averaging method explained in sub-section 2.4. Obtaining retrospective and annual series however requires making some adjustments vis-à-vis UNCDP calculation principles.

We built series covering 128 developing countries over 1975-2008. The sample is similar to that of the UNCDP 2009 review, except for two countries that have been removed, namely Israel and Brunei, because of their high level of GDP *per capita*. The sample includes 49 Least Developed Countries (LDCs) and 63 Low Income Countries (LICs). The classification of LDCs corresponds to the list of LDCs established by the United Nations in 2007 (excluding Cap Verde from the list), while LICs have been identified according to the World Bank income group classification. In what follows we consider all countries presently LICs or formerly LICs between 1987 and 2009 as LICs. Moreover, we excluded Papua New Guinea and Zimbabwe from the "non LDCs" category because they have been eligible for their inclusion in the LDCs category (but refused it in 2006 and 2009, respectively).

We explain in detail the calculation of each variable below. Annex 3.A provides a list of countries included in our sample and their corresponding country category (LICs or LDCs). Country EVI scores of LDCs are presented in annex 3.C.vii). EVI scores for the entire sample of countries are presented in annex 3.D, and ordered by decreasing ranking difference between scores of retrospective series and scores of the UNCDP 2009 review. Averages by country income group are presented in section 4.2 (and in Annex 3.C).

3.1. Population size

We did not encounter difficulties with the computation of this component as annual raw data from the WDI database are available for the entire sample. For Afghanistan, data prior to 1990 are World Bank's, while data posterior to 1990 are United Nations'. Population size is then expressed in logarithm and normalized using the inversed *min-max* procedure with the corresponding boundaries presented in table 2.

3.2. Remoteness from world markets, adjusted for landlockness

The remoteness component is the trade weighted average distance from world markets. Two sets of data are required: the bilateral distance (in kilometres) between the country and world main's exporters, and the share of each world exporter in total world exports. Then, trade-weighted bilateral distances are summed up until the cumulative share of exports of all possible combination

of these trade partners reaches 33% of the world markets (the UNCDP established a threshold of 50% in the 2009 review). It is then minimized according the following formula:

$$\textit{Distance from world markets} = \text{Min} \sum_{j=1}^{k} Dij * \frac{Xj}{Xwld} \qquad (3.1a)$$

With the country *i* and the trade partner *j*, *k* the combination of trade partners allowing to reach 33% of the world market with a minimal distance, D_{ij} the bilateral distance between country *i* and partner *j*, and X_j and X_{wld} total exports of trading partner j and total world exports, respectively.

Beyond the proper effect of distance, *landlockness* is another structural handicap, which is often associated with increased barriers to trade and higher transport costs, for a given distance to the world markets. *Distance* has hence been adjusted for this additional handicap by applying an adjustment coefficient of 15% for landlocked countries. Thus, the remoteness component finally consists in applying the formula:

$$\textit{Remoteness} = [0{,}85*\ln D + 0{,}15*L] \qquad (3.1b)$$

With *D* the normalized *Distance from world markets* (min-max procedure), and *L* a dummy variable indicating whether the country is landlocked (L=1) or not (L=0). The remoteness index is available from 1975 to 2007 on an annual basis. In 2008, we used data of 2007.

It worth mentioning that data were missing in the following countries: Kiribati, Maldives, St Kitts & Nevis, Timor Leste, Tonga, Tuvalu and Vanuatu. We therefore fill in missing data by copying remoteness scores of relevant neighboring countries. Thus, missing data from:

- Kiribati, Tuvalu, and Vanuatu equals data from Salomon Islands;
- Maldives equals data from Sri Lanka;
- St Kitts and Nevis equals data from Antigua and Barbuda;
- Timor Leste equals data from Indonesia;
- Tonga equals data from Samoa.

3.3. Merchandise export concentration index

The export concentration index is derived from the Herfindhal index applied to exports of merchandises (excluding services) as categorised by the three-digit level of the Standard International Trade Classification (SITC). This index is between 0 and 1, a high level of concentration being associated with a score close to 1. A country exporting only one product would score 1 according to this index. The derived Herfindhal Index formula is the following:

$$H_j = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{x_i}{X_j}\right)^2} - \sqrt{1/n}}{1 - \sqrt{1/n}} \qquad (3.2a)$$

Where *j* is the country index, x_i is the value of exports of commodity *i*, X_j the total exports of country *j*, and *n* the number of products at the three-digit SITC level. The index is then normalized using the min-max procedure with the bounds specified in table 2.

In 1971, 1977, 1978 and 1979, data is missing for the entire sample. Gaps have been filled using a centered moving average of the closest past and future available data:

$$Concent\_1_t = (concentration_{t-k} + concentration_{t+k})/2 \qquad (3.2b)$$

k is set according to the availability of previous and future data. For instance, in 1971, interpolated data is the average of 1970 and 1972. In 1977, data is the average of 1976 and 1978; in 1978, data is the average of 1976 and 1980; and in 1979, we averaged data from 1978 and 1980.

When missing data is dispersed, two additional methods have been applied:

- Data is copied from previous (t-k) or later (t+k) available data.

$$Concent\_2_t = Concentration_{t-/+k} \qquad (3.2c)$$

- Data is interpolated by adding to the last available observation a variation corresponding to the difference between this last observation (*t-p*) and the next one (*t+q*), weighted by the ratio of the number of years passed since the last observation over the total number of years between the last and the next observations:

$$Concent\_3_t = concentration_{t-p} + [(p+1)/(p+q+1)] * (concentration_{t+q} - concentration_{t-p}) \qquad (3.2d)$$

Finally, even after these procedures, data is still missing in 2007 and/or 2008 for the following countries: Vanuatu, Tuvalu, Tonga, Timor Leste, Somalia, Salomon Island, Sierra Leone, Mauritania, Lesotho, Kiribati, Iraq, Dominica, Djibouti, Comoros, Chad, Bahrain, and Afghanistan. To address this issue, we extrapolated missing data using the annual mean growth rate of country export concentration index between 1975 and 2006/2007.

3.4. Share of agriculture, forestry and fisheries in GDP

Raw data has been retrieved from the United Nations National Accounts Main Aggregates Database. The *min-max* procedure with the bounds specified in table 2 has then been applied to the data.

For Timor Leste, the value in 1995 has been applied to previous years from 1975 to 1994; while for Yemen, values from 1975 to 1988 are the weighted averages of the two Yemen values.

3.5. Homeless due to natural disasters

The construction of the *homeless* component required to adapt the method of the UNCDP in a manner that we obtain annual data and fill in missing data for a large number of countries. Raw data is gathered from various databases (Emergency Disasters Database (EM-DAT) – WHO in collaboration with the Centre for Research on the Epidemiology of Disasters (CRED) –, and the World Bank – World Development Indicators database) and covers 1970-2008. In some countries data is missing over the whole period, while in other countries data is missing for a few years, which again imposed making some extrapolations.

In the UNCDP 2009 review, the *homeless* component is the cumulative sum of homelessness from 1990-2007, divided by the national population during the middle of the period (1998/99). In order to obtain annual series, we computed, for each year, the cumulative annual mean share of homelessness in the population.

First, we computed the cumulated yearly-averaged number of homeless for each year. For instance, in 1979, we added up the number of homeless people from 1970 to 1979 and divided it by the number of years since 1970, i.e. 10 years. In 1980, we added up the number of homeless people from 1970 to 1980 and divided it by the number of years since 1970, i.e. 11 years, and so on. We then computed each year the ratio between the yearly-averaged number of homeless and the annual population size. The resulting *annual mean share of homeless in the population* was then expressed in logarithm and normalized through the min-max procedure (using boundaries presented in table 2).

To summarize, the construction of an annual retrospective homeless component consists in applying the following formula:

$$Homeless_{1970+k} = \min \max \left[\log \left(100 \times \left(\frac{\sum_{1970}^{1970+k} Homeless \Big/ k+1}{population_{1970+k}} \right) \right) \right] \qquad (3.3)$$

For countries with missing data over the whole period, we followed three distinct procedures to approximate it.

3.5.1. First procedure

We predicted missing data by an Ordinary Least Square regression of the logarithm of the annual mean share of homeless in the population over the annual mean share of *people affected by natural*

disasters in the population of neighbouring countries. Estimates were then used to extrapolate homeless data from data on people affected by natural disasters:

- For **Equatorial Guinea**, relevant chosen neighbouring countries are Cameroon, Central African Republic, the Republic of Congo, Nigeria, and the Democratic Republic of Congo.
- **For Timor Leste** relevant chosen neighbouring countries are Indonesia, Malaysia, Papua New Guinea, the Philippines, and Thailand.

Estimates are reported in Annex 3.B.

3.5.2. Second procedure

We extrapolated missing data by averaging neighbouring countries' annual mean share of homeless in the population:

- For **Cote d'Ivoire**, we averaged values from Burkina Faso, Liberia, and Mali.
- For **Libya**, we averaged values from Algeria, Tunisia, Egypt, and Chad.
- For **Grenada**, we averaged values from Trinidad-and-Tobago, St. Lucie, St Vincent, Dominica, Antigua-and-Barbuda, and Barbados.
- For **Gabon**, we averaged values from the Republic of Congo and Cameroon.

3.5.3. Third procedure

We replaced missing data by the annual mean share of homeless in the population of a relevant neighbouring country.

- For **Singapore**, the data was taken from Malaysia;
- For **Sierra Leone**, the data was taken from Cameroon;
- For **Surinam**, the data was taken from Guyana.

3.6. Instabilities in exports receipts and agricultural production

Raw data on exports of goods and services (deflated by the import unit value index in developing countries) and agricultural production (net PIN base 1999-2001 in dollars) have been retrieved from United Nations National accounts and Food and Agriculture Organization, respectively.

Following the parametric approach presented in chapter 2, the measurement of instability consists in averaging deviations of the observed value of export proceeds from their trend, estimated over a finite time interval. For these retrospective series of EVI, we follow the general principles governing the calculation of instability in the UNCDP 2009 review: (i) the reference value is a

mixed trend (deterministic and stochastic) estimated over a period specified below, (ii) instability indicators are measured as the standard deviation of the prediction error calculated over the same period. However, instabilities calculated for the retrospective EVI differ from those of the UNCDP 2009 review, in that the retrospective (and annual) nature of series constrained us to compute standard deviations on a rolling basis, and over a shorter period than the UNCDP does.

Thus,

- in regard to **the instability in the agricultural production**: while the UNCDP chose a 16-year period (1990-2005), we chose a rolling 15-year period to compute standard deviations, i.e. a period covering the current year and the 14 previous years[65];
- in regard to **the instability in exports of goods and services**: while the UNCDP chose a 28-year period, we proceeded in the same way as we did for instability in the agricultural production by choosing a rolling 15-year period.

Regarding trends estimation, we apply the formula described in chapter 2, which consists in estimating a mixed trend, including a deterministic component and a stochastic component:

$$Log\ \hat{Y}_{t_t}^{T} = \hat{\alpha}^{T} + \hat{\beta}^{T}.\log Y_{t-1} + \hat{\gamma}^{T}.t \qquad (3.4a)$$

with Y the export receipts or agricultural production variable, *t* the deterministic trend, and T the period of estimation. Trend values are estimated over the current and last 14 years, that is, $T = (t\text{-}14;\ t)$. Predictions of $log\ y_t$ are then rescaled using an exponential transformation. The indicator of instability is the 15-year standard deviation of the prediction error in per cent of the trend:

$$Instab_t = 100 \times \sqrt{\frac{1}{T}\sum^{T}\left(\frac{y_t - \hat{y}_t}{\hat{y}_t}\right)^2} \quad with\ T = [t;\ t\text{-}14] \qquad (3.4b)$$

To sum up, the construction of an annual retrospective EVI involved to make marginal adjustments from the UNCDP 2009 review, concerning the calculation of four (among seven) components of the EVI. Regarding the *remoteness* component, the share of world market has been modified and established at 33% of world exports (while 50% in the UNCDP last review). Regarding the *homeless* component, the annual mean share of homeless in the population replaced the share of homeless in the population cumulated from 1990 to 2007. Thus, an annual averaging has been preferred to an 18 year-based averaging. Regarding instability components, we chose to compute instabilities in exports and agricultural production over the same reference period, 15

[65] As a consequence, computing instability in 1975 requires raw data starting in 1961, which is actually the case for a limited number of countries.

years, instead of two longer but different periods in the UNCDP review.[66] These changes explain why retrospective EVI scores may in certain cases slightly differ from those of the UNCDP review. We provide in the next section further insights into the way the retrospective EVI behaves, first by comparing 2006 scores with respect to those of the UNCDP 2009 review, and then by analysing its retrospective evolution by country category.

4. Statistical highlights

In this section, we propose a comparative analysis of retrospective EVI scores in 2006 and scores of the UNCDP 2009 review. We also analyse main trends taken by the retrospective EVI and its components, in developing countries and different categories of developing countries. Further empirical highlights are provided in Annexes 3.C and 3.D.

4.1. Comparing retrospective EVI scores with those of the UNCDP 2009 Review

We compare scores and rankings of the retrospective EVI in 2006 with those of the UNCDP 2009 review, in order to check the validity of our methodology and to identify sources of divergences between these two databases. We chose the year 2006 as benchmark because periods of computing components of the 2006 retrospective EVI are the closest to those of UNCDP 2009 review. As a reminder, we expect the following variables to show the most noticeable differences:

Exposure index:

- *Remoteness from world markets*: in the UNCDP 2009 review, the share of world market is set at 50%, while in the retrospective series this share is set at 33%.

Shock index:

- *Homeless due to natural disasters*: in the UNCDP 2009 review, homelessness has been added over the 1990-2007 period and weighted by national population in 1998/1999. In the retrospective series, we computed each year the annual mean share of homelessness in the population.

- *Instability in the agricultural production*: in the UNCDP 2009 review, the period chosen to compute instability in agricultural production starts in 1990 and ends in 2005, while in the 2006 retrospective EVI, the instability in the agricultural production has been calculated over the 1992-2006 period. Given the proximity between the periods chosen, very few differences are expected.

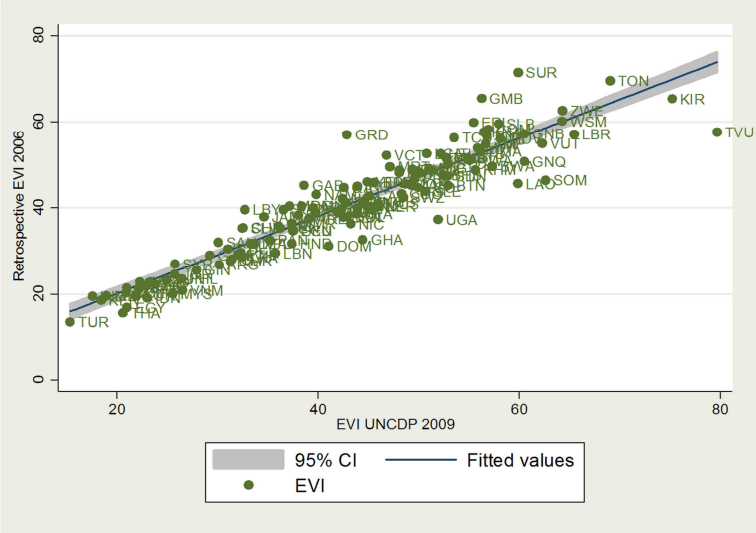
[66] 16 and 28 years for these two instabilities respectively.

- *Instability in export earnings*: in the UNCDP 2009 review, the period chosen to compute instability in exports covers 1980-2007, while in the 2006 retrospective EVI, it has been calculated from 1992-2006.

Thus, the main causes of divergences between these two versions of EVI should be the "Homeless" and "Instability in exports" components. Figure 3.2 plots scores of vulnerability provided by the UNCDP 2009 review (*x* axis) against those of the retrospective EVI in 2006 (*y* axis). This figure shows a strong positive and significant correlation between the two versions of the EVI, confirmed by a 94% rank correlation.

Figure 3.2. Correlation between the EVI-UNCDP 2009 and the 2006 retrospective EVI

Rank correlation = 94%



Nevertheless, discrepancies between the two EVI arise at high levels of vulnerability. Figure 3.3 shows that these divergences between the two versions of EVI are mainly explained by differences in shock index scores (rank correlation of 83%). Figure 3.4 compares scores between each component of shock indexes. As stressed earlier, the "homeless" and "exports instability" components are the main sources of divergence between the retrospective EVI and the UNCDP 2009 review, with rank correlations of 68% and 85% respectively. However, the graph plotting scores of "homeless" shows a *de facto* stronger correlation between the two databases than fitted values suggest. Indeed, the strength and the significance of the correlation appears to be understated since the new retrospective "homeless" indicator gives scores higher than 0 for various countries which had null scores in the UNCDP 2009 review.

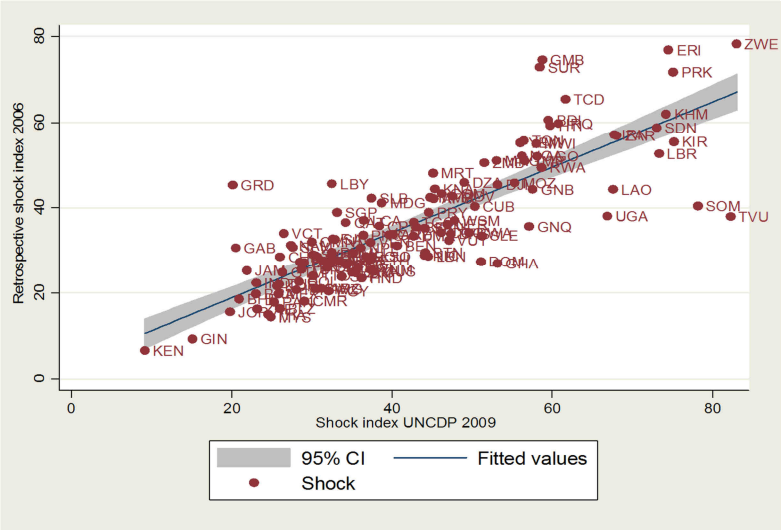
In regard to instability indicators, instability in agricultural production scores display, as expected, a strong rank correlation (96%). Exports instability scores, despite a weaker (but still strong) 85% rank correlation, are sometimes dispersed for more unstable countries. In the retrospective EVI

database, yearly export instabilities have been calculated over a rolling 15-year period (1992-2006 for the retrospective EVI in 2006) while in the UNCDP 2009 review the export instability component has have been calculated over a 28-year period (1980-2007). As a consequence, export instability in the UNCDP 2009 review is on average higher than in the retrospective series because: i) important episodes of instability in exports that occurred in the 80's are not taken into account in the retrospective series; ii) trends around which annual deviations are averaged are less sensitive to medium term variations when the period over which they have been estimated is longer (see chapter 2, subsection 3.2.3), which results in larger residuals. As a consequence, countries seeing the largest gaps between the two scores are located in the bottom-right side of the chart in figure 3.4, meaning that UNCDP instability scores tend to be higher, in average.

Figure 3.3. Correlations between the UNCDP 2009 and the 2006 retrospective shock and exposure indexes

i) Shock index

Rank correlation = 83%



ii) Exposure index

Rank correlation = 99%

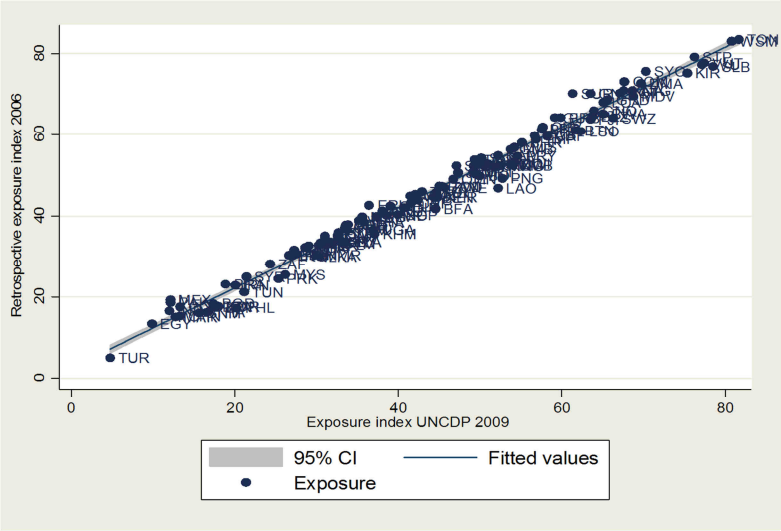
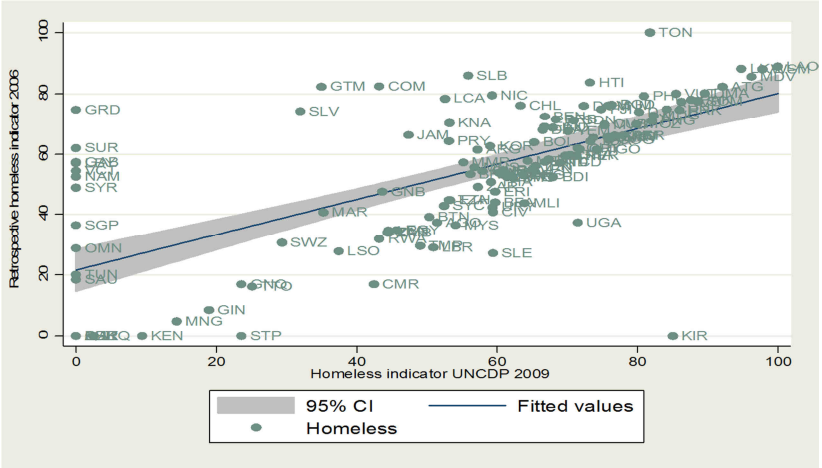
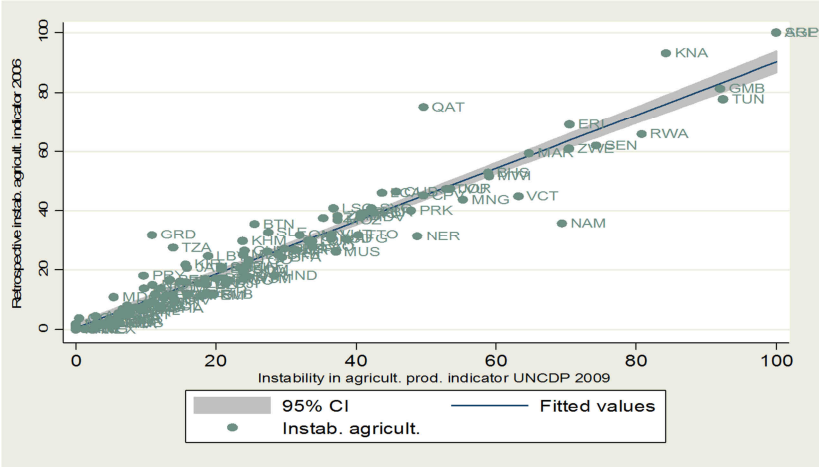


Figure 3.4. Correlations between shock index components

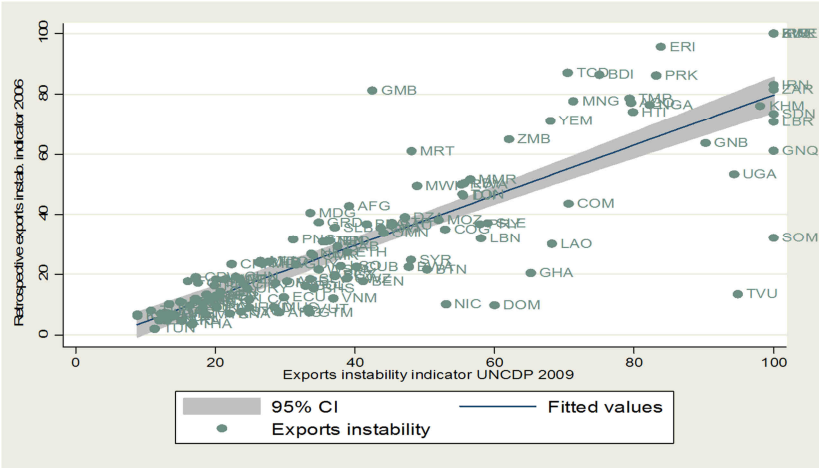
*i) Homeless index (*rank correlation = 68%)



*ii) Instability in agricultural production (*rank correlation = 96%)



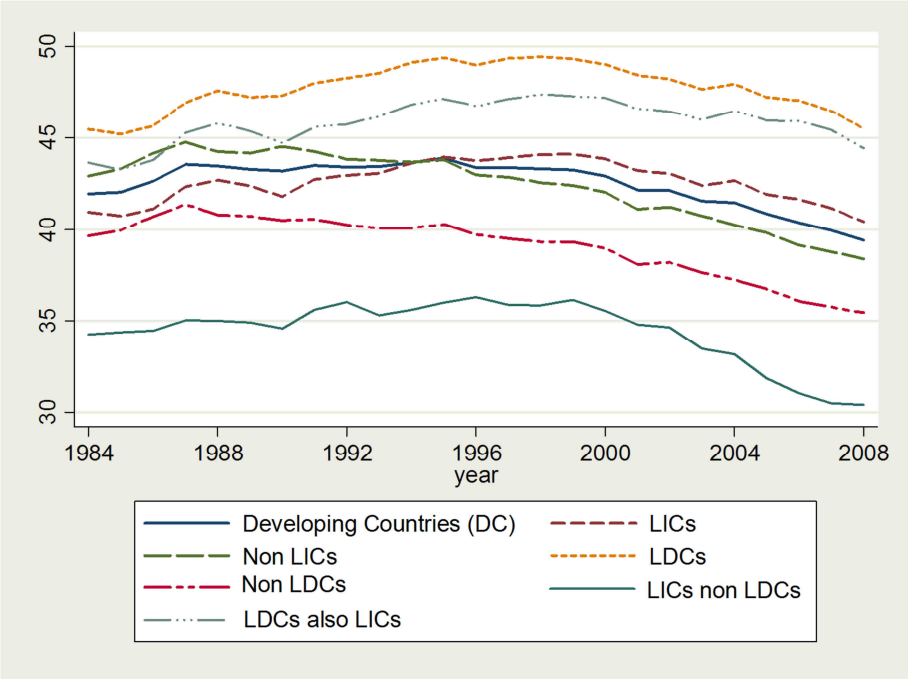
*iii) Instability in export earnings (*rank correlation = 85%)



4.2. Evolution of the retrospective EVI and its components, by country category

What have been the main trends of structural vulnerability in developing countries? Graphs thereafter presented give some insights into the way economic vulnerability evolved in developing countries over the last decades. They expose averaged evolutions of the EVI and its components by group of countries from 1984 to 2008.[67] Annex 3.C provides further results regarding average scores of EVI and its components by country group and by decade, as well as their corresponding Wilcoxon mean tests. Figure 3.5 and tables 3.C.i) and 3.C.ii) in annex C show the average evolution of structural vulnerability in the following groups of countries: all developing countries, LICs, non-LICs, LDCs, non-LDCs, LICs-non-LDCs and LDCs-also-LICs.

Figure 3.5. Evolution of the EVI by group of countries.



While the EVI has been in average decreasing when considering the whole sample, vulnerability trends by category of countries evidence two main schemes of evolution. On the one hand, vulnerability in LICs, LDCs, LDCs-also-LICs and LICs-non-LDCs showed an inversed U-curve evolution with a turning point occurring in the second half of the 90's. LDCs and LICs display a similar pattern of evolution as they both came back in 2008 to a level of vulnerability close to 1984. It can be noticed that vulnerability in LDCs-also-LICs converged toward that of the LDCs, which

[67] Results presented in this subsection are obtained from a sample of 127 developing countries, among which include 48 LDCs, 63 LICs, 43 LDCs also LICs and 18 LICs non LDCs. Timor Leste (LDC) has been excluded from the sample because data is missing until 2004. EVI scores prior to 1984 are not available for the whole sample.

is not surprising since many LDCs are also LICs.[68] By contrast, the LICs-non-LDCs group experienced a rapid collapse of its vulnerability since 2000, which made it diverge from LDCs. On the other hand, trends in vulnerability scores of non-LDCs and non-LICs categories have been strictly declining since 1987 up until 2008. As a consequence, the gap between the most vulnerable groups of countries (LDCs and LICs) and the least vulnerable ones (non-LICs and non-LDCs) has been increasing until the mid-90's, and has then been stabilizing during the second half of the 1984-2008 period. From 1984 to 2008, the LDC category remains the most vulnerable category of countries, while the group of LICs-non-LDCs remains the least vulnerable one.

Table 3.3. Correlations between within standard deviations of the EVI and those of its components

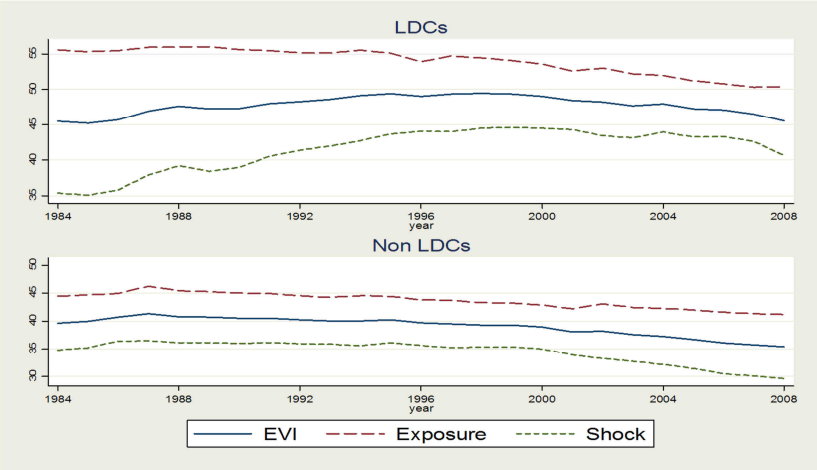
	Retrospective EVI
Exposure index	**21%**
Population	10%
Remoteness	3%
Exports concentration	27%
Share of agriculture, …, in GDP	30%
Shock index	**96%**
Homeless	19%
Instability in agricultural production	31%
Exports instability	88%

Table 3.3 exposes correlations of intra-individual (at the country level) standard deviations of the EVI with intra-individual standard deviations of its components. It appears that the shock index explains most of the within variation in country vulnerability scores. Indeed, shock index country-level standard deviations are found to be 96% correlated with EVI country-level standard deviations, while exposure index standard deviations exhibit a 21% correlation with those of the EVI. Among components of the shock index, exports instability is the main source of changes in vulnerability scores. Actually, export instability intra-individual standard deviation displays an 88% correlation with the EVI standard deviation. Thus, time variability in EVI scores seems mainly driven by the evolution of the shock index, in particular that of the export instability component.

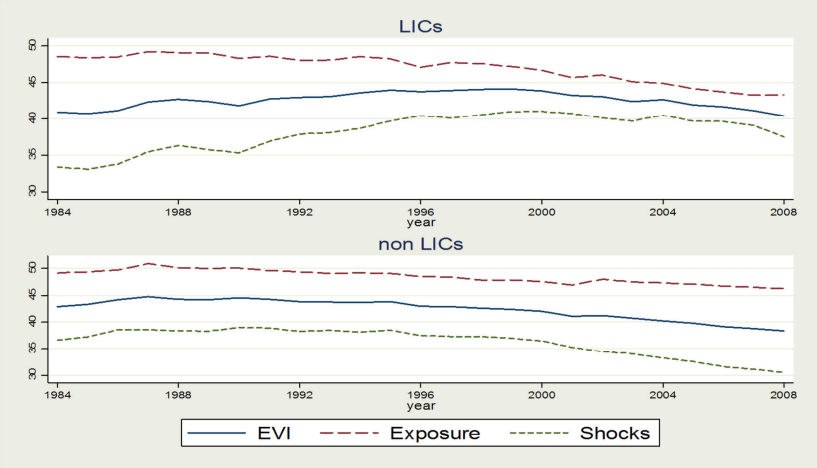
[68] Actually six LDCs are not LICs. See Annex 3.A.

Figure 3.6. Respective evolution of exposure and shock indexes, 1984-2008.

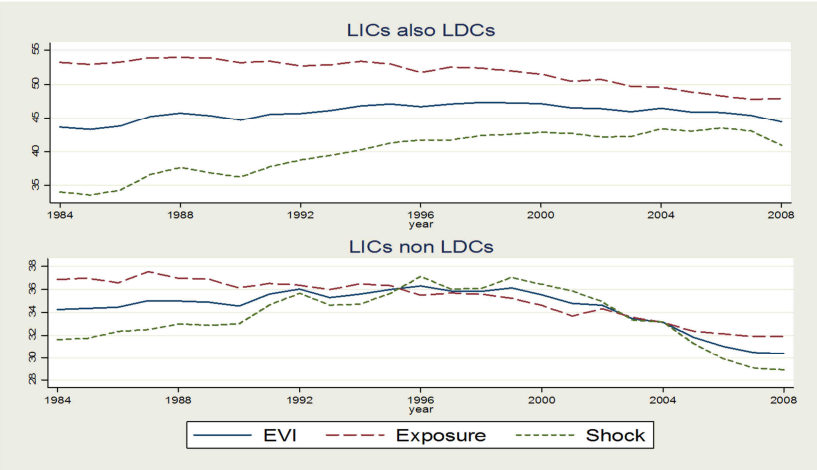
i) *LDCs versus non-LDCs countries*



ii) *LICs versus non-LICs countries*



iii) *LICs-also-LDCs versus LICS-non-LDCs*



However, figure 3.6 and annex 3.C.i) show that, though the exposure index declined in all categories of countries, the level of exposure to shocks is a also a great source of divergence between categories' average vulnerability scores. But the shock index remains the main driver of time variations in average vulnerability scores. Indeed, the turning point in vulnerability scores observed in LDCs, LICs, LICs-non-LDCs can also be observed in the evolution of shock scores. The sole category seeing a strict increase in its average shock index between 1995 and 2006 is the group of LDCs-also-LICs, which explains why vulnerability decreases less in this category than in LDCs and why both are converging since 1995. The category of LICs-non-LDCs also exhibits specific trends since it is the unique group experiencing a simultaneous decrease in both exposure and shock scores since 1997. One possible explanation is the inclusion in this group of current emerging economies that were formerly LICs (e.g. China, India, or Indonesia), and which saw their exposure and shock indexes strongly decreasing during the last two decades.

Figures 3.7 and 3.8 plot the evolutions of shock and exposure indexes' components by country group. Looking at trends in shock index components, we first observe that all categories underwent, on average, a positive and continuous growth of their homeless component during the entire period. LDCs and LICs experienced a slight increase in their exports instability component and a relative stagnation of their agricultural instability component during the first two decades, but saw them both decreasing since the late 90's. The decline in the shock index in LDCs-also-LICs observed in 2006 (see figure 3.6) is corroborated by a decline in the two instability components. In regard to groups of non-LDCs and non-LICs, the decrease in their shock index also seems to be both driven by a decrease in agricultural and exports instability components. The analysis of trends evolution tend to confirm that the instability in exports component, and in a lesser extent the instability in agricultural production component, contribute significantly to time variations in country group vulnerability scores.

It is worth noting that the rise in the annual mean share of homeless in the population observed in all categories is statistically explained by a improved country coverage of the indicator through time. Indeed, as missing data decreases over time, the number of countries that previously had null scores diminishes in all categories, which logically increases group averages. Thus, the rise in the index observed in figure 3.7 does not imply a *de facto* rise in countries' share of homeless in the population since 1984.

As for exposure index components, the rise in the population size and the downturn in the share of agriculture, forestry and fishery in GDP, common for many countries, mostly contributed to the decrease in the exposure index in all categories. The rapid decline in the exposure index in both LDC and LIC categories is partly due to the remoteness component, which has been decreasing for these two groups during the last two decades. This feature may be explained by recent changes in

the location of world markets in favour of LDCs and LICs, illustrated by the emergence of new leading exporting countries such as China, Brazil, Mexico, South Korea, and so on.

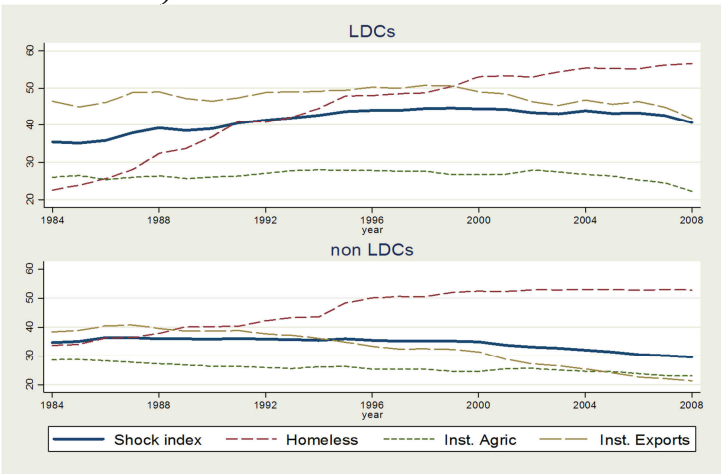
5. Conclusion

We introduced in this chapter our retrospective Economic Vulnerability Index, and provided a comparative analysis of retrospective vulnerability scores with those of the UNCDP 2009 review. If our methodology closely follows definitions and sources of variables used for the elaboration of the EVI in the UNCDP 2009 review, the retrospective nature of our index implied some changes in the computation of shock index components – namely the homeless, instability in the agricultural production and instability in exports components. Comparisons between the retrospective EVI in 2006 and the UNCDP 2009 review show a strong 94% rank correlation. If the retrospective exposure index is almost perfectly correlated with its counterpart of the UNCDP 2009 review, the shock index is the main source of divergence between the two versions of EVI.

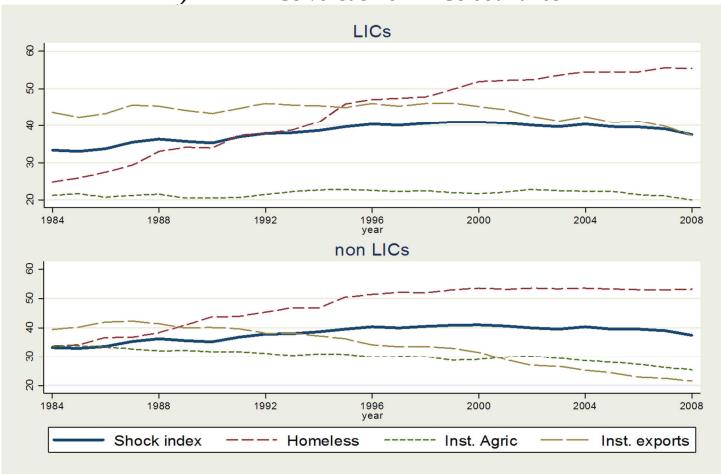
Then, we exposed retrospective EVI's main trends as well as those of its components. It appears that, according to this new retrospective index, vulnerability in developing countries slightly declined over the 1987-2008 period, in average. However, the evolution of structural vulnerability displays disparities among groups of countries. In particular, LICs and LDCs categories saw their structural vulnerability rising continuously until the mid-90s, while other categories (non-LDCs and non-LICs) experienced a early decrease, starting by the end of the 80's. The retrospective series evidenced that LDCs, as classified by the UNs in 2007, are the most vulnerable countries, from 1984 to 2008. A further analysis of EVI components' main trends reveals that the export instability component is the main driver of changes in vulnerability scores over time.

Figure 3.7. Evolution of shock index components – 1984-2008.

i) LDCs versus non-LDCs countries



ii) LICs versus non-LICs countries



iii) LICs-also-LDCs versus LICS-non-LDCs

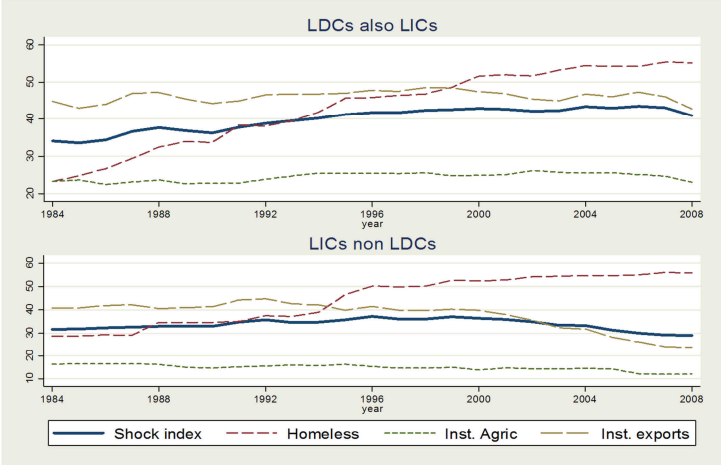
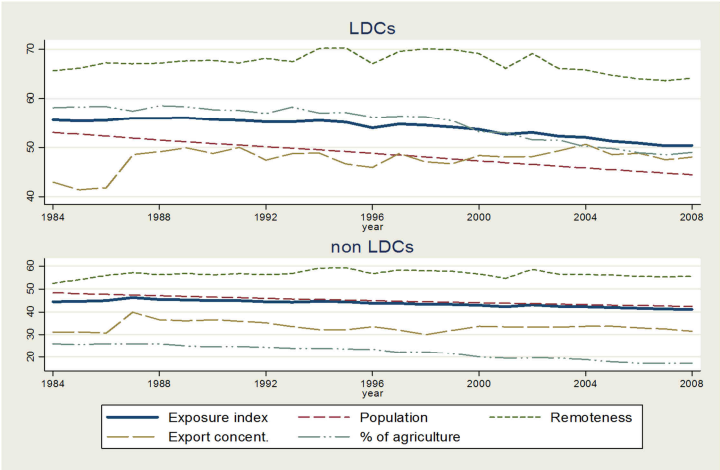
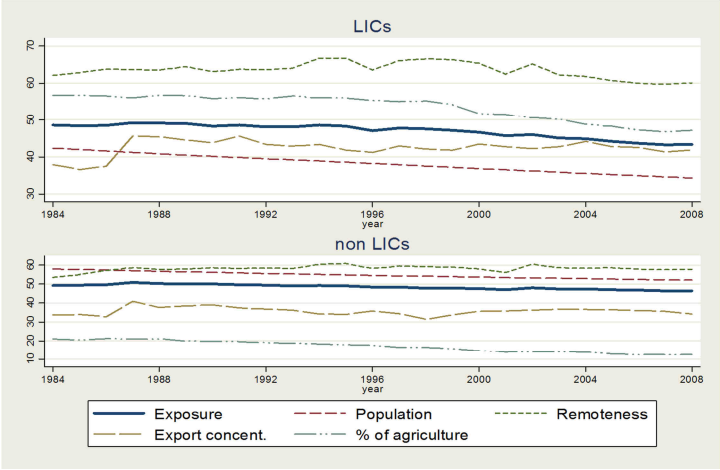


Figure 3.8. Evolution of exposure index components – 1984-2008.

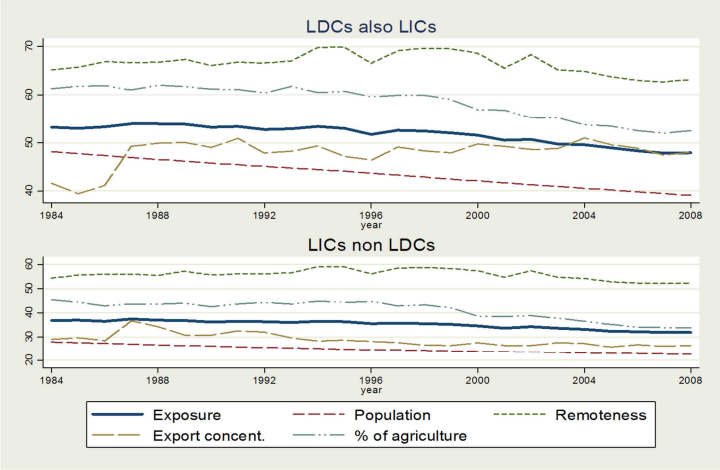
i) LDCs versus non-LDCs countries



ii) LICs versus non-LICs countries



iii) LIC-also-LDCs versus LICS-non-LDCs



Chapter 4

When corruption is a response to export instability

Country and firm-level evidence

"On dit qu'au fond d'une urne habite l'espérance ; Au fond d'un pot de vin cherchons notre assurance."

Édouard Pailleron, *Le Parasite.*

1. Introduction

As the columnist Eduardo Porter pointed out in the New York Times, if trust in institutions and perceptions of good governance are probably better off during good times than during hard times (Stevenson and Volfers, 2011; Kaplan and Panthania, 2010), there is in parallel a high temptation for fraud, embezzlement and other corruption offences during "the general prosperity of economic booms".[69] His view strongly coincides with a former work of Galbraith (1997), who stresses that economic crises are often followed by scandals of large-scale corruption, revealing the prevalence of malpractices in the administration of public and private affairs prior to economic reversal. The 2008 worldwide financial crisis and its consequences on national public accounts and fiscal solvency are striking illustrations of this complex link between public and private sector governance and output fluctuations. While poor norms of transparency and lack of accountability mechanisms in the management of public and private funds contributed to the dramatic economic collapse

[69] Eduardo Porter "The Spreading Scourge of Corporate Corruption", in *The New York Times*, July 10, 2012.

experienced by industrialized economies, these malpractices found a fertile ground in the recklessness and opulence of economic and financial expansion.

The relationship between governance quality and output fluctuations has already been emphasised by the economic literature. On the one hand, the contribution of bad governance to the instability of output is evidenced in important cross-country analyses, such as Acemoglu et al. (2003) or Mobarak (2005). On the other hand, Rodrik (2000), and more recently Arin et al. (2011), show that the ability of governments to handle economic crisis depends on the quality of institutions. According to Rodrik (2000), democratic institutions encourage political consensus around policy responses to external shocks, while Arin et al. (2011) find that corrupt OECD countries are less likely to rebalance their budget during serious attempts of fiscal consolidation. Thus, according these studies and in the light of the recent economic events, the contour of a vicious circle between bad governance and the instability of output looms: economic shocks are more likely to occur, and their destabilizing effects are more likely to persist, where institutions fostering good public and private governance are weaker.

The missing (or under-documented) element of this puzzling equation is the reverse causality, namely, the impact of output fluctuations on institutions and governance quality. The consequences of economic fluctuations on institutional variables have been so far studied by very few contemporaneous empirical studies. Brückner and Ciccone (2011) find a positive effect of adverse shocks on the quality of institutions, arguing that citizens are likely to voice their discontent and hasten democratic change during hardships. By contrast, others advance that transient economic booms may foster illegal enrichment of agents in charge of public affairs in 29 African countries (Voors et al., 2011), and 39 developed and emerging countries (Gokcekus and Suzuki, 2011). Building on these recent contributions, we provide additional insights into the effects of economic instability on corruption, at both macro and micro levels. While taking into account the pro-cyclical relationship between transient output movements and corruption stressed by Voors et al. (2011) and Gokcekus and Suzuki (2011), we advance that corrupt transactions may also arise from the necessity to protect against the detrimental effects of income fluctuations on welfare. In other words, corruption may represent a response to risk, together with the usual risk-coping and risk-management strategies emphasised by analyses of households saving and insurance decisions (Bardhan and Udry, 1999; Dercon, 1996, 2002; Elbers et al. 2007).

A striking illustration of a risk-coping corruption strategy is when a firm undergoing adverse shocks bribes to get rid of the "state burden" – e.g. excessive red tape, taxation, or custom duties – and, in so doing, relaxes its liquidity or budgetary constraint. On the other hand, an example of a risk-management corruption strategy is when trade-related or natural sources of economic instability makes future market demand, tax rates, public spending or subsidies unpredictable, so that bribes

are paid by private agents to secure future revenue inflows. Such a 'resource-locking corruption strategy' may consist in buying protection from foreign competition through political corruption, or illegally influencing procurement procedures for the award of public tenders.

Similar strategies may also be adopted by public agents, when politicians and public officials cope with adverse income shocks by increasing extortion or embezzling public funds; or when public procurement officers corrupt higher-level officials to secure their monopoly and discretionary powers over public tenders and to maintain their income stable.

Along this chapter, we focus on corrupt transactions involving both public and private agents, considering corruption as "the abuse of entrusted power for private gain" (Transparency International, 2009, p.24). We place the emphasis on the instability in the constant value of export earnings, since exports are a major mostly-external source of output fluctuations, with strong destabilizing effects on growth, tax, and redistribution policy (Guillaumont 2010, 2009ab; Jones and Olken, 2010; Easterly et al., 1993; Bevan et al., 1993). Building on researches made by Guillaumont and Demeocq (1989), Bardhan and Udry (1999), Dercon (1996, 2002), and Elbers et al. (2007), we assume that export instability has *ex ante* and *ex post* effects on corruption, resulting from agents' *perception* and *experience* of economic instability. We identify the *ex ante* and *ex post* effects of instability using measures of instability based on the standard deviation and the skewness of the distribution of exports around their trend, respectively.

Ex ante and *ex post* effects of instability are tested on measures reflecting corruption prevalence at both macro and micro-levels. On the one hand, fixed effect (FE), instrumental variable (IV) and system-Generalized Method of Moments (GMM) estimations are conducted on a panel of 68 developed and developing countries covering the period 1985-2005, using data on corruption perceptions taken from the International Country Risk Guide (ICRG). On the other hand, as corruption perceptions are probably influenced by business cycles (Stevenson and Volfers, 2011; Kaplan and Panthania, 2010), we run comparable Ordinary Least Square (OLS) and IV cross-section estimations on a sample of more than 9000 firms clustered in 23 developing countries, using data on bribes paid by firms drawn from the World Bank Enterprise Survey (WBES). Country-level and firm-level estimates provide evidence of nonlinear *ex post* and *ex ante* effects of instability, depending on the frequency and size of export fluctuations and on the liquidity constraint faced by economic agents.

The next section presents our conceptual framework. Section 3 presents the data and our empirical approach. In sections 4, 5 and 6, we expose and comment our main empirical results. Robustness checks are performed in section 7. Section 8 concludes.

2. Conceptual framework: how does instability impact corruption?

Following the distinction between household's responses to instability in incomes proposed by Elbers et al. (2007), we posit there exists *ex post* and *ex ante* effects of instability on corrupt behaviours (see box no.4.1). According to these authors,

> "a household's economic decisions (for example, on savings) are affected by risk in two ways: through the household's experience of shocks and through its perception of the distribution of the shocks it faces. (…). Hence, the ex ante effect results from the household's view of the world: two households that differ in their perception of the risks they face but that are identical in all other aspects will in general make different investment decisions. By contrast, the ex post effect measures the impact of the shocks themselves".[70]

Thus, the *ex post* effect of instability refers to the agent's *experience* of instability and its consequences on income and welfare. As for the *ex ante* effect, it refers to agent's *perception* of instability and the way he adjusts his behaviour to lower his exposure to it, regardless the actual impact of shocks.[71] Transposing this framework to the analysis of corruption determinants, we identify two types of *ex post* effects of economic instability on corruption schemes, acting in opposite ways:

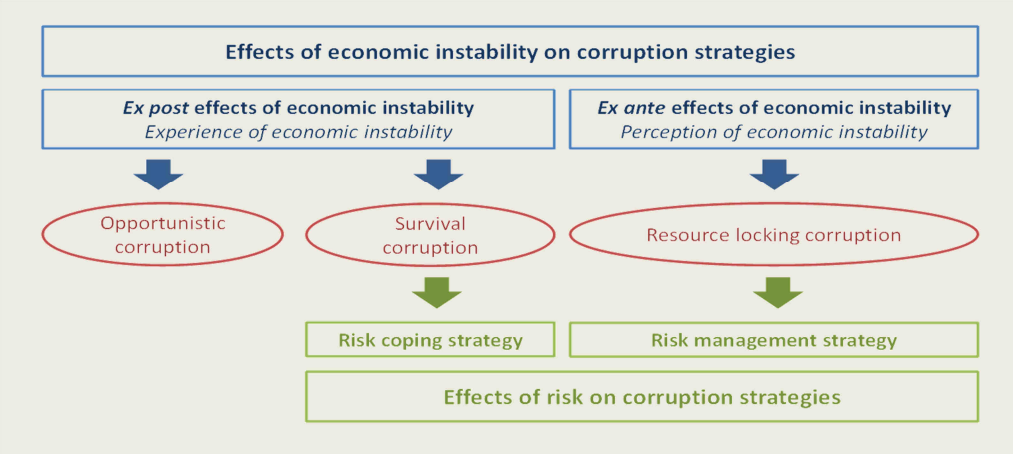
- **opportunistic corruption** (Voors et al., 2011; Gokcekus and Suzuki, 2011), which feeds on the mechanical ups and downs in opportunities for corruption following ups and downs in economic activity; and
- **survival corruption**, which spreads when resources become scarcer and when formal and informal risk coping mechanisms cannot fully cushion economic hardships.

As for the *ex ante* effect of instability on corruption, i.e. the effect of instability through agents' *perception* of shocks, we draw a parallel between corruption strategies and risk-management strategies aimed at reducing the risk in the income generating process. In this regard, we posit that agents perceiving their economic environment as unstable may engage in **resource-locking corrupt transactions,** that is, they may reduce *ex ante* the variance of their income by locking future resource inflows through bribery. These effects of economic fluctuations on corrupt schemes are illustrated in figure 4.1 and further explained below.

[70] Elbers, C., Gunning, J.W., and B.H. Kinsey (2007) "Growth and Risk: Methodology and Micro Evidence", *World Bank Economic Review*, Vol.21, No.1, p.4.

[71] This distinction between the *ex ante* and *ex post* effects of instability made by Elbers et al. (2007) echoes that made by Guillaumont and Demeocq (1989) between the *risk effects* of export instability, related to the uncertainty in export fluctuations, and the *ratchet effects* of export instability, relying on the asymmetrical reactions ton ups and downs in export earnings.

Figure 4.1. Economic instability, risk, and corruption strategies



Source: author.

Box No. 7. Households' strategies to protect against economic fluctuations.

The literature on the link between risk, saving and consumption in developing countries emphasises the effects of income fluctuations on microeconomic decisions (Elbers et al. 2007; Dercon, 2002, 1996; Paxson, 1992; Alderman and Paxson, 1992). The absence or incompleteness of credit and insurance markets in developing countries fosters the use by households of sophisticated strategies to protect against income shocks. These strategies commonly fall into two main categories: *risk-coping* and *risk-management* strategies.

Risk-coping strategies are mechanisms implemented by households to smooth the impact of positive or negative income shocks on their consumption through time or across individuals. Households may accomplish inter-temporal consumption smoothing by saving during positive shocks and dissaving during negative shocks, by increasing labour supply or borrowing on formal and informal credit markets during hardships, and by accumulating assets or storing consumption goods. Inter-households consumption smoothing can be ensured through formal risk-sharing mechanisms such as insurance markets, or through informal risk-sharing mechanisms such as transfers between relatives, friends, or neighbours. While inter-temporal consumption smoothing strategies are effective against idiosyncratic (individual) and covariate (common, aggregate, economy-wide) shocks, risk-sharing mechanisms are effective against idiosyncratic shocks only.

To summarize, **risk-coping strategies** are often referred as **consumption smoothing strategies** (when implemented by producer-consumer households), resulting from individuals' **experience** of **idiosyncratic** (inter-temporal consumption smoothing and risk-sharing) and/or **covariate** (inter-temporal consumption smoothing) shocks. Thus, risk-coping strategies are considered as an ***ex post* effect of risk or instability**, as they are implemented following the occurrence of economic shocks.

Risk-management strategies are undertaken to smooth income, i.e. to lower income variability, when formal and informal risk-coping mechanisms do not allow agents to fully smooth consumption. Income smoothing strategies may consist in reducing income exposure to shocks by diversifying productive assets, techniques and/or activities, or skewing income by choosing less profitable but less risky productive activity. The optimal degree of income smoothing depends on i) individuals' ability to smooth consumption *ex post*, ii) individuals' attitude toward risk – i.e. how much households are willing to pay to stabilize income –, and iii) individuals' perception of risk.

To summarize, **risk-management strategies** are often referred as **income smoothing strategies**, resulting from individuals' attitudes toward risk and **perception of it**. Therefore, risk-management strategies refer to the ***ex ante* effect of risk or instability**, as they aim to reduce exposure to future income shocks, regardless their actual consequences.

2.1 The *ex post* effects of instability on corruption

In regards to the *ex post* effect of instability, we invoke two main competing corruption responses to income shocks: *opportunistic corruption*, which stems from the mechanical ups and downs in public and private rents induced by export transitory movements; and *survival corruption*, which arises from the necessity to relax the liquidity/budgetary constraint during hardships. While both mechanisms result from individuals' experience of instability, only the latter can be, strictly speaking, referred as a coping or smoothing mechanism (see figure 4.1 and box No.7). Since these two effects are expected to act in opposite ways, the direction and strength of the resulting net effect are *a priori* uncertain. We thereafter emphasise different scenarios according to which the *ex post* net effect of export instability on corruption is expected to differ.

2.1.1. Opportunistic corruption

As stressed by Voors et al. (2011) and Gokcekus and Suzuki (2011), positive shocks increase opportunities for corrupt transactions, which may incite agents to intensify their efforts to accumulate wealth through corrupt activities. Conversely, adverse shocks reduce the number and/or the size of rents of which public and private agents were or would have unduly taken advantage.

The literature on the natural resource curse provides striking illustrations of how 'voracious' appetites for wealth accumulation are stimulated by resource expansions. For instance, important rises in international raw material demand may undermine the rule of law and reorient economic activity toward rent-seeking activities (Van der Ploeg, 2011, 2010; Arezki and Brükner, 2010). Notably, Isham et al. (2005) and Sala-i-Martin and Subramanian (2003) stress that it is the adverse effect of resource booms on institutional quality, rather than a "Dutch disease" effect, which contributed to poor long-run economic performances in many resource-dependent countries, such as Nigeria or Cameroon (see also Gauthier and Zeufack, 2009). In addition, Van der Ploeg (2010) also shows that, in natural resource rich countries, a precautionary motive may lie behind oil rent extraction during temporary oil-demand positive shocks. By extrapolation, it is plausible that favourable export shocks also give liquidity-constrained agents the incentive to insure themselves against future economic collapses, by engaging in corrupt activities during 'good years' and spending the resulting corruption proceeds during 'bad years'.[72]

In a more general setting, public and private agents are likely to accumulate extra-wealth through bribery, extortion or embezzlement when opportunities for corrupt transactions flourish. Therefore, opportunistic corrupt behaviours are expected to be pro-cyclical, i.e. spreading during

[72] suggesting that, in contrast to the view expressed in figure 4.1, a risk-coping motive for corruption may also exist during positive shocks.

positive shocks and decreasing during negative shocks. In figure 4.2, we propose a very simple graphical representation of the relationship between transitory income or shock (Y) and *opportunistic corruption*. Graphs displayed in figure 4.2 illustrate three scenarios, in which the marginal effect of transitory income (or income shocks) on *opportunistic corruption* is either:

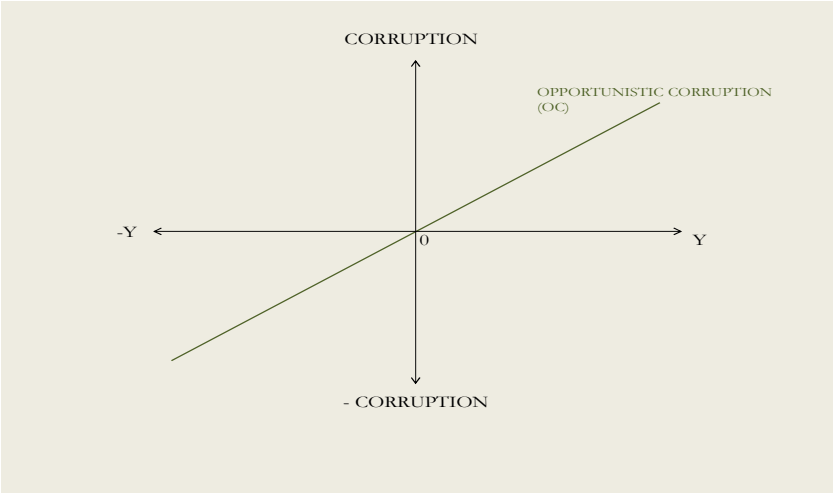
i) **constant**, depicting a standard situation where corruption rises in same proportion as transitory income increases;
ii) **decreasing**, which may illustrate situations where the opportunity cost of engaging in additional corrupt transactions decreases as income gets bigger and access to legal income-generating activities is better off, or where the probability of being detected and sanctioned rises with the size or occurrence of corrupt transactions;
iii) or **increasing**, which may characterize situations where the appetite for accumulation of corrupt actors intensifies as their transitory wealth increases. It may also apply to situations where the profitability of corrupt activities rises with the size and frequency of transactions (Bardhan, 1997), and when the incentive to engage in corrupt transactions increases with the number of corrupt agents (Andvig and Moene, 1990).

2.1.2. Survival corruption

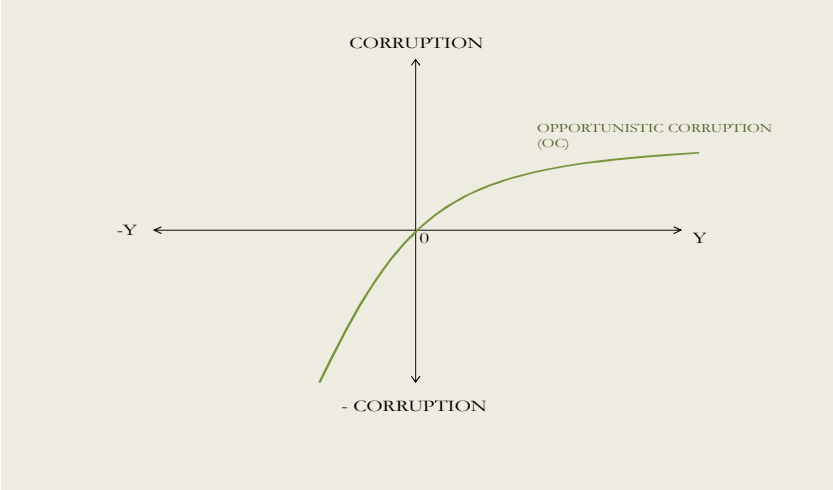
If the negative correlation between economic development and corruption prevalence has been widely emphasised (see for instance Treisman, 2000), the possibility of contra-cyclical variations in corruption levels has been less considered by the literature. To our knowledge, Robertson and Watson (2004) are the few authors mentioning that corruption may spread when resources become temporarily scarcer. Yet, various microeconomic surveys show that during negative income shocks, usual productive activities may not enable households to maintain their standard of living, so that labour supply adjustments represent an appealing strategy to earn extra income (Jacoby and Skoufias, 1997; Dercon, 2002). Interestingly, in a recent study, Robinson and Yeh (2009) show that transactional unprotected but better compensated sex is a way chosen by sex workers in Kenya to cope with health shocks, when formal and informal risk coping mechanisms do not allow them to fully smooth consumption. A similar motive for engaging in criminality has been stressed by Guillaumont and Puech (2006), who point out that individuals may be likely to compensate income losses during hardships by engaging in criminal activities.

Figure 4.2. The effect of export shocks on 'opportunistic' corruption

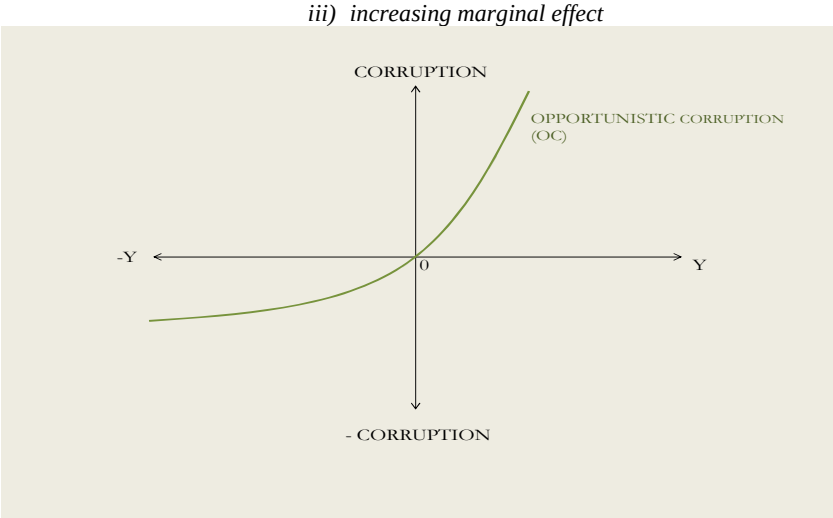
i) constant marginal effect



ii) decreasing marginal effect



iii) increasing marginal effect



Thus, adverse transitory shocks may lead liquidity-constrained agents to engage in corrupt activities in order to cushion income losses. For instance, during economic downturns, public officials may require firms to pay higher and/or more frequent bribes to complete their income. Similarly, firms under economic stress may be prone to fraud and bribery in order to avoid taxation, to get business or export licenses, to evade red tape, or to smuggle. Therefore, if the 'survival' motive prevails, corruption should increase during economic downturns when the liquidity constraint hardens, and should decrease during economic upturns when the liquidity constraint softens. As illustrated in figure 4.3, we consider that the marginal effect of income shocks on survival corruption can be either:

i) **constant**, which depicts a standard situation where corruption decreases in the same proportion as transitory income declines;
ii) **decreasing**, which may illustrate the decreasing marginal return of efforts to corrupt when rents become scarcer and competition for them intensifies. It may also reflect a probability of being detected and sanctioned increasing with the size of corrupt transactions, because of stronger checks and balances during hard times (Brückner and Ciccone, 2011; Galbraith, 1997). Or, this decreasing marginal effect of shocks may reflect situations where access to legal risk coping mechanisms is good, thereby increasing the opportunity cost of engaging in additional survival corrupt transactions.
iii) Or **increasing**, which may characterize situations where institutional safeguards against corruption fall as growth collapses, encouraging the impunity for acts of corruption. It may also reflect situations where formal and informal traditional risk coping mechanisms that are typically available to people are dysfunctional, and where illegal or risky activities such as corruption represent one of the few remaining options to cope with adverse shocks and minimize income losses.

By reassembling these corrupt patterns in a unified analytical framework, we derive testable hypotheses on the relationship between export shocks and corruption. We consider in figure 4.4 four main situations yielding four different corruption outcomes. Graphs 4.4i) and 4.4ii) depict the simplest cases, where the marginal net effect of shocks is constant and corruption responses are symmetric, yielding:

i) **a positive net effect of shocks on corruption**: variations in opportunistic corruption (OC) during positive and negative shocks outweigh variations in survival corruption (SC).
ii) **a negative net effect of shocks on corruption**: variations in SC during positive and negative shocks outweigh variations in OC.

In graphs 4.4iii) and 4.4iv), we relax the linearity assumption upon the marginal effect of shocks on corruption, asymmetric responses to shocks emerge and yield more complex corruption patterns:

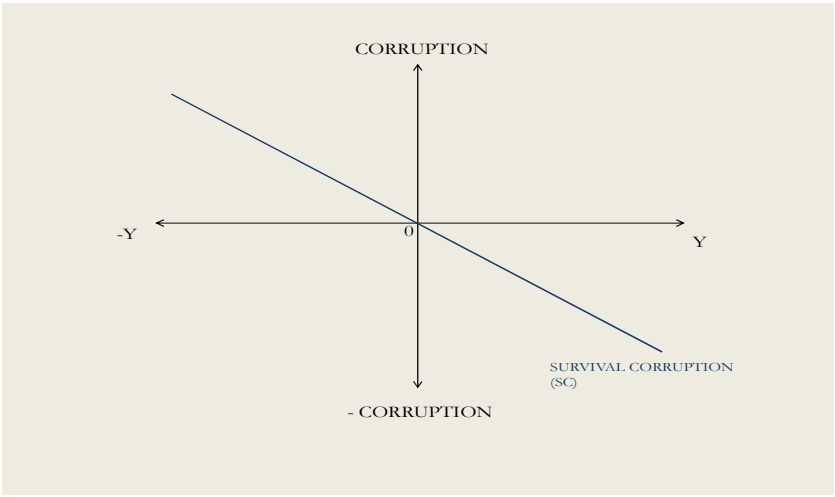
iii) **a 'global deterrent' effect of shocks on corruption**: when the marginal effect of (positive or negative) income shock is decreasing – i.e. the relationship between transitory income and corruption is concave – OC outweighs SC during negative shocks while SC outweighs OC during positive shocks. As a result, corruption decreases during both positive and negative shocks.

iv) **a 'global boosting' effect of shocks on corruption**: when the marginal effect of (positive and negative) income shocks is increasing – i.e. the relationship between transitory income and corruption is convex – SC outweighs OC during negative shocks while OC outweighs SC during positive shocks. As a result, corruption spreads during both positive and negative shocks.

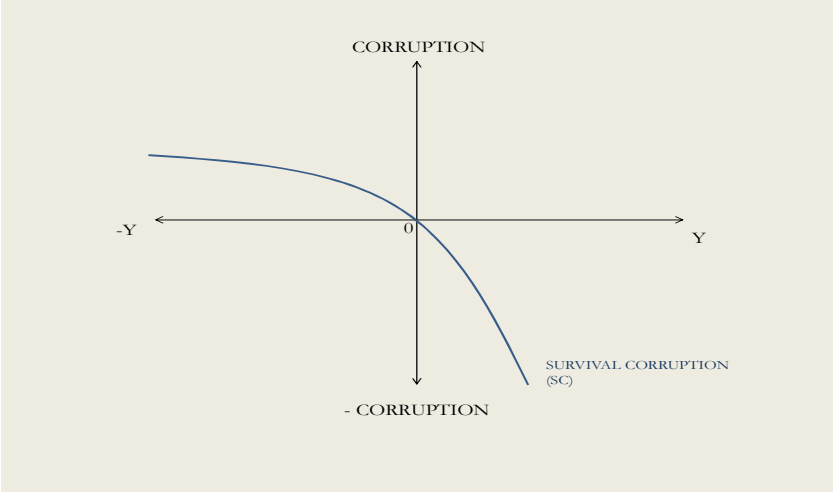
To sum up, when the relationship between corruption and shocks is linear, corruption may be pro-cyclical or contra-cyclical, depending on the relative prevalence of opportunistic or survival corruption. When the linearity assumption is relaxed, economic instability may have either a 'global deterrent' *ex post* effect or a 'global boosting' *ex post* effect on corruption, depending on the marginal effect of shocks on corruption.

Figure 4.3. The effect of export shocks on 'survival' corruption

i) constant marginal effect



ii) decreasing marginal effect



iii) increasing marginal effect

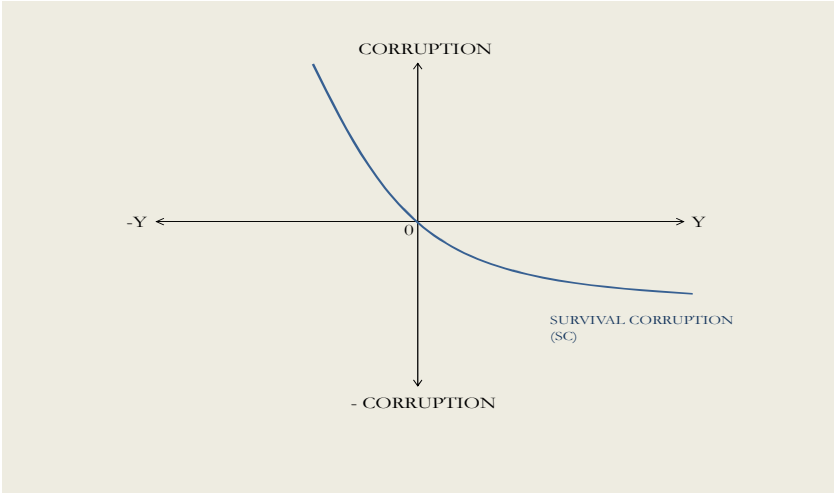
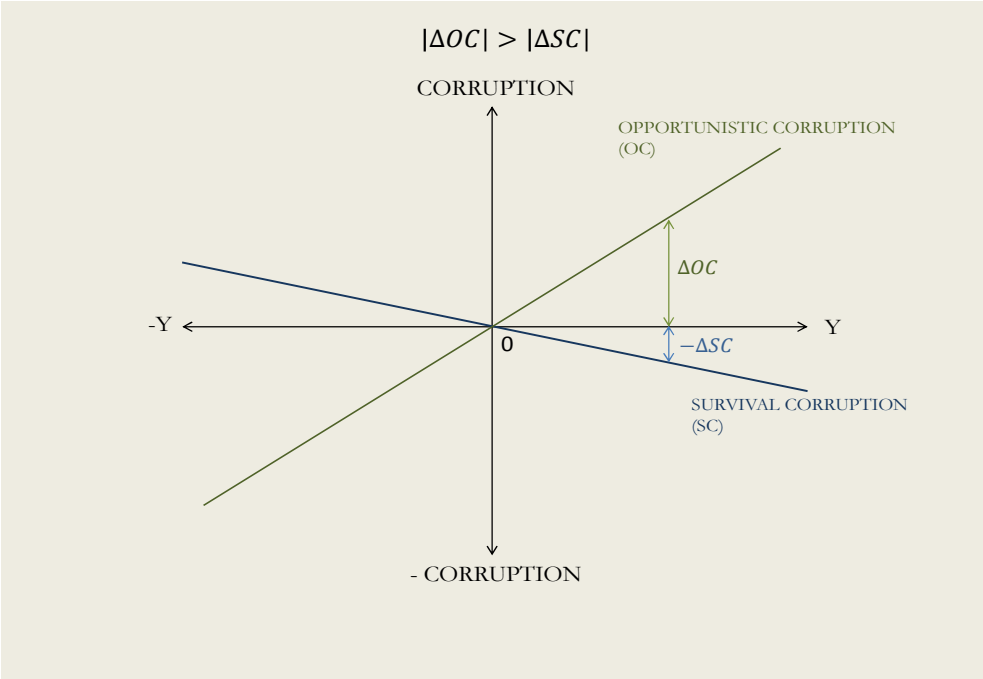


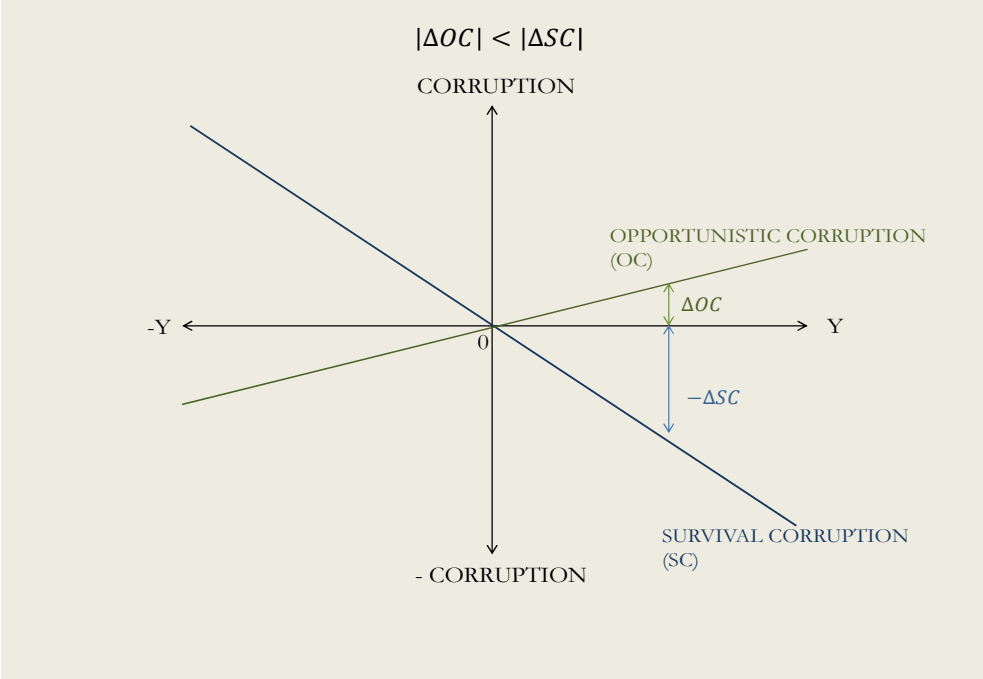
Figure 4.4. The net *ex post* effects of shocks on corruption

Symmetric corruption responses

i) *Pro-cyclical relationship*



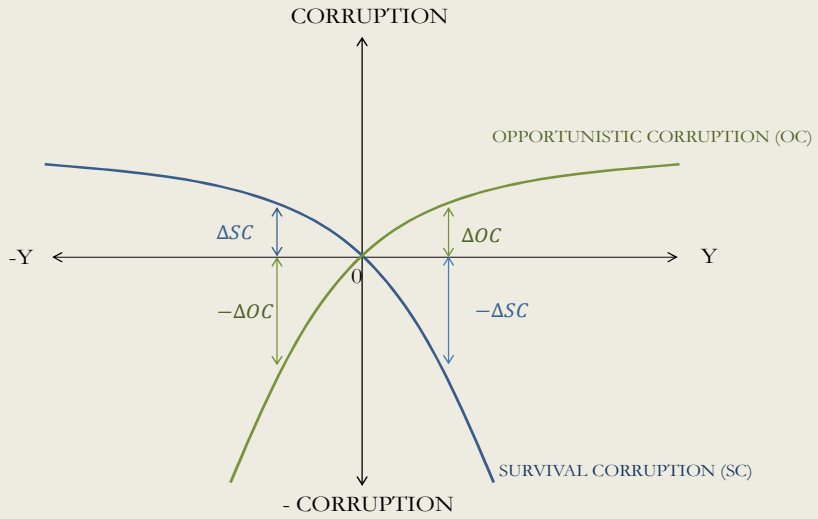
ii) *Contra-cyclical relationship*



Asymmetric corruption responses

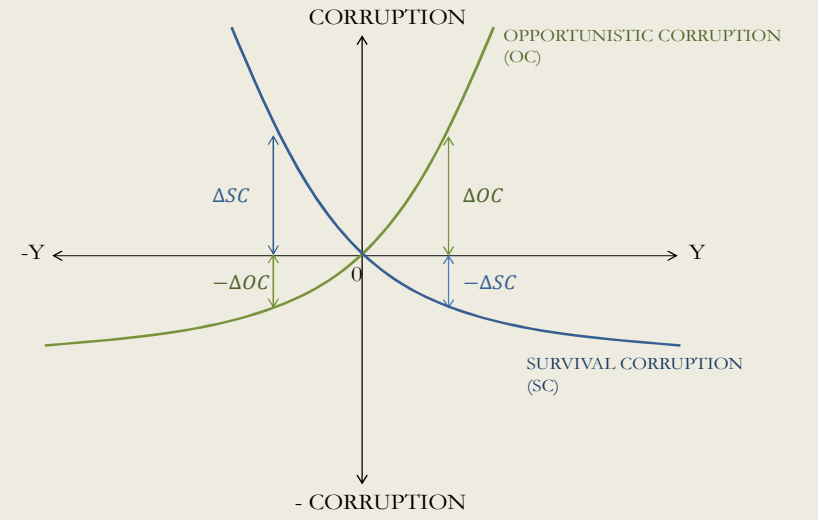
iii) 'Global deterrent' effect of shocks

$$|\Delta OC| < |\Delta SC| if \Delta Y > 0 \text{ and } |\Delta OC| > |\Delta SC| if \Delta Y < 0$$



iv) 'Global boosting' effect of shocks

$$|\Delta OC| > |\Delta SC| \;\; if \Delta Y > 0 \text{ and } |\Delta OC| < |\Delta SC| \;\; if \Delta Y < 0$$



2.2 The *ex ante* effect of instability on corruption

The *ex ante* effect of instability refers to agents' productive decisions aimed at reducing revenue exposure to economic fluctuations (Bardhan and Udry, 1999; Dercon, 1996, 2002). Income smoothing strategies consist in reducing the risk in the income process by, for example, diversifying production choices, or re-orienting production toward lower-return but lower-risk activities (Dercon, 2002). Business literature on the effects of cultural orientations on corrupt schemes also emphasises that an uncertainty avoidance motive for corruption may operate, especially in cultures where the aversion for uncertain or unknown situations prevails (Husted, 1999, Robertson and Watson, 2004). As Husted (1999, p.345) stresses,

> "corruption can be viewed as a mechanism to reduce uncertainty. In situations where outcomes are uncertain, corruption may serve to secure a more certain result."

From a rent-seeking perspective, it can be asserted that bribes are paid by economic agents to ensure the control of resource inflows over a given timeframe. *Resource-locking* corruption strategies can therefore be undertaken to maintain current and future revenue inflows, thereby reducing the variance of income over a certain period. Thus, when macroeconomic instability undermines the predictability of the government's fiscal policy, creating uncertainty upon the allocation of resources at different layers of the government (ministries, sub-ministries, and agencies), public officials may bribe higher-level public agencies in order to secure the allocation of such resources. The instability of output generates similar incentives for private agents. For instance, private firms may be inclined to secure the attribution of public tenders through bribery or other corrupt arrangements, thereby securing future revenue inflows over time. For the same reason, they may also be incited to unduly influence governments and legislators to initiate and pass laws and rules that give effect to their interest in trade protections or favourable economic regulations (Grossman and Helpman, 1994). This point is corroborated by the recent work of Arin et al. (2011), who show that during serious attempts to correct fiscal imbalances, corrupt governments are less likely to cut spending than honest ones, since the former have "higher incentives to keep expenditures large (…) in order to accommodate the interests of influential lobbies".[73] That is why we expect *resource-locking* corruption to be an appealing income smoothing corrupt strategy, spreading (lessening) in environments with high (low) output instability.

[73] in Arin, K.P., Chmelarova, V., Feess, E., and A. Wohlschlegel (2011), "Why are corrupt countries less successful in consolidating their budgets?", *Journal of Public Economics*, Vol.95, No.7-8, p.529.

3. Data and empirical approach

3.1 Corruption data

In this chapter, we try to systematically provide comparable and consistent empirical country-level and firm-level evidence of corruption mechanisms described previously. On the one hand, we use a measure of corruption perception drawn from the International Country Risk Guide (ICRG), provided by the Political Risk Service (PRS) group.[74] This measure is constructed by a network of country experts and assesses corruption in the political and (to a lesser extent) administrative spheres. It measures corruption as a risk for business by assessing to what extent it may take the form of excessive patronage, nepotism, job reservations, 'favour-for-favours', secret party funding, suspiciously close ties between politics and business, or bribes. The ICRG ranges from 0 (higher corruption level) to 6 (lower corruption level). Whilst the ICRG corruption indicator takes into consideration low-level bureaucratic corruption, it insists on corruption prevailing in the political arena or high levels of the administration, which makes this indicator rather political-oriented (as shown in chapter 1, section 3.1.2). We favour the use of the ICRG corruption indicator for various reasons:

- It covers a range of 135 countries and an extensive 22-year period (1984-2005), which allows exploiting the time dimension of corruption data.
- We favour a single-source measure rather than composite indexes such as the Corruption Perception Index of *Transparency International*, since their construction may sometimes induce conceptual imprecision, uncertainty and inconsistency (see Knack, 2006). Many studies find a high correlation between the ICRG and other popular corruption perception indicators such as the Transparency International's Corruption Perception Indicator (CPI), or the World Bank's "Control of Corruption" (CoC) Index (Kaufmann, Kraay, and Mastruzzi, 2010), arguing that these correlations are evidence of their reliability. However, as shown in annex 4.C rank correlations between the ICRG and composite indexes in 2004 are pretty low (around 50%) once restricting our sample to low and middle-income countries. This discrepancy between corruption scores in lower-income countries is a first argument for the use of this single source dataset.
- ICRG ratings put the emphasis on the risk of corruption for foreign investor or firms, which is of great interest given the emphasis placed on private sector corruption in our analysis.

However, as stressed by Donchev and Ujhelyi (2010), Treisman (2007), and Knack (2006), the ICRG corruption perception indicator suffers from certain drawbacks:

[74] http://www.prsgroup.com/ICRG.aspx

- The ICRG is a centralized indicator, which means that despite ratings are sourced from country-specific diagnosis, they are *in fine* set centrally by a small number of people. This feature raises the issue of the transparency in the rankings of countries. Moreover, the perception of the prevalence of corrupt practices is probably culturally oriented, since most data users are international or foreign firms and investors.
- The methodology and assessment criteria are not fully documented. The ICRG provides a single measure of corruption reflecting various aspects of corruption without mentioning precisely the relative weights given to each aspect, and how these are documented.

For the ease and convenience of result interpretation, we reversed the score of the ICRG indicator, a high score corresponding to a higher level of corruption and *vice versa*.

As for the WBES data, it provides a comprehensive and comparable-internationally firm-level assessment of business environment conditions around the world, based on a survey administered to around 130 000 companies in 135 countries. Notably, the WBES provides a wide range of data highlighting the burden of corruption for private firms along with key other firm-level characteristics. In our study, we use a measure of experiences of corruption in conducting business, based on firm's informal payments in percent of total sales.[75]

3.2 Instability measurements

As stressed in box no.4.1, whilst the *ex post* effect of instability relies on agent's *experience* of instability, reflecting the consequences of shocks on well-being or firms' performance, the *ex ante* effect of instability depends on agents' *perception* of it (Elbers et al., 2007; Guillaumont, 2010).

To test the *ex ante* and *ex post* effects of instability, we use two measures of instability based on the distribution of export earnings in constant dollar, y_t, around a 16-years rolling mixed trend, $\hat{y}_{it}$ (the method is presented in chapters 2 and 3). Considering the export process exhibits both deterministic and stochastic paths,

$$y_t = \chi_0 + \chi_1 t + \chi_2 y_{t-1} + \xi_t \quad \text{with } \xi_t \text{ a zero-mean i.i.d disturbance term,}$$

We estimate each year and for each country, over the current and past 15 years, trend values ($\hat{y}_{it}$) as follows[76],

$$\hat{y}_t = \hat{\chi}_0 + \hat{\chi}_1 t + \hat{\chi}_2 y_{t-1} \qquad (4.1)$$

[75] Enterprises were asked the following question: "We've heard that establishments are sometimes required to make gifts or informal payments to public officials to "get things done" with regard to customs, taxes, licenses, regulations, services etc. On average, what percent of total annual sales, or estimated total annual value, do establishments like this one pay in informal payments or gifts to public officials for this purpose?"

[76] This approach of the measurement of volatility has been applied by the United Nations' Committee for Development Policy for the design of the economic vulnerability index.

where *t* is a time trend. We consider the distribution of exports around this trend as stationary, hence reflecting only transitory variations in export earnings.[77]

Export deviations around an estimated trend are preferred to business cycles that can be extracted by two-sided filtering methods, such as the Hodrick-Prescott filter (HP filter). Since tested relationships rely on agents' past experience and perception of instability, we believe the parametric approach of computing the trend more appropriate. Alternative measures of instability based on the HP filter are used in section 7 to check the robustness of our results.

3.2.1. Estimating the *ex post* effect of instability

The empirical literature generally analyses the *ex post* effect of instability using annual shock variables, reflecting the impact of positive or negative shocks on economic decisions (Dercon, 2002). As stressed by Voors et al. (2011), there may be a time dyssynchrony between export shocks – which are annual events in our dataset – and variations in corruption scores – which are of longer periodicity. The literature introduces lagged shock variables to study their impact on institutional variables (Brückner and Ciccone, 2011; Voors et al, 2011). However, this approach presents the major drawback of overlooking the effect of repeated asymmetric shocks on welfare or economic performances. Using a panel dataset on rural households from Pakistan, Alderman (1996) finds that a negative shock following a positive shock affects consumption patterns in a different way than do two consecutive negative shocks. As underlined by Alderman and Paxson (1992, p.13),

> "a negative shock to income may produce little effect on consumption, but two consecutive negative shocks may have large effect".

Therefore, the shock-variable approach is likely to understate the lasting and persistent effect of repeated shocks, especially their effect on institutional outcomes such as corruption, which is known to change rather slowly over time. To circumvent these potential drawbacks, we use in this chapter an alternative measure of experienced instability, based on the 6-year rolling skewness of the distribution of exports around their trend:

$$Skewness_{it} = 100 \times \frac{\frac{1}{T}\sum^{T}\left(\frac{y_{it} - \hat{y}_{it}}{\hat{y}_{it}}\right)^{3}}{\left(\frac{1}{T}\sum^{T}\left(\frac{y_{it} - \hat{y}_{it}}{\hat{y}_{it}}\right)^{2}\right)^{3/2}} \quad with\ T = [t;\ t\text{-}5] \qquad (4.2)$$

Where y_{it} is the observed value of export in country *i* at time *t*, and $\hat{y}_{it}$ the rolling mixed trend. As a reminder, the skewness is the third moment of the probability distribution of a random variable. Computed on a short timeframe, it provides a *de facto* measure of the asymmetry of shocks around a

[77] Throughout this chapter, annual variations around this rolling mixed trend are referred as "shocks" or "deviations". The terms "instability" or "fluctuations" are generic, and qualify both annual shocks or an accumulation of shocks.

reference value (Rancière et al., 2008). An increase in the value of the skewness corresponds to an increase in the size or the frequency of positive shocks compared to negative ones. In addition to reflecting the asymmetry of shocks, this measure captures an eventual persistent effect of repeated negative or positive shocks.

The skewness is also an appropriate measure of the frequency and intensity of fluctuations. Indeed, Rancière et al. (2008) show that high values of skewness are strongly associated with the occurrence of crisis (if negative) or boom (if positive) in a large sample of countries over 1960-2000. They stress the strong link between the skewness and the kurtosis of a distribution, the latter reflecting the fatness of the tails or the peakedness of a distribution. Chapter 2 and annex 4.B support this statement, by showing strong correlations between absolute values of skewness and values of kurtosis. Thus, our skewness-based measure of instability is expected to reflect two major dimensions of economic instability, namely the asymmetry, and the frequency and size of export fluctuations: while a high negative value of skewness reflects the predominance of low-frequency large-size negative fluctuations, a small positive value of skewness reflects the predominance of high-frequency small-size positive fluctuations.

Figure 4.5 illustrates the relationship between export shocks, export skewness, and corruption in Cameroon, Argentina, Indonesia and Bangladesh. It can be observed that, in these countries, the evolution of the skewness of exports fits quite well with the evolution of corruption scores (right-sided graphs), revealing pro-cyclical relationships in Cameroon and Argentina, and contra-cyclical relationships in Indonesia and Bangladesh. Such synchronicity cannot be easily established on the sole observation of how corruption responds to annual export shocks (left-sided graphs), which supports that our 6-year rolling skewness of exports should better capture the *ex post* effects of instability on corruption than annual shock variables.

3.2.2. Estimating the *ex ante* effect of instability

The *ex ante* effect of instability refers to adjustments in agents' behaviours aimed at lowering the variability in their income, regardless the impact of output fluctuations on agents' wealth or well-being (Elbers et al., 2007). As suggested by Elbers et al. (2007) and following Guillaumont (2009, 2010), we look for a measure reflecting agents' *perception* of instability. We compute this measure as the 16-year rolling standard deviation of exports around the rolling mixed trend $\hat{y}_{it}$ in country i at time t:

$$Std\_dev_{it} = 100 \times \sqrt{\frac{1}{T}\sum^{T}\left(\frac{y_{it} - \hat{y}_{it}}{\hat{y}_{it}}\right)^2} \quad with\ T = [t;\ t\text{-}15] \qquad (4.3)$$

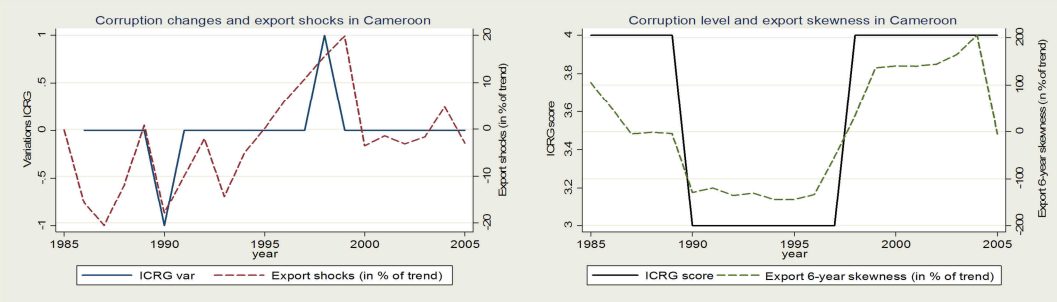
We expect it to be an adequate approximation of agent's changing perception of aggregate output variance. By computing the standard deviation of exports on a rolling basis and over a long time

frame, we allow the perception of instability to change over time while giving equal weights to remote and present fluctuations. In other words, this measure limits the influence of contemporaneous sharp export movements on agents' perception of instability, while capturing the lasting influence of remote fluctuations. Thus, we expect this measure to give more prominence to the way agents perceive instability than the way they actually and currently experience it. Figure 4.6 illustrates the respective evolution of corruption levels and the 16-year standard deviation of exports in Thailand, France, Italy and Spain, and shows that the evolution of corruption scores clearly tracks that of the standard deviation of exports in these countries.

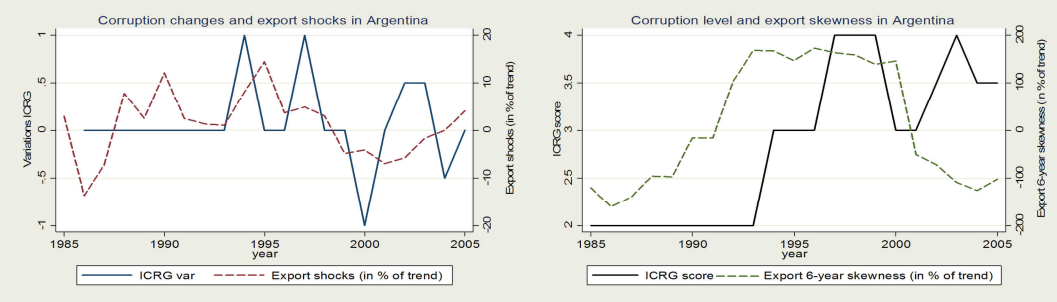
Figure 4.5. Export shocks, export skewness and corruption in Cameroon, Argentina, Indonesia, and Bangladesh

i) Pro-cyclical relationships

Cameroon

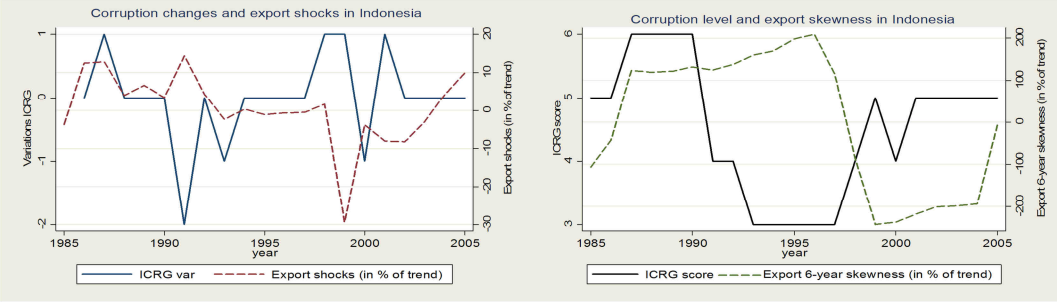


Argentina



ii) Contra-cyclical relationships

Indonesia



Bangladesh

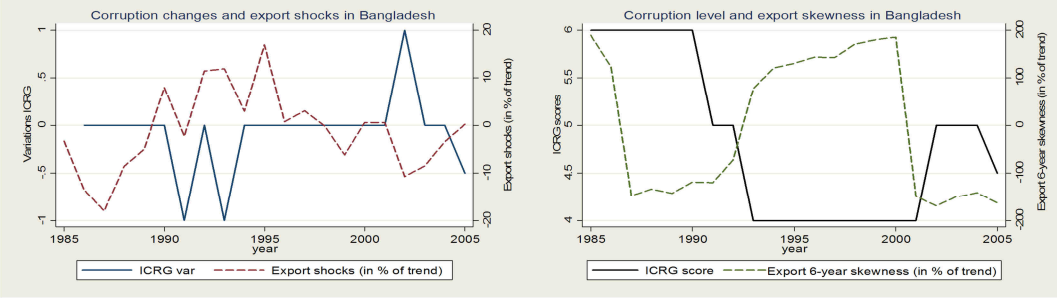
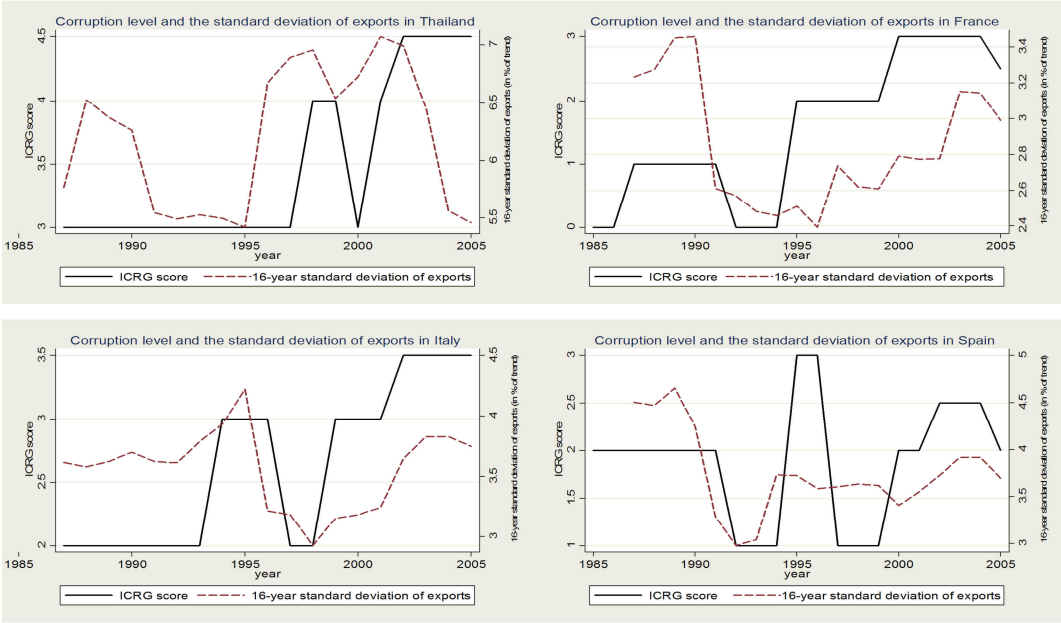


Figure 4.6. The standard deviation of exports and corruption levels in Thailand, France, Italy and Spain



3.3 Control variables

We estimate the effects of export instability on corruption with two econometric models. On the one hand, we set a dynamic panel framework using panel data on corruption perceptions in 68 developed and developing countries over the period 1985-2005. On the other hand, we conduct cross-section estimations using micro data on informal payments made by more than 9000 firms, interviewed between 2008 and 2011, clustered in 23 developing countries. Descriptive statistics and data sources are presented in annex 4.A.

3.3.1. Controlling for the structural determinants of the development process

Economic development is a major corruption deterrent (see chapter 1), explaining around 75-80% of cross-section variation in "Corruption Perception Index" (from Transparency International) and "Control of Corruption" (from the World Bank) scores, according to Treisman (2000) and estimates of chapter 1 (section 3.2). The economic development process is indeed accompanied by several changes in economic, socio-political and legal conditions, expected to directly or indirectly impact corruption levels. In empirical studies, economic development is usually proxied by the GDP per capita. Including a measure wealth per inhabitants in corruption regressions may however correlate with other important determinants of corruption, such as the population size, trade openness, or democracy. We rather approximate the effect of the economic development process on corruption, by using variables capturing the structural long-term determinants of growth evidenced by Sala-i-Martin et al. (2004). These authors use a Bayesian statistical approach to identify

robust traditional determinants of long-term growth, and find strong evidence on the effect of human capital variables (primary school enrollment, life expectancy in 1960, malaria prevalence), the public sector size (% of government consumption and investment in GDP), the initial level of income, the share of mining in GDP, and the geographical location.

In our empirical specifications, we include the annual growth rate of the population (World Development Indicators 2010), as a proxy for human capital conditions. We expect low demographic growth rates to result from a healthy and educated population, while high growth rates to characterize countries with low human capital which have not achieved their demographic transition. We also use the share of governmental spending in GDP (Penn World Tables) as a proxy for the effect of public sector size on growth and income levels. We include a measure of total natural resource rents (in % of GDP) drawn from the World Bank database, to account for the effect of natural resources endowments on long term growth.

In panel country-level regressions, we expect the country fixed effect to capture the effect of time invariant unobserved country characteristics, as well as time invariant growth determinants found significant by Sala-i-Martin et al. (2004) in their growth regressions: initial conditions, the average price of goods between 1960 and 1964, and the geographical location. In cross-section firm-level regressions, we control for the initial income level using the twenty-year lagged GDP *per capita*[78], and account for the effect of geography by including the country latitude, and dummies for landlockness and regional location. Following La Porta et al. (1999), we also include a dummy equal to one for common-law based legal systems and zero otherwise.

3.3.2. Controlling for the main determinants of corruption

In addition, we control for determinants of corruption usually identified by the literature (Treisman, 2000; Tanzi, 1994; and Mauro, 2004), described in chapter 1: *trade openness* (using the ratio of exports plus imports on GDP, from the Penn World Tables), *democracy* (using the revised polity2 indicator from the Polity IV database), the *political regime stability* (using the regime durability variable from the Polity IV database), and the *size of the population* (using the logarithm of the population from the Penn World Tables). It is worth reminding that many variables may both explain long term income growth and corruption, e.g. natural resources (Van der Ploeg, 2011) or state interventions (Tanzi, 1994; Guriev, 2004).

In cross-section regressions, following the literature on business corruption using firm-level surveys (Clarke, 2011; Jensen et al., 2010; Kaplan and Pathania, 2010), we also control for the firm's size, public ownership (in % of firms), and export orientation (% of direct and indirect exports in total sales). This data is drawn from the WBES dataset.

[78] Since firms have been interviewed between 2008 and 2011, the lagged GDP per capita is between 1988 and 1991.

3.4 Baseline estimation framework

Following Elbers et al. (2007), we estimate the *ex post* and the *ex ante* effects by including in a corruption equation our measures of experienced instability (6-year export skewness) and our measure of perceived instability (16-year standard deviation of exports) along with other control variables:

$$Corrupt_{it} = \alpha_0 [+\alpha_1.Corrupt_{it-1}] + \boldsymbol{\alpha_2.Skewness_{it}} + \boldsymbol{\alpha_3.Std\_dev_{it}} + \alpha_4.Macro\_controls_{it} \\ \{+\alpha_5.Micro\_controls_{it}+\alpha_6.timefixed\_controls\} + \lambda_t [+ \mu_i]+ \varepsilon_{it}, \quad (4.4)$$

Variables in square brackets are included in country-level dynamic panel regressions only, while variables in curly brackets are included in firm-level cross-section estimations only. In panel regressions, $Corrupt_{it}$ is the ICRG indicator of corruption perception, while in cross-section regressions it represents the share of informal payments in total sales made by firm *i* interviewed at time *t*.

Thus, corruption is function of its lagged level (in panel regressions only)[79], the 6-year rolling skewness of exports, the 16-year rolling standard deviation of exports, macro-level control variables, micro-level and time-fixed control variables (in firm-level regressions only), time dummies, country fixed effects (in panel regressions only), and an i.i.d. error term. Finally, since firm-level regressions are cross-section regressions without any time dimension (the time subscript may be misleading), time dummies only control for the year of firms interview (2008, 2009, 2010 or 2011).

[79] This dynamic empirical framework allows capturing regression-to-the-mean effect, as well as persistence in corruption perception scores (Voors et al., 2011).

4. Baseline empirical results

Within fixed effect (FE) panel estimations, instrumental variable (IV) panel estimations, and the generalized method of moment in system (sys-GMM) are applied to equation (4.4), using panel data from 68 developed and developing countries over 1985-2005 (1144 observations in baseline estimations). In parallel, Ordinary Least Square (OLS) and IV cross-section estimations with standard errors clustered by country are conducted on a sample of 9212 firms from 23 developing countries (interviewed between 2008 and 2011). To ensure that measurement errors, omitted variables, and reverse causality problems do not bias estimations, we systematically compare i) FE and OLS estimates with IV or sys-GMM estimates, and ii) panel country-level estimates with firm-level cross-section estimates. Comparing panel country-level with firm-level cross-section estimates not only enables us to check whether results are sensitive to different corruption measurements and different units of observation, it also allows to compare short-term with long term relationships (Kennedy, 2008). Results are presented in table 4.1.

4.1 Ordinary Least Square (OLS) and Fixed Effect (FE) estimates

Contrary to Voors et al. (2011), FE estimations of equation (4.4) in column (2) show a 10% significant negative effect of the export skewness on corruption perceptions.[80] An increased experience of positive (negative) shocks significantly reduces (increases) country corruption scores, which supports the hypothesis of survival corruption prevalence (as illustrated in figure 4.4ii)). In contrast to panel estimations, OLS firm-level estimates in column (9) support the hypothesis of opportunistic corruption prevalence, as firms' informal payments are found to increase (decrease) with the experience of positive (negative) shocks.

Concerning the *ex ante* effect of instability on corruption, firm-level estimates in column (9) show a strong positive effect of the standard deviation of exports on firms' informal payments, which cannot be observed in FE estimates. Since the effect of the perception of instability on corruption may be observable on the long run rather than on the short run, cross-section regressions may reflect such a long term relationship better than does the FE estimator (Kennedy, 2008).

While this *a priori* contrasting empirical evidence may simply reflect sample differences, or differences between the long run and the short run effects of instability, problems of reverse causality or omitted variable bias might have been misleading us. This issue is addressed in the following sub-section.

[80] The high between-R^2 in column (2) may result from problems of multi-colinearity between time dummies and export skewness, since universal time-related export shocks may have been captured by time dummies. To check whether results are sensitive to the exclusion of time dummies, we run FE estimation of equation (4.4) without them. Results are displayed in annex 4.Ei) and show a more significant and stronger negative effect of export skewness on corruption score once time dummies are removed.

Table 4.1. Export instability and corruption, baseline results.

Dependent variable:	**ICRG**						**WBES**						
	Within fixed effects		IV-2SLS	IV-LIML	IVGMM-CUE	Sys-GMM	OLS			IV-2SLS		IV-LIML	IVGMM-CUE
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**	**(13)**
Lagged Corruption	0.723*** (0.00)	0.695*** (0.00)	0.677*** (0.00)	0.677*** (0.00)	0.706*** (0.00)	0.713*** (0.00)							
Export skewness		**-0.0002* (0.10)**	**-0.001 (0.24)**	**-0.001 (0.27)**	**-0.001* (0.07)**	**-0.001* (0.09)**			**0.003† (0.11)**	**0.002 (0.16)**	**0.003* (0.07)**	**0.003* (0.07)**	**0.004*** (0.00)**
Export std_dev		**-0.003 (0.77)**	**-0.051 (0.18)**	**-0.058 (0.18)**	**-0.081** (0.05)**	**-0.050 (0.63)**			**0.654*** (0.00)**	**0.560*** (0.00)**	**0.230* (0.09)**	**0.230* (0.09)**	**0.361*** (0.00)**
Population growth	-0.044 (0.24)	-0.039 (0.33)	0.015 (0.88)	0.038 (0.76)	0.090 (0.43)	-0.523 (0.42)	-0.463† (0.11)	-0.423† (0.12)	1.712*** (0.00)	1.374*** (0.01)	0.091 (0.86)	0.091 (0.86)	0.544 (0.16)
Nat. resources	0.007** (0.04)	0.009*** (0.01)	0.010** (0.05)	0.011* (0.06)	0.012** (0.02)	0.047 (0.29)	-0.012† (0.14)	-0.012 (0.17)	0.108*** (0.00)	0.089*** (0.00)	0.013 (0.65)	0.013 (0.65)	0.039* (0.07)
Government size	-0.011** (0.06)	-0.013** (0.04)	-0.018** (0.05)	-0.019* (0.06)	-0.017* (0.07)	0.028 (0.53)	2e-11* (0.09)	2e-11* (0.10)	3e-11*** (0.00)	3e-11*** (0.00)	3e-11*** (0.01)	3e-11*** (0.01)	3e-11*** (0.00)
Log population	0.718*** (0.00)	0.073 (0.79)	0.795 (0.14)	0.813 (0.14)	0.481 (0.40)	-2.013 (0.28)	0.545** (0.04)	0.560** (0.03)	0.438*** (0.00)				
Pol. regime stability	0.001 (0.74)	-0.003* (0.07)	-0.004** (0.04)	-0.004** (0.04)	-0.004* (0.07)	0.025 (0.21)	-0.019*** (0.00)	-0.019*** (0.00)	0.005 (0.59)	-0.001 (0.88)	-0.006 (0.33)	-0.006 (0.33)	-0.003 (0.54)
Democracy	-0.015** (0.02)	-0.018*** (0.01)	-0.010 (0.16)	-0.010 (0.19)	-0.009 (0.22)	0.010 (0.92)	0.158* (0.08)	0.165* (0.08)	0.831*** (0.00)	0.728*** (0.00)	0.359* (0.06)	0.359* (0.06)	0.518*** (0.01)
Log openness	0.135 (0.16)	0.065 (0.56)	0.126 (0.44)	0.157 (0.41)	0.228 (0.18)	0.740 (0.33)	0.021** (0.02)	0.021** (0.02)	0.023*** (0.00)	0.024*** (0.00)	0.023*** (0.00)	0.023*** (0.00)	0.025*** (0.00)
Latitude							0.048*** (0.00)	0.048*** (0.00)	0.064*** (0.00)				
Landlocked							2.489*** (0.00)	2.480*** (0.00)	-2.316** (0.02)				
Initial GDP per cap							0.809** (0.02)	0.856** (0.02)	1.395*** (0.00)				
Common Law							-11.26*** (0.01)	-11.05*** (0.02)	-2.869 (0.50)				
Firm size								-0.161** (0.04)	-0.159** (0.05)	-0.157** (0.03)	-0.036 (0.52)	-0.036 (0.52)	-0.039 (0.47)
State owned								0.027 (0.21)	0.028 (0.18)	0.028 (0.16)	-0.005** (0.05)	-0.005** (0.05)	-0.006** (0.02)
Direct exports (% sales)								-0.001 (0.54)	-0.002 (0.44)	-0.001 (0.51)	0.004 (0.41)	0.004 (0.41)	0.005 (0.24)

Indirect exports (% sales)							-0.002 (0.17)	-0.002 (0.31)	-0.001 (0.35)	-0.001 (0.20)	-0.001 (0.20)	-0.001** (0.04)
Constant	-11.44*** (0.00)	3.763 (0.44)				30.36 (0.36)	-2.978 (0.53)	-3.362 (0.59)	-22.28*** (0.00)			
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No			
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes			
Region dummies	No	No	No	No	No	No	Yes	Yes	Yes			
Obs(countries/clusters)	1144 (68)	1144 (68)	700 (46)	700 (46)	700 (46)	1144 (68)	9212 (23)	9212 (23)	9212 (23)	9212 (23)	4210 (23)	4210 (23)	4210 (23)
R-squared						Wald	0.083	0.084	0.084	0.02	0.02	0.02	0.02
Within	0.604	0.641	0.561	0.561	0.561	chi2(28) =							
Between	0.543	0.934				620							
Weak instrument test													
Kleibergen-Paap stat(critical value)			4.7 (21.7) [a]	4.7 (4.1) [a]	4.7 (4.1) [a]					1.2(16.9)[a]	5.2(16.9)[a]	5.2(4.7)[a]	5.2(4.7)[a]
F-test of excluded instruments													
1st stage equation - export skewness			6.44	6.44	6.44					8.42	5.86	5.86	5.86
1st stage equation - export std_dev			6.97	6.97	6.97					12.25	9.23	9.23	9.23
Hansen test (p-val)			0.17	0.19	0.21	0.84				0.04	0.45	0.45	0.50
Endogeneity test (difference-in-Hansen test), Chi2 p-value:													
6-yr skew + 16-year std-dev exports				0.32								0.81	
6-yr skew				0.35								0.84	
16-year std dev of exports				0.14								0.58	
AR(1) test (p-val)						0.00							
AR(2) test (p-val)						0.20							
Number of instruments			6	6	6	49				4	4	4	4

Standards errors robust to heteroskedasticity in all regressions, and clustered by country for OLS firm-level estimations. In column (5) standard errors are robust to heteroskedasticity and autocorrelation of order 1. P-values in parenthesis. *significant at 10%; **significant at 5%; ***significant at 1% † significant at 14%. Hansen J-statistic tests for joint instrument validity; null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term, and that instruments are correctly excluded from the second-stage equation. IV-estimates are adjusted for small sample bias.

In the sys-GMM estimation, time dummies are excluded instruments; the skewness of exports is treated as predetermined and instruments the differenced equation by its lagged levels (lags 1 to 10); the standard deviation is treated as endogenous and instruments the differenced equation by its lagged levels (lags 2 to 10); lagged corruption is treated as endogenous and instruments the equation in system by its lagged levels and differences (lags 2 to 11). Instruments are collapsed, orthogonal deviations are preferred to first-difference deviations, and the Windmeijer correction of the two-step estimated variance is applied.

In columns (10), (11), (12), and (13) we partialled-out the 20-year lag GDP per capita, geographic and common-law system dummy variables, and the logarithm of population to make the covariance matrix of the orthogonality conditions full rank. In blue-colored columns (11), (12), and (13) we restrict the sample to firms considering that corruption is not an obstacle or is a minor obstacle to their current operations.

a.When the Kleibergen-Paap statistic is below the Stock-Yogo critical value, then a standard significance test on estimated coefficient with nominal size of 5 percent has a maximal size of 10 percent or more.

4.2 Identification strategy

We conduct instrumental variable (IV) estimations with country-level and firm-level data to ensure that measurement errors, omitted variables or reverse causality problems do not bias our results (see box no.8). Then, we run system-GMM estimations to check whether autocorrelation between residuals induced by the lagged dependent variable does not bias results in panel FE and IV regressions (see box no.9).

4.2.1. Instrumental Variable (IV) estimations

While instability in real export earnings is mainly structural for small "price-taker" countries, caused by natural or trade shocks, fluctuations in exports around their trend may be sometimes generated by unstable or poorly designed policies (Chapter 3; Guillaumont 2010, 2009ab).[81] Moreover, the conceptual framework exposed in section 2 underlines a possible direct contribution of corruption to export fluctuations, in particular when corrupt schemes prevail in the custom sector and impact export volumes. Last but not least, in so far as corruption influences economic policy, the presence in our panel of "price maker" developed and emerging countries such as the United States, China or Brazil may bias our results because of a direct effect of their domestic policies on international trade. Our objective is hence to control for a possible reverse causality bias, but also for the omission of variables correlated with both export instability and corruption.

Instruments description

Building on a study on the climate origins of export movements (Jones and Olken, 2010) and the literature on the causes and consequences of structural economic vulnerability (Guillaumont, 2010, 2009ab), we instrument the 6-year skewness and the 16-year standard deviation of exports using a set of climatic and natural disasters variables, and a variable reflecting country exposure to trade shocks.

In both panel and cross-section IV-estimations, we use natural shock variables as instruments for the instability of exports. We therefore assume that natural shocks impact corruption through their effect on exports only. Although Jones and Olken (2010) find strong evidence of an impact of weather shocks on agricultural exports and light manufacturing exports of poor countries, this exclusion restriction may not hold if there is a direct effect of natural shocks on corruption passing

[81] Although it can be certainly advanced that "policy is likely to influence the trend more than it influences fluctuations around the trend" (Guillaumont, 2009a, p.191).

through variations in domestic (not exported) incomes, infrastructure destructions, health damages.[82]

On the one hand, we account for the effect of climate on export instability, by using as instruments the contemporaneous and lagged values of the 6-year skewness and 16-year standard deviation of rainfall levels around their average value. Rainfall-based shock variables have already been used by Voors et al. (2011) and Brückner and Ciccone (2011) to identify the effect of income shocks on corruption and democracy in Sub-Saharan African countries. Using rainfall data from *Global Air Temperature and Precipitation: Gridded Monthly and Annual Time Series* (Version 2.01)[83] treated by Guillaumont and Simonet (2011), we expect the instability in rainfall levels to be a direct internal cause of export instability in developing countries (Jones and Olken, 2010). On the other hand, we include the annual share of people affected by natural disasters – such as drought, tsunami, cyclone, floods, earthquakes and others – in the population. The computation of this indicator follows a methodology based on the calculation of the homeless index presented in chapter 3 and used by the United Nations Committee for Development Policy for the computation of the Economic Vulnerability Index (Guillaumont, 2009ab). Raw data is gathered from the Emergency Disaster Database (EM-DAT)[84], and the computation method is detailed in Annex 4.Di).

In IV-panel estimations, in addition to natural shock variables, we also use an index of country merchandize export concentration as excluded instrument, which has been used for the computation of the retrospective EVI in chapter 3. Following Guillaumont (2009ab), we expect merchandize export concentration to increase the countries' exposure to trade shocks and their structural vulnerability to them. Its computation method is presented in annex 4.Di).

First-stage estimation of the following system is conducted:

$$Skewness_{it} = \beta_0\ [+\beta_1.Corrupt_{it-1}] + \boldsymbol{\beta_2.Natural\_shocks_{it}\ [+\beta_3.Concentration_{it}]} + \beta_4.Macro\_controls_{it}\ \{+ \beta_5.Micro\_controls_{it}+\beta_6.timefixed\_controls\}\ [+\varphi_t + \chi_i\ ] +\upsilon_{it} \quad (4.4a)$$

$$Std\_dev_{it} = \beta'_0\ [+\beta'_1.Corrupt_{it-1}] + \boldsymbol{\beta'_2.Natural\_shocks\ [+\beta'_3.Concentration_{it}]} + \beta'_4.Macro\_controls_{it}\ \{+ \beta'_5.Micro\_controls_{it}+\beta'_6.timefixed\_controls\}\ [+\varphi'_t + \chi'_i] +\upsilon'_{it} \quad (4.4b)$$

where $Natural\_shocks_{it}$ and $Concentration_{it}$ are respectively the set of natural shock variables and the merchandise export concentration index. υ_{it} and υ'_{it} are random error terms.

[82] Brückner and Ciccone (2011) encountered the same kind of issue. In this case, this would lead to understate estimated causal effects of export instability on corrupt deals, since corruption mechanisms emphasised in section 2, such as survival corruption or resource-locking corruption strategies, are likely to operate in those contexts too.

[83] From the Center for Climatic Research of the University of Delaware. Data is interpolated and documented by Cort J. Willmott and Kenji Matsuura, with support from IGES and NASA, University of Delaware (for more information see Matsuura and Willmott, 2007).

[84] Data compiled by the Center for Research on the Epidemiology of Disaster (CRED) at the School of Public Health, Université Catholique De Louvain.

In all regressions, we choose the combination of exogenous instruments that minimize under-identification and weak identification problems. Correlations between instrumented variables and instruments are presented in annex 4.Dii). In panel regressions, we instrument the 6-year skewness and the 16-year standard deviation of exports by the following set of instruments:

- the contemporaneous and 4th lag of the 6-year skewness of rainfall levels. We include the fourth lag of rainfall skewness to account for the potential lasting effects of rainfall shocks on exports variations, while minimizing the correlation between current and lagged rainfall skewness and avoiding instrument redundancy.
- the contemporaneous and 4th lag value of the annual share of people affected by natural disasters. We include the fourth lag of the annual share of people affected by natural disasters to account for the lasting effects of past natural disasters on current export skewness, while minimizing the correlation between current and lagged values of the annual share of people affected by natural disasters and avoiding instrument redundancy.
- the contemporaneous value of the 16-year standard deviation of rainfall level.
- the contemporaneous value of the merchandize export concentration index. As this index has been calculated for a panel of 128 developing countries from 1984 to 2008 (see chapter 3), developed countries are excluded from IV panel estimations.

In cross-section firm-level IV estimations, our instrument set consists of:

- the contemporaneous (2008) and 4th (2004) lagged value of the 6-year skewness of rainfall levels. We include the fourth lag of rainfall skewness to account for the potential lasting effects of rainfall shocks on exports variations, while minimizing the correlation between current and lagged rainfall skewness and avoiding instrument redundancy.
- the contemporaneous value of the 16-year standard deviation of rainfall levels.
- the 3rd lag (2005) value of the annual share of people affected by natural disasters, which has the strongest correlations with instrumented variables (see annex 4.Dii)).

IV country-level panel estimates

Second stage country-level panel estimates are presented in columns (3), (4), and (5) of table 4.1. First stage results are displayed in annex 4.Diii). Two-Stage Least Square (2SLS) estimates of equation (4.4) are displayed in column (3). If the Hansen test does not reject the validity of our instrument set, endogeneity tests (robust to heteroskedastic standard errors) do not reject the null hypothesis that export instability variables can actually be treated as exogenous, in a 10% confidence level. However, the difference-in-Hansen test conducted on the standard deviation of

export alone rejects the null of exogeneity in a 14% confidence level. It is therefore plausible that estimates of the *ex ante* effect of export instability on corruption are biased.

F-tests of excluded instruments are below 10, suggesting that our instrument set is weakly correlated with the two measures of export instability. Moreover, the Kliebergen-Paap test of weak instrumentation displays statistics which are far below the 2SLS Stock-Yogo critical value, implying that a conventional significance test on β_2 and β_3 with a nominal size of 5% has an actual size of at least 10%. To address the problem of weak instruments bias, Limited Information Maximum Likelihood (LIML) estimation is performed. The LIML estimator has the advantage of being more robust to weak instruments than the 2SLS estimator (see box no. 8). Results are displayed in column (4). The Hansen test of over-identification does not reject the orthogonality of our instrument set, and the Kliebergen-Paap statistic is higher than Stock-Yogo LIML critical value. LIML estimates do not support any significant effects of export instability on corruption perceptions, at the usual confidence levels.

Box No. 8. Instrumental Variable methods and hypothesis testing.

Ordinary Least Square estimation of equation (4.4) leads to consistent and unbiased estimates of α_2 and α_3 as long as $skewness_{it}$ and std_dev_{it} are uncorrelated with ε_{it}, i.e. when $E[skewness_{it}\ \varepsilon_{it}] = E[std\_dev_{it}\ \varepsilon_{it}] = 0$. When these moment conditions are violated, variations in our instability variables are associated with variations in $corrupt_{it}$ and variations in ε_{it}, leading to inconsistent estimates of α_2 and α_3. $Skewness_{it}$ and std_dev_{it} are potentially endogenous regressors because of *measurement errors*, *omitted variables*, or *reverse causality*.

An instrumental variable method is conducted to generate variations in $skewness_{it}$ and std_dev_{it} uncorrelated with the error term, by regressing them on a set of excluded exogenous regressors (or instruments) along with other explanatory variables included in the baseline specification. A valid excluded instrument is a variable respecting the following ***orthogonality conditions***: i) it is correlated with our instability variable, ii) without being correlated with the error term. While the first condition imposes a direct association between our instruments and our instability variable, the second condition excludes instruments from being explanatory variables of $corrupt_{it}$. One necessary additional condition for a valid instrumental variable estimation is ***the order condition for identification*****,** implying that there must be at least as many instruments as there are endogenous regressors. If the number of instruments is lower than the number of endogenous regressors, then the equation is *under-identified*. If the number of instruments exceeds the number of endogenous regressors, the equation is *over-identified*. And if the number of instruments equals the number of endogenous regressors, the equation is *exactly identified*.

Test 1: when instruments outnumber endogenous regressors, i.e. when the equation is over-identified, it is possible to test the orthogonality conditions and the correctness of model specification using the **J-statistic of Hansen** (1982). A rejection of the null is a rejection of the hypothesis of valid instruments. This statistic is robust to heteroskedasticity and clustering.

Test 2: another test of orthogonality and order conditions is the **difference-in-Hansen test** or **C-test**, which consists in calculating the difference between the Hansen statistic corresponding to the IV regression with the full set of excluded instruments and the Hansen statistic corresponding to the IV regression using a smaller set of excluded instruments. This test can be performed to identify weak or invalid instruments among a large set of instruments. A rejection of the null is a rejection of the orthogonality conditions on the specified dubious variables.

Another necessary condition for valid IV estimation is ***the rank condition***, which requires in its simplest formulation that the correlation or covariance between instruments and our instability variable is significantly different from 0. If this condition is violated, the model is *under-identified* and the IV estimator is biased. If this condition is respected but correlations between excluded instruments and our endogenous regressors are low, the equation is then *weakly identified*,

leading to a weak instrument bias (Hahn and Haussman, 2002).

Test 3: it possible to test the relevance of excluded instruments by looking at the explanatory power of excluded instruments. This can be done using the F-test of joint-significance of excluded regressors or the partial R^2 of first-stage equations. Such an approach is however not sufficient to ensure the equation is correctly identified, since a high partial R^2 may arise from valid instruments excluded together with weak instruments. It is possible to address this issue using the Shea partial R^2 which reflects the explanatory power of each instrument by taking into account inter-correlations among all excluded instruments. As a benchmark, a "rule of thumb" proposed by Staiger and Stock (1997) suggests that weak identification problems are likely to arise when first-stage F-test are below 10 (Baum et al., 2007).

Test 4: even if first stage statistics point to strong instruments, some of them may still carry insufficient independent information. A statistic has been proposed by Cragg and Donald (1993) and by Kleibergen-Paap (2006) in a version robust to heteroskedasticity-autocorrelation-clustering, to test the relevance of the weakest instrument. A Cragg-donald statistic higher than the critical values calculated by Stock and Yogo (2002) leads to the rejection of the null hypothesis of the absence of weak instrument problem, according to different levels of bias acceptability. This test requires disturbances to be homoscedastic. If not, one may wrongly conclude that the model is correctly identified. Moreover, in case of robust-cluster estimations, the comparison between Kleibergen-Paap statistics and Stock-Yogo critical values should be undertaken with caution, and one should better apply the previous F-test "rule of thumb".

A further alternative for weak instrument problem is to apply the Limited Information Maximum Likelihood Estimator. This estimator is more robust to weak instrument than the usual 2-Stage Least Square. The reported Stock-Yogo critical values are lower than those reported in 2SLS estimations, as the weak identification bias is lower in LIML estimations. One drawback of the LIML estimator is its sensitivity to non-i.i.d disturbances. When the i.i.d. assumption is rejected, a solution may consist in applying the GMM version of the LIML estimator, namely the *Continuously Updated GMM* estimator or CUE, which can deal with heteroskedasticity of unknown form (Hansen et al., 1996).

As stressed by Baum et al. (2007), LIML estimates may be biased in presence of heteroskedasticity. Following Hansen et al. (1996), we perform the Continuously Updated GMM Estimator (CUE), which is an estimator robust to weak instrument problems and heteroskedasticity of unknown form. Results are presented in column (5). Hansen and Kliebergen-Paap tests do not reject the validity of our instrument set. CUE-GMM estimates support a significant negative effect of both the 6-year skewness (7% significant) and the 16-year standard deviation of exports (5% significant) on corruption perceptions.

IV firm-level cross-section estimates

Second stage firm-level IV estimates are presented in columns (10), (11), (12), and (13) of table 4.1. First stage results are displayed in annex 4.Diii). In column (10), estimates do not provide evidence of a significant *ex post* effect of export instability on corrupt transactions, in the usual confidence levels. While F-tests of excluded instruments suggest that instrumental variables have a reasonable explanatory power, the Hansen test rejects with a 6% confidence level the validity of our instrument set. Here, the non-violation of orthogonality conditions relies on the hypothesis that country-level natural shock variables impact a firm's corruption expenses through its own income fluctuations. This hypothesis may be unrealistic since a firm' bribe payments may be caused by variations in other economic agents' income. For instance, rainfall-induced export shocks may incite custom officers to extort higher bribes to firms, or may incite a firm to engage in corruption because of an intensified competition from other firms for economic rents. It is therefore very

likely that the validity of our instrument set is rejected because a firm's informal payments also result from the pressure exerted by other agents affected by common natural shocks. One solution to this problem may consist in using measures of instability reflecting idiosyncratic (individual) fluctuations only. Such an approach is carried out in sub-section 7.1. The approach followed in this sub-section consists in excluding from the sample firms which do not engage proactively in corrupt transactions ("passive" firms). Indeed, firms which bribe without feeling compelled to do it are expected to engage in corruption because of fluctuations in their own income rather than in other economic agents' income. To distinguish 'passive' firms from 'active' ones, we combine WBES data on firms' informal payments with WBES data on firms' perception of corruption. We expect that firms considering corruption as "no obstacle" or "a minor obstacle" for their business to be proactive corrupters if they declare in parallel making informal payments.[85] We perform the same 2SLS estimation of equation (4.4) on a sample of potentially "active" firms (also including firms which declared they did not pay any bribes but considered corruption as no obstacle or a minor obstacle to their business).[86]

Results are exposed in column (11). The Hansen test does not reject the null hypothesis of instrument orthogonality, which tends to advocate the relevance of our identification strategy.[87] Endogeneity tests do not reject the null hypothesis that export instability variables can actually be treated as exogenous, in a reliable confidence level. Estimates show a 10% significant positive effect of the instrumented export skewness on corruption expenses, similar to that estimated in OLS regression. They also support a 10% significant positive effect of the instrumented standard deviation of exports on corrupt transactions.

However, F-tests of excluded instruments and the Kleibergen-Paap statistic are low, which still casts doubts on the consistency of 2SLS estimates. To address a possible weak instrument bias, the Limited Information Maximum Likelihood procedure is applied to estimate β'_2 and β'_3. The Kleibergen-Paap statistic is higher than the reported Stock-Yogo LIML critical values, suggesting that LIML estimates should not be affected by weak instrumentation bias. Estimated parameters of instability variables and their corresponding standard errors are very similar those obtained with the

[85] Interviewed firms have been asked whether they perceive corruption as an obstacle to business, and to what extent. They were asked the following question: "Is corruption 'No Obstacle', a 'Minor Obstacle', a 'Moderate Obstacle,' a 'Major Obstacle', or 'a Very Severe Obstacle' to the current operations of this establishment?" (WBES core questionnaire, p17). Removing firms which consider corruption as an obstacle to their business also allows to remove from the sample firms presenting the risk of "false responses", i.e. firm considering corruption as an obstacle but which did not dare reporting the size of informal payments (Jensen et al., 2010).

[86] It can be objected that this approach may be conceptually imperfect since firms perception of corruption probably depends on the cycle (Kaplan and Pathania, 2010). Such procedure may in this case suffer from reverse causality bias.

[87] 2SLS estimation of equation (4) has also been conducted on the remaining sample of firms, i.e. firms considering corruption as at least a moderate obstacle to their business. Results are presented in the last column of annex D.3, and the corresponding Hansen-J statistic significantly rejects the hypothesis of instruments validity.

2SLS estimator. However, since 2SLS and LIML estimates are not consistent under heteroskedasticity, we again perform the Continuously Updated GMM Estimator (CUE), robust to non-i.i.d disturbances. We observe that the strength and significance of estimated instability coefficients were understated in both 2SLS and LIML estimations.

4.2.2. System GMM estimations

We provide further empirical evidence on the causal effects of export instability on corruption by applying the dynamic panel GMM estimator to equation (4.4). This approach is motivated by i) the presence of the lagged dependent variable in the right-hand side of the equation, and ii) problems of weak instruments that arose in IV panel estimations.

As the time length of our panel may cause problems of instrument proliferation (Roodman, 2009), the number of instruments is minimized by performing difference-GMM on instability variables (Arellano and Bond, 1991). We consider the skewness of exports as a predetermined variable and instrument it in difference by its first and higher order lagged levels (lags 1 to 10). As difference-in-Hansen test brings the exogeneity of the 16-year standard deviation of exports into question, we treat it as an endogenous regressor, and instrument it in difference by its second and higher order lagged levels (lags 2 to 10). The lagged level of the corruption perception indicator is considered as endogenous and is instrumented in system (Blundell and Bond, 1998) by its second and higher order lagged levels and differences (lags 2 to 11).

Moreover, we prefer the orthogonal deviation transform to the first-difference transform of equation (4.4). The "forward orthogonal deviation" transform (Arellano and Bover, 1995) consists in removing the fixed effect by subtracting the average of all future available observation of a variable (Y_t) as follow (Roodman, 2006):

$$Y^{\perp}_{t} = c_t \cdot \left(Y_t - \frac{1}{T_t} \sum_{s>t} Y_s \right) \text{ with } t = 1, \ldots, T$$

where the sum is taken over available future observations, T_t is the number of available observations at time t, and the scale factor is

$$c_t = \sqrt{\frac{T_t}{T_t + 1}}$$

The orthogonal deviation transform is usually applied to minimize data losses with unbalanced panel data, or when first differencing creates artificial correlations between errors that were uncorrelated before the transformation. It has been shown that in balanced panels, both transformations produces identical estimators, holding the instrument set fixed (Arellano and Bover, 1995). Applying separately first differencing and orthogonal deviation transforms to our

GMM specification yields pretty different estimates, which points to problems of unbalanced panel data. Notably, performing sys-GMM on equation (4.4) in first-difference produces estimates of the lagged dependent variable that are far below the value of FE estimates, which is not consistent with the econometric reasoning underlying the use of dynamic panel GMM (see box no.9). By contrast, applying the orthogonal deviation transform to equation (4.4) for different GMM specifications produces estimates that are higher than FE estimates and lower than OLS estimates (the latter are presented in annex 4.E).

Results are presented in column (6) of table 4.1. Estimates pass the Hansen test of identification and the Arellano-Bond test of two-order autocorrelation in a reliable confidence level, and confirm the significant negative *ex post* effect of export instability on corruption perceptions observed in FE estimations. In particular, despite differences in the sample (in sys-GMM estimations, developed countries are not excluded from the sample) and in the instrumentation technique, estimates of the lagged dependent variable and the skewness variable are strikingly similar to those obtained in IV estimation (columns (3), (4) and (5)).[88] However, the 16-year standard deviation of export does not appear significant in sys-GMM estimations, which contrasts with previous GMM-CUE estimates.

4.3 Summary results

To make sure that problems of endogeneity do not bias FE country-level and OLS firm-level estimates, we conducted Instrumental Variable (IV) estimations and system-GMM (sys-GMM) estimations of the effects of export instability on corruption.

Regarding panel estimations, while endogeneity (difference-in-Hansen) tests on export instability variables do not point to serious problems of reverse causality with corruption perceptions, we had to check for the consistency of IV panel estimates in presence of i) a probable weak instrument bias, and ii) a probable dynamic bias caused by the presence of the lagged dependent variable in the right-hand side of equation (4.4). We address the first bias by applying the GMM-CUE estimator to equation (4.4), which is robust to weak instruments and non-spherical disturbances. We address the second bias by applying the sys-GMM estimator to equation (4.4).

Regarding cross-section estimations, we had to address an omitted variable bias in IV estimates of the effects of aggregate export fluctuations on firms' informal payments. Our identification strategy was aimed at ensuring that the effects of instability in aggregate exports on a firm's informal payments are channelled by fluctuations in its income only, not through movements in other economic agents' income. We circumvented this problem by restricting the sample to "active" firms, i.e. firms which consider corruption as no obstacle or minor obstacle to their business and

[88] Suggesting that the bias in the value of the estimated coefficient potentially induced by an indirect effect of natural shocks passing through other channels than the export channel is somewhat limited.

therefore would engage on purpose in bribery. Hansen-J statistic of IV estimations on the sample of "active" firms in table 4.1 did not indicate problems of endogeneity (columns (11), (12), and (13)), while Hansen-J statistic of IV estimations on the sample of "passive" firms in annex 4.Diii) did. Moreover, endogeneity (difference-in-Hansen) tests on export instability variables, conducted on the restricted sample of active firms, did not reject in a 10% confidence level orthogonality conditions for the specified endogenous regressors. In the next cross-section estimations, we therefore prefer the OLS estimator to the IV estimator because of the former has better asymptotic properties when regressors of interest are exogenous. Cross-section estimations of the following empirical specifications are conducted on both the original sample of firms and the restricted sample of "active" firms. In fact, estimating together the direct effect of firms' income instability and the indirect effect of instability via other economic agents' income is still of interest for our analysis.

Despite methodological and sample differences, GMM and IV panel estimations both point to a negative *ex post* effect of instability on corruption perceptions, similar in strength and in significance, suggesting that survival corruption transactions prevail over opportunistic corruption transactions during export fluctuations. By contrast, IV cross-section estimations point to a positive *ex post* effect of instability on firms' informal payments, suggesting that opportunistic corruption transactions prevail over survival corruption transactions. We also find contrasting evidence of an *ex ante* effect of export instability on corruption perceptions and firms' bribe payments. Suspecting that such contrasting estimates are driven by sample differences and reflect nonlinear rather than inconsistent effects of export instability, we relax the linearity assumption on the effects of instability on corruption in the next section.

Box No. 9. Applying the GMM system estimator[89]

OLS estimation of equation (4.4) cannot produce consistent estimates of α_2 and α_3, because the correlation between the lagged dependent variable and the fixed effect creates a dynamic panel bias additional to traditional estimation bias addressed earlier:

$$Corrupt_{it} = \alpha_0 + \alpha_1.Corrupt_{it-1} + \alpha_2.Skewness_{it} + \alpha_3.Std\_dev_{it} + \beta.Controls + \lambda_t + \mu_i + \varepsilon_{it} \quad (4.4)$$

with $E[Corrupt_{it-1}\ \mu_i] \neq 0$. Such a correlation biases OLS estimates upward. It attributes spurious explanatory power to the lagged dependent variable, $Corrupt_{it-1}$, which is actually attributable to the fixed effect. Unfortunately, addressing this problem using the usual within-group fixed effect estimator creates a negative correlation between the lagged dependent variable and the error term, which biases FE estimates downward (Roodman, 2006). Removing unobservable heterogeneity by estimating equation (4.4) in first difference may be a solution to this dynamic bias:

$$\Delta Corrupt_{it} = \alpha_1.\Delta Corrupt_{it-1} + \alpha_2.\Delta Skewness_{it} + \alpha_3.\Delta VAR_{it} + \beta.\Delta Controls + \Delta\lambda_t + \Delta\varepsilon_{it} \quad (4.4')$$

First-differencing does however create artificial correlation between $\Delta Corrupt_{it-1}$ and $\Delta\varepsilon_{it}$ because both terms have ε_{it-1} in common, leading to inconsistent estimates of α_2 and α_3. A solution stressed by Anderson and Hsiao (1981) is to

[89] This box has been adapted from a box in Gaëlle Balineau's thesis "Le commerce équitable: un outil de développement?", University of Auvergne, Centre d'Etudes et de Recherches sur le développement International, 2010.

instrument the first difference of the lagged dependent variable by its second lag in level. This approach produces consistent and efficient estimates of α_2 and α_3, as long as hypotheses of weak exogeneity of regressors (not correlated with future disturbances) and no auto-correlation of disturbances are respected, i.e. when $E[Corrupt_{it-2}\,\Delta\varepsilon_{it}] = 0$.

This approach has been further developed by Arellano and Bond (1991), who exploited longer lags of the dependent variable in level to instrument its lagged first-difference. However, because lagged levels of the dependent variable may be poor predictors of its lagged first difference, particularly for random-walk like variables (Roodman, 2006; Blundell and Bond, 1998) the Arellano-Bond estimator may suffer from weak instrumentation bias. Arellano and Bover (1995) and Blundell and Bond (1998) address the violation of rank condition by instrumenting the first lagged difference of the dependent variable ($\Delta Corrupt_{it-1}$) by its lagged levels, and the first lagged level by its lagged differences ($Corrupt_{it-k}$ and $\Delta Corrupt_{it-k}$, with $k \geq 2$). This approach consists in estimating simultaneously equation (4.4) in level and in difference, by applying the Generalized Method of Moment (GMM) to the following system of orthogonality conditions (the GMM-system estimator):

$$\begin{cases} E[Corrupt_{it-k}\,\Delta\varepsilon_{it}] = 0 & \text{with } k \geq 2;\ T=3,\ldots T \quad (a) \\ E[\Delta Corrupt_{it-k}\,\varepsilon_{it}] = 0 & \text{with } k \geq 2\ T=3,\ldots T \quad (b) \end{cases}$$

Respecting the above conditions requires instrumenting the lagged difference of the dependent variable by its lagged levels of order two or higher (a), and instrumenting the lagged level of the dependent variable by it lagged differences of order two or higher (b). Other exogenous regressors of equation (4.4) can also be introduced in level or difference as excluded instruments of the system.

Because of a possible mean-reversal process, the presence of the lagged corruption in the differenced equation may bias the estimation of regressors orthogonal to the contemporaneous error term (ε_{it}) in equation (4.4). In these circumstances, it is probable that export instability variables are correlated with lagged error terms, i.e. are weakly exogenous or pre-determined:

$$\begin{cases} E[Instability\_measure_{it-k}\,\varepsilon_{it-s}] \neq 0 & \text{for all } s>k \\ E[Instability\_measure_{it-k}\,\varepsilon_{it-s}] = 0 & \text{for all } s \leq k \end{cases}$$

To remove such a correlation, a solution consists in instrumenting the pre-determined variable by its first or higher order lagged values (in level and/or difference).

Testing sys-GMM specification

- Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998) test the orthogonality of lagged regressors and non GMM-type instruments using the **Sargan-Hansen test of over-identification**. Because of its sensitivity to auto-correlation in error terms, the Hansen test must be performed along with **the two-order autocorrelation test of Arellano and Bond** (Roodman, 2006).
- Instrument proliferation makes estimators and specification tests misleading. As the time dimension rises the number of instrument (lagged variables) mechanically increases, which may overfit endogenous variables and lead the Hansen test to under-reject the null of instrument validity. One typical symptom of instrument proliferation is when the Hansen J-stat approaches 1. Another check for instrument proliferation is to make sure that the number of instrument does not exceed panel width (Roodman, 2009).
- Roodman (2006) stresses that while OLS estimates of the lagged dependent variable are biased upward, within group FE estimates are biased downward. Thus, one simple test of the sys-GMM specification is to ensure that the estimated parameter of the lagged dependent variable is lower than OLS estimates but higher than FE estimates.

5. Disentangling the *ex post* and *ex ante* effects of instability on corruption

In a first sub-section, we insert simultaneously in the corruption equation a variable of positive skewness and a variable of negative skewness, to account for possible asymmetric *ex post* effects of shocks and asymmetric corruption responses to them. In the second and third sub-sections, we show that the direction of the *ex post* and *ex ante* effects of export instability on corrupt deals depends on the size and frequency of export fluctuations.

5.1. Disentangling the *ex post* effect of instability: accounting for the asymmetry of export fluctuations

Following Rancière et al. (2008), we insert the negative and the positive skewness of exports together in the corruption equation. The negative (positive) skewness of export is computed as a variable equal to the absolute value of skewness if the latter is negative (positive) and equal to zero otherwise. By doing this, we can identify *asymmetric effects* of positive and negative shocks – by looking at the relative *strength* of estimated coefficients – and *asymmetric corruption responses* to positive and negative shocks – by looking at the *sign* of estimated coefficients. We therefore estimate the following corruption equation:

$$Corrupt_{it} = \alpha_0 \; [+ \; \alpha_1.Corrupt_{it-1}] \; + \; \boldsymbol{\alpha_{2a}.Positive\_skewness_{it}} \; + \; \boldsymbol{\alpha_{2b}.Negative\_skewness_{it}} \; + \; \alpha_3.std\_dev_{it} \; + \; \alpha_4.Macro\_controls_{it} \{+ \; \alpha_5.Micro\_controls_{it} + \alpha_6.timefixed\_controls\} + \lambda_t \; [+ \; \mu_i] \; + \varepsilon_{it} \qquad (4.5)$$

Results are presented in table 4.2. Both country-level and firm-level estimations support a 'global deterrent' *ex post* effect of export instability on corruption. This evidence is consistent with the assumption presented in sub-section 2.1 of a decreasing marginal effect of transitory shocks on corruption practices (whether opportunistic or survival), yielding *asymmetric corruption responses* to shocks. Moreover, difference in the *asymmetric* deterrent *effect* of positive and negative shocks explains why previous panel and cross-section estimations of the *ex post* 'net' effect of instability were ambiguous in table 4.1. If the deterrent effect of adverse shocks is not significant in a 10% confidence level in FE and GMM estimations, OLS firm-level estimation conducted on the original sample of firms (column (4)) shows that adverse shocks have a stronger deterrent effect on corruption than positive shocks. Finally, looking at the effect of export shocks on "active" informal payments in column (5), neither episodes of positive shocks nor episodes of negative shocks are found to significantly impact corruption.

In the following sub-section, we further disentangle the *ex post* effects of export instability on corruption by testing whether the decreasing or increasing nature of the marginal effect of shocks, and therefore the direction of the estimated relationship, depends on the size and frequency of export fluctuations.

Table 4.2. Accounting for the asymmetry of export fluctuations

Dependent variable:	**ICRG**			**WBES**	
	Within fixed effects		Sys-GMM	OLS	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Lagged Corruption	0.694*** (0.00)	0.714*** (0.00)	0.700*** (0.00)		
Export skewness > 0	**-0.0006* (0.06)**	**-0.001*** (0.01)**	**-0.001** (0.02)**	**-0.004* (0.08)**	**0.002 (0.61)**
Export skewness < 0	**-0.0002 (0.38)**	**-0.0003 (0.46)**	**-0.001 (0.22)**	**-0.013** (0.02)**	**-0.004 (0.47)**
Export std_dev	-0.001 (0.89)	0.001 (0.93)	-0.001 (0.99)	0.813*** (0.00)	0.213 (0.28)
Population growth	-0.043 (0.32)	-0.039 (0.28)	-0.196 (0.63)	1.380*** (0.00)	-0.27 (0.69)
Nat. resources	0.008*** (0.01)	0.007** (0.04)	0.038 (0.19)	0.125*** (0.00)	0.009 (0.76)
Government size	-0.013** (0.05)	-0.013** (0.03)	0.014 (0.70)	3e-11*** (0.00)	3e-11*** (0.00)
Log population	-0.074 (0.79)	0.629*** (0.00)	-0.193 (0.86)	0.448*** (0.00)	0.386** (0.02)
Pol. regime stability	-0.0031** (0.05)	0.000 (0.99)	-0.005 (0.81)	0.015* (0.08)	-0.008 (0.41)
Democracy	-0.018*** (0.01)	-0.016*** (0.01)	-0.077 (0.36)	0.902*** (0.00)	0.345** (0.05)
Log openness	0.068 (0.55)	0.178* (0.08)	0.636 (0.40)	0.026*** (0.00)	0.026*** (0.00)
Latitude				0.080*** (0.00)	0.044*** (0.01)
Landlocked				-2.672*** (0.00)	0.162 (0.90)
Initial GDP per cap				1.309*** (0.00)	0.333 (0.28)
Common Law				-3.147 (0.39)	-13.67** (0.02)
Firm size				-0.154* (0.06)	-0.035 (0.52)
State owned				0.027 (0.17)	-0.006** (0.04)
Direct exports				-0.001 (0.51)	0.003 (0.42)
Indirect exports				-0.002 (0.27)	-0.001** (0.05)
Constant	2.366 (0.62)	-9.971*** (0.00)	1.871(0.92)	-22.54*** (0.00)	0.153 (0.98)
Country fixed effects	Yes	Yes	Yes	No	No
Time dummies	Yes	No	Yes	Yes	Yes
Observations (countries/clusters)	1144 (68)	1144 (68)	1144 (68)	9212 (23)	4283 (23)
R-squared				0.083	0.10
Within	0.642	0.609	Wald chi2(29) =		
Between	0.954	0.612	679		
Hansen test (p-val)			0.36		
AR(1) test (p-val)			0.00		
AR(2) test (p-val)			0.32		
Number of instruments			55		

When possible, coefficients are rounded to three decimal places. Standards errors robust to heteroskedasticity in all regressions, and clustered by country for OLS firm-level estimations. P-values in parenthesis. *significant at 10%; **significant at 5%; ***significant at 1%. Hansen J-statistic tests for joint instrument validity; null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term, and that the excluded instruments are correctly from the second-stage equation. In the sys-GMM estimation, time dummies are excluded instruments; the skewness of exports is treated as predetermined and instrument the differenced equation by its lagged levels (lags 1 to 9); the standard deviation of exports is treated as endogenous and instrument the differenced equation by its lagged levels (lags 2 to 9); lagged corruption is treated as endogenous and instrument the equation in system by its lagged levels and differences (lags 2 to 10). Instruments are collapsed, orthogonal deviations are preferred to first-difference deviations, and the Windmeijer correction of the two-step estimated variance is applied. Hansen J-statistic tests for joint instrument validity; null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term, and that the excluded instruments are correctly from the second-stage equation.

5.2. Disentangling the *ex post* effects of instability: accounting for the frequency and size of export fluctuations

Following Alderman (1996), Dercon (2002), Collier (2002) or Wolf (2005), we posit that the direction of the *ex post* of instability may differ according to the destabilizing nature of output variations. As Dercon (2002, p.2) points out,

> "Other characteristics of income risk include the frequency and intensity of shocks, and the persistence of their impact (…). Relatively small but frequent shocks are more easily to deal than large, infrequent negative shocks."

Following Olson (1993)'s analysis of economic development under different political system, opportunist *roving bandits*, motivated by a strong appetite for wealth accumulation during periods of political or economic disarray, are likely to spread during sudden and sharp transitory booms, when usual institutional safeguards against malpractices are overwhelmed by rent-seeking behaviours. Survival corruption is also likely to expand during sharp unexpected busts, when usual coping mechanisms cannot fully absorb their negative consequences on income or welfare. Conversely, institutional and financial constraints may not bind during normal fluctuations, which may increase the opportunity cost of engaging in corruption during moderate positive shocks while enabling agents to (at least partly) cushion the consequences of moderate adverse shocks on income. It is therefore likely that the decreasing or increasing nature of the marginal effect of exports shocks on corruption, illustrated in graphs 4.4iii) and 4.4iv) of section 2.1, depends on the destabilizing nature of export variations.

Rancière et al. (2008) stress that the coefficient of skewness is a bi-dimensional measure that appraises both the asymmetry and the tail's fatness of a distribution. Chapter 2 and annex 4.B support their findings by highlighting a strong and positive relationship between absolute values of skewness and the kurtosis of exports.[90] Thus, to account for nonlinear *ex post* effects reliant on the abruptness of export fluctuations, we introduce together in the corruption equation the quadratic terms of the positive and negative 6-year rolling skewness of exports (equation (4.6a)). As an additional test for such nonlinearities, we replace the quadratic terms by the interactions of the 6-

[90] The kurtosis is a measure of both the peakedness and tails' fatness of a random variable's probability distribution. Often referred as "the instability of instability", the kurtosis measures the extent to which observed values far from the mean (or their trend) are frequent in comparison to those in the neighborhood of the mean (or their trend). We compute the *k*-year rolling kurtosis of exports as follows:

$$\text{Kurtosis}_t = 100 \times \frac{\frac{1}{T}\sum_{1}^{T}\left(\frac{y_t - Y_t}{Y_t}\right)^4}{\left[\frac{1}{T}\sum_{1}^{t}\left(\frac{y_t - Y_t}{Y_t}\right)^2\right]^2}$$

with T = [t; t-k], y_t the observed value of export earnings and Y_t their trend value.

year rolling kurtosis of exports with the positive and negative 6-year rolling skewness of exports (equation (4.6b)).

Panel fixed effect, sys-GMM, and cross-section OLS firm-level estimations of the following equations are conducted:

$$Corrupt_{it} = \alpha_0 [+ \alpha_1.Corrupt_{it-1}] + \boldsymbol{\beta_{2a}.Positive\_skewness_{it}} + \boldsymbol{\beta_{2b}.Negative\_skewness_{it}} + \boldsymbol{\beta_{2c}.Positive\_skewness^2_{it}} + \boldsymbol{\beta_{2d}.Negative\_skewness^2_{it}} + \alpha_3.std\_dev_{it} + \alpha_4.Macro\_controls_{it} \{+ \alpha_5.Micro\_controls_{it} + \alpha_6.timefixed\_controls\} + \lambda_t [+ \mu_i] + \varepsilon_{it} \quad (4.6a)$$

and

$$Corrupt_{it} = \alpha_0 [+ \alpha_1.Corrupt_{it-1}] + \boldsymbol{\beta'_{2a}.Positive\_skewness_{it}} + \boldsymbol{\beta'_{2b}.Negative\_skewness_{it}} + \boldsymbol{\beta'_{2c}.Positive\_skew*6yr\_kurtosis_{it}} + \boldsymbol{\beta'_{2d}.Negative\_skew*6yr\_kurtosis_{it}} + \beta'_{2e}.6yr\_Kurtosis_{it} + \alpha_3.std\_dev_{it} + \alpha_4.Macro\_controls_{it} \{+ \alpha_5.Micro\_controls_{it} + \alpha_6.timefixed\_controls\} + \lambda_t [+ \mu_i] + \varepsilon_{it} \quad (4.6b)$$

Results are presented in table 4.3. FE estimates of equations (4.6a) and (4.6b) highlight a significant U-shaped *ex post* effect of export instability on corruption perceptions. Below a 6-year skewness of 150% and a 6-year kurtosis of 286%[91], we find a 1%-significant 'global deterrent' *ex post* effect of export instability on corruption perceptions (as illustrated in figure 4.4iii of section 2.1). Above these threshold values, the sign of the relationship reverses and a 1 or 3%-significant 'global boosting' *ex post* effect of instability is evidenced (as illustrated in figure 4.4iv of section 2.1). Sys-GMM estimates of equation (4.6a) also support the existence of an 11-15% significant U-shaped *ex post* effect of export instability on corruption, with a turning point corresponding to an absolute skewness of 125-150%. Sys-GMM estimation of equation (4.6b) does not however display significant evidence of a similar relationship.

OLS firm-level estimates of equations (4.6a) and (4.6b) with the original sample of firms are presented in left-sided uncoloured columns of table 4.3, while estimates obtained with the sample of "active" firms are presented in right-sided blue columns. Estimations of equation (4.6b) conducted on both the whole sample and the sample of "active" firms support a similar U-shaped *ex post* effect of export instability on firms' corruption expenses. Estimation of equation (4.6b) conducted on the whole sample of firms supports the evidence of a 15%-significant U-shaped effect of both positive and negative skewness of exports, with a kurtosis threshold of 220% and 226%, respectively. When the sample is restricted to "active" firms, estimates of equation (4.6b) support the evidence of a 1%-significant U-shaped effect of both positive and negative skewness of exports, with a kurtosis threshold of 328% and 186%, respectively.

[91] A value of kurtosis surprisingly close to the kurtosis of a normal distribution (300%).

Thus, we highlight a 'global deterrent' *ex post* effect of instability, resulting from the decreasing marginal effect of moderate and frequent shocks on corruption (as explained in figure 4.4iii of section 2.1). We also find a 'global boosting' *ex post* effect of instability, resulting from the increasing marginal effect of large and infrequent shocks on corruption (as explained in figure 4.4iv of section 2.1).

5.3. Disentangling the *ex ante* effects of instability: accounting for the "normal" or "abnormal" nature of export instability

Distinct effects of "normal" and "systemic" risk on insurance patterns have been underlined by Collier (2002), who points out the existence of a "paradox of insurance provision". Although insuring against systemic risk should be the desirable practice, it appears that the most common practice is the opposite pattern: small-size, frequent, idiosyncratic shocks are better insured than economy-wide, infrequent and large shocks. Considering that corruption activities can act as an insurance against income fluctuations when they are undertaken to secure future resource inflows, a positive relationship between perceptions of instability and resource-locking corrupt transactions should be empirically observed in case of "normal" or "humdrum" fluctuations; while a negative relationship should be observed in case of "abnormal" or "systemic" fluctuations.

Nonlinearities depending on the size and frequency of economic fluctuations may therefore characterize the *ex ante* effect of instability and corruption. We consider that the long-run kurtosis of the distribution of exports around their trend provides additional information on the way economic agents perceive instability. For a given 16-year standard deviation of exports, a low rolling 16-year kurtosis characterizes contexts where agents perceive economic instability as the result of "normal" fluctuations. By contrast, a high 16-year kurtosis of exports rather characterizes contexts where agents perceive instability as the result of "abnormal" fluctuations.

Therefore, we disentangle the *ex ante* effect of instability on corruption by inserting into the corruption equation the product of the 16-year rolling kurtosis of exports with the 16-year rolling standard deviation of exports:

$$Corrupt_{it} = \alpha_0 [+ \alpha_1.Corrupt_{it-1}] + \alpha_{2a}.Positive\_skewness_{it} + \alpha_{2b}.Negative\_skewness_{it} + \boldsymbol{\beta_{3a}.\ std\_dev_{it}} + \boldsymbol{\beta_{3b}.std\_dev_{it}*16yr\_kurtosis} + \beta_{3c}.16yr\_Kurtosis_{it} + \alpha_4.Macro\_controls_{it} \{+ \alpha_5.Micro\_controls_{it} + \alpha_6.timefixed\_controls\} + \lambda_t [+ \mu_i] + \varepsilon_{it} \quad (4.7)$$

Results are presented in table 4.3. FE estimates of equation (4.7) show a significant kurtosis threshold equal to 400%, beyond which the statistical relationship between the 16-year standard deviation of exports and corruption becomes highly significant and negative. In other words, when perceptions of instability result from "abnormal" fluctuations corruption is found to decrease, which is consistent with the "paradox of insurance provision" previously mentioned.

To address the potential endogeneity bias in the relationship between the standard deviation of exports corruption in panel estimations[92], we instrument the standard deviation and the interaction term in equation (4.7) by our natural disaster variable, the 16-year standard deviation of rainfall, and the products of the 16-year export kurtosis with these two excluded regressors. First-stage estimations are hence conducted on the following system:

$$Std\_dev_{it} = \gamma_0 + \gamma_1.Corrupt_{it-1} + \gamma_2.\mathbf{Natural\_shocks_{it}} + \gamma_3.\mathbf{Natural\_shocks*16yr\_export\_kurtosis_{it}} + \gamma_4.16yr\_Kurtosis_{it} + \gamma_5.controls_{it} + o_t + \pi_i + \omega_{it} \quad (4.7a)$$

$$Std\_dev*16yr\_export\_kurtosis_{it} = \gamma'_0 + \gamma'_1.Corrupt_{it-1} + \gamma'_2.\mathbf{Natural\_shocks_{it}} + \gamma'_3.\mathbf{Natural\_shocks*16yr\_export\_kurtosis_{it}} + \gamma'_4.16yr\_Kurtosis_{it} + \gamma'_5.controls_{it} + o'_t + \pi'_i + \omega'_{it} \quad (4.7b)$$

where $Natural\_shocks_{it}$ is a vector including the natural disaster and the rainfall instability variables. 2SLS and GMM-CUE regressions are run on equations (4.7), (4.7a) and (4.7b). Second-stage results are presented in table 4.3, and first-stage results are presented in annex 4.Civ).

2SLS and GMM-CUE estimations pass the Hansen test of over-identification restrictions, and do not seem to suffer from weak identification bias. Both estimations support a hump-shaped *ex ante* effect of export instability on corruption. Below a kurtosis threshold of 635% (2SLS) and 675% (GMM-CUE), a 1% significant positive *ex ante* effect of instability is found, while above these thresholds the direction of the effect reverses in a 1% confidence level. Thus, corruption is found to significantly increase when perceptions of export instability arise from "normal" fluctuations, while corruption is found to significantly decrease when perceptions of export instability arise from "abnormal" fluctuations.

It could be rightly objected that very few observations exhibit a kurtosis exceeding 635%[93], which suggests that the hump-shaped relationship between the standard deviation of exports and corruption should be considered with caution. Nevertheless, a robust significant positive *ex ante* effect of perceptions of "normal" instability is evidenced in both panel IV estimations and in cross-section OLS estimations, which is still consistent with the paradox of insurance provision emphasised earlier. According to our results, resource-locking corruption strategies are likely to spread where and when perceptions of instability arise from "normal" fluctuations.

[92] As a reminder, the endogeneity test conducted on the standard deviation of exports alone rejects in a 14% confidence level the exogeneity assumption.

[93] 58 observations in 9 countries: Cuba (3), Denmark (9), Finland (3), Greece (8), Guyana (12), Indonesia (3), Madagascar (11), Mali (4), and Portugal (5)

5.4. Summary results

In this section, we tried to disentangle the *ex post* and *ex ante* effects of instability on corruption by emphasising the asymmetry and the occurrence of extreme variations in the distribution of exports around their trend. First, we relaxed the symmetry assumption on the effects of positive and negative shocks and corruption responses to them, by separating the effect of a negative skewness of exports from the effect of a positive skewness of exports on corruption incidence in empirical estimations. Second, we further characterized how exports fluctuate, by considering the size and frequency of export fluctuations in our estimations of the *ex post* and *ex ante* effects of instability.

We find country-level and firm-level evidence of a 'global deterrent' *ex post* effect of repeated and moderate export fluctuations on corruption. We support that this effect is driven by the asymmetric corruption responses to shocks, which result from the decreasing marginal effect of frequent and moderate fluctuations on corrupt transactions. We also provide country-level and firm-level evidence of a 'global boosting' *ex post* effect of infrequent and large fluctuations on corruption. We support that this effect is driven by the asymmetric corruption responses to shocks which result from the increasing marginal effect of abrupt fluctuations on corrupt transactions.

We find a strong and robust positive *ex ante* effect of perceptions of "normal" instability in both country-level and firm-level estimations. Such evidence supports the hypothesis of resource-locking corrupt transactions acting as an effective insurance against humdrum fluctuations. Evidence of a hump-shaped *ex ante* effect of instability, depending on the size and frequency of export fluctuations, is weaker but observable in FE and IV country-level estimations. This suggests that resource-locking corrupt transactions may not enable to protect against abnormal fluctuations.

Table 4.3. Nonlinear *ex post* and *ex ante* effects of instability

Dependent variable:	**ICRG**								**WBES**					
	Within fixed effects			IV-2SLS	GMM-CUE	Sys-GMM			OLS					
Equations:	**(4.6a)**	**(4.6b)**	**(4.7)**	**(4.7)**		**(4.6a)**	**(4.6b)**	**(4.7)**	**(4.6a)**		**(4.6b)**		**(4.7)**	
Lagged Corruption	0.694***	0.692***	0.690***	0.674***	0.676***	0.742***	0.747***	0.721***						
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)						
Skew>0	-0.003***	-0.002***	-0.001*	-0.001**	-0.001**	-0.005**	-0.003†	-0.001*	-0.002	-0.027	-0.112†	-0.328***	-0.003	-0.003
	(0.00)	(0.00)	(0.06)	(0.03)	(0.03)	(0.03)	(0.14)	(0.09)	(0.94)	(0.33)	(0.14)	(0.00)	(0.30)	(0.43)
Skew<0	-0.003***	-0.002***	-0.0003	-0.0004	-0.0003	-0.003*	-0.002	-0.001	0.016	-0.017	-0.068*	-0.186***	-0.013**	-0.005
	(0.00)	(0.01)	(0.39)	(0.28)	(0.30)	(0.09)	(0.50)	(0.35)	(0.51)	(0.69)	(0.09)	(0.00)	(0.02)	(0.44)
$[Skewness>0]^2$	1e-05***					2e-05†			7e-06	0.0001				
	(0.00)					(0.11)			(0.96)	(0.32)				
$[Skewness<0]^2$	1e-05***					1e-05†			-0.0002	4e-05				
	(0.00)					(0.15)			(0.29)	(0.87)				
[Skew>0]*6Kurt		7e-06**					1e-05				0.0005†	0.001***		
		(0.02)					(0.24)				(0.13)	(0.00)		
[Skew<0]*6Kurt		7e-06**					8e-06				0.0003†	0.001***		
		(0.03)					(0.48)				(0.11)	(0.00)		
Export std_dev	-0.003	-0.003	0.020	0.127**	0.135***	-0.051	-0.039	0.007	0.884***	0.275	0.980***	0.602***	0.867***	0.299*
	(0.84)	(0.84)	(0.19)	(0.02)	(0.01)	(0.59)	(0.64)	(0.99)	(0.00)	(0.32)	(0.00)	(0.00)	(0.00)	(0.10)
Std_dev*16Kurt			-4e-05***	-2e-04***	-2e-04***			-5e-05					-0.0002	-0.0002
			(0.01)	(0.01)	(0.01)			(0.90)					(0.42)	(0.35)
Kurtosis		-0.001*	0.0005**	0.001***	0.001***		-0.002	-0.0003			-0.066*	-0.173***	1e-05	0.0005
		(0.10)	(0.03)	(0.01)	(0.01)		(0.24)	(0.62)			(0.09)	(0.00)	(0.99)	(0.75)
Population growth	-0.046	-0.043	-0.038	-0.037	-0.037	-0.213	-0.222	-0.254	1.842***	-0.712	1.543***	-1.977***	1.306***	-0.355
	(0.24)	(0.34)	(0.37)	(0.35)	(0.34)	(0.69)	(0.65)	(0.71)	(0.01)	(0.52)	(0.00)	(0.00)	(0.00)	(0.63)
Nat. resources	0.008**	0.008**	0.008**	0.006†	0.006†	0.043†	-0.003	0.026	0.143***	0.008	0.164***	0.052**	0.128***	0.016
	(0.02)	(0.02)	(0.02)	(0.11)	(0.12)	(0.15)	(0.64)	(0.72)	(0.00)	(0.86)	(0.00)	(0.04)	(0.00)	(0.60)
Government size	-0.012*	-0.012*	-0.014**	-0.013*	-0.013*	0.075*	-0.005	0.041	2e-11	7e-12	5e-11***	1e-11	4e-11***	4e-11***
	(0.07)	(0.07)	(0.02)	(0.06)	(0.06)	(0.07)	(0.91)	(0.51)	(0.63)	(0.87)	(0.00)	(0.45)	(0.00)	(0.00)
Log population	-0.117	-0.051	-0.245	-0.463	-0.489	0.044	-0.332	0.486	0.850	1.001	0.389	1.399***	0.494***	0.418**
	(0.66)	(0.85)	(0.39)	(0.21)	(0.18)	(0.98)	(0.73)	(0.86)	(0.36)	(0.40)	(0.28)	(0.01)	(0.00)	(0.03)
Pol. regime stability	-0.003*	-0.003*	-0.003*	-0.002	-0.002	-0.016	-0.018	-0.043	0.020†	0.0002	0.029†	0.045**	0.007	-0.015
	(0.06)	(0.06)	(0.06)	(0.36)	(0.33)	(0.45)	(0.58)	(0.33)	(0.11)	(0.99)	(0.14)	(0.03)	(0.22)	(0.33)
Democracy	-0.019***	-0.019***	-0.017***	-0.014**	-0.014**	-0.037	-0.059	-0.135	0.953***	0.298†	0.851***	-0.361**	0.998***	0.454***
	(0.00)	(0.00)	(0.01)	(0.04)	(0.04)	(0.62)	(0.44)	(0.31)	(0.00)	(0.12)	(0.00)	(0.02)	(0.00)	(0.01)
Log openness	0.066	0.068	0.0480	-0.034	-0.048	0.918	0.214	1.063	0.032	0.033*	0.034***	0.048***	0.022***	0.022***
	(0.57)	(0.55)	(0.66)	(0.77)	(0.68)	(0.32)	(0.83)	(0.45)	(0.21)	(0.09)	(0.00)	(0.00)	(0.00)	(0.04)
Latitude									0.075***	0.049***	0.055***	-0.020	0.084***	0.048***
									(0.00)	(0.00)	(0.00)	(0.18)	(0.00)	(0.01)
Landlocked									-3.08***	0.665	-3.764***	-0.071	-2.713***	0.009
									(0.00)	(0.67)	(0.00)	(0.93)	(0.00)	(0.99)
Initial GDP per cap									1.932**	0.739	1.433***	0.551***	1.108***	0.117
									(0.05)	(0.59)	(0.00)	(0.01)	(0.00)	(0.78)
Common Law									-2.008	-14.31**	-5.867†	-20.55***	-3.360***	-14.05***
									(0.59)	(0.02)	(0.11)	(0.00)	(0.00)	(0.01)
Firm size									-0.155**	-0.027	-0.146*	-0.031	-0.1649	-0.043

									(0.05)	(0.61)	(0.07)	(0.57)	(0.16)	(0.43)		
State owned									0.027	-0.006**	0.025	-0.005*	0.028	-0.006**		
									(0.18)	(0.05)	(0.20)	(0.10)	(0.53)	(0.05)		
Direct exports									-0.001	0.003	-0.001	0.005	-0.001	0.003		
									(0.52)	(0.40)	(0.63)	(0.28)	(0.28)	(0.45)		
Indirect exports									-0.002	-0.001*	-0.002	-0.001**	-0.002***	-0.001**		
									(0.26)	(0.006)	(0.31)	(0.05)	(0.00)	(0.04)		
Constant	3.199	2.181	5.112			4.335	7.505	-10.43	-36.34*	11.28	-12.50*	-15.21*	-21.90***	1.098		
	(0.49)	(0.64)	(0.31)			(0.89)	(0.66)	(0.83)	(0.10)	(0.74)	(0.10)	(0.09)	(0.00)	(0.90)		
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No		
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		
Obs. (countries)	1144 (68)	1144 (68)	1144 (68)	1143 (67)	1143 (67)	1144 (68)	1144 (68)	1144 (68)	9212(23)	4283(23)	9212(23)	4283(23)	9212(23)	4283(23)		
Thresholds:																
∂Corr/∂(skew>0) = 0	150%	286%				125%					220%	328%				
∂Corr/∂(skew<0) = 0	150%	286%				150%					226%	186%				
∂Corrupt/∂std_dev= 0			400%	635%	675%											
Weak instrument test																
Kleibergen-Paap stat(critical value)				10.8 (11) [a]	10.8 (4.7) [a]											
F-test of excluded instruments																
Export std_dev				11.2	11.2											
Export std_dev*Kurtosis				7.9	7.9											
Hansen test (p-val)				0.67	0.67	0.85	0.35	0.75								
R-squared:				0.626	0.623	Wald (31)	Wald (32)	Wald (31)	0.10	0.10	0.10	0.10	0.10	0.10		
Within	0.645	0.644	0.643			= 962	= 953	= 511								
Between	0.931	0.964	0.842													
AR(1) test (p-val)						0.00	0.00	0.00								
AR(2) test (p-val)						0.28	0.33	0.58								
Number of instruments				4	4	56	51	44								

When possible, coefficients are rounded to three decimal places. Standards errors robust to heteroskedasticity in all regressions and clustered by country in OLS firm-level estimations. P-values in parenthesis. †significant at 15% *significant at 10%; **significant at 5%; ***significant at 1%. In estimations (1), (2), (4), (5), (7), and (8), the variable Kurtosis corresponds to the 6-year rolling kurtosis of exports. In estimations (3), (6) and (9), the variable Kurtosis corresponds to the 16-year rolling kurtosis of exports. Hansen J-statistic tests for joint instrument validity; null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term, and that instruments are correctly excluded from the second-stage equation. 2SLS and GMM-CUE estimates are adjusted for small sample bias. GMM-CUE estimates are robust to heteroskedasticity and first-order autocorrelation.

Sys-GMM estimation of equation (4.6a): The positive and negative skewness of exports, and the squared terms are treated as predetermined and instrument the differenced equation by their lagged levels (lags 1 to 6). Lagged corruption is treated as endogenous and instruments the equation in system by its lagged levels and differences (lags 2 to 8). The standard deviation of exports is treated as endogenous and instruments the differenced equation by its lagged levels (lags 2 to 6). **Sys-GMM estimation of equation (4.6b)**: The positive and negative skewness of exports, the 6-year kurtosis and the interaction terms are treated as predetermined, and instrument the differenced equation by their lagged levels (lags 1 to 4). Lagged corruption is treated as endogenous and instruments the equation in system by its lagged levels and differences (lags 2 to 6). The standard deviation is treated as endogenous and instruments the differenced equation by its lagged levels (lags 2 to 6). **Sys-GMM estimation of equation (4.7)**: The 16-year kurtosis of exports is an excluded instrument. The positive and negative skewness of exports, and the squared terms are treated as predetermined and instrument the differenced equation by their lagged levels (lags 1 to 6). Lagged corruption is treated as endogenous and instruments the equation in system by its lagged levels and differences (lags 2 to 8). The standard deviation of exports and the interaction term are treated as endogenous and instrument the differenced equation by their lagged levels (lags 2 to 5). In all sys-GMM estimations, time dummies are excluded instruments, instruments are collapsed, orthogonal deviations are preferred to first-difference deviations, and the Windmeijer correction of the two-step estimated variance is applied.

6. The role of the liquidity constraint in channelling the effects of export instability on corruption

As a reminder, Alderman and Paxson (1992), Dercon (1996), Sarris (2000) and Agenor and Aizenman (2004) stress that access to credit and insurance markets determines households' strategies for smoothing their consumption or income path. Notably, it has been argued that informal "risky" risk-coping and risk-managing strategies, such as prostitution (Robinson and Yeh (2011)) or crime (Guillaumont and Puech (2006)), may be adopted when financial markets do not enable agents to fully protect against fluctuations in their revenue. It is hence likely that survival or resource-locking corruption strategies are undertaken by liquidity-constrained agents to alleviating the adverse effects of income instability.

Moreover, by increasing or reducing the opportunity cost of engaging in illegal income-generating activities, access to lending may also determine the nature of the marginal *ex post* effect of income shocks on corrupt transactions (whether they are driven by survival or opportunistic motives). As a result, it can be hypothesised that the 'global deterrent' *ex post* effect arising from the decreasing marginal effect of shocks on corruption (see graph 4.4iii)) holds in situations of *soft budget constraint*. On the contrary, it is plausible that the 'global boosting' *ex post* effect arising from the increasing marginal effect of shocks on corruption (see graph 4.4iv)) holds in situations of *hard budget constraint*.

An analysis of the role of agents' liquidity constraint in driving the *ex post* and *ex ante* effects of instability on corruption is therefore a logical next step in our empirical analysis. We use the logarithm of the credit provided to the private sector in % of GDP (*credit_market*) as a proxy for formal financial markets access, and insert it as interaction term with the skewness and the standard deviation of exports in the corruption equation.

In equation (4.8a), we test whether financial market access is a key channel for the *ex post* effect of instability on corruption:

$$Corrupt_{it} = \alpha_0 [+ \alpha_1.Corrupt_{it-1}] + \boldsymbol{\rho_{2a}.Positive\_skewness_{it}} + \boldsymbol{\rho_{2b}.Negative\_skewness_{it}} + \boldsymbol{\rho_{2c}.Positive\_skew_{it}*credit\_market_{it}} + \boldsymbol{\rho_{2d}.Negative\_skew_{it}*credit\_market_{it}} + \rho_{2e}.credit\_market_{it} + \alpha_3.std\_dev_{it} + \alpha_{4b}.Macro\_controls_{it} \{+ \alpha_5.Micro\_controls_{it} + \alpha_6.timefixed\_controls\} + \lambda_t [+ \mu_i] + \varepsilon_{it} \quad (4.8a)$$

In equation (4.8a), we test whether financial market access is a key channel for the *ex ante* effect of instability on corruption:

$$Corrupt_{it} = \alpha_0 [+ \alpha_1.Corrupt_{it-1}] + \alpha_{2a}.Positive\_skewness_{it} + \alpha_{2b}.Negative\_skewness_{it} + \boldsymbol{\rho_{3a}.std\_dev_{it}} + \boldsymbol{\rho_{3b}.std\_dev_{it}*credit\_market_{it}} + \rho_{3b}.credit\_market_{it} + \alpha_{4b}.Macro\_controls_{it} \{+ \alpha_5.Micro\_controls_{it} + \alpha_6.timefixed\_controls\} + \lambda_t [+ \mu_i] + \varepsilon_{it} \quad (4.8b)$$

Fixed effect, sys-GMM panel estimates, and OLS firm-level estimates of equations (4.8a) and (4.8b) are presented in table 4.4. In cross-section OLS regressions, we run equations (4.8a) and (4.8b) on the original sample of firms (left-sided uncoloured columns) and on the restricted sample of potentially "active" firms (right-sided blue columns).

6.1. Credit market as a channel for the *ex post* effects of instability

In regards to the *ex post* effects of instability (equation (4.8a)), FE estimates evidence a 'global deterrent' effect of instability on corruption when access to credit is improved. Estimation of equation (4.8a) without time dummies (column (2)) suggests that above a respective 8.5% and 12.2% credit threshold, episodes of positive and negative shocks are both found to deter corruption. Below this threshold, a 'global boosting' effect of instability on corruption level is evidenced, but not in the usual confidence level (with a 22% and an 11%-significant level for the positive and negative skewness, respectively). Following our conceptual framework presented in section 2.1, FE estimations therefore support that a softened (hardened) liquidity constraint is associated with a decreasing (increasing) marginal effect of export shocks on corruption. Thus, the liquidity constraint appears as a credible channel for the nonlinear *ex post* effect of instability evidenced in section 5 and depicted in section 2.

OLS firm-level estimates of equation (4.8a), conducted on the original sample of firms (column (8)), support the existence of a 5% credit threshold beyond which the relationship between the negative skewness of exports and firms' corruption expenses reverses and becomes negative. Estimation of equation (4.8a) on the sample of 'active' firms (column (9)) provides significant evidence of a hump-shaped relationship between the negative skewness of exports and firms' informal payments, with a 5% significant turning point corresponding to a credit threshold of 20% of GDP. This evidence is consistent with FE estimates of equation (4.8a), which also show that the credit-channel is more significant during negative shocks than during positive shocks. Thus, estimations support that survival bribe payments are made to cope with adverse shocks, when access to lending is imperfect[94].

[94] In section 7, we further investigate how firms' cash surplus drives the effect of positive shocks on bribe payments.

6.2. Credit markets as a channel for the *ex ante* effect of instability

FE country-level estimates of equation (4.8b), displayed in columns (3) and (4), highlight a hump-shaped relationship between the standard deviation of exports and firms' informal payments. In fact, the first-order condition of equation (4.8b) shows that a higher perception of export instability is significantly and positively associated with corruption when the share of credit provided to the private sector is below 24% of GDP, while it is significantly and negatively associated with corruption beyond this threshold. A similar hump-shaped relationship is evidenced in firm-level estimation of equation (4.8b), when the sample is restricted to "active" firms (column (11)). We observe that the effect of the standard deviation of exports on bribe payments is 1%-significant and positive below a credit threshold of around 60% of GDP; while it is 1%-significant and negative above it. As a consequence, access to credit markets also appears as a key channel for the *ex ante* effect of export instability on corruption.

Evidence on the role of financial markets in channelling the *ex post* and *ex ante* effects of export instability on corruption is striking and strongly supports that corruption may allow liquidity-constrained agents to cope with and insure against adverse shocks. We also stress that the liquidity constraint is likely to drive the nonlinear *ex post* effect of instability evidenced in section 5. In the following section, we check the robustness of our conclusions by addressing additional empirical issues.

Table 4.4. The role of the liquidity constraint in channelling the *ex post* and *ex ante* effects of instability on corruption

Dependent variable:	**ICRG**						**WBES**			
	Within fixed effects				Sys-GMM		OLS			
Equations	**(4.8a)**		**(4.8b)**		**(4.8a)**	**(4.8b)**	**(4.8a)**		**(4.8b)**	
	(1)	(2)	(3)	(4)	(6)	(7)	(8)	(9)	(10)	(11)
Corruption t- 1	0.691*** (0.00)	0.711*** (0.00)	0.685*** (0.00)	0.706*** (0.00)	0.733*** (0.00)	0.701*** (0.00)				
Export skew>0	0.001 (0.42)	0.001 (0.22)	-0.0005* (0.07)	-0.001*** (0.00)	-0.006 (0.36)	-0.001† (0.11)	-0.043 (0.17)	0.060 (0.40)	-0.004* (0.06)	0.003 (0.42)
Export skew<0	0.002 (0.26)	0.002† (0.11)	-0.0003 (0.44)	-0.0002 (0.57)	-0.007 (0.21)	-0.001† (0.13)	0.017 (0.41)	0.048** (0.04)	-0.014*** (0.01)	-0.015** (0.02)
Skew>0*credit access	-0.0004 (0.21)	-0.001* (0.06)			0.001 (0.45)		0.009 (0.25)	-0.016 (0.35)		
Skew<0*credit access	-0.0005 (0.19)	-0.001* (0.08)			0.002 (0.25)		-0.011* (0.08)	-0.016** (0.05)		
Export std_dev	-0.001 (0.93)	-0.001 (0.91)	0.050** (0.05)	0.057*** (0.00)	-0.005 (0.92)	-0.134 (0.62)	0.961*** (0.00)	0.110 (0.51)	1.223*** (0.00)	2.648*** (0.00)
Std_dev* credit access			-0.016* (0.07)	-0.018** (0.02)		0.066 (0.47)			-0.104 (0.38)	-0.647*** (0.00)
Credit to private sector	0.055 (0.34)	0.098† (0.11)	0.010† (0.11)	0.122** (0.03)	-0.212 (0.47)	-0.558 (0.37)	-0.272 (0.57)	-0.131 (0.91)	0.731** (0.03)	1.951*** (0.00)
Population growth	-0.035 (0.42)	-0.027 (0.45)	-0.056 (0.19)	-0.052† (0.13)	0.063 (0.78)	-0.101 (0.80)	1.003** (0.03)	-0.504 (0.69)	1.399*** (0.00)	-0.203 (0.77)
Nat. resources	0.008*** (0.01)	0.008** (0.02)	0.007** (0.03)	0.007** (0.05)	0.037 (0.23)	0.003 (0.91)	0.138*** (0.00)	0.016 (0.43)	0.129*** (0.00)	0.080*** (0.00)
Government size	-0.014** (0.02)	-0.014** (0.02)	-0.013** (0.04)	-0.012** (0.04)	0.003 (0.94)	-0.014 (0.70)	3e-11*** (0.00)	3e-11 (0.36)	5e-11*** (0.00)	5e-11*** (0.00)
Log population	-0.0413 (0.88)	0.635*** (0.00)	-0.108 (0.70)	0.544*** (0.00)	-0.058 (0.86)	0.805 (0.18)	0.324 (0.01)	0.612† (0.15)	0.228** (0.04)	0.155 (0.51)
Pol. regime stability	-0.003* (0.06)	-0.0001 (0.94)	-0.003** (0.07)	0.0003 (0.86)	-0.011 (0.30)	-0.012 (0.58)	0.027** (0.02)	0.014 (0.53)	0.012 (0.13)	0.016** (0.05)
Democracy	-0.018*** (0.01)	-0.015*** (0.01)	-0.016*** (0.01)	-0.013** (0.03)	-0.052 (0.38)	-0.149** (0.03)	0.938*** (0.00)	0.521*** (0.00)	0.922*** (0.00)	0.847*** (0.00)
Log openness	0.060 (0.59)	0.166* (0.10)	0.078 (0.48)	0.178* (0.08)	0.918 (0.30)	-0.043 (0.94)	0.024*** (0.00)	0.046*** (0.00)	0.020*** (0.00)	0.034*** (0.01)
Latitude							0.086*** (0.00)	0.051*** (0.00)	0.091*** (0.00)	0.100*** (0.00)
Landlocked							-2.980*** (0.00)	-0.106 (0.91)	-2.793*** (0.00)	-1.745* (0.06)
Initial GDP per cap							1.111*** (0.00)	0.183 (0.64)	1.262*** (0.00)	0.388* (0.09)
Common Law							-5.802 (0.17)	13.70* (0.07)	-2.573 (0.46)	-11.14*** (0.00)
Firm size							-0.158** (0.05)	-0.050 (0.38)	-0.157* (0.06)	-0.05 (0.36)
State owned							0.026 (0.19)	-0.006* (0.08)	0.027 (0.17)	-0.004† (0.14)

Direct exports							-0.001 (0.57)	0.003 (0.43)	-0.001 (0.58)	0.004 (0.38)
Indirect exports							-0.002 (0.30)	-0.001** (0.03)	-0.001 (0.31)	-0.001** (0.03)
Constant	1.652 (0.73)	-10.38*** (0.00)	-2.549 (0.60)	-8.995*** (0.00)	-1.104 (0.87)	-8.902 (0.42)	-17.09*** (0.00)	--5.082 (0.55)	-21.63*** (0.00)	-12.96** (0.02)
Country fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No
Time dummies	Yes	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Obs (countries/cluster)	1130 (67)	1130 (67)	1130 (67)	1130 (67)	1130 (67)	1130 (67)	9212(23)	4283(23)	9212 (23)	4283(23)
Thresholds:										
∂Corrupt/∂(skew>0) =0		8.5%								
∂Corrupt/∂(skew<0) =0		12.2%					4.7%	20.1 %		
∂Corrupt/∂std_dev = 0			22.8%	23.6%						59.7%
R-squared:										
Within	0.895	0.606	0.647	0.649	Wald chi2(32)= 2143	Wald chi2(31) = 1037	0.10	0.10	0.10	0.11
Between	0.966	0.628	0.933	0.645						
Hansen test (p-val)					0.76	0.83				
AR(1) test (p-val)					0.00	0.00				
AR(2) test (p-val)					0.21	0.34				
Number of instruments					55	53				

When possible, coefficients are rounded to three decimal places. Standards errors robust to heteroskedasticity in all regressions, and are clustered by country in OLS firm-level estimations. P-values in parenthesis. † significant at 15% *significant at 10%; **significant at 5%; ***significant at 1%. Hansen J-statistic tests for joint instrument validity; null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term, and that the excluded instruments are correctly from the second-stage equation. **Sys-GMM estimation of equations (4.8a)**: The positive and negative skewness of exports are treated as predetermined and instrument the differenced equation by their lagged levels (lags 1 to 5). Lagged corruption and the interaction terms are treated as endogenous and instrument the equation in system by their lagged levels and differences (lags 2 to 7). The standard deviation of exports is treated as endogenous and instruments the differenced equation by its lagged levels (lags 2 to 6). **Sys-GMM estimation of equations (4.8b)**: Time dummies are excluded instruments. The positive and negative skewness of exports are treated as predetermined, and instrument the differenced equation by their lags 1 to 7. Lagged corruption is treated as endogenous and instrument the equation in system by its lagged levels and differences (lags 2 to 7). The standard deviation of exports is treated as endogenous and instrument the differenced equation by its lagged levels (lags 2 to 7). In all GMM estimations, time dummies are excluded instruments, instruments are collapsed, orthogonal deviations are preferred to first-difference deviations, and the Windmeijer correction of the two-step estimated variance is applied.

7. Robustness checks

In this last section, we address empirical issues that could potentially improve or weaken our results. First, we check whether previous estimated relationships hold when we look at the effects of idiosyncratic export fluctuations. Then, we ensure that OLS firm-level standard errors are not biased downward because of inappropriate clustering, by applying the multi-way cluster-robust OLS estimators to the previous equations. Finally, we test the sensitivity of our results when measures of standard deviation, skewness and kurtosis of exports are based on HP-filtered export data.

7.1. Idiosyncratic versus common export fluctuations

We check whether nonlinear relationships previously evidenced hold when we emphasise the effects of idiosyncratic export fluctuations on firms' informal payments. As stressed by Dercon (2002, p.4),

> "the nature of the shocks is important to understand the possibilities to deal with its consequences (…) Common (aggregate, economy-wide, covariate) risk is distinguished from individual (idiosyncratic) risk: the former affects everybody in a particular community or region; the latter only affects a particular individual in this community".[95]

Most shocks are not purely idiosyncratic or purely covariates, but have both idiosyncratic and covariate components. To account for firms' individual experience and perception of export instability, we weight measures of skewness and standard deviation of exports by the share of direct and indirect exports[96] in firm's total sales:

$$\textit{Idiosyncratic instability} = \textit{(instability measure)} \times \textit{(\% of exports in total sales)} \qquad (4.9)$$

We test the effects of idiosyncratic export fluctuations by inserting into equations (4.5), (4.6a), (4.6b), (4.7), (4.8a) and (4.8b) our measures of idiosyncratic instability. Previous indicators of aggregate export instability are maintained in the corruption equation to control for the separate effects of aggregate fluctuations. The resulting OLS estimates, presented in table 4.5, tell an interesting story.

First, estimated effects of aggregate instability indicators in column (1) are strikingly similar to those of equation (4.5) in table 4.2 (column (4)), suggesting that these previous estimations were merely reflecting the *ex ante* and *ex post* effects of common fluctuations on firms' bribe payments, not the joint effects of common and idiosyncratic fluctuations. Second, estimates of equation (4.5) (columns (1) and (2)) suggest that the 'global deterrent' *ex post* effect of instability evidenced in table

[95] Dercon, S. (2002) "Income risk, coping strategies, and safety nets", Discussion Paper No.2002/22, UNU/WIDER.

[96] Indirect exports are merchandizes and services sold domestically to exporter third party.

4.2 also holds for idiosyncratic fluctuations. By contrast, the *ex ante* effect of perceived instability holds for economy-wide exports fluctuations only, suggesting that i) resource-locking strategies act as a protection against common shocks, or ii) firms' perception of instability is more influenced by economy-wide fluctuations than individual ones.

7.1.1. Emphasising the size and frequency of idiosyncratic export fluctuations

In columns (3) to (8), evidence of an *ex ante* and *ex post* effects of idiosyncratic export instability nonlinear in the size and frequency of shocks cannot be established in the same confidence levels as for aggregate instability (see table 4.3). To ensure that estimated standard errors are not inflated by problems of multicolinearity between the many instability variables inserted in our specification, we computed the variance inflation factors (VIF) of equations (4.6a), (4.6b), and (4.7) without time dummies.[97] VIF statistics are presented in annex 4.Fii). Multicolinearity is present in equations (4.6a) and (4.7), and very worrying in equation (4.6b). This suggests that the statistical significance of the relationship tested in equation (4.6b) may be understated by inflated standard errors.

In spite of these inflated standard errors, estimates of equation (4.6a) in column (3) and (4) are highly consistent with FE and sys-GMM estimates in table 4.3. We indeed find significant evidence of a 'global deterrent' *ex post* effect of small and frequent idiosyncratic export fluctuations, and (less significant) evidence of a 'global boosting' *ex post* effect of large and infrequent idiosyncratic export fluctuations on firms' informal payments. However, there are no evidence of a nonlinear *ex ante* effect of idiosyncratic export instability depending on normal/abnormal patterns of export fluctuations (columns (7) and (8) in table 4.5).

7.1.2. How liquidity-constrained firms respond to idiosyncratic export fluctuations

In columns (9) to (12), we emphasise the role of the liquidity constraint in channelling the *ex post* and *ex ante* effects of idiosyncratic instability. We use two proxies of firms' liquidity constraint. As done previously, we use the logarithm of the domestic credit provided to the private sector, as a country-level proxy for the ease with which firms accede to lending. We also use the share of the firms' working capital financed by internal funds or retained earnings (drawn from the WBES database) as a micro-level proxy for firms' actual cash position.[98] Estimates of equation (4.8a) are displayed in columns (9) and (10), and estimates of equation (4.8b) are displayed in columns (11) and (12).

[97] It is generally considered that problems of colinearity may be problematic when a VIF exceeds 10.

[98] It is worth mentioning that estimates of the cash-surplus channel should be considered with caution given a plausible bi-directional relationship between firms' informal payments and cash position. As an illustration, a firm's cash surplus may feed corrupt networks, it may also stem from corrupt activities, or simply may incite public official to extort more money.

Estimates of equation (4.8a) in column (9) support that an increase in the share of credit provided to the private sector dampens the positive effect of negative idiosyncratic shocks on firms' informal payments. In parallel, using the firm's share of working capital financed by internal funds as a proxy for its actual liquidity constraint (column 10), we find that, in a 9% confidence level, an improved cash position reduces the deterrent effect of episodes of positive idiosyncratic shocks on firms' informal payments. In other words, while an improved access to credit is found to mitigate the boosting effect of adverse idiosyncratic shocks on survival bribe payments, a favourable cash position is found to mitigate the deterrent effect of favourable idiosyncratic shocks on survival bribe payments.

Estimates of equation (4.8b) in column (11) do not support that access to lending is a significant channel for the *ex ante* effect of idiosyncratic instability on firms' informal payments. However, estimates of equation (4.8b) in column (12) show a significant negative *ex ante* effect of idiosyncratic instability on corruption when firms' cash position improves. Thus, while access to credit is found to mitigate the positive *ex ante* effects of aggregate instability on bribe payments (see table 4.4 columns (3), (4) and (11)), cash surplus is found to mitigate the positive *ex ante* effect of idiosyncratic instability on bribe payments.

Table 4.5. The effects of idiosyncratic and aggregate export fluctuations (controls not reported)

Dependent variable: WBES	Eq (4.5)		Eq(4.6a)		Eq(4.6b)		Eq(4.7)		Eq (4.8a)		Eq (4.8b)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Aggregate fluctuations												
Positive skewness	-0.003	-0.003	-0.003†	-0.003	0.002	0.003†	-0.002	-0.002	-0.003*	-0.003	-0.003†	-0.002
	(0.16)	(0.31)	(0.15)	(0.30)	(0.28)	(0.15)	(0.25)	(0.34)	(0.09)	(0.16)	(0.12)	(0.32)
Negative skewness	-0.012 **	-0.009***	-0.012**	-0.009***	-0.006	-0.003	-0.013***	-0.011***	-0.013***	-0.013***	-0.013***	-0.010***
	(0.02)	(0.00)	(0.02)	(0.00)	(0.24)	(0.29)	(0.01)	(0.00)	(0.01)	(0.02)	(0.01)	(0.00)
Std_dev	0.813***	0.814***	0.817***	0.819***	0.814***	0.823***	0.828***	0.830***	0.847***	0.824***	0.851***	0.912***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Idiosyncratic fluctuations												
Positive skew	-0.009*	-0.010**	-0.020**	-0.020**	-0.003	-0.005	-0.009*	-0.010**	-0.042	-0.012**	-0.009†	-0.010***
	(0.06)	(0.02)	(0.05)	(0.02)	(0.84)	(0.72)	(0.07)	(0.02)	(0.35)	(0.03)	(0.12)	(0.01)
Negative skew	-0.007*	-0.008**	-0.027*	-0.026*	-0.004	-0.004	-0.006*	-0.007*	0.015	-0.010†	-0.006	-0.008**
	(0.06)	(0.03)	(0.10)	(0.09)	(0.61)	(0.61)	(0.09)	(0.06)	(0.21)	(0.13)	(0.24)	(0.03)
Positive skew^2			0.0001	5e-05†								
			(0.19)	(0.15)								
Negative skew^2			0.0001	0.0001								
			(0.26)	(0.25)								
Positive skew * Kurtosis					2e-05	1e-05						
					(0.64)	(0.76)						
Negative skew * Kurtosis					-6e-06	1e-05						
					(0.87)	(0.72)						
Positive skew *credit									0.009			
									(0.44)			
Negative skew *credit									-0.007**			
									(0.05)			
Positive skew *intern funds										5e-05*		
										(0.09)		
Negative skew *intern funds										7e-05		
										(0.42)		
Export std_dev	-0.022	-0.001	-0.011	0.009	-0.041	-0.018	-0.051	-0.026	0.061	-0.044	-0.037	-0.001
	(0.83)	(0.99)	(0.91)	(0.93)	(0.72)	(0.87)	(0.64)	(0.80)	(0.72)	(0.68)	(0.79)	(0.99)
Export std_dev* Kurtosis							5e-05	3e-05				
							(0.95)	(0.87)				
Export std_dev*credit											0.001	
											(0.67)	
Export std_dev*intern funds												-0.001**
												(0.03)

6 or 16-year Kurtosis					-0.006***	-0.006***	-0.001***	-0.001***				
					(0.00)	(0.00)	(0.00)	(0.00)				
Log domestic credit									0.330*		0.386**	
									(0.09)		(0.03)	
Intern funds										-0.005**		0.004
										(0.05)		(0.17)
Country fixed effects	No	No	No	No	No	No	No	No	No	No	No	No
Time dummies	Yes	No	Yes	No	Yes	No	Yes	No	Yes	Yes	Yes	Yes
Observations (clusters)						9212(23)						
R-squared						0.10						

When possible, coefficients are rounded to three decimal places. Standards errors robust to heteroskedasticity in all regressions and clustered by country. P-values in parenthesis. † significant at 15% *significant at 10%; **significant at 5%; ***significant at 1%. Controls not reported.

n.a. : non applicable because of very low confidence level. The "Kurtosis" variable refers to the 6-year kurtosis of exports when it enters in interaction with the skewness of exports, while it refers to the 16-year kurtosis when it enters in interaction with the standard deviation of exports.

7.2. Robust inference with two-way clustered standard errors

The hierarchical relationship in our cross-section data may have been misrepresented in the previous OLS firm-level regressions, so that intra-class correlations within a missing cluster lower standard errors (Baum et al., 2010). Notably, it is plausible that correlations between errors within sectors of activity lead us to over-state the statistical significance of tested relationships. To address this issue, we implement the two-way cluster-robust OLS estimator proposed by Cameron et al. (2006) to equations (4.5), (4.6a), (4.6b), (4.7), (4.8a), and (4.8b), clustering standard errors by country and sector of activity. Results are presented in annex 4.Fiii). Columns entitled "idiosync." refer to regressions including measures of aggregate and idiosyncratic export instability. Two-way clustered robust estimates of equations (4.5), (4.6a), (4.6b), (4.7), (4.8a), and (4.8b) suggest that relationships are robust to the procedure, but their corresponding standard errors were sometimes slightly understated. Thus, though not really questioning the robustness of our previously estimated relationships, it seems that clustering standard errors by country and sector of activity reduces their significance.

7.3. Estimations with HP-based instability indicators

As stressed in Chapter 2, great discrepancies arise between trend computation methods when addressing the asymmetry of export deviation around their trend – measured by the skewness of a distribution – or the occurrence of extreme deviations – measured by the kurtosis of a distribution. To check whether results are robust to an alternative trend computation method, we apply the HP filter to export revenue data. As a reminder, the HP filter isolates the cyclical component by optimizing the following program in relation to HP:

$$\min_{\{HP_t^*\}} \left[\sum_{t-1}^{T} \left(y_t - HP_t \right)^2 + \lambda \left(\sum_{t=2}^{T-1} \Delta^2 HP_t \right)^2 \right]$$

The parameter λ is the "smoothing parameter", and is set at 6.25 (Maravall and del Rio, 2001). Formula (4.2) and (4.3) are applied to the resulting cycle, $\widehat{\varepsilon_t} = y_t - HP_t{}^*$, yielding new measures of experienced and perceived instability of exports. The 6-year and 16-year kurtosis of exports around their HP-filtered values are also calculated according to the formula specified in section 5.2. Then, we re-estimate equations (4.4), (4.5), (4.6a), (4.6b), (4.7), (4.8a), and (4.8b) using these alternative measures of export instability.

Results of country-level panel regressions and those of firm-level cross-section regressions with two-way clustered standard errors are presented in annexes 4.Fiv) and v). Within FE do not provide evidence of significant *ex post* and *ex ante* effects of instability, whereas firm-level OLS estimates in annex 4.Fv) are strikingly close to estimates presented in annex 4.Fiii).

Suspecting that problems of autocorrelation inflate estimated standard errors in panel regressions, we perform the Feasible Generalized Least Square (FGLS) estimator, including time and country dummies, with standard errors corrected for heteroskedasticity and first-order autocorrelation.[99] Despite the strong differences between the two approaches of measuring instability (see chapter 2), new estimates of equation (4.4) and (4.5) are consistent with those evidenced in table 4.1 (column (2)) and table 4.2 (column (1)). However, evidence of non-linear *ex post* and *ex ante* effects of instability depending on the size and frequency of export fluctuations and on the liquidity constraint are less robust to the use of alternative instability indicators.

8. Conclusion

In this chapter, we set a conceptual framework for an empirical analysis of the effects of export instability on corruption. We assumed that export instability has *ex post* and *ex ante* effects on corruption, considering that corrupt transactions may result from strategies implemented by economic agents to protect against economic fluctuations.

Regarding the *ex post* effects of instability on corruption, i.e. the effect of instability through agents' *experience* of shocks, we invoked two corruption schemes, acting in opposite way: *opportunistic corruption*, resulting from the mechanical increase (decrease) in rents during positive (negative) shocks; and *survival corruption*, spreading (lessening) when resources are lacking (abounding). As for the *ex ante* effect of instability on corruption, i.e. the effect of instability through agents' *perception* of shocks, we drew a parallel between certain corruption strategies and risk-management strategies aimed at reducing the risk in the income process. In this regard, we posited that agents perceiving their economic environment as unstable may reduce *ex ante* the variance of their income by securing future resource inflows through bribery.

Our empirical strategy is built around two measures of instability based on moments 2 and 3 of the distribution of exports around a 16-year rolling mixed trend. On the one hand, we tested the *ex post* effect of instability using a measure of experienced instability based on the 6-year rolling skewness of exports around their trend. On the other hand, we tested the *ex ante* effect of instability on corruption using an indicator of perceived instability based the 16-year rolling standard deviation of exports.

We estimated the *ex ante* and *ex post* effects of instability on country corruption perceptions in a dynamic panel analysis, and on firms' bribes payments in a cross-section analysis. Despite the strong discrepancies between perceptions and experiences of corruption, and in spite of differences in the econometric framework and the scope of micro and macro samples, we found robust, consistent, and nonlinear corruption responses to export instability.

[99] We ran the Wooldridge test of autocorrelation in panel data (Wooldridge, 2002) and reject the null of no first-order auto-correlation of residuals.

First, we found macro and micro evidence of a nonlinear *ex post* effect of instability depending on the asymmetry, and the frequency and size of export fluctuations. On the one hand, we highlighted a 'global deterrent' *ex post* effect of episodes of positive and negative shocks, when export fluctuations are repeated and moderate. We explain this evidence by the asymmetric corruption responses to shocks arising from the decreasing marginal effect of regular fluctuations on corruption incidence. On the other hand, we highlighted a 'global boosting' effect of export booms and busts. We explain this evidence by the (reversed) asymmetric corruption responses arising from the increasing marginal effect of large and infrequent fluctuations on corruption incidence.

Then, we provided empirical evidence of a positive *ex ante* effect of export instability on corruption, when perceptions of instability result from frequent and small export fluctuations. Estimates suggest that resource-locking corrupt transactions spread in a context of "normal" export fluctuations, which is consistent with "the paradox of insurance provision" emphasised by Collier (2002). FE and IV panel estimates even pointed that resource-locking corrupt transactions decrease in a context of "abnormal" instability, driven by large but infrequent fluctuations. However, this additional empirical evidence is weak; it should hence be taken with careful consideration.

In a logical next step, we tested the role of economic agents' liquidity constraint in channelling the effects of export instability on corruption. Regarding the *ex post* effects of instability, FE estimates suggest that above a credit threshold of 12.2% and 8.5% of GDP, episodes of negative and positive shocks are both found to deter corruption. Below these thresholds, a 'global boosting' effect of instability on corruption level is observed, but not in a 10% confidence level. Following our conceptual framework, these findings support that a better (lesser) access to credit is associated with a decreasing (increasing) marginal effect of export shocks on corruption. In addition, firm-level OLS estimations support a hump-shaped effect of episodes of adverse export shocks on firms' informal payments, depending on firms' access to credit. This evidence suggests that survival corruption may be a substitute for lending when hardships occur and firms' cash position worsens. A hump-shaped *ex ante* effect of instability on corruption incidence is also evidenced in panel and firm-level estimations, suggesting that resource-locking corrupt transactions are undertaken by liquidity-constrained agents to reduce their income variance. To summarize, export instability is found to have *ex post* and *ex ante* boosting effects on corruption when the liquidity constraint binds, while it is found to have deterrent effects when the liquidity constraint relaxes.

General conclusion

Summary

This thesis is an attempt to improve the understanding of the causes of corruption emergence and incidence around the world. It highlights a new feature of corrupt transactions, that is, their contribution to informal risk-coping and risk-management mechanisms used by economic agents to protect against economic fluctuations.

To address this issue, we proposed in a first introductory chapter a general state of art of current and past researches on corruption definitions, measurements, typologies and determinants. Notably, we stressed that the incidence of corruption in a given country results from individual costs and benefits to engage in corrupt transactions, and that these incentives are strongly shaped by the international environment (trade and financial globalization process, private sector growth, tax havens, etc.) and domestic factors (public sector size, political stability, national wealth, natural resource endowments, the legal system, etc.). We also pointed out that, holistically, corruption can be considered as an informal institutional arrangement which may coexist with dysfunctional legal institutions. In this institutional setting, corrupt transactions are undertaken when formal rules and practices are not fully integrated by economic agents or when they do not allow to fully relieving uncertainty prevailing upon market and non-market exchanges.

In chapters two and three, we focused on export instability issues, by first addressing its measurement and then highlighting its damaging effects in developing economies. In chapter two, we explained, applied and compared standard methods of computing instability indicators using export revenue data. We compared parametric and filter methods of computing the trend around which exports fluctuate. We stressed that both methods converge on the measurement of the average amplitude of economic fluctuations (using variance-based instability indicators for instance), but diverge on the measurement of the asymmetry or the occurrence of extreme events. We also stressed that these latter dimensions of instability – that is the asymmetry and the tail's fatness of a statistical distribution of an economic variable around its trend – should be more systematically considered in the study of the effects of economic instability on economic outcomes.

In chapter three, we built a retrospective economic vulnerability index for a sample of 128 developing countries over the period 1984-2008, consistent with the definitions of the EVI provided by the UNCDP 2009 review. The economic vulnerability index is a composite index reflecting the risk for a country of seeing its development hampered by natural and trade shocks. According to this retrospective index, vulnerability in developing countries slightly declined from 1987 to 2008, but less rapidly in Low-Income and Least-Developed Country categories (LICs and LDCs). We also stressed that the export instability component is the greatest driver of changes in vulnerability scores over time, and also one of the greatest factor of difference between the most vulnerable groups (LDCs and LICs) and the least vulnerable groups of countries (non-LDCs and non-LICs).

In chapter 4, we build on the previous chapters to study the effects of export instability on corruption in both developed and developing countries. We decompose these effects into *ex post* effects, resulting from agent's experience of shocks, and an *ex ante* effect, resulting from their perception of instability. We used instability measurements emphasised in chapters 2 and 3 to identify these effects, and evidenced nonlinear relationships which depend on the frequency and size of export fluctuations. On the one hand, export instability is found to have a deterrent *ex post* effect on corruption when fluctuations are moderate and frequent, while it is found to have a boosting *ex post* effect when fluctuations are large and infrequent. On the other hand, export instability is found to have a strong and robust positive *ex ante* effect on corruption when fluctuations are moderate and frequent. Evidence of a deterrent *ex ante* effect of instability when export fluctuations are large and infrequent was also found, but should be taken with caution. Finally, we highlighted the liquidity constraint as a key channel for the *ex post* and *ex ante* effects of instability on corruption: when the liquidity constraint hardens export instability is found to increase corruption; while when it softens, export instability is found to reduce it.

Research implications

Building on the works of Elbers et al. (2007) and Rancière et al. (2008), this thesis proposes a novel approach of studying the effects of output fluctuations on economic behaviours. It is indeed a first attempt to estimate the *ex post* and *ex ante* effects of economic instability using together skewness-based and variance-based measures of instability. Applied to our problematic, this approach yields interesting results. First, using the skewness of the distribution of an economic variable around its trend as a measure of *experienced* economic instability enables to i) identify distinct corruption responses to asymmetric fluctuations, while ii) capturing eventual persistent impact of repeated asymmetric shocks on economic outcomes. This feature is particularly interesting when the effects of negative shocks on economic outcomes differ from those of positive shocks, and when

economic outcome variations are of medium or long periodicity – as for institutional outcomes like democracy or corruption. Second, using the skewness refines the analysis of the consequences of economic fluctuations on economic behaviours: while low absolute values of skewness reflect the proper effect of high-frequency low-size variations, high absolute values of skewness reflect the proper effect of low-frequency large-size variations. In this regard, we stressed that corruption responses display strong nonlinearities, depending on these diverging patterns of instability.

One another interesting finding is the strong consistency of estimations based on country perceptions of corruption on the one hand, and firms' bribe payments on the other hand. The fact that we found similar effects with the ICRG data on corruption perceptions as with the WBES data on firms' informal payments suggests that the effects picked up in chapter 4 are real effects rather than artefacts of the data. Therefore, despite the many studies raising legitimate questions on the reliability and comparability of corruption measurements, this thesis is an invitation to check the consistency of estimated corruption relationships, by comparing macro and micro corruption data, perception-based and experience-based corruption data.

Finally, an interesting avenue for future research would be to extend the problematic to other forms of crime. Our framework for the analysis of the effects of economic fluctuations on corrupt behaviours could indeed be applied to the analysis of other criminal behaviours – such as murders and theft (as in Guillaumont and Puech, 2006), or petty and organized crime – using for instance the International Crime Victim Survey dataset or data from Interpol already used by Neumayer (2003, 2005).

Policy implications

The long-run cultural foundations of corruption prevalence and the endogenous nature of usual policy levers against it, call for further efforts to identify additional and less endogenous entry points to combat this phenomenon. Hopefully, this thesis opens new rooms for anti-corruption interventions.

Policy implications stemming from results of chapter 4 are strongly related to the problems of structural economic vulnerability to shocks and governments capacity for reacting to them emphasised in chapters 2 and 3. In particular, results point out the damaging institutional effects of export instability in fragile states, since corrupt strategies may spread as a substitute for imperfect financial markets and/or a low state resilience to external fluctuations. We find here an additional argument in support to the reinforcement of state capacity for mitigating the consequences of shocks and policies lowering country's exposure to them. Moreover, the credit lever appears to be a strong corruption deterrent, inasmuch it does not translate into corruption in the banking sector (Barth et al., 2009). In fact, the liquidity constraint appears in our estimations as a key determinant

of the direction of the *ex post* and *ex ante* effects of export instability upon corrupt transactions: when it hardens export instability is found to increase corruption; while when it softens, export instability is found to decrease it. Therefore improving access to credit, in broader extent the access to formal and informal financial services, is expected to yield significant anti-corruption outcomes. Last but not least, evidence of boosting *ex post* and *ex ante* effects of instability on corruption strategies also points to the role of external factors of output stability, such as aid and remittances (Guillaumont and Le Goff, 2010; Guillaumont, 2005), in improving the quality of governance.

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GENERAL INTRODUCTION

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CHAPTER 1

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GENERAL CONCLUSION

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Annexes

CHAPTER 1

Annex 1.A. Forms of public sector corruption

Bribery, that is "*the bestowing of a benefit in order to unduly influence an action or decision. It can be initiated by a person who seeks or solicits bribes or by a person who offers and then pays bribes*".[100] Bribery is a regular part of many developing countries citizens' daily routine, and spreads at all level of the government and public administration. It generally affects the poorest and most vulnerable segment of the society. Bribery between an individual and a public official may occur to get the latter doing what he is paid for. For instance, a bureaucrat may accept bribe from someone or an enterprise to get a driving license. Or, bribery may occur to get a public officer doing what he is not expected to do. As an example, a custom official may accept bribes to overlook smuggling, forgery, or other illegal/illicit trade flows, or a procurement officer may be bribed by an enterprise to favour it during a public tender.

Embezzlement. Embezzlement is the "*theft of resources by a person entrusted with authority and control over anything of value*".[101] This form of corruption can involve public officials, private individuals or companies. For instance, it occurs when a public enterprise director employs company workers to build his own house; or when low-level officials charged with the administration of a local road project steal construction materials and re-sell it through parallel distribution networks. In certain cases, embezzlement feeds large networks of corrupt politicians and high-level officials and strongly undermines the delivery of basic public services, such as the education or health sector programs or public works.

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[100] UNODC, *United Nations Anti-corruption Toolkit*, Chapter 1 Introduction, 2004, p.11

[101] UNODC, "Value Added of Partnership In the Fight Against Corruption", *Global Programme Against Corruption Conferences*, Centre for International Crime Prevention, CICP-11, 2001, p.3.

Fraud. Fraud refers to "*any behaviour designed to trick or fool another person or entity for one's own or a third party's benefit*".[102] Typical examples of fraud include cases of forgery or other complex schemes unduly exempting g someone from his legal or professional obligations such as taxation, office attendance, etc.). Another possible illustration of fraud is when intimidations and ballot box stuffing occur during local or national elections.

Extortion. Extortion refers to any person/company/institution "*forcing* [another party] *to pay money or other valuables in exchange of acting or failing to act*".[103] Dutt and Traca (2010) define extortion as the act of public officials requesting bribes to do what they are supposed to do.[104] For instance, a checkpoint police officer may charge drivers additional payments to let them go, or a custom officer can threaten exporters to over-report the value their merchandize if the latter does not pay bribes.

Abuse of discretion. Abuse of discretion occurs when someone uses is "*vested authority to give undue preferential treatment to any group or individuals or to discriminate against any group or individuals"* [105] for personal gain. For instance, a procurement officer in charge of public tender (e.g. health, water, etc.) may favour an enterprise in which he holds personal interest during the bidding process. Or, a politician may favour (neglect) the delivery of public services in (outside) his constituency.

Creation or exploitation of conflicting interests. A conflict of interest in the public sector arises from the interference between a public official's duty to serve the general interest and his own private interests. The OECD (2005) proposes the following definition: "*A 'conflict of interest involves a conflict between the public duty and private interests of a public official, in which the public official has private […] interests which could improperly influence the performance of their official duties and responsibilities*".[106] As an illustration, a conflict of interest arises when an elected municipal official owns real estate in a city's area where he granted the permission for the implementation of a large a public work, expected to raise the value of the surrounding properties.

Favouritism, nepotism and cronyism. The U4 defines favouritism as "*the normal human inclination to prefer acquaintances, friends and family over strangers. […] [Corruption occurs] when officials demonstrate favouritism to unfairly distribute positions and resources*". Nepotism and cronyism are specific cases of favouritism. The former refers to the case where an official offers unfair favours to family members, while the latter refers to the favourable treatments of friends (Europeaid, 2011). However, cases of favouritism may go beyond ties of kinship and extend to geographical, ethnic, or

[102] UNODC, "Value Added of Partnership In the Fight Against Corruption", *Global Programme Against Corruption Conferences*, Centre for International Crime Prevention, CICP-11, 2001, p.3.

[103] *Ibid*

[104] while they refer to *evasion* when officials request bribes to do what they are not supposed to do.

[105] *Ibid.*

[106] OECD, *OECD guideline for managing conflict of interest in the public service*, September 2005

cultural ties. In an illustrative article, Garicano et al. (2005) analyzed how and to which extent soccer referees may favour the home team in order to satisfy the crowd of the stadium.

Illegal political contributions. Illegal or improper political contributions arise when "*political parties or a government receive bribes in exchange for non-interference* [or favouritism] *with the affairs of the group or entity making the contribution*".[107] Illegal political contributions encompass activities such as the diversion of public resources to fund political parties, or the extortion of donations from the private sector. Illegal political party financing feeds grand corruption in extended networks of corrupt politicians and high-level officials induces strong economic distortions, social injustices and strongly undermines democratic principles.

[107] UNODC, "Value Added of Partnership in the Fight against Corruption", *Global Programme Against Corruption Conferences*, Centre for International Crime Prevention, CICP-11, 2001, p.4.

Annex 1.B. Variables' definitions

Bureaucratic Compensation: concerns the change of bureaucratic compensation relative to the private sector. It is an equal-weight index of the following two questions:
(1) How would you estimate the salaries (and perquisites, not including bribes or other extra legal sources of income) of higher officials in these agencies relative to those of private sector managers with roughly comparable training and responsibilities? ("less than 50%", "50–80%", "80–90%", "Comparable", "Higher") ;
(2) Over the period in question (roughly 1970–1990) what was the movement of legal income in these agencies relative to salaries in the private sector? ("declined dramatically", "declined slightly", "maintained the same position", "improved their position").

Career opportunities: The respondents were asked to choose 'the four most important agencies in the central state bureaucracy in order of their power to shape overall economic policy'. "Career Opportunities" is an equal-weight index, ranging from 0 to 1, of the following five questions:
(1) Roughly how many of the top levels in these agencies are political appointees (e.g. appointed by the President or Chief Executive)? "none", "just agency chiefs", "agency chiefs and vice-chiefs", "all of top 2 or 3 levels";
(2) Of political appointees to these positions, what proportion is likely to already be members of the higher civil service? "less than 30%", "30–70%", "more than 70%";
(3) Of those promoted to the top 2 or 3 levels in these agencies (whether or not they are political appointees), what proportion come from within the agency itself or its associated ministry(ies) if the agency is not itself a ministry? "less than 50%", "50–70%", "70–90%", "over 90%";
(4) What is roughly the modal number of years spent by a typical higher level official in one of these agencies during his career? "1–5 years", "5–10 years", "10–20 years", "entire career";
(5) What prospects for promotion can someone who enters one of these agencies through a higher civil service examination early in his / her career reasonably expect? Assuming that there are at least a half dozen steps or levels between an entry-level position and the head of the agency, how would you characterize the possibilities for moving up in the agency? If respondent circled 'if performance is superior, moving up several levels to the level just below political appointees is not an unreasonable expectation' or 'in at least a few cases, could expect to move up several levels within the civil service and then move up to the very top of the agency on the basis of political appointments' and not 'in most cases, will move up one or two levels but no more' or 'in most cases, will move up three or four levels, but unlikely to reach the level just below political appointees'.

Annex 1.C. Procurement process and associated risks of corruption

Stage of the procurement process	Description	Main risks
A. Decision to contract	Purchase of good and services	The decision aims at benefiting to an individual or an organisation rather than following a policy rationale
B. Identification/Definition of contract characteristics	Identification of government needs. Definition of the terms of contract.	Contract's characteristics favour special supplier or contractor. Bidding process biased towards single source process. Limited participation of stakeholders, implying contracts maladapted to local needs. Evaluation criteria are not set adequately, making them prone to abuse.
C. Contracting process	The contracting process starts and should comply the rules set by the law (open or single source bidding process)	Invitation to tenders is not publicized When short lists are used, companies bribe to access it. Invitation to tender is publicized in a very short timeframe, so that bidders without prior knowledge of the contract tend to be excluded. Abuse of confidentiality creates unequal playing field for bidders Collusion between bidders to share the market by artificially loosing bids or not presenting offers
D. Contract award	Selection of winning bidder (in open bid) or the contractor (single source)	Evaluation criteria are not clearly stated, leading to unjustified decisions. Evaluation of bids is subjective and/or biased. Contract awards are not publicized nor the ground for the decision.
E. Contract implementation and supervision	The contract is signed with the selected bidder	Supervising entities are unduly influenced to change the content of their reports. Contractor's claims are false or inaccurate and are protected by those in charge of revising them. Subcontractors and partners are chosen in a non-transparent way, are unaccountable or are used to channel bribes.

Source: Anti-Corruption Resource Centre – U4

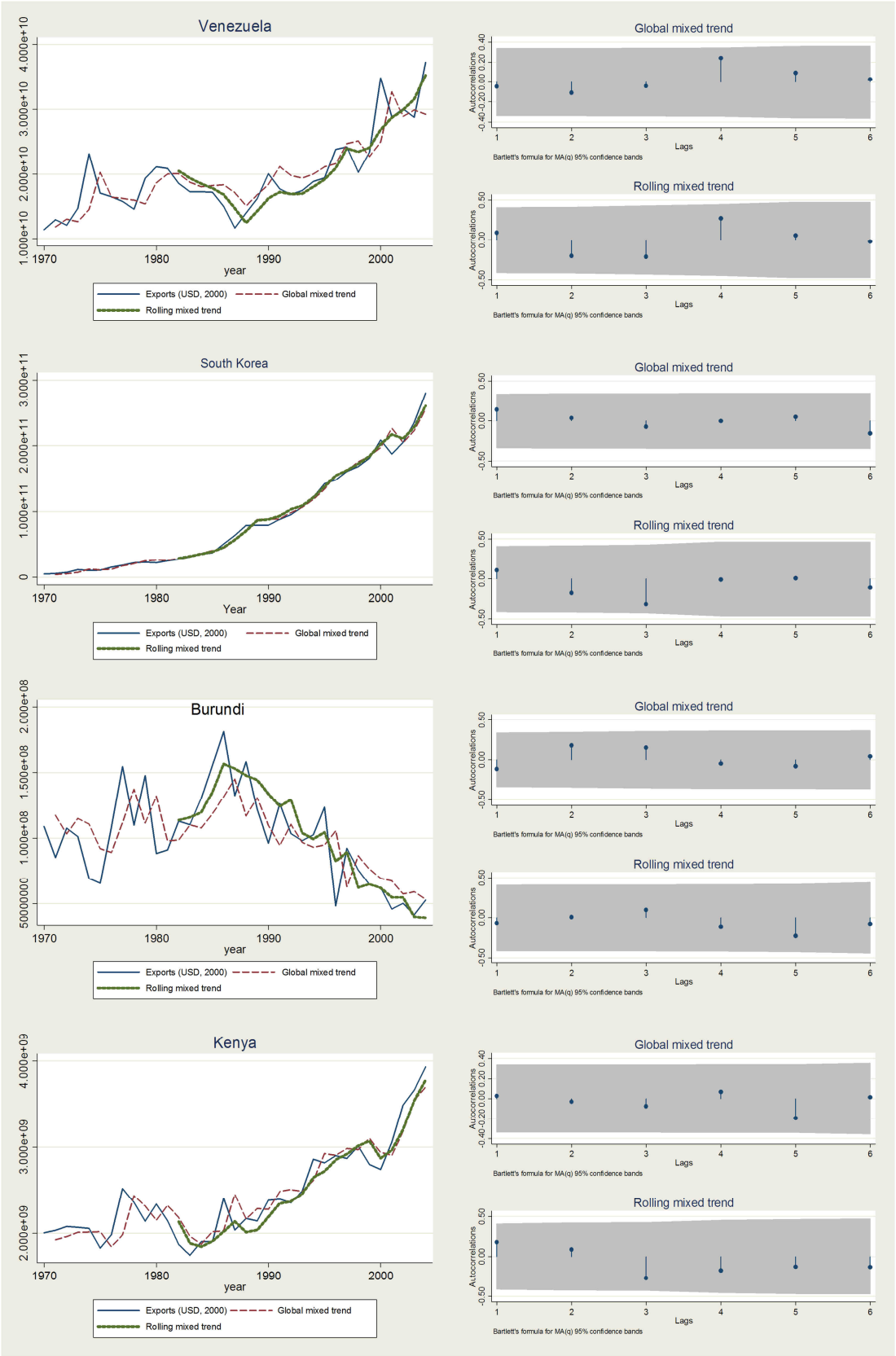
CHAPTER 2

Annex 2.A. Overview of indicators of instability and their application in the literature.

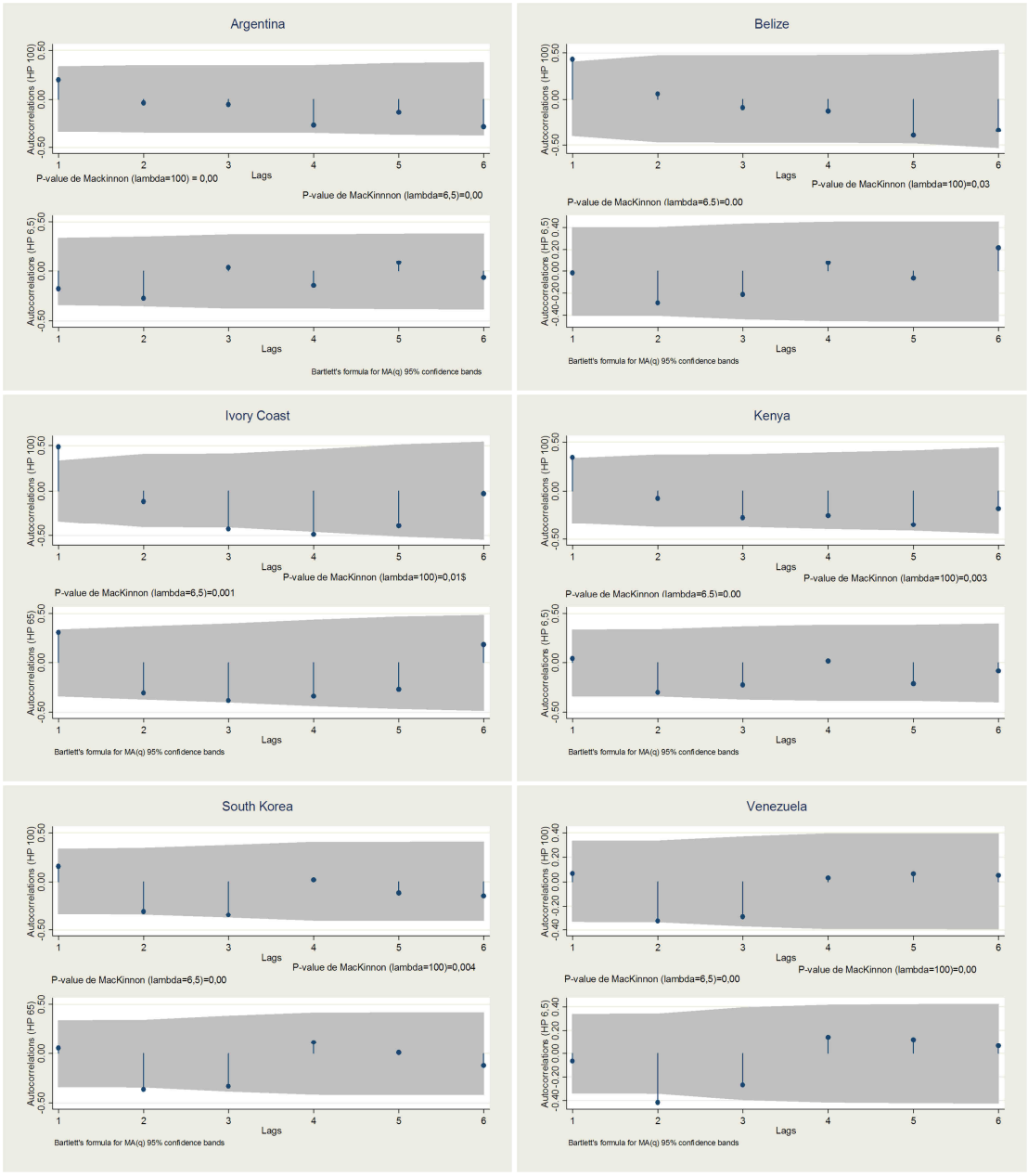
Indicators		Authors	Expected measure of	Variables concerned (y_t)
Growth rate/first difference	Standard deviation or coefficient of variation of growth rate	Servén (1997), Acemoglu et al. (2003), Mobarak (2005), Koren and Tenreyro (2006), Raddatz (2007), Di Giovanni and Levchenko (2007), Malik and Temple (2009), Ploeg and Poelhekke (2009)	Variability	GDP/inhabitant, inflation, terms of trade, actual exchange rate, black-market premium, international interest rate (LIBOR), development aid/inhabitant, public spending, ratio of wheat cultivation yields to national yield
	Variance of growth rate over five years	Koren and Tenreyro (2006)	variability	Annual growth rate of work productivity
Filters	Decline in GDP: decrease of more than 1% of the (annual) series log smoothed by the HP filter (lambda=1000)	Mauro and Becker (2006)	Variability	GDP
	Standard deviation of the cyclical component, i.e. the standard deviation of the difference between series smoothed by the HP or BK filter and actual series.	Hnatkovska and Loayza (2005); Guillaumont and Chauvet (2007), Afonso and Furceri (2010)	Variability	Aid, export revenues, GDP, budget variables (transfers, subsidies, public spending, tax revenues, etc.)

	Average over five years of the ratio of the absolute deviation between the observed value of export revenues (X) and the value filtered using the ratio of export five-year moving average process over GDP (Y): $INST = \frac{1}{T-4}\sum_{j=3}^{T-2}\frac{\left\lvert X_j - \frac{1}{5}\sum_{k=j-2}^{j+2} X_k \right\rvert}{Y_j}$	Dawe (1996)	Variability	Export revenues
Forecasts/Estimates	$\Delta\bar{y}_{it} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \alpha_3 t_{1974} + \varphi\, dummy_{1974} + \beta y_{it-1} + \gamma y_{it-2} + \lambda I_{it}^{initial} + \delta pop_{it}^{initial} + \theta Khum_{it}^{initial} + \varepsilon_{it}$ The standard deviation of the residual ε_{it} is seen as a measure of instability reflecting uncertainty. This approach is adopted for the whole of the sample, and for each country.	Ramey and Ramey (1995)	Uncertainty	Growth rate of GDP
	The standard deviation of the residual ε_{it}, obtained using a regression of y_t on a linear trend: $y_t = \alpha + \beta_t + \varepsilon_{it}$	Pritchett (2000), Mobarak (2005)	Variability	Growth rate of GDP per inhabitant, growth rate of capital per worker
	Rolling standard deviation or average absolute deviation of the residual ε_{it} obtained based on a regression of y_t on a rolling mixed trend: $y_t = \alpha + \beta_t + \gamma y_{t-1} + \varepsilon_{it}$	Guillaumont and Combes (2002), Guillaumont and Chauvet (2007), Servén (1998)	Variability/uncertainty	Development aid, exports, terms of trade, inflation rate, relative price of capital, actual exchange rate, growth rate of GDP.
	Standard deviation of the residual ε_{it}, in a regression of FDI over three lags and a temporal trend: $y_t = \alpha + \beta_t + \gamma_1 y_{t-1} + \gamma_2 y_{t-2} + \gamma_3 y_{t-3} + \varepsilon_{it}$	Lensink and Morrissey (2006)	Uncertainty	FDI/GDP, FDI
	They estimate instability measures for each country based on the following GARCH(1,1) model: $\Delta y_{it} = \alpha_0 + \alpha_1 t + \alpha_2 t^2 + \beta_1 \Delta y_{it-1} + \beta_2 y_{it-2} + \beta_3 D_t + \varepsilon_{it}$ where t=1…,T and D the vector of mute quarterly variables. They impose the following conditions on individual variance: $\sigma_{it}^2 = \gamma_0 + \gamma_1 \varepsilon_{i,t-1}^2 + \gamma_3 \sigma_{it-1}^2$ The estimated value of $\hat{\sigma}_{it}$ reflects the uncertainty in y_{it}.	Dehn (2000), Servén (1998)	Uncertainty	Prices of raw materials, inflation rate, price of capital relative to actual exchange rate

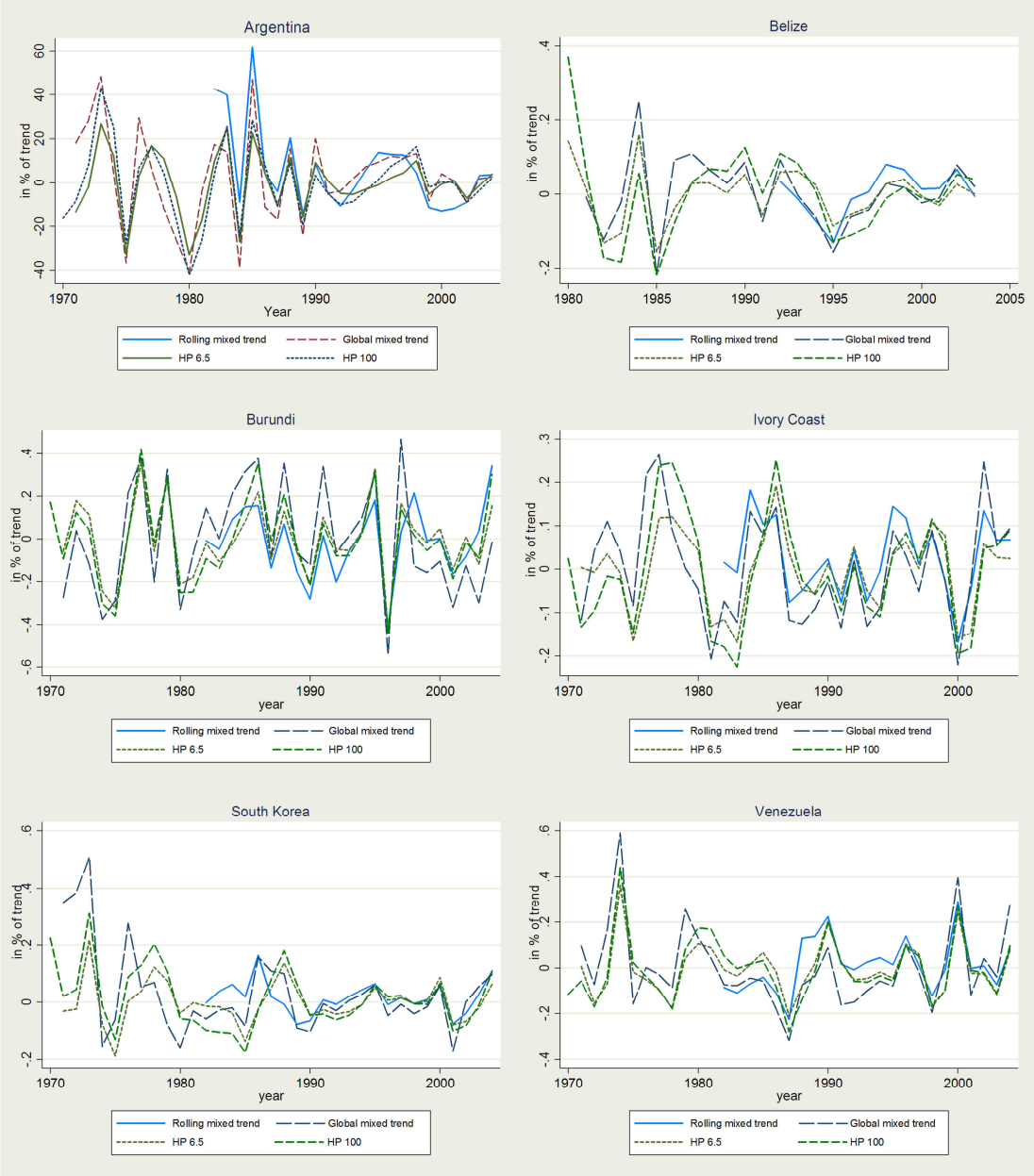
Annex 2.B. Mixed trends and correlograms of residuals



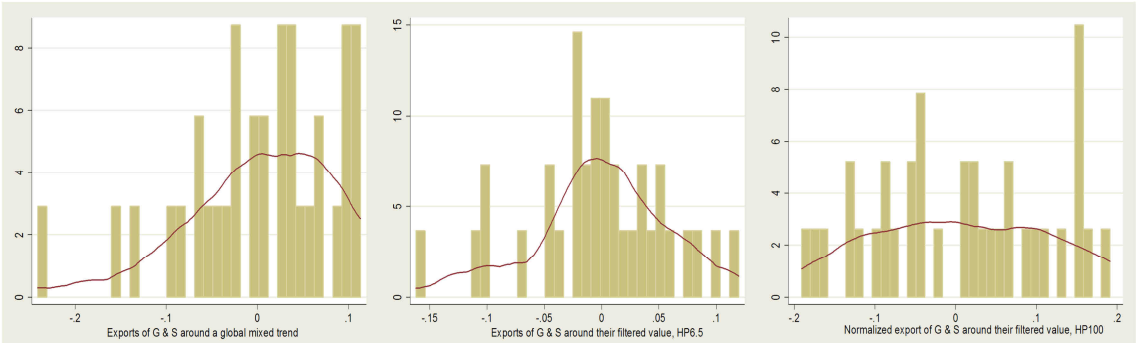
Annex 2.C. Correlograms of export revenue cycles smoothed by the HP filter



Annex 2.D. Comparative evolution of deviations (residuals or cycles), in % of trend values

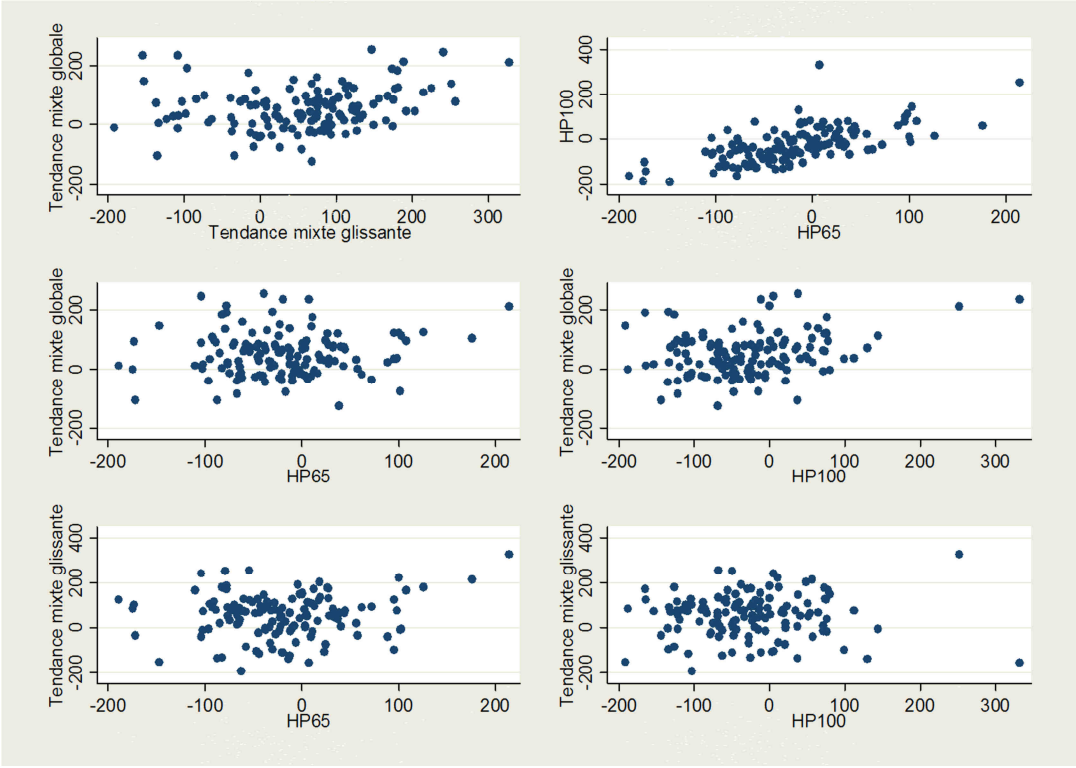


Annex 2.E. Kernel densities of the distribution of exports around the global mixed trend, HP100, and HP6.5, in Mexico

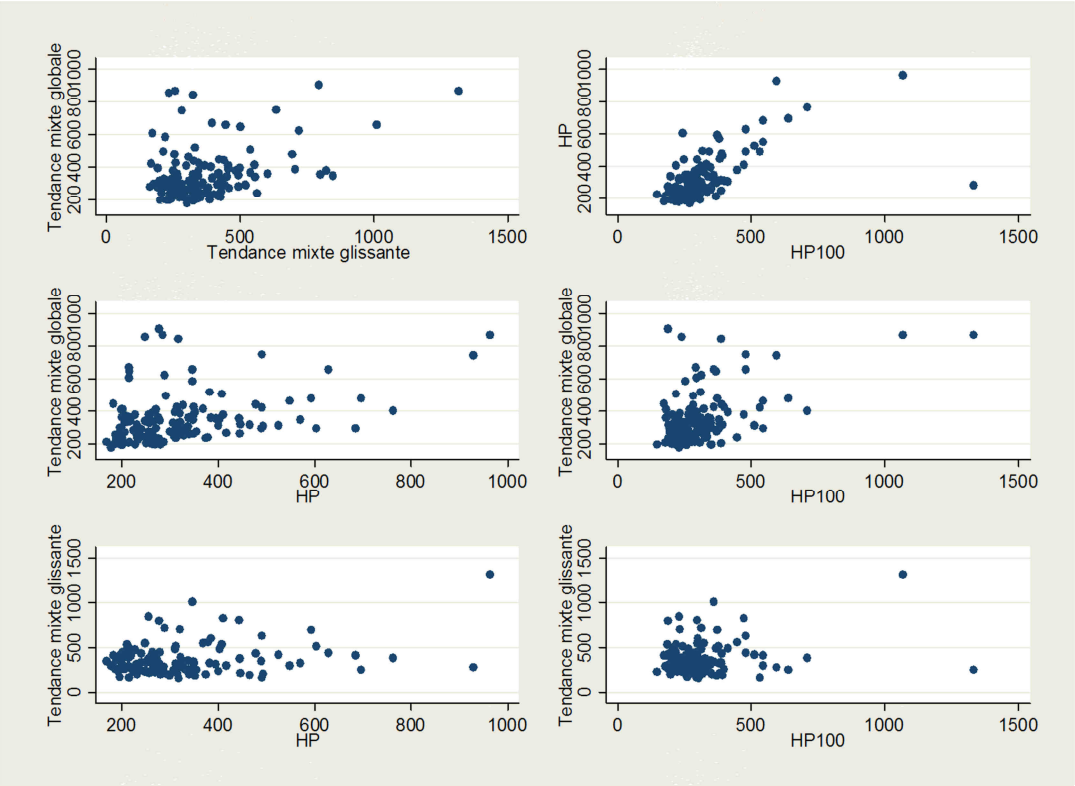


Global mixed trend	HP6.5	HP100
Std. Dev. = 8%	Std. Dev. = 6%	Std. Dev. = 11%
Skewness = −87%	Skewness = −45%	Skewness = −3%
Kurtosis = 369%	Kurtosis = 333%	Kurtosis = 191%

Annex 2.F. Graphical illustration of correlations between coefficients of skewness of export distributions around different reference values



Annex 2.G. Graphical illustration of correlations between coefficients of kurtosis of export distributions around different reference values



CHAPTER 3

Annex 3.A. List of countries

Country	LIC	LDC	Country	LIC	LDC	Country	LIC	LDC
Afghanistan	X	X	Gambia	X	X	Papua New Guinea	X	eligible
Algeria			Ghana	X		Paraguay		
Angola	X	X	Grenada			Peru		
Antigua and Barbuda			Guatemala			Philippines		
Argentina			Guinea	X	X	Qatar		
Bahamas			Guinea-Bissau	X	X	Rwanda	X	X
Bahrain			Guyana	X		Saint Kitts and Nevis		
Bangladesh	X	X	Haiti	X	X	Saint Lucia		
Barbados			Honduras	X		Saint Vincent and.		
Belize			India	X		Samoa		X
Benin	X	X	Indonesia	X		Sao Tome and Principe	X	X
Bhutan	X	X	Iran, Islamic Republic of			Saudi Arabia		
Bolivia			Iraq			Senegal	X	X
Botswana			Jamaica			Seychelles		
Brazil			Jordan			Sierra Leone	X	X
Burkina Faso	X	X	Kenya	X		Singapore		
Burundi	X	X	Kiribati		X	Solomon Islands	X	X
Cambodia	X	X	Korea, Republic of			Somalia	X	X
Cameroon	X		Lao PDR	X	X	South Africa		
Cape Verde			Lebanon			Sri Lanka	X	
Central African Republic	X	X	Lesotho	X	X	Sudan	X	X
Chad	X	X	Liberia	X	X	Suriname		
Chile			Libyan Arab Jamahiriya			Swaziland		
China	X		Madagascar	X	X	Syrian Arab Republic		
Colombia			Malawi	X	X	Tanzania, United Rep. of	X	X

Country	LIC	LDC	Country	LIC	LDC	Country	LIC	LDC
Comoros	X	X	Malaysia			Thailand		
Congo,Rep of	X		Maldives	X	X	Timor-Leste		X
Costa Rica			Mali	X	X	Togo	X	X
Côte d'Ivoire	X		Mauritania	X	X	Tonga		
Cuba			Mauritius			Trinidad and Tobago		
Dem. Peo's Rep.Korea	X		Mexico			Tunisia		
Dem. Rep. of the Congo	X	X	Mongolia	X		Turkey		
Djibouti		X	Morocco			Tuvalu		X
Dominica			Mozambique	X	X	Uganda	X	X
Dominican Republic			Myanmar	X	X	United Arab Emirates		
Ecuador			Namibia			Uruguay		
Egypt	X		Nepal	X	X	Vanuatu, Republic of		X
El Salvador			Nicaragua	X		Venezuela		
Equatorial Guinea	X	X	Niger	X	X	Viet Nam	X	
Eritrea	X	X	Nigeria	X		Yemen	X	X
Ethiopia	X	X	Oman			Zambia	X	X
Fiji			Pakistan	X		Zimbabwe	X	eligible
Gabon			Panama					

Annex 3.B. Econometric estimations of homeless due to natural disasters

Dependent variable: Log of annual mean % of homeless in the population.	Sierra Leone (1)	Timor Leste (2)
Log of annual mean % of displaced due to natural disasters in the population	0,426	0,696
	(0,253)	(0,173)
Constant	-1,871	-1,404
	(0,001)	(0,016)
Observations	5	5
R2	0,23	0,43

P-values are between brackets. (1) Estimations of the annual mean share of homeless in the population of Sierra Leone. Data is averaged over the 1970-2008 period, of the following neighboring countries: Gambia, Guinea-Bissau, Liberia, Mali and Senegal. (2) Estimations of the annual mean share of homeless in the population of Timor Leste. Data is averaged over the 1970-2008 period, of the following neighboring countries: Indonesia, Malaysia, Papua New Guinea, Philippines, and Thailand.

Annex 3.C. Additional results

i) Average values for the retrospective economic vulnerability index and its components, by developing country category, 1984-2008.

Country category	N	Economic Vulnerability Index								
		EVI			Exposure Index			Shock Index		
		1984-89	1990-99	2000-08	1984-89	1990-99	2000-08	1984-89	1990-99	2000-08
Developing countries	121	42,9	43,6	41,3	49,3	48,4	45,9	36,4	38,8	36,7
Low income countries (LICs)	63	41,7	43,4	42,3	48,8	47,9	44,8	34,6	38,9	39,8
Non-LICs	58	44,2	43,8	40,3	49,9	48,9	47,2	38,4	38,7	33,4
Least developed countries (LDCs)	48	46,4	48,8	47,5	55,7	54,9	51,8	37,0	42,6	43,2
Non-LDCs	71	40,4	40,0	37,0	44,8	43,8	41,8	36,1	36,1	32,2
Low-income LDCs	45	44.5	46.5	46.1	53.5	52.7	49.5	35.5	40.2	42.7
Low-income non LDCs	83	34.7	35.7	32.8	37,0	36,0	33.1	32.3	35.5	32.5
Small Islands Developing States (SIDS)	30	53,6	55,4	52,2	67,1	67,0	66,1	40,2	43,8	38,2
Non-SIDS	91	39,3	39,7	37,8	43,5	42,3	39,3	35,2	37,2	36,2
LDCs Non-SIDS	39	43,5	45,5	44,6	51,4	50,4	46,5	35,6	40,6	42,8
LDCs SIDS	11	57,4	61,5	56,9	71,2	71,1	70,7	43,6	52,0	43,1
SIDS Non-LDCs	19	51,4	51,9	49,4	64,6	64,7	63,4	38,2	39,0	35,5
Sub-Saharan Africa (SSA)	48	43,9	45,3	44,6	54,1	53,4	50,6	33,7	37,3	38,7
Non SSA	73	42,2	42,5	39,2	46,2	45,1	42,9	38,2	39,8	35,4
SSA LDCs	33	45,4	47,5	46,7	54,4	53,9	50,8	36,4	41,1	42,6
SSA Non-LDCs	15	40,6	40,4	40,1	53,4	52,2	50,1	27,9	28,7	30,1

In addition to Timor Leste, Israel and Brunei, the United Arab Emirates, Bahrain, the Bahamas, Qatar, Singapore and South Korea have been excluded from the sample, because of their level of GDP *per capita*.

ii) Wilcoxon tests on average values for the retrospective economic vulnerability index and its components, 1984-2008.

		Economic Vulnerability Index								
		EVI			Exposure Index			Shock Index		
Wilcoxon P-values		**1984-89**	**1990-99**	**2000-08**	**1984-89**	**1990-99**	**2000-08**	**1984-89**	**1990-99**	**2000-08**
Non LICs/LICs	Wilcoxon-z	-0,09	-0,85	-2,17	-1,01	-1,04	-0,73	0,64	-0,51	-3,62
	pvalue	0,926	0,393	0,030	0,312	0,296	0,468	0,525	0,608	0,000
Non LDCs/LDCs	Wilcoxon-z	-3,52	-3,56	-3,91	-4,10	-4,05	-3,98	-1,49	-1,54	-2,92
	pvalue	0,000	0,000	0,000	0,000	0,000	0,000	0,137	0,123	0,004

In addition to Timor Leste, Israel and Brunei, the United Arab Emirates, Bahrain, the Bahamas, Qatar, Singapore and South Korea have been excluded from the sample, because of their high level of GDP *per capita*.

iii) Average values for the retrospective economic vulnerability index and its components, by developing country category, 1984-2008 (Exposure Index).

		Exposure Index											
		Population			Remoteness			Exports concentration			Share of Agriculture, forestry and fisheries in GDP		
Country category	**N**	**1984-89**	**1990-99**	**2000-08**	**1984-89**	**1990-99**	**2000-08**	**1984-89**	**1990-99**	**2000-08**	**1984-89**	**1990-99**	**2000-08**
Developing countries	121	48,6	46,1	43,6	60,4	62,6	60,6	39,2	39,2	39,4	40,2	38,3	32,6
Low income countries (LICs)	63	41,4	38,7	35,6	63,4	65,1	62,0	41,3	42,9	42,7	56,6	55,6	49,2
Non-LICs	58	56,3	54,2	52,3	57,2	60,0	59,2	37,0	35,1	35,9	22,4	19,5	14,6
Least developed countries (LDCs)	48	52,1	49,3	45,8	66,9	68,8	65,9	45,6	47,9	48,6	58,2	56,9	50,6
Non-LDCs	71	46,1	44,0	42,0	55,9	58,2	56,9	34,7	33,1	32,9	27,6	25,3	19,9
Low-income LDCs	45	47.1	44.2	40.6	66.4	68.1	65.0	45.2	48.4	49.0	61.6	60.4	54.3
Low-income non LDCs	18	27.1	25.0	23.2	55.8	57.5	54.3	31.5	29.1	26.7	44.1	43.7	36.4
Small Islands Developing States (SIDS)	30	84,0	82,8	81,4	61,6	65,5	65,2	43,3	42,7	46,5	33,9	31,3	26,1
Non-SIDS	91	36,8	34,0	31,1	60,1	61,7	59,1	37,9	38,0	37,1	42,3	40,7	34,7
LDCs Non-SIDS	39	42,8	39,7	36,0	66,8	68,3	65,0	45,1	47,9	45,3	60,9	59,7	52,6
LDCs SIDS	11	84,9	83,0	80,8	67,0	70,9	69,4	47,3	48,0	60,3	48,8	46,8	43,5
SIDS Non-LDCs	19	83,5	82,7	81,8	58,4	62,4	62,8	40,9	39,6	38,5	25,3	22,3	16,1
Sub-Saharan Africa (SSA)	48	49,8	46,8	43,3	68,3	70,2	68,2	47,2	50,2	49,5	49,8	49,3	45,3
Non SSA	73	47,7	45,7	43,7	55,3	57,6	55,6	34,0	32,0	32,7	33,9	31,1	24,2
SSA LDCs	33	48,8	45,8	41,9	66,1	68,1	66,1	49,4	52,9	51,9	58,6	59,0	54,5
SSA Non-LDCs	15	52,0	48,9	46,4	73,0	74,8	72,7	42,3	44,1	44,4	30,5	28,0	25,0

In addition to Timor Leste, Israel and Brunei, the United Arab Emirates, Bahrain, the Bahamas, Qatar, Singapore and South Korea have been excluded from the sample, because of their high level of GDP *per capita*.

iv) Average values for the retrospective economic vulnerability index and its components, by developing country category, 1984-2008 (Exposure Index).

Wilcoxon P-values		Exposure Index											
		Population			Remoteness			Exports concentration			Share of Agriculture, forestry and fisheries in GDP		
		1984-89	1990-99	2000-08	1984-89	1990-99	2000-08	1984-89	1990-99	2000-08	1984-89	1990-99	2000-08
Non LICs/LICs	Wilcoxon-z	2,44	2,51	2,70	-1,65	-0,90	-0,17	-0,90	-1,91	-1,52	-7,98	-8,31	-8,07
	pvalue	0,015	0,012	0,007	0,098	0,371	0,866	0,367	0,056	0,128	0,000	0,000	0,000
Non LDCs/LDCs	Wilcoxon-z	-1,24	-1,13	-0,88	-3,05	-2,52	-2,02	-2,96	-3,89	-3,62	-6,81	-6,76	-6,44
	pvalue	0,214	0,258	0,376	0,002	0,012	0,044	0,003	0,000	0,000	0,000	0,000	0,000

In addition to Timor Leste, Israel and Brunei, the United Arab Emirates, Bahrain, the Bahamas, Qatar, Singapore and South Korea have been excluded from the sample, because of their high level of GDP *per capita*.

v) Average values for the retrospective economic vulnerability index and its components, by developing country category, 1984-2008 (Shock Index).

Country category	N	Shock index								
		Homeless			Agricultural instability			Exports instability		
		1984-89	1990-99	2000-08	1984-89	1990-99	2000-08	1984-89	1990-99	2000-08
Developing countries	121	34,1	46,9	55,0	25,7	25,1	23,4	43,0	41,6	34,3
Low income countries (LICs)	63	29,1	42,7	53,8	21,2	22,0	21,8	44,1	45,4	41,7
Non-LICs	58	39,5	51,4	56,3	30,6	28,6	25,1	41,8	37,5	26,2
Least developed countries (LDCs)	48	27,7	44,9	54,7	26,0	27,3	26,0	47,1	49,2	46,1
Non-LDCs	71	38,6	48,3	55,2	25,5	23,6	21,6	40,1	36,3	25,9
Low-income LDCs	45	28.5	42.5	53.6	23.2	24.7	25.1	45.2	46.9	46,0
Low-income non LDCs	83	30.8	43.2	54.5	16.2	15.3	13.6	41.2	41.6	31.0
Small Islands Developing States (SIDS)	30	36,1	58,3	63,8	32,4	32,5	27,8	46,2	42,2	30,6
Non-SIDS	91	33,5	43,1	52,1	23,5	22,7	21,9	41,9	41,4	35,5
LDCs Non-SIDS	39	27,9	39,2	52,0	25,0	27,1	27,9	43,8	46,9	46,6
LDCs SIDS	11	27,0	65,1	64,5	29,4	27,9	19,4	59,0	57,5	44,1
SIDS Non-LDCs	19	41,3	54,3	63,4	34,0	35,2	32,7	38,8	33,3	22,8
Sub-Saharan Africa (SSA)	48	20,4	32,2	47,3	25,4	27,3	25,9	44,5	44,8	40,8
Non SSA	73	43,1	56,5	60,0	25,9	23,7	21,7	42,0	39,5	29,9
SSA LDCs	33	25,5	37,0	48,3	24,2	27,1	27,4	47,9	50,2	47,4
SSA Non-LDCs	15	9,2	21,7	45,2	28,1	27,6	22,5	37,1	32,8	26,4

In addition to Timor Leste, Israel and Brunei, the United Arab Emirates, Bahrain, the Bahamas, Qatar, Singapore and South Korea have been excluded from the sample, because of their high level of GDP *per capita*.

vi) Average values for the retrospective economic vulnerability index and its components, by developing country category, 1984-2008 (Shock Index).

Wilcoxon P-values		Shock index								
		Homeless			Agricultural instability			Exports instability		
		1984-89	1990-99	2000-08	1984-89	1990-99	2000-08	1984-89	1990-99	2000-08
Non LICs/LICs	Wilcoxon-z	1,76	1,61	0,66	2,79	1,89	1,31	-0,70	-2,15	-4,14
	pvalue	0,079	0,108	0,507	0,005	0,058	0,191	0,487	0,032	0,000
Non LDCs/LDCs	Wilcoxon-z	1,77	0,54	0,07	0,36	-1,05	-1,41	-1,75	-3,11	-5,22
	pvalue	0,076	0,589	0,941	0,720	0,292	0,158	0,080	0,002	0,000

In addition to Timor Leste, Israel and Brunei, the United Arab Emirates, Bahrain, the Bahamas, Qatar, Singapore and South Korea have been excluded from the sample, because of their high level of GDP *per capita*.

vii) Ranking of LDCs according to the retrospective EVI, 2008.

Country	EVI 2008	Rank	Country	EVI 2008	Rank	Country	EVI 2008	Rank
Kiribati	69,31	1	Timor-Leste	50,02	25	(Papua New Guinea)	41,58	57
Gambia	64,13	4	Mauritania	49,72	26	Madagascar	40,92	60
Solomon Islands	60,13	5	Sudan	48,46	31	Somalia	40,38	64
(Zimbabwe)	59,76	6	Sao Tome and Principe	48,18	33	Niger	39,84	66
Samoa	57,71	7	Bhutan	48,11	34	Burkina Faso	39,65	67
Chad	57,31	9	Rwanda	46,63	39	Mali	39,42	70
Comoros	56,47	10	Angola	46,58	40	Togo	39,04	72
Burundi	56,13	12	Dem. Rep. of the Congo	44,51	44	Benin	37,61	76
Maldives	55,64	13	Lao PDR	44,40	45	Myanmar	37,18	79
Guinea-Bissau	55,24	14	Lesotho	44,13	47	Cambodia	37,04	82
Vanuatu, Republic of	55,08	15	Yemen	43,59	48	Uganda	35,86	83
Liberia	53,88	16	Haiti	43,31	49	Senegal	35,42	87
Equatorial Guinea	52,88	17	Sierra Leone	43,24	50	Nepal	30,08	96
Zambia	52,48	19	Central African Republic	42,91	51	Tanzania, United Rep. of	27,07	105
Malawi	52,11	21	Djibouti	42,75	53	Guinea	26,04	106
Eritrea	51,13	23	Mozambique	42,42	54	Ethiopia	24,79	109
Tuvalu	50,51	24	Afghanistan	42,25	56	Bangladesh	22,16	112

Annex 3.D. List of countries ordered by decreasing ranking differences (in absolute value) between the retrospective EVI and the UNCDP 2009 review.

Country	EVI retro 2006	*ranking retro EVI, 2006*	EVI UNCDP 2009 review	*Ranking UNCDP 2009 review*	Absolute difference in scores	*Ranking difference*
Grenada	56,94	*14*	42,87	*66*	14,07	*52*
Uganda	37,28	*82*	51,91	*35*	14,63	*-47*
Somalia	46,33	*44*	62,63	*7*	16,30	*-37*
Lao PDR	45,51	*47*	59,89	*12*	14,38	*-35*
Ghana	32,69	*91*	44,45	*60*	11,76	*-31*
Gabon	45,14	*51*	38,60	*79*	6,53	*28*
St Vincent and Grenadines	52,09	*24*	46,81	*52*	5,27	*28*
Libyan Arab Jamahiriya	39,61	*71*	32,71	*95*	6,90	*24*
Dominican Republic	31,19	*97*	41,07	*74*	9,88	*-23*
Bhutan	45,20	*49*	52,93	*28*	7,74	*-21*
Madagascar	40,45	*65*	37,17	*86*	3,28	*21*
Equatorial Guinea	50,73	*29*	60,54	*9*	9,81	*-20*
Nicaragua	36,27	*84*	43,25	*64*	6,97	*-20*
Mauritania	49,46	*32*	47,13	*51*	2,33	*19*
Namibia	43,01	*57*	39,81	*75*	3,20	*18*
Eritrea	59,78	*7*	55,46	*24*	4,33	*17*
Gambia	65,45	*3*	56,27	*20*	9,19	*17*
Botswana	49,63	*31*	57,32	*15*	7,69	*-16*
Sierra Leone	43,78	*55*	50,67	*39*	6,88	*-16*
Oman	40,46	*64*	38,38	*80*	2,09	*16*
Saint Lucia	52,47	*23*	50,79	*38*	1,68	*15*
Singapore	39,61	*72*	36,55	*87*	3,06	*15*
Bolivia	37,90	*79*	42,90	*65*	5,00	*-14*
Jamaica	37,91	*78*	34,60	*92*	3,31	*14*
Qatar	44,61	*54*	42,56	*68*	2,06	*14*
Burkina Faso	38,58	*76*	43,81	*63*	5,23	*-13*
Cambodia	48,80	*36*	55,63	*23*	6,84	*-13*
Niger	40,36	*67*	45,84	*54*	5,47	*-13*
Cape Verde	48,71	*37*	48,06	*49*	0,65	*12*
Haiti	52,48	*22*	52,19	*34*	0,29	*12*
Lesotho	44,63	*53*	49,94	*41*	5,31	*-12*
Sudan	47,34	*42*	52,86	*30*	5,52	*-12*
Yemen	45,99	*45*	44,90	*57*	1,08	*12*
Honduras	31,72	*96*	37,39	*84*	5,67	*-12*
Saudi Arabia	32,09	*93*	30,08	*105*	2,01	*12*
Swaziland	42,45	*59*	48,47	*47*	6,02	*-12*
Fiji	48,21	*39*	48,05	*50*	0,16	*11*

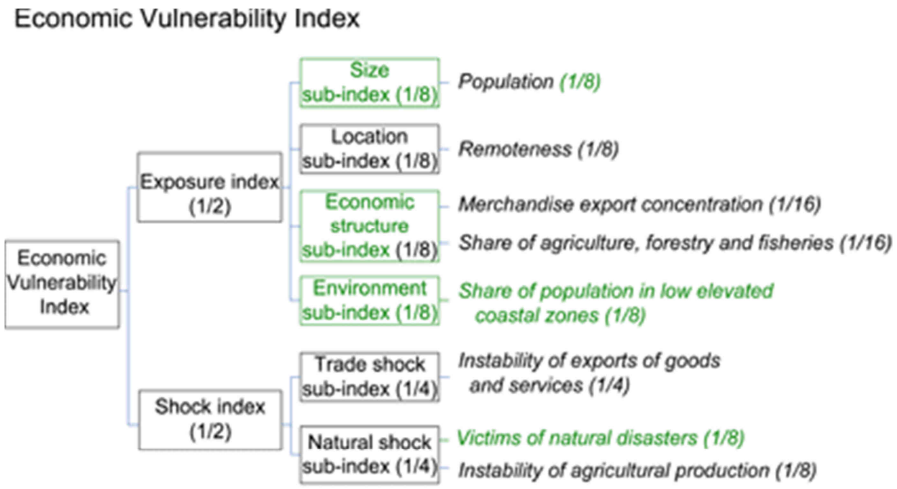
Country	EVI retro 2006	*ranking retro EVI, 2006*	EVI UNCDP 2009 review	*Ranking UNCDP 2009 review*	Absolute difference in scores	*Ranking difference*
Benin	37,78	*80*	42,50	*69*	4,73	*-11*
Chad	56,28	*16*	53,53	*27*	2,75	*11*
Chile	35,41	*86*	32,53	*96*	2,88	*10*
Guyana	48,92	*34*	49,39	*44*	0,47	*10*
Tuvalu	57,56	*11*	79,69	*1*	22,14	*-10*
Iraq	44,94	*52*	43,88	*62*	1,06	*10*
Vanuatu, Republic of	54,94	*18*	62,30	*8*	7,36	*-10*
Lebanon	29,50	*100*	35,74	*90*	6,24	*-10*
Mauritius	40,91	*63*	45,96	*53*	5,05	*-10*
Nigeria	42,14	*60*	42,42	*70*	0,28	*10*
Suriname	71,46	*1*	59,90	*11*	11,55	*10*
Viet Nam	20,72	*118*	26,51	*108*	5,79	*-10*
Barbados	45,82	*46*	45,62	*55*	0,19	*9*
El Salvador	35,29	*88*	32,47	*97*	2,82	*9*
Liberia	57,01	*13*	65,46	*4*	8,44	*-9*
Saint Kitts and Nevis	57,59	*10*	56,48	*19*	1,11	*9*
Bahamas	47,54	*41*	52,44	*33*	4,90	*-8*
Belize	40,38	*66*	44,87	*58*	4,49	*-8*
Congo, Rep of	43,26	*56*	48,29	*48*	5,03	*-8*
Indonesia	19,09	*124*	23,00	*116*	3,91	*-8*
Afghanistan	39,98	*69*	39,52	*77*	0,46	*8*
Malaysia	19,91	*120*	25,53	*112*	5,62	*-8*
Ecuador	34,77	*90*	37,47	*83*	2,70	*-7*
Iran, Islamic Republic of	40,03	*68*	43,89	*61*	3,86	*-7*
Comoros	58,15	*9*	56,94	*16*	1,21	*7*
Senegal	34,80	*89*	37,58	*82*	2,77	*-7*
Mongolia	51,64	*25*	52,74	*32*	1,10	*7*
Brazil	21,39	*116*	20,96	*122*	0,43	*6*
Solomon Islands	59,52	*8*	57,98	*14*	1,53	*6*
Pakistan	22,77	*112*	22,25	*118*	0,52	*6*
Egypt	16,84	*126*	20,99	*121*	4,15	*-5*
Dem. Rep. of the Congo	45,19	*50*	49,27	*45*	4,07	*-5*
Tanzania, United Rep. of	30,39	*98*	31,02	*103*	0,63	*5*
Togo	41,25	*62*	42,79	*67*	1,54	*5*
Zambia	51,44	*26*	52,79	*31*	1,35	*5*
Sri Lanka	28,53	*103*	32,43	*98*	3,90	*-5*
Antigua and Barbuda	49,14	*33*	51,02	*37*	1,88	*4*
Bahrain	38,27	*77*	38,01	*81*	0,26	*4*
Colombia	20,13	*119*	20,87	*123*	0,74	*4*
Costa Rica	35,80	*85*	36,08	*89*	0,29	*4*
Guatemala	29,01	*102*	29,20	*106*	0,19	*4*

Country	EVI retro 2006	*ranking retro EVI, 2006*	EVI UNCDP 2009 review	*Ranking UNCDP 2009 review*	Absolute difference in scores	*Ranking difference*
India	19,43	*123*	17,55	*127*	1,89	*4*
Angola	48,44	*38*	49,77	*42*	1,33	*4*
Maldives	56,05	*17*	58,18	*13*	2,13	*-4*
Syrian Arab Republic	27,01	*106*	25,76	*110*	1,25	*4*
Argentina	26,81	*107*	30,15	*104*	3,34	*-3*
Cameroon	27,61	*105*	31,29	*102*	3,68	*-3*
Côte d'Ivoire	28,10	*104*	31,48	*101*	3,38	*-3*
Mexico	19,51	*122*	18,96	*125*	0,55	*3*
Rwanda	50,90	*28*	55,05	*25*	4,15	*-3*
Thailand	15,53	*127*	20,56	*124*	5,04	*-3*
United Arab Emirates	37,51	*81*	39,11	*78*	1,60	*-3*
China	21,82	*115*	22,91	*117*	1,09	*2*
Jordan	24,56	*109*	25,72	*111*	1,15	*2*
Morocco	21,25	*117*	22,12	*119*	0,87	*2*
Papua New Guinea	41,41	*61*	44,57	*59*	3,16	*-2*
Bangladesh	22,68	*113*	23,21	*115*	0,53	*2*
Burundi	56,71	*15*	56,81	*17*	0,10	*2*
Central African Republic	42,77	*58*	45,06	*56*	2,29	*-2*
Guinea-Bissau	57,15	*12*	60,53	*10*	3,38	*-2*
Kiribati	65,30	*4*	75,25	*2*	9,95	*-2*
Malawi	53,84	*20*	55,88	*22*	2,04	*2*
Mozambique	45,50	*48*	48,68	*46*	3,18	*-2*
Myanmar	36,42	*83*	37,39	*85*	0,97	*2*
Tunisia	23,34	*111*	24,92	*113*	1,58	*2*
Uruguay	38,99	*74*	42,25	*72*	3,26	*-2*
Algeria	31,72	*95*	33,25	*94*	1,53	*-1*
Kenya	18,57	*125*	18,39	*126*	0,18	*1*
Korea, Republic of	19,60	*121*	21,81	*120*	2,21	*-1*
Panama	32,53	*92*	35,17	*91*	2,64	*-1*
Philippines	23,44	*110*	26,37	*109*	2,93	*-1*
Seychelles	50,15	*30*	52,90	*29*	2,75	*-1*
Djibouti	48,83	*35*	51,20	*36*	2,37	*1*
Ethiopia	29,03	*101*	32,04	*100*	3,00	*-1*
Guinea	25,63	*108*	27,90	*107*	2,27	*-1*
Tonga	69,59	*2*	69,05	*3*	0,54	*1*
Trinidad and Tobago	38,86	*75*	39,76	*76*	0,90	*1*
Mali	39,78	*70*	42,32	*71*	2,54	*1*
Nepal	31,76	*94*	33,65	*93*	1,89	*-1*
Sao Tome and Principe	51,43	*27*	54,97	*26*	3,54	*-1*
Venezuela	35,33	*87*	36,29	*88*	0,96	*1*
Timor-Leste	54,85	*19*	56,70	*18*	1,86	*-1*

Country	EVI retro 2006	*ranking retro EVI, 2006*	EVI UNCDP 2009 review	*Ranking UNCDP 2009 review*	Absolute difference in scores	*Ranking difference*
Cuba	39,01	*73*	41,97	*73*	2,96	*0*
Dem. Peo's Rep.Korea	48,12	*40*	50,19	*40*	2,07	*0*
Dominica	52,97	*21*	56,20	*21*	3,23	*0*
Paraguay	46,75	*43*	49,60	*43*	2,85	*0*
Peru	29,66	*99*	32,28	*99*	2,62	*0*
South Africa	22,19	*114*	23,73	*114*	1,53	*0*
Turkey	13,44	*128*	15,32	*128*	1,88	*0*
Samoa	60,04	*6*	64,29	*6*	4,24	*0*
Zimbabwe	62,61	*5*	64,32	*5*	1,71	*0*

Annex 3.E. The EVI in the UNCDP 2012 review

"The EVI incorporates eight indicators, which are grouped into two broad areas comprising an exposure index and a shock index. The weights attached to each indicator in each composite index and sub-index are as follows:



Bold and green indicate change compared to the 2006/2009 EVI.
Numbers in parenthesis indicate the weight in the overall EVI.

The various sub-indices of the EVI denoted in the figure above are the simple averages of the index values of their components. Thus, the overall EVI score is a weighted rather than a simple average of the eight indicators. As for the HAI, original data for each EVI component are converted into index numbers using a max-min procedure and re-scaled to remove significant outliers.

The EVI described above incorporates the refinements introduced in 2011, namely, the share of the population living in low elevated coastal zones and victims of natural disasters to better capture structural vulnerability to climate change. Moreover, the weighting of sub-indices has been harmonized and some sub-indices have been renamed."

Source: http://www.un.org/en/development/desa/policy/cdp/ldc/ldc_criteria.shtml#criteria

Annex 3.F. Glossary

CERDI: Centre for Studies and Researches on International Development

EVI: Economic Vulnerability Index

DC: Developing Countries

LICs: Low income countries

LDCs: Least developed countries

LDC-also-LICs: Least Developed Countries also Low Income Countries

LIC-non-LICs: Low Income Countries non Least Developed Countries

UNCDP: United Nations Committee for Development Policy

UNDESA: United Nations Department of Economic and Social Affairs

CHAPTER 4

Annex 4.A. Descriptive statistics and data sources

i) Country-level panel data

country	Obs	country	Obs	country	Obs
Algeria	19	France	19	Norway	19
Argentina	19	Gabon	19	Pakistan	19
Australia	14	Greece	19	Papua New Guinea	17
Austria	19	Guatemala	19	Paraguay	19
Bangladesh	19	Guyana	11	Peru	19
Belgium	19	Honduras	19	Philippines	19
Bolivia	9	Hungary	19	Portugal	19
Botswana	4	India	19	Senegal	19
Brazil	19	Indonesia	19	South Africa	19
Burkina Faso	14	Ireland	19	Spain	19
Cameroon	19	Italy	19	Sudan	19
Canada	19	Japan	19	Sweden	19
Chile	19	Jordan	3	Syria	4
China	1	Kenya	19	Thailand	19
Colombia	5	Madagascar	19	Togo	19
Costa Rica	19	Malawi	19	Trinidad and Tobago	16
Cuba	9	Malaysia	19	Tunisia	18
Cyprus	4	Mali	12	United Kingdom	19
Denmark	19	Mexico	19	United States	9
Dominican Republic	19	Morocco	19	Uruguay	19
Ecuador	19	Netherlands	19	Zambia	19
El Salvador	19	New Zealand	19	Zimbabwe	3
Finland	19	Nicaragua	19		

East Asia and Pacific = 13% of total sample
Europe and Central Asia = 1,7% of total sample (Hungary)
Latin America and Caribbean = 28,2% of total sample
Middle East and North Africa = 9% of total sample
North America = 2,5% of total sample (Canada, USA)
South Asia = 5% of total sample (India, Bangladesh, Pakistan)
Sub Saharan Africa = 19,9% of total sample
Western Europe = 20,7% of total sample

ii) Firm-level cross section data.

country	Obs	country	Obs	country	Obs
Argentina	794 (8%)	Gabon	13 (0.1%)	Mexico	87 (1%)
Bolivia	302 (3%)	Guatemala	556 (6%)	Nicaragua	319 (3%)
Botswana	235 (2%)	Honduras	321 (3%)	Panama	31 (0.3%)
Chile	970 (10%)	Indonesia	1,152 (12%)	Paraguay	254 (3%)
Colombia	836 (9%)	Lesotho	12 (0.1%)	Peru	828 (9%)
Costa Rica	35 (0.4%)	Madagascar	63 (1%)	Philippines	1,115 (12%)
Dom. Republic	318 (3%)	Malawi	122 (1.32%)	Uruguay	512 (6%)
Ecuador	330 (4%)	Mauritius	7 (0.1%)		
East Asia and Pacific = 25% of total sample					
Latin America and Caribbean = 70% of total sample					
Sub Saharan Africa = 5% of total sample					

iii) Summary statistics of panel data

	Source	Obs	Mean	Std. Dev.	Min	Max
Dependent variable						
ICRG	PRS group	1144	2.61014	1.431315	0	6
Instability variables						
Export 16-year std dev	World Development Indicators 2010	1144	6.995185	3.620236	1.899827	20.58558
Export 6-year skewness		1144	18.36777	124.2091	-242.9317	242.9239
Export 6-year skewness > 0		1144	66.80871	69.34003	0	242.9239
Export 6-year skewness < 0		1144	48.44095	64.35557	0	242.9317
Export 6-year kurtosis		1144	233.2955	83.85703	109.9743	593.4952
Export 16-year kurtosis		1144	319.7907	166.7265	146.7546	1386.653
Rainfall 16-year std dev	Maatsura and Willmott (2007)	1144	12.81215	5.239885	2.756109	29.84307
Rainfall 6-year skewness		1144	-32.14799	106.1514	-204.6579	230.3528
People affected by natural disaster	EM-DAT (2012)	1144	1.275625	2.295293	0	20.65531
Export concentration	CERDI	775	27.08626	20.96736	0	91.88235
Controls						
Population growth (in %)	WDI 2010	1144	1.49221	.991445	-.6979211	6.047563
Log population		1144	16.56923	1.372346	13.52666	20.98849
Log credit to private sector (in %)		1130	3.544881	0.964273	0	5.442772
Natural resources (% of GDP)	World Bank	1144	5.203671	8.15379	0	59
Political regime stability	Polity IV	1144	29.46416	33.17404	0	196
Democracy		1144	5.369755	5.858688	-9	10
Govt expenditures (% of GDP)	Penn World Tables 2010	1144	15.69565	5.862845	4.652345	53.25081
Log openness (const. LCU)		1144	4.031649	.5520936	2.396314	5.35706

iv) Summary statistics of firm-level data

	Source	Obs	Mean	Std. Dev.	Min	Max
Dependent variable						
% of annual sales paid as informal payments	WBES 2008 – 2011	9212	0.7733391	4.090082	0	100
Instability variables (in % of the trend)						
Export 16-year std dev	World Development Indicators 2010	23	6.340868	2.396597	2.551279	12.998
Export 6-year skewness		23	63.55887	76.90412	-179.9973	166.0257
Export 6-year skewness > 0		23	76.55234	49.78118	0	166.0257
Export 6-year skewness < 0		23	12.99347	38.03289	0	179.9973
Export 6-year kurtosis		23	189.6478	47.9019	116.4359	416.3812
Export 16-year kurtosis		23	363.3209	180.9741	185.497	739.2167
Rainfall 16-year std dev 2008	Maatsura and Willmott (2007)	23	12.57644	4.866297	5.373374	22.89103
Rainfall 6-year skewness 2008		23	18.86488	121.7952	-178.599	182.2015
Rainfall 6-year skewness 2004		23	56.85211	111.7317	-196.032	173.3912
People affected by natural disaster 2005	EM-DAT (2012)	23	1.26377	1.335354	0.035672	7.292787
Macro – controls						
Gov expenditures (cst USD2000)	WDI 2010	23	1.36^{e}+10	1.42^{e}+10	3.82^{e}+08	6.74^{e}+10
Trade (in % of GDP)		23	69.83776	22.65299	38.29338	170.9021
Population growth (in %)		23	1.385411	0.5141451	.3047784	2.77755
Log population		23	17.08152	1.272961	14.05363	19.24198
Log GDP per cap t – 20		23	7.36509	0.81249	4.89926	8.762737
Log credit to private sector		23	3.410941	0.5103423	2.146021	4.57458
Natural resources (% of GDP)	World Bank	23	10.02095	9.668229	0	57
Political regime stability	Polity IV	23	20.49989	12.93696	6	89
Democracy		23	8.175423	1.212451	-4	10
Common law	La Porta et al. (1999)	23	0.0400564	0.1961023	0	1
Latitude		23	-7.94213	19.16726	-36.676	18.561
Landlockness		23	0.1004125	0.3005655	0	1
Firm's characteristics						
Size (1: small; 2:medium; 3:large)	WBES 2008-2011	9212	1.871581	0.7907208	1	3
State/govt ownership (% of firm)		9212	0.161637	2.93871	0	90
Direct exports (%of firm's sales)		9212	8.128745	22.52709	0	100
Indirect exports (%of firm's sales)		9212	3.050369	13.97412	0	100
% of working capital financed by internal funds		9212	61.99436	38.17022	0	100

Annex 4.B. Correlations between the standard deviation and the skewness of export distributions

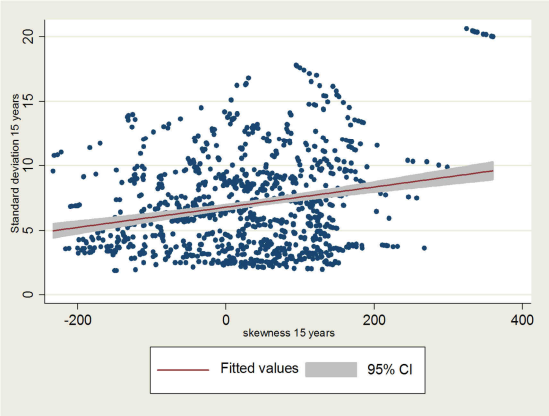
i) Correlation coefficients

	Standard deviations (rolling, 16 years)	Skewness (rolling, 16 years)	Kurtosis (rolling, 16 years)
Whole sample – Observations: 1122			
Standard deviations (rolling, 15 years)	1.0		
Skewness (rolling, 16 years)	0.2243*	1.0	
Kurtosis (rolling, 16 years)	0.3007*	0.2529*	1.0
Positive skewness (when 16-year skewness > 0) – Observations: 630			
Standard deviations (16 years)	1.0		
Skewness (16 years)	0.2415*	1.0	
Kurtosis (16 years)	0.3967*	**0.7615***	1.0
Negative skewness (when 16-year skewness < 0) – Observations: 492			
Standard deviations (16 years)	1.0		
Skewness (16 years)	0.1003	1.0	
Kurtosis (16 years)	0.0271	**-0.7121***	1.0

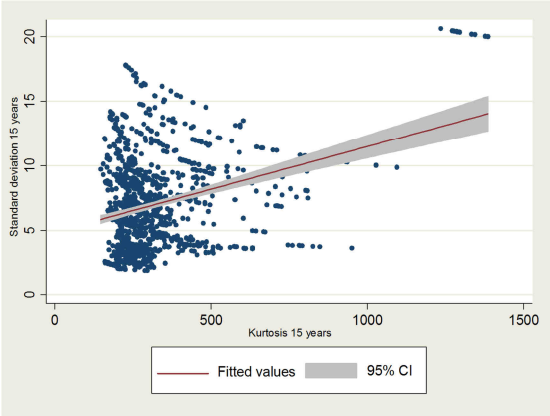
* 1% significant.

ii) Graph correlations

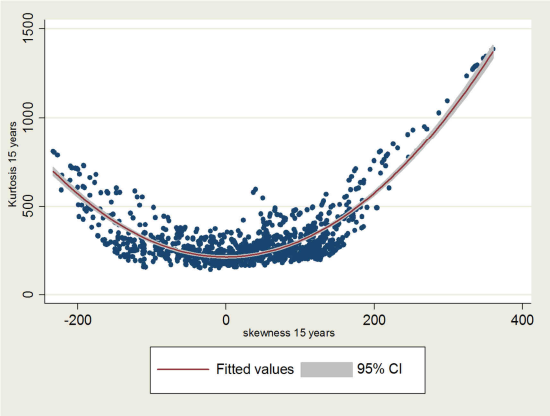
16-year standard deviation versus 16-year skewness



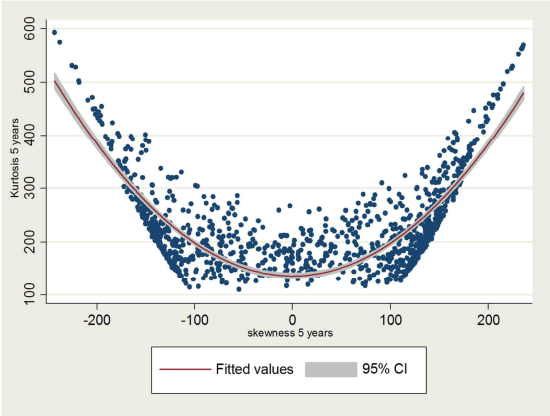
16-year standard deviation versus 16-year kurtosis



16-years skewness versus 16-year kurtosis



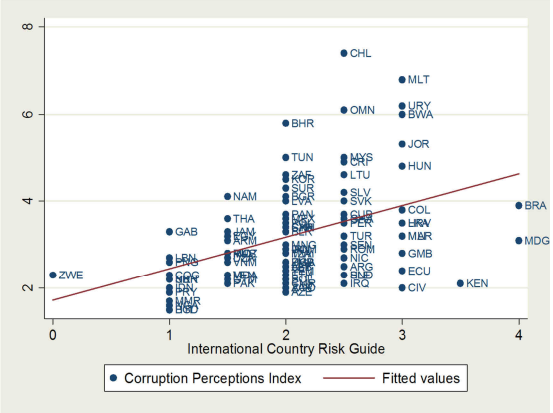
6-years skewness versus 6-year kurtosis



Annex 4.C. Graph correlations between corruption perception indicators

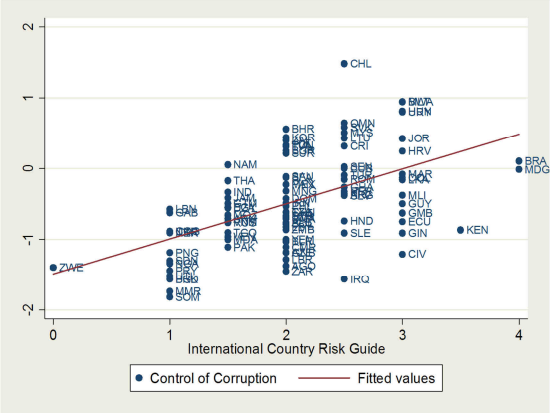
ICRG versus CPI

spearman rank correlation = 47%



ICRG versus Control of Corruption

spearman rank correlation = 55%



Sample of 93 low and middle-income countries in 2004.

Annex 4.D. Instrumental variable and GMM estimations: instruments and first stage estimates.

i) Instruments description

Annual share of people (total) affected by natural disasters in the population

We compute each year the ratio between the yearly-averaged number of total affected by natural disasters and the national population, which consists in applying the following formula:

$$\text{Annual \% of people affected}_t = 100 \times \frac{\frac{\sum_{t=1}^{T} Total\ affected}{T}}{Population_t}$$

Total affected is the sum of injured, homeless, and people requiring immediate assistance during the period of emergency following a natural disaster. It can also include displaced or evacuated people. Further detailed on the database is provided at http://www.emdat.be/criteria-and-definition.

6-year skewness of rainfall levels

This is the 6-year rolling skewness of the distribution of rainfall levels (r_{it}) around their average value (R_{it}). We compute it in country *i* at time *t* as follow:

$$Skew\_rainfall_{it} = 100 \times \frac{\frac{1}{T}\sum^{T}\left(\frac{r_{it} - R_{it}}{R_{it}}\right)^3}{\left(\frac{1}{T}\sum^{T}\left(\frac{r_{it} - R_{it}}{R_{it}}\right)^2\right)^{3/2}} \quad with \quad T = [t\,;\, t-5]$$

16-year standard deviation of rainfall levels

This is the 16-year rolling standard deviation of the distribution of rainfall levels (r_{it}) around their average value (R_{it}). We compute this measure in country *i* at time *t* as follow:

$$Stddev\_rainfall_{it} = 100 \times \sqrt{\frac{1}{T}\sum^{T}\left(\frac{r_{it} - R_{it}}{R_{it}}\right)^2} \quad with \quad T = [t\,;\, t-15]$$

The export concentration index

This variable is drawn from the retrospective EVI database constructed in chapter 3. The export concentration index is derived from the Herfindhal index applied to export of merchandises (excluding services) as categorized by the three-digit level of the Standard International Trade Classification (SITC). This index is between 0 and 1, a high level of concentration being associated with a score close to 1. A country exporting only one product would score 1 according to this index. The derived Herfindhal Index formula is the following:

$$H_j = \frac{\sqrt{\sum_{i=1}^{n}\left(\frac{x_i}{X_j}\right)^2} - \sqrt{1/n}}{1 - \sqrt{1/n}}$$

Where j is the country index, xi is the value of exports of commodity I, Xj the total exports of country j, and n the number of products at the three-digit SITC level. The resulting data is then normalized using the min-max procedure with the bounds specified below.

Boundaries used for normalization.

Variables/components	Lower boundary	Upper boundary
Export concentration	0.100	0.950

ii) Correlations between instruments and measures of export instability

Panel country-level data

	Export std-dev	Export skewness	Rainfall skewness	Rainfall skewness t-1	Rainfall skewness t-2	Rainfall skewness t-3	Rainfall skewness t-4	Rainfall stddev	Rain stddev t-1	Rain stddev t-2	Rain stddev t-3	Rainfall stddev t-4	Annual % affected	Annual % of affected t-1	Annual % of affected t-2	Annual % of affected t-3	Annual % of affected t-4	Export concentration
Export std_dev	1.0000																	
Export skewness	0.0305	1.0000																
Rainfall skewness	-0.0008	-0.0284	1.0000															
Rainfall skewness t-1	0.0040	-0.0399	0.7679	1.0000														
Rainfall skewness t-2	0.0044	-0.0420	0.6001	0.7761	1.0000													
Rainfall skewness t-3	-0.0031	-0.0174	0.4373	0.6044	0.7718	1.0000												
Rainfall skewness t-4	-0.0159	-0.0021	0.2769	0.4491	0.6043	0.7764	1.0000											
Rainfall std_dev	-0.0906	0.0222	0.0032	-0.0040	-0.0027	-0.0044	-0.0014	1.0000										
Rainfall std_dev t-1	-0.1012	0.0297	0.0101	0.0051	-0.0008	-0.0025	-0.0074	0.9829	1.0000									
Rainfall std_dev t-2	-0.1113	0.0374	0.0168	0.0127	0.0093	0.0018	-0.0012	0.9641	0.9830	1.0000								
Rainfall std_dev t-3	-0.1187	0.0510	0.0184	0.0180	0.0161	0.0120	0.0033	0.9454	0.9656	0.9839	1.0000							
Rainfall std_dev t-4	-0.1268	0.0660	0.0218	0.0198	0.0194	0.0174	0.0110	0.9252	0.9472	0.9669	0.9841	1.0000						
Annual % of affected	0.2227	-0.1228	0.0695	0.0783	0.0965	0.0990	0.0887	0.0601	0.0513	0.0413	0.0317	0.0169	1.0000					
Annual % of affected t-1	0.2050	-0.0930	0.0596	0.0612	0.0744	0.0927	0.0858	0.0572	0.0522	0.0437	0.0327	0.0195	0.9249	1.0000				
Annual % of affected t-2	0.1843	-0.0619	0.0370	0.0494	0.0580	0.0652	0.0752	0.0534	0.0485	0.0433	0.0330	0.0188	0.8449	0.9158	1.0000			
Annual % of affected t-3	0.1631	-0.0236	0.0045	0.0412	0.0549	0.0595	0.0586	0.0569	0.0480	0.0447	0.0401	0.0266	0.8034	0.8387	0.9108	1.0000		
Annual % of affected t-4	0.1359	0.0336	-0.0208	0.0086	0.0462	0.0560	0.0511	0.0571	0.0527	0.0452	0.0427	0.0356	0.7825	0.7950	0.8311	0.9075	1.0000	
Export concentration	0.2843	0.0737	-0.0481	-0.0457	-0.0626	-0.0830	-0.0898	0.0633	0.0655	0.0773	0.0874	0.0917	0.0654	0.0627	0.0563	0.0569	0.0621	1.0000

Cross-section firm-level data

	Export std_dev	Export skewness	Rainfall skewness	Rainfall skewness t-1	Rainfall skewness t-2	Rainfall skewness t-3	Rainfall skewness t-4	Rainfall stddev	Rain stddev t-1	Rain stddev t-2	Rain stddev t-3	Rainfall stddev t-4	Annual % affected	Annual % of affected t-1	Annual % of affected t-2	Annual % of affected t-3	Annual % of affected t-4	Export concentration
Export std_dev	1.0000																	
Export skewness	0.2514	1.0000																
Rainfall skewness	-0.2949	-0.0837	1.0000															
Rainfall skewness t-1	-0.3197	-0.0617	0.2527	1.0000														
Rainfall skewness t-2	-0.2459	0.1321	0.2737	0.9291	1.0000													
Rainfall skewness t-3	-0.1206	0.2089	0.1716	0.7698	0.9258	1.0000												
Rainfall skewness t-4	-0.1269	0.2532	0.1028	0.6486	0.8299	0.9355	1.0000											
Rainfall std_dev	0.5884	0.0772	-0.1532	-0.2072	-0.1614	-0.0858	-0.1427	1.0000										
Rainfall std_dev t-1	0.6139	0.0514	-0.2194	-0.2653	-0.2356	-0.1754	-0.2077	0.9777	1.0000									
Rainfall std_dev t-2	0.6178	0.0546	-0.2332	-0.2781	-0.2509	-0.1910	-0.2143	0.9729	0.9987	1.0000								
Rainfall std_dev t-3	0.6446	0.0703	-0.2750	-0.2954	-0.2781	-0.2157	-0.2409	0.9752	0.9908	0.9926	1.0000							
Rainfall std_dev t-4	0.6372	0.1007	-0.3157	-0.2605	-0.2401	-0.1758	-0.2059	0.9716	0.9847	0.9863	0.9968	1.0000						
Annual % of affected	0.1447	-0.1732	0.4882	0.2055	0.2618	0.2212	0.2296	0.2005	0.1163	0.1165	0.1036	0.0722	1.0000					
Annual % of affected t-1	0.1480	-0.2016	0.4615	0.1988	0.2487	0.2078	0.2217	0.2004	0.1237	0.1242	0.1099	0.0786	0.9978	1.0000				
Annual % of affected t-2	0.1439	-0.2153	0.4389	0.1760	0.2277	0.1930	0.2098	0.2177	0.1391	0.1400	0.1281	0.0967	0.9958	0.9970	1.0000			
Annual % of affected t-3	0.1230	-0.2472	0.4223	0.1737	0.2119	0.1734	0.1959	0.1953	0.1250	0.1269	0.1137	0.0830	0.9891	0.9947	0.9964	1.0000		
Annual % of affected t-4	0.1188	-0.2037	0.4707	0.1950	0.2422	0.2038	0.2019	0.2130	0.1313	0.1306	0.1142	0.0821	0.9935	0.9929	0.9940	0.9900	1.0000	
Export concentration	-0.0624	-0.0345	-0.4485	0.1709	0.1063	-0.0128	-0.0515	-0.0673	0.0358	0.0213	0.0036	0.0369	-0.3124	-0.2744	-0.2835	-0.2479	-0.2713	1.0000

iii) Instability and corruption: Instrumental variable estimations of equation (4.4) – first stage estimates (included instruments not reported) of equations (4.4.a) and (b).

	ICRG			WBES				
					"Active" firms			"Passive" firms
2nd stage estimates	**IV-2SLS**	**IV-LIML**	**GMM-CUE**	**2SLS**	**2SLS**	**LIML**	**GMM-CUE**	**2SLS**
Lagged Corruption	0.677*** (0.00)	0.677*** (0.00)	0.706*** (0.00)					
Export skewness	-0.001 (0.24)	-0.001 (0.27)	-0.001* (0.08)	0.002 (0.16)	0.003* (0.07)	0.003* (0.07)	0.004*** (0.00)	0.004*** (0.00)
Export std_dev	-0.051 (0.18)	-0.058 (0.18)	-0.081* (0.06)	0.560*** (0.00)	0.230* (0.09)	0.230* (0.09)	0.361*** (0.00)	0.495*** (0.01)
1st stage estimates (a): export skewness								
Lagged Corruption	-5.82 (0.43)	-5.82 (0.43)	-5.82 (0.43)					
Annual share of affected (% pop) (t)	-16.06*** (0.00)	-16.06*** (0.00)	-16.06*** (0.00)					
Annual share of affected (% pop) (t-3)				-31.34*** (0.01)	-33.05*** (0.00)	-33.05*** (0.00)	-33.05*** (0.00)	-28.71** (0.05)
Annual share of affected (% pop) (t-4)	13.59*** (0.00)	13.59*** (0.00)	13.59*** (0.00)					
Export concentration index	0.609 (0.21)	0.609 (0.21)	0.609 (0.21)					
5-yr skewness of rainfall (t)	-0.037 (0.40)	-0.037 (0.40)	-0.037 (0.40)	-0.158 (0.51)	0.126 (0.64)	0.126 (0.64)	0.126 (0.64)	-0.139 (0.53)
5-yr skewness of rainfall (t-4)	0.043 (0.38)	0.043 (0.38)	0.043 (0.38)	0.362 (0.22)	0.372 (0.24)	0.372 (0.24)	0.372 (0.24)	0.424* (0.09)
15- year standard deviation of rainfall	-4.538** (0.04)	-4.538** (0.04)	-4.538** (0.04)	13.21*** (0.01)	12.33** (0.04)	12.33** (0.04)	12.33** (0.04)	12.81*** (0.00)
F(5,514)	6.44	6.44	6.44	8.42	5.86	5.86	5.86	15.35
Shea partial R2	0.04	0.04	0.04	0.44	0.42	0.42	0.42	0.47
1st stage estimates (b): export std_dev								
Lagged Corruption	0.129 (0.11)	0.129 (0.11)	0.129 (0.11)					
Annual share of affected (% pop) (t)	0.393*** (0.00)	0.393*** (0.00)	0.393*** (0.00)					
Annual share of affected (% pop) (t-3)				0.093 (0.64)	-0.020 (0.92)	-0.020 (0.92)	-0.020 (0.92)	0.242* (0.09)
Annual share of affected (% pop) (t-4)	0.039 (0.44)	0.039 (0.44)	0.039 (0.44)					
Export concentration index	0.021*** (0.01)	0.021*** (0.01)	0.021*** (0.01)					
5-yr skewness of rainfall (t)	0.002*** (0.00)	0.002*** (0.00)	0.002*** (0.00)	-0.014*** (0.00)	-0.015*** (0.00)	-0.015*** (0.00)	-0.015*** (0.00)	-0.013*** (0.00)
5-yr skewness of rainfall (t-4)	0.001*** (0.00)	0.001*** (0.00)	0.001*** (0.00)	0.009** (0.02)	0.012*** (0.01)	0.012*** (0.01)	0.012*** (0.01)	0.006** (0.02)

15- year standard deviation of rainfall	0.050** (0.04)	0.050** (0.04)	0.050** (0.04)	0.168*** (0.01)	0.156*** (0.01)	0.156*** (0.01)	0.156*** (0.01)	0.200*** (0.00)
F(5,514)	6.97	6.97	6.97	12.25	9.23	9.23	9.23	16.42
Shea partial R2	0.12	0.12	0.12	0.57	0.62	0.62	0.62	0.61
Weak instrument test								
Kleibergen-Paap stat(critical value)	4.7 (21.7) [a]	4.7 (4.1) [a]	4.7 (4.1) [a]	1.24(16.9)[a]	5.18 (16.9)[a]	5.18 (4.72)[a]	5.18 (4.72)[a]	0.20(9.9)[a]
Hansen test (p-val)	0.17	0.19	0.21	**0.04**	0.45	0.45	0.50	**0.04**
Endogeneity test, Chi2 p-value:								
6-yr skew + 16-year std-dev exports	0.04							
6-year export skewness	0.25							
16-year std dev of exports	0.03							
Country fixed effects	Yes	Yes	Yes	No	No	No	No	No
Time dummies	Yes	Yes	No	No	No	No	No	No
Observations (countries or clusters)	700 (46)	700 (46)	700 (46)	9212(23)	4210 (23)	4210 (23)	4210 (23)	3387(23)
R squared				0.02	0.02	0.02	0.02	0.03
Number of instruments	5	5	5	4	4	4	4	4

When possible, coefficients are rounded to three decimal places. Included instruments not reported. Standards errors robust to heteroskedasticity in all regressions, to autocorrelation in GMM-CUE estimations, and are clustered by country in OLS firm-level estimations. P-values in parenthesis. *significant at 10%; **significant at 5%; ***significant at 1% † significant at 14%. Hansen J-statistic tests for joint instrument validity; null hypothesis is that the instruments are valid, i.e., uncorrelated with the error term, and that the excluded instruments are correctly from the second-stage equation. In columns “active firms”, we restrict the sample to firms considering that corruption is not an obstacle or is a minor obstacle to their current operations. In column “passive firms”, we restrict the sample to firms considering that corruption is a moderate, major, and very severe obstacle to their current operations.

a.When the Kleibergen-Paap statistic exceeds the Stock-Yogo critical value, then a standard significance test on estimated coefficient with nominal size of 5% has a maximal size of 10% or more.

iv) Instability and corruption: Instrumental variable estimations of equation (4.7) – first stage estimates of equations (4.7a) and (4.7b) (included instruments not reported).

	ICRG	
2nd stage estimates	**IV-2SLS**	**GMM-CUE**
Lagged Corruption	0.674*** (0.00)	0.676*** (0.00)
Skewness>0	-0.001** (0.03)	-0.001** (0.03)
Skewness<0	-0.0004 (0.28)	-0.0004 (0.30)
Export std_dev	0.127** (0.02)	0.135** (0.02)
Export std_dev*16-year kurtosis	-0.0002*** (0.01)	-0.0002*** (0.01)
1st stage estimates (a): export std_dev		
Lagged Corruption	0.105* (0.07)	0.105* (0.07)
Annual share of homeless	0.171* (0.07)	0.171* (0.07)
16-year standard deviation of rainfall	0.008 (0.81)	0.008 (0.81)
Annual share of homeless*16-year kurtosis	0.0005** (0.04)	0.0005** (0.04)
16-year standard deviation of rainfall*16-year kurtosis	0.0001 (0.46)	0.0001 (0.46)
F(5,514)	11.19	11.19
Shea partial R2	0.06	0.06
1st stage estimates (b): export std_dev*16-year kurtosis		
Lagged Corruption	1.670 (0.96)	1.670 (0.96)
Annual share of homeless	-91.54 (0.23)	-91.54 (0.23)
16-year standard deviation of rainfall	76.02** (0.03)	76.02** (0.03)
Annual share of homeless*16-year kurtosis	0.726* (0.07)	0.726* (0.07)
16-year standard deviation of rainfall*16-year kurtosis	-0.181† (0.11)	-0.181† (0.11)
F(5,514)	7.89	7.89
Shea partial R2	0.08	0.08
Country fixed effects	Yes	Yes
Time dummies	Yes	Yes
Observations (countries or clusters)	1143 (67)	1143 (67)
R squared	0.626	0.623
Number of instruments	4	4

When possible, coefficients are rounded to two or three decimal places. Included instruments not reported. Standards errors robust to heteroskedasticity (2SLS; GMM-CUE) and autocorrelation (GMM-CUE). P-values in parenthesis. *significant at 10%; **significant at 5%; ***significant at 1% † significant at 14%.

Annex 4.E. Benchmarks for baseline estimations of equation (4.4)

i) Fixed effect estimation of equation (4.4), without time dummies

Dependent variable : ICRG	**Coefficient**	**P-value**
Lagged Corruption	0.716***	0.00
Export skewness	-4e-04***	0.00
Export std_dev	-0.003	0.78
Population growth	-0.035	0.30
Nat. resources	0.008**	0.03
Government size	-0.013**	0.03
Log population	0.616***	0.00
Pol. regime stability	2e-04	0.91
Democracy	-0.015**	0.02
Log openness	0.177*	0.08
Constant	-9.835***	0.00
Observations(country)	1144(68)	
R-squared		
Within	0.608	
Between	0.617	
Country fixed effects	Yes	
Time dummies	No	
Region dummies	No	

When possible, coefficients are rounded to three decimal places. Standards errors robust to heteroskedasticity. P-values in parenthesis. *significant at 10%; **significant at 5%; ***significant at 1% † significant at 14%.

ii) OLS estimates of equation (4.4)

Dependent variable : ICRG	**Coefficient**	**P-value**
Lagged Corruption	**0.862*** **	0.00
Export skewness	-0.0001	0.33
Export std_dev	0.009*	0.06
Population growth	0.018	0.22
Nat. resources	0.004***	0.00
Government size	-0.002	0.61
Log population	0.046***	0.00
Pol. regime stability	-0.018***	0.00
Democracy	-0.009***	0.00
Log openness	0.045	0.14
Constant	-0.589***	0.00
Observations(country)	1144(68)	
R-squared	0,91	
Country fixed effects	No	
Time dummies	Yes	
Region dummies	No	

When possible, coefficients are rounded to three decimal places. Standards errors robust to heteroskedasticity. P-values in parenthesis. *significant at 10%; **significant at 5%; ***significant at 1% † significant at 14%.

Annex 4.F. Robustness checks

i) Random effect estimator

	Eq(4.4)	Eq(4.5)	Eq(4.6a)	Eq(4.6b)	Eq(4.7)	Eq(4.8a)	Eq(4.8b)
Corruption t-1	0.862*** (0.00)	0.860*** (0.00)	0.860*** (0.00)	0.860*** (0.00)	0.857*** (0.00)	0.858*** (0.00)	0.857*** (0.00)
Standard deviation	0.009* (0.10)	0.018** (0.04)	0.010* (0.07)	0.010* (0.06)	0.019*** (0.00)	0.011** (0.04)	-0.002 (0.84)
Standard deviation*Kurtosis					-0.0001† (0.11)		
Standard deviation*credit							0.004 (0.28)
Skewness	-0.0001 (0.22)						
Positive skewness		-0.001*** (0.01)	-0.002*** (0.00)	-0.001** (0.04)	-0.001** (0.03)	-0.0002 (0.81)	-0.001*** (0.01)
Negative skewness		-0.0004* (0.06)	-0.003*** (0.00)	-0.002*** (0.01)	-0.0004* (0.10)	0.0001 (0.93)	-0.0005* (0.06)
Positive skewness^2			7e-06* (0.07)				
Negative skewness^2			0.00001*** (0.00)				
Positive skewness* Kurtosis				3e-06 (0.30)			
Negative skewness* Kurtosis				4e-06† (0.12)			
Positive skewness* credit						-0.0001 (0.69)	
Positive skewness* credit						-0.0001 (0.61)	
Observations	1144	1144	1144	1144	1144	1064	1064
R2	0.92	0.92	0.92	0.92	0.92	0.92	0.92
Time fixed effect	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Haussman test random effect versus fixed effect estimator - Chi-2 stat (p-value):					**96.95(0.00)**		

When possible, coefficients are rounded to three decimal places. P-values in parenthesis. † significant at 15%; * significant at 10%; ** significant at 5%; *** significant at 1%. Controls are not reported. Standard errors robust to heteroskedasticity.

ii) Variance inflation factors for the independent variables, table 4.5.

Variable	VIF	1/VIF
Equation (4.6a) without time dummies		
Positive skewness	6.49	0.154197
Negative skewness	4.96	0.201716
Idiosyncratic positive skew	30.91	0.032348
Idiosyncratic negative skew	17.93	0.055769
Idiosyncratic positive skew^2	11.77	0.084951
Idiosyncratic negative skew^2	14.10	0.070910
Std_dev	24.31	0.041135
Idiosyncratic std_dev	14.68	0.068117
Mean VIF	**14.93**	
Equation (4.6b) without time dummies		
Positive skewness	14.85	0.065362
Negative skewness	11.07	0.089086
Idiosyncratic positive skew	23.82	0.003971
Idiosyncratic negative skew	23.17	0.027550
Idiosync positive skew * idiosync. Kurtosis	18.58	0.004011
Idiosync negative skew * idiosync Kurtosis	20.68	0.020283
Std_dev	24.48	0.040583
Idiosyncratic std_dev	17.58	0.057971
Kurtosis	8.86	0.109476
Mean VIF	**20.06**	
Equation (4.7) without time dummies		
Positive skewness	6.58	0.151920
Negative skewness	5.11	0.195760
Idiosyncratic positive skew	7.68	0.129635
Idiosyncratic negative skew	1.90	0.527480
Std_dev	24.37	0.041023
Idiosyncratic std_dev	40.69	0.020563
Idiosyncratic std_dev*idiosync. Kurtosis	22.05	0.015996
Kurtosis	3.55	0.279813
Mean VIF	**14.64**	

iii) Firm-level OLS estimations with 2-way clustering.

	Eq(4.5)		Eq(4.6a)		Eq(4.6b)		Eq(4.7)		Eq(4.8a)			Eq(4.8b)		
		idiosync.		idiosync.		idiosync.		idiosync.		idiosync.			idiosync.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)
Aggregate fluctuations														
Positive skew	-0.004	-0.003	-0.005	-0.003	-0.069*	-0.003	-0.003	-0.002	-0.050	-0.003	-0.003	-0.004	-0.003	-0.003
	(0.28)	(0.47)	(0.69)	(0.46)	(0.10)	(0.40)	(0.50)	(0.64)	(0.26)	(0.48)	(0.50)	(0.39)	(0.52)	(0.52)
Negative skew	-0.010***	-0.009***	0.023	-0.009***	-0.043†	-0.003	-0.012***	-0.011***	0.025*	-0.010***	-0.010***	-0.013***	-0.010**	-0.010***
	(0.00)	(0.00)	(0.47)	(0.00)	(0.15)	(0.39)	(0.00)	(0.00)	(0.09)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Positive skew^2			3e-05											
			(0.95)											
Negative skew^2			-0.0002											
			(0.35)											
Positive skew* Kurt					0.0003*									
					(0.08)									
Negative skew* Kurt					0.0002									
					(0.17)									
Positive skew* credit									0.011					
									(0.34)					
Positive skew* credit									-0.014**					
									(0.02)					
Export std_dev	0.818***	0.814***	0.884***	0.818***	0.918***	0.823***	0.867***	0.830***	0.983***	0.841***	0.852***	1.411***	0.844***	0.951***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Std_dev*Kurt							-0.0001							
							(0.56)							
Std_dev *credit												-0.157*		
												(0.07)		
Idiosyncratic fluctuations														
Positive skew		-0.010**		0.019**		-0.005		-0.010*		-0.47	-0.013**		-0.010*	-0.011**
		(0.05)		(0.03)		(0.72)		(0.07)		(0.31)	(0.03)		(0.06)	(0.02)
Negative skew		-0.007		-0.026†		-0.004		-0.007		0.20	-0.011*		-0.007	-0.008†
		(0.16)		(0.15)		(0.76)		(0.26)		(0.15)	(0.09)		(0.28)	(0.12)
Positive skew^2				6e-05										
				(0.24)										
Negative skew^2				0.0001										
				(0.33)										
Positive skew*Kurt						9e-06								
						(0.88)								
Negative skew*Kurt						1e-05								
						(0.74)								
Positive skew*credit										0.10				
										(0.41)				
Negative skew*credit										-0.009*				
										(0.08)				

Positive skew *intern funds						5e-05 (0.36)			
Negative skew*intern funds						7e-05 (0.72)			
Export std_dev	-0.001 (0.99)	0.008 (0.93)	-0.018 (0.87)	-0.026 (0.82)	0.90 (0.58)	-0.018 (0.87)		-0.016 (0.90)	0.003 (0.97)
Export std_dev*Kurt				2e-05 (0.90)					
Export std_dev*credit								0.001 (0.75)	
Export std_dev*intern funds									-0.001* (0.08)
			Observations 9200						

When possible, coefficients are rounded to three decimal places. Standard errors are two-way clustered by country (23) and sector of activity (14). P-values in parenthesis. † significant at 15%; * significant at 10%; ** significant at 5%; *** significant at 1%. Controls not reported. Time dummies are excluded from all equations. The "Kurtosis" variable refers to the 6-year kurtosis of exports when it enters in interaction with the skewness of exports, while it refers to the 16-year kurtosis when it enters in interaction with the standard deviation of exports.

iv) Country-level panel regressions with HP-based export instability measures

	Eq(4.4)		Eq(4.5)		Eq(4.6a)		Eq(4.6b)		Eq(4.7)		Eq(4.8a)		Eq(4.8b)	
	Within FE	FGLS dummy variable	Within FE	FGLS dummy variable	Within FE	FGLS dummy variable	Within FE	FGLS dummy variable	Within FE	FGLS dummy variable	Within FE	FGLS dummy variable	Within FE	FGLS dummy variable
Corruption t-1	0.691*** (0.00)	0.690*** (0.00)	0.691*** (0.00)	0.690*** (0.00)	0.691*** (0.00)	0.691*** (0.00)	0.691*** (0.00)	0.694*** (0.00)	0.689*** (0.00)	0.691*** (0.00)	0.690*** (0.00)	0.689*** (0.00)	0.689*** (0.00)	0.688*** (0.00)
Standard deviation	0.011 (0.64)	-0.007 (0.68)	0.011 (0.67)	-0.003 (0.85)	0.011 (0.66)	-0.003 (0.89)	0.011 (0.67)	-0.003 (0.85)	0.04 (0.30)	0.026 (0.40)	0.011 (0.65)	-0.001 (0.93)	0.068 (0.28)	-0.012 (0.77)
Standard deviation*Kurtosis									-0.0001* (0.08)	-0.0001 (0.18)				
Standard deviation*credit													-0.20 (0.38)	0.002 (0.85)
Skewness	0.0002 (0.41)	-0.0003** (0.04)												
Positive skewness			5e-05 (0.93)	-0.0007** (0.03)	-0.0003 (0.89)	-0.0003 (0.76)	-0.0005 (0.80)	-0.001 (0.21)	-0.0001 (0.90)	-0.0005† (0.11)	-0.002 (0.32)	0.0004 (0.78)	0.0001 (0.91)	-0.0007** (0.04)
Negative skewness			0.0004 (0.51)	-0.0001 (0.73)	0.003 (0.23)	0.002** (0.06)	0.001 (0.65)	0.001 (0.22)	0.0005 (0.48)	-0.001 (0.86)	0.001 (0.63)	-0.001 (0.51)	0.0004 (0.53)	-0.0001 (0.79)
Positive skewness^2					1e-07 (0.99)	4e-06 (0.44)								
Negative skewness^2					1e-05 (0.24)	1e-05 ** (0.04)								
Positive skewness* Kurtosis							1e-06 (0.90)	7e-06** (0.02)						
Negative skewness* Kurtosis							-1e-06 (0.89)	-5e-06† (0.15)						
Positive skewness* credit											0.001 (0.34)	0.0001 (0.76)		
Positive skewness* credit											-0.0002 (0.76)	0.0002 (0.55)		
	Observation (countries) 1059(66)													
Country dummies	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
Time dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wooldridge test of autocorrelation: Fstat(p-value)	113(0.00)		113(0.00)		111(0.00)		115(0.00)		112(0.00)		113(0.00)		116(0.00)	
AR(1) estimated autocorrelation		0.08		0.08		0.08		0.08		0.08		0.08		0.08

When possible, coefficients are rounded to three decimal places. P-values in parenthesis. † significant at 15%; * significant at 10%; ** significant at 5%; *** significant at 1%. Controls not reported. Standard errors robust to heteroskedasticity. The "Kurtosis" variable refers to the 6-year kurtosis of exports when it enters in interaction with the skewness of exports, while it refers to the 16-year kurtosis when it enters in interaction with the standard deviation of exports.

v) Firm-level two-way cluster robust OLS estimations with HP-based export instability measures

	Eq(4.4)	Eq(4.5)	Eq(4.6a)	Eq(4.6b)	Eq(4.7)	Eq(4.8a)	Eq(4.8b)
Standard deviation	0.758***	0.761***	0.777***	0.875***	0.846***	0.940***	1.837***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)	(0.00)	(0.00)
Standard deviation*Kurtosis					-0.0004		
					(0.43)		
Standard deviation*credit							-0.357
							(0.22)
Skewness	-0.004***						
	(0.00)						
Positive skewness		-0.003	-0.020*	-0.028*	-0.005	0.057	-0.002
		(0.32)	(0.08)	(0.07)	(0.54)	(0.26)	(0.54)
Negative skewness		-0.004***	-0.014†	0.001	-0.001	0.040	-0.010**
		(0.00)	(0.13)	(0.91)	(0.96)	(0.49)	(0.02)
Positive skewness^2			0.0001				
			(0.21)				
Negative skewness^2			0.0001**				
			(0.05)				
Positive skewness* Kurtosis				0.0001***			
				(0.01)			
Negative skewness* Kurtosis				-0.0001			
				(0.18)			
Positive skewness* credit						-0.015	
						(0.27)	
Positive skewness* credit						-0.013	
						(0.42)	
Observations	9200						

When possible, coefficients are rounded to three decimal places. Standard errors are two-way clustered by country (23) and sector of activity (14). P-values in parenthesis. † significant at 15%; * significant at 10%; ** significant at 5%; *** significant at 1%. Controls not reported. Time dummies are excluded from all equations. The "Kurtosis" variable refers to the 6-year kurtosis of exports when it enters in interaction with the skewness of exports, while it refers to the 16-year kurtosis when it enters in interaction with the standard deviation of exports.