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LE SYSTÈME FINANCIER INDIEN À L'ÉPREUVE DE LA CRISE.

THÈSE

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“ what matters most is
how well you
walk through the
fire[*] *”*

Extrait du poème *“How is your heart ?”* de Charles Bukowski

[*] *Ce qui importe le plus, c’est notre capacité à traverser le feu*

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INTRODUCTION

La plupart des travaux de recherche effectués après 2008 ont été consacrés à l'analyse de l'impact de la crise et de ses multiples aspects (e.g. la crise de liquidité sur les marchés interbancaires, la volatilité accrue sur les marchés actions, la crise de la dette souveraine au sein de la zone euro, les fortes fluctuations des prix des matières premières etc…) sur les économies développées. De facto, les études concernant les pays émergents sont plus rares. Pourtant les principaux pays émergents ne sont pas épargnés par la crise et connaissent depuis 2010 des difficultés économiques ; en outre, ils ont libéralisé leurs systèmes financiers, qui se rapprochent désormais de plus en plus de ceux des pays développés.

L'Inde est un cas pratique intéressant à étudier car son évolution au cours des dernières décennies correspond assez bien au schéma précédent. En effet, malgré une importante crise de sa balance des paiements, l'Inde a traversé les décennies 1990 et 2000 sans difficultés majeures. La croissance a été soutenue, l'inflation relativement maîtrisée, le pays s'est ouvert sur le monde, tant sur le plan commercial que financier. En outre, l'économie indienne s'est fortement tertiarisée au cours de ces décennies. Ainsi, de 1990 à 2009, l'Inde a connu un développement et des transformations économiques majeures. Ces transformations et cette réussite ont valu à ce pays d'être perçu comme une future grande puissance économique au même titre que la Chine, le Brésil, la Russie et l'Afrique du Sud – un groupe de pays désormais désigné par l'acronyme BRICS (Brésil,…). Toutefois, depuis 2011 la croissance ralentit en Inde et les perspectives ne semblent pas aujourd'hui très encourageantes. En outre, dès la décennie quatre-vingt-dix, l'Inde, a libéralisé progressivement son secteur financier ; enfin, l'économie indienne présente des caractéristiques particulières : importance des banques publiques, déficits budgétaires et déficits courants récurrents, etc…

Cette thèse présente quatre études a priori indépendantes, mais cependant liées par une problématique générale : celle consistant à comprendre comment l'économie indienne et plus particulièrement son système financier traversent la crise actuelle. Plus précisément, elle a pour ambition de proposer sous différents angles, une grille de lecture du comportement ou de la réaction de l'économie et du système financier indiens durant la crise. Dans la mesure du possible, l'économie indienne sera comparée à celles d'autres pays des BRICS pour dégager les similitudes ou les caractéristiques spécifiques à l'intérieur de ce groupe de pays. Ainsi, dans les trois premiers chapitres, on pose la question de l'intégration des marchés indiens durant la crise à travers différentes approches : celle des marchés actions, celle du marché de

la dette souveraine et enfin à travers la relation prix des matières premières – politique monétaire. Enfin dans le dernier chapitre, nous nous interrogerons sur la capacité du système bancaire local à permettre à l'économie indienne de retrouver la voie de la croissance.

Depuis 2011, le ralentissement de la croissance, la forte inflation, les déficits considérables font peser une grande incertitude sur l'avenir économique de l'Inde. Parallèlement, ces faits ont relancé des débats concernant les reformes à mettre en œuvre pour permettre au pays de retrouver le chemin d'une croissance soutenable. Des questions concernant l'importance de la taille du secteur public, la réforme de la fiscalité etc… se posent de nouveau avec vigueur. Afin de cerner les enjeux et les défis auxquels doit faire face l'Inde, il est nécessaire de faire un cadrage macroéconomique de l'économie indienne et de son système financier. Dans cette perspective, le premier chapitre de cette thèse propose une brève présentation de l'économie indienne, souvent comparée à celles des autres pays des BRICS, ainsi qu'un exposé succinct du système financier indien. Le chapitre est complété par une analyse économétrique permettant de traiter la question de l'intégration financière du marché boursier indien.

L'intégration permet d'évaluer la liaison entre les marchés financiers. Elle autorise, par exemple, une meilleure allocation des capitaux ou une meilleure répartition des risques (voir par exemple Obstfeld, 1994 ; Levine, 1997 ; Kose *et al.* 2006). Elle peut aussi induire des effets néfastes comme une plus grande vulnérabilité aux chocs extérieurs (Stiglitz, 2002 ; Bekaert *et al.*, 2002). De ce fait, il nous a semblé pertinent de tenter d'analyser ce phénomène à l'heure d'une crise qui a démarré hors des frontières indiennes. L'analyse est effectuée sur la période allant de janvier 1997 à septembre 2013 à l'aide d'un modèle sans a priori théorique, un modèle GARCH (generalized autoregressive conditional heteroskedasticity, Bollerslev, 1986) multivarié à corrélations conditionnelles dynamiques (DCC, Engle, 2002). Ce modèle inclue un indice boursier indien (le Sensex) et le Standard & Poors 500. Des travaux récents (Dimitriou *et al.*, 2013 ou encore Bianconi *et al.*, 2014) ont utilisé des modèles de type DCC pour étudier la corrélation et la contagion des chocs entre marchés développés et marchés émergents (Inde comprise) comme nous le faisons dans ce chapitre. Nos résultats, en ligne avec ceux des travaux précédents, confirment une intégration croissante des marchés actions indiens et notamment durant la période récente, soulignant ainsi la vulnérabilité des marchés indiens aux chocs internationaux. Notre apport réside essentiellement dans le cadrage économique et financier qui est effectué, retraçant 30 ans

d'histoire économique et mettant en perspective les forces et faiblesses de l'Inde à l'heure où des interrogations sur son avenir sont devenues fréquentes.

La crise de la dette souveraine en zone euro en 2010-2011 a ravivé la question du risque souverain et de ses déterminants. Ainsi récemment, un certain nombre de travaux sur la détermination des spreads des credit default swaps (CDS) ont vu le jour. En effet, les spreads des CDS sur la dette souveraine illustrent le risque souverain perçu par les investisseurs. Les CDS sont des contrats d'assurance qui protègent leurs acheteurs contre un défaut de l'entité ayant émis le titre de dette, à travers leurs prix on peut donc cerner le risque perçu par les marchés. Il existe plusieurs méthodes pour modéliser les CDS, la première établit une relation entre le risque de crédit et le taux de défaut mais cette méthode n'est pas fondée théoriquement. La seconde, découle des travaux précurseurs de Merton (1974) et lie le risque de crédit à des facteurs fondamentaux (macro et micro). Les travaux récents qui se sont penchés sur la question en suivant cette seconde méthode, parmi lesquels on peut citer Pan et Singleton (2008), Longstaff *et al.* (2011) ou encore Fender *et al.* (2012), ont révélé l'influence de facteurs macroéconomiques et financiers notamment américains dans la détermination des CDS des pays émergents. Poursuivant l'interrogation esquissée au premier chapitre sur l'intégration des marchés, le second chapitre de cette thèse s'appuie sur la littérature existante pour étudier les déterminants des CDS souverains des BRICS de 2002 à septembre 2013. L'analyse est axée sur un examen des effets des indicateurs financiers de la zone euro sur les CDS souverains des BRICS dans le cadre d'un modèle à changement de régime. La question posée ici est : quels sont les facteurs qui déterminent le risque d'un émetteur souverain perçu par le marché ? Et plus particulièrement dans quelle mesure les facteurs globaux (européens) ont-ils un impact sur le risque souverain de ces pays ?

Au motif qu'il n'existe pas de CDS sur la dette souveraine de l'Inde, le pays est systématiquement écarté des études empiriques consacrées à cet actif financier. Nous avons pris le parti d'inclure l'Inde dans notre panel en prenant en considération les CDS de State Bank of India, considérée comme un bon proxy du risque souverain. Enfin, notre étude se démarque de la littérature par le cadre retenu (modèles à plusieurs régimes) et par des tests sur des variables européennes au lieu des traditionnelles variables américaines, utilisées dans la plupart des études. Nos conclusions montrent l'importance des facteurs macroéconomiques et

financiers, particulièrement ceux de la zone euro, dans la détermination des CDS des BRICS. Par ailleurs, la crise de la zone euro n'a pas eu un impact significatif sur les CDS des BRICS.

Au cours de la dernière décennie deux épisodes (2007-2008 puis 2010-2011) de fortes hausses des prix des matières premières ont été observés. De manière générale, la période récente correspond à une phase de forte volatilité de ces prix. Dans ce contexte, les BRICS ont affiché leur inquiétude concernant la tendance de la volatilité des prix des matières premières qui peut menacer la reprise de leur activité économique. Aujourd'hui, il existe une large littérature concernant l'impact des prix des matières premières, notamment des prix du pétrole, sur l'activité et le niveau des prix (voir par exemple Hamilton, 1983 ; Gisser et Goodwin, 1986; Mork, 1989). Un courant de la littérature s'est intéressé au rôle des prix des matières premières dans la conduite de la politique monétaire (Hall, 1982 ; Bloomberg et Harris, 1995 ; Polley et Iombra, 1999 etc…). Enfin, des travaux sur l'influence de la politique monétaire sur les prix des matières premières ont également été conduits, notamment dans les années 2000 (Barsky et Kilian 2002; Frankel, 2007). Le troisième chapitre de la thèse s'intéresse surtout à l'examen de la réaction des autorités monétaires face aux fluctuations des prix des matières premières. On s'intéresse à certains pays des BRICS (Brésil, Inde, Russie et Afrique du Sud), comparés ici aux Etats-Unis et à la zone euro. La question posée ici est de savoir si la Reserve Bank of India (et les banques centrales des autres pays considérés) réagit aux fluctuations des prix des matières premières. Pour cela, on étudie plus particulièrement la relation entre certains instruments de la politique monétaire et la volatilité des prix des matières premières. L'analyse est effectuée dans un cadre multivarié avec une prise en compte d'un effet de seuil ; l'hypothèse sous-jacente est qu'au-delà d'un certain seuil de volatilité des prix des matières premières, les autorités monétaires réajustent leurs positions.

Peu d'études sont consacrées à l'analyse de la relation entre politique monétaire et prix des matières premières dans les pays émergents, notamment en Inde. De même l'utilisation d'un modèle TVAR constitue aussi une originalité par rapport aux études précédentes. Enfin, concernant les résultats, on constate que dans la période récente la relation entre prix des matières premières et politique monétaire a été plus forte ; ce qui peut traduire une forme de vulnérabilité extérieure ou être interprété comme tel.

Rendre le système bancaire local davantage efficient afin qu'il puisse remplir son rôle et bénéficier à l'économie, est l'un des thèmes débattus aujourd'hui en Inde. La littérature théorique concernant le lien entre l'activité bancaire et l'économie réelle remonte aux travaux de Schumpeter (1911). Pour ce dernier, le développement financier stimule la croissance de l'économie réelle. En effet, un système financier développé offre des services efficients et permet aux entrepreneurs les plus innovants d'avoir des financements. Les banques collectent l'épargne et offrent des crédits. Elles opèrent une transformation qualitative des actifs en conciliant les horizons temporels des déposants et des emprunteurs ainsi qu'en supportant le risque de crédit et de liquidité (Gurley et Shaw, 1960). Enfin, elles assurent le système des paiements (Diamond, 1984 ; Diamond et Dybvig, 1984). La question de l'efficience du marché bancaire se pose donc pour les marchés en plein essor et en voie de restructuration, d'autant que dans le cas indien la question est encore plus importante, il semble en effet qu'un nombre limité d'entreprises ont accès aux capitaux via les marchés financiers (voir Didier et Schmukler, 2013). Le quatrième et dernier chapitre tente d'analyse l'efficience du système bancaire indien dans le cadre d'un modèle d'équilibre général inter-temporel et stochastique (DSGE). Il cherche notamment à savoir dans quelle mesure un secteur bancaire davantage efficient peut relancer l'économie. Le modèle prend explicitement en considération le système bancaire et est estimé par méthodes Bayesiennes avec des données indiennes allant de 1996 à 2013. Il devrait permettre d'étudier par exemple l'impact d'un choc positif de technologie bancaire afin, notamment d'en tirer des conclusions concernant l'orientation à donner à la politique économique en matière bancaire. Un article récent de Sharma et Jah (2012) étudiait le système bancaire dans le cadre d'un modèle d'équilibre général sous la forme réduit d'un VAR. Il soulignait en particulier que la libéralisation incomplète isolait l'économie des chocs extérieurs mais réduisait l'efficience du secteur bancaire. D'autres articles ont étudié la performance des banques individuelles et du secteur en général durant la crise (Eichengreen et Gupta, 2013 ; Shukla, 2014). Shukla soulignant notamment la nécessité de changements stratégiques et opérationnels dans les banques pour qu'elles puissent s'adapter au contexte économique, mais il n'évalue pas l'impact d'une efficience accrue ; ce que nous faisons dans notre étude. Par ailleurs, à notre connaissance, il n'existe pas de travaux développant un modèle DSGE pour l'Inde incluant un secteur bancaire. Enfin, nos résultats soulignent les effets positifs pour l'économie indienne d'un système bancaire davantage efficient.

Les travaux de cette thèse mettent en évidence le fait que l'intégration des marchés indiens est un fait certains. Toutefois, les effets de cette intégration varient d'un marché à l'autre ; (i)

sur les marchés actions et sur ceux de matières premières, elle révèle une vulnérabilité accrue aux chocs extérieurs ; (ii) sur le marché de la dette souveraine, bien qu'influencée par des facteurs globaux, l'Inde n'a pas connu de crise similaire à celle de la zone euro. Enfin, le secteur bancaire peut permettre à l'économie indienne une sortie de crise : les effets d'un choc de technologie bancaire y sont positifs.

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RÉSUMÉ

I. CHAPITRE 1 : UNE COURTE HISTOIRE DE L'ECONOMIE ET DU SYSTEME FINANCIER INDIEN DEPUIS 1980

Après avoir mis en place une économie socialiste suite à son indépendance, l'Inde s'est peu à peu dirigée vers une économie de marché durant les 30 dernières années. Entre 1991 et 2008, le pays a connu un taux de croissance élévé et une inflation relativement maîtrisée. En outre, l'Inde n'a connu qu'une seule crise – la crise de la balance des paiements de 1990-1991. Toutefois, depuis 2009, la croissance a fortement ralenti, l'inflation est à un niveau inquiétant et des doutes concernant les capacités du pays à sortir de cette mauvaise passe se sont progressivement installés. L'objectif du premier chapitre est (i) de fournir un cadrage macroéconomique de l'économie indienne permettant de cerner la situation économique et les enjeux actuels, (ii) d'évaluer les forces et faiblesses de l'économie indienne afin de se faire une idée précise de sa capacité à sortir de la crise et (iii) d'analyser le rôle du système financier. Pour ce faire, le chapitre retrace l'histoire économique de l'Inde durant les 3 dernières décennies. Lorsque cela est possible et pertinent, une comparaison avec les autres pays des BRICS est effectuée. Par ailleurs, ce chapitre contient une analyse du système financier et pose également la question de l'intégration des marchés actions dans le cadre d'une analyse économétrique.

1. Réformes et croissance économique en Inde: 1980-2010

L'Inde se développe fortement durant la première moitié du XX^{ème} siècle, elle connaît une croissance rapide et figure économiquement dans le peloton de tête des pays du Sud. Toutefois, la politique protectionniste de substitution aux importations, pénalise la compétitivité des produits indiens, les investisseurs étrangers ne sont pas les bienvenus et la convertibilité de la roupie est limitée. L'important secteur public tourne parfois à perte, les entreprises privées doivent obtenir la contraignante « licence Raj » avant d'exercer leur activité. La part de l'Inde dans les échanges mondiaux passe de 2% en 1950 à 0,5% en 1980. Seul point positif durant cette période : la « révolution verte » entamée par l'agriculture indienne. Les rendements du blé et du riz triplent entre 1965 et 1980 et le pays réduit fortement sa dépendance alimentaire.

Bien qu'elle ait gagné les élections sur un programme socialiste en 1971, Indira Gandhi se décide finalement à écouter les réformateurs libéraux et entame un virage économique en 1980 pour sortir le pays de sa torpeur. Indira Gandhi puis son fils, Rajiv Gandhi, vont étamer une série de réformes : le développement des grandes entreprises est encouragé, les règles concernant les importations de biens d'équipement sont allégées, le système fiscal est simplifié et certains droits de douane sont abaissés. Les réformes donnent de premiers résultats satisfaisants : entre 1981 et 1990 le Produit National Brut (PNB) croît de 5,7% en moyenne sur toute la période avec toutefois une explosion du déficit budgétaire qui est passé de 6,3% du PNB en 1984 à 8,4% en 1990. La dette extérieure est multipliée par 2,5 entre 1981 et 1991. L'inflation s'envole pour atteindre 17% à la mi-1991 ; les marchés financiers perdent confiance en la capacité du pays à soutenir sa dette. L'assassinat de Rajiv Gandhi ne fait qu'accentuer l'incertitude autour de l'Inde. Les réserves de change s'amenuisent de semaine en semaine et le début de la décennie 1990 s'ouvre sur une crise de change. Cependant le pays va rapidement rebondir contre toute attente. La nouvelle politique économique est orientée vers la réduction du déficit budgétaire, le redressement de la balance commerciale et la réduction de l'inflation. Le secteur privé poursuit sa libéralisation, les prix sont libéralisés pour un grand nombre de produits, les investissements étrangers sont encouragés. Suite à ces réformes, en 1992 la croissance souffre des mesures d'urgence mais elle s'accélère dans la suite de la décennie 1990. Depuis les élections générales de 1996, il y a une absence de majorité politique et la nécessité de former des coalitions réduit le rythme des réformes. Néanmoins, le pays affiche des performances économiques remarquables, entre 1992 et 2000 la croissance est en moyenne à 6,4% par an et l'inflation à 9% par an. Celles-ci s'améliorent encore entre 2000 et 2007 (7,10% de croissance par an en moyenne et une inflation de 4,70% par an).

Lorsque la crise éclate en 2007, l'Inde connaît des difficultés (fuite de capitaux, déclin du commerce extérieur, déficit courant, chute des volumes des crédits offerts). Les autorités réagissent en mettant en place des mesures pour soutenir l'activité et le crédit, en combinant dépenses et réduction d'impôts. La croissance en 2009 est de 8,50% puis en 2010 de 10,25%.

2. Etat des lieux de l'économie indienne

En 2012, selon la Banque Mondiale, l'Inde est la 3ème puissance économique en parité de pouvoir d'achat, derrière la Chine mais devant tous les autres BRICS. Le PIB a crû de 4,30% en 2013, un chiffre nettement en dessous des performances passées, mais le pays est toujours deuxième en termes de croissance parmi les BRICS. Notons par ailleurs, que l'inflation était de 9,50% pour la même année, ce qui fait dire à certains que le pays est proche d'une situation de *stagflation*. L'Inde est une économie de services (67% du PIB en 2012-2013), l'agriculture et l'industrie y représentent respectivement 14% et 19% du PIB. Néanmoins, l'agriculture représente 53% des emplois, devant les services (27,70%) et l'industrie (19,30%).

Le déficit public pour l'année 2012-2013 s'élevait en Inde à 5,10% du PIB, la dette publique est à hauteur de 67% du PIB. Parmi les BRICS l'Inde est le pays ayant le déficit, et la dette le plus élevés. L'endettement relatif de l'Inde reste cependant inférieur à celui des pays développés (73% du PIB au troisième trimestre 2013 pour les Etats-Unis à titre de comparaison).

Les réformes libérales des années 1990 ont profondément modifié le commerce ainsi que la structure de la balance des paiements du pays. D'une part, l'Inde s'est considérablement ouvert au commerce international, son 'indice d'ouverture est de 70%. Les investissements étrangers sont passés de 0,10% du PIB en 1980 à 3% du PIB en 2013. Par ailleurs, le pays connaît des déficits récurrents de sa balance courante. Ainsi, dans les BRICS, l'Inde connaît le 2nd plus important déficit budgétaire (5,10% du PIB) derrière l'Afrique du Sud (6,26% du PIB en 2012), il est aussi le seul pays des BRICS affichant une balance commerciale déficitaire. Le déficit de la balance courante était essentiellement financé par l'aide extérieure en 1980, mais celle-ci a été remplacée progressivement par les investissements étrangers.

Le financement de l'économie indienne doit beaucoup à la finance alternative (prêteurs individuels, les institutions de micro-finance etc…) et à l'épargne des ménages. En 2012, le taux d'épargne des ménages était de l'ordre de 31%, chiffre moins important qu'en Chine (50%) mais largement plus élevé que la moyenne de la zone euro par exemple (13%). Le crédit bancaire est seulement la 3eme source de financement des entreprises derrière l'autofinancement et la finance alternative. Les capitaux provenant des marchés sont dirigés vers un faible nombre d'entreprises (voir Didier et Schmukler, 2013).

3. Forces et faiblesses de l'économie indienne

Parmi les menaces qui planent sur les perspectives économiques indiennes on peut citer la *stagflation* ; en 2013 l'inflation était de l'ordre de 9,50% alors que la croissance avait fortement ralenti. Les doutes concernant la capacité du pays à retrouver une croissance soutenue et la capacité de la Reserve Bank à contenir l'inflation sont de plus en plus palpables parmi les investisseurs.

De plus, le gouvernement a du mal à contrôler le déficit public. Certains observateurs dénoncent les mesures « cosmétiques » utilisées pour diminuer celui-ci (e.g. le décalage de la reconnaissance des dépenses publiques) ainsi que les effets pervers liés au déficit, comme le tarissement des financements pour les entreprises privées qui sont obligées de recourir à des crédits en devises, ce qui accentue davantage le déficit de la balance courante.

L'endettement des entreprises a atteint un niveau élevé et continue de croître alors que les profits sont stables voire en recul. Le nombre de défaillance est aussi en hausse ainsi que les créances douteuses dans les bilans des banques (3,60% des actifs bancaires en décembre 2013).

Le défaut d'infrastructures est de plus en plus criant dans des secteurs stratégiques comme l'énergie et les transports. L'éducation primaire est peu performante ; le taux d'alphabétisation est de seulement 66% en 2013 (contre 93% en Chine par exemple). La taille des universités est aussi montrée du doigt par certains experts qui redoutent que celles-ci ne soient plus en mesure de former suffisamment de travailleurs qualifiés.

Enfin, parmi les sources d'inquiétude, on désigne souvent une bureaucratie et une classe politique corrompues et incapables de prendre les décisions nécessaires.

Malgré les sources d'inquiétude, l'Inde a un certain nombre d'atouts. Le pays est autosuffisant sur le plan alimentaire, il dispose de nombreuses ressources naturelles. L'épargne des ménages est à un niveau élevé. En décembre 2013, les réserves de changes étaient suffisantes pour couvrir plus de 6 mois d'importations (à des niveaux comparables avec le Brésil et la Russie).

La base fiscale en Inde est large et seulement 2,50% des ménages payent l'impôt sur le revenu. De même, une grande partie de l'activité des petites entreprises est informelle et

échappe à l'impôt. La collecte de l'impôt peut donc être largement améliorée et permettre la réduction des déficits publics. L'étude d'une réforme fiscale est d'ailleurs à l'ordre du jour.

La dépréciation actuelle de la roupie peut permettre, à court terme, à l'industrie de gagner en compétitivité et d'augmenter les exportations.

La nomination de Raghuram Rajan, économiste de réputation mondiale et ancien économiste en chef du FMI, à la tête de la RBI a redonné confiance aux marchés au profit de la banque centrale indienne.

D'ici 2020 l'Inde sera le pays le plus peuplé du monde et 200 millions d'Indiens auront entre 15 et 24 ans (à peu près la population actuelle du Brésil). L'Inde peut tirer parti de cet avantage démographique si elle parvient à former et fournir du travail à cette population tout en gérant l'accès au soin et la retraite des séniors qui seront eux aussi plus nombreux.

Enfin, bien que l'éducation primaire soit insuffisante, l'Inde a beaucoup investi dans l'éducation supérieure ; le pays dispose d'une main d'œuvre qualifiée de haut niveau, un atout majeur dans un monde où le marché du travail se mondialise grâce aux nouvelles technologies.

4. Vers un système financier cohérent et intégré

En 1980, suite à deux vagues de nationalisation qui avaient pour but de permettre aux secteurs prioritaires ainsi qu'aux ruraux d'accéder aux services bancaires, l'État contrôlait 90% du secteur bancaire, en termes d'actifs. Des mesures comme la planification du crédit ou le contrôle strict des taux d'intérêt étaient en place. L'Inde était dans une configuration typique de « répression financière » à la McKinnon (1973) et Shaw (1973). Malgré la multiplication des agences et la hausse de la taille des bilans des banques suite à la politique socialiste des années 1960-1970, les banques publiques prêtent trop massivement. Cela n'est pas sans conséquence sur l'inflation et le nombre de crédits non performants au bilan des banques publiques explose. Les banques publiques, l'économie et la stabilité financière sont menacées.

Parallèlement aux réformes économiques dans d'autres secteurs, le secteur bancaire va aussi connaître une série de réformes indispensables pour assurer sa pérennité. Les réformes ont pour objectif de (i) affranchir les banques des contraintes externes, (ii) réduire la participation de l'État dans le secteur bancaire, (iii) améliorer l'efficience des banques en

introduisant davantage de concurrence et (iv) renforcer le cadre réglementaire et la supervision des banques. La RBI a joué un rôle clé dans le processus de réformes en assouplissant les réserves obligatoires, libéralisant les marchés tout en surveillant leurs différents acteurs. Suite aux réformes, les performances des banques s'améliorent ; le rendement des actifs bancaires était de 1,1% en 2009 en Inde, ce qui place l'Inde en bonne position dans le monde. Les actifs non performants sont passés de 14,4°% des actifs totaux en 1998 à 3% en 2012.

Outre le secteur bancaire, les marchés financiers vont aussi être libéralisés et se développer de façon importante. Les marchés actions, le marché monétaire, le marché obligataire (plus particulièrement celui de la dette souveraine) ainsi que le marché des changes sont progressivement libéralisés. A partir de 1990, le marché monétaire est libéralisé, les institutions non-bancaires sont peu à peu admises, de nouveaux produits sont autorisés et à partir de 2000, la mise en place d'un segment collatéralisé supervisé par la RBI permet au marché de se développer considérablement. Le marché de la dette souveraine connaît un premier bouleversement en 1997 lorsque l'Etat renonce aux émissions ad hoc puis en 2006 lorsque la RBI n'est plus autorisée à souscrire aux émissions. Concernant le marché des changes, la convertibilité de la roupie n'est toujours pas totale mais depuis 1994 la monnaie indienne est convertible pour les transactions courantes et le marché a cru de façon conséquente. Enfin, on a observé la libéralisation et le boum des marchés actions à partir de 1990.

5. Intégration financière : quid des marchés actions ?

L'intégration financière est un phénomène qui lie les marchés financiers entre eux. Des marchés intégrés offrent une meilleure allocation du capital, une meilleure gouvernance d'entreprise ainsi qu'une meilleure répartition des risques (voir par exemple Obstfeld 1994, Levine 1997, Kose *et al.* 2006). Il y a aussi des effets non désirables liés à l'intégration financière, comme une vulnérabilité accrue aux chocs extérieurs (Stiglitz 2002, Bekaert *et al.* 2002). Nous nous proposons de vérifier dans cette section l'intégration des marchés actions indiens en étudiant la corrélation qui existe entre le Sensex (BSE), un indice majeur en Inde et le Standard & Poors 500 (SPX), communément admis comme un indice de référence global. Notre analyse, effectuée dans le cadre du modèle *Dynamic Conditional Correlation* (DCC) *Generalized Autoregressive Conditional Heteroscedasticity* (GARCH) développé par Engle (2002) et Tse et Tsui (2002) à l'aide de données allant de Juillet 1997 à Septembre 2013, montre

que la corrélation entre le BSE et le SPX a cru entre 1997 à 2013. En particulier, la corrélation a connu un pic entre 2008 et 2011, au moment de la crise des *subprimes*. Ce résultat suggère une intégration croissante des marchés actions indiens ainsi qu'une forme de fragilité puisque la corrélation a été très importante durant une période de crise.

II. CHAPITRE 2 : LES DETERMINANTS DES SPREADS DES CDS DES BRICS DANS UN CADRE A CHANGEMENT DE REGIMES MARKOVIENS

Les *credit default swaps* (CDS) sont des instruments financiers pour échanger et couvrir les risques liés au défaut d'un emprunteur. Ils offrent une protection contre le défaut d'un emprunteur, privé (entreprises, banques,…) ou public (états, municipalités,…). Le *spread* d'un CDS, exprimé en point de base, représente le coût annuel associé à l'achat d'un contrat. Si un événement de crédit a lieu (défaut, restructuration,…), alors le vendeur du contrat devra couvrir les pertes liées à celui-ci. Comme la plupart des instruments financiers, les CDS sont aussi utilisés à des fins spéculatives.

Notre article s'inscrit dans la littérature qui traite du *pricing* et des déterminants des CDS et poursuit dans le sillage de l'article précurseur de Merton (1974). Plus particulièrement, il fait suite à des travaux comme ceux de Longstaff *et al.* (2011), Fender *et al.* (2012) ou encore Chan et Marsden (2014). Nous avons pour but d'examiner les relations entre les *spreads* des CDS des BRICS et les facteurs financiers notamment ceux de la zone euro. En d'autres termes, notre travail esquisse une réponse aux questions suivantes : "Quels sont les principaux déterminants des CDS des BRICS ?" "Dans quelle mesure les facteurs liés aux risques financiers en zone euro sont autant voire plus pertinents que ceux liés aux US pour expliquer la dynamiques des CDS des BRICS?". Pour ce faire, nous utilisons un modèle à changement de régimes Markoviens incluant des facteurs financiers et macroéconomiques afin de traiter les différentes phases des dynamiques des CDS. Notre approche est similaire à celle adoptée par Chan et Marsden (2104) ou Alexander et Kaeck (2008). Chan et Marsden ont utilisé des modèles à changement de régimes Markoviens pour analyser l'influence des facteurs réels et financiers sur les CDS des émetteurs « *investment grade* » nord-américains.

Notre étude diffère de la littérature existante car elle observe les CDS souverains des BRICS, elle prend en compte les facteurs de la zone euro et elle inclut la période de crise récente. Par ailleurs, elle est complétée par de nombreux tests de sensibilité (comparaison

avec un modèle incluant les variables US, etc…). L'analyse économétrique est effectuée à partir de données mensuelles allant de Janvier 2002 à Septembre 2013.

1. Fondements théoriques

Il existe globalement dans la littérature deux approches pour modéliser les *spreads* de crédit et de CDS. La première est fondée sur la relation qui existe entre risque de crédit et taux de défauts. Cette méthode omet les fondements théoriques des déterminants du risque de crédit. La seconde, l'approche structurelle inspirée de Merton, lie les *spreads* aux facteurs économiques et financiers qui influent sur la firme émettrice de la dette.

Les résultats empiriques concernant les déterminants micro des *spreads* de crédit dans les études utilisant un modèle structurel sont discordants : Ericsson *et al.* (2009) ou Zhang *et al.* (2009) confirment les résultats de Merton; Collin-Dufresne *et al.* (2001) réfutent l'importance des facteurs micro dans la détermination des *spreads* de crédit.

Nous fondons notre analyse sur l'approche structurelle et ses extensions. Tous les facteurs pouvant affecter la valeur d'une firme ou sa probabilité de défaut, au sens large, sont considérés comme des déterminants des *spreads* de crédit. Suivant la littérature théorique et empirique, nous choisissons dans notre étude d'inclure certains facteurs macroéconomiques et financiers : des indicateurs conjoncturels (e.g. croissance, inflation, balance commerciale etc…), des indicateurs de risques ou encore des indicateurs concernant la liquidité et les conditions de financement des entreprises.

Par exemple, le taux de change courant est un facteur clé dans les modèles structurels de *spreads* de crédits. Longstaff *et al.* (2011) ont démontré que les *spreads* de crédits et le taux sans risque étaient négativement corrélés. En particulier, ils ont souligné l'influence des facteurs américains sur le risque souverain des pays émergents. Les marchés actions sont aussi souvent considérés comme un facteur explicatif dans les modèles structurels (Alexander et Kaeck, 2008). Notamment, la volatilité implicite de ces marchés peut être interprétée comme un indicateur de risque sur les conditions économiques et il devrait être positivement corrélé aux *spreads* de crédits.

Malgré l'importance du marché de la dette souveraine, peu de papiers se sont penchés sur la question des CDS souverains. Parmi ceux-là, on peut citer Edwards (1986), Duffie *et al.* (2003) ou Zhang (2008) qui se sont intéressés aux déterminants des *spreads* de crédits

étatiques. De plus, certains travaux ont mis en avant la prépondérance de l'impact des facteurs américains sur les spreads de crédits des pays émergents (Pan et Singleton, 2008; Longstaff *et al.*, 2011; Ang et Longstaff, 2013).

2. Le modèle

Partant des travaux de Jeanne et Masson (2000) et d'un certain nombre d'hypothèses (e.g. hypothèse d'anticipations rationnelles), Blommestein et Eijffinger (2012) ont démontré que la relation entre les spreads des CDS souverains et leurs facteurs explicatifs pouvait être dérivée et prendre la forme de *k* relations distinctes, chacune correspondant à un état du marché. En d'autres termes, la dynamique des spreads de CDS peut être décrite dans cadre à changement de régimes. De plus, plusieurs études empiriques ont mis en évidence la non-linéarité des spreads de crédits (Chan et Marsden, 2014; Alexander et Kaeck, 2008; Davies, 2004).

Parmi les modèles à plusieurs régimes, il existe deux grandes familles : les modèles à seuil comme les *Threshold AutoRegressive* (*TAR*) et les modèles à changement de régimes Markoviens (Markov-switching). Nous poursuivons notre analyse en utilisant un modèle à changement de régimes Markoviens car il est plus général et semble plus approprié à notre thématique. Dans ce modèle la dynamique de la variable endogène dépend d'une variable latent non-observable S_t (si l'on considère *k* états, $S_t = 1, \dots, k$) qui représente les différents états de l'activité économique. Le modèle à 2 régimes est souvent utilisé dans la littérature afin de détecter et dater les retournements du cycle d'activité et il semble pertinent pour analyser la dynamique des *spreads* des CDS.

Le modèle *Markov-switching Autoregressive Moving-Average* (*MS (k)-ARMA (p, q)*) est une extension du modèle ARMA classique qui permet aux coefficients de celui-ci de varier d'un régime à l'autre. Dans sa forme générale, le modèle *MS (k)-ARMA (p, q)* augmenté de variables explicatives prend la forme suivante :

(1) $y_t = c_{S_t} + \sum_{i=1}^{p} \phi_{iS_t} y_{t-i} + \sum_{l=0}^{m} \vartheta_{lS_t} x_{t-l} + \varepsilon_{S_t} + \sum_{j=1}^{q} \psi_{jS_t} \varepsilon_{S_{t-j}}$

Avec y_t la variable endogène, x_t une série de facteurs exogènes; ε_{S_t} un terme d'erreur dépendant du régime; c_{S_t} la constante qui dépent aussi du régime; enfin les du processus *AR*

(p), $\phi_{iS_t}, i = 1, \dots, p$, ceux du processus *MA(q),* $\psi_{j,S_t}, j = 1, \dots, q$, et ceux des variables exogènes, $\vartheta_{lS_t}, l = 1, \dots, m$, dépendant aussi du régime.

L'estimation du modèle par maximum de vraisemblance est effectuée par l'algorithme *Expectation-Maximization* (EM) (Diebold *et al.,* 1994 Hamilton, 1990). La résolution numérique du modèle est obtenue par l'exécution de l'algorithme Broyden-Fletcher-Goldfarb-Shanno (BFGS).

3. Les données

Les *spreads* de CDS proviennent de la base de données Bloomberg. Nous utilisons les *spreads* des contrats d'une maturité de 5 ans portant sur la dette senior internationale, qui est le segment le plus actif et le plus liquide du marché. Notre échantillon va de Janvier 2002 à Septembre 2013 pour le Brésil, la Russie et l'Afrique du Sud et de Février 2003 à Septembre 2013 pour la Chine. Concernant l'Inde, le gouvernement central ne vend pas de dette en dehors de ses frontières et il n'y a pas de CDS sur le marché domestique. Néanmoins, les investisseurs et les experts considèrent le *spread* des CDS portant sur la *State Bank of India* (SBI), la plus grande banque publique du pays, comme un bon *proxy* du risque souverain indien. Les données concernant les CDS de SBI vont de Janvier 2005 à Septembre 2013, après traitement de séries tirées de Bloomberg et de Thomson-Reuters.

Les indices actions locaux, régionaux et internationaux (Dow Jones Euro Stoxx 50 et Standard & Poors 500), les taux de change, les volatilités implicites des indices actions de la zone euro et des Etats-Unis (Vstoxx et Vix), ainsi que les taux obligataires proviennent de Bloomberg. Les taux d'intérêt *overnight* sont tirées des bases de données des banques centrales. Le spread entre un taux d'intérêt de long terme (10 ans) et un taux d'intérêt de court terme (1, 2 ou 3 ans selon les pays et les données disponibles) est utilisée comme un *proxy* de la pente de la courbe des taux. Ces taux sont extraits de la base de données Datastream. Les facteurs spécifiques aux pays (balance commerciale, réserves de changes…) sont extraits de Datastream. Les soldes des finances publiques des BRICS proviennent des sources nationales. Ces facteurs sont normés avec les chiffres du PIB, mensualisés par extrapolation. Les prix des matières premières sont intégrés à notre modélisation avec l'indice calculé par le Commodity Research Burean (CRB).

Une large partie de la littérature existante a mis évidence l'influence des variables financières américaines sur les *spreads* des CDS des pays émergents. Néanmoins, les BRICS effectuent un commerce intense avec les pays de la zone euro. Par exemple, en 2012, la zone euro a exporté davantage que les Etats-Unis vers le Brésil, la Russie et l'Afrique du Sud. De plus, la zone euro est le premier investisseur en termes d'investissements directs à l'étranger (IDE) dans les BRICS. De plus, l'exposition des banques européennes aux BRICS est nettement plus élevée que celle des banques américaines (1 042 billion de dollars contre 272 billion pour les banques américaines en Mars 2012). Par conséquent, il nous a semblé intéressant d'étudier la dynamique des CDS des BRICS en prenant en compte les variables financières de la zone euro, d'autant que cette option n'a pas été retenue dans les travaux précédents, exception faite de Fender et al. (2012).

Par ailleurs, avant de procéder à l'estimation des modèles, nous avons mené des tests de stationnarité prenant en compte les changements de régimes. A la suite de Hall *et al.* (1999) et Shi (2013) nous avons effectué des tests *Markov-switching Augmented* Dickey–Fuller (MS-ADF) afin de détecter les bulles explosives dans le comportement des CDS des BRICS. Les résultats de ces tests indiquent l'approche à changement de régimes Markoviens est pertinente pour l'Afrique du Sud, l'Inde, le Brésil et la Russie. Bien que le cas de la Chine soit davantage discutable, nous prenons le parti de continuer l'analyse en gardant ce pays dans notre échantillon.

4. Résultats empiriques

Etant donné que les critères de sélection traditionels ne sont pas adaptés aux modèles à plusieurs régimes, nous avons choisi le critère pertinent dans le cadre des modèles à plusieurs régimes, le Markov Switching Criterion (MSC) de Smith *et al.* (2006). Celui-ci indique que le modèle MS-ARMA à deux régimes et d'ordre 1 était celui qui convient le mieux à notre analyse – hormis dans le cas du Brésil où nous ne retenons que des variables explicatives (absence de termes ARMA).

Le modèle détecte bien 2 régimes pour chacun des pays. Le Régime 1 correspond à une faible moyenne de la variable endogène ainsi qu'à une faible variance. Le Régime 2 est associé à une moyenne nettement plus élevée des CDS et à une variance globalement supérieure.

Les termes *ARMA* sont significatifs à différents degrés, selon les régimes et les pays. Dans le Régime 1, exception faite du Brésil, les facteurs macroéconomiques (réserves de changes, finances publiques et balance commerciales) ont un impact significatif sur les CDS des pays étudiés. Par exemple, dans le cas de la Chine, conformément à l'intuition économique, si les finances publiques s'améliorent, le spreads de CDS diminue toutes choses égales par ailleurs. Les variables financières (indice action local, taux de change, indice action de la zone euro et sa volatilité implicite et les taux obligataires) sont globalement significatives. On peut noter, entre autres, que le Dow Jones Euro Stoxx 50 a un impact négatif sur les *spreads* des CDS, ce qui suggère qu'une amélioration des conditions de marché en zone euro fait diminuer le risque perçu par les investisseurs concernant les BRICS. Dans le Régime 2, les facteurs macro et financiers ont un impact significatif sur l'ensemble des CDS des pays étudiés. Les coefficients ont une valeur différente d'un régime à l'autre. Ces résultats confirment la pertinence de l'approche à plusieurs régimes. Globalement, les facteurs financiers de la zone euro sont des déterminants significatifs des CDS des BRICS.

Par ailleurs, notons que la duration du Régime 1 est plus importante que celle du Régime 2, ces résultats sont en ligne avec ceux de Chan et Marsden (2014). Bien que dans le cas du Brésil, les chiffres des durations ne plaident pas en faveur d'une approche à plusieurs régimes, nous décidons de poursuivre l'analyse dans ce cadre.

De plus, lorsque l'on regarde la période récente allant d'Octobre 2009 à Septembre 2013, on note que le Régime 2 apparaît 11 fois pour l'Inde, la Chine, l'Afrique du Sud, plus de 20 fois pour la Russie et seulement 4 fois pour le Brésil. Il y a seulement 1 mois, durant la crise des *subprimes*, où tous les pays sont simultanément dans le Régime 2.

Enfin, dans l'ensemble, nos résultats confortent ceux de Chan et Marsden (2014).

5. Tests de robustesse

Afin d'étudier la robustesse de nos résultats, nous avons effectué une série de tests. Nous avons estimé un modèle MS(2)-ARMA(1,1) moins flexible où la variance ne dépend pas du régime, nous estimons aussi un modèle sur la période allant de Janvier 2002 à Août 2008 avant la faillite de Lehman Brothers. De plus, nous avons estimé des modèles incluant des variables supplémentaires ou alternatives et tout particulièrement des variables américaines.

Enfin, nous avons estimé un VAR pour étudier une éventuellement dynamique jointe des CDS des BRICS.

Les outils utilisés ici pour analyser les performances relatives des différents modèles sont le test de linéarité de Davies (Davies, 1987) et la mesure de classification des régimes (RCM) développée par Ang et Bekaert (2002).

L'introduction de certaines variables (cycle du PIB, indices actions régionaux) ou l'utilisation de variables alternatives (variables américaines) ne remet pas en cause nos résultats principaux et n'améliorent pas les performances du modèle. Globalement, l'introduction des deux régimes ainsi que la prise en compte des variables de la zone euro dans la dynamique des CDS des BRICS sont pertinentes.

Enfin, la modélisation VAR à changement de régimes Markoviens n'améliore pas la compréhension de la dynamique des CDS. En effet, il n'y a pas de liens robustes entre les CDS des BRICS.

6. Conclusion

L'approche à changement de régimes Markoviens semble appropriée pour étudier les *spreads* des CDS des BRICS. Nos résultats confirment l'existence de 2 régimes et l'influence de facteurs macroéconomique et financiers dans la détermination de ces CDS, bien que ce soit à des degrés différents d'un pays à l'autre. En particulier on note l'importance des facteurs financiers de la zone euro (Dow Jones Euro Stoxx 50 et Vstoxx notamment). Enfin, les tests de robustesse soulignent la pertinence de notre approche.

III. CHAPITRE 3 : LES VARIATIONS DES PRIX DES MATIERES PREMIERES ONT-ELLES UNE INFLUENCE SUR LES TAUX D'INTERETS DE COURT TERME ?

Les effets des chocs du prix du pétrole sur les économies développées ont été étudié dans de nombreux papiers (par exemple Hamilton, 1983 ; Gisser et Goodwin, 1986 et Mork, 1989). Leurs principales conclusions sont que les chocs de prix du pétrole ont des effets inflationnistes et récessionnistes. Une seconde branche de la littérature s'est attachée à étudier l'impact de la politique monétaire sur les prix des matières premières (Barsky et Kilian 2002; Frankel, 2007). Une troisième branche, fondée sur les travaux de Hall (1982), a examiné le rôle des prix des matières premières dans la conduite de la politique monétaire. Un grand nombre de ces papiers ont étudié le cas de la politique monétaire américaine. Les conclusions de cette littérature divergent : pour certains, la politique monétaire ne devrait pas se soucier des prix des matières premières car ceux-ci n'ont pas de lien stable avec les prix à la consommation (Garner 1985, 1989) ; pour d'autres, les prix des matières premières sont un indicateur avancé des prix à la consommation (Boughton et Branson, 1988) ou permettent de mieux comprendre l'inflation et l'activité (Cody et Mills, 1991). De ce fait, ils devraient être regardés par les autorités monétaires. Les travaux plus récents ont montré l'évolution dans le temps de la relation entre les prix des matières premières et l'inflation. Notamment, il semble que les prix des matières premières pouvaient aider à prévoir l'inflation des années 1970 jusqu'au début des années 1980, mais ce n'est plus le cas depuis le milieu des années 1980 (Bloomberg et Harris, 1995 et Furlong et Ingenito, 1996). Enfin, Bodenstein et al. (2012), partant des conclusions de Kilian et Lewis (2011), ont développé un modèle Dynamic Stochastic General Equilibrium (DSGE) où le prix du pétrole était endogénéisé et sont arrivés à la conclusion que les banquiers centraux devaient répondre aux variations des prix du pétrole.

Par ailleurs, peu d'études sont consacrées à d'autres pays que les Etats-Unis. Ainsi, Boughton et Branson (1988) ont étudié un panel d'économies développées, Hamori (2007) s'est penché sur le cas du Japon, Bloch *et al.* (2006) ont analysé le cas de deux grands exportateurs de matières premières (l'Australie et le Canada), Ocran et Biepke (2007) ont analysé l'Afrique du Sud.

Notre papier se situe dans la littérature considérant les prix des matières premières comme l'un des déterminants de la politique monétaire. Notre objectif est d'étudier la relation entre la

volatilité des prix des matières premières et les instruments de la politique monétaire dans un panel de pays (Etats-Unis, zone euro, Brésil, Inde, Russie et Afrique du Sud) sur une période allant de Janvier 1999 à Août 2012. Ici, le taux d'intérêt de court terme représente l'instrument de politique monétaire. Afin de souligner certains faits stylisés concernant la volatilité de nos variables d'intérêt, on utilise un modèle exponentiel GARCH (EGARCH). Puis on estime des modèles Vectoriels Autoregressifs (VAR) et on étudie les réactions des taux courts aux chocs de volatilité des prix des matières premières. Enfin, on implémente des modèles VAR à seuil (TVAR) afin de tester la dépendance au temps des relations étudiées. L'hypothèse implicite de ces derniers modèles étant que les banquiers centraux utilisent les prix des matières premières comme un signal annonçant une modification de la tendance de l'inflation pouvant entraîner celle de la politique monétaire.

1. Cadrage général

Les objectifs des banques centrales des pays étudiés sont quelque peu différents : la Fed a pour mandat de stabiliser l'inflation et de favoriser le plein emploi ; la Banque Centrale Européenne (BCE) a pour objectif de juguler l'inflation ; de même, les banques centrales sud-africaine et brésilienne ciblent un certain niveau d'inflation ; la banque centrale russe cible l'inflation ainsi qu'un certain niveau de taux de change ; enfin la Reserve Bank of India (RBI) a plusieurs objectifs incluant la stabilité financière, la stabilité des prix et assurer les flux de crédits suffisants à l'économie. Bien qu'elles aient à leurs dispositions des instruments variés (taux de réserves, taux d'intérêts etc…) pour atteindre leurs objectifs, toutes ces banques centrales utilisent principalement les taux d'intérêts de court terme pour mettre en œuvre leur politique.

Notre échantillon inclut des pays exportateurs nets (Brésil, Russie et Afrique du Sud) et des importateurs nets (Etats-Unis, zone euro et Inde) de matières premières, il y a aussi une hétérogénéité dans les catégories de matières premières, par exemple, le Brésil est un exportateur de pétrole brut mais un importateur de pétrole raffiné. Ces pays sont donc touchés différemment par des fluctuations des prix des matières premières.

Notre base de données contient des observations mensuelles de Janvier 1999 à Août 2012. Nous choisissons de prendre en compte l'indice de prix des matières premières calculé par le Commodity Research Bureau (CRB) ainsi que le prix du Brent brut comme indicateurs de prix des matières premières car ils sont largement utilisés dans la littérature. Nous utilisons

aussi les séries d'indices des prix à la consommation (CPI) des différents pays et les séries d'indices de production industrielle (IPI). Enfin, nous prenons les taux d'intérêts de court terme (3 mois) comme indicateurs des politiques monétaires (Borio, 2012 ; Svensson, 2003). Les séries sont utilisées en log-différence.

Les prix des matières premières ont augmenté fortement après 2003, et plus particulièrement après la crise des *subprimes* en 2007. Les prix du pétrole ont connu un pic durant l'été 2008 avant de plonger début 2009. Depuis la mi-2009, ils ont de nouveau une tendance haussière. Cette évolution est souvent imputée à un certain nombre de facteurs comme la forte demande dans les pays émergents, la faiblesse du dollar, la demande croissante pour les biocarburants, la « financiarisation » des matières premières.

Cashin et McDermott (2002) soulignent que les changements dans la volatilité des prix des matières premières ont des implications pour la politique monétaire, par ailleurs des travaux comme ceux de Mensi *et al*., (2013), Nazlioglu *et al.* (2013) ou Sari *et al.* (2012) ont montré que la volatilité des prix des matières premières peut être perçue comme un facteur important pour la stabilité financière globale. Par conséquent, les banquiers centraux devraient prendre en compte la volatilité des prix des matières premières dans leur prise de décision.

Nous modélisons la volatilité des prix des matières premières à l'aide de modèles AR(1)-EGARCH(2,2), conformément aux critères de sélections conventionnels (Akaike, Schwartz, Hannan and Quinn …). Nous démontrons la pertinence de ces mesures de volatilité en les comparant à des mesures traditionnelles de dispersion comme l'écart-type, le ratio inter-quartile, la valeur absolue des écarts, le coefficient de variation ou encore le ratio inter-quartile normalisé.

De même, nous avons calculé la volatilité des taux courts et observé les corrélations glissantes des séries. Celles-ci sont volatiles, on note cependant qu'elles ont été faibles au début des années 2000, puis fortes à l'automne 2008 suite à la faillite de Lehman Brothers pour tous les pays étudiés.

2. Analyse de la dynamique des taux d'intérêt courts termes et de la volatilité des prix des matières premières

Nous décidons d'étudier la dynamique jointe de la politique monétaire et de la volatilité des prix des matières premières à l'aide d'un modèle VAR non-restreint (Sims 1980,

Lütkepohl, 1991) comprenant le taux d'intérêt de court terme, le CPI et la volatilité de l'indice CRB (telle qu'extraite par notre modélisation EGARCH) et ce pour chaque pays. Conformément aux indications des critères d'information, nous estimons des VAR(2).

Hormis pour le Brésil, la volatilité du CRB affiche un voire deux coefficients significatifs dans l'équation du taux d'intérêt dans tous les pays. Globalement, on constate que, toutes choses égales par ailleurs, une plus forte volatilité des prix des matières premières entraîne des taux d'intérêts de court termeplus faibles. En d'autres termes, si l'incertitude augmente autour des prix des matières premières, les réponses des banquiers centraux sont atténuées. Ce qui est cohérent avec l'attitude de prudence des banquiers centraux.

Lorsque l'on observe les réactions des taux d'intérêts de court terme à un choc de volatilité du CRB, on note malgré les différences entre pays que le choc a un impact rapide et relativement persistant puisque les taux d'intérêts reviennent à leurs niveaux initiaux après seulement 3 ou 4 trimestres.

L'analyse de sensibilité montre que l'introduction d'un agrégat monétaire (M2) n'améliore pas les performances du modèles, en revanche l'estimation du modèle jusqu'en Août 2008 seulement et les projections *out-of-sample* effectuées à partir de celui-ci mettent en lumière le fait qu'il y a probablement eu un changement dans la relation entre taux d'intérêts de courts termes et volatilité des prix des matières premières au cours du temps. Par conséquent, il semble adéquat de recourir à une modélisation non-linéaire comme celle permise par les modèles VAR à seuil (TVAR).

3. Les modèles TVAR

Supposons que les changements d'orientation de la politique monétaire dependent d'une valeur spécifique de la volatilité des prix des matières premières, $ג^{\sim}$, alors les variations des taux d'intérêts de court terme auraient lieu en concordance avec $ג^{\sim}$. Il faut donc introduire la non-linéarité dans la dynamique des variables étudiées. Rappelons que Kilian et Vigfusson (2013) ont montré que des modèles non-linéraires peuvent permettre une meilleure anticipation du PIB à partir des prix du pétrole.

Plus précisément, pour chaque pays i ($i = 1, \dots, 6$) un modèle VAR bivarié à seuil (TVAR) incluant le taux d'intérêt de court terme et le CPI est considéré. Le système passe d'un regime à

l'autre (Régime 1 et Régime 2) selon les changements dans la volatilité du CRB z_t respectivement à un seuil inconnu λ. Le modèle TVAR s'écrit ainsi :

$$y_{it} = \begin{cases} A_i^{(1)}(L)y_{i,t-1} + \varepsilon_{it} & \text{if } z_{t-k} \leq \lambda, \\ A_i^{(2)}(L)y_{i,t-1} + \varepsilon_{it} & \text{if } z_{t-k} > \lambda, \end{cases} \quad (1)$$

Avec $A_i^{(1)}(.)$ et $A_i^{(2)}(.)$ des matrices polynomiales contenant les opérateurs de retard L d'ordre p_1 et p_2 respectivement, k l'ordre du retard de z_t et $\varepsilon_{it} \sim \mathcal{N}_2(0, \Sigma_i)$, avec $\mathcal{N}_2(\cdot)$ la distribution normale bivariée et Σ_i une matrice de covariance dépendant du temps.

Avant d'estimer les modèles, nous avons effectué les tests de linéarité à la Hansen (1999) afin de confirmer la non-linéarité de nos séries pour tous les pays, sauf l'Inde.

La distribution des régimes est équilibré dans les pays émergents que sont le Brésil, l'Inde et la Russie, en revanche, près de 80% des observations sont dans le Régime 1 pour les Etats-Unis, la zone euro et l'Afrique du Sud. La variable de seuil est en moyenne autour de 5,20%.

Dans le Régime 1, les taux d'intérêts sont uniquement influencés par leurs propres retards pour les Etats-Unis, la zone euro, l'Inde et l'Afrique du Sud. Pour le Brésil et la Russie, le CPI a aussi des coefficients significatifs dans les équations des taux d'intérêts. Dans le Régime 2, les relations sont plus complexes et varient grandement d'un pays à l'autre.

Les différents tests de sensibilité effectués (introduction de M2, introduction de variables d'activité, utilisation de variables de seuil alternatives) ont démontré la pertinence et la robustesse de notre modélisation.

4. Conclusion

L'estimation des modèles VAR a démontré qu'une plus forte volatilité des prix des matières premières entraîne des taux d'intérêts plus bas pour les Etats-Unis, la zone euro, Inde et l'Afrique du Sud. La Russie affiche le cas symétrique. En revanche, il n'y a pas de relation robuste entre taux courts et volatilité des prix des matières premières au Brésil. Globalement nos résultats nous suggèrent que pour les pays importateurs nets, le taux d'intérêt de court terme est une fonction décroissante de la volatilité des prix des matières premières.

L'introduction de 2 régimes est pertinente pour la plupart des pays. Le niveau du seuil se situe en moyenne à 5% pour tous les pays. Par conséquent, les autorités monétaires réagissent

lorsque les fluctuations de prix des matières premières deviennent significativement différentes de zéro. La dynamique du taux d'intérêt de court terme varie grandement d'un régime à l'autre et d'un pays à l'autre. Les tests de robustesses confirment notre approche.

Pour résumer, on peut dire que (i) l'approche à plusieurs régimes est appropriée pour étudier et comprendre la relation entre politique monétaire et volatilité des prix des matières premières et (ii) qu'il semble que les banquiers centraux portent davantage d'attention aux marchés de matières premières depuis la crise récente.

IV. CHAPITRE 4 : COMMENT L'INDE BENEFICIERAIT D'UN SECTEUR BANCAIRE PLUS EFFICIENT ? ANALYSE VIA UN MODELE DSGE.

Depuis les travaux précurseurs de Schumpeter (1911), le lien entre économie réelle et activité bancaire a été étudié par un grand nombre de papiers. La littérature théorique souligne le rôle des banques dans la collecte de l'épargne (De Gregorio, 1993), dans l'amélioration de l'allocation des actifs (Levine, 1991) etc… La littérature empirique est aussi riche. Par exemple King et Levine (1993) ou Levine et Zervos (1998) ont mis en évidence une relation positive et robuste entre finance et croissance.

En 1980, les banques publiques indiennes accumulaient 90% des actifs bancaires. Les taux d'intérêts étaient contrôlés, les crédits étaient planifiés. L'Inde était dans une situation type de répression financière à la McKinnon (1973) et Shaw (1973). Les mauvaises performances du secteur ont poussé les autorités à libéraliser le secteur à partir de 1990. L'efficience des banques et les rendements bancaires ont été nettement améliorées (voir Bhattacharyya *et al.*, 1997; Ataullah and Le, 2006). Néanmoins le processus de libéralisation est incomplet et les performances et standards des banques indiennes sont loin de ceux des pays développés. Dans le cas de l'Inde, le secteur bancaire est clé car des recherches récentes ont montré que peu d'entreprises ont accès aux financements via les marchés de capitaux (Didier et Schumkler, 2013).

D'un point de vue macréonomique, la croissance ralentit en Inde depuis 2011 et les perspectives sont désormais sources d'inquiétude. Ce contexte a ranimé le débat autour de la liberalization financier et du besoin de rendre les banques davantage efficientes (voir Shukla, 2014) ; beaucoup d'observateurs soutiennent qu'un secteur bancaire plus efficient serait bénéfique à l'économie et permettrait à l'Inde de sortir de l'impasse.

Ce papier vise à contribuer à ce débat en analysant l'effet d'un système bancaire indien davantage efficient. Il développe un modèle Dynamic Stochastic General Equilibrium (DSGE) incluant un secteur bancaire. Il analyse l'impact d'un choc positif de technologie bancaire. Il n'existe à la connaissance de l'auteur aucun travail ayant étudié cette question à travers un modèle DSGE. Des études précédentes ont implémenté des modèles DSGE de l'Inde, comme Anand *et al*. (2010), Batini *et al.* (2010), Gabriel *et al.* (2010) et Levine et Pearlman (2011). Néanmoins, ces papiers n'ont pas pris en compte le secteur bancaire ni traité la question de l'efficience du système bancaire.

1. Le modèle

Pour réaliser notre exercice, nous utilisons un modèle simplifié sans distinction entre les ménages Ricardiens et non-Ricardiens, sans séparation entre secteurs formel et informel ou encore entre producteurs de biens intermédiaires et producteurs de biens finaux. Les prix sont égaux à 1. De plus, certains secteurs institutionnels (banque centrale et état notamment) n'apparaissent pas explicitement dans notre modèle. Cette simplification ne compromet pas outre mesure nos objectifs qui peuvent être résumés à l'analyse (détermination des cractéristiques principales) du comportement des variables macroéconomiques agrégées (activité, stock de capital, …) dans un cadre où l'efficience du système bancaire est améliorée.

Les ménages, affichant une aversion aux risques, maximisent une fonction d'utilité séparable en travail et loisir. L'agent représentatif choisit ses niveaux de consommation, son offre de travail et de dépôts bancaires afin de maximiser sa fonction d'utilité.

Les entreprises sont neutres aux risques et maximisent leur profit. Elles peuvent faire défaut sur leurs crédits. Le cas échéant, elles auront des difficultés futures à accéder aux crédits. La firme représentative offre du travail aux ménages et demande des capitaux aux banques. Elles remboursent ces capitaux et les intérêts courus à chaque période. Par ailleurs, le capital se déprécie d'une période à l'autre.

Les banques sont parfaitement compétitives et maximisent leur profit. Elles offrent des crédits, selon une technologie donnée, à l'aide des dépôts des ménages et des prêts qu'elles effectuent à l'étranger. Elles peuvent faire défaut sur ces prêts.

Deux processus stochastiques non corrélés sont introduits dans la technologie de production des entreprises et dans la technologie bancaire.

L'équilibre du modèle est (i) une allocation de consommation et des dépôts qui résout le problème des ménages, (ii) une allocation des capitaux, de l'offre de travail et du taux de remboursement des crédits qui optimise le programme des firmes, (iii) une allocation d'emprunts à l'étranger et des dépôts qui résout le problème des banques et (iv) un vecteur de prix (salaires réels, taux d'intérêt des dépôts et taux d'intérêt des crédits).

2. Estimation Bayesienne

L'estimation du modèle est réalisée par les méthodes bayesiennes avec de donnée trimestrielles concernant les dépenses de consommation et les capitaux entre le troisième trimestre 1996 et le dernier trimestre 2013. Les données sont extraites de Datastream. Les distributions a priori ont été choisies en suivant les valeurs traditionnellement utilisées dans la littérature générale ou spécifique aux modèles DSGE estimés sur l'Inde. Les distributions a postériori ont été estimées à l'aide de l'algorithme de Metropolis-Hastings.

La part du capital dans la production est évaluée à 37% pour l'Inde, ce qui est légèrement supérieur aux valeurs que l'on estime dans les pays développés (autour de 33%). Les pays émergents comptent en général un nombre important de travailleurs indépendants qui génèrent des revenus de leurs capitaux et de leur travail, ceci complique et biaise à la hausse la part du capital dans la production (voir Gollin, 2002). Les résultats de ce papier confirment que l'Inde est dans cette situation ; ils sont en ligne avec les estimations précédentes, notamment celle de Gabriel *et al.* (2011). Le paramètre de préférence aux loisirs et l'élasticité inverse de Frisch estimés correspondent à des valeurs proches de celles de la littérature et à celles des pays développés. Le taux d'actualisation inter temporel est fixé à priori à 0,995. Cette valeur est supérieure à celle des économies développées, ce qui montre que les ménages indiens sont relativement patients et sont prêts à reporter leurs consommations pour un taux d'intérêt réel de 2%. Cette observation est conforme aux conditions économiques récentes en Inde. Le taux de dépréciation du capital est estimé à 2,40% par trimestre, ce qui est proche des estimations récentes concernant les économies développées. Le taux des dépôts dans les crédits est estimé à 0,84. Le résultat implique un ratio crédits-dépôts de 1,20 ce qui est moins important que dans les pays développés où les banques ont accès à davantage de sources de financements. Les estimations concernant le coût de défaut des entreprises est plus faible que le coût de défaut estimé pour les économies développées.

3. Les faits stylisés et les résultats

Comment atteindre davantage d'efficience dans le secteur bancaire indien ? Une solution de facilité, exigée par certains, serait de libéraliser davantage le secteur. Berger et Humphrey (1997), Hermes et Lensink (2008) ou Claessens *et al.* (2001) défendent la libéralisation financière en avançant qu'elle améliore l'efficience des banques via la découverte des prix et des conditions de marchés améliorée. King et Levine (1993), Rajan et Zingales (1998), Bekaert *et al* (2005) ou Reinhart et Tokatlidis (2005) soulignent que la libéralisation et le développement du système financier stimulent la croissance économique. Néanmoins, une autre partie de la littérature (Kaminsky et Reinhart (1999), par exemple) ont montré que la libéralisation engendre l'instabilité financière et peut générer des crises. Des études empiriques ont également démontré que la libéralisation augmente la probabilité de crise (Demirgüç-Kunt et Detragiache, 2001; Eichengreen et Arteta, 2002; Ranciere *et al.*, 2006). Selon Angkinand et al. (2010), en mettant en place des contrôles et des institutions nécessaires, un pays peut libéraliser son système financier en évitant les effets néfastes. Par conséquent, une libéralisation accrue devrait être accompagnée par des mesures de prévention et une régulation adéquate. Par ailleurs, selon Shukla (2014), les banques indiennes doivent œuvrer dans le but de (i) maintenir des niveaux appropriés de capitaux, (ii) d'améliorer la gestion de la liquidité et (iii) de mettre en place des meilleurs standards dans la gestion de la trésorerie. Ces objectifs ne peuvent être atteints qu'avec un cadre réglementaire adapté.

En 2014, en plus de la baisse de la croissance économique, l'Inde fait face à une hausse des la dettes publique et privée, à une inflation galopante et à des infrastructures dont la vétusté est de plus en plus criante. Les actifs non-performants (NPA) sont en hausse dans les bilans des banques. Le gouvernement connaît des difficultés à maîtriser les déficits. Dans des secteurs comme l'énergie ou les transports les infrastructures se révèlent de plus en plus insuffisantes. Un système bancaire plus efficient permettrait en effet de résoudre un certain nombre de ces problèmes. Mais qu'en est-il du véritable impact macroéconomique d'un secteur bancaire plus efficient ? On observe un choc suite à une hausse de 1% de la productivité bancaire. Ceci signifie une multiplication par 2 du bilan des banques. Cela semble possible en Inde où le taux de bancarisation est de 30% et où 40% des prêts proviennent de la finance informelle (Basu, 2005). Comme attendu, le choc provoque une augmentation de l'offre de crédit et de l'investissement. Par conséquent, le stock de capital dans l'économie augmente. Dans un premier temps, le taux d'intérêt des crédits augmente, cela s'explique par l'ampleur du choc ; par la suite ce taux diminue avant de revenir

progressivement à son niveau d'équilibre. Ce qui est plus intuitif : les banques devenant plus efficientes, elles peuvent offrir du crédit à moindre coût. Portée par une plus forte consommation, l'activité croît avant de revenir à son niveau d'équilibre. Les dépôts diminuent. Les taux d'intérêt des dépôts augmentent avant de converger vers la valeur de l'état stationnaire. Les taux d'intérêt des crédits ayant augmenté dans un premier temps, les entreprises ont des coûts liés aux emprunts en hausse, afin de maintenir leurs profits, elles sont contraintes d'augmenter leurs prix ce qui a pour conséquence de diminuer les salaires réels juste après le choc. Puis, avec la baisse des taux d'intérêt, le salaire réel croît au-delà de son niveau initial avant de converger vers celui-ci après quelques trimestres. Les emprunts à l'étranger effectués par les banques augmentent dans un premier temps pour compenser la baisse des dépôts, puis déclinent en dessous de son niveau initial avant de revenir au niveau correspondant à l'état stationnaire. Comme la production et la consommation croissent, le taux de remboursement des entreprises s'améliore après le choc.

Globalement, le choc s'avère positif pour l'économie indienne : la production, la consommation et l'investissement sont stimulés alors que le risque de crédit diminue. Nos résultats suggèrent que les autorités doivent libéraliser le secteur financier en améliorant les contrôles et la régulation et/ou qu'elles agissent directement sur la gestion des banques publiques afin d'améliorer leur fonctionnement.

4. Conclusion

Ce chapitre développe un modèle DSGE simplifié pour l'Inde prenant en compte les banques. Le modèle est estimé par méthodes bayesiennes avec de données trimestrielles. La réaction à un choc de technologie bancaire de l'économie est globalement positive : la production, la consommation et le salaire réel augmentent alors que le risque de crédit diminue.

Selon nos résultats, les autorités indiennes devraient améliorer les standards de gestion des banques publiques et/ou libéraliser le secteur bancaire tout en prenant soin de mettre en place les contrôles et régulations nécessaires.

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CHAPTER 1

A SHORT HISTORY OF INDIA'S ECONOMY AND FINANCIAL STRUCTURE SINCE 1980

By Kuhanathan ANO SUJITHAN

Abstract – *This paper presents the main features of the Indian economy including a comparison of India among the BRICS countries. It outlines the economic developments in India since 1980, assessing about 3 decades of economic liberalization and the current economic issues. It also presents the strengths and weaknesses of the Indian economy. Furthermore, the paper features a brief summary of India's financial structure development and its liberalization process is outlined. Finally, using a DCC-GARCH model, it investigates the Indian financial integration process focusing on stock markets. Based on monthly data from January 1999 to September 2013, the model allows to analyse the joint dynamic of the Sensex and the S&P 500 indices. The S&P 500 index obviously influences positively the Sensex, while reciprocity does not hold. Meanwhile, the linear correlation between the two indices grew over time, supporting the hypothesis of a larger integration.*

JEL classification: O11, O16, O53, G20

Keywords: India, BRICS, economic liberalization, financial integration, DCC-GARCH

After implementing socialist economic policies in the early stage of modern India's history, the country started shifting progressively to a free market economy. Between 1980 and 2008 the economy has grown quite steadily and inflation stayed mostly under control. Whereas other countries were hit by severe economic and/or financial crisis, India experienced a single crisis in 1991. In the early stage of the current global crisis, India had not been greatly affected and some observers even mentioned an alleged "decoupling theory", but since 2009 growth is slowing down, inflation is rising and more generally economic fundamentals seem rather weak. As a consequence policy makers, investors are concerned about the ability of India to resume the path that won the country its inclusion within the BRIC back in 2001. There is also a large debate on the reforms that should be implemented by the country to end the turmoil. The main objectives of this paper are (i) to provide a comprehensive review of the recent developments of the Indian economy in order to have a better understanding of the current issues; (ii) to assess the country's ability to get back on the path of sustained growth and where it stands among the BRICS group and (iii) to analyse the role of India's financial system. To do so, this paper carries out a critical analysis of the way that has been covered by the Indian economy during the last decades. Also, it outlines reasons for concerns and optimism regarding the future of Indian economy. When possible and relevant, it often draws up a comparative analysis between India and the other BRICS members. Moreover, it focuses on a specific key sector: the financial sector and provides a specific review of the recent developments in the Indian financial system. Furthermore, it investigates the question of financial integration within an econometric framework.

The remainder of the paper is organized as follows: section 1 summarizes the outstanding economic reforms implemented in India from the 1980's through the 2000's. Section 2 emphasises the current economic current situation the challenges faced by the Indian economy. Section 3 discusses its strengths and weaknesses. Section 4 presents the development course of the financial sector. Section 5 studies the integration of Indian stock markets using a DCC-GARCH model and finally section 6 presents some concluding remarks.

I. REFORMS AND ECONOMIC DEVELOPMENTS IN INDIA: 1980-2010

1. Economic framework in 1980

India was a fast growing economy in the second half of the 20th century. Despite social disparities and poverty issues the country was considered as a model among developing economies. The industrial network was developed, efficient and kept growing after World War II. At that time, the country imported very few goods, its economy did not depend on western countries, and even better, "made in India" products were spreading in foreign markets.

Nevertheless, the economy did not build on these successes: industrial equipment and infrastructure were not renewed and new investments were missing. Those factors combined with an economic policy hostile to the emergence of large private firms and to foreign investments and trade led the Indian industry to obsolescence and pushed global firms such as IBM to leave the Indian market. For instance, the Monopolies and Restrictive Trades Practices Act (MRTPA) prevented the rise and development of large scale companies; the Foreign Exchange Regulation Act prevented imports and foreign investments; and firms also had numerous administrative constraints (symbolized by the "Raj licence" mandatory for any industrial firm wanting to have activities in India): India's part in global trade went from 2% in 1950 to 0.5% in 1980. The Indian industry which was the 10th industry production-wise in the world fell to the 20th rank during the same period. Besides, the positive evolution in India regarded the primary sector, where the "Green Revolution" led India towards alimentary independence. For instance, between 1965 and 1980, rice and wheat yields have been doubled.

2. The 1980's: uncontrolled economic liberalization

Before Reagan and Thatcher, Indian high public servants such as L.K. Jha, Abid Hussain or P.R. Alexander stood for free-market policies. Even though Indira Gandhi was elected in 1981 with a socialist economic program, she set up liberalization reforms in order to revive the country's economy. In 1984, after Indira was murdered, Rajiv took on the Prime Minister position and showed that he was committed to implementing liberalization policies. The MRTPA was softened. In order to modernize equipment and to boost the country's

competitivity, imports were eased. Meanwhile, the fiscal system was also deeply simplified and many tariffs were lowered.

Between 1981 and 1990, real GNP grew by 5.7% per year on average. The GNP was boosted by industrial production (+7% per year on average during this period). Nevertheless, the liberalization process was erratic and uncontrolled. Thus this success was soon going to be wiped-out by a very concerning inflation rate - that reached 17% per year in the middle of 1991 - and by growing interior and exterior deficits. At the beginning of 1991, financial markets lost their confidence in the Indian economy and the country was facing a current account crisis. The assassination of Rajiv Gandhi during the same year would only raise further concerns on India's future. Economic studies reached very different conclusions regarding this period. Some of them, (Rodrik and Subramanian, 2005 and Kohli, 2006a, 2006b) underline the importance of the first liberalization measures implemented by the authorities in the early 1980's, while others (Srinivasan, 2003 and Panagyria, 2004) argue that growth was built mostly on unsustainable public expenditures and foreign borrowing that led India into the 1991 crisis and stress that the good performance observed in the last decades stems from the reforms launched in early 1991.

3. 1990-2007: liberalization, growth and stability

Against all odds, India bounced back rapidly. The new government wanted to keep reforming the Indian economy, but first it would make emergency decisions regarding the current account crisis. Thus all reforms were thought in a long-run perspective and implemented gradually (see Table 1). The aim was to reduce the deficits, to stop inflation and to pursue the liberalization of the private sector. Prices of many products were liberalized, administrative formalities softened, and foreign investments permitted again. In 1992, the Indian growth suffered from deficits reduction policy but inflation was contained and the current account improved (see Figures 1 and 2).

Between 1992 and 1995, India kept reforming its economy: imports were liberalized, tariffs lowered or taken down, the rupee became convertible for current transactions, and the huge public sector reduced. Growth accelerated in the aftermath of these comprehensive reforms involving many sectors of the economy. In the second half of the decade, growth slowed down a little, consecutively to the East Asian financial crisis. Fiscal consolidation did not go on as planned. Lower than normal monsoon years also impacted negatively agriculture.

Since the general elections of 1996, there is no clear politic majority in India. In order to rule, coalitions have to be made and the pace of reforms was dramatically reduced due to a lack of consensus. As in other fast growing emerging economies, an excessive enthusiasm led to huge investments, some of which revealed major viability issues. Finally, inflationary pressures which pushed the Reserve Bank to monetary tightening also explain the short loss of growth momentum by the end of the 1990's.

Nevertheless, overall India kept going towards a free-market type of economy and can boast of high growth rates and relatively controlled inflation from 1992 to 2000, respectively 6.37% on average and 9%. From 2000 to 2007, economic performances were enhanced and that period was the best ever in modern India's history: growth accelerated reaching an average of 7.10% and inflation was as low as 4.70% on average. In 2004, Manmohan Singh took office as Prime Minister and pursued the gradual liberalization of the economy with pro-industry, pro-finance, pro-trade reforms and is often credited for economic performances during that period.

	Main Reforms	
	Date	**Implemented Policy**
Fiscal and Monetary Policy	1991	Devaluation of the Rupee (18% against the USD)
	1991	Liberalization of Banking System and interest rates (see Section 4)
	From 1991	Steps toward full convertibility of the Rupee for current account transactions
	From 1991	Tax reforms
	From 1991	Desinvestment policy and greater autonomy granted to public sector firms
	1999	Liberalization of Insurance sector
	2004	Reduction of capital controls
	2003	Fiscal Responsibility Act to bind government to fiscal rules
	2004-2005	Reform of Financial Regulatory Authorities
External Sector	1991	Virtual abolition of import licensing control
	1991	Abolition of quantitative restrictions on imported capital and intermediate goods
	1991	Amendment of the Foreign Exchange Regulation Act to reduce restrictions on firms
	1998	Abolition of quantitative restrictions on imported consumer goods
Industry	1991	Virtual abolition of industrial licensing
	1991	Larger access to foreign technology
	1991	Opening of strategic sectors to private investments (e.g. telecommunications, electricity)
	1991	Foreign investment allowed up to 51% of equity
	1997	Further steps toward foreign ownership of equity
	1998-1999	Further abolition of industrial licensing
Agriculture	1991	Liberalization of exports
	1991	Liberalization of domestic trade
	1991	Higher procurement prices for cereals
Social / Labour Policy	1997	Introduction of targets for public food distribution
	2001	93rd Constitutional amendment : education becomes a fundamental right
	2001	Health reforms at the state level
	2001	Proposals to reform labour market

Table 1 - Main economic reforms in India since 1991

Source: Acharya (2002); Mooij (2002); Srinivasan (2003); Williamson and Zagha (2002)

4. 2008-2010: Global financial crisis and the Indian response

The effect of the global financial crisis was not significant in the very beginning, it was even positive, as India benefited from investment flows during 2007Q4. Nevertheless, as soon as January 2008 capital started to flee the country consequently capital inflows declined by 63% from September 2007 to September 2008 and net capital flows became negative. Trade also began to decline; exports decreased by 18% during that same period. These phenomena led the country to experience one of its largest current account deficit and its lowest capital

account surplus in 2008. The rupee weakened against the USD starting January 2008 and exchange rate volatility began to go out of control. Inflation also ran out of control, reaching levels as high as 9% in 2008 mainly led by rising food prices. To offset the negative impact of the global financial and economic turmoil, the government set up fiscal stimulus package and charged the Reserve Bank to take a number of monetary easing and liquidity enhancing measures in order to maintain credit supply to all productive sectors. As a result, reserve and liquidity ratios went down in 2008. The Reserve Bank also intervened on currency markets in order to prevent high volatility on INR-USD. The stimulus package accounted for 3.5% of GDP of fiscal year 2008-2009, it consisted in tax relief measures and larger expenditures in public projects. Consequently, the fiscal deficit rose from 2.7% of GDP in 2007-2008 to 6.5% of GDP in 2008-2009.

These measures led the country to achieve good results in terms of output; real GDP grew about 8.50% in 2009 and 10.25% in 2010. The drop in credit was contained, credit growth to non-food industry went from -25% in 2008 to -17% in 2009. Volatility on INR-USD was curbed and the exchange rate in December 2009 was back to its level of September 2006, mostly because of the weakening of the US Dollar in the international markets. Yet, inflation was still at very high levels (almost 10%), government deficit and current account deficit were getting larger and these points were growing concerns in 2010.

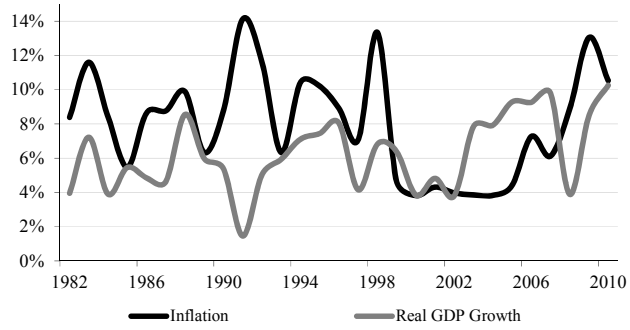


Figure 1 - Growth and Inflation rates in India (in %)

Source: IMF

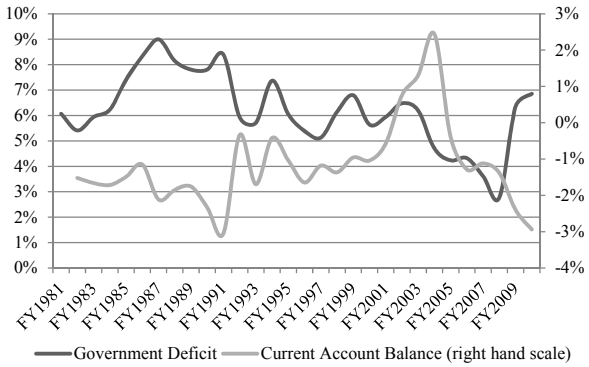


Figure 2 - India's "Twin deficit" (in % of GDP)

Source: Reserve Bank of India

II. THE CURRENT STATE AND CHALLENGES OF THE INDIAN ECONOMY

1. Since 2011: heading towards stagflation?

According to the World Bank, the Indian economy was the world's 10th largest in terms of GDP computed in current USD and the 3rd one on a purchasing power parity (PPP) basis in 2012. In PPP, only China (2nd behind the USA) performed better than India among the BRICS. Russia, Brazil and South Africa were respectively 6th, 8th and 23rd. Even though, the country has still a long way to go in terms of development; while observing the GDP per capital ranking one can note that India fell at the 126th place, behind all BRICS and all the largest OECD countries.

Regarding Indian GDP growth rate in the recent period, one note that after a steep rebound in 2009 and 2010, GDP growth declined progressively from 6.60% in 2011 to 4.30% in 2013 according to the IMF. More precisely, industrial output growth decelerated from around 1% in 2011 to 0.70% in 2013. Private consumption growth is on a downward trend (about 4% in 2013), consequently capital goods and consumer goods have been experiencing an important contraction. Another consequence of weak consumption growth is the fall in services growth. For instance, trade, hotels, transport and communication which accounted for 25% of Indian GDP, grew by 3.5% in 2013. Agriculture suffered in 2011 and 2012 but thanks to a good monsoon, grew by 4.6% in 2013.

Even though India experienced a growth in real GDP significantly below that of previous years, it is still the 2nd fastest growing economy among the BRICS behind China in 2013 (see Figure 3). The rise in consumer goods' prices is quite a concern and a great risk for India; none of other BRICS member showed such a large inflation rate.

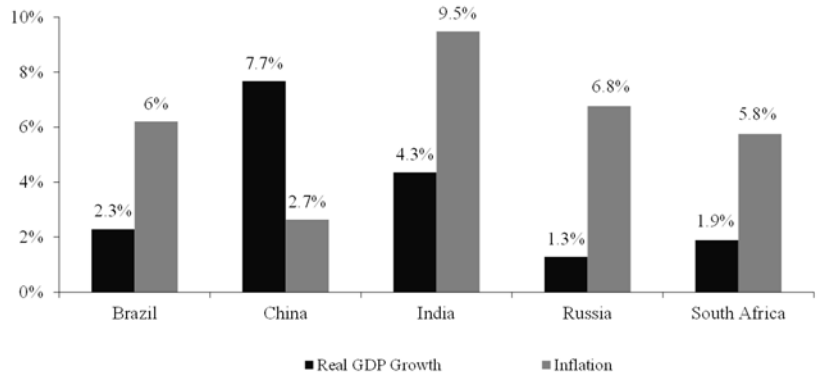


Figure 3 - 2012 Real GDP growth and inflation rates in the BRICS

Source: IMF

2. Indian economic structure

As mentioned above, India is a service-type economy. Indeed, the service represented 67% of GDP for 2012-2013 while agriculture and industry accounted for respectively 14% 19% of GDP (see Figure 4). However, agriculture is the largest employer (53% of total jobs in 2012-2013), whereas services and industry account respectively for 27.7% and 19.3% of total jobs.

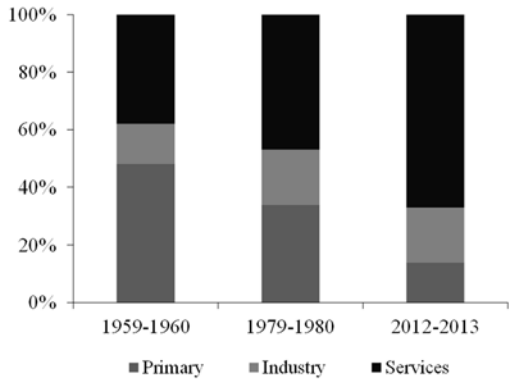


Figure 4 - Economic structure of India, 2013 (in % of GDP)

Source: Reserve Bank of India

Regarding agriculture, India is the world's 4th largest food commodity producer; the first tea exporter, the second rice and cotton producer, and the third milk producer. These results are due to the richness of Indian soil, its favourable relief, diversity of climate and also to the "green revolution" implemented by the government in the 1960-1970's. This reform allowed modernisation, higher yields and led the country to move from food importations to auto-sufficiency in the 1980's.

The industrial sector in India is very different from that of other emerging countries: more diversified, less specialized and more oriented towards the domestic market than towards exports. Industrial production is well balanced: about one third is dedicated to basic products (steel, cement, and petro-chemicals), another third is dedicated to intermediate products and the last third is dedicated to consumer goods. Firm structure is also an interesting pattern as there is a large mosaic in India. Small scale companies (accounting for 40% of total production and 65% of industrial jobs) co-exist along with large capitalistic industrial conglomerates such as Tata and Reliance Industries. A final important feature of the Indian industry is the dominion public firms in highly capitalistic activities; as a results public firms account for 30% of all industrial firms' capital.

Since 1990, half of direct investments were made in sectors such as telecommunications, IT, energy; that accelerated the tertiarization of the economy (see Figure 4). The service sector was undersized until the 1990's, the heavy industry-oriented policies of post-colonial period is often used to explain that feature between 1950 and 1990. Liberalization of this sector, economic growth and foreign investment helped the country to converge rapidly towards international standards. And more surprisingly, the recent Indian growth was mostly service-led. In 2013, services' sector is the first contributor to economic growth. Contrary to popular belief, the sector is not only composed of Information Technology (IT) and Business Process Outsourcing (BPO) firms. The country developed a wide range of services, including financial services, education, real estate, etc. Even though, some papers questioned the sustainability of the Indian services' sector and consequently Indian growth, they especially stressed the sector's poor contribution to capital accumulation (compared to industry) and its specific workers' population (mainly highly-skilled employees) (see Bosworth *et al.,* 2007; Mazumdar, 2008; Acharya, 2003 and Panagariya, 2008). Eichengreen and Gupta (2011) provided elements contradicting the sceptical view and showed that the "modern services"[1] that were growing rapidly were now large enough and could have a significant macroeconomic impact on output and employment. More specifically, they showed that modern services can be a viable employment destination for rural and unskilled Indian; such development would have a major impact on the Indian economy.

[1] Including, financial intermediation, computer services, business services, communications, and legal and technical services.

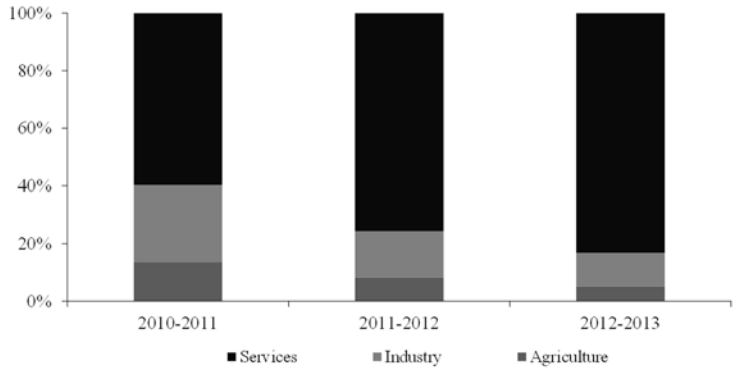


Figure 5 - Economic sectors contributions to Indian GDP growth since 2010-2011

Source : Reserve Bank of India

Except for China, all BRICS are service-led economies. Among the comparison group, industry's part in GDP is the lowest in India, and agriculture's part is the largest one. Regarding industry, activities such as chemical industry or textile have a larger part in Indian industrial added value than in most other countries. Regarding services a cross-country comparison is not straightforward. Indeed, due to discrepancies in terms of measures and reporting standards, it would not be relevant.

3. Government deficit and debt

Since Independence in 1947, India never managed to produce a government surplus. The country which has a large public sector and many subsidy policies experiences deficits and borrows large amounts in debt markets. For the fiscal year 2012-2013, subsidies accounted for 2% of Indian GDP. Main subsidies concern petroleum, food and fertilizers. The National Food Security Act of 2013 (which makes the access to food a legal right) combined with higher, more volatile commodity prices and a weakened currency have pushed subsidy expenditures higher. Moreover as mentioned earlier, the public sector is quite large in India, especially in the industrial sector; the banking sector is also largely state-owned (see Section 4). As a consequence, the deficit should be around 5.1% of GDP for the fiscal year 2013-2014.

Unsurprisingly, India's central government debt for the civil year 2013 was the largest one among the BRICS (but very close to the one of Brazil) – though BRICS figures are still lower than those of developed countries (e.g. 73% of GDP for the United States in 2013Q3). Moreover, when looking at the government net lending/borrowing for that same year, India is the country that borrowed the most in debt markets among the BRICS (see Figure 6).

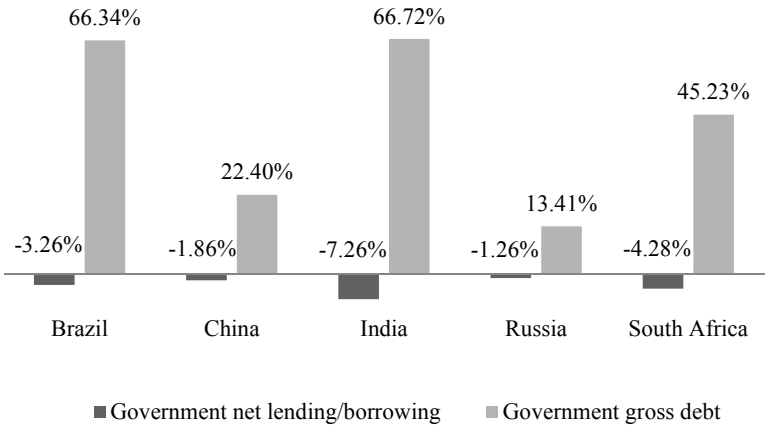


Figure 6 - 2013 BRICS Public finance figures (in % of GDP)

Source: IMF

In the early 2000's, as growth was high and financial markets were positive about India, borrowing was not an issue, since 2011 and lower growth rates, debt spiral is a real risk for the Indian economy. Indeed, debt issuances fuel both inflation and current account deficits and they deny funds to the private sector.

4. Opening to the world: changes in trade, current account and capital flows

During the 1990's, India's trade doubled. In 2001, the final remaining quantitative restrictions based on balance of payments were removed and India had at last a relatively liberal international trade framework, only some tariffs and non-tariff barriers (e.g. standards, quotas, safety regulations, etc.) were still governing imports. As a result, exports were multiplied fivefold from 2001 to 2008 and imports multiplied by almost four during the same period. Indian openness index went from less than 5% in 1980 to more than 70% in 2013 (see Figure 7).

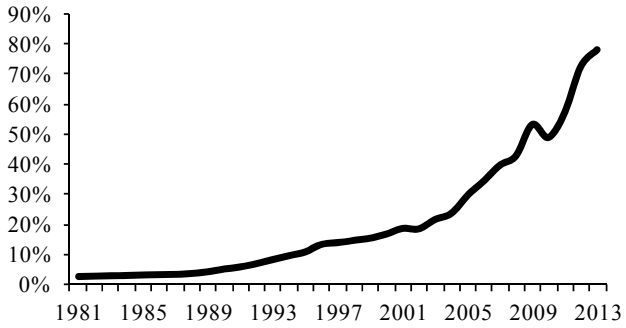


Figure 7 - India's openness index (in %)

Source : Reserve Bank of India

Economic reforms and the gradual integration of India in global trade had a significant impact on the country's balance of payments. The figures concerning trade balance and capital movements have dramatically increased. Foreign investments represented 0.1% of GDP in 1980, versus 3% of GDP in 2013. India faces current account deficits that have to be financed. In the 1980's it was mostly financed by external aid; then aid has been progressively replaced by foreign investment (see Figure 8) of witch portfolio investments represent a significant part (nearly 60% of total foreign investments in 2013).

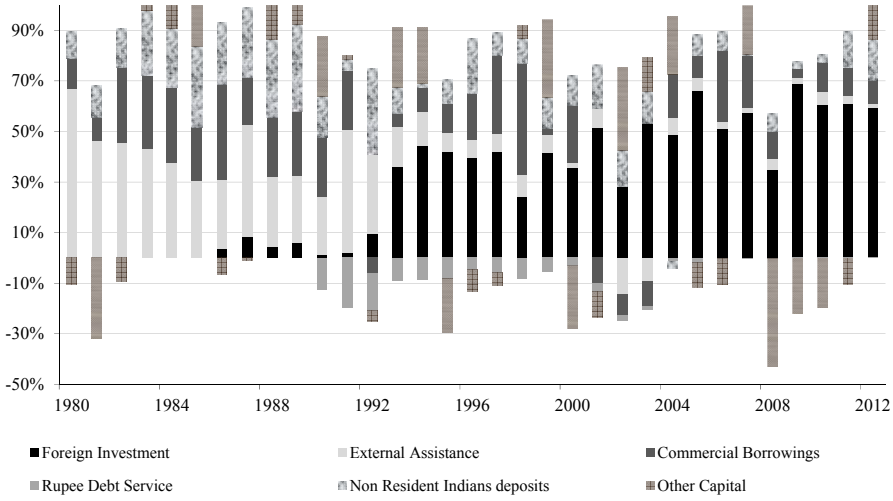


Figure 8 - Indian capital account decomposition (1980-2013)

Source: Reserve Bank of India

Regarding international capital flows, thanks to financial deregulation (see Section 3), investment flows grew from 130 million USD in 1992 to almost 55 billion USD cumulated in 2013. The Bombay Stock Exchange, founded in 1875, is a recognized financial place and helped India attract portfolio investments. Those investments grew tremendously; despite the global financial crisis, they remain at high level in India.

Among the BRICS, India and Brazil are the only countries that experienced both trade and current account deficits in 2012. South Africa had a larger current account deficit (see Figure 9). India had the worst trade deficit and even though, current account deficit was lower than trade deficit in India. Besides, Indian external deficits per GDP are larger than those of the USA in 2012 (i.e. 4.3% trade deficit and 2.3% current account deficit for the US). In terms of Foreign Direct Investments, India is with South Africa the least attractive country to foreign investors (see Figure 10), its figures were actually closer to those of advanced economies such

as the USA or Germany but that can be explained by the fact that there are still investment barriers.

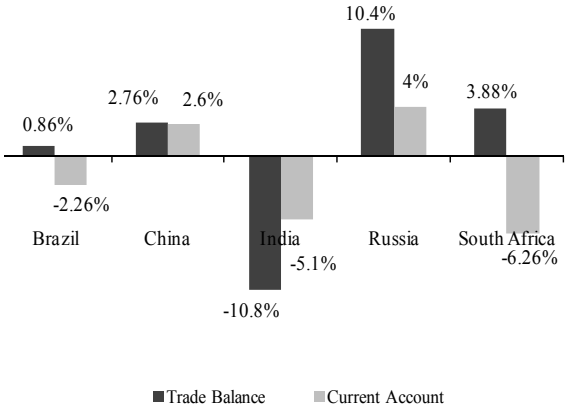


Figure 9 - 2012 BRICS exterior balances (% of GDP)

Sources: UN, World Bank

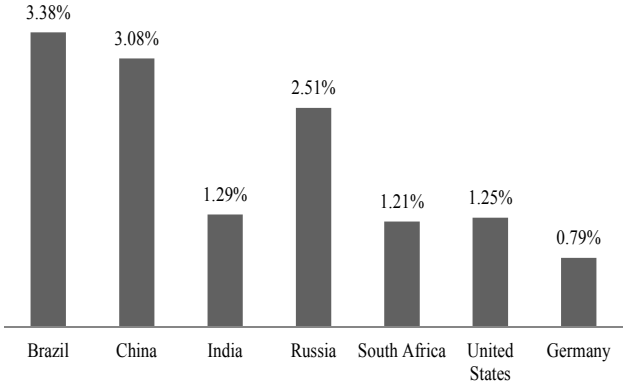


Figure 10 - 2012 FDI inflows of selected countries (% of GDP)

Sources: World Bank

5. The economy's financing

During the last decade, Indian households' savings have sharply increased. Such a phenomenon can be explained by both low social security that leads to precautionary savings and the development of the financial system. In 2012, the saving rate of Indian households was around 31%, which was lower than China's saving rate (50%) but largely above the euro area's average (13%) for instance. The sustained level of domestic savings has often been put forward as one of the key determinants of Indian growth (see Mohan 2008). The private sector also benefits from relatively high savings, which allows firms to finance investments at least partially with internal resources. Since 2005, only public firms showed intrinsic financing needs (see Table 2).

Unsurprisingly, when we observe the financing structure of non-financial firms from 2001 to 2005, the first source is auto financing which accounts on average for 45.3% of new financings (see Table 3). Traditional bank loans are only the 3rd source of financing behind alternative finance. Allen *et al.* (2012) demonstrated that access to bank or market finance are not associated with higher firm growth rates. Furthermore, Didier and Schmukler (2013) underlined that only a few firms have access to funds from capital markets. Alternative finance is an efficient funding channel in India for the corporate sector.

	2005	2006	2007	2008	2009	2010	2011	2012
Gross savings	**35.36**	**36.43**	**37.59**	**40.08**	**33.99**	**35.73**	**34.15**	**33.10**
Households	25.70	25.63	25.15	24.41	25.09	26.83	24.07	23.99
Private firms	7.15	8.18	8.56	10.24	7.87	8.71	8.29	7.72
Public sector	2.51	2.62	3.87	5.43	1.02	0.19	1.79	1.40
Investments	**10.77**	**10.73**	**10.59**	**10.58**	**10.66**	**10.77**	**10.37**	**10.50**
Households	3.74	3.70	3.64	3.57	3.71	3.76	3.72	-
Private firms	3.36	3.51	3.63	3.84	3.88	3.90	3.82	-
Public sector	3.67	3.52	3.33	3.17	3.07	3.11	2.83	-
Net savings	**24.59**	**25.70**	**26.99**	**29.50**	**23.33**	**24.96**	**23.79**	**22.61**
Households	21.96	21.93	21.51	20.83	21.39	23.07	20.36	-
Private firms	3.79	4.67	4.94	6.40	3.99	4.81	4.47	-
Public sector	-1.16	-0.90	0.54	2.27	-2.04	-2.92	-1.04	-

Table 2 - Savings and investments by type of agent (in % of GDP)

Source: Reserve Bank of India

	All firms			Large Enterprises (LE)		Small and Medium Enterprises (SME)	
	All firms	LE	SME	Listed LE	Listed LE	Listed SME	Unlisted SME
Internal sources	45.29	46.6	15.11	58.32	34.51	39.49	11.16
Market finance	6.47	5.47	9.98	8.09	2.76	24.87	7.57
Bank/FI finance	18.18	18.86	25.02	12.18	25.75	19.42	25.92
Alternative finance	30.06	29.08	49.89	21.42	36.98	16.21	55.34

Table 3 - Financing structure of non-financial firms (in % of new financings), 2001-2005

Source: *Prowess* database compiled by the Centre for Monitoring the Indian Economy[2]

These achievements have been made possible thanks to large public investments in the banking sector and the gradual liberalization of the sector from 1991 (see Section 4). Especially, the high savings rate of households is a striking figure in a country in which there is a large poor rural population and in which 77% of the population lives with less than 20 rupees per day[3]. India compares positively with other emerging economies in terms of the average population served per bank branch thanks to an active policy through the 1970s and 1980s in a view to expand rural banking and credit. Nevertheless, despite all these efforts and the development of microfinance, there is room for improvement; in 2006, 71% of the poorest rural households did not have any access to savings (Basu, 2006).

[2] CMIE is a Mumbai-based economic and business information and research organization.

[3] Arjun Sengupta Report, April 2009 (from National Commission for Enterprises in the Unorganized Sector)

III. STRENGTHS AND WEAKNESSES OF THE INDIAN ECONOMY

1. Reasons for concern

In the following section, the paper outlines the challenges and the risks faced by the Indian economy:

- *Stagflation:* Inflation was still around 9.50% in 2013 while output growth was slowing down. There are rising concerns on the sustainability of Indian growth and the ability of the Reserve Bank to contain price surges.
- *Fiscal troubles*: Authorities have been experiencing troubles to control government deficit. Many experts are worried that they would use cosmetic measures such as postponing recognition of expenditures or compensation of public firms. Moreover, public banks and firms are being compelled to buy government bonds. This pushes private firms to resort to foreign funding and increases pressures on current account deficits.
- *Corporate debt and credit defaults*: The corporate sector is under pressure with rising debt levels while earnings and profitability remain stable. As a result, interest coverage ratios are under a lot of stress, at a low 1.4[4]. Moreover, 40% to 70% of corporate loans are denominated in foreign currency and a recent survey by Fitch Ratings revealed that a majority of firms with exchange rate exposure did not follow hedging strategies, endangering further earnings and debt reimbursements. These risks are being transmitted to the financial sector: gross NPA are increasing in banks' balance sheets. It accounted for about 3.6% of bank assets in December 2013.
- *Poor infrastructures*: In critical sectors such as energy, transportation or utilities, there are important shortages stemming mostly from underinvestment from public firms. Public education performs quite poorly at basic education and literacy; the overall literacy rate is of 66% in India, compared for instance with 93% in China. The capacity of universities is also an issue as many forecasts that the country will lack of skilled labour force.
- *Poor governance and political atrophy*: Decision making is slow in India, bureaucracy is cumbersome. Political paralysis is an impediment to growth and development;

[4] Credit Suisse « House of Debt », Report August 2013

successive government coalitions have failed to reach agreements on labour reforms, tax reforms etc… Corruption remains also an issue among the political class.

2. Why is there room for optimism?

Besides these issues and concerns, there is room for optimism regarding the future of Indian economy:

- *Strong fundamentals:* India has been feeding its population for years now; the country has large natural resources. As mentioned in Section 2, Indian households' savings rate is still high. The foreign currency reserves at the end of 2013 were sufficient to cover more than 6 months of imports. About 300 million USD for India, which is comparable to Brazil and Russia (360 and 470 million USD respectively) but far away from China (4 billion USD). South Africa has the smallest reserves among the BRICS with 50 millions.
- *A large fiscal basis:* A large part of the Indian economy is informal and cash-based. Small firms often remain out of sight of the taxman. According to Oxus Investment[5], only 2.5% of Indians pay income tax. Much improvement can be made regarding tax collection and fiscal policy. The central government is examining a Goods and Services Tax (GST) in order to put an end to the diversity of tax rates amid states.
- *Currency effect:* In the medium term, the fall of the Indian Rupee may help the manufacturing sector to gain competitiveness and boost exports.
- *The appointment of Raghuram Rajan* who became the 23rd governor of the Reserve Bank of India in August 2013. Raghuram Rajan, an economist of great renown, and a former chief economist of the IMF, benefits from a strong experience as an academic and a policy maker. He revived market confidence towards the Reserve Bank.
- *Demographic dividend:* By 2020, India will become the largest country in the world. In 2013, India was the 2nd largest country, behind China. Approximately 200 million Indians were aged between 15 and 24; which represents Brazil's population. The country can benefit from this growing population of working age if it manages demand and supply of labour and improves access to education and food. Also,

[5] Oxus Investment is an asset manager based in Mumbai.

population is starting to ageing and the country will have to face issues such as pension and medical care.

- *Skilled workers:* Despite poor performances at basic education, India invested quite massively in higher education after 1947. As a result, India's intellectual, technical and engineering skills are very high. In a globalized economy with modern technology, the country is likely to benefit from a global labour market.

IV. INDIA: SHIFTING TOWARDS A COMPLETE AND INTEGRATED FINANCIAL SYSTEM

Economic theory has stressed the key role of a functional banking system and the need for emerging countries to get one. Banks help collect and diffuse savings thus contributing to economic growth. They operate a qualitative transformation of assets (Gurley and Shaw 1960) as they bear solvency and liquidity risks and transform maturity and quality of assets. Furthermore financial intermediaries monitor risks on behalf of their clients (Diamond 1984, Diamond and Dybvig 1983). Also, implementing a banking system allows a country to benefit from a reliable payment system and to estimate fiscal revenues. I will cover the development of both banking system and financial markets in India in this section.

1. Bank nationalization in 1969

In the 1950's the Indian banking system was relatively free: many private actors, low control, low reserve requirements, etc. However, the system was not efficient. The need of an efficient banking system was becoming more and more pressing in order to support the country's development. The government decided to tackle this issue by the socialist way. During the 1960's the control on banks was reinforced so that available funds are lent to priority sectors (agriculture and industry). Furthermore, India was essentially a rural country and the authorities wanted to establish bank agencies in rural areas so that everyone could have an access to banking services. Following such a path, India nationalised the majority of banks in two steps: the first one, took place in 1969 when the government took control of the fourteen largest banks of the country; the second step, was taken in 1980 to complete the process. Consequently, at that date, public banks accounted for 90% of total assets owned by the banking sector. Furthermore, interest rates were controlled by the government, loans are

planned. India was in a typical situation of financial repression à la McKinnon (1973) and Shaw (1973).

The result of that policy is contrasted. On the one hand, between 1969 and 1980 the number of bank agencies has been multiplied by nine (Mohan 2005) and deposits volumes went from 35 billion rupees to almost 430 billion rupees in the same period. On the other hand, banks contributed to the rising inflation and have seen a concerning increasing in non-performing loans.

2. The Reserve Bank of India (RBI): a key player in the reform process

According to the Reserve Bank of India Act of 1934, the Central bank has for mission to "guaranty monetary stability". In a strict sense, one could interpret this aim as price stability. In larger terms however, this could also include exchange rate policy and financial system stability. Besides the different possible interpretations, the RBI recognizes as its mission: (i) ensuring price stability, (ii) facilitating credit access to productive activities in order to sustain growth and (iii) guarantying financial stability. RBI is also in charge of bank and financial markets regulation and supervision since the Banking Regulation Act of 1949.

In order to fulfil its targets, the RBI uses the following instruments:

- Bank rate: lending interest rate charged by the institution to commercial banks
- Repo rate: interest charged for a collateralized loan to a financial intermediary
- Reverse repo rate: interest paid for a collateralized loan from a financial intermediary
- Cash reserve ratio (CRR): mandatory reserve rate. Fluctuates between 3% and 15%
- Statutory liquidity ratio (SLR): reserve rate that forces banks to put in reserve liquid assets (cash, bonds, gold, etc.)

The Reserve Bank also has a wide range of administrative instruments in order to control credit growth and allocation. Bank regulation framework is presented in Table 4.

Competition restriction	Interest Rate controls Restrictions on business areas Restrictions on bank mergers Market-entry restrictions Restrictions on non-price competitions Restrictions on international transactions
Prudential regulations	Balance sheet ratio regulations Asset valuation rules Transaction regulations
Safety nets	Deposit Insurance Scheme Bailout plans
Development of financial infrastructure	Information disclosure Supervisory regimes

Table 4 - Bank regulation framework

Source: Shimizu (2010)

The RBI is also in charge of managing government debt in liaison with the Ministry of Finance and is responsible of the stability of the local currency. The institution holds an essential part in the liberalization process. It managed the gradual lowering of mandatory reserve ratios and softening of banking regulation. The RBI would also become a major actor in the Indian monetary market.

3. Banking deregulation process from 1991

The poor returns on assets (RoA) of public banks and the rising non-performing assets (NPA) in the banking industry led the authorities to reconsider their policy. Several expert comities are formed in order to come up with recommendations and solutions to improve the sector. The most important ones were the Chakravarty (1985), Narasimham I (1992) and Narasimham II (1998) committees. Their main recommendations, which would be implemented by the government, were to:

- Reduce external constraints on banks: liberalization of interest rates, gradual lowering of CRR and SLR, etc.
- Lower state participation: many public banks also have private shareholders now, etc.
- Improve efficiency by introducing more competition: Since 1993, twelve new banks have been created. Foreign investors can own up to 74% a bank operating in India
- Reinforce regulatory framework

The impact of this policy is largely positive; the RoA of Indian commercial banks is of 1.1% in 2012 (see Figure 11). Before the subprime crisis, banks' RoA fluctuated between

0.9% and 1.5% around the globe; which shows the step forward made by the Indian banking industry. NPA in banks' balance sheets went from 14.4% in 1998 to around 3% in 2012 according to the RBI (see Figure 12). The savings collection that was on a lowering trend in 1990 is growing steadily. Furthermore, between 1979 and 2009, banks' balance sheets grew on average at 17.7% per year. In public banks, turnover by employee has doubled between 1999 and 2004. Also, the last decade saw the creation and rise of new financial intermediaries such a private pensions funds, mutual funds, etc.

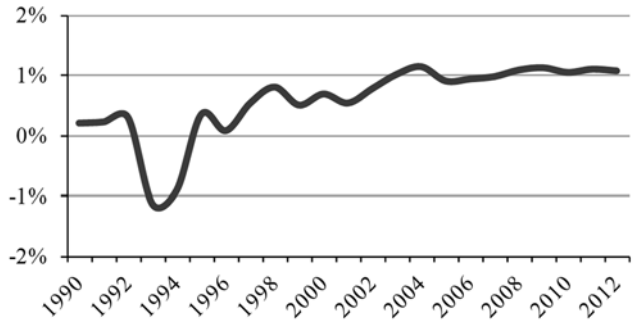


Figure 11 - Evolution of Indian Banks' RoA (in %)

Source: Reserve Bank of India

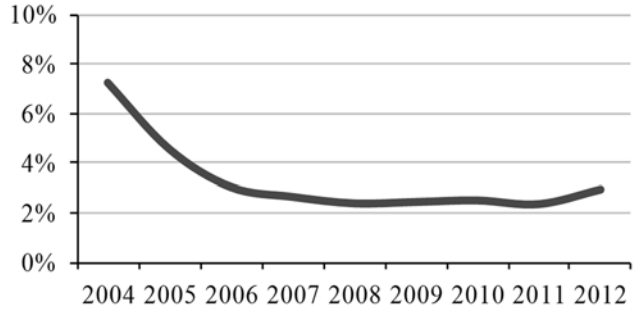


Figure 12 - Evolution of Indian Banks' NPA

Source: Reserve Bank of India

4. The rise of financial markets

The financial markets-economic growth nexus has been studied both theoretically and empirically across countries on various levels (Levine, 1991; Levine and Zevos, 1995 and Demirgue-Kunt, 1994 among others). They have suggested that financial market development affect economic growth in developing countries. Indian authorities considered financial markets as a key instrument to boost economic growth, and reforming them was part of the overall financial system reform. With growing savings, new financial intermediaries, increasing global integration, developing financial markets was a necessary step for Indian financial structure. Unlike other developing countries, India chose to liberalize markets gradually; an approach that allowed the country to avoid the fallout of the 1997 Asian crisis. Stock markets, monetary markets, debt markets and forex markets were, and still are being progressively deregulated.

The monetary market began to be liberalized when interest rates were deregulated in the 1990's. Progressively non-banking financial institutions were admitted into the market and

new products allowed to be issued (Treasury bills, certificates, etc.). In 2000 the Liquidity Adjustment Facility (LAF) was set up and allowed repo operations supervised and cleared by the RBI. Since then, the collaterized segment of the market rose considerably.

The sovereign debt market has also known some tremendous change in the last couple of decades. In 1997, the government gave up on ad hoc issues and since 2006 the Reserve Bank cannot subscribe to primary issues. Indian government like in many developed countries use an auction system to issue its debt securities. Such a step was crucial for the development of an efficient debt market as it allowed investor to have access to a key piece of information: the Indian risk-free rate. One also has to mention that more private actors are subscribing to government issues as pressures on banks and the Reserve Bank were relieved.

Before 1993, India had a fixed exchange rate policy. In 1994, the rupee became convertible for current transactions and the exchange rate policy became flexible. Full convertibility is still on the agenda of authorities, who are attached to gradualism and do not move forward so rapidly. The first set of decisions made possible the growth of the forex market. The introduction of new products such as futures, swaps and options also contributed to boost the market. Between 1998 and 2007, the volume of the market was multiplied fivefold; it represents today six times the balance of payment of India.

Even though the Bombay Stock Exchange was founded in 1875, it has started to be liberalized only in 1988 when the government created the Securities and Exchange Board of India which was in charge of regulating and leading the stock market reforms. Stock market began its dematerialization in the 1990's; it has progressively opened to new investors (Foreign Institutional Investors, mutual funds, etc.) and to new products (convertible, priority shares, derivatives, etc.). The stock market boom that followed the initial liberalization reforms of the early 1990s draw attentions of researchers. Singh and Weisse (1998), among others, contributed to the literature providing policy recommendations in order to optimize the role of stock markets in long-term development. Since 1995, India has become the second country in terms of number of active investors. Trading volumes went from 36 billion rupees in 1991 to 1000 billion rupees in 2012 according to the RBI, stock market capitalization-to-GDP ratio have also been almost constantly increasing.

The BRICS countries started a liberalization process of their financial markets during the 1990's. Brazil and Russia liberalized their markets in 1991, South Africa in 1996. China had a more ambiguous position as Chinese firms benefited from the Hong Kong Stock Exchange,

and then in 2002 the Shanghai Stock Exchange has been liberalized. In 2012, Stock Market Capitalization to GDP ratio was of 68.6% in India, way behind South Africa 159.2% but in front of Russia and China. In terms of traded volumes, India is in last position (see Figures 13 and 14). For comparison purposes, one can note that India's ratio is greater than Germany's (43.4%) but smaller than the USA's (115%) or the United Kingdom (122%).

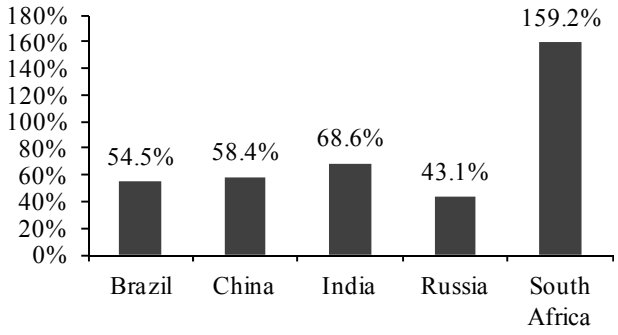


Figure 13 - 2012 BRICS stock market capitalisation (% of GDP)

Source: World Bank

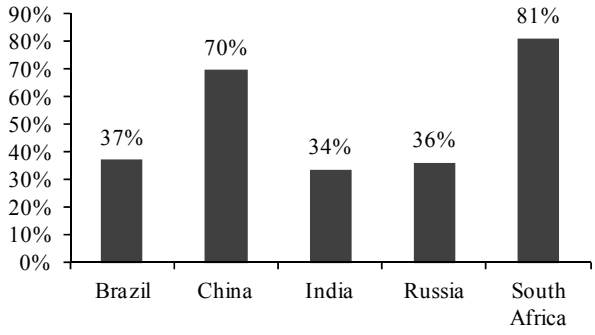


Figure 14 - 2012 BRICS stocks market traded volume 2012, (% of GDP)

Source: World Bank

V. FINANCIAL INTEGRATION: WHAT ABOUT INDIAN STOCK MARKETS?

Financial integration is a phenomenon linking closely together financial markets. It can take several forms: larger capital flows, information/technology sharing etc. Benefits of integrated financial markets include better capital allocation, better corporate governance, better risk-sharing and higher investments (see Obstfeld 1994, Levine 2001, Kose et al. 2006 among others). There are also undesirable effects stemming from integration such as increased vulnerability to external shocks (see for instance Stiglitz 2002, Bekaert et al. 2002).

In order to understand the current situation of Indian financial markets, the paper assess India's financial integration within the global market. To do so, it examines the linkage between the S&P Bombay Stock Exchange Sensitive Index (Sensex) and the Standard & Poor's 500 Index (S&P 500) which is widely considered as a global leading stock index. There are many ways to assess financial integration, cointegration methods (Kasa 1992, Richard 1995), Multivariate Generalized Autoregressive Conditional Heteroscedasticity (MGARCH) models (e.g. Booth et al. 1997), among others. As cointegration methods require theoretical backgrounds, the paper chooses to develop a model based on the time-varying dynamical properties of the endogenous variables.

1. Data and model framework

The sample goes from July, 1st 1997 (i.e. the inception of the Sensex) to September, 30th 2013. Closing prices have been downloaded from the Yahoo finance website. Computation of daily log-returns for both indexes has been done (RSENSEX and RSP respectively for the Sensex and the S&P 500). The empirical distributions display both excess leptokurtosis and negative skewness with respect to the normal distribution. Unit root tests (ADF and KPSS) confirm that the returns are stationary and the Engle (1983) LM test for the presence of ARCH effects reveals heteroscedasticity in both series; which can comfort the GARCH approach.

Since 1982, GARCH models have been widely used for financial modelling, to specify returns conditional variance. The initial specifications have been greatly improved and extended to allow specifying more particular patterns in the conditional variance process. Frequently, GARCH models are also associated with ARIMAX models to take into account the mean conditional process in the return series and/or in exogenous variables. Finally, MGARCH models extend the ARMA-GARCH models to a multivariate framework. The Dynamic Conditional Correlation (DCC) model, by Engle (2002) and Tse and Tsui (2002), is among the most useful MGARCH models. One of the main advantage of a DCC framework is that it allows the time-dependency of all the second order moments. In fact, it allows us to treat the dynamic correlations like the dynamic variances. In other words, the dynamic correlations can be decomposed exactly like the dynamic variances. In addition, it is possible to add in this framework some additional assumptions regarding the distribution of the error terms.

We carry out a bivariate model to catch the individual and the joint dynamics of the Sensex and S&P 500 returns (both for conditional means and conditional variance-covariance matrix) and how it evolves across time. The specification that we use here corresponds with the general VAR (X)-GARCH(P,Q)-DCC(M,N) model is specified as follows:

$$
\begin{cases}
RSENSEX_t = \theta_{1,0} + \sum_{x=1}^{X} \theta_{1,x} RSENSEX_{t-x} + \sum_{x=1}^{X} \varphi_{1,x} RSP_{t-x} + \varepsilon_{1,t} \\
RSP_t = \theta_{2,0} + \sum_{x=1}^{X} \theta_{2,x} RSP_{t-x} + \sum_{x=1}^{X} \varphi_{2,x} RSENSEX_{t-x} + \varepsilon_{2,t} \\
\varepsilon_{1,t} = h_{1,t} v_{1,t} \\
\varepsilon_{2,t} = h_{2,t} v_{2,t} \\
h_{1,t} = \alpha_{1,0} + \sum_{p=1}^{P} \alpha_{1,p} {\varepsilon^2}_{1,t-p} + \sum_{q=1}^{Q} \beta_{1,q} h_{1,t-q} \\
h_{2,t} = \alpha_{2,0} + \sum_{p=1}^{P} \alpha_{2,p} {\varepsilon^2}_{2,t-p} + \sum_{q=1}^{Q} \beta_{2,q} h_{2,t-q} \\
H_t = D_t P_t D_t \\
P_t = diag(Q_t)^{-1/2} Q_t diag(Q_t)^{-1/2} \\
Q_t = \left(1 - \sum_{m=1}^{M} a_m - \sum_{n=1}^{N} b_n\right) S + \sum_{m=1}^{M} a_m \, \varepsilon_{t-1} {\varepsilon'}_{t-1} + \sum_{n=1}^{N} b_n \, Q_{t-1}
\end{cases}
$$

Where, θ_{ij} and φ_{ij} are the parameters of the factors included in the VAR;

α_{ij} and β_{ij} are the parameters of the ARCH and GARCH terms in the variance equations, respectively.

$\varepsilon_{1,t}$ and $\varepsilon_{2,t}$ are the vector of residual returns of Sensex and S&P 500 respectively

$v_t = [v_{1,t}, v_{2,t}]$ is a vector of error terms following the student-*t* distribution such that $E[v_t] = 0$ and $E[v_t v_t^T] = I$.

H_t is a 2×2 conditional variance covariance matrix

$D_t = \text{diag}(h_{1,t}, h_{2,t})$ is diagonal matrix of conditional standard deviations of $\varepsilon_{1,t}$ and $\varepsilon_{2,t}$ at time t

P_t is the positive definite conditional correlation matrix

Q_t is a dynamic matrix representing the correlation structure, with Q_0 positive definite.

S is an unconditional correlation matrix of the standardized residuals $\varepsilon_t = (\varepsilon_{1t}, \varepsilon_{2t})$.

Parameters a_m et b_n satisfy $a_m \in \mathbb{R}^+, b_n \in \mathbb{R}^+$ and for $i = 1, \ldots, \max(m, n)$: $a_i + b_i < 1$.

2. Estimation and results

We specify a DCC(1,1) framework. To be more precise, our approach is an VAR(1)-DCC(1,1)-GARCH(1,1). As the standard criteria lead to this selection of the lags. The model is estimated using a two-step maximum likelihood procedure. The results show that the Sensex does not impact the S&P500 ($\varphi_{2,1}$ is not significant) whereas the S&P 500 positively impacts the Sensex. In fact, $\varphi_{1,1}$is significant ; in addition, it is the largest coefficient in our regression (see Table 5). These findings seem to support that Indian stock markets are integrated but do not have a leading role or an influence on a major stock index like the S&P 500.

		Estimate	Std.Error	t-value	Pr(>|t|)
Univariate estimates	$\theta_{1,0}$	ε***	0.00	-4.53	0.00
	$\theta_{1,1}$	0.04**	0.02	2.28	0.02
	$\varphi_{1,1}$	0.22***	0.02	10.48	0.00
	$\theta_{2,0}$	ε***	0.00	-4.45	0.00
	$\theta_{2,1}$	-0.06***	0.02	-4.08	0.00
	$\varphi_{2,1}$	ε	0.01	-0.15	0.88
DCC estimates	$\alpha_{1,0}$	ε***	0.00	3.76	0.00
	$\alpha_{1,1}$	0.11***	0.01	7.59	0.00
	$\beta_{1,1}$	0.88***	0.02	57.19	0.00
	$\alpha_{2,0}$	ε***	0.00	3.25	0.00
	$\alpha_{2,1}$	0.08***	0.01	7.17	0.00
	$\beta_{2,1}$	0.91***	0.01	78.17	0.00
	dcc, alpha	ε**	0.00	1.97	0.05
	dcc, beta	0.99***	0.00	316.32	0.00
Test ARCH(10)			**p value =**	**0.00**	

Table 5 - Estimation results of the AR(1)-DCC(1,1)-GARCH(1,1) model

All coefficients for the DCC estimates are positive and one note that $\alpha_{1,1} + \beta_{1,1} < 1$ and $\alpha_{2,1} + \beta_{2,1} < 1$, meaning that conditional variances are stationary and residuals from the fitted model are homoscedastic.

The results indicate that overall, correlation between the Sensex and the S&P 500 grew overtime from 1997 to 2013 (see Figure 15). It is interesting to observe that at the beginning of the financial crisis, correlation grew stronger. US economy and financial markets seemed to be on the way of recovery by 2013, on the other hand, Indian financial markets have had a few swings in the recent years without clear directional trend as the economic situation raised

and still raises a lot of questions (see Section 5). Nevertheless correlation between both financial indices remained quite stable, at a much higher level than before 2008. This result suggests that financial liberalization and integration is also a frailty as correlation increased and remained high during economic turmoil.



Figure 15 - Dynamic conditional correlation between Sensex and S&P 500 indices

VI. CONCLUSION

India was a fast growing economy in the second half of the 20th century. Because of underinvestment, lack of openness and administrative rigidities among other reasons, the economy slipped in the 1960's and 1970's. The country started reforming its economy in the 1980's, but liberalization was not controlled and eventually India experienced a major current account crisis in 1991. In the aftermath of such a crisis, India engaged a gradual and controlled liberalization process. It achieved sustained growth and contained inflation during 20 years. The economy opened to the rest of the world, became less dependent to foreign aid and the service sector developed tremendously, transforming radically the economic structure of the country. In the early stages of the global crisis in 2008, India set up a fiscal stimulus package and performed quite well. Nevertheless, since 2011 growth pace has been slowing down, inflation has been at very high levels and many observers and investors have been concerned by the economic outlook of the country. This paper listed the current issues faced by India and also pinpointed the reasons for being optimistic about the future (strong fundamentals, fiscal basis, demographic dividend etc…). To complement the analysis, this study provided an overlook of the development and integration of India's financial system, which played a pivotal role in the liberalisation process and the recent achievements of the economy. Furthermore, it implemented an econometric study to observe the financial integration process for a particular market, i.e. stock market. Within a VAR(1)-DCC(1,1)-GARCH(1,1) framework, the results show growing correlation between Indian and US stock markets. Especially, correlation has been greater since 2008. Such result reveals that financial integration is also a source a frailty for Indian financial markets.

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Appendices

Appendix A – Standard Statistics of Estimated Models

	mGARCH(1,1)	mGARCH(2,1)	mGARCH(1,2)	mGARCH(2,2)	mGARCH(3,1)	mGARCH(1,3)	mGARCH(3,2)	mGARCH(2,3)	mGARCH(3,3)
Log-Likelihood	23367.4	23375.57	23367.24	23380.51	23376.49	23367.08	23381.49	23380.47	23383.52
AIC	-11.935	-11.938	-11.934	-11.939	-11.937	-11.933	-11.939	-11.938	-11.939
BIC	-11.908	-11.907	-11.903	-11.906	-11.904	-11.899	-11.902	-11.902	-11.899

mGARCH(p,q) stands for AR(1)-DCC(1,1)-GARCH(p,q)

CHAPTER 2

DETERMINANTS OF BRICS CDS SPREADS IN A MARKOV-SWITCHING FRAMEWORK

By Kuhanathan ANO SUJITHAN[†]

Abstract *– Based on the standard theoretical framework, we analyze the BRICS CDS spreads over the period from January 2002 to September 2013. We identify the main drivers of their dynamics which display regime-specific behavior. Overall, using Markov-switching models, we detect two regimes for these spreads; each regime is influenced by both financial and real factors. Lastly, the euro area financial markets indicators play a key role in the dynamics of BRICS CDS spreads. These results are robust and consistent with some changes in the benchmark models*

JEL classification: C13, G12, G15

Keywords: Credit default swap (CDS), BRICS, euro area financial markets factors, Markov-switching model

(†) This chapter is part from a joint work with Sanvi AVOUYI-DOVI. I would like to thank him for allowing it to be part of the thesis.

Credit default swaps (CDS) are financial instruments for hedging and trading credit risks. They are insurance contracts offering protection against the default of a debt issuer, corporate or sovereign. Basically, the buyer of a CDS on a certain entity pays the seller an annuity premium, defined as a percentage on the notional hedged i.e. the CDS spreads. More precisely, CDS spreads are quoted in basis points representing the percentage cost per year of the protection subscribed. So, a spread of 100 represents 1 percent of the face value of the investment, and is the price paid to transfer the risk on the investment to the insurer. If there is a credit event, which means that the entity fails to meet its debt obligation, it triggers the settlement of the contract.

Like most CDS contracts, sovereign CDS contracts are not only insurance instruments but also trading instruments. Investors use them for hedging macro risks, but also for arbitrage trading, relative-value trading or for pure speculative trading on spreads. In addition, sovereign CDS represent one of the most liquid, highly rated and dynamic segments of the CDS market.

Our paper is related to the strand of literature on the pricing and determinants of CDS. It complements and extends the body of work based on the seminal paper by Merton (1974) and on more recent papers by Longstaff et al. (2011) and Fender et al. (2012) or Chan and Marsden (2014). We aim to explore the relations between the BRICS CDS spreads and the financial risk factors, especially those of the euro area. In other words, the main questions addressed in this paper are: “What are the main drivers for the BRICS spreads?” and “Are the euro area risk factors more relevant than the US ones to explain the BRICS spreads?”. We use a Markov-switching model including macroeconomic explanatory factors in order to deal with the different phases of the dynamics of CDS spreads. Our approach is similar to that implemented by Chan and Marsden (2014) or Alexander and Kaeck (2008). Chan and Marsden investigated Markov-switching models in order to analyze the influence of economic and financial factors on North American investment-grade and high-yield CDS indices.

Our approach differs from the previous ones, as it concerns the BRICS sovereign CDS spreads. It especially focuses on the euro area risk factors to explain these spreads (Ang and Longstaff, 2013); it also includes the entire recent turmoil period. It is completed by numerous sensitivity analyses including a comparison between the euro area-based model and the US-based model. Besides, the empirical analysis is performed with monthly data (over the

period running from January 2002 to September 2013) in order to allow for the introduction of both financial and macroeconomic factors.

Our paper intends to improve the understanding of the dynamics of the BRICS CDS spreads especially over the period including the recent financial crises. It also contributes to the strand of the literature which relates the CDS spreads changes to the aggregate domestic (country-specific) and global factors in a nonlinear framework. Lastly, it highlights the links between the BRICS CDS spreads and the euro area factors by distinguishing the effects of the determinants in each regime. One of the practical implications of this study is that investors can have a better understanding of the dynamics of BRICS sovereign CDS spreads in order to improve the management of their positions. From a policy-maker perspective, our findings can enhance governments' monitoring of the factors that impact the risks perceived by financial markets.

The remainder of the paper is organized as follows. Section I briefly reviews the theoretical background of the model. Section II discusses the methodological basis of the approach used in this paper and it also presents the model. Section III describes the development of sovereign CDS in the BRICS countries and gives data and some basic descriptive statistics. Section IV provides the empirical results. Section V discusses the economic relevance and robustness of the results. Section IV addresses the main conclusions.

I. THEORETICAL BACKGROUND

We aim to provide a guideline of the selection of the potential explanatory factors used in the model below. This guideline is based on certain theoretical papers including Merton's seminal work. Besides, the results of Blanco et al. (2005) (see also Duffie, 1999 and Hull et al., 2004) support the theoretical equivalence of CDS prices and credit spreads. Therefore, we can use the theory related to credit spreads to explain CDS prices or spreads.

Overall, researchers have two main approaches to model credit spreads and CDS or more generally, credit derivative prices. The first one, the intensity-based approach, establishes the relation between credit risk and hazard rates but the determinants of the credit risk are not theoretically founded. The second one is the structural approach drawn from Merton's seminal work. Here, the prices of defaultable securities are related to the losses or the economic determinants of financial distress regarding the firm. Basically, Merton's structural

approach involves modeling the processes that govern firm value and the default threshold associated with the firm.

However, regarding the micro determinants of credit spreads, the empirical results based on the structural model are unclear. On the one hand, the findings of Ericsson et al. (2009), and Zhang et al. (2009), among others, confirm the main conclusions of Merton concerning the determinants of credit spreads. For example, Ericsson et al. (2009) found that the swap spreads are related to the firm leverage factor and volatility whereas Zhang et al. (2009) highlighted the robustness of the relationship between CDS spreads, equity long run historical volatility and risk on individual firms. On the other hand, the firm-level factors do not play a significant role in the dynamics of credit spreads in the work of Collin-Dufresne et al. (2001). To be more precise, Collin-Dufresne et al. mentioned that the spread changes in corporate bonds are significantly driven by supply and demand shocks. The characteristics of the impact of micro variables are still questionable.

In this paper, we focus on the structural approach and its extensions. Broadly speaking, in these approaches, any factors that drive changes in the firm value and/or the default threshold are, theoretically, determinants of changes in the credit spreads. In order to ease the comparison between the countries under review and due to the availability of the data, we focus exclusively on the examination of the effects of macroeconomic and financial factors on the CDS spreads. Many aggregate structural factors are exhibited in the theoretical and empirical literature regarding the changes in the credit spreads dynamics. Some proxies of general economic conditions (business cycle, changes in GDP growth, inflation, commodity prices, government balance, foreign reserve, trade balance, exchange rate, etc.) which govern the situation of firms are the fundamental determinants of credit spreads in structural models (Wu and Zhang, 2008; Tang and Yan, 2010; Annaert et al., 2013). The sectoral and global risk factors (sector-wide risk at industry-level, economy-wide risk indicator, or GDP growth volatility, etc.) often intervene as main explanatory variables in structural models of CDS spreads (Ericsson and Renault, 2006; Bhansali et al., 2008; Tang and Yan, 2010). Firm leverage and liquidity factors also appear as fundamental determinants in this approach (Bongaerts et al., 2011). Bongaerts et al., for example, found that CDS spreads are highly correlated to expected liquidity. Some factors related to firms' activity or describing their health are often considered as strong determinants of CDS spreads (high yields markets, etc.).

For example, the spot rate is one of the key factors in structural models of credit spreads. Longstaff et al. (2011) showed that credit spreads and risk free rate are negatively correlated. More specifically, they mentioned that sovereign risk premium for emerging countries is mainly linked to global factors and particularly to US factors. The characteristics of equity markets are often considered like relevant explanatory factors in the structural models (Alexander and Kaeck, 2008). The return on equity markets is a proxy of business conditions. It is a measure of uncertainty (related to the real activity) which can negatively impact the firm's health. In a specific country, a firm can be affected by domestic and global equity markets performances. Implied volatility is also a good candidate for describing the dynamics of equity market in structural models. It should be positively correlated to credit spread.

Explanatory factors	Expected sign
Corporate Yield	+
Forex Reserves	-
Government Balance	-
Stock Mkt. (return) Local Global (euro, USA)	 - (Longstaff *et al.* 2011) + (Fender *et al.* 2012, during the crisis period)
Implied Volatility	+
Sector-wide risk	-
Economy-wide risk	-
Slope of term structure	-
Economic conditions (GDP growth, inflation etc…)	-
Liquidity	-
Trade Balance	-
Vstoxx	-
Exchange Rate	+
Commodity Price	-

Table 1 - Expected effects of certain determinants of CDS

Source: authors' synthesis

Table 1 reports the expected signs of some fundamental determinants of CDS spreads. Certain factors are not ambiguously related to CDS spreads whereas the effect of others is undetermined or ambiguous, due to information carried by these factors. For example, certain factors could display the opposite effects from one regime to another one.

It is worth noting that there are relatively few papers devoted to the analysis of dynamics of sovereign CDS. However Edwards (1986), Duffie *et al.* (2003) and Zhang (2008), for example, have specifically focused on the determinants of sovereign credit spreads. In addition, in line with the structural models, some papers particularly showed that sovereign credit spreads are strongly influenced by global factors, particularly factors emanating from the US (Pan and Singleton, 2008; Longstaff *et al.*, 2011; Ang and Longstaff, 2013). Pan and Singleton (2008) showed that credit spreads for some emerging countries are strongly related to the implied volatility of US stock markets. Longstaff *et al.* (2011) used a theoretical model to decompose spreads into expected loss and risk premium. They noticed that sovereign risk premium for emerging countries is mainly linked to global factors and particularly to US factors. More accurately, Longstaff *et al.* showed that sovereign risk premium can be explained by US stock market and high yield markets. In the same vein, Remolona *et al.* (2008) also adopted the same decomposition of the CDS spreads. They showed that the expected loss is linked to country-specific factors and market liquidity, whereas the risk premium is driven by global investors' risk aversion. In addition, Fender *et al.* (2012) found that shifts in emerging countries' sovereign CDS spreads were mostly related to global and regional factors.

II. MODEL SPECIFICATION

1. Methodological justification of the multi-regime approach

Here we justify the relevance of Markov-switching approach by providing a relatively simple framework which allows us to distinguish two separate states in the dynamics of CDS spreads. Basing their work on the findings of Jeanne and Masson (2000), Blommestein and Eijffinger (2012) showed how a theoretical relationship between the sovereign CDS spreads and its explanatory factors could be derived. They also demonstrated that the derived relationship could be broken into $k$different relations, each of them corresponding to one state of the market. In other words, the dynamics of the CDS spreads could be described by a Markov-switching process. Indeed, under some specific assumptions, the probability of default (d_t) can be defined by:

$$d_t = \sum_{s=1}^{n} q(s_t, s) F(f_t, f_s^*) \quad (Eq.i)$$

Where:

- f_t is an index of economic fundamentals at date t;

- f_s^* is a the critical value of the index under the state s;

- $F(f_t, f_s^*) = Prob[f_{t+1} < f_s^* / f_t]$;

- $q(s_t, s)$ is the transition probability from current state, s_t at date t, to state s, $1 \leq s \leq k$, at date $t+1$.

Some additional assumptions are needed in order to derive the relationship between the sovereign CDS spreads and its fundamental determinants:

The fundamental index is assumed to be a linear function of some macroeconomic variables (mv_t) (Jeanne and Masson, 2000; Blommestein and Eijffinger, 2012). In other words, the index could be defined as follows: $f_t = \alpha^T mv_t$ (mv_t is a matrix of macroeconomic fundamentals, α^T is a transpose vector of scalars. Under this first assumption, Jeanne and Masson showed that the probability of default can be re-written as follows: $d_t = \partial_{s_t} + \varphi^T mv_t$ (*Eq.*ii) (where only the intercept of this equation is state-dependent and the slope of the regression is constant across the state).

The second hypothesis is that CDS spreads vary under the rational expectation assumption. Under this assumption, it could be demonstrated that the sovereign CDS spreads are determined by the probability of default and additional macroeconomic variables not included in mv_t. In this respect, the linear version of the equation of the sovereign CDS spreads, is as follows: $CDS_t = \gamma + \theta d_t + \mu^T omv_t$ $(Eq.iii)$ (where γ is the intercept of the equation, θ is an unknown parameter, μ^T is a transpose vector of scalars, and omv_t is a matrix of a set of macroeconomic factors different from those contained in mv_t). Replacing the probability of default in (*Eq. iii*) by its expression defined by (*Eq. ii*) leads to: $CDS_t = \beta_{s_t} + \tau mv_t + \mu^T omv_t$ $(Eq.iv)$ (where the intercept $\beta_{s_t} = \gamma + \theta \partial_{s_t}$ is state-dependent and the slope $\tau = \theta \varphi^T$ is neither time-dependent nor state-dependent). In other words, the sovereign CDS spreads model is assimilated to a Markov-switching model in which the intercept changes across the states.

Blommestein and Eijffinger also demonstrated that, under an alternative hypothesis, the fundamental index could be defined by a state-dependent relationship. To be more precise, the index is linked to the macroeconomic factors (drawn from the structural approach for example) through a state-dependent relation. By a simple substitution, it is easy to show that the equation of the sovereign CDS spreads has a slope which changes across the states. In other words, the CDS spreads are driven by a Markov-switching model in which the effects of some macroeconomic variables vary across the different regimes.

This view confirms the relevance of the Markov-switching model to distinguish between the states of the CDS spreads. In addition, many empirical studies highlighted some evidence on nonlinearity in credit spreads (Chan and Marsden, 2014; Alexander and Kaeck, 2008; Davies, 2004). However, we do not impose any condition on either the intercept or the slope. We expect that the data would allow us to obtain the most relevant specifications of Markov-switching models in terms of the description of the dynamics of the BRICS CDS.

2. Markov-Switching model

This section is devoted to the presentation of the Markov-switching model used in the empirical part of the paper. Linear models are not consistent with state-dependency. This led to an increasing interest for non-linear models capable of dealing with switching regimes. Broadly speaking, the regime-switching models can be broken down into two sub-sets. The first one is represented by threshold autoregressive (*TAR*) models that are suitable for the dynamics of variables in relation to threshold values. The second sub-set is defined by Markov-switching (*MS*) models in which breaks stem from an unobservable latent variable. This variable is assumed following a Markov process. The *MS* model is more general than the *TAR* one and seems to be more appropriate for capturing successive changes in the dynamics of macroeconomic or financial variables. In the *MS* model, the dynamics of the endogenous variables depend on a latent non-observable variable S_t (if we assume that there are k states, then, $S_t = 1, \dots, k$) which represents different states of economic activity. In the empirical work, the two-state version of Markov-switching model ($S_t = 1, 2$) is often used as a useful approach for detecting and dating business cycle turning points. One of the main advantages of *MS* models is that they allow for introducing nonlinearity and asymmetry into the time series dynamics. As mentioned above, the Markov-switching model seems suitable with the analysis of the CDS dynamics.

The Markov-switching Autoregressive Moving-Average (*MS (k)-ARMA (p, q)*) model is considered as extensions of the model that allows *ARMA (p, q)* coefficients to be state-dependent. Let us consider an augmented version of a univariate *MS (k)-ARMA (p, q)* model with some additional explanatory macroeconomic or financial factors:

(1) $$y_t = c_{S_t} + \sum_{i=1}^{p} \phi_{iS_t} y_{t-i} + \sum_{l=0}^{m} \vartheta_{lS_t} x_{t-l} + \varepsilon_{S_t} + \sum_{j=1}^{q} \psi_{jS_t} \varepsilon_{S_{t-j}}$$

Where y_t is the endogenous variable, x_t is a set of exogenous factors;ε_{S_t} the error terms which are state-dependent; the intercept c_{S_t} is also state-dependent; finally, the coefficients of the *AR (p)* process,$\phi_{iS_t}, i = 1, \dots, p$, those of the *MA(q)* process, $\psi_{j,S_t}, j = 1, \dots, q$, and those of the set of exogenous variables, $\vartheta_{lS_t}, l = 1, \dots, m$, are also state-dependent.

According to Hull *et al.* (2004), Blanco *et al.* (2005) and Annaert *et al.* (2013), CDS spreads react more quickly than bonds to information regarding the changes in the credit quality. In addition, our model is not devoted to the forecasts but to the explanation of CDS dynamics. Therefore, the main explanatory variables in Equation 1 are contemporaneous to CDS spreads ($m = 0$). Each regime is associated with a single conditional distribution of the endogenous variable y_t, the selection of the explanatory factors, x_t, is based on the findings of Merton's structural model and its theoretical and empirical extensions. The set of these factors include: i) general economic condition factors (GDP growth, business cycle indicator, commodity prices, government and trade balances, etc.); ii) sectoral or global risk factors (return on local or global equity markets, implied volatility, etc.); iii) firms activity indicators (corporate yield, etc.).

In addition, the hypothesis of state dependency of variance-covariance matrix of ε_{S_t} ($\sum_{S_t}$)is accepted:

(2) $\varepsilon_{S_t} \sim N(0, \sum_{S_t})$

If the hypothesis of the regime dependency is rejected, $\sum_{S_t}$ is diagonal.

McConnell and Perez-Quiros (2000) proposed two main changes in the standard Markov-switching model: i) the dynamics of the mean and the variance are driven by two separate states; ii) the state process for the mean depends on the state of variance. However, due to data limitations, if we specify two different driving processes for mean and variance dynamics, we cannot guarantee the robustness of the estimation. As a result, McConnell and

Perez-Quiros' proposals are not introduced in our framework. However, our model is still governed by a state dependent variance Markov-switching process.

The state variable S_t is assumed to follow a first-order Markov-process. The fixed transition probability is:

(3) $\Pr(S_t = j | S_{t-1} = i) = p_{ij}$

Where p_{ij} is the probability that state *i* at *t-1* will be followed by state *j*.

We can define the fixed transition matrix $P(k \times k)$ as follows:

(4) $P = \begin{pmatrix} p_{11} & \cdots & p_{k1} \\ \vdots & \ddots & \vdots \\ p_{1k} & \cdots & p_{kk} \end{pmatrix}$

With $\sum_{j=1}^{k} p_{ij} = 1$ where *i=1, …, k* and $0 \leq p_{ij} \leq 1$

The set of the unknown parameters (Θ) is defined by:

$\Theta = (c_{S_t}, \phi_{iS_t}, \psi_{jS_t}, \vartheta_{lS_t}, \sigma_{uv}, p_{uv})$ with $S_t = (1, \ldots, k)$, $i = 1,\ldots,p$, $j = 1,\ldots,q$, $l = 1, \ldots, m$, $u=1,\ldots k$, and $v=1,\ldots,k$, $\sigma_{uv} = cov(\varepsilon_{S_t}, \epsilon_{S_{t'}})$ with $\varepsilon_{S_t} = u$, $\epsilon_{S_{t'}} = v$

The maximum likelihood estimation of the model is based on the Expectation-Maximization (EM) algorithm (Diebold *et al.,* 1994 Hamilton, 1990). The model is estimated using the Broyden-Fletcher-Goldfarb-Shanno search algorithm. By plugging the set of estimated parameters into the formulae of filtering (smoothing) probabilities, we obtain the estimated filtering (smoothing) probabilities of the regimes which are used to identify the regimes. The log-likelihood function $Ln\, L(\Theta/Y_t)$ is given by the sum of the log-densities *f(.)* of the observations y_t conditional on the history of the endogenous and exogenous variables ($Y_t = \{y_\tau, \tau = 1, \ldots, t\}$, $X_t = \{x_\tau, \tau = 1, \ldots, t\}$ with a sample size *T*).

$$Ln\, L(\Theta/\, X_t\, ; Y_t) = \sum_{t=1}^{T} ln\, f(y_t |\, X_{t-1}\, ; Y_{t-1}; \Theta)$$

With

(5) $f(y_t |\, X_{t-1}\, ; Y_{t-1}; \Theta) = \sum_{u=1}^{k} f(y_t, S_t = u |\, X_{t-1}\, ; Y_{t-1}; \Theta) =$

$$\sum_{u=1}^{k} f(y_t|S_t = u; X_{t-1}, Y_{t-1}; \Theta) * \Pr(S_t = u)$$

III. DATA AND DESCRIPTIVE STATISTICS

1. Sources

The CDS spreads data are extracted from the Bloomberg database. We analyze dollar-denominated 5-year contracts on senior international debt, which constitute the most liquid and active segment of the CDS market. The sample runs from January 2002 to September 2013 for Brazil, South Africa and Russia and from February 2003 to September 2013 for China. As India has never sold debt overseas and CDS are not yet traded domestically, there are no CDS spreads on Indian sovereign debt. Financial data providers (Thomson-Reuters, etc.) and markets analysts assess India's sovereign risk with reference to the cost of protection against a default of State Bank of India (SBI). This proxy variable runs from January 2005 through December 2009 in the Bloomberg database and from October 2008 to September 2013 on the Thomson-Reuters database. We run a linear regression on the overlapping sample and use the estimated coefficients to generate the missing values in order to complete the Thomson-Reuters time series. Overall, the BRICS CDS spreads display large variations on the period under review.

Most domestic stock exchange indices (the Shanghai Composite Index for China, the *IBOVESPA* for Brazil, the Sensex Index for India, MSCI for Russia and the MSCI for South Africa) and exchange rates are drawn from the *Bloomberg* database. The overnight interbank rates are provided by national central banks. The difference between a long-run interest rate (10 year sovereign yields) and a short-run rate (1 year yield, less than a 2 year yield and less than a 3 year yield for resp. India, Russia, and South Africa) is used as a proxy of yield curve slope. These interest rates are extracted from *Datastream* where these series for Brazil and China are not available.

The global financial markets factors are measured by the regional or the largest developed countries financial indicators:

a) The Dow Jones (DJ) Euro Stoxx 50, its implied volatility the Vstoxx index , and the Thomson-Reuters euro zone Corporate benchmark 5-year yield for AAA issuers, for the euro area;
b) The Standard & Poor's 500 index, its implied volatility the VIX index, the exchange rates versus the US dollar, and the Thomson-Reuters US Corporate benchmark 5-year yield for AAA issuers, for the USA;
c) The MSCI regional stock market indices (the MSCI Emerging Latin America[1] for Brazil; the MSCI Emerging and Frontier Markets Asia for both China and India; the MSCI Emerging and Frontier Markets Central and Eastern Europe & CIS for Russia and the MSCI Emerging and Frontier Markets Africa for South Africa or the global MSCI Emerging Markets Index.

The country-specific factors (trade-balance, foreign-currency-reserves, etc.) are extracted from *Datastream*. The government-finance-balance of the BRICS countries is provided by national sources. We need monthly GDP in order to normalize the previous macroeconomic variables. However, only quarterly GDP figures are available. Therefore, for all data involving GDP, we assess the ratio on the quarterly basis. Then we compute monthly ratios by assuming that intermediate points are on a natural cubic spline. The commodity prices measure is the synthetic index of commodity prices by the *Commodity Research Bureau*.

2. The BRICS CDS and the euro area risk factors

A large body of literature shows that the most significant explanatory variables for CDS spreads are related to the US financial markets (US stock, high-yield market returns, implied volatility, etc.). However, the BRICS countries intensively trade with the euro area. For example, in 2012, euro area exported more goods to Brazil, Russia and South Africa than the USA whose exportations towards China were significantly larger than that of the euro area (349billion versus 243 billion). However the euro area exportations towards the BRICS are larger than that of the USA. The trade balances between the BRICS and both the euro area and the USA are positive but it is slightly greater for the US (10.4 versus 2.8 billion). In addition, the euro area is the primary investor of foreign direct investment (FDI) in BRICS

[1] Constituents for EMLA: Argentina, Brazil, Chile, Colombia, Mexico, Peru; for EFMAs: Bangladesh, China, India, Indonesia, Korea, Malaysia, Pakistan, Philippines, Sri Lanka, Taiwan, Thailand, Vietnam; for EFMCEC: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Kazakhstan, Lithuania, Poland, Romania, Russia, Serbia, Slovenia, Ukraine; for EFMAf: Egypt, Kenya, Mauritius, Morocco, Nigeria, South Africa, Tunisia.

countries (378.2 billion versus 178.8 billion). Prior to the crisis, the euro area was the largest holder of external assets and liabilities worldwide and a net creditor to the BRICS (see Milesi-Ferretti *et al.*, 2010).

The cross-border exposures of the major global banks – corresponding with the assessment of systemic risk – reveal that; in recent periods, the cross-border exposures of European banks to the BRICS are stable and greater than those of US banks. According to the Bank for International Settlements, European banks' exposures to the BRICS countries in US dollars amounted to 1,041 billion vs. 268 billion for US banks in September 2011, and to 1,042 billion vs. 272 billion for US banks in March 2012. The cross-border exposures of European banks in US dollars to Brazil are significantly higher than those of US banks to all the BRICS countries (347 billion vs. 268 billion in September 2011 and 352 billion versus 272 billion in March 2012). Degryse *et al.* (2010) showed that a liabilities shock in just one country could undermine the stability of the entire global financial system. Therefore, it is interesting to check the strength and the relevance of the links between the BRICS CDS spreads and the euro area risk factors. This test can also allow us to compare the euro area based models to the USA based ones. In addition, these relationships have never been explored in the literature, except by Fender *et al.* (2012). Besides, the set of countries under review could be extended to other emerging countries. However, we have focused on the BRICS which are commonly identified as the main drivers of the global economy in the foreseeable future.

3. Test for stationary and Markov-switching models

The unit roots could exist in the series under review. Therefore, we perform some tests to check if we can accept the stationary hypothesis or not. The conventional ADF tests are less powerful in the presence of several regimes. The Markov-switching Augmented Dickey–Fuller (*MS-ADF*) test (Hall *et al.,* 1999; Shi, 2013) can allow us to detect explosive bubble behavior in the CDS spreads dynamics.

Given the *MS* model specified as:

$$\Delta y_t = \mu_{S_t} + \phi_{S_t} y_{t-1} + \sum_{i=1}^{k} \psi_{S_{t,i}} \Delta y_{t-i} + \sigma_{S_t} \varepsilon_{S_t}$$

With $\phi_{S_t} = \phi_1 + (S_t - 1)(\phi_2 - \phi_1)$. If we refer to the regime with a larger (resp. lower) ADF coefficient as regime 1 (resp. 2), the *MS-ADF* bubble test is defined as follows[2]:

- In Regime 1, the unit root null hypothesis is $\kappa_1 \equiv \max(\phi_1, \phi_2) = 0$ against the explosive alternative $\kappa_1 > 0$.
- In Regime 2, the unit root null hypothesis is $\kappa_2 \equiv min(\phi_1, \phi_2) = 0$ against the stationary alternative $\kappa_2 < 0$.

We calculate the rejection probability of the *MS-ADF* by implementing tests on 1,000 simulated data (van Norden and Vigfusson, 1998; Shi, 2013, see Table 2)[3]. In addition, following Shi (2013) and Hall *et al.* (1999), we use the bootstrapping critical values which display good performances. We reject the unit root null hypothesis of κ_2 for Brazil and South Africa at 1% significance levels and at 5% confidence level for India and Russia. We accept the null hypothesis for China at 10%. Furthermore, we accept the unit root null hypothesis in Regime 1 of all CDS spreads at the 10% significance level. In other words, for Brazil, South Africa, India and Russia, a mixture of a unit root process and an explosive process prevails. However, the Chinese CDS spreads are only driven by random walk processes. These results validate the choice of the Markov-switching approach. Indeed, this seems relevant for analyzing the dynamics of CDS spreads of Brazil, South Africa, India and Russia. Although, in the case of China, this issue is not as clear as in the previous cases, we will run a similar model for Chinese sovereign CDS spreads in the first step of our empirical analysis.

		Estimates		Critical Values		
		Coefficients	**MS-ADF**	**10%**	**5%**	**1%**
Brazil	κ_1	-0.05	-31.30	-41.59	-43.55	-49.30
	κ_2	0.02	1.67	1.41	1.51	1.57
China	κ_1	-0.15	-1.97	-9.19	-10.04	-11.26
	κ_2	0.67	0.74	2.45	2.52	2.58
India	κ_1	-0.19	-2.05	-15.52	-17.10	-19.71
	κ_2	0.96	0.06	-0.04	0.04	0.09
Russia	κ_1	-0.45	-0.04	-15.70	-16.11	-17.25
	κ_2	0.22	1.12	0.89	1.04	1.17
South Africa	κ_1	-0.13	-1.25	-7.75	-8.90	-19.78
	κ_2	0.78	0.24	-4.81	-0.95	0.08

Table 2 - MS-ADF tests for the BRICS CDS spreads

[2] The *MS* simulations are run using the codes provided by Perlin (http://sites.google.com/site/marceloperlin/matlab-code/).

[3] The *MS-ADF* test is also applied to the explanatory factors. The results are similar to those regarding the CDS spreads.

As a consequence of the previous results, the first-order differences of the CDS spreads (or the first-order differences of the log of explanatory variables) are used in the empirical analysis. The mean values of first-order differences of CDS spreads range from -0.015 for Brazil to 0.018 for India. All CDS spreads are relatively volatile.

IV. EMPIRICAL RESULTS

1. Estimation results

To start the empirical analysis, we run Equation (1) by assuming that the unknown parameters are regime-independent. The main results are briefly presented in following. The conventional information criteria enable us to select the appropriate lags for the *ARMA* terms. In this context, Brazilian CDS are driven by Vstoxx, euro corporate yield, local stock markets and foreign currency reserves. China shares the same determinants augmented with DJ Euro Stoxx 50 and the exchange rate. Indian CDS are only determined by stock market variables (local stock markets, DJ Euro Stoxx 50 and Vstoxx). In the case of Russia, the significant coefficients are those of Vstoxx, euro corporate yield, local stock markets and commodity prices. South African CDS spreads are driven by foreign currency reserves, local stock markets and Vstoxx. As conventional criteria are biased in the case of state-dependent dynamics and can lead to a misspecification's problem, we substitute the previous criteria by the Markov Switching Criterion (MSC) (Smith *et al.,* 2006).[4] This criterion can help to select both the number of regimes and the lags in Equation (1). The decision rule is based on the values of statistics: the best specification corresponds with the lowest MSC in absolute terms.

	Brazil#	China	India	Russia	S.A.
M(1,1)	-164*	157*	426	81	105*
M(2,1)		-4437	333*	62*	116
M(1,2)		365	878	351	320
M(2,2)		439	400	442	345

Table 3 - Markov Switching Criterion (2-regime)

[4] $MSC = -2 * LL + \sum_{i=1}^{N} \frac{T_i(T_i+\lambda_i K)}{\delta_i T_i - \lambda_i K - 2}$ where LL is the log-likelihood associated with the estimation, N is the number of regimes, T_i is calculated as the sum of smoothing probabilities of each state *i*, λ_i = N and δ_i = 1 as suggested by Smith *et al.* (2006).

** Indicates the best specification, M(p,q) means ARMA(p,q) model augmented with exogenous variables.* [#] *For Brazil, the tested models does not include ARMA terms. Source: authors' calculations*

2-regime models including macroeconomic and financial explanatory factors prevail in the BRICS countries (see Table 3). However, the empirical models applied to Brazil CDS spreads exclusively include exogenous factors. Besides, the lags of the *ARMA* terms display various values for India and Russia, the *MS(2)-ARMA(2,1)* displays the best performance; for China and South Africa, the *MS(2)-ARMA(1,1)* is the best out of all of them. For the sake of parsimony, we privilege an *MS(2)-ARMA(1,1)* including macroeconomic and financial factors for China, India, Russia and South Africa. 3-regime models exhibited the poorest statistics and are not reported here. The Markov-switching models have been estimated using *OxMetrics 6.1* and the *PcGive 13.* subroutines (see Table 4).

Regime 1 corresponds to a significantly negative average of the endogenous variable (respectively -1.8%, -4.1%, -2.5%, -10% and -3.8% for Brazil, China, India, Russia and South Africa,) and a lower variance (respectively 0.18, 0.21, 0.17, 0.13, 0.13 for Brazil, China, India, Russia and South Africa). Regime 2 is associated with a large and positive average of the explained variable (4%, 8.8%, 11.5%, 10.5% and 6.1% for Brazil, China, India, Russia and South Africa)[5] and a slightly higher variance overall (0.28, 0.20, 0.20, 0.19 and 0.23 for Brazil, China, India, Russia and South Africa).

The *AR* terms are significant in both regimes for India and South Africa. For Russia the AR term is significant only in Regime 1, while it is only significant in Regime 2 for South Africa. The *MA* terms are not significant for China but they are different from 0 for India. Finally, the *MA* terms are significant only in Regime 2 for Russia and South Africa. Intercepts are significant whatever the regime in all countries except Brazil and China in Regime 1.

In Regime 1, except for Brazil, non-financial factors are strongly linked to the CDS spreads. Foreign currency reserves have a significant but weak effect on the CDS for all countries with the exception of Russia. For China, the fiscal balance significantly and negatively impacts the CDS spreads. This confirms economic intuition: better (worse) fiscal balance should drive sovereign CDS spreads down (up). The coefficient of trade balance is

small but statistically different from zero in the case of Africa. Commodities prices have a negative impact on CDS spreads for China and South Africa. This result could stem from the increase in government revenues for these two metals-exporting countries. The domestic stock market definitely impacts CDS spreads negatively in all countries except in South Africa. In addition, the Dow Jones Euro Stoxx 50 negatively influences all CDS spreads except for the Brazilian CDS spreads. These results suggest that the improvement of market conditions, which could be interpreted as positive signals for investors, leads to the decrease in CDS spreads and vice-versa. The exchange rate negatively influences all CDS spreads. VStoxx is positively linked to CDS spreads in Brazil and India. This result means that risk shifts all markets at the same time. As expected, with the exception of India, the euro corporate yield is also positively correlated to CDS spreads everywhere.

In Regime 2 (see Appendix A for smoothed probabilities of Regime 2), for Brazil, both macroeconomic and financial factors have a significant effect on CDS spreads. Fiscal balance and commodity prices are correlated to CDS spreads in China. All factors, with the exception of the euro corporate yield and Vstoxx, are statistically related to CDS spreads for India. Russian CDS spreads are only impacted by MSCI Russia, DJ Euro Stoxx 50, Vstoxx and foreign currency reserves. South African CDS spreads are influenced by trade balance, foreign currency reserves, local stock market and euro-related factors (the euro corporate yield, the exchange rate and the Vstoxx). For all countries, the signs of the coefficients of the main determinants are the same for both regimes but their values are largely different (with the exception of local stock markets for India, euro stock markets for Russia and euro corporate yield for South Africa which exhibit opposite signs from one regime to another). These results confirm that CDS spreads dynamics are regime-dependent. Overall, according to the estimates, euro area factors are the main drivers of BRICS CDS spreads in both regimes.

In addition, the duration of Regime 1 is between 1.6 months (Russia) and 4.5 months (India) whereas the duration corresponding to Regime 2 is approximately 1.5 months. For the US corporate CDS spreads, the durations calculated by Chan and Marsden (2014) are equivalent to 1.5 and 1.2 months respectively for Regime 1 and Regime 2. Our results are rather consistent with these findings. However, the durations calculated for the CDS spreads for Brazil are dramatically different from those of the other BRICS. As the duration for Regime 1 is around 8 months for Brazil, the hypothesis of a single regime for the CDS spreads for Brazil appears reasonable. However, the single regime equation displays a statistically poor performance for this country. Therefore, we have decided to pursue the

analysis within a 2-regime framework by being very cautious in the interpretation of results for Brazil.

Furthermore, looking at the period ranging from October 2009 to September 2013, we note that Regime 2 appears more than 11 times for India, China and South Africa and more than 20 times for Russia but only 4 times for Brazil. However, there is no simultaneity in the appearance of the regimes across the BRICS. There are 49 periods when at least 3 countries are in Regime 2, but only 1 month when all the countries are simultaneously in this regime. This result is in line with the fact that Regime 2 is observed during a major global event (Wang and Moore, 2012).

		Brazil		China		India		Russia		South Africa	
		Reg. 1	**Reg. 2**	**Reg. 1**	**Reg. 2**	**Reg. 1**	**Reg. 2**	**Reg. 1**	**Reg. 2**	**Reg. 1**	**Reg. 2**
AR (ϕ_{S_t})				-	1.33*	-0.31*	-1.62*	-0.48**	-	0.7*	-0.49*
MA (ψ_{S_t})				-	-	0.22*	0.61*	-	0.18***	-	0.18**
Euro Corp. Yield		0.13**	0.26*	0.1***	0.21*	-	-	0.12**	-	0.19*	-0.2**
Forex Reserves		-	ε *	ε *	ε *	ε *	ε *	-	ε **	ε *	0.01*
Govt. Balance		-	ε *	-0.23*	-	-	-0.35*	-	-	-	-
Local Stock Mkt.		-1.6*	-1.04*	-0.87*	-0.53*	-1.11*	1.75*	-0.43**	-1*	-	0.04**
Euro Stock Mkt.		-	0.99*	-2.18*	-0.78*	-0.76*	-3.94*	-2.02*	0.73**	-1.18*	-
Trade Balance		-	ε *	-	0.01**	-	ε *	-	-	ε *	ε **
Vstoxx		0.24*	0.99*	-	0.86*	0.24*	-	-	0.55*	-	0.46*
Exchange Rate		-0.61**	0.17*	-0.02**	-0.07*	-0.97**	-1.43*	-0.72***	-	-0.06**	-0.1**
Commo. Price		-	0.86*	-0.79**	-	-	-1.06*	-	-	-1.65*	-
Intercept		-	0.09*	-0.04*	0.19*	-	0.07*	-0.06*	0.07*	-0.04*	0.05*
σ^2		0.11*	ε*	0.07*	0.08*	0.07*	0.03*	0.07*	0.1*	0.05*	0.14*
Transition probabilities	$p_{1,1}$=	0.89	(0.03)	0.65	(0.07)	0.78	(0.06)	0.34	(0.12)	0.44	(0.08)
	$p_{1,2}$=	0.83	(0.1)	0.72	(0.08)	0.54	(0.1)	0.6	(0.13)	0.72	(0.1)
Log Likelihood		138.49		87		106.95		109.15		98.62	

Table 4 – Estimates of MS(2)-ARMA(1,1)

, **, and * denote respectively 1%, 5% and 10% significance. Standard errors are in parenthesis; Reg.1= Regime 1; Reg.2= Regime 2.*

2. What do the recent empirical findings tell us?

Overall, our results are in line with the findings of some papers which highlighted the significant role of both macroeconomic and global financial factors in the explanation of the dynamics of CDS spreads (Gonzalez-Rozada and Yeyati, 2008; Chan and Mardsen, 2014). More specifically, some of our results comply with the findings of Chan and Marsden (2014), Fender *et al*. (2012), and Longstaff *et al.* (2011) whereas others appear to challenge their analysis. As our framework is similar with that of Chan and Mardsen, it would be interesting to compare their findings to our results.

To do that, we distinguish two sub-sets of explanatory factors: i) the common factors of the two papers; ii) the specific factors only introduced in our paper. Regarding the common factors (corporate yield, stock markets returns, implied volatility), we notice a large similarity between our results and that of Chan and Marsden. In fact, the results by Chan and Marsden and ours are qualitatively equivalent. Generally in both papers, the stock returns are negatively correlated to CDS spreads whereas implied volatility positively impacts the CDS spreads. For the second-sub set of factors which especially concerns general economic conditions (government balance, commodity prices, etc.), the effects obtained in our paper are consistent with economic intuition or theoretical results. For example, the increase in commodity prices could deteriorate the firms' health. Therefore, a negative relationship between commodity prices and CDS spreads is expected (except for Brazil in Regime 2). The trade balance coefficient is overall positive. It means that when exportations go up after a positive demand shock, the general economic situation of the firms can be improved.

Our results confirm the economic intuition. However, there are some differences between the BRICS. Brazil has a positive coefficient in Regime 2. China and India display positive coefficients in Regime 1 and negative in the Regime 2, while South Africa shows the opposite configuration. Russia's CDS spreads are positively impacted in Regime 1.

V. SENSITIVITY ANALYSIS

To examine the robustness of our model, we estimate a less flexible *MS (2)-ARMA (1,1)* in which the variance is not regime dependent ($\sigma_1 = \sigma_2$). In addition, we run a *MS (2)-ARMA(1,1)* model in which the variance is regime-dependent over the period prior to the

Lehman Brothers collapse (January 2002 – August 2008). These sets of models also include our set of exogenous factors. Furthermore, we examine the effects of some additional factors, especially the US ones. The models are compared with the benchmark model presented in the previous session. Finally, we run a VAR model in order to test the relevance of the joint dynamics of the CDS spreads.

1. Is it relevant to introduce-nonlinearity in the framework?

It is not simple and easy to perform a formal and powerful test of the Markov-switching model against linear alternatives. A large body of literature has been devoted to the tabulation of theoretical distributions under the null hypothesis (Davies, 1987; Cho and White, 2007; Carter and Steigerwald, 2012). To our knowledge, the current results regarding the asymptotical distributions under the null hypothesis only apply to specific cases. One way to reach an acceptable result is to use Davies' linearity tests (Davies, 1987) with approximations to the critical values. Here, we complete this approach by alternative tests such as the regime classification measure (RCM) by Ang and Bekaert (2002). The hypothesis is accepted when the RCM statistic is less than 50. The similarity of the results of Davies and RCM tests could help to make a decision (see Table 5).

Overall, the Davies tests show that the *MS-ARMA* models (including macroeconomic and financial factors) with state-dependent variance dominate the others, except for Russia and South Africa. In these cases, the *MS-ARMA* models with state-independency variance prevail. The RCM statistics are weaker or close to 50 for all countries. These results validate the relevance of the two-regime with state-dependency hypothesis. In addition, the estimation of the *MS-ARMA* models with state-dependent variance over the pre-crisis sub-period (January 2002-August 2008) confirms the existence of two regimes for the BRICS. Besides, the models estimated over the entire period seem preferable to those corresponding to the short period.

		Brazil	China	India	Russia	South Africa
RCM	*MS(2)-ARMA(1,1)*	3.95	16.24	15.27	58.28	32.15
	MS(2)-ARMA(1,1) $\sigma_1 = \sigma_2$	37.74	17.74	13.72	18.05	7.88
	MS(2)-ARMA(1,1) until Aug. 2008	21.8	2.72	124.1	7.59	11.58
	MS(2)-ARMA(1,1) + regional factors	-	5.85	6.11	38.44	22.87
	MS(2)-ARMA(1,1) + emerging factors	5.83	2.05	11.20	7.78	34.8
	MS(2)-ARMA(1,1) + business cycle variable	8.58	-	16.63	53.97	34.96
	MS(2)-ARMA(1,1) + US variables	-	1.67	18.54	22.36	33.64
Davies' tests	*MS(2)-ARMA(1,1)*	2.54	3.13	4.46	2.16	3.70
	MS(2)-ARMA(1,1) and $\sigma_1 = \sigma_2$	2.03	3.13	4.27	2.53	3.92
	MS(2)-ARMA(1,1) until Aug. 2008	1.33	2.10	4.44	1.43	2.81

Table 5 – Non linearity Tests

2. What are the contributions of certain specific risk factors to the BRICS CDS spreads?

Firstly, we include uncertainty in the model linked to the real activity via a business cycle variable, using the cyclical component from GDP growth extracted through a Hodrick-Prescott filter and the effect of monetary policy stringency via a short-term interest rate. We also introduce the yield curve slope in the set of explanatory factors to examine the effect of an alternative measure of activity uncertainty. Secondly, we take into account the uncertainty induced by the regional financial markets via stock market indices. We also use the global MSCI Emerging Markets Index for describing the regional risk. Thirdly, we replace euro area variables by US financial factors in the models. This substitution enables us to test an alternative view of the global risk and to assess the relative importance of the two major economic areas. We also estimate models including both euro and US financial factors. In this case, due to the multi-collinearity constraints, we run two sets of regressions: first, a set of

models including all euro area variables plus the US corporate yield and the exchange rate versus the US dollar (Specification 1), and another set of models including all US variables plus the euro area corporate yield and the exchange rate versus the euro (Specification 2).The empirical results are as follows:

i) We analyze the estimates of our models including the cyclical component of GDP. Unfortunately these models do not converge in the case for China. The results are not enhanced for any country; the number of significant variables is larger in this framework. The effects are as expected. Furthermore, the coefficients of the business cycle indicators, is close to 0 when significant. Regarding the models including short term interest rates, the results are not enhanced for all countries. Concerning the models including the curve yield slope, we note that the slope coefficient is not significant for India in both regimes and its cumulated effect is negligible for South Africa. Then, we run the regressions with regional equity indices instead of local stock indices. The model did not converge for Brazil. Overall, the set of models with only euro area variables exhibits more significant parameters (except for India and Russia). Once again, the results confirm economic intuition. Moreover, the regional equity index coefficients are less influent than local stock market coefficients. Introducing an emerging market index does not significantly improve the performance of the models[6].

ii) We examined the results of the models in which only US variables are included (see Table 6). The model did not converge for Brazil. In the case of China, there are more significant parameters. In the case of India, even though there are more significant parameters within the US framework, the euro-based model displays better performance (especially, in terms of likelihood's statistics). In addition, the dynamics regarding the regimes are sometimes quite different: for example, for South Africa, the model with US parameters shows more significant coefficients in Regime 1 whereas the model with euro area and US factors exhibit a lesser number of significant coefficients in Regime 2. Besides, overall, the effects of euro area and US factors are in accordance with the theoretical findings.

[6] We have not reported the results of models where regional indices are added to domestic market indices as they were poorer.

iii) Regarding the sets of models including both the US and the euro area variables, the euro area-based model display the best performance in explaining the BRICS CDS spreads (Appendices B1 and B2). The results regarding China are statistically poor to be reported and commented here. For Brazil, in specifications for Regime 1 and Regime 2, the euro area parameters are more relevant. For India, US parameters are more significant than those of the euro area. For South Africa, euro area parameters statistically dominate US variables. Russia is not very sensitive to the choice of variables included in the models. In general, when two variables of the same type appear in the regressions, the euro corporate yield factor often has a greater impact in the equation. Both the euro area-based model and the US-based model lead to the expected effects. However, taking into account euro area financial factors improves the explanatory power of the regressions.

		Brazil		**India**		**Russia**		**South Africa**	
		Reg. 1	**Reg. 2**	**Reg. 1**	**Reg. 2**	**Reg. 1**	**Reg. 2**	**Reg. 1**	**Reg. 2**
AR (ϕ_{S_t})		-0.99*	-0.69*	-	-1.53*	-0.67*	-1.03*	-0.71*	-
MA (ψ_{S_t})		-0.2*	0.19**	-	0.46*	-	0.33*	-0.21*	-
US Corp. Yield		0.14*	-0.04*	0.06***	-0.17*	0.06**	-0.09*	0.09*	-
Forex Reserves		ε *	ε *	ε **	ε *	-	ε **	ε *	ε ***
Govt. Balance		-0.4*	0.01**	-	-0.78*	-	ε **	ε *	ε **
Local Stock Mkt.		-1.2*	-0.3*	-1.28*	-1.02*	-0.88*	0.18***	-0.03*	-2.72*
US Stock Mkt.		-2.4*	-0.52*	-0.45***	-0.64***	1.08*	-0.52*	-1.17*	-
Trade Balance		-0.1*	0.01*	-	ε **	-	-	-	-
Vix		1.44*	0.35*	-	0.25*	-	1.13*	0.15*	0.72*
Exchange Rate v USD		3.38*	8.35*	-1.07**	-1.45**	-1.54**	0.63*	-2.22*	-
Commo. Price		0.95*	-1.39*	-	-	-	-0.63**	0.54**	2.19*
Intercept		-0.13*	0.06*	-	0.11*	-0.03*	0.04*	-	0.07**
σ^2		ε *	0.17*	0.05*	0.1*	0.1*	0.02*	0.06*	0.12*
Transition probabilities	$p_{1,1}$=	0.34	(0.09)	0.69	(0.11)	0.81	(0.08)	0.59	(0.08)
	$p_{1,2}$=	0.2	(0.04)	0.78	(0.1)	0.55	(0.11)	0.71	(0.11)
Log Likelihood		120.9		87.61		119.18		108.1	

Table 6 – MS-ARMA(1,1) with US variables

, **, and * denotes respectively 1%, 5% and 10% significance. Standard errors are in parenthesis.*

3. Comparison with an alternative approach of the BRICS CDS dynamics: MS-VAR models

As expected, correlations are higher within the BRICS CDS spreads (from 0.68 to 0.79). The highest correlation among BRICS is between Brazil and Russia. According to Depository Trust and Clearing Corporation, in June 2014, the gross notional of outstanding CDS for Brazil reached 139 billion US dollars, versus 115 billion for Russia which is the second largest entity in the market within the BRICS. Due to the strong link between the BRICS CDS spreads, we estimate Markov-switching *VAR* (*MS-VAR*) models to perform the joint analysis of BRICS CDS dynamics. For the sake of parsimony we run 10 *MS-VAR* models for the BRICS CDS. Each *MS-VAR* only contains 3 different CDS spreads (out of the initial set of 5) and 3 lags.

The estimates show that there is no single CDS spread that influences all the others. In addition, the links between the CDS spreads does not appear robust. Hence, the model including Russia, China and South Africa reveals that the Russian CDS has a strong impact on the Chinese sovereign risk; but when we substitute South Africa with India or Brazil, the relationship between Russia and China disappears. Furthermore, in all the specifications, the coefficients are much less significant in Regime 2. These results show that by including risk factors in the models, substantially improves the understanding of BRICS CDS dynamics.

VI. CONCLUSION

A Markov-switching approach seems appropriate to examine the BRICS (including Brazil to a lesser extent) CDS spreads dynamics. Indeed, for these countries, we isolate two states driven by macroeconomic and financial factors. Overall, our results are in line with those of previous papers. For all countries, there are macroeconomic and financial factors which impact the CDS spreads, even though these spreads are not sensitive to the same factors nor to the same extent. Especially, the effects of financial factors (both domestic and euro-related: corporate yield, stock markets returns and implied volatility) comply qualitatively with the findings of Chan and Marsden (2014). Furthermore, euro area financial indicators play a key role in CDS dynamics for the BRICS countries whatever the regime. Apart from India and Russia in the Regime 2, all countries are impacted by the euro corporate yield. The DJ Euro Stoxx 50 impacts all CDS spreads in both regimes except for Brazil in Regime 1 and South Africa in Regime 2. Vstoxx impacts all countries in at least one regime.

Regarding the factors related to general economic conditions (government balance, fiscal balance, commodity prices, etc.), and despite some differences among countries, the effects obtained in our study are consistent with theoretical backgrounds or economic intuition.

Finally, various robustness checks confirmed the relevance of the Markov-switching approach. Integrating US factors, widely used in previous studies, does not improve the empirical results. The introduction of regional or US risk factors into the benchmark models shows that the euro indicators are strong determinants of the BRICS CDS spreads. This observation is also valid while introducing a regional equity index. The Markov-switching *VAR* model of CDS spreads is dominated by the models which contain additional euro area explanatory factors.

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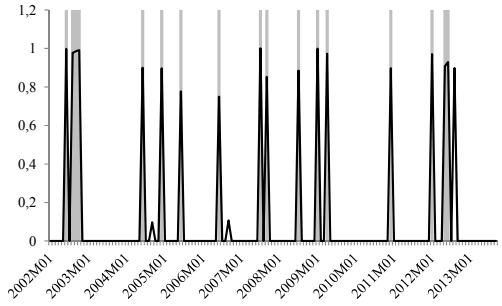
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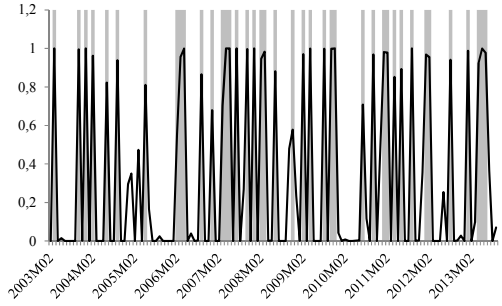
Appendices

Appendix A – Smoothed Probabilities of Regime 2

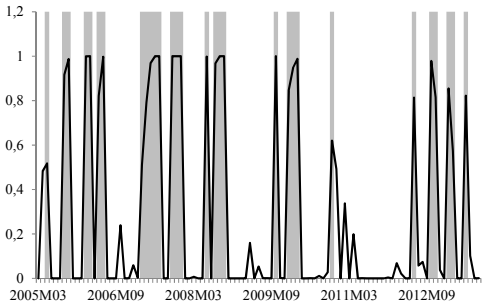
Brazil



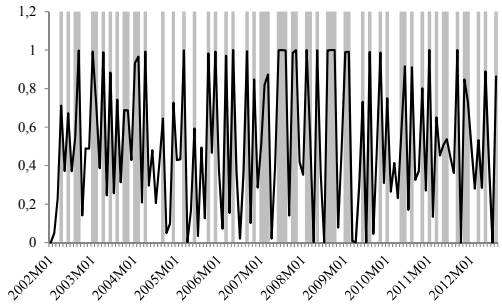
China



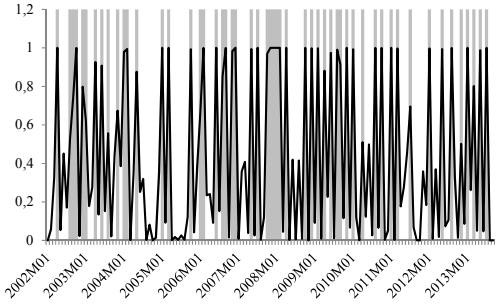
India



Russia



South Africa



Appendix B.1 - MS(2)-ARMA(1,1) with euro area variables, US Corp. Yield and Exchange rate vs USD

	Brazil		India		Russia		South Africa	
	Regime 1	**Regime 2**	**Regime 1**	**Regime 2**	**Regime 1**	**Regime 2**	**Regime 1**	**Regime 2**
AR (ϕ_{S_t})			-0.34*	-1.07*	-0.23*	-0.72*	-	-0.65*
MA (ψ_{S_t})			0.06**	0.51*	0.06***	0.39*	-	0.43*
Euro Corp. Yield	0.08***	0.47*	-	-	0.28*	-0.14*	-	-
US Corp. Yield	-	-0.29*	0.09*	-0.1*	-0.05*	0.11*	0.03***	0.18*
Forex Reserves	-	-	ε *	ε *	ε **	-	-	-
Govt. Balance	-	-	0.2*	-0.87*	ε *	ε *	-	-
Local Stock Mkt.	-1.25*	-2.41*	-1.02*	1.01*	-0.45*	-0.43*	-0.43**	-
Euro Stock Mkt.	-0.45***	3.82*	-0.94*	-2.51*	-1.73*	0.83*	-0.84*	-1.15*
Trade Balance	-	-	ε *	ε *	-	ε *	-	-
Vstoxx	-	1.52*	0.08**	-	-	0.79*	-	0.56*
Exchange Rate vs. EUR	0.63**	-3.44**	-1.95*	-	-	-0.69**	0.08*	0.09**
Exchange Rate vs. USD	-1.89*	3.06**	-0.8*	-2.9*	-1.39*	-	-2.03*	-1.37*
Commo. Price	-	-	0.8*	-0.62*	-1.12*	-0.84*	-0.56*	-
Intercept	-	-	-0.02*	0.06*	-0.01*	0.03*	-0.02**	0.03***
σ^2	0.08*	0.12*	0.03*	0.12*	0.02*	0.13*	0.04*	0.17*
Transition probabilities $p_{1,1}$=	0.97*	(0.02)	0.54*	(0.07)	0.47*	(0.09)	0.7*	(0.08)
Transition probabilities $p_{1,2}$=	0.16**	(0.08)	0.76*	(0.09)	0.39*	(0.07)	0.41*	(0.09)
Log Likelihood	122.22		108.89		126.75		111.68	

, **, and * denote respectively 1%, 5% and 10% significance. Standard errors are in parenthesis.*

Appendix B.2 - *MS(2)-ARMA(1,1)* with US variables, i Euro Corp. Yield and Exchange rate vs Euro

	Brazil		India		Russia		South Africa	
	Regime 1	**Regime 2**	**Regime 1**	**Regime 2**	**Regime 1**	**Regime 2**	**Regime 1**	**Regime 2**
AR (ϕ_{S_t})			-0.42*	-1.19*	-0.73*	-0.98*	-0.7*	-0.34*
MA (ψ_{S_t})			-	0.6*	0.17*	0.51*	-	0.59*
Euro Corp. Yield	0.11**	0.36*	-0.11*	-0.22*	0.09*	-0.15*	-	-0.5*
US Corp. Yield	-	0.06*	0.11*	-0.06***	-	-0.05*	0.1*	-
Forex Reserves	-	ε *	ε *	ε *	ε *	ε *	ε ***	ε **
Govt. Balance	-	ε *	-	-0.6*	ε *	ε *	ε *	-
Local Stock Mkt.	-1.2*	0.31*	-0.9*	-0.46*	-1.06*	0.32*	-0.02**	-2.86*
US Stock Mkt.	-	0.38*	-	-	1.01*	-0.44*	-0.58**	-
Trade Balance	-	ε *	-	ε *	ε *	ε *	ε ***	-
Vix	0.18**	0.6*	0.18*	0.31*	-	1.05*	0.12**	0.9*
Exchange Rate vs. EUR	-	0.8*	-2.43*	-	-2.3*	-0.06***	0.07*	-
Exchange Rate vs. USD	-	-1.56*	-0.88**	-2.43*	-1.09*	-	-2.15*	-
Commo. Price	-	1.09*	-0.73**	-	-0.63*	-0.38*	-	-1.99***
Intercept	-0.02**	0.1*	-0.04*	0.1*	0.01*	0.02*	-	0.12*
σ^2	0.1*	ε *	0.04*	0.1*	0.11*	ε *	0.06*	0.1*
Transition probabilities $p_{1,1}$=	0.86*	(0.03)	0.52*	(0.07)	0.84*	(0.04)	0.68*	(0.09)
Transition probabilities $p_{1,2}$=	0.9*	(0.07)	0.75*	(0.09)	0.57*	(0.09)	0.8*	(0.12)
Log Likelihood	145.75		95.15		150.79		114.18	

, **, and * denote respectively 1%, 5% and 10% significance. Standard errors are in parenthesis.*

CHAPTER 3

DO CHANGES IN COMMODITY PRICES INFLUENCE SHORT-TERM INTEREST RATE DYNAMICS?

By Kuhanathan ANO SUJITHAN†

Abstract *– We have investigated the relation between commodity prices and short-term interest rates for the USA, the euro area, Brazil, India, Russia and South Africa. First, we estimated VAR models which allow us to show that short-term interest rates respond to commodity shocks in the most of the countries. Furthermore, shocks are quite persistent. Second, due to the acceptance of the non-linearity hypothesis and, to a lesser extent, to the poor predictive performances of the VAR models, we implemented TVAR models, which validate the existence of two regimes of monetary policy. These models enable us to identify the characteristics of each regime in terms of the links between changes in short-term interest rates and developments in commodity prices. In addition, the robustness checks confirm the relevance of the empirical findings linked to TVAR models.*

JEL classification: E43, E52, E58

Keywords: monetary policy, commodity prices, VAR models, TVAR models

(†) This chapter is part from a joint work with Sanvi AVOUYI-DOVI and Lyes KOLIAI. I would like to thank them for allowing it to be part of the thesis.

The effects of oil price shocks on economic activity have been analysed in developed economies (Hamilton (1983), Gisser and Goodwin (1986) and Mork (1989), among others). The main findings of this body of literature are that oil price shocks have both inflationary and recessionary effects on output. A second body of literature has investigated the impact of monetary policy on commodity prices (Barsky and Kilian 2002; Frankel, 2007). A third strand of literature (initiated by Hall (1982)) examined the role of commodity prices in the conduct of monetary policy. Indeed, many papers have investigated the impact of commodity prices on the monetary policy of the US Federal Reserve (Fed). We have noted, among others:

- Garner (1985, 1989), who argued that central bankers should not target commodity prices because these prices are difficult to control. In addition, the Consumer Price Index (CPI) and commodity prices are not fully cointegrated. In other words, the combination of the CPI and commodity prices does not lead to a stable relation in the long run;

- Boughton and Branson (1988), who interpreted commodity prices as a leading indicator of the CPI; thus, turning points in commodity prices preceded those in CPI inflation;

- ong (1989), who noted that commodity prices help to improve inflation forecasting and can be useful for the conduct of monetary policy;

- Cody and Mills (1991), who concluded that taking commodity prices into account in monetary policy decisions makes it possible to improve the understanding of inflation and output dynamics. They noted nevertheless that the Fed has made its policy decisions without using commodity prices.

However, more recent papers have not confirmed these findings, but have shown time-dependent links between commodity prices and inflation. Bloomberg and Harris (1995), for example, found that commodity prices are reliable forecasters of the CPI in the 1970s and early 1980s but not in the mid-1980s. Furlong and Ingenito (1996) reached the same conclusion. According to Polley and Iombra (1999), commodity prices do not provide significant information on the dynamics of short-term interest rate spreads and exchange rates. Subsequently, the use of commodity prices in the conduct of monetary policy has been marginal since the 1990s.

A third strand of literature examined the impact of commodity prices on expected inflation. For example, Kilian and Lewis (2011) claimed that the conventional monetary policy model should be replaced by a more structural one, such as Dynamic Stochastic General Equilibrium (DSGE) models that allow better account to be taken of the endogeneity of oil prices. Bodenstein *et al.* (2012) used the proposals of Kilian and Lewis (2011) and concluded that central bankers should respond to oil price fluctuations.

In addition, a few studies have focused on countries other than the USA. In this respect, we can cite: Boughton and Branson (1988) for a set of developed countries; Hamori (2007) for the Japanese economy; Bloch *et al.* (2006) for two major commodity exporters, namely Australia and Canada; Ocran and Biepke (2007) for South Africa; and Hassan and Salim (2011) for Australia.

Our paper is related to the strand of literature in which changes in commodity indicators are one of the determinants of the conduct of monetary policy. Our aim is to study the relation between commodity indicators and monetary policy instruments. We focus on a set of heterogeneous countries (the USA, the euro area, Brazil, India, Russia and South Africa) over the period spanning January 1999 to August 2012. Here, short-term interest rates represent the monetary policy instrument. In order to highlight some stylised facts linked to the volatility of the variables of interest, we first run univariate exponential GARCH (EGARCH) models of commodity prices and short-term rates. Then, we implement country-by-country Vector Autoregressive (VAR) models and investigate the impulse responses of short-term interest rates to shocks in commodity volatilities. Finally, we implement threshold VAR (TVAR) models to test the presence of multi-episodes in interest rate dynamics. These are designed to describe interest rate dynamics, assuming that the threshold variable is represented by commodity volatilities. The implicit assumption is that central bankers use commodity prices as a signal to change the policy stance.

The remainder of the paper is organised as follows: Section 1 provides a general overview of monetary policy frameworks and of recent developments in commodity markets. Sections 2 and 3 present the benchmark models along with the empirical results. Section 4 concludes.

I. GENERAL OVERVIEW

Regarding the different monetary policy frameworks, we recall that the main objectives of the Fed are to stabilise inflation and to promote full employment. To achieve these objectives, the Fed adjusts its funds rate. However, during the recent financial crisis, unconventional measures were implemented to provide markets with liquidity (e.g. forward guidance, large-scale asset purchases, and short-term interest rates close to the zero bound). The single objective of the European Central Bank (ECB) consists in stabilising inflation. Its main instruments are its refinancing rates. The ECB also experimented with unconventional measures during the recent crisis (e.g. Long-Term Refinancing Operations (LTROs), the Securities Market Programme (SMP), etc.). Brazil and South Africa apply inflation targeting policies. The Central Bank of Brazil (CBB) has a CPI inflation target range of 2.5% to 6.5%. The CBB's main instrument is the SELIC rate on overnight collateralised loans. The South African Reserve Bank (SARB) has a CPI inflation target range of 3% to 6%. Its key policy instrument is the repurchase rate.

The objectives of the Reserve Bank of India (RBI) are, on the one hand, to keep stable the prices of goods and services and to guarantee financial stability and, on the other hand, to ensure a sufficient flow of credit to productive sectors. The RBI uses two key instruments (repo and reverse repo rates) and two reserve requirements (the cash reserve ratio and statutory liquidity ratio). Finally, the Bank of Russia (BoR) has adopted an inflation target and an exchange rate target. The BoR can adjust reserve requirements or intervene directly on financial markets via open market operations in order to achieve its objectives. Thus, inflation-targeting is one of the main objectives of these central banks, while short-term interest rates serve as an instrument of monetary policy.

Regarding trade in commodities, the countries under review include net commodity exporters (Russia, Brazil and South Africa) and net commodity importers (the USA, the euro area and India).[7] In 2011, India showed one of the highest negative commodity trade balances: -7.2% of GDP, compared with -2.1% and -3.6% for the USA and the euro area respectively. In addition, India recorded a high ratio of commodity exports to GDP (around 8% of GDP, compared with 2.5% for the USA). The net exporters group is also rather heterogeneous**:** in 2011, Russia posted a commodity trade balance to GDP ratio of 15%

[7] It could also be useful to split commodities into oil and soft commodities, which are quite different in terms of production processes, contribution to GDP, market organization, etc. (see "Robustness checks" section).

(compared with 4.1% for Brazil) while its ratio of commodity exports to GDP reached 17.6% (compared with 6.6% for Brazil and 13.6% for South Africa). Moreover, Brazil is a net exporter of crude oil but a net importer of processed oil. Conversely, India is a net importer of crude oil and a net exporter of processed oil. The euro area, the USA and South Africa are net importers of energy.

Thus, commodity price swings may affect these countries differently: an increase in commodity prices could boost export revenues, stimulate aggregate demand and most likely lead the economy to inflationary pressures through demand in the case of Russia; inflationary pressures could be driven only by the supply side in the case of India or the USA.

1. Which commodities and policy instruments should we focus on?

The dataset is drawn from Datastream. The sample of countries allows us to consider the two major global developed economies and some of the largest emerging markets. China has been excluded from the analysis given that the corresponding financial markets and public policies are less market-driven. The database consists of monthly observations spanning January 1999 to August 2012. Last-day-of-the-month observations are used in order to avoid any overlapping bias. Monthly frequency enables us to include macroeconomic factors in the analysis. The starting date matches the introduction of a common monetary policy in the euro area. The sample period is quite representative as it encompasses several episodes of increases and decreases in commodity prices and volatility, as well as phases of conventional and unconventional monetary policy measures.

The Commodity Research Bureau (CRB) index and the Brent crude oil price are the commodity indicators used. Both are traded in US dollars. We chose the CRB index for the following reasons: i) it is widely accepted in the literature (Kilian and Lewis (2009); ii) unlike other indicators such as the US Bureau of Labour Statistics (BLS) or the Producer Price Index (PPI) which are compiled from surveys of US firms and based on current prices, the CRB index is a global market-based indicator indexed on futures contracts on a large set of commodities. Early signals from futures contracts on commodities can help to derive inflation expectations; they may therefore be relevant for monetary policy purposes. Third, the PPI is mainly used in studies relating to the USA. In a more global perspective, the CRB index is more relevant. Nonetheless, despite the low correlation between the two indicators over our sample period (0.35), the CRB and the PPI display quite similar dynamics. Indeed, since the

last rebalancing of the CRB index, the two indicators share most commodity category weightings.[8] However, the CRB index appears to be more volatile, with movements preceding those of the PPI.

It is worth noting that findings may be sensitive to the choice of volatility measures or monetary policy instruments, for example. Robustness checks could help to disentangle the effects of these choices.

Unfortunately, indicators of activity such as the industrial production index and the retail sale index are not available with a monthly frequency for some countries in our sample. Therefore, real activity indicators are not included in the benchmark empirical analysis.

According to Borio (2011) and Svensson (2003) among others, a monetary policy can be seen to operate by controlling the short-term interest rate. In other words, a short-term interest rate captures the effect of the monetary policy on the economy. In this respect, it can be regarded as a monetary policy instrument. We can therefore assume that the short-term interest rate reflects the monetary policy stance. Indeed, for the monetary policy of the ECB, it is customary to use the Euribor (1-month or 3-month) or the Eonia (overnight) rates as policy instruments. It is also traditional to use the short-term Federal Fund rate for the Fed's monetary policy. Thus, in this paper, the domestic interbank 3-month interest rate acts as a monetary policy instrument. Note that the first-order difference (for short-term interest rates) and log-difference (for commodity indicators and real activity indicators) prove to be sufficient to remove any unit root in the considered series.

In general, central bankers do not take into account commodity price inflation for the conduct of monetary policy. Many central bankers, especially those of the emerging countries, use core inflation (excluding food and energy prices) to determine the inflation's target. Despite the fact that most of emerging countries' central banks base their decision on the development of core inflation target, we use headline CPI series for all economies under review in this paper. Our approach can be justified by: i) it is not easy to have coherent and reliable core inflation for the countries over review, especially for the BRICS countries; (ii) in developedcountries, and especially in the euro area and the US, central bankers monitor headline inflation; (iii) taking into account core inflation only would dramatically differ from

[8] The CRB index weights since 2005: 39% energy; 41% food; 20% precious metals and industrial base. BLS PPI weights for crude materials since 2009: 41% energy; 41% food; 18% industrial base. See Gubler and Hertweck (2013) for more details on the characteristics of the Bureau of Labour Statistics commodity price index.

the representative consumption basket, especially for the developing countries. For instance, food products alone represent more than 40% of the consumer basket in India, 30% in China and Russia and about 25% in Brazil.

The monthly real activity indictors (retail sales index and industrial production index (IPI)), used in the robustness checks section, are also drawn from the Datastream database. Unfortunately, reliable monthly indicators of real activity are not available for Russia and South Africa. We performed an interpolation on India's quarterly IPI to obtain monthly data. In addition, sales data for Brazil and IPI data for Russia are also converted to monthly frequency.

2. Commodity prices and monetary policy instruments

Changes in both commodity indicators and domestic short-term interest rates present historical averages close to zero over the period under review. Most of these variables are leptokurtic and display negative skewness. In addition, short-term interest rates dropped over the period. However, their standard deviations are quite high for Russia and Brazil, reflecting their domestic financial issues (banking crisis in Russia and debt crisis in Brazil).

Figure 1 shows that the Brent crude oil price and CRB index display similar patterns over the period under review. Between 1999 and 2002, non-fuel commodity prices declined steadily, while oil prices were fairly stable. Commodity prices rose sharply from 2003 onwards: the price of a barrel of crude oil hovered around $25 in 2002 to reach a record $140 during the summer of 2008, while metal and mineral prices also displayed a historic increase. Commodity prices continued to rise after the 2007 subprime crisis. However, oil prices peaked during the summer of 2008 and then plummeted to their 2005 levels at the beginning of 2009 in the aftermath of the global economic crisis. From mid-2009, commodity prices were back on a positive trend due to the fast recovery in the emerging economies (particularly China and India), which were the drivers of the global demand for commodities. This demand is mainly driven by structural factors which have positive outlooks (Radetzki 2006). The other salient demand-side factors include: the weakness of the US dollar, a growing demand for biofuels that pushed up demand for agricultural commodities, and a massive "financialization" of commodity markets, leading to a sharp rise in speculation on these markets. The supply side was especially marked by shortfalls following the 2010 droughts in Eastern Europe and Russia, and floods in Asia. Other factors include: unanticipated demand

shocks and, with respect to oil, geopolitical unrest and increasing uncertainty about the global economy.

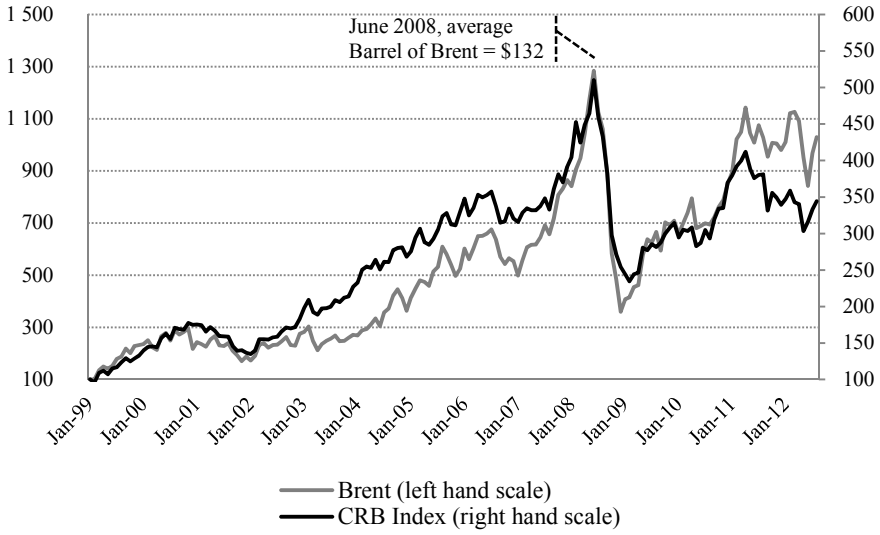


Figure 1 - Brent and CRB (Jan. 1999=100)

Source: Datastream.

In addition, according to Cashin and McDermott (2002), changes in volatility, especially increases in the volatility of commodity prices, have more policy implications than its long-run trend. Moreover, the commodity markets are reliable alternative investment instruments both for hedging and diversification. Therefore, commodity price volatility can be viewed as one of the key factors in the dynamics of global financial stability (Mensi *et al.*, 2013; Nazlioglu *et al.*, 2013; Sari *et al.*, 2012).[9] In other words, the volatility of commodity prices can be likened to that of other financial assets. Thus, central banks could incorporate the dynamics of commodity price volatility into their decision-making processes.

3. What indicators should we use for commodity price and short-term interest rate volatilities?

We assume that the CRB, the price of Brent and short-term interest rates are driven by an ARMA-EGARCH process. This specification is commonly used for the returns on financial assets. More formally, the process $\{y_t\}_{t=1}^{T}$ of an endogenous variable is defined by an ARMA(p,q)-EGARCH(r,s)

$$y_t = \mu + \sum_{i=1}^{p} \psi_i y_{t-i} + \sum_{i=1}^{q} \phi_i \varepsilon_{t-i} + z_t \sqrt{h_t}$$

$$\log(h_t) = \alpha_0 + \sum_{i=1}^{r} \left(\alpha_i z_{t-i} + \gamma_i (|z_{t-i}| - \mathbb{E}|z_{t-i}|) \right) + \sum_{i=1}^{s} \beta_i \log(h_{t-i}) \qquad (1)$$

$$z_{i,t} \overset{i.i.d}{\longrightarrow} \text{GED}(\nu, \xi)$$

where, ψ_i and ϕ_i capture the AR and MA dynamics on the conditional mean respectively, and α_i, β_i, and γ_i capture the GARCH, the asymmetry and the leverage effects on the conditional variance or volatility respectively. GED (ν, ξ) is the standardised asymmetric Generalised Error Distribution (GED), with skewness parameter ν and shape parameter ξ, which allows us to take into account the presence of fat tails and asymmetry in the distribution of the series.

Univariate models (two for commodity prices and six domestic interest rates) are estimated over the whole period. Conventional information criteria (Akaike, Schwartz, Hannan and Quinn, etc.), enable us to select an AR(1)-EGARCH(2,2) for both commodity prices and short-term interest rates. The regressions are run using the rugarch R package designed by Ghalanos (cf. http://cran.r-project.org/web/packages/rugarch/). The results are reported in Appendix A. Apart from Russia's short-term interest rate, the maximum likelihood estimators converge for the parameters of all of the models. Most of the estimated parameters are significantly different from 0. The estimated conditional variances are stationary ($\sum_{i=1}^{s} \beta_i < 1$).

In order to test the reliability of our model-based measure of volatility, we have compared the fitted conditional volatility with more standard rolling non-parametric indicators of dispersion, namely the standard deviation (SD), the inter-quartile ratio (IQR), the mean absolute deviation (MAD), the variation coefficient (VC) and the normalised inter-quartile ratio (NIQR). We note that the SD, IQR and MAD statistics display patterns similar to that of the conditional variance derived from our AR-EGARCH models (see Figure 2). With regard to the CRB data, the cross-correlations of these measures lead to even better results, as they are greater than 0.60 irrespective of the country (compared with 0.50 for the Brent series). The calculations of the concordance index confirm these findings, especially for SD, IQR and MAD.

In other words, these statistics are broadly characterised by similar dynamics. In particular, the peaks and troughs coincide, irrespective of the statistic. From this point of view, these results appear fairly robust. As the patterns displayed by the rolling VC and NIQR are quite different from the model-based measures, we will use these indicators as alternative indicators of volatility in the robustness checks.

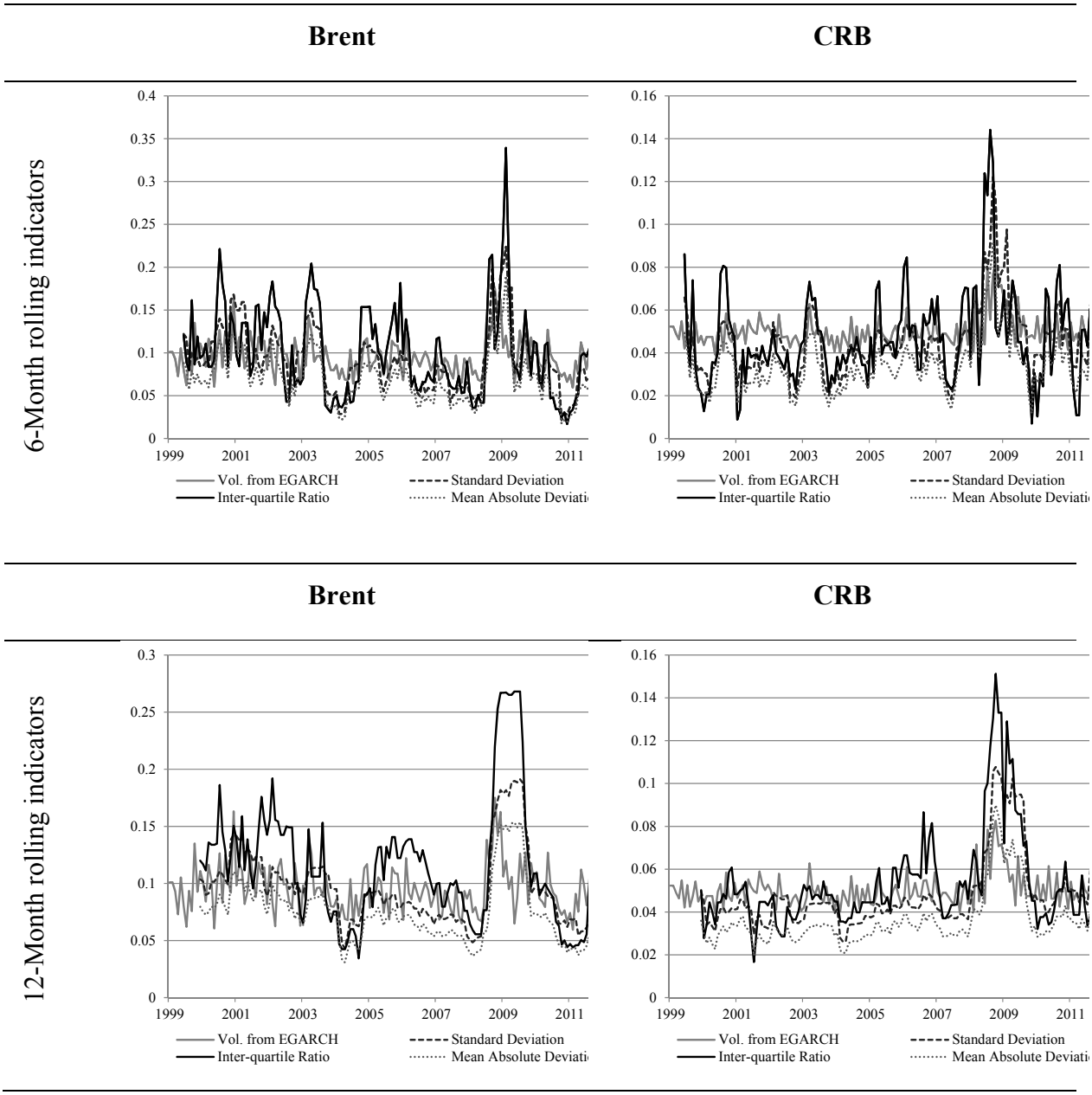


Figure 2 - Dynamics' comparison between the indicators of dispersion

4. What conclusion can we draw from the joint descriptive analysis of commodity prices and short-term interest rate volatilities?

The 12-month rolling correlations between model-based commodity and short rate volatilities are clearly time-varying (Appendix A).[10] In addition, the correlation coefficients between the volatility of short-term interest rates and of the CRB on the one hand and that of Brent on the other hand, are roughly similar. Thus, whatever the indicator of commodity prices, there is no significant discrepancy between the correlation values, even though the levels of correlation are not exactly the same.

Moreover, we note that the correlation coefficients are quite volatile (they move roughly from -0.70 to 0.90 in each country over the period) and can be positive or negative depending on the global outlook or country-level events. For instance, we observe the highest change in correlations in the immediate aftermath of the Lehman Brothers failure. For Brazil, the euro area and Russia, the correlations peak just after the crisis. The peak is observed later for the USA, India and South Africa. The early 2000s correspond to low correlations in all countries. However, the correlations are significantly high and subject to sharp variations between 2002 and 2008, when the oil price increased dramatically (from $25 to $140).

II. JOINT DYNAMIC ANALYSIS OF COMMODITY PRICE VOLATILITIES AND SHORT-TERM INTEREST RATES

1. Model specification and estimation results

In order to analyse the joint relation between commodity price volatilities and monetary policy instruments in each country, we estimate an unrestricted VAR model (Sims 1980, Lütkepohl 1991). The domestic short-term interest rate, the CPI, and CRB volatility (derived from the estimated AR-EGARCH models) are the endogenous variables. If we note y_{it} the vector of the stationary endogenous variables for country i $(i = 1, \dots, 6)$, the corresponding VAR model is given by

$$A_i(L)y_{it} = c_i + \varepsilon_{it} \qquad (2)$$

[10] The results obtained with 6-month rolling correlations are roughly similar to those presented here. As expected, the 12-month rolling correlations are smoother.

Where $A(L)$ is a polynomial matrix in the lag operator L of order p, c is a 3×1 vector of intercepts, and $\varepsilon_{it} \sim \mathcal{N}_3(0, \Sigma_i)$, with $\mathcal{N}_3(\cdot)$ a 3-dimensional normal distribution and Σ_i a time invariant covariance matrix.

According to conventional information criteria, a VAR(2) model seems to be the most suitable one for most of the six economies under review. All calculations are performed using the vars R package by Pfaff (cf. http://cran.r-project.org/web/packages/vars/). Hereafter, we refer to these models as "benchmark models". Impulse response analysis is performed on each of them to study the impact on the domestic short-term interest rate of a unit (1 standard deviation) shock on CRB volatility. The empirical results are reported in Table 1.

Commodity volatility influences the short-term interest rate of all the countries with the exception of Brazil. The interest rate is impacted negatively with a one-month lag by CRB volatility for India and the euro area, with a much higher coefficient for the former (-0.17 compared with -0.07 for the euro area). These results might be explained by the macroeconomic context of these two countries with respect to commodities. Indeed, they post the highest commodity trade-to-GDP deficit within our sample. In addition, except for Brazil and Russia, the short-term interest rate is impacted negatively by two-month lagged CRB volatility. In the case of Russia, the short-term interest rate displays very different dynamics: it is positively linked to one-month lagged CRB volatility. Brazil's short-term interest rate does not react to commodity volatility. These two characteristics might be due to the trade profile of Brazil and Russia which are the only net exporters of crude oil in our set. Moreover, if we break down the commodities composite index into different components (oil, soft commodities, etc.), it is possible to improve the relation between the short-term interest rate and commodity volatility in Brazil, which is one of the biggest producers of soft commodities. To sum up, with the exception of Brazil and Russia, higher commodity volatility leads to lower short-term interest rates. In other words, if uncertainty regarding commodity prices increases, the responses of central banks are attenuated. These results are in line with common central bank responses when uncertainty prevails with respect to other macroeconomic and financial indicators.

The impulse response functions of the domestic short-term interest rate following a CRB volatility shock reveal common patterns with a slightly specific feature (see Appendix B). Due to insignificant coefficients of its VAR model, Brazil has been excluded from the analysis. First, the US interest rate decreases one month after the shock, reaches its lowest value after two months, and then reverts to its initial value three quarters later. The

convergence pattern is quite erratic. Second, the Indian interest rate decreases to its lowest value after one month. The shock absorption is rather slow (around three quarters), but the effect is less protracted than for South Africa or the euro area. South Africa's and the euro area's interest rates also react after one month and reach a trough after two. The shock is absorbed quite slowly since it takes about a year for interest rates to revert to their former values. Finally, Russia's interest rate rises in response to the shock. It peaks after one month and falls slowly for about twelve months to reach its initial value.

Overall, the commodity shock has a very rapid impact; short-term interest rates reach a trough (a peak in the case of Russia) after just one or two months. The effect is quite persistent since the recovery takes place in all countries after three or four quarters.

		Endogenous		
		SIR	CRB Volatility	CPI
USA	SIR (-1)	-	-	-
	SIR (-2)	-	-	0.00**
	CRB Volatility (-1)	-	-	-
	CRB Volatility (-2)	-0.08***	0.53*	-0.08***
	CPI (-1)	-	-	0.59*
	CPI (-2)	-	0.38**	-0.30*
	Intercept	-	0.02*	0.01***
Euro area	SIR (-1)	0.40*	-	-
	SIR (-2)	-	-	-
	CRB Volatility (-1)	-0.07*	-	-
	CRB Volatility (-2)	-0.07*	0.41*	-
	CPI (-1)	-	-	-
	CPI (-2)	-	-	-0.26*
	Intercept	0.01*	0.03*	0.01**
Brazil	SIR (-1)	0.61*	-	0.00*
	SIR (-2)	-0.16***	-	0.00**
	CRB Volatility (-1)	-	-	-
	CRB Volatility (-2)	-	0.43*	-
	CPI (-1)	0.53**	-	0.62*
	CPI (-2)	-0.48**	-	-
	Intercept	-	0.03*	0.01*
India	SIR (-1)	-0.14***	-	-
	SIR (-2)	-	-	-
	CRB Volatility (-1)	-0.17**	-	-
	CRB Volatility (-2)	-0.09***	0.44*	-
	CPI (-1)	-	0.12***	0.19**
	CPI (-2)	-	-	-
	Intercept	0.01**	0.02*	-
Russia	SIR (-1)	-0.24*	0.00***	-
	SIR (-2)	-	-	-
	CRB Volatility (-1)	0.46***	0.42*	-
	CRB Volatility (-2)	-	-	-
	CPI (-1)	-	-	0.58*
	CPI (-2)	-	-	-
	Intercept	-	0.03*	-
South Africa	SIR (-1)	0.25*		0.01*
	SIR (-2)	-		-
	CRB Volatility (-1)	-		-
	CRB Volatility (-2)	-0.08**	0.45*	0.08*
	CPI (-1)	-		0.22*
	CPI (-2)	0.11***		-
	Intercept	0.01**	0.02*	-

Table 1 – Results for country-level VAR(2)

SIR: short-term interest rate.
*, ** and *** denote 90%, 95% and 99% confidence levels respectively – otherwise, the coefficients are not reported.

2. Sensitivity analysis

We have carried out a set of robustness checks by comparing the previous VAR models with two alternative specifications. First, we introduce a domestic monetary aggregate (M2) as an additional variable into the VAR models (hereafter "augmented models"). Second, we split the sample into two, and we estimate the benchmark VAR models over the period spanning April 1999 to August 2008 (prior to Lehman brothers' collapse). The resulting models are referred to as "truncated models".

2.1. Introduction of monetary aggregate

The monetary aggregate indicator is considered to challenge the role of commodity volatility (namely the CRB volatility) as a driver of interest rates. Unfortunately, there is no monetary aggregate for Russia, which is not included in this paragraph. The results of the introduction of M2 into the VAR models do not significantly affect the empirical results (not reported here due to space limitations). Except for South Africa, the results are almost stable regarding the relation between the short-term interest rate and commodity volatility. Significant coefficients in the benchmark VAR model are still significant and very close in value in the corresponding augmented models. There is no relation between M2 and CRB volatility for Brazil, which seems to confirm the result of the previous section. Regarding South Africa, CRB volatility impacts the short-term interest rate positively in the augmented setting. However, the interest rate remains sensitive to two-month lagged CRB volatility and the related coefficient is even higher in absolute terms.

2.2. Out-of-sample simulations

The estimates over the period spanning April 1999 to August 2008 lead to some different conclusions compared to the results of the benchmark model. The impact of CRB volatility on interest rates disappears for the USA and South Africa. There is also no longer any negative impact after two months for India. As for Brazil, there is still no link between the two variables, and in the case of Russia, the short-term interest rate still reacts positively to one-month lagged volatility. The euro area exhibits a significant negative impact on the short-term interest rate of one-month lagged CRB volatility. The coefficients are close to those estimated earlier

Overall, the results are quite consistent with the benchmark models for the euro area, India and Russia. The discrepancies regarding the USA and South Africa could be explained by the financial crisis which may have modified central banks' views on commodity markets. It is possible that commodity price developments have been monitored closely since the Lehman Brothers collapse.

We then conduct recursive 1-step out-of-sample simulations over the period September 2008-August 2012. The simulated variables and confidence intervals are reported in Figure 3. The predictive power of the models appears to be quite poor as the truncated models now became unsuited to explain or forecast short-term interest rates. In addition, the RMSE statistics confirm the previous results: the predictive performances of the VAR models are poor for all countries: the RMSE is at least three times greater than the average variation in short rates for all countries. This is probably due to changes in the relation between short-term interest rates and commodity volatility. The expected model is a state-dependent model. Thus, models such as Threshold VAR (TVAR) models can help to improve the analysis.

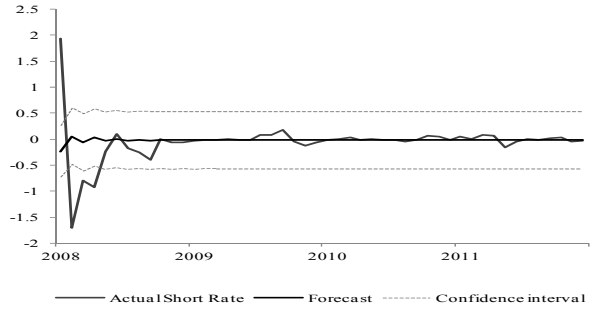
III. TVAR MODELS

Policy-makers react to commodity market changes if they observe or expect significant variations or trend breaks on these markets. From this perspective, it is relevant to use commodity volatility as an indicator of changes in the monetary policy stance.

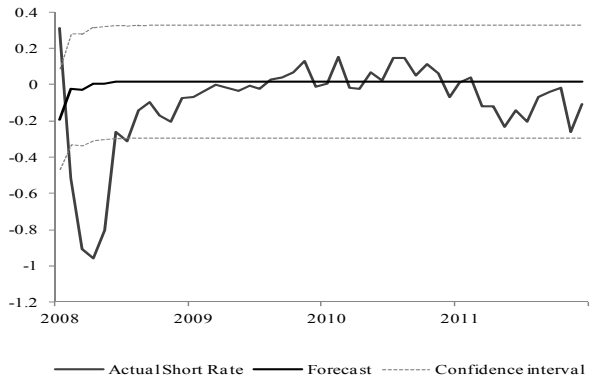
1. Model specification and estimation results

If we assume that changes in monetary policy depend on a specific value of the growth rate of commodity volatility, γ, then the variations in the short-term interest rate occur in accordance with γ. Therefore non-linearity is introduced into the dynamics of the variables under review. Let us recall that Kilian and Vigfusson (2013) showed that symmetric non-linear models help to improve GDP forecasts based on oil prices.

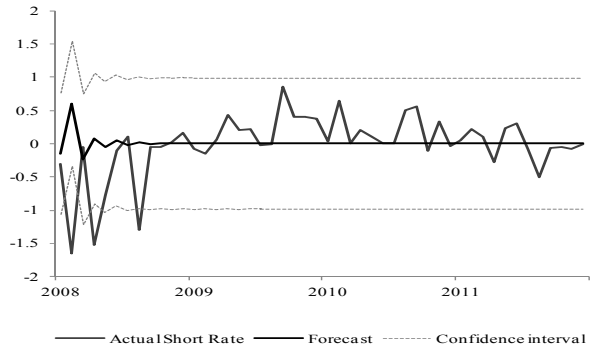
USA



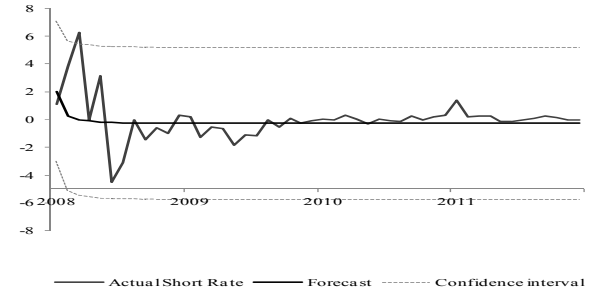
Euro area



India



Russia



South Africa

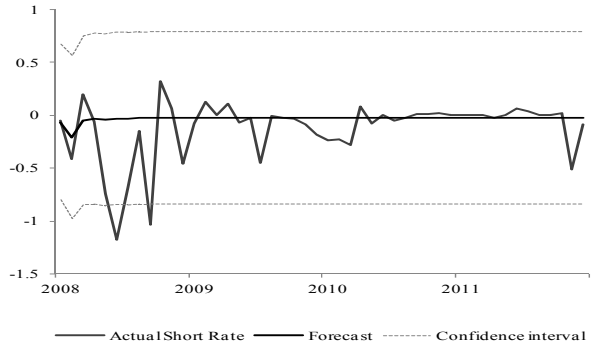


Figure 3 - Simulated and actual interest rates (Sep. 2008-Aug. 2012)

To be more precise, for each economy i ($i = 1, \dots, 6$) a bivariate threshold VAR (TVAR) model including short-term interest rates and the CPI is considered. The system switches between two regimes (hereafter called "high-growth regime" and "low-growth regime"[11]) depending on the position of changes in CRB volatility z_t with respect to an unknown threshold, λ.

[11] "High-growth" (respectively "low-growth") regimes refer to periods during which endogenous variables' average is high (respectively low). It is not a reference to macroeconomic conditions.

The form of the TVAR model is as follows:

$$y_{it} = \begin{cases} A_i^{(1)}(L) y_{i,t-1} + \varepsilon_{it} & \text{if } z_{t-k} \leq \lambda, \\ A_i^{(2)}(L) y_{i,t-1} + \varepsilon_{it} & \text{if } z_{t-k} > \lambda, \end{cases} \quad (3)$$

Where $A_i^{(1)}(.)$ and $A_i^{(2)}(.)$ are polynomial matrices in the lag operator L of order p_1 and p_2 respectively, k the delay order of z_t and $\varepsilon_{it} \sim \mathcal{N}_2(0, \Sigma_i)$, with $\mathcal{N}_2(\cdot)$ a bivariate normal distribution and Σ_i a time-dependent covariance matrix.

Before estimating the models, we perform the Hansen-type linearity test (Hansen, 1999): a linear VAR against one-threshold TVAR, and a linear VAR against two-threshold TVAR. Both tests lead us rejecting the linearity null hypothesis (at least at the 90% significance level) for all countries except India (Table 2).

	VAR against one-threshold TVAR		VAR against two-thresholds TVAR	
	Statistic	p-value	Statistic	p-value
USA	42.57	0.02	78.56	0.02
Euro area	44.47	0.00	67.38	0.00
Brazil	56.88	0.01	86.97	0.03
India	22.96	0.14	39.27	0.26
Russia	31.9	0.06	59.68	0.05
South Africa	49.63	0.00	82.22	0.00

Table 2 – Linearity tests results

The traditional criteria allow us to identify the TVAR(2) model for all of the countries. The TVAR(2) models are estimated using the *tsDyn* R package designed by Di Narzo, Aznarte and Stigler (cf. http://cran.r-project.org/web/packages/tsDyn/). Hereafter, we refer to these models as "benchmark models". The results exhibit some common patterns (Table 3).

First, the distribution of the regimes seems linked to the degree of development of the countries, except for South Africa. Indeed, the proportion of low-growth regimes is larger than that of the high-growth regimes in the USA and the euro area, where the percentage of the low-growth regime is higher than 80%. The results are more balanced in Brazil, India and, to a lesser extent, Russia where the percentage of low and high-growth regimes is closer. Finally, the distribution of the regimes for South Africa is similar to that observed in the most developed countries.

Second, the empirical thresholds fluctuate around 5.20% and range from 4.6% (Russia) to 5.9% (euro area). The differences between the countries are fairly small, even though the thresholds for the most developed economies are slightly larger. Once again, South Africa behaves like the USA and the euro area.

Third, in the low-growth regimes, short-term interest rates are driven by their own lagged values for the USA, the euro area, India and South Africa. In addition, except for India, the coefficients of the lagged short-term rates are positive and quasi-identical. In the case of Brazil and Russia, only lagged values of the CPI have an impact on short-term interest rates: the short-term interest rate is positively correlated to one-month lagged CPI (with a small but negative intercept, -0.30) for Brazil, and negatively linked to two-month lagged CPI (with a high and positive intercept, 1.40) for Russia.

Finally, the situation is more interesting in high-growth episodes where the regimes seem driven by more explanatory factors. For the most advanced countries, regarding short-term interest rates, we observe a joint effect of the lagged values of both interest rates and the CPI. Thus, for the USA, the effects of one-month and two-month lagged short-term interest rates are negative but those of the CPI are positive. For the euro area, the dynamics regarding the short-term interest rate are more complex, but a positive effect prevails. Indeed, the sum of the coefficients of the one-month and two-month lagged short-term interest rate remains positive. Brazil, India and South Africa display a positive impact of the one-month or two-month lagged short-term interest rate on the monetary policy instrument. South Africa is also characterized by a negative effect of the two-month lagged short-term rate. The link between the short-term interest rate and its one-month lagged rate is negative in Russia. The effect of inflation on the short-term rate is more heterogeneous: there is no effect for Brazil; the impact is positive for India and South Africa, and negative for Russia.

2. Robustness checks

For the purposes of robustness (Table 4), we first introduce a monetary aggregate (M2) into the TVAR models (hereafter "M2-augmented TVAR models"). Second, some activity variables (retail sales index and IPI) are integrated in the TVAR's framework (hereafter "sales-augmented" and "IPI-augmented" models). Finally, we run alternative models by replacing the CRB volatility threshold variable by the volatilities of the CRB Food Index, the CRB Metals Index and the CRB Crude Industrial Index; as well as the rolling VC and NIQR

measures of volatility. Whatever the alternative threshold variable used, we refer to these models as "alternative-threshold TVAR models".[12]

Countries	Regimes	Endogenous	SIR (-1)	SIR (-2)	CPI (-1)	CPI (-2)	Intercept	Threshold (%)	Obs. (%)
USA	LGR	SIR	0.35*	-	-	-	-	5.52	83
		CPI	-	-	0.45*	-0.27*	0.00*		
	HGR	SIR	-0.35*	-0.21***	0.27**	0.34*	-0.15**		17
		CPI	0.00**	0.00*	1.02*	-	-		
EURO	LGR	SIR	0.30*	-	-	-	-	5.85	89
		CPI	-	-	-	-0.32*	0.00*		
	HGR	SIR	1.22*	-0.39*	-0.26*	-	-		11
		CPI	0.01**	-0.01***	-	0.43**	-		
BRAZIL	LGR	SIR	-	-	0.80*	-	-0.30***	4.82	50
		CPI	0.00*	0.00*	0.71*	-	0.00*		
	HGR	SIR	0.92*	-	-	-	-		50
		CPI	-	0.00***	0.49*	-0.27**	0.00*		
INDIA	LGR	SIR	-0.26**	-	-	-	-	4.90	55
		CPI	-	-	0.23**	-	0.00*		
	HGR	SIR	-	0.30*	0.13*	-	-0.16**		45
		CPI	0.00**	-	0.19**	-	0.01*		
RUSSIA	LGR	SIR	-	-	-	-2.43*	1.40**	4.64	31
		CPI	0.00*	-	0.52*	-	0.00*		
	HGR	SIR	-0.19**	-	-0.82**	-	-		69
		CPI	-	-	0.64*	-	0.00*		
SOUTH AFRICA	LGR	SIR	0.20*	-	-	-	-	5.47	81
		CPI	0.01*	-	-	-	0.00*		
	HGR	SIR	0.39*	-0.47**	-	0.44*	-0.29*		19
		CPI	-	-	-	-	-		

Table 3 – Results for TVAR(2) models

SIR: short-term interest rate.
*, ** and *** denote 90%, 95% and 99% confidence levels respectively – otherwise, the coefficients are not reported.

2.1. Introduction of M2

The introduction of M2 into the framework does not change the regime distribution except for India, where the proportion of the high-growth regime is larger (67% compared with 45% in the benchmark model) even though the estimated thresholds are still identical in the two models. In addition, there are no discrepancies between the two models regarding the low-

[12] We also test for robustness by replacing the 3-month interbank rate by overnight interbank rates. Due to the difference between these two monetary policy instruments, the empirical results are quite different.

growth regime, especially in terms of the main determinants of this regime. The coefficients are still statistically equal irrespective of the country. Regarding the high-growth regime for the USA, the impact of inflation on the short-term interest rate no longer prevails in the M2-augmented model – rather, we observe a significant impact of M2. For the euro area, the results are still roughly similar even though the benchmark model seems almost stable. Results for the emerging countries are the most robust as there are no significant differences between the two frameworks. So overall, the estimation of the M2-augmented model does not lead to significant differences regarding the dynamics of short-term interest rates. As a consequence, we still favour the benchmark model since it is easier to control.

2.2. Introduction of real activity indicators

We notice a broad similarity in the regime distribution in both the IPI-augmented and benchmark models irrespective of the country. The regime distributions are nearly identical in the USA, Brazil and South Africa. They differ slightly for the euro area due to the larger proportion of the low-growth regime in the IPI-augmented model. The distribution is quite different for India (where the high-growth regime prevails in the IPI-augmented model while the low-growth regime predominates in the benchmark model) and for Russia (where the proportion of low-growth regimes is larger than that of high-growth regimes). The estimated thresholds are still similar (especially for the USA, Brazil and India) and range from 4.6% to 5.9% for the two models. However, we observe a very slight difference between the estimated thresholds for the euro area and Russia. Regarding the coefficients, we can divide the set of countries into two sub-groups. In the first group, which includes the USA, Brazil, South Africa and, to a lesser extent, the euro area, the coefficients for the IPI-augmented model are still statistically invariant whatever the regime. In the second group (India and Russia), only some coefficients are still invariant. For this second group, the differences between the coefficients appear, in general, when the real activity indicator has an impact on the short-term rate in at least one regime. Overall, the performances of the two models are roughly comparable, while the benchmark model seems almost robust.

For the sales-augmented model, the regime distribution and the estimated thresholds are still identical except for Brazil, where the high-growth regime clearly prevails (81% in the sales-augmented model compared with 50% in the benchmark model). However the dynamics of the short-term interest rates generated by the model vary according to both the regimes and

countries concerned. For the euro area, the estimated coefficients of the two models are equivalent in both the low-growth and high-growth regimes, while they significantly differ for the USA. The rest of the countries share one of these features. To sum up, the performances of the sales-augmented and benchmark models are similar in terms of regime distribution but more nuanced with regard to the coefficients' values.

2.3. Sensitivity to the choice of threshold variable

The idea consists in replacing the model-based AR-EGARCH volatility of the CRB index by that of the CRB index for a specific product (metals, food or crude industrial goods). We then compare the results to those of the benchmark model. We only focus on the regime distribution and the estimated thresholds. When the threshold variable is defined by the volatility of the CRB Metals Index, the results of the benchmark models are confirmed for four out of six countries (the euro area, India, Russia and South Africa). For the euro area, for example, the low-growth regime still prevails in the alternative-threshold model and the threshold remains relatively large (around 5%).

Replacing the composite CRB index by the CRB Crude industrial goods index leads to some changes, particularly in terms of the regime distribution, which remains unchanged only for some countries. For India, the USA and South Africa, the low-growth regime predominates in the alternative-threshold model, as was the case in the benchmark model. However, the alternative-threshold models seem more volatile as the threshold ranges from 3.4% (Brazil) to 6.20% (India), compared with 4.6% to 5.90% in the benchmark model. Finally, the results of the alternative-threshold models yielded by the CRB Food Index, are quite similar to those of the CRB Crude industrial goods index: the euro area, Brazil and India still display comparable regime distribution (predominance of the low-growth regime) while the thresholds vary substantially depending on the country and range from 2.9% (South Africa) to 8.2% (Russia). Except for India, the thresholds associated with the two models are significantly different.

2.4. Sensitivity to the choice of volatility statistics

A comparison of the different measures of volatility showed that the inter-quartile ratio (IQR) and the variation coefficient (VC) do not behave in line with the other volatility measures. We then estimated alternative-threshold TVAR models where the threshold

indicator is given by the IQR and VC instead of an AR-EGARCH-based volatility. 12-month rolling calculations of IQR and VC are performed.

Irrespective of the country, the results of the alternative-threshold models are significantly different from those of the benchmark model. For the VC, for example, the thresholds range from 1.20% (Russia) to 7.2% (India), while they range between 4.6% and 5.9% in the benchmark model. Regarding the IQR, the thresholds range from 0.90 (India) to 5% (USA). These results do not seem very consistent as the triggers of change are either too small or too large. In addition, unlike the previous alternative-threshold models, the range of variation of the threshold here is too large. In this respect, the IQR and VC indicators considered seem less relevant than the previous ones.

The regime distributions are also significantly different from those obtained with the previous alternative-threshold models. In the case of the IQR, for example, only the distribution for Russia is still in line with that of the benchmark framework. Regarding the VC, only the regime distributions for the USA and Russia are still comparable to those of the benchmark model.

	M01		M02		M03		M04		M05		M06		M07		M08		Benchmark	
	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)	Threshold (%)	Observations (%)
USA	5.52	83	5.52	83	5.85	89	2.98	22	2.86	21	5.56	57	3.12	79	-5.08	11	5.52	83
EURO AREA	5.84	89	4.93	59	5.85	89	4.69	57	4.75	59	3.49	30	3.88	17	-2.36	16	5.85	89
BRAZIL	4.81	50	4.82	50	4.48	19	5.64	68	3.83	41	3.36	26	1.44	35	1.13	56	4.82	50
INDIA	4.67	33	4.63	27	-	-	4.86	61	4.55	57	6.18	66	-7.17	10	-0.88	27	4.90	55
RUSSIA	-	-	5.28	72	4.66	32	8.21	87	3.07	26	5.90	65	1.20	33	-2.64	14	4.64	31
S. AFRICA	5.46	81	5.47	81	5.83	87	2.86	15	6.08	73	5.36	55	-1.97	24	1.01	48	5.47	81

Table 4 – Robustness checks for the TVAR models

Observations (%): weight of "low-growth regime" dates in percentage of the number of observations; M01: benchmark TVAR(2) including M2; M02: benchmark TVAR(2) including IPI; M03: benchmark TVAR(2) including Retail Sales; M04: benchmark TVAR(2) with CRB Food volatility; M05: benchmark TVAR(2) with CRB Metals volatility; M06: benchmark TVAR(2) with CRB Crude industrial goods volatility; M07: benchmark TVAR(2) with the 12-month CRB variation coefficient; M08: benchmark TVAR(2) with the 12-month CRB Inter-quartile ratio.

IV. CONCLUSION

The estimation of the VAR models shows that higher commodity volatility leads to lower short-term interest rates for the USA, the euro area, India and South Africa. Brazil and Russia display divergent results. While Brazil shows no linkage between short-term interest rates and commodity volatility, Russia's short-term interest rate is a decreasing function of commodity volatility. Regarding the impact of commodities on short-term interest rates, our results allow us to postulate that for net importers of crude oil, the short-term interest rate is a decreasing function of commodity volatility, whereas for net exporters, there is no relation between the variables. A common feature for all countries is the persistence of the shock.

TVAR models show that it is appropriate to consider two different regimes for most countries. However, for the USA, the euro area and South Africa, the percentage of high-growth episodes is quite low (around 15% of the whole sample). The estimated thresholds are around 5% for all countries. Thus, the monetary authorities react when the growth rate of commodity prices becomes significantly different from zero.

The dynamics of short-term interest rates are very different from one regime to another. In the low-growth environment, short-term rates for the USA, the euro area, India, Russia and South Africa are only impacted by their lagged values. In the high-growth regime, the short-term rates of all of the countries except Brazil exhibit a significant negative effect of inflation. Brazil's short-term interest rate shows a different pattern: it is driven only by its own lagged values in the high-growth regime whereas the CPI has a significant impact in the low-growth one. The robustness checks carried out on the TVAR models roughly confirm the good performance of our benchmark model. Indeed, the empirical results confirm that:

(i) The TVAR models are suitable for identifying and understanding the joint dynamics of short-term interest rates and commodity volatility. This finding is in line with that of Kilian and Vigfusson (2013) who have shown that symmetric non-linear models help to improve GDP forecasts based on oil prices;

(ii) Commodity markets appear to have been closely scrutinised by central banks since the global financial crisis;

(iii) Monetary policy and commodity volatility remain related when M2 or real activity indicators are introduced into TVAR models;

(iv) Replacing the composite CRB index by the disaggregated indexes in the TVAR models does not significantly change the empirical results, especially in terms regime identification and estimated thresholds. From this point of view, the empirical results are relatively insensitive to the choice of indicator of commodity prices defining the threshold's variable. However, the results seem more sensitive to some statistics of commodity price volatility.

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Appendices

Appendix A.1. AR-EGARCH

	$\hat{\mu}$	$\hat{\phi}_1$	$\hat{\omega}$	$\hat{\alpha}_1$	$\hat{\alpha}_2$	$\hat{\gamma}_1$	$\hat{\gamma}_2$	$\hat{\beta}_1$	$\hat{\beta}_2$	$\hat{\nu}$	$\hat{\xi}$	LL
Brent	0.02***	0.02	-0.63	-0.35**	0.36***	-0.05	0.23	0.87	0.00	0.72*	1.45*	162.94
CRB	0.01***	0.04	-1.47	-0.21***	0.15	0.04	0.1	0.38	0.38*	0.74*	1.52*	264.63
USA	0.03*	0.55*	-0.31*	0.20*	-0.04*	0.85*	-0.03*	0.59*	0.33*	1.04*	0.72*	87.82
Euro area	-0.01***	0.49*	-0.11*	-0.13*	0.43*	0.41*	-0.68*	0.98*	0.00	0.96*	1.11*	127.88
Brazil	-0.02*	0.45*	-0.17*	-0.05*	0.12*	0.41*	-0.07	0.86*	0.00	1.00*	0.73*	-117.85
India	0.04*	0.06*	-0.00*	0.35*	-0.04*	0.62*	-0.36	0.99*	0.00	1.04*	0.69*	-70.26
South Africa	0.00*	0.18*	0.03***	0.51*	0.10	1.02*	-0.53**	0.33*	0.67*	1.00*	0.54*	-3.7

LL: log-likelihood.

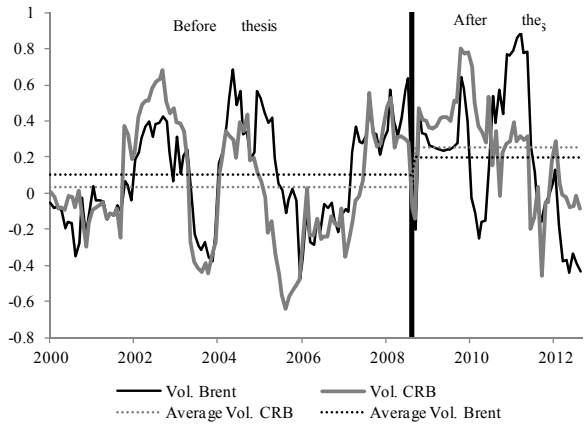
*, ** and *** denote 90%, 95% and 99% confidence levels respectively – otherwise, the coefficients are not reported.

Appendix A.2. Diagnostic tests

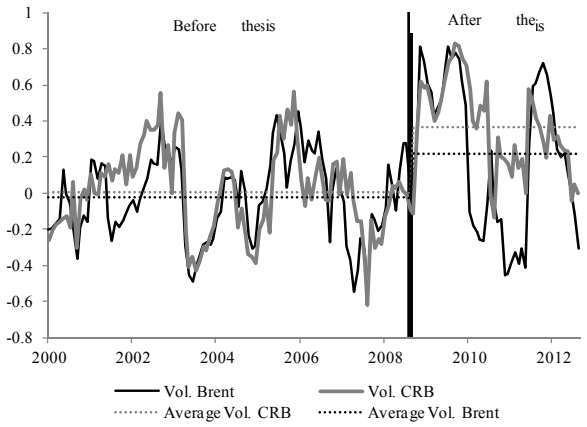
	LB(20)		LBc (20)		ARCH(20)	
	Statistic	p-value	Statistic	p-value	Statistic	p-value
Brent	29.03	0.07	9.78	0.96	6.22	0.80
CRB	20.58	0.36	14.71	0.74	9.77	0.46
USA	19.45	0.42	31.54	0.04	2.69	0.99
Euro area	32.35	0.03	15.92	0.66	7.007	0.72
Brazil	11.61	0.90	0.45	1.00	4.57	0.91
India	24.11	0.19	21.02	0.34	5.78	0.83
South Africa	12.82	0.85	1.99	1.00	2.08	1.00

Appendix A.3. 12-Month rolling correlation between short rate and commodity volatilities

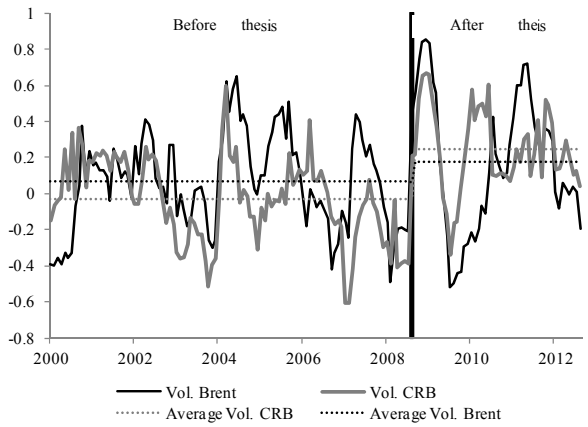
USA



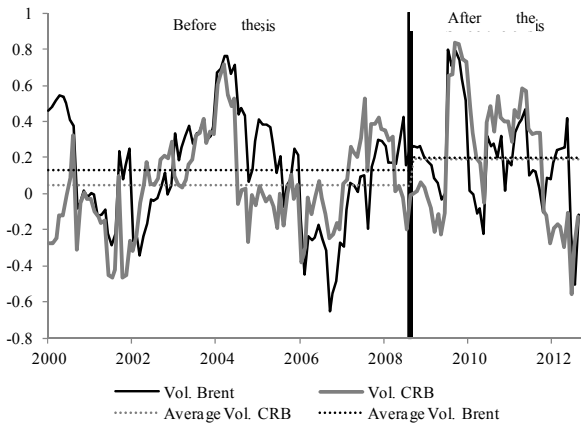
Euro area



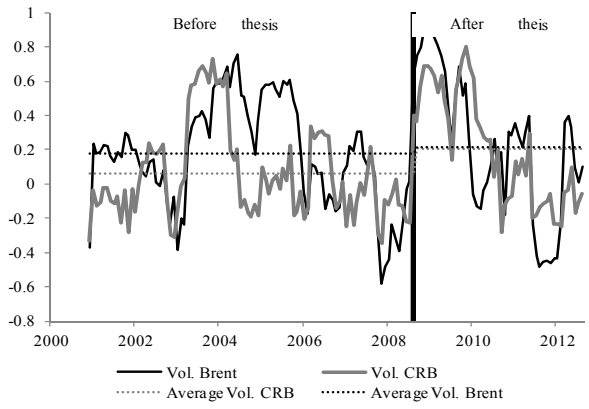
Brazil



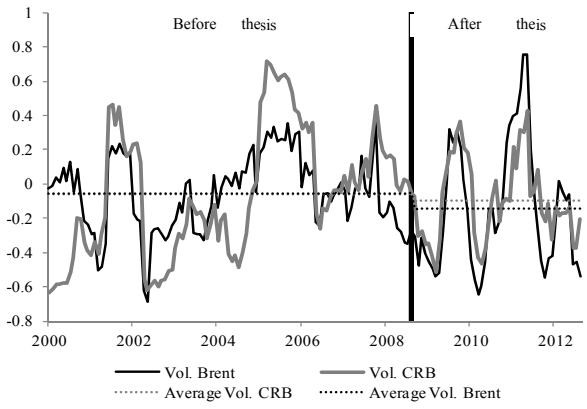
India



Russia*

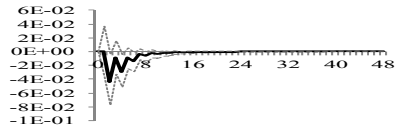
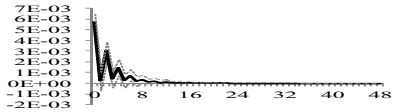
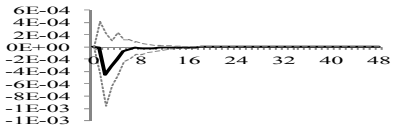
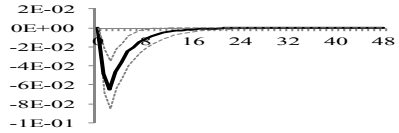
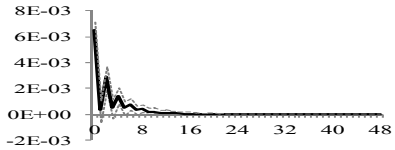
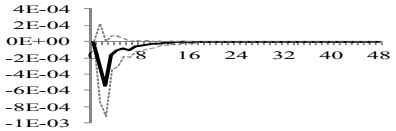
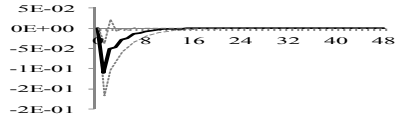
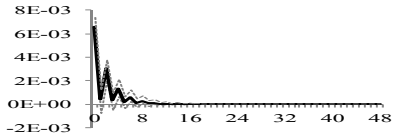
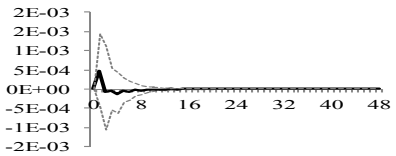
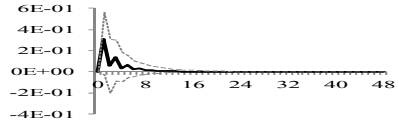
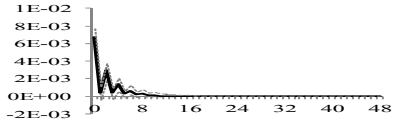
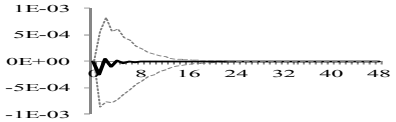
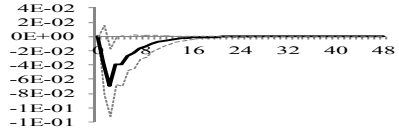
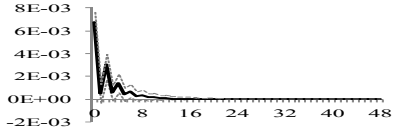
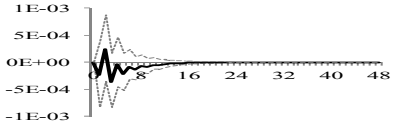


South Africa



* Calculations are derived from the 12-month rolling standard deviation of short-term interest rates.

Appendix B. Impulse responses to a CRB volatility shock (with 95% confidence bands)

	Short Rate	Commodity Volatility	CPI
USA			
Euro area			
India			
Russia			
South Africa			

CHAPTER 4

HOW COULD INDIA BENEFIT FROM A MORE EFFICIENT BANKING SECTOR? EXAMINATION THROUGH A DSGE MODEL.

By Kuhanathan ANO SUJITHAN

Abstract *– This paper follows the Real Business Cycle literature and develops a Dynamic Stochastic General Equilibrium (DSGE) model with an explicit banking sector. This models enables us to analyze the impact of increased efficiency within banks (i.e. a positive banking technology shock) for the Indian economy. Using data for India from 1996Q3 to 2013Q4, we estimate the unknown parameters using Bayesian techniques. Then impulse response functions are computed in order to pinpoint the effects of an exogenous banking technology shock. The main results reveal that a banking technology shock increases the output, the capital stock, the real wage while it reduces loan interest rates and credit risk. Overall, the shock is positive for the economy. The policy implication of this study is that Indian authorities should take measures to improve management in the local banking system through direct action on state-owned banks and/or further liberalization coupled with appropriate regulations.*

JEL classification: E20, G21

Keywords: banking sector efficiency, banking technology shock, India, dynamic stochastic general equilibrium model, Bayesian estimation

Since the seminal work of Schumpeter (1911), the banking-growth nexus has been analyzed by a vast body of literature. The theoretical literature underlines the contribution of banking to growth through increased savings (De Gregorio, 1993), improved investment allocation (Levine 1991) for instance. The empirical literature is also rich, we can cite King and Levine (1993), Levine and Zervos (1994) among others. Most of these studies report a steady, robust and positive relation between finance and growth.

In 1980, Indian public banks accounted for 90% of total assets owned by the local banking sector. Furthermore, interest rates were controlled by the government, loans are planned. India was in a typical situation of financial repression. The concept of financial repression can be traced back to the 1970s (McKinnon, 1973 and Shaw, 1973). McKinnon and Shaw argued that it is an impediment to economic growth, especially in developing countries.

The poor performances of the banking industry led the authorities to reconsider their policy. Consequently, India started liberalizing its financial system in the 1990's. External constraints on banks were progressively reduced, competition was encouraged, foreign participation was allowed etc. Banking efficiency and performance improved steadily (see for instance Bhattacharyya *et al.*, 1997; Ataullah and Le, 2006). Nevertheless, the liberalization process is still incomplete and Indian banks' practices and performances are not yet at the level of those of developed economies. In the case of India, the banking sector is key for firms as recent studies underlined the fact that only a few firms have access to most of the funding from capital markets (see Didier and Schmukler, 2013).

From a macroeconomic perspective, since 2011, growth pace has steadily declined and the outlook of Indian economy has become much less positive. Which reanimated the debate over financial liberalization and the need to improve banking efficiency (see Shukla, 2014); many observers feel that a more efficient banking system could benefit the economy and help it recover from the current turmoil.

This paper aims at contributing to this debate by analyzing the effect of a more efficient banking sector in India. It develops a Dynamic Stochastic General Equilibrium (DSGE) model explicitly taking into account a banking system. The model is estimated with Indian data using a Bayesian framework. We study the impact of a positive banking technology shock in our model in order to study the impact of a banking sector with improved efficiency. To the best of our knowledge, this is the first attempt to study such an issue within an estimated DSGE model for India. Former research on Indian economy implementing DSGE

models include works such as Anand *et al*. (2010), Batini *et al.* (2010), Gabriel *et al.* (2010) and Levine and Pearlman (2011) did not take into account formally the banking sector nor address the issue of the banking sector efficiency.

The remainder of the paper is organized as follow. Section 1 presents the model. In section 2, the Bayesian estimation of the model is described. Section 3 reports impulse-response functions, presents some stylized facts and analyzes the impact of a banking technology shock. Finally, the concluding remarks are drawn in section 4.

I. THE MODEL

The model we present here is a simplified framework; for instance we do not distinguish Ricardian and non-Ricardian households, intermediate good producers and final goods producers or formal and informal sectors. Also it does not include the government or the central bank, and prices are assumed to be equal to one. Even though it is a basic model, we believe it suited for our purpose which is to understand the macroeconomic effects of improved efficiency in the banking sector for a small semi-open economy like India.

1. Households

Households are risk-averse and maximize a utility function separable in leisure and consumption. The maximization problem of the representative agent is given by:

$$\underset{C_t,N_t,D_{t+1}}{\text{Max}} \; E_t\left\{\sum_{t=0}^{\infty}\beta^t\left(\log(C_t)-\chi\frac{N_t^{1+\psi}}{1+\psi}\right)\right\} \qquad (1)$$

Subject to the budget constraint:

$$C_t + D_{t+1} = W_t N_t + \left(1+i_t^d\right)D_t + \Omega_t^f \qquad (2)$$

Where β^t is the intertemporal discount factor, C_t is consumption, N_t is the fraction of time devoted to work, W_t is the real wage, D_t are banking deposits remunerated at rate i_t^d and Ω_t^f is the firms' profit. χ is the relative weight on leisure, ψ is the inverse Frisch labor elasticity (i.e the sensitivity of the labor supply to real wage, see Romer, 2006).

The representative consumer chooses levels for consumption, labor supply and banking deposits to maximize utility.

We can form a current value Lagrangian; the 1st order conditions characterizing an interior solution are:

$$\frac{\partial \mathcal{L}}{\partial C_t} = 0 \Leftrightarrow \frac{1}{C_t} = \lambda_t \tag{3}$$

$$\frac{\partial \mathcal{L}}{\partial N_t} = 0 \Leftrightarrow \chi\, N_t^{\psi} = \lambda_t W_t \tag{4}$$

$$\frac{\partial \mathcal{L}}{\partial D_{t+1}} = 0 \Leftrightarrow \lambda_t = \beta E_t \lambda_{t+1}\left(1 + i_{t+1}^{d}\right) \tag{5}$$

Combined together we have the following optimal conditions:

$$E_t C_{t+1} = \beta E_t C_t\left(1 + i_{t+1}^{d}\right) \tag{6}$$

$$W_t = \chi\, C_t\, N_t^{\psi} \tag{7}$$

Equation 6 shows that next period consumption is increased by interest rate earned in deposits, so that the marginal utility of current consumption equals the marginal utility of future consumption. Equation (7) indicates the optimal labor supply path.

2. Firms

Firms are assumed to be risk neutral and maximize profit. They can default on their bank credits with a probability (1 - θ_t). If they do so, they will have difficulty to access credit in the future. The representative firm demands labor to the household sector and capital through banks. Firms reimburse principal and pay interest charges at each period. Taking into account capital depreciation δ, the capital stock in period *t* is:

$$K_t = (1 - \delta)K_{t-1} + I_t \tag{8}$$

Where the stock of capital at period t is, I_t is the investment in period *t*. Following De Walque *et al.* (2010), the representative firm's maximization problem is:

$$\underset{K_t, N_t, \theta_t}{\text{Max}}\; E_t\left\{\sum_{t=0}^{\infty} \beta^t \Omega_t^f\right\} \tag{9}$$

subject to:

$$Y_t = expA_t K_t^{\alpha} N_t^{1-\alpha} \quad (10)$$

$$\Omega_t^f = Y_t - W_t N_t - \theta_t\left(i_t^l - \delta\right)K_t - \frac{\gamma}{2}[(1-\theta_{t-1})\left(i_{t-1}^l - \delta\right)K_{t-1}]^2 \quad (11)$$

Where Ω_t^f is the firm's profit with prices equal to one, Y_t is the output, α stands for the capital participation in the output, W_t is the real wage, N_t is the demand for labor, θ_t is the rate of credit payment, A_t is the technological process of the firm and i_t^l the interest rate paid by the firms. The last term of equation 11 is the default cost.

The 1st order conditions are:

$$\frac{\alpha Y_t}{\theta_t K_t} - \delta = i_t^l \quad (12)$$

$$(1-\alpha)expA_t K_t^{\alpha} N_t^{-\alpha} = W_t \quad (13)$$

$$\beta\gamma(1-\theta_t)\left(i_t^l - \delta\right)K_t = 1 \quad (14)$$

Equation (12) defines the interest rate paid after replacement of depreciated capital; it depends on the payment rate θ_t which defines the credit risk. Equation (13) determines the real wage; it is equal to the marginal productivity of labor. Equation (14) defines the marginal default cost paid if the firm was to keep a unit of current investment.

3. Banking sector

Banks are perfectly competitive; they used domestic households' deposits and they borrow from foreign creditors in order to produce loans. They can default on foreign borrowings. Banks produce loans according to the following technology:

$$L_t = expλ_t D_t^{\omega} B_t^{1-\omega} \quad (15)$$

Where L_t is the credit supply, λ_t is the technology adopted by the banking sector, D_t is the demand for deposits, B_t is the foreign borrowings and ω determines the participation of deposits in the production of loans. The bank's maximization problem is:

$$\underset{D_t, B_t}{\text{Max}}\, E_t\{\sum_{t=0}^{\infty}\beta^t \Omega_t^b\} \quad (16)$$

subject to:

$$\Omega_t^b = \theta_t i_t^l L_t - i_t^d D_t - q i_t^* B_t e_t \quad (17)$$

Where i_t^l is the interest charged to debtors; consequently $\theta_t i_t^l L_t$ is the operating revenue of the bank, $i_t^d D_t$ is the cost of deposits, q is the fraction of foreign debt repayment, i_t^* is the interest rate of foreign borrowings and e_t is the nominal exchange rate.

The 1st order conditions are:

$$\theta_t i_t^l(\omega\ exp\lambda_t D_t^{\omega-1} B_t^{1-\omega}) = i_t^d \tag{18}$$

$$\theta_t i_t^l\{(1-\omega) exp\lambda_t D_t^{\omega} B_t^{-\omega}\} = q i_t^* e_t \tag{19}$$

Equation (18) states that the marginal coast of capturing deposits equals the marginal product of deposits adjusted for the cost of opportunity due to reserve requirements. Equation (19) states that the cost of borrowing equals the marginal productivity of the banks' borrowings.

4. Stochastic processes

The stochastic component of the model is driven by two uncorrelated shocks affecting firms' productivity and banks' technology. They are represented by the following equations:

$$A_t = \rho_A A_{t-1} + \varepsilon_{A,t} \tag{20}$$

$$\lambda_t = \rho_\lambda \lambda_{t-1} + \varepsilon_{\lambda,t} \tag{21}$$

where ρ_A and ρ_λ are persistence coefficients and $\varepsilon_{A,t} \sim N(0, \sigma^2)$, $\varepsilon_{\lambda,t} \sim N(0, \sigma^2)$.

5. Competitive equilibrium

The equilibrium is an allocation $\{(C_t, D_t), (K_t, N_t, \theta_t), (B_t, D_t)\}_{t=0}^{\infty}$ and a price vector $\{W_t, i_t^l, i_t^d\}_{t=0}^{\infty}$ so that (C_t, D_t) solves the households' problem, (K_t, N_t, θ_t) maximizes firms' profits, (B_t, D_t) maximizes banks' profits and all markets are balanced. The equilibrium conditions are represented by equations 6, 7, 8, 10, 12-15, 18-21, and the aggregate constraint.

II. BAYESIAN ESTIMATION

Bayesian techniques are increasingly used in macroeconomics in order to estimate structural parameters of DSGE models. For instance, we can cite Schorfheide (2000), Smet and Wouters (2003), Lubik and Schorfheide (2004) and Smet and Wouters (2007) which all implemented Bayesian methods in their models. Amid the main advantages of Bayesian estimation first we can argue that Bayesian techniques fit the complete solved DSGE model whereas GMM estimation is based on a particular equilibrium. Second, Bayesian methods allow the inclusion of prior information which avoids posterior distributions with peaks at marginal points that we can observe in likelihood estimations and improve the identification of parameters. Third, Bayesian estimation explicitly takes into account observation errors by including exogenous shocks in the structural equations while likelihood estimation is based on matching the data regardless of out of sample information. More detailed discussion on Bayesian estimation can be found for instance in An and Schorfheide (2007), Fujiwara et al. (2008) and Fernández-Villaverde (2009). Bayesian estimation requires build-up of the posterior density of the parameters of interest based on a set of data. Let ζ be the set of parameters to be estimated as using observations on a set of variables X. Then the posterior density $P(\zeta|X)$ is the probability distribution of ζ, conditional on the data X. It is given by the following equation:

$$P(\zeta|X) = \frac{P(\zeta)f(X|\zeta)}{f(X)} \tag{22}$$

where $f(X)$ is the marginal distribution of the data, $f(X|\zeta)$ is the conditional distribution function of the data given the parameters; which is equivalent to the likelihood function of the parameters given the data $L(\zeta|X)$. The posterior mode of the parameters can be approximated by a Laplace approximation based on a given likelihood function and prior distributions. These posteriors modes can then be used as starting values for MCMC- Metropolis-Hastings algorithm which will deliver the posterior densities of parameters.

Box 1– On Bayesian estimation

The Bayesian estimation implemented in this paper is based on quarterly data of private consumption expenditure and gross fixed capital formation from 1996Q3 to 2013Q4. Data is provided by the Reserve Bank of India and is drawn from Datastream. Before 1996, there are

no quarterly data available. Computations are made under Matlab with the software platform Dynare[1].

The prior were defined according to values used in the literature. Therefore, β has an average set at 0.99, such value is largely used in many calibrated models (see for instance Batini *et al.*, 2010), and a variance of 0.004. A beta distribution is adopted in order to guarantee $\beta \in (0,1)$. Priors regarding the inverse Frisch elasticity and leisure preference of households are defined to values suggested by Canova (2007) and Lim and McNelis (2008). For the rate of capital depreciation we used an average value of 0.05; which is between standard value used in Fernández-Villaverde (2009) and the calibrated value for India used in Batini *et al.* (2010); and a standard deviation of 0.005. We adopted a mean of 0.36 and a standard deviation of 0.005 for the share of capital in output. Regarding $\omega \in (0,1)$, the share of deposits in loans, we implemented an average of 0.75 and a standard deviation of 0.05. Default cost priors are set following Da Silva & Divino (2013) who estimated a similar model for Brazil.

Posterior distributions are estimated using the Metropolis-Hastings algorithm with 2 parallel chains. 20,000 replications were realized discarding the first 10,000 draws in order to achieve numerical convergence.

Parameters		**Prior**			**Posterior**	
		Distribution	**Average**	**SD**	**Average**	**90% Confidence Interval**
Capital share in output	α	Beta	0.360	0.005	0.374	[0.366 0.381]
Leisure preference	χ	Gamma	3.500	0.040	3.496	[3.434 3.563]
Inverse Frisch elasticity	ψ	Gamma	0.110	0.020	0.119	[0.085 0.154]
Inter-temporal discount factor	β	Beta	0.990	0.004	0.995	[0.994 0.996]
Capital depreciation	δ	Beta	0.050	0.005	0.024	[0.024 0.025]
Default cost	γ	Gamma	2.500	0.050	2.387	[2.302 2.466]
Deposit share in loans	ω	Beta	0.750	0.050	0.835	[0.803 0.866]

Table 1 - Prior and posterior distributions of parameters

In developed economies, such as the US the capital share in output is usually around 1/3. However, developing economies have a large number of self-employed persons who generate income from both capital and labor and that complicates measurements of income shares and often biases them upward (see Gollin, 2002 for further discussion). Our results confirm that observation as the average capital share in output in India was estimated at 0.37 within our model (see Table 1). Besides, this estimate is consistent with previous studies, indeed, our estimation suggests a labour share of 0.63 which is almost equal to the estimate of Gabriel *et*

[1] Available at : http://www.dynare.org/

al. (2011) who found a labour share of 0.62 for India within a New Keynesian DSGE framework using with data ranging from 1996Q1 to 2008Q3.

Leisure preference and inverse Frisch elasticity estimates are close the standard value used as prior mean suggesting that India is close to developed economies regarding these parameters.

The inter-temporal discount factor was estimated at 0.995. For developed economies, the parameter is generally close to 0.99, India exhibits a higher discount factor, which reveals that Indian households are willing to report consumption at a real interest rate higher than 2%. This estimate is rather in line with the recent economic conditions in India, indeed, the real interest rate averaged at around 2% between 2008 and 2013.

The rate of capital depreciation is estimated at 2.4% per quarter, implying a depreciation rate comparable to those in developed economies. Our estimate is very close to the calibration of 2.5% used by Gabriel *et al.* (2011) for the Indian economy. Besides, Gerali *et al.* (2010) estimated a rate of capital depreciation of 2% per quarter using date for the European Union.

The share of deposits in loans is estimated at 0.84. This result implies a loan-to-deposit ratio of 1.2 and suggests that Indian bank use mostly deposits to produce loans, this is a common feature of banking systems in emerging economies. Whereas in developed economies, banks have more funding options and generally exhibit higher loan-to-deposit ratios, for instance, between 1995 and 2008, such ratio was at about 1.4 in the USA according to the Fed. Estimate for default cost is very similar to prior averages and thus to previous estimates for developed economies.

Default cost parameter is estimated at 2.4, which is slightly lower than in developed economies and also to the parameter estimated by Da Silva and Divino (2013) for Brazil. Among possible explanations to this, we can point out the fact that a large fraction of the banking sector is state-owned; likewise the corporate sector also has numerous state-owned actors. Furthermore, the existence of public loan guarantee scheme reduces default costs (see Riding and Haines, 2001). Since 2000, the Credit Guarantee Fund Scheme for Micro and Small Enterprises (CGMSE), a state-owned trust, provides bank guarantees to micro and small firms and acts to ease their financial constraints.

From Figure 1, one can observe the contribution of information provided by the data. We observe that for leisure preference and inverse Frisch elasticity parameters posterior

distributions are very close to priors, especially for the leisure preference parameter. Regarding capital share in output and default cost, posterior distributions quite have similar shapes as prior distributions, nevertheless the contribution of data leads to shifts (upwards for capital share and downwards for default cost) so that resulting averages are different from the prior averages. In the case of deposit share in loans, we can note that the posterior distribution has a much lower standard deviation than the priors and that the average is higher. The same comment also applies to the inter-temporal discount factor. Finally, for the capital depreciation parameter, estimates suggest a standard deviation close to 0 and an average twice as low as the prior.

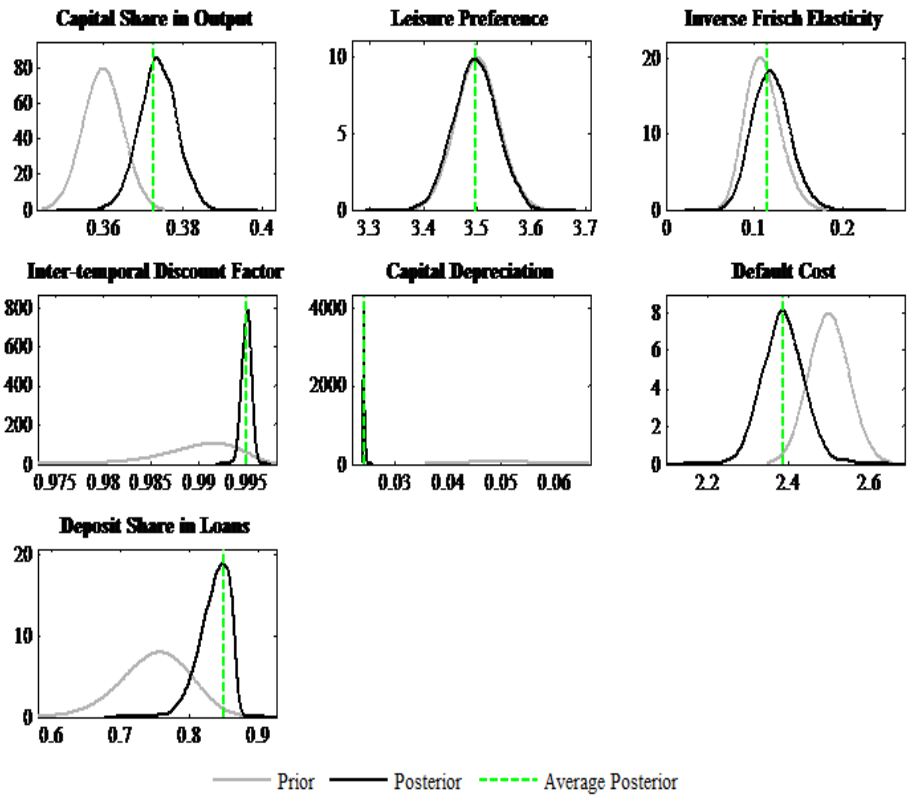


Figure 1 – Prior and posterior distributions of parameters

III. RESULTS

1. Stylized facts

How can greater efficiency in the banking sector be achieved? One apparent shortcut to increased efficiency in the banking sector in India is further liberalization; indeed previous theoretical works by Berger and Humphrey (1997), Hermes and Lensink (2008) and Claessens *et al.* (2001) support that financial liberalization improves bank efficiency through improved market conditions and price mechanism. As a large part of the sector is state-owned, capital mobility is partially restricted and there are some other technical and administrative restrictions on banks, there is still room for further liberalization measures. A large number of researchers stressed that liberalization and development of the financial system spurs economic growth (King and Levine, 1993 ; Rajan and Zingales, 1998 ; Bekaert *et al*, 2005 or Reinhart and Tokatlidis, 2005 among others). Also, in the case of India, empirical studies suggested that local banking sector was overall more efficient and benefited the economy after the reforms of the 1990's. Following these views, many observers and corporate leaders ask for further liberalization in the Indian banking sector.

On the other hand, financial liberalization also represent some risks. Kaminsky and Reinhart (1999) argued that financial liberalization is often followed by financial instability that may lead to banking crises. Moreover, several empirical studies supported that financial liberalization increases the probability of banking crises (see Demirgüç-Kunt and Detragiache, 2001; Eichengreen and Arteta, 2002; Ranciere *et al.*, 2006). A more recent work by Angkinand *et al.* (2010) underlined that the positive growth effects of financial liberalization can be obtained without an increase in the probability of banking crises if appropriate institutions and regulations are developed. Following their views, some pointed out that the incomplete liberalization process isolated in some extent the Indian economy from the global turmoil and spared it from a banking crisis. Hence any further liberalization step should be implemented with caution and adequate regulation.

According to Shukla (2014), Indian banks should act in a view to (i) maintain the appropriate quantum and quality of capital, (ii) improve liquidity management (iii) set better standards in asset and liability management (ALM). The objective is to have banks that can survive in worst case scenarios and that do not put at risk the whole system. These goals are not compatible with uncontrolled liberalization, thus implying that authorities should make

decisions in order to improve management in banks. That could also probably be achieved by liberalization coupled with adequate regulations especially regarding liquidity and capital adequacy. As the state-owned banking sector represents a very large part of the sector, authorities can act both at the corporate level by setting up higher standards in the banks which they have control over or via the regulatory framework.

In 2014, besides a slowing pace of growth, the Indian economy faces major issues such as rising corporate debt level, growing fiscal deficit and poor infrastructure. Indeed, corporate sector is under a lot of pressure with interest coverage ratios under stress, at a low 1.4 at the end of 2013. These risks are being transmitted to the financial sector: gross non-performing assets (NPA) are increasing in banks' balance sheets. Moreover, in the recent period, the central government has been experiencing troubles to control deficit. Furthermore, public banks and firms are being compelled to buy government bonds. It accounted for about 3.6% of bank assets in December 2013. This pushes private firms to resort to foreign funding and increases pressures on current account deficits. Finally, in critical sectors such as energy, transportation or utilities, there are important shortages stemming mostly from underinvestment. As one considers these issues, increased efficiency in banking sector might be at least a partial solution. But how would actually the economy react to an improvement in banking efficiency? That is the question we offer to answer within our simple model.

2. Impulse-Responses to a technological shock in the banking sector

According to various estimates (World Bank, RBI etc…), bancarization rate was only at about 30% in the 2000s in India. Especially, informal finance provided more than 40% of loans in rural areas and about 80% of rural population had no access to credit (Basu, 2005). This observation is not trivial as the majority of India's population is rural. Consequently, there is large room for improvement in banking reach and efficiency. For that reason, we compute the dynamic responses of endogenous variables to a 1% increase in productivity of the banking system (see Figure 2). Such a shock would mean that banks' balance sheets would be multiplied more than twice. Nevertheless, it seems that the Indian banking sector has the potential to reach such an achievement.

As expected, the technology shock leads to higher credit supply and investment. Consequently, we observe a sharp rise in the capital stock of the economy. The increase is about 1% after the first quarter and displays a hump shape response. The interest rate of loans

first reacts positively to the shock. This phenomenon can only be explained by the large size of the shock and numerical reasons. Even though, our framework does not include information asymmetry the rise in loan interest rate complies with previous findings; as the supply and the demand of credit are increasing there can be credit rationing by banks in order to select the best debtors (see Stiglizt and Weiss, 1981). After a few quarters, the loan interest rate declines bellow its initial value before reaching back its steady state value. This behavior is more in line with what one could expect from the banking technology shock. Indeed, as financial intermediaries are getting more efficient, they become able to reduce loan prices.

Output grows about 0.18% after the first quarter and reverts slowly back to the steady state. As bank productivity increases, demand for funding gets lower which implies higher level of consumptions. Deposits level falls by 2% after the technology shock, and as it decreases sharper than the demand for funding, the deposit interest rate increases in reaction before reverting slowly back to its steady state value.

As credit interest rate increases in a first step, firms have higher costs of debt repayment, in order to maintain level of profits, they need to adjust mark-ups and thus raise goods' prices. Consequently, real wage first declines. Then, as interest rates gets lower, real wages increase above its initial level after a few quarters.

Foreign borrowings from banks increase in a first step in order to compensate the initial decrease in deposits, then decline bellow the initial level (as banks need less funds to produce loans) before reverting back to the steady state level. As output and consumption increase, firms profits also increase and the repayment rate of loans raises in the first quarter after the shock before reaching back the steady state level.

Overall, one can observe through these IRFs that efficiency gains of the banking sector benefit the rest of the economy; production, consumption, investment are stimulated while credit risk is reduced. These results are in favor of actions from the decision makers in order to increase efficiency in the sector.

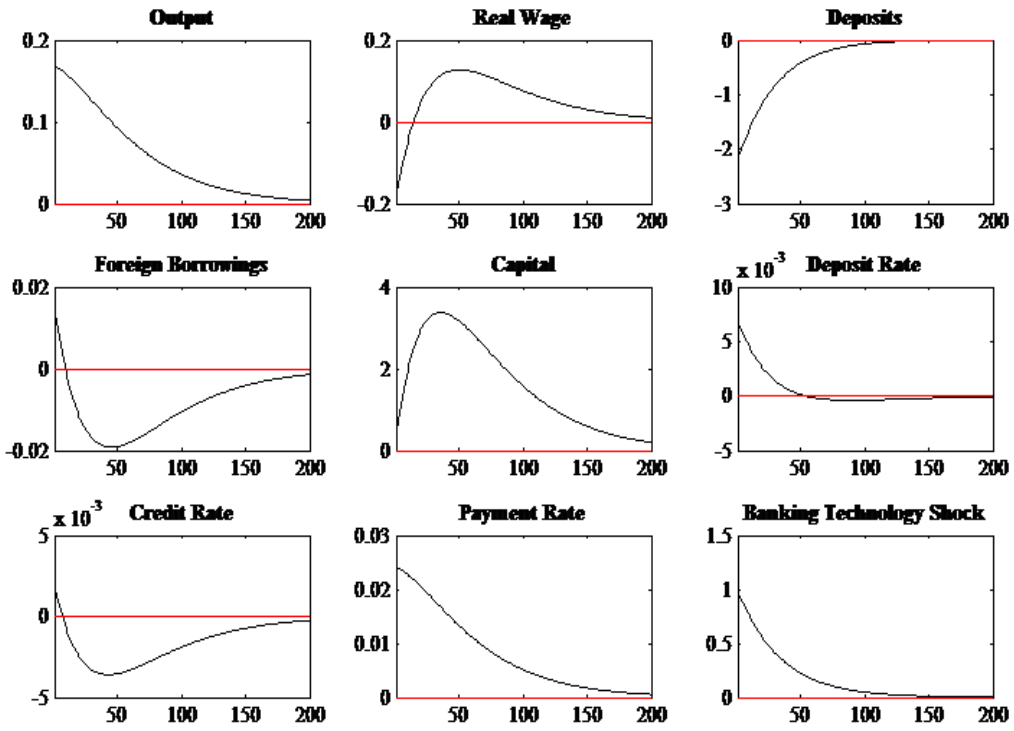


Figure 2 – IRFs to a banking technology shock

IV. CONCLUSION

Following the Real Business Cycle literature, this paper developed a simple Dynamic Stochastic General Equilibrium model including the banking system. The model has been estimated within a Bayesian framework using Indian data from 1996Q3 to 2013Q4. As the study was aiming to study the impact of improved bank efficiency in India, the analysis was based on a banking technology shock within the model. The results show the shock leads to higher credit supply and investment. Output, consumption, capital stock of the economy and the real wage increase after the shock. After a positive reaction, both deposit and loan interest rates decline. Deposits level falls by 2% after the technology shock. Dependence of banks to foreign borrowings decreases. The repayment rate of loans increases, hence reducing credit risk within the economy. Overall, a more efficient banking sector benefits the rest of the economy.

The policy implication of our results it that local authorities should support and act in order to improve management and efficiency in bank. As suggested by recent works, that objective

can be pursued by implementing higher standards for management in public banks in terms of capital adequacy, liquidity management and ALM. Further liberalization of the Indian banking system combined with appropriate regulations, in a view to guarantee the best possible management of banks, could also be an alternative/complementary solution to provide the country with a more efficient banking sector.

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CONCLUSION GÉNÉRALE

Cette thèse, consacrée à l'économie indienne, présente quatre études. Celles-ci s'attachent à comprendre comment cette économie et, plus particulièrement, son système financier traversent la crise actuelle. Dans les trois premiers chapitres, on pose la question de l'intégration des marchés financiers, bancaires ou des matières premières indiens durant la crise, sous différents angles.

Dans le premier chapitre, nous avons montré que l'Inde avait une économie en forte croissance dans la première moitié du 20ème siècle. Faute, entre autres, au sous-investissement, à une faible ouverture économique et à des rigidités administratives, l'économie indienne a connu un fort ralentissement dans les décennies 1960 et 1970, avant d'entamer dans les années 1980 une libéralisation partielle. Ce processus n'était pas contrôlé et ceci a conduit à une crise de changes en 1991. Au lendemain de cette crise, l'Inde s'est alors engagé dans une libéralisation progressive et contrôlée. Cela lui a permis d'atteindre une croissance forte, soutenue, avec une inflation maîtrisée pendant 20 ans. L'économie indienne s'est parallèlement ouverte aux échanges internationaux ; elle s'est tertiarisée de façon importante tout en devenant moins dépendante de l'aide extérieure. Aux premières heures de la crise actuelle, l'Inde a mis en place une politique de soutien à l'économie qui a porté ses fruits jusqu'en 2010. Toutefois, le pays connaît depuis 2011 une croissance ralentie et une inflation galopante. Nous avons montré que malgré les faiblesses observées ces dernières années (déficit public, endettement élevé des entreprises, infrastructure insuffisantes,…), l'Inde garde des atouts qui peuvent lui permettre de sortir de la crise (fondamentaux solides, une base fiscale large, une démographie dynamique,…). Nous avons aussi analysé la structure ainsi que le rôle du système financier indien dans les réalisations récentes de l'économie indienne. Enfin, nous avons étudié la question de l'intégration financière des marchés actions. Nos résultats empiriques ont montré que les marchés indiens étaient de plus en plus corrélés aux marchés actions américains. Plus particulièrement, la corrélation était plus élevée depuis 2008, l'intégration financière pourrait ainsi être interprétée comme une source d'instabilité et de fragilité accrue face aux chocs extérieurs pour l'Inde.

Poursuivant, sur le thème de l'intégration financière, le chapitre deux étudie la question des déterminants des *spreads* des CDS de l'Inde par référence à ceux des autres pays des BRICS. Tout d'abord, nos résultats confirment que les relations explicatives des *spreads* des CDS des BRICS dépendent du temps et qu'il est pertinent de les analyser dans un cadre à changements

de régimes Markoviens. En effet, pour chacun des pays, on constate que les facteurs macroéconomiques et financiers interviennent différemment dans la dynamique à deux régimes des CDS. Dans le cas de l'Inde, on observe que le Régime 1 est associé à une moyenne et une variance plus faible des *spreads* de CDS (-2,50% de moyenne et 0,17 de variance) et présente une duration de 4 mois et demie, tandis que le Régime 2 est associé à une moyenne et une variance plus élevé (11,50% et 0,20 respectivement) et présente une duration de seulement 2 mois. Ces résultats sont conformes à ceux de travaux récents de Chan et Marsden (2014). Dans le Régime 1, les spreads de CDS de l'Inde sont influencés par les réserves de change, et un certain nombre de facteurs financiers (Vstoxx, taux de change, marchés actions locaux et euro). Dans le Régime 2, ceux-ci sont influencé par d'autres facteurs macroéconomiques (réserves de changes, balance commerciale, solde fiscal, prix des matières premières), et des facteurs financiers (taux de change, marchés actions locaux et euro). Les facteurs commun aux deux régimes sont associés à des coefficients très différents d'un régime à l'autre. On note également, l'importance des facteurs financiers de la zone euro. Par ailleurs, l'Inde a connu 30 mois de Régime 2 dans la période d'étude, notamment durant la crise des *subprimes* mais le Régime 2 n'apparaît pas durant la crise de la dette de la zone euro. Par conséquent, le risque perçu quant à la dette souveraine indienne est sensible aux évènements extérieurs mais dans une certaine mesure seulement. Enfin, ces résultats sont confortés par une série de tests de sensibilité effectués. Par exemple, l''introduction de variables supplémentaires, ou alternatives (notamment les variables américaines) n'altère pas les performances explicatives du modèle.

Dans la continuité de cette réflexion sur l'intégration financière, nous avons posé dans le troisième chapitre le problème du lien qui existe entre les marchés des matières premières et la politique monétaire. Les résultats tirés de nos modèles VAR montrent que le taux d'intérêt de court terme, assimilé ici à l'instrument de la politique monétaire, est influencé négativement par la volatilité des prix des matières en Inde. En d'autres termes, une forte volatilité des prix des matières premières implique, toutes choses égales par ailleurs, une baisse du taux d'intérêt. En effet, on observe une diminution du taux d'intérêt en Inde en cas de choc de volatilité des prix des matières. L'analyse à plusieurs régimes s'avère néanmoins davantage pertinente. L'estimation d'un modèle VAR à seuil montre que la répartition des observations entre régimes est équilibrée et que le seuil se situe autour de 5% pour l'Inde. Cela signifie que les autorités monétaires indiennes réagissent lorsque les variations de prix des matières premières sont de grande ampleur. Nos résultats suggèrent que les autorités

monétaires prêtent de plus en plus attention aux fluctuations des prix des matières premières. Enfin, les différents tests de robustesse confirment l'intérêt de cette dernière approche.

Le quatrième chapitre de cette thèse analyse une problématique quelque peu différente de celle des chapitres précédents. Il questionne la capacité du système bancaire indien à sortir l'économie locale de sa torpeur. En suivant la littérature sur les cycles réels, nous développons un modèle DSGE, relativement simple, incluant un système bancaire. Le modèle, estimé sur des données de l'économie indienne entre 1996 et 2013, permet de montrer qu'un choc de technologie bancaire entraîne une augmentation de la production, de la consommation, du stock de capital et du salaire réel alors que les dépôts et le taux d'intérêt des dépôts et des crédits diminuent après une réponse immédiate à la hausse. La dépendance des banques aux emprunts étrangers diminue tout comme le risque de crédit. Globalement, un secteur bancaire plus efficient semble profiter au reste de l'économie. Par ailleurs selon nos résultats, les pouvoirs publics en Inde devraient œuvrer pour améliorer l'efficience des banques. Dans le cas indien où le secteur public est important, les autorités peuvent agir directement au niveau de la gestion des banques publiques ou bien le secteur peut être davantage libéralisé, tout en veillant à ce qu'il soit correctement régulé et contrôlé.

Dans l'ensemble cette thèse montre que l'Inde a connu une intégration financière croissante et ce sur de multiples marchés : (i) les marchés actions sont de plus en plus intégrés avec les marchés américains (ii) les *spreads* des CDS indiens sont influencés par une série de variables macroéconomiques et financières et notamment des facteurs financiers de la zone euro et (iii) les autorités monétaires indiennes semblent prendre en compte, au-delà d'un certain seuil, les variations des prix des matières premières. Globalement, cette intégration indique une certaine fragilité. En effet les marchés actions sont davantage intégrés depuis 2008, les CDS ont connu des périodes à fort moyenne et écart-type (Régime 2) durant la crise des *subprimes* et la relation entre taux d'intérêt de court terme et volatilité des prix des matières premières est plus forte depuis 2008. Néanmoins, comme le montre les résultats du dernier chapitre, le système financier peut aussi permettre à l'économie indienne de surmonter ses difficultés actuelles, s'il l'on y implémente les réformes adéquate et que la productivité est améliorée dans des secteurs comme celui des banques.

Cette thèse se limite à certains marchés et omet ainsi volontairement d'autres qui ne sont pas moins importants (marché des changes, marché obligataire etc…). L'analyse peut, bien entendu, être complétée par des études sur d'autres marchés que ceux examinés dans cette

thèse. Par ailleurs, on peut aussi approfondir les études effectuées en actualisant les bases de données par intégration de celles des années 2013-2014. On peut aussi enrichir les modèles utilisés. On peut par exemple envisager (i) une modélisation plus complexe que celle du DCC-GARCH dans le chapitre 1, (ii) des modèles à changements de régimes Markoviens avec des probabilités de transitions qui varient dans le temps dans le chapitre 2, (iii) des modèles à facteurs dans le chapitre 3 ou encore (iv) un modèle DSGE plus complet dans le chapitre 4 en y ajoutant d'autres agents (états, secteur informel…) et des hypothèses complémentaires.

Le système financier indien à l'épreuve de la crise.

Résumé : Cette thèse présente dans un premier temps l'histoire récente et les enjeux de l'économie et du système financier indien. Puis, en se concentrant la période récente, elle étudie la question de l'intégration financière sur différents marchés : les marchés actions sont traités dans le 1er chapitre, les *spreads* des CDS indiens sont abordés dans 2nd chapitre et la relation entre les prix des matières premières et la politique monétaire est analysée dans le 3e chapitre. Enfin, le dernier chapitre pose la question de savoir si un secteur bancaire plus efficient peut aider l'économie indienne à sortir de la crise. Globalement, les résultats indiquent que les marchés étudiés sont plus intégrés depuis la crise, ce qui suggère une fragilité du secteur financier indien aux chocs extérieurs. Néanmoins, les résultats du chapitre 4 montrent, dans le cadre d'un modèle simple, que le système financier peut aussi permettre à l'économie indienne de surmonter ses déboires actuels, s'il l'on y implémente les réformes adéquate et que la productivité des banques est améliorée.

Mots clés : système financier, banques, Inde, BRICS, crise, intégration, CDS, matières premières, politique monétaire

Indian financial structure: resilient to the global crisis?

Abstract: This thesis first presents India's economy and financial system's recent history and current issues. Then, with an emphasis on the recent turmoil period, it studies the question of financial integration in various markets: equity markets are dealt with in the 1st chapter, CDS spreads are analyzed in the 2nd chapter while the 3rd chapter focuses on the monetary policy-commodity prices nexus. Finally, the last chapter reflects on the ability of the banking system to help the country out of the current crisis. Overall, our results indicate that markets are more integrated since the crisis, which suggest a frailty of the Indian financial structure to exterior shocks. Nevertheless, results for chapter 4 show, within a simple framework, that the financial system could also allow the economy to recover if the proper reforms are implemented and that banking efficiency is improved.

Key words: financial system, banks, India, BRICS, crisis, integration, CDS, commodities, monetary policy

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