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ESSAYS ON INFLATION DYNAMICS AND MONETARY POLICY IN A GLOBALIZED WORLD

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Abstract

The aim of this thesis is to analyze the impact of globalization on the dynamics of inflation and monetary policy in a globalized world. It consists of three essays.

In the first essay we investigate the impact of financial globalization on the behaviour of inflation targeting emerging market economies with respect to exchange rate – Do central banks respond to exchange rate movements or not? We use quarterly data for six emerging market inflation targeting economies from the date of their inflation targeting adoption to 2009 Q4. The chapter uses small open economy new Keynesian model à la Gali and Monacelli (2005), and employs multi-equation GMM technique to investigate the relationship. We find that the response of central bank to the exchange rate in case of Brazil, Chile, Mexico and Thailand is statistically significant while insignificant for Korea and Czech Republic. Theoretically, it should not be so as even under flexible inflation targeting central bank responds to inflation deviation and output gap; we think that the peculiar characteristics of emerging markets, like fear of floating, weak financial system and low level of central bank credibility make exchange rate important for these economies.

In the second essay we investigate empirically the relative importance of monetary transmission channels for Brazil, Chile and Korea. This chapter uses monthly data from the inception of inflation targeting regime to 2009 M12. We use a SVAR model incorporating the main monetary transmission channels combined together instead of individual channels in isolation. The empirical results indicate that the exchange rate channel and the share price channel have higher relative importance than the traditional interest rate and credit channel for industrial production. The results are not much different in case of inflation, except for Korea. The high ranking of exchange rate and share price channel is in line with the results by Gudmundsson (2007), which finds that exchange rate channel might have overburdened in the wake of financial globalization.

In the third chapter we investigate empirically the role of openness – real and financial – on the inflation dynamics of Brazil, Chile and Korea. The chapter uses monthly data from the inception of inflation targeting regime to the end month of 2009. In this chapter we employ the Generalized Method of Moments (GMM) technique. We use imports to GDP ratio as an indicator for real openness whereas Chinn and Ito index (KAOPEN) and total assets plus total liabilities to GDP ratio form the data set of Lane and Milesi-Ferretti are two proxies for

financial openness. The chapter concludes that there exists, generally, a positive relationship between real openness and inflation. However, in case of financial globalization the results are inconclusive as they are sensitive to measurement method of financial globalization.

Keywords: Monetary Policy, Inflation Targeting, Inflation Dynamics, Globalization, Emerging Markets, Fear of Floating, Transmission Mechanism, GMM, Structural VAR.

Résumé

L'objectif de cette thèse est d'analyser l'effet de la globalisation sur la dynamique de l'inflation et sur la politique monétaire dans un monde de globalisation. Cette thèse porte 3 chapitres :

Dans le premier chapitre, nous nous intéressons à l'impact de la globalisation financière sur le comportement du ciblage d'inflation dans les pays émergents, avec une attention particulière portée au taux de change : la Banque centrale répond-elle aux mouvements du taux de change ? Nous nous sommes basés sur des données trimestrielles de six pays émergents qui pratiquent la politique de ciblage d'inflation, depuis la date de l'adoption de cette dernière, jusqu'au dernier trimestre 2009 (2009 Q4). L'étude se base sur un modèle de petite économie ouverte néo-Keynésien à la Gali et Monacelli (2005). Nous utilisons un estimateur GMM à équations multiples pour analyser la relation. Les résultats nous montrent que la réponse de la Banque Centrale au taux de change est statistiquement significatif dans le cas du Brésil, du Chili, du Mexique et de la Thaïlande. En revanche, elle ne l'est pas pour la Corée ni pour la République Tchèque. Théoriquement, le résultat ne devrait pas être significatif même avec un ciblage d'inflation flexible où la banque centrale répond aux écarts d'inflation et de production.

Nous pensons que les caractéristiques particulières des pays émergents, telles que la peur du flottement "fear of floating", le manque de développement du système financier ainsi qu'un manque de crédibilité de la banque centrale, expliquent cette préoccupation des banque centrales pour les variations de change.

Dans le deuxième chapitre, nous étudions d'une façon empirique l'importance relative des canaux de transmission de la politique monétaire pour le Brésil, le Chili et la Corée. Cette partie se base sur des données mensuelles depuis l'adoption du ciblage d'inflation jusqu'à décembre 2009 (2009 M12). Nous utilisons un modèle SVAR, en incorporant les principaux canaux de transmission monétaire simultanément au lieu de les considérer séparément. Les résultats empiriques indiquent que le canal de taux de change ainsi que canal du prix des actifs ont une importance relativement plus élevée que le canal du taux d'intérêt traditionnel ou le canal du crédit pour la production industrielle. Les résultats sont très différents dans le cas de l'inflation, à l'exception de la Corée. Le classement élevé canal du taux de change et du canal du prix des actifs correspondent aux résultats de Gudmundsson (2007) : le canal du

taux de change pourrait avoir pris une importance grandissante avec la développement de la globalisation financière.

Dans le troisième chapitre, nous étudions empiriquement le rôle de l'ouverture - réelle et financière - sur la dynamique de l'inflation au Brésil, Chile en Corée du Sud. L'étude se base sur des données mensuelles, depuis l'adoption du ciblage d'inflation jusqu'à décembre 2009. Dans ce dernier chapitre, nous utilisons méthode de moments généralisée (GMM). Le ratio Importation sur PIB est considéré comme étant l'indicateur de l'ouverture réelle. En ce qui concerne l'ouverture financière, nous considérons alternativement l'indice de Chinn et Ito (KAOPEN) mesurant le degré de libéralisation des opérations sur le compte financier, et l'indicateur proposé per Lane et Milesi-Ferreti (2009).

Nous concluons dans ce chapitre qu'il existe en général une relation positive entre l'ouverture réelle et l'inflation. En ce qui concerne l'ouverture financière, les résultats sont moins tranchés et dépendent largement de l'indicateur utilisé pour mesurer l'ouverture financière.

Mots-clés : Politique monétaire, ciblage d'inflation, dynamique de l'inflation, globalisation, pays émergents, peur du flottement, mécanisme de transmission, GMM, VAR structurel.

Introduction Générale

Les deux dernières décennies ont été marquées par une ouverture commerciale et financière croissante des économies à l'échelle internationale. En effet, on observe que les pays sont de plus en plus intégrés tant sur le plan des échanges commerciaux, qu'au niveau la sphère financière. Dans ce monde globalisé, la mise en œuvre d'une politique monétaire optimale devient une tâche de plus en plus difficile. Lorsque l'on se réfère à l'histoire des banques centrales, on remarque que ces dernières selon la conjoncture économique, ont dû faire recours à différents régimes monétaires afin d'atteindre l'objectif de stabilité des prix qui constitue généralement le principal objectif de la politique monétaire. Au nombre des régimes monétaires ayant été adoptés par les banques centrales se trouvent les régimes de ciblage de taux de change, les régimes de ciblage d'agrégats monétaires, et les régimes de ciblage d'inflation qui connaissent actuellement un succès conséquent, et qui sont de plus en plus adoptés par des pays à la fois développés et en développement[1]. La Nouvelle Zélande fut la première à adopter le ciblage d'inflation comme stratégie de politique monétaire en décembre 1989.

Un fait intéressant à souligner est que d'une part, le nombre de pays ayant adopté un régime de ciblage d'inflation est en constante augmentation et d'autre part, dans le contexte actuel de libre-échange et de mouvements de capitaux, le rôle du taux de change dans la stabilisation de l'économie apparaît comme déterminant. Ainsi ces différentes évolutions posent un certain nombre de difficultés d'actions aux autorités monétaires, et peuvent donc influencer la dynamique de l'inflation. Par exemple, l'ouverture commerciale croissante a des effets sur la dynamique de l'inflation à travers de nombreux facteurs tels que : une concurrence accrue, la présence de plus de produits de substitution, l'inflation importée (canal des coûts), ou encore par "l'effet discipline". La globalisation financière (l'intégration du système financier d'un pays aux marchés financiers internationaux) influe sur la dynamique de l'inflation par le biais de "l'effet discipline", des IDE et autres flux de capitaux ce qui rend la politique monétaire d'un pays plus difficile à mettre en œuvre. Plus précisément, l'intégration financière nécessite de la part des gouvernements, une libéralisation du secteur financier national ainsi que du compte financier. L'intégration se produit dès lors que les économies une fois libéralisées,

1 Selon Truman (2003), 22 pays ont formellement adopté des régimes de ciblage d'inflation.

connaissent une augmentation des mouvements de capitaux entre elles, y compris une participation active des prêteurs et emprunteurs nationaux sur les marchés financiers internationaux, ainsi qu'un recours massif aux intermédiaires financiers internationaux. De ce fait, l'intégration financière conduit à une augmentation des stocks d'actifs et engagements extérieurs des investissements directs étrangers et investissements de portefeuille des pays en % de leurs PIB. Cette libéralisation du compte financier ainsi que les nombreuses innovations financières qui ont suivi se sont accompagnées d'une forte augmentation des positions d'excédents nets des pays émergents. L'intégration croissante des marchés financiers a accru la sensibilité des investisseurs domestiques et étrangers aux différentiels de taux d'intérêt entre les pays. Ce phénomène a conduit à la convergence des courbes de rendements entre des pays à caractéristiques de risques comparables. Nous pensons que ces facteurs peuvent profondément affecter la dynamique de l'inflation.

Notons cependant que chaque cadre de politique monétaire a ses propres caractéristiques d'actions sur l'économie. Par exemple, les régimes de ciblage d'inflation répondent à la déviation de l'inflation par rapport à la cible ainsi qu'à la déviation de l'output gap, mais ne tiennent pas compte des mouvements des taux de change, au moins théoriquement. Mishkin et Schmidt-Hebbel (2001) soulignent que l'accent mis sur le contrôle des mouvements du taux de change en régime de ciblage d'inflation, ne ferait que faire courir le risque de transformer le taux de change en point d'ancrage nominal prenant le pas sur l'objectif d'inflation. Il serait donc intéressant d'étudier si, dans la pratique, les économies émergentes répondent aux mouvements des taux de change ou non. Si c'est le cas, ces réactions aux taux de change peuvent conduire à des problèmes de crédibilité, mais aussi à la remise en cause de la théorie du ciblage de l'inflation en intégrant clairement le taux de change dans la fonction de réaction par crainte de la peur du flottement et/ou des problèmes de stabilité financière.

Spiegel (2007) souligne que la globalisation financière a des effets ambigus sur les pays émergents. En effet, d'une part, la globalisation financière permet aux économies émergentes de lever des fonds à des taux d'intérêt favorables, mais d'autre part, soulève la possibilité d'une volatilité élevée du taux de change, en particulier dans le cas de la «base monétaire» qui peut être une source de volatilité de la production en raison de la rigidité des prix. Ainsi donc, le taux de change s'il n'est pas contrôlé efficacement peut déstabiliser l'économie. L'autre question que la globalisation financière a mise au centre des débats est celle de l'autonomie monétaire. Selon Aizenman et al. (2008), les marchés émergents ont dû accumuler d'importantes réserves de devises internationales afin de préserver une certaine autonomie

monétaire. Kramer et al. (2008) soulignent quant eux que l'accroissement des flux de capitaux entre les pays a fait surgir le débat sur "le triangle de Mundell". En effet, l'incompatibilité classique entre la stabilité des taux de change, l'indépendance monétaire nationale et l'ouverture financière se trouve au centre des débats dans la littérature concernant la politique monétaire. L'étude de ces auteurs indique en outre que la liberté des mouvements de capitaux a un impact significatif sur les pratiques monétaires des banques centrales. Par exemple, les prévisions et gestions de liquidités sont devenues déterminantes pour assurer une politique monétaire optimale dans un contexte de globalisation financière. Un autre débat porte sur la rareté des instruments de politique monétaire. Par exemple, selon Kramer et al. (2008), « l'une des contraintes opérationnelles les plus importantes dans la conduite de la politique monétaire face aux flux de capitaux, est l'existence d'instruments stérilisateurs de la dette domestique à plusieurs échéances pour permettre à la fois la gestion de la volatilité de court terme de la liquidité, ainsi que la stérilisation des entrées de capitaux de long terme».

Dans ce contexte d'accroissement des échanges commerciaux et de globalisation financière, *le but de cette thèse* est d'étudier empiriquement comment la globalisation financière a influé sur la dynamique de l'inflation et la conduite de la politique monétaire des pays émergents ayant adopté des régimes de ciblage d'inflation. Ainsi donc, il s'agit d'enrichir notre compréhension de la dynamique de l'inflation et des mécanismes de transmission monétaire dans un tel contexte. Plus précisément, nous divisons cette question générale en trois questions suivantes, en proposant une analyse empirique.

(i) Les banques centrales ciblant l'inflation réagissent-elles en pratique aux mouvements du taux change?

(ii) Quelle est l'importance relative des différents canaux de transmission de la politique monétaire?

(iii) Quel est l'impact de la globalisation financière sur la dynamique de l'inflation?

Dans le *premier chapitre* de cette thèse, nous traitons de la question suivante : Les banques centrales ciblant l'inflation réagissent-elles en pratique aux mouvements du taux change? Cette étude est motivée par (i) la *peur du flottement*, une notion bien expliquée dans Calvo and Reinhart (2002), (ii) la libéralisation du compte financier entraînant une plus grande volatilité des taux de change, et (iii) la forte pression sur les taux de change due aux entrées de capitaux. En outre, dans la plupart des économies émergentes ciblant l'inflation, la banque

centrale a un double objectif à savoir, la stabilité des prix et la stabilité financière. Cependant, la stabilité financière dépend aussi de la stabilité du taux de change, ce qui fait du taux de change une variable encore plus importante pour ces économies. En revanche, la théorie du ciblage d'inflation stipule que la banque centrale ajuste son instrument monétaire en réponse aux déviations de l'inflation par rapport à la cible, et en réponse à l'écart de production (Svensson (2000), Taylor (2001) et Walsh (2009)). Ainsi, selon cette théorie, le taux de change n'est pas pris en compte dans la fonction de réaction de la banque centrale. Dans ce contexte de peur du flottement et de théorie du ciblage d'inflation, ce premier chapitre étudie empiriquement la question de savoir si les banques centrales des pays de l'échantillon considéré ici répondent aux variations des taux de change ou non. Nous utilisons dans cet essai modèle néo-keynésien de petite économie en suivant Gali et Monacelli (2005), et estimons le modèle en utilisant la Méthode des Moments Généralisés (MMG) à équations multiples. Nous trouvons que les réponses des banques centrales aux mouvements des taux de change sont statistiquement significatives dans le cas du Brésil, du Chili, du Mexique et de la Thaïlande, alors qu'elles sont non significatives dans les cas de la Corée et de la République tchèque.

Dans *le second chapitre*, nous abordons la question de l'importance relative des canaux de transmission de la politique monétaire. Dans la mesure où les économies deviennent de plus en plus interdépendantes, certaines questions relatives à la politique monétaire ont suscité un regain d'intérêt. Parmi celles-ci, les chercheurs ont commencé à s'intéresser aux questions suivantes : le contrôle des autorités monétaires sur l'inflation et le taux d'intérêt a-t-il diminué ou non? Y a t-il eu des changements dans l'importance relative des canaux de transmission monétaire? Woodford (2007) met en évidence un certain nombre de facteurs qui pourraient conduire à moins de contrôle des autorités monétaires sur l'inflation. Cependant, l'étude conclut qu'il y a peu de raisons de penser que la globalisation financière élimine ou même affaiblisse considérablement l'influence de la politique monétaire nationale sur l'inflation domestique. Utilisant un modèle à correction d'erreurs, Gudmundsson (2007) se focalise sur les mécanismes de transmission de la politique monétaire dans une économie prenant en compte la globalisation financière, et conclut qu'il existe une évidence quant à l'affaiblissement du canal du taux d'intérêt, et l'influence du canal du taux de change dans l'économie.

Malgré une abondante littérature concernant l'impact de la globalisation financière sur l'efficacité de la politique monétaire[2], la question de l'importance relative des canaux de transmission monétaires dans les économies intégrées reste une question sans réponse. Les canaux de transmission de la politique monétaire que sont le canal des taux d'intérêt, le canal du crédit, le canal du prix des actifs et le canal du taux de change, ont-ils le même ordre d'importance, ou cet ordre a-t-il changé en raison de la globalisation financière? L'objectif de ce second chapitre est donc d'analyser l'importance relative des différents canaux de transmission de la politique monétaire dans des économies intégrées financièrement. *Ce chapitre est motivé par:* (i) L'accroissement de l'ouverture financière, la valeur de la monnaie peut devenir plus sensible aux écarts de taux d'intérêt, ce qui renforce le canal du taux de change comme mécanisme de transmission de la politique monétaire. En dépit de l'abondante littérature mettant en évidence la baisse du degré de *pass-through*[3] dans de nombreux pays, il existe encore des effets opposés sur le taux de change. En effet, d'une part, l'ouverture commerciale et financière aurait pu renforcer le canal du taux de change et d'autre part, une baisse du degré de *pass-through* en raison de la concurrence pourrait avoir affaibli le canal du taux de change. Gust et al. (2006) concluent dans leur modèle théorique qu'un accroissement simultané de l'ouverture des échanges et la baisse du degré pass-through peut être due à la concurrence avec les entreprises étrangères. (ii) L'importance croissante du canal d'évaluation comme expliqué dans Lane et Milesi-Ferretti (2006). (iii) L'évolution des conditions de liquidité et de crédits engendrée par la globalisation financière. Les activités de prêts des banques étrangères peuvent être moins affectées par les conditions domestiques. Ils pourraient recevoir ou envoyer des fonds à leurs banques filiales-, ce qui peut conduire à une relation décroissante entre l'outil d'exploitation et la variable de transmission (crédit bancaire) et par la suite un affaiblissement du canal du crédit. (iv) La potentielle pression à la hausse des prix des actifs exercée par les entrées de capitaux rendant ainsi plus conséquent le canal des prix des actifs. Si les prix des actifs sont des créances sur les résultats futurs, la globalisation financière pourrait renforcer le canal de prix des actifs. Nous utilisons un modèle VAR structurel afin de quantifier l'importance relative des différents canaux par une analyse par décomposition de la

2 Voir entre autres, Mumtaz and Surico (2009), Boivin and Giannoni (2008), Kamin (2010) and Speigel (2008).

3 Canal par lequel les variations du taux de change influencent les prix domestiques.

variance. Notre modèle de base comprend: deux variables cibles, la production et l'inflation, quatre variables intermédiaires: le taux des prêts bancaires, les prêts bancaires, le taux de change et les prix des actions représentant respectivement le canal des taux d'intérêt, le canal du crédit, le canal du taux de change et le canal des prix des actifs. Enfin, le taux d'intérêt directeur sert d'instrument à la politique monétaire. Dans le test de robustesse, nous ajoutons les prix du pétrole en tant que variable de contrôle de la composante systématique de la règle de politique monétaire, pour identifier les changements exogènes de politique monétaire. Nous trouvons que les canaux du taux de change et des prix des actifs expliquent une part significative des fluctuations de la production et de l'inflation par rapport aux canaux traditionnels de taux de change et du crédit. Ces résultats montrent l'impact majeur de la globalisation financière sur la transmission de la politique monétaire.

Dans *le troisième essai*, nous explorons plus en détails l'impact de l'ouverture commerciale et financière sur la dynamique de l'inflation. Dans la mesure où les économies sont de plus en plus ouvertes, la dynamique de l'inflation devient de plus en plus difficile à contrôler. Ce phénomène de globalisation financière a initié deux principaux débats : le premier concerne l'évolution du rôle des facteurs externes comme le taux d'intérêt mondial, l'écart de production mondial. Le second concerne l'inflation importée, la présence de produits de substitution, et les effets de discipline dans la détermination de l'inflation domestique. Dans cet essai, nous nous focalisons sur le deuxième aspect du débat en nous demandant: quelle est la relation entre la globalisation (en termes réels et financiers) et la dynamique de l'inflation? Nous utilisons également dans ce chapitre la Méthode des Moments Généralisés pour résoudre les problèmes d'endogénéité. Nous considérons le ratio des importations en % du PIB pour mesurer l'ouverture commerciale et de deux mesures de l'ouverture financière: (i) L'indice de Chinn et Ito (2010) et (ii) le ratio des actifs et engagements totaux en % du PIB. Contrairement aux résultats de Romer (1993), nous trouvons une relation positive entre le niveau de l'inflation et de l'ouverture commerciale. Toutefois, dans le cas de l'ouverture financière, nos résultats sont moins robustes.

Cette thèse dégage plusieurs implications en termes de politique monétaire:

(i) Dans le premier essai, sur le plan théorique, l'étude souligne la nécessité de formuler une théorie du ciblage d'inflation tenant compte du taux de change dans la fonction de réaction des banques centrales. En termes de politique monétaire, l'enjeu consiste à concevoir une stratégie de communication efficace qui empêcherait que le taux de

change ne constitue un point d'ancrage nominal tel que suggéré par Mishkin et Schimdt-Hebbel (2001).

(ii) Dans le deuxième chapitre, l'étude met en évidence l'importance des canaux du taux de change et des prix des actifs, de sorte que dans la mise en œuvre de leurs politiques monétaires, les États doivent se focaliser sur ces deux canaux dans un contexte de globalisation financière.

(iii) Dans le troisième essai de la thèse, le caractère instable de la relation entre l'inflation et l'ouverture commerciale exige des études plus approfondies afin de formuler une théorie mettant en évidence la relation positive entre ouverture commerciale et inflation. En termes de politique monétaire, les autorités monétaires ne devraient pas définitivement considérer que l'ouverture commerciale entraîne une baisse du niveau de l'inflation. Au contraire, elles devraient considérer cette relation avec prudence, en gardant à l'esprit qu'il existe une multitude de facteurs comme les structures de marché, la disponibilité de produits de substitution, et la composition des produits importés pouvant influer sur cette relation et la rendre ainsi instable.

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À mes parents, ma femme, ma fille, mes sœurs et mon frère

والدین، زوجہ، بیٹی، بھائی اور بہنوں کے نام

Contents

General Introduction

For the last two decades or so the world has been experiencing the phenomenon of real openness and financial globalization. The economies are becoming more and more integrated. In this globalized world, the implementation of monetary policy is becoming a more and more challenging task. Historically speaking, different central banks have tried different monetary regimes from time to time to attain the objective of price stability that is, generally, the main objective of the monetary policy. For instance, there has been exchange rate targeting, monetary targeting, and now an increasing number of countries[1] are adopting inflation targeting (IT) regimes. New Zealand was the pioneer in adopting this monetary arrangement in December 1989.

Interestingly, on one hand, the number of countries that adopted an IT regime is increasing and on the other hand, in the environment of free trade and capital mobility the role of exchange rate in stabilizing the economy has increased. These developments pose different challenges to the monetary policy and can change the dynamics of inflation. For instance, the increasing real openness (trade openness) changes the inflation dynamics through many factors like: more competition, availability of more substitutes of goods, imported inflation (cost channel), and "discipline effect". The financial globalization (the integration of country's local financial system with international financial markets and institutions) influences the dynamics of inflation through the "discipline effect", FDI, and capital inflows that make monetary management a more difficult task. The financial integration, in particular, requires that governments liberalize the domestic financial sector and the capital account. Integration takes place when liberalized economies experience an increase in cross-country capital movements including an active participation of local borrowers and lenders in international markets and a widespread use of international financial intermediaries. This phenomenon leads to an increase in the stocks of external assets and liabilities of foreign direct investment and portfolio investment as a percent of GDP. Several reasons explain these increases in capital movements including financial innovations and capital account liberalization. These flows have coincided with a large buildup of net surplus positions by emerging markets. This enhanced integration of financial markets has increased the sensitivity of domestic and foreign investors to interest rate differential. This phenomenon has led to the convergence of yield curves across nations with comparable default-risk characteristics.

[1] According to Truman (2003), there are 22 countries who have formally adopted Inflation Targeting regime.

According to Spiegel (2007) this has made the inflation tax a redundant tool. We think that these factors can deeply affect the dynamics of inflation.

Nonetheless, each monetary framework has its own features, for example, IT regime responds to inflation deviation and output gap and keeps the exchange rate aside at least theoretically. Mishkin and Schmidt-Hebbel (2001) say that a focus on limiting exchange rate movements, in IT regime, runs the risks of transforming the exchange rate into a nominal anchor that takes precedence over the inflation target. So it is worth exploring whether IT emerging market economies respond to exchange rate in practice or not. If so it may lead to credibility problems down the road, and also pinpoints that theory of inflation targeting aside, exchange rate is still in the reaction function because of fear of floating and/or financial stability issue.

With respect to financial globalization, Spiegel (2007) says, on the one hand financial globalization provides an opportunity to the emerging market economies to raise funds at a favorable interest rate, but on the other hand it raises the possibility of exacerbated exchange rate volatility, especially in the case of "hot money", which can be a source of output volatility due to price stickiness. So the exchange rate if not managed carefully can play havoc with the economy. The other issue that financial globalization brought to the center stage is the question of monetary autonomy. According to Aizenman et al. (2008), emerging markets have buildup sizeable international reserves as a buffer to preserve some degree of monetary autonomy. Whereas Kramer et al. (2008) say that the increased capital inflows have revived the debate about the "impossible trinity". The classic tension, among exchange rate stability, domestic monetary independence and financial openness has come to limelight in the literature concerning monetary policy. Their study further states that the phenomenon of increased inflows has an impact on monetary policy operations. For instance, liquidity forecasting and liquidity management have become the key pillars to effective monetary management in the backdrop of financial globalization. Another debate is about the scarcity of monetary policy instruments. For instances, according to Kramer et al. (2008), " a key operational constraint on the conduct of monetary policy in the face of large inflows is therefore the availability of domestic sterilization debt instruments, with a broad range of maturities to allow both "fine-tuning" (dealing with short-term volatility in liquidity conditions) and the sterilization of more durable inflows".

In this environment of increasing trade and financial globalization *the aim of this dissertation* is to investigate empirically how the globalization has influenced the dynamics of inflation and the conduct of monetary policy in emerging market inflation targeting economies. On the way, we would like to enrich the understanding of inflation dynamics and monetary transmission mechanisms. So the general question is the impact of globalization on inflation dynamics and monetary policy. More specifically, we divide this broad question into the following three questions and investigate them empirically.

(i) Do inflation targeting central banks respond to the exchange rate movements?
(ii) What is the relative importance of different monetary transmission channels?
(iii) What is the impact of globalization on the dynamics of inflation?

In the *first chapter* of this thesis, we address the question: Do inflation targeting central banks respond to exchange rate movements? *The motivation* behind this question comes from (i) the *fear of floating*, a fact that is well documented in Calvo and Reinhart (2002), (ii) the liberalization of capital account leading to more volatile exchange rates, and (iii) the upward pressure on exchange rate due to capital inflows, especially the hot money. In addition, in most of the IT emerging economies, the central bank has dual objective, i.e., price stability and financial stability. Financial stability also hinges upon exchange rate stability, which makes exchange rate even more important for these economies. By contrast, the theory of IT says that the central bank adjusts its policy instrument in response to inflation deviations of the inflation rate from the target and the output gap (Svensson (2000), Taylor (2001) and Walsh (2009)). Thus, according to the theory of IT, the exchange rate is not in the reaction function of the central bank. Against this backdrop, the *motivation of the chapter* comes from the fear of floating and the *theory of inflation targeting.* Thus, *the first chapter* investigates empirically whether the central banks of the sample countries respond to exchange rate movements or not. In this essay we use a small open-economy New Keynesian model à la Gali and Monacelli (2005), and estimates the model using a multi-equation GMM technique. We find statistically significant responses of central banks to the exchange rate in the case of Brazil, Chile, Mexico and Thailand, while it is insignificant for Korea and Czech Republic.

In the *second essay* we address the issue of the relative importance of monetary transmission channels. As the economies are becoming more and more interdependent. Some questions concerning monetary policy have gained more importance. Among them, has the control of

monetary authority over domestic inflation & interest rate has decreased or not? Has there been any change in the relative importance of the channels of monetary transmission mechanism? Researchers have started to look for these questions. Woodford (2007) highlights a variety of factors that might lead to less control of the monetary authority on inflation. However, the study concludes that there is little reason to expect that globalization should eliminate or even substantially weaken the influence of domestic monetary policy over domestic inflation. Gudmundsson (2007) focuses on the monetary policy transmission mechanism within the economy with respect to financial globalization and concludes that there is some evidence of weakening of the interest rate channel and overburdening of the exchange rate channel. The study uses Vector Error Correction Model (VECM) and conclude based on a simple correlation matrix.

In spite of the sizeable literature about the impact of financial globalization on the effectiveness of monetary policy,[2] the issue of relative importance of monetary transmission channels in globalized economies remain an unanswered question. Do the channels of monetary policy transmission - interest rate channel, credit channel, asset price channel and exchange rate channel - have the same order of importance as is generally believed or it has changed due to financial globalization? The *objective of the second chapter* is to investigate the relative importance of different channels of monetary transmission mechanism in globalized economies. The *motivation for this chapter comes from:* (i) As financial globalization increases, the currency value may become more responsive to interest rate differentials, thereby reinforcing the exchange rate channel of monetary transmission mechanism. Despite the vast literature on falling exchange rate pass-through in many countries there are still opposing forces. On the one hand, trade and financial globalization might have strengthened the exchange rate channel and on the other hand, a fall in pass-through due to competition might have weakened exchange rate channel. [Gust et al. (2006) conclude in their theoretical model that a simultaneous increase in trade openness and decline in pass-through can be due to competition with the foreign firms]. (ii) The increasing importance of the valuation channel, for instance, Lane and Milesi-Ferretti (2006). (iii) The evolution of liquidity and credit conditions implied by financial globalization. The lending activities of foreign banks might be less affected by the domestic conditions. They might be

[2] See for example, Mumtaz and Surico (2009), Boivin and Giannoni (2008), Kamin (2010) and Speigel (2008) among others.

receiving from or sending funds to their parent banks offshore, which can lead to a waning relationship between the operating tool and the transmission variable (bank credit) and subsequently a weakening of the credit channel. (iv) The potential upward pressure on asset prices exerted by capital inflows making the asset price channel stronger. If asset prices are claims, as is considered, on future output, then financial globalization may have strengthened asset price channel. We use a Structural VAR model and quantify the relative importance of channels through variance decomposition. Our base-line model includes 7 variables: 2 target variables: output and inflation, 4 intermediate variables: the bank lending rate, the bank loans, the exchange rate and the share prices, supposed to represent the interest rate channel, the credit channel, the exchange rate channel and the asset price channel, respectively. Finally, the policy interest rate which gauges the stance of the monetary policy. In the robustness check, we add oil prices as a variable to control for the systematic component of the policy rule to identify "exogenous" monetary policy changes. We find convincing evidence that exchange rate and asset price channels explain a high share of fluctuations in output and inflation relative to the traditional interest rate and credit channel. These relative variances show the great influence of globalization on the transmission of monetary policy.

In the *third essay*, we explore in detail the impact of trade openness and financial globalization on inflation dynamics. As the economies are becoming more and more open, inflation dynamics are becoming more and more complex. This phenomenon of globalization has initiated two strands of debate: one is about the changing role of external factors, like the world interest rate, the global slack, the world output gap,[3] and the other is about imported inflation, the availability of substitutes, and disciplining effects in the determination of domestic inflation. In this essay, we deal with the second question: what is the relationship between globalization (real and financial) and inflation dynamics. To take care of inherent endogeneity, this chapter uses GMM technique. We use import to GDP ratio to measure the trade openness and two proxies for the financial openness: (i) Chinn and Ito index (2010) and (ii) total assets *plus* total liabilities over GDP ratio. Contrary to the results of Romer (1993), we find a positive relationship between level of inflation and trade openness. However, in the case of financial openness, our results are less conclusive.

This dissertation has several theoretical and policy implications:

[3] See Ihrig et al. (2007) for comprehensive literature review on this issue.

(i) In the first essay, on the theoretical front, the study points to the necessity to formulate a theory of IT that assigns some positive weight to the exchange rate in inflation targeting regime. On the policy side, the challenge is to design an effective communication strategy that prevents exchange rate from becoming a nominal anchor as suggested by Mishkin and Schimdt-Hebbel (2001).

(ii) In the second essay, the study highlights the importance of exchange rate and asset price channel, so the need is to focus more on these channels while designing monetary policy in a globalized world.

(iii) In the third essay of the dissertation, the time-variant nature of relationship between inflation and openness demands extensive studies to formulate a theory about openness and inflation in which openness would affect inflation positively. On the policy side, policy-makers should not take it for granted that openness leads to decline in level of inflation. Rather, they should consider this relationship very meticulously, keeping in mind plethora of factors like market structures, availability of substitutes, and composition of imported goods.

Chapter 1

Inflation Targeting, Exchange Rate and Financial Globalization

1.1 Introduction

The world has witnessed an increase in capital movement in the last two decades among the countries on the one hand and an increment in the number of countries who adopted inflation targeting on the other hand. Among the Inflation Targeting (IT) adopters there are advanced countries like New Zealand, Sweden and UK which are relatively less concerned about the exchange rate movements due to their peculiar economic structure, but there are also many emerging market economies, which are more concerned about exchange rate. The one reason of assigning more importance to exchange rate by emerging markets is typically the *fear of floating* well documented in Calvo and Reinhart (2002). Secondly, the liberalization of capital account by the emerging market economies has made the capital movements more volatile leading to volatility in exchange rates. Thirdly, when the capital inflows come in these countries, especially the hot money, it can put an upward pressure on exchange rate. This phenomenon has recently reignited a debate that should central bank respond to exchange rate or not.

However, on the other hand, according to Svensson (1999) under the IT regime a high degree of transparency is required. Therefore, economic agents should be certain that central bank is targeting only inflation or exchange rate also. We think that if this is not the case, it may lead to time inconsistency problem well documented by Kydland and Prescott (1977). Similarly, another study by Mishkin and Schimdt-Hebbel (2001), says that a focus on limiting exchange rate movements runs the risk of transforming the exchange rate into a nominal anchor that takes precedence over the inflation target. Theoretically speaking, under inflation targeting the central bank has been assigned with exclusive objective of price stability then there is less room for discussion about the reaction of monetary policy toward exchange rates but this is not the case in practice. However, it is interesting to note that in most of the IT countries the central bank has dual objective i.e. price stability and financial stability see Table A1 in appendix A. Also one might argue that regulatory framework is the tool to achieve financial stability. We do not deny the role of prudent regulations but we think that a prudent monetary

policy can also contribute in this regard. Interestingly, in our sample all the central banks have been empowered with the mandate of ensuring not only price stability but also financial stability (see Table A 1 in Appendix A).

Furthermore, there is the well known *"impossible trinity",* according to which high capital mobility can co-exist with independent monetary policy only when exchange rate is free float, otherwise, the monetary policy becomes subservient to exchange rate policy. So theoretically, a country cannot have all three goals simultaneously. As for the last decade, emerging markets have increasingly been adopting inflation targeting. On the other hand, in the environment of free capital mobility the role of exchange rate in stabilizing the economy cannot be underestimated, due to economic structures of emerging market economies particularly. Against this backdrop, the *motivation of the study* comes from the fear of floating and the *theory of inflation targeting.* The *purpose of this study* is to investigate empirically whether the central banks of the sample countries respond to exchange rate or not.

The rest of the document is structured as follows. Section 2 provides a brief overview of the literature. In section 3 we present model and theoretical explanation of the model. Section 4 describes the methodology and the data. Section 5 explains the empirical results. In section 6 we check robustness and the final section provides some concluding remarks.

1.2 Literature Review

The paper by Calvo and Reinhart (2000) finds that the countries that say they allow their exchange rate to float mostly do not – there seems to be an epidemic case of "fear of floating". Similarly, Cavoli (2009) concludes that fear of floating is justified in open developing economies. Another paper with the same line of arguments is by Ball (2000). According to this paper the exchange rate should also be included in the reaction function of the central bank. However, whether it should be on the right side of the Taylor Rule or the left side is an empirical question. In the former case it is extended Taylor rule but the latter is Monetary Condition Index (MCI). Thus the paper introduces MCI. The question is that why exchange rate is so important? There is variety of channels through which exchange rates impact the economy, illustrated in the paper by Svensson (1999). The interest rate differential impacts the exchange rate and the expected future exchange rate through the interest rate parity condition. And due to existence of sticky prices, the nominal exchange rate affects the real exchange rate. The real exchange rate will affect the relative price between domestic and

foreign goods, which consequently, have an impact on both domestic and foreign demands for foreign goods and thus contribute to the aggregate demand channel for the transmission of monetary policy. Then there is a direct channel, which brings *imported inflation* in the case of depreciation. Typically the impact of direct channel is quicker relative to the aggregate demand channel. Besides these, another channel through which exchange rate affects the economy is the domestic currency prices of imported intermediate inputs. Due to depreciation the prices of the inputs increase and this leads to increase in the cost of production and subsequently to domestic inflation, this is called *cost channel*. Furthermore, if the wages are indexed to the CPI the depreciation will cause an increase in nominal wages. This is the real side of the economy, then there is financial side, according to Calvo and Reinhart (2000) and Kaminsky and Reinhart (1999) if the liabilities of the banking sector or the government sector or of both are dollar denominated the value of foreign debt in domestic currency goes up in the wake of depreciation and this makes the smooth functioning of these institutions quite difficult and even, in some cases, may lead to banking sector crises. According to another study, Aghion, Bacchetta and Banerjee (2000), if nominal prices are rigid currency depreciation causes an increase in the foreign currency debt repayment obligations of the firms leading to a decline in their profits; this reduces firms borrowing capacity and subsequently investment and output in a credit constrained economy, which leads to depreciation spiral. Another channel, which recently has been identified by Lane and Milesi-Ferretti (2004), emphasizes those larger gross cross-holdings of foreign assets and liabilities means that the valuation channel of exchange rate has grown in importance, relative to the traditional trade balance channel. All these effects bring the exchange rate in central stage in an open economy, and in this globalized world economies are becoming more and more open, (see figures A 1 and A 2 in appendix A).

The literature about the response of central bank, specifically, to exchange rate movements can be divided into two strands; (1) the empirical and (2) the theoretical or calibrated. In the former category we have Edwards (2006), the study concludes that, among other results, there is some evidence that IT countries with history of high inflation takes into account exchange rate movements while conducting monetary policy. Similarly, Aizenman et al. (2008) conclude that inflation targeting emerging market economies follow mixed strategy. This study also uses single equation like Edwards (2006). In another study by Hebbel and Tapia (2002) the conclusion is that, although exchange rate pass-through has declined, the Bank of

Chile still responds to exchange rate misalignments. Osawa (2006) concludes that Philippines, Thailand and Korea do not react to exchange rate movements. Mohanty and Klau (2004) use GMM technique to estimate Taylor rule for 13 emerging and developing economies and conclude that central banks in most of these countries respond to exchange rate movements.

In the second category we have De Paoli (2006), which uses calibration and impulse response. The study takes exchange rate into account, arguing that welfare is affected by exchange rate volatility, so exchange rate cannot be ignored. The paper concludes that domestic inflation targeting is only preferable when the economy is closed. The study uses two country dynamic general equilibrium model. Similarly Parrado (2004) uses simple dynamic new Keynesian model and concludes that if there is a real shock, flexible exchange rates dominates managed exchange rates. Secondly, domestic inflation appears to outperform CPI, and flexible inflation target is preferable to strict inflation target. Cavoli (2009) uses small open economy model for Philippines, Thailand, Korea and Indonesia and concludes that fear of floating still exists for developing economies. According to Gali and Monacelli (2005) domestic inflation targeting policy, in terms of contribution to welfare losses, is a better policy relative to CPI target or Pegged exchange rate. Gali and Monacelli is a special case where elasticity of substitution between goods is 1. The result does not hold for more general environments.

The studies mentioned in the above paragraph use either single equation Taylor rule or rely on calibration. Our study is different as it uses a small open economy new Keynesian model but most of the parameters are estimated. So this study has a consistent estimation of a small new Keynesian model instead of single equation Taylor rule or relying heavily on parameterization (calibration). The *contribution of the study* is that it bridges the gap between the two strands – empirical and calibrated studies. The methodology we use is multi-equation GMM technique that takes very much care of the simultaneity inherent to monetary policy studies due to transmission lag and interdependence among the variables in the model. So the study answers a very relevant question – due to financial globalization – that emerging market inflation targeting central banks respond to exchange rate movements or not using small open economy new Keynesian model estimated with multi-equation GMM that is robust to simultaneity bias. Secondly, this paper also differs from the Gali and Monacelli (2005) in the sense that here $\sigma \neq \sigma_{\alpha} \;\; and \; \eta \neq 1$.

Our sample includes six countries; Brazil, Chile, Mexico, Korea, Thailand and Czech Republic. The reasons behind the selection of these countries are (i) they are inflation targeters (ii) they have been under fixed or managed floating exchange rate regime before adoption of IT (iii) the sample represents Latin America, Asia and Central Europe. Coming to the characteristics of sample countries, if we look at recent history, before adoption of IT, the situation is very interesting. According to Calvo et al. (1995), Chile provides an example of Purchasing Power Parity (PPP) rule, the study further says that in July 1985, an exchange rate band was established whose central parity was adjusted at daily intervals according to the schedule based on the inflation rate during the previous month minus the estimated world inflation rate and this rule was intact until January 1992. According to Carstens and Werner (1999), Mexico experienced a forced transition to the floating regime. The study says that current account deficit; illiquidity of the Mexican government and the looming banking crises paved the path for balance of payment and financial crises. These developments compelled the central bank to let the peso float. Brazil was under a crawling pegged system from 1994 to 1998. After the late-1998 currency crises, Brazil adopted floating exchange rate system. On the other hand, in South East Asia, too, the situation was more or less similar to the above mentioned Latin American countries. According to Osawa (2006), Korea was under the managed floating regime until October 1997, however, it became independently floater after November 1997, whereas Thailand was under fixed exchange rate regime till June 1997, and then moved to managed floating. In the Eastern Europe, Czech Republic was under the fixed exchange rate regime against Deutsche Mark (DM) when the Czech Republic was struck by currency crisis in 1997. According to a study by Creel and Levasseur (2004), the root cause of the crisis was excessive credit to the firms by the state-owned banks and on the other hand, the firms did not go for restructuring and lost competitiveness. Consequently, the external imbalances engulfed the economy. The Central Bank increased the interest rate in vain to defend the regime and ultimately, abandoned the fixed exchange rate regime in favour of managed float against DM. And few months later in December 1997, Czech Republic adopted inflation targeting regime.

We now contrast the level of financial globalization of these countries with respect to their movements toward flexible exchange rate regime. Brazil adopted independent floating in 1999, Chile also in 1999, although it is interesting to note that Chile adopted inflation targeting in 1991, Mexico adopted independent floating exchange rate at the end of 1994.

According to Dooley et al. (2002), before the crisis in 1997 Korea was characterized by a tightly managed exchange rate regime. Similarly, according to Osawa (2006), Korea was under the managed floating regime until October 1997, whereas Thailand was under fixed exchange rate regime until June 1997, and then moved to managed floating.

As depicted in the above paragraphs, the countries that constitute our sample have been associated with the fixed exchange rate regime before adopting inflation targeting. This also makes a convincing reason to explore the response of the central banks to exchange rate movements, as the exchange rate might still be haunting the economic agents in these countries. We turn to our model in the next section.

1.3 The Model

We use a small open economy New Keynesian Model that closely follows Gali and Monacelli (2005). The model consists of households, firms and a central bank. So our econometric model for the inflation targeting framework for open economies includes three basic equations: an aggregate demand or dynamic IS type equation, the Phillips Curve representing the supply side and our third equation is an interest rate rule, a modified Taylor rul. *The assumptions* of the model are: (i) the prices of the goods and inputs are set by the private economic agents instead of Walrasian auctioneer seeking to clear all the markets at once that is that is firms face monopolistic competition; (ii) there exist nominal rigidities, that is, firms are subject to some constraints on the frequency with which they can adjust the prices of the goods and services they sell. That is, the existence of menu cost has been assumed. Needless to say, that these nominal rigidities induce short run non-neutrality of monetary policy. In the long run, however, monetary policy is no more non-neutral; (iii) uncovered interest rate parity and purchasing power parity hold.

$$y_t = E_t y_{t+1} - \frac{1}{\sigma_\alpha}\left(i_t - E_t\left(\pi_{h,t+1}\right)\right) + \varepsilon_t^y \qquad 1$$

y_t is output gap measured as natural log deviation of Gross Domestic Product (GDP) from the potential value of GDP measured with HP filter, σ_α is a structural parameters that depends upon some other structural parameters, that we will explain shortly, whereas Fisherian ex-ante equation $(i_t - E_t\left(\pi_{h,t+1}\right))$ has been used to calculate the real interest rate and ε_t^y is the stochastic error term.

Equation (1) which represents the demand side of the economy is an open economy expectational, forward-looking dynamic IS curve where current output gap is a positive function of one period ahead expected output gap, and a negative function of the real interest rate. Indeed as it is commonly argued that an increase in the real interest rate will depress the level of investment on one hand, and increase the level of saving on the other hand, thus having downward impact on output level through investment and consumption, while the opposite holds true for the decline in real interest rate (Chadha and Dimsdale, 1999). However, the story is not as smooth as it looks, for example, Bilbiie (2008) emphasize the role of degree of asset market participation in the determination of slope of IS curve. The study is of the view that moderate participation in financial markets strengthen the role of monetary policy while low enough participation can cause an inversion of the IS curve. This can lead to blatant opposition to the 'Keynesian' conventional wisdom. This also in fact depends upon the relative strength of the *substitution effect*, which works toward more saving at higher interest rate, and the *income effect* which works toward less saving at higher interest rate. So the substitution effect and income effect are not only concerned with the asset market participation but also with the income distribution in the society.[1] Similarly, in deflationary episodes the potency of monetary policy becomes questionable as despite very low interest rates economy does not grow as it would in normal days. This is the situation where zero bound interest rate becomes a constraint on the monetary authorities and they resort to tools like fiscal stimulus or quantitative easing or both. The other factor that explains negative relationship between real interest rate and output is investment. It would not be out of place to mention here that in developing countries political instability also matters but it is not the problem of developed economies. Besides all that, recent research emphasizes that it is not the level of real rate as such rather the *'natural' or 'equilibrium'* value of the real rate that matters for the output gap (Neiss and Nelson, 2001; Woodford, 2003). However, the academic questions arise there with what certainty one can calculate the 'natural' or 'equilibrium' value of the interest rate and does it remains constant for a reasonable period of time to implement and see the results.

An important parameter of equation (1) is

[1]Furthermore, the position of households that they are net creditors or debtors is also important in this regard. However, we assume that substitution effect dominates so consumption decreases in first period and increases in second.

$$\sigma_\alpha = \frac{\sigma}{(1-\alpha)} + \alpha\omega$$

where σ is the coefficient of relative risk aversion and under the assumption of usual time-separable utility function $\frac{1}{\sigma}$ is the elasticity of intertemporal substitution (EIS) between consumption in any two periods. So EIS measures the extent to which an increase in the interest rate induces consumers to substitute future consumption for present consumption. According to Favero (2005) the value of EIS below 1 means that income effect dominates whereas if it is greater than 1 the substitution effect dominates. The other parameter is α, it measures the degree of openness. The third parameter is the function of some structural parameters as;

$$\omega = \sigma\gamma + (1-\alpha)(\sigma\eta - 1)$$

whereas γ measures the substitutability between goods produced in different countries. It captures the taste preference of the economy and η measures the substitutability between domestic and foreign goods from the view point of domestic consumers. According to Gali and Monacelli (2005) if ω is greater than 1 contractionary effect of real appreciation dominates and vice versa.

The last term ε_t^y is an unanticipated demand shock (like public spending, or preference disturbance) or expectation error. It is assumed to be white-noise and temporary in nature.

Now we move to the supply side of the economy that is captured through the small open economy New Keynesian Phillips Curve (NKPC). This equation is essential to evaluate monetary policy, as it traces the price setting behaviour of the firms and therefore the characteristics of inflation dynamics. We start with the closed economy NKPC;

$$\pi_{h,t} = \beta E_t \pi_{h,t+1} + \lambda mc_t + \varepsilon_t^\pi \qquad 2$$

β is the subjective discount factor and it can take the value $0 < \beta < 1$. In most of the studies its value has been assumed 0.99, which means a riskless annual return around 4 percent in the steady state.

Equation (2) represents the supply side of a closed economy. It is a New Keynesian Phillips Curve, which can be derived from various price setting behaviour. It is also a measure of excess demand, assuming that there is no stagflation. It is a forward-looking expectation-augmented Phillips curve where current domestic inflation $(\pi_{h,t})$, measured here as GDP

deflator, depends upon expectations of economic agents about future domestic inflation and a second term mc_t which denotes real marginal cost. So it is evident domestic inflation is positive function of real marginal cost. The simple text book argument that as real marginal cost increases, so does the cost of production and subsequently inflation. The coefficient attached with mc_t is λ. It is the slope of the Phillips curve and is of first order importance, as it tells us how flat or steep a Phillips curve is. This parameter is a function of some structural parameters as;

$$\lambda \equiv \frac{(1-\theta)(1-\theta\beta)}{\theta}$$

where θ is the probability that a firm keeps its price unchanged. So it is related to the degree of price stickiness à la Calvo (1983). Conversely, $(1-\theta)$ is the probability that a firm is allowed to adjust the price. While firm changing their prices, they need to take into account future inflation, as they may not be able to adjust their prices for several periods. The higher the value of θ, the lesser the pressure on inflation as firms change price less frequently. The value of θ depends upon many factors like, competition among firms, economic situation, historical level of inflation, etc. Furthermore, the value of θ can also be influenced by the market structure and the issues like complementarity among the firms. Besides these factors, it also depends upon the communication strategy and credibility of the central bank. Consequently, λ captures the speed of price adjustment, the larger λ implies that a larger proportion of firms adjust their prices each period, keeping the aggregation problems aside.

Finally, in equation (2), ε_t^{π} is a cost push shock, for example, an adverse supply shock of oil. In new Keynesian literature this causes the trade-off between inflation and output variance.

However, the NKPC presented in equation (2) is a closed-economy version. As we are dealing with open economy, we relate it to the open economy as the study of Gali and Monacelli (2005) does. As according to Gali and Monacelli (2005), in a small open economy the Consumer Price Inflation (CPI), π_t, is the combination of domestic price inflation $\pi_{h,t}$ and of changes in the terms of trade Δs_t. So the relationship can be described as following

$$\pi_t = \pi_{h,t} + \alpha \Delta \mathrm{s_t} \qquad 3$$

so the difference between two measures of inflation comes through the percent change in the terms of trade whereas α is the index of trade openness. We can relate the terms of trade with the real effective exchange rate as follows;

$$s_t = \frac{q_t}{(1-\alpha)} \qquad 4$$

where q_t is the real effective exchange rate. Hence;

$$\pi_t = \pi_{h,t} + \frac{\alpha}{(1-\alpha)}\Delta qt \qquad 5$$

Substituting the value of $\pi_{h,t}$ from equation (2) in equation (5) we get;

$$\pi_t = \beta E_t \pi_{h,t+1} + \lambda mc_t + \frac{\alpha}{(1-\alpha)}\Delta q_t + \varepsilon_t^{\pi} \qquad 6$$

Equation (6) is thus the open-economy NKPC, where foreign elements have been incorporated through the real effective exchange rate (q_t). An increase in q_t means a depreciation of the domestic currency in real terms. It is worth mentioning here that the study of Gali and Monacelli (2005) does not incorporate real exchange rate explicitly as our study does.

Equation (6) can also be represented in terms of output gap, following Gali and Monacelli (2005) we can relate the real marginal cost and output gap as:

$$mc_t = (\sigma_\alpha + \psi) y_t$$

So equation (6) becomes;

$$\pi_t = \beta E_t \pi_{h,t+1} + \lambda(\sigma_\alpha + \psi) y_t + \frac{\alpha}{(1-\alpha)}\Delta q_t + \varepsilon_t^{\pi} \qquad 7$$

where $\lambda(\sigma_\alpha + \psi)$ is the slope of the open economy NKPC. As σ_α depends upon some open economy structural parameters like degree of openness, substitutability between domestic and foreign goods so here competition with foreign firms also influences the price setting behaviour of domestic firms. In addition, ψ is the elasticity of labour supply with respect to wage rate.

The equation (7) can also be presented in more compact form as:

$$\pi_t = \beta E_t \pi_{h,t+1} + k_\alpha y_t + \frac{\alpha}{(1-\alpha)} \Delta q_t + \varepsilon_t^\pi \qquad 8$$

where;

$$k_\alpha = \lambda(\sigma_\alpha + \psi)$$

So we have derived a small open economy NKPC, where CPI inflation depends upon expected domestic future inflation, output gap and real effective exchange rate. It is a micro founded rational-expectations Phillips curve, where firms set their price à la Calvo (1983), and where degree of trade openness also matters.

Now we move to monetary policy rule;

$$i_t = \rho i_{t-1} + (1-\rho)[\varphi_\pi(\pi_t - \pi^*) + \varphi_y y_t + \varphi_e(\Delta e_t)] + \varepsilon_t^i \qquad 9$$

Equation (9) closes the model by a monetary policy rule. It is a type of Instrument Rule adopted by the central bank for an open economy, where the current nominal interest rate i_t is a positive function of inflation deviation, that is, if current inflation (π_t) is higher than the announced target (π^*) – for target of inflation set by the central bank of the respective country, in this model we use two periods ahead inflation – the central bank will jack up the nominal interest rate and vice versa. For this the central bank will also rely on its forecast of inflation, as inflation forecast becomes its intermediate target.

Secondly, the current nominal interest rate is also a positive function of output gap, in case of positive output gap (y_t) central bank will increase interest rate to slow down the overheated economy. Assuming that substitution effect is stronger than income effect and thus putting downward pressure on aggregate demand, the increase in interest rates will pay the dividends. Thirdly the nominal exchange rate (e_t) also enters with positive sign in the equation (an increase in e is a depreciation) and this is due to imported inflation. The other possible explanation is that the central bank seeks to stop outflows in the backdrop of depreciation or encourage inflows, if the economy is much integrated with the world economy, especially financially.

Finally, we assume that the central banks tend to smooth interest rate changes because of parameter uncertainty, data uncertainty and because they dislike financial market volatility. Therefore, we include a smoothing term (ρ) whereby the current interest rate also depends on the lagged interest rate. The equation also has ε_t^i stochastic monetary policy shock.

Although the Taylor type reaction function is very much in use; there are other potential candidates. Batini, Harrison and Millard (2003) discuss a battery of rules. Beside the Taylor rule, their study gauges the performance of naïve MCI rule, Ball (1999), inflation-forecast-based rule (IFB) and some other variants. Their study finds that IFB, a rule that reacts to deviations of expected inflation from the target, is a good simple rule. The study further says that, an IFB rule, with or without exchange rate adjustment, appears robust to different shocks, in contrast to naïve or Ball's MCI-based rules. Furthermore, a study by Svensson (1997) goes this way "even though I believe instrument rules like the McCallum and Taylor rules are important advances in the theory of monetary policy, I consider a commitment to a target rule to be more advantageous than a commitment to an instrument rule. A target rule focuses on the essential, that is, to achieve the goal, and allows more flexibility in finding the corresponding reaction function". However, we use this Taylor-type rule due to its simplicity and we use this small scale micro founded canonical New Keynesian model because of its parsimony and tractability. Although it is without solid micro foundations like habit persistence, we think that it yet provides the stylized representation of the key aggregates in the economy and captures the essence of monetary policy transmission mechanism.

Now we turn to our two critical assumptions, i.e., uncovered interest rate parity and purchasing power parity. Equation (10) below is the uncovered interest rate parity;

$$i_t - i_t^* = E_t(e_{t+1} - e_t) \qquad 10$$

which states that if the domestic nominal interest rate is above the foreign nominal interest rate there is a positive expected appreciation of the foreign currency to compensate for the lower foreign interest rate. So interest rate parity simply means that the expected returns are same on both domestic currency deposits and foreign currency deposits in the long run. It thus characterizes international asset market equilibrium.

The last equation of our model is equation (11)

$$E(e_t - e_{t-1}) = \pi_t - \pi_t^f \qquad 11$$

This equation describes how exchange rate and inflation rate are related through purchasing power parity. If the domestic price level is higher than the foreign price level the domestic currency will depreciate. Equation (10) and (11) reveal that we assume complete financial

markets. After setting our model and explanation of the assumption we extensively describe the methodology in our next section.

1.4 The Methodology and Data Description

As our model describes the dynamics of inflation, output gap, interest rates and exchange rates, endogeneity might be a problem. In this context, this study uses the Generalized Method of Moments (GMM) technique to estimate the values of the parameters. More specifically the study uses multi-equation GMM. The multi-equation GMM technique is considered as efficient compared to the single-equation GMM. So we distinguish our study from the ones that use only single equation GMM to estimate Taylor rule or calibrate the model. As multi-equation GMM technique makes joint estimation, we have "efficiency gain". The reason for efficiency gain is, the single equation ignores the information about the equation contained in other equations. We will make no assumption about the interequation (or contemporaneous) correlation between the error terms and no prior restrictions are placed on the coefficients from different equations. The advantage of this technique that on one hand it obviates the endogeneity bias or simultaneity bias and on the other hand it brings "efficiency gain".

We use lagged values of explanatory variables as instruments. Another important issue is orthogonality condition. According to Hayashi (2000), orthogonality condition for the system of equation is just a collection of orthogonality condition for individual equation. It is worth mentioning here that instrument and lag selection has always been a ticklish task. A good instrument is a predetermined variable that is correlated with the endogenous regressor but orthogonal to the error term. To the best of our knowledge, there is no hard and fast rule for lag selection. Tauchen (1986) claims that it is better to use small number of instruments set, because the confidence intervals are more reliable. For further discussion on this issue see Gallant and Tauchen (1996). However, following the standard practice in literature the instrument set consists of lagged dependent variables.

The study uses quarterly data from various sources like International Financial Statistics (IFS-IMF), Bank for International settlements (BIS) and websites of respective Central Banks. The starting date corresponds to the date of adoption of inflation targeting by the respective country. We calculate output gap by log difference of real GDP from its detrended value. Detrending is achieved using Hodrick-Prescott filter (The smoothing parameter is set to the default of 1600 for quarterly data). To calculate the real interest rate we use the Fisherain

equation. The nominal exchange rate (domestic currency per US Dollar), is taken in log difference, and an increase in e_t means depreciation. For inflation deviation we take the difference of current inflation minus two period ahead target of inflation set by the central bank of the respective country. The inflation target has been taken from the website of the central bank of the respective country. The real exchange rate has been taken from the website Bank for International Settlements (BIS). We converted the monthly REER index into quarterly by taking end-period average. Interestingly, it was in line with the quarterly data of REER quoted by IFS as the REER Index for Chile was available in the IFS. Furthermore, we inversed the index to make it compatible with the explanation that an increase in an index means depreciation of domestic currency. Indeed, we would like to mention that for Chile's discount rate, the policy rate was not available since 1991 so we used lending rate up to 1993 Q1.

In the traditional time series econometrics, stationarity is critical. To check the stationarity we use Augmented Dickey Fuller (ADF) and Kwiatkowski, Phillips, Schmidt and Shin (1992). According to Verbeek (2004), in the latter test, stationarity is the null hypothesis and the existence of a unit root is the alternative. The basic idea is that a time series is decomposed into the sum of a deterministic time trend, a random walk and a stationary error term (typically not white noise). The null hypothesis (of trend stationarity) specifies that the variance of the random walk component is zero. Although we report the results of both tests, we heavily rely on KPSS test (see table A 2 and A 3 in Appendix A). The sample size is as follows; for Brazil 1999:1 to 2009:4, Chile 1991:1 to 2008:4, Mexico 1999:1 to 2009:1, Korea 1998:1 to 2009:4, Thailand 2000:1 to 2008:4 and Czech Republic 1998:1 to 2009:4. For detail of data description, key facts and descriptive statistics (see Tables A 4, A 5 and A 6 in Appendix A).

1.5 Estimation and Results

In this section, we describe the estimation results. Table 1.1 reports the results of the following three equations

$$y_t = E_t y_{t+1} - \frac{1}{\sigma_\alpha}\left(i_t - E_t\left(\pi_{h,t+1}\right)\right) + \varepsilon_t^y$$

$$\pi_t = \beta E_t \pi_{h,t+1} + k_\alpha y_t + \frac{\alpha}{(1-\alpha)}\Delta q_t + \varepsilon_t^\pi$$

$$i_t = \rho i_{t-1} + (1-\rho)\left[\varphi_\pi(\pi_t - \pi^*) + \varphi_y y_t + \varphi_e(\Delta e_t)\right] + \varepsilon_t^i$$

The basic idea underlying our estimation strategy is to use the theoretical NK Small Open Economy model (NKSOE) to investigate the reaction of central bank toward exchange rate movements in a general equilibrium model where we can also estimate structural parameters like risk aversion, and the duration of price contracts. We would like to mention that we calibrate the time discount factor β. As it is standard in literature that the studies using quarterly data, we set $\beta = 0.99$. The second parameter that we calibrate is α. We tried to estimate it but it was not well identified. It is openness index measured as import to GDP ratio.

The overall results are encouraging and in line with our expectations. However, the study also finds some interesting results for coefficient of relative risk aversion. The value of risk aversion is much controversial in literature and its value has very wide range[2] from 1 to 55.

Our first coefficient (σ_α) is relative risk aversion. As it is evident from the Table 1.1 (below) that have a negative and significant relationship between output gap and real interest rate as the theory suggests. The value of the risk aversion is rather large for Brazil and Chile. As mentioned earlier in the text, the value of this parameter is much controversial in literature. The high risk aversion parameter indicates that economic agents in Brazil and Chile are more risk averse and they have strong tendency to smooth consumption relative to other countries. Moreover, the negative relationship of output gap with the real interest rate supports that substitution effect is stronger than income effect, as it is generally expected.

We might have taken risk aversion parameter from literature and circumvent the problem of its high value – that of course is not unusual – but we prefer to let the data speak. We think that this exercise brings originality in other parameters of the model so it is more representative of the economic situation.

Table 1.1: Estimates of NKSOE model (β and α calibrated)

	σ_α	k_α	ρ	φ_π	φ_y	φ_e	*J(Prob)*
Brazil	-38(6.52)	.071(.035)	.96(.002)	3.12(.27)	2.42(.44)	.84(.11)	10.72(.97)
Chile	-24(11.10)	.55(.10)	.65(.08)	5.20(1.38)	1.00(.83)*	1.57(.27)	15.34(.28)
Mexico	-8.35(.95)	.98(.05)	.92(.00)	4.79(.15)	1.31(.13)	.14(.04)	9.55(.98)
Korea	-11.34(4.9)	-.06(.05)*	.96(.00)	7.90(1.76)	1.28(.14)	-1.13(.23)	11.33(.83)
Thailand	-1.67(.22)	.41(.03)	.97(.00)	5.26(1.67)	.69(.27)	1.24(.60)	9.58(.65)
Czech Rep.	-6.17(1.88)	.54(.25)	.93(.00)	1.09(.29)	.46(.08)	-.17(.03)	11.93(.85)

Note: The * attached to the coefficient means it is insignificant at 5% level. Standard Errors in Parenthesis. For instrument details see appendix.

[2] See Attanasio et al. (2000), Campbell (1996), Campbell et al. (2003), Chapman (2002) and Mehra and Prescott (1985).

The second coefficient (k_α) is slope of the Phillips curve. For most of the countries the study finds a positive slope of Phillips Curve as it should be. It means that output gap is an important indicator in determining the current inflation. In literature the magnitude of k_α varies widely. For example, Mihailov et al. (2011) while estimate an open economy NKPC and find the minimum value for slope parameter to be 0.00 in case of Austria and the maximum to be 0.24 in case of UK.

This a complex parameter due to its dependence on real globalization, competition and complementarity among firms, historical level of inflation, labour sector reforms as elasticity of labour also influences the cost of production, immigration laws as they impact the supply of labor and consequently ability of firms to hire workers at higher or lower wages and above all social norms as participation of women in the labour force can also have influence on this parameter. Each of these demands a specific investigation, which of course is beyond the scope of this study. However, we would like to say that k_α is well estimated, has positive sign for all countries except one, and is in line with the existing literature. The negative sign for Korea is not unusual. For example, Mihailov et al. (2011) finds negative coefficient for Sweden when estimating the full sample (from 1970:1 to 2007:4), for Austria, Sweden and Switzerland for subsample (from 1970:1 to 1986:4) and for Germany, Spain and Netherlands (from 1987:1 to 2007:4). As Korea is relatively open economy, there is possibility that owing to increased openness, domestic factors might have become less important in the determination of inflation. This line of arguments has been put forward by Borio and Filardo (2007) and White (2008), however, as usual, there is another strand of literature like Ball (2006), Mishkin (2007, 2009) and Woodford (2007) that conclude that there is no evidence for a strong effect of globalization in determining domestic inflation. Graphically speaking, if the Phillips curve shifts inward and new equilibrium can take place either at the same level of inflation with lower unemployment (higher output gap) or an economy can strike a point with lower unemployment lower inflation. But what improves the trade-off between inflation and output is an empirical question. Secondly, if productivity is increasing and increase in wages is not catching up the increased productivity, economy might face an improved trade-off between inflation and output gap. Nevertheless, in our case we would like to emphasize that for Korea the coefficient is insignificant at conventional level of 5 %.

Here, we think it is worth mentioning that while estimating we restrict α (import to GDP ratio) so our k_α is not independent of α . By imposing this restriction on our Phillips curve we

get the value for k_α that truly represents the data. We might have estimated both, the κ_α and α, but our focus is to get slope parameter that corresponds to the openness index and this has been done by restricting α. This makes our Phillips curve different from the one estimated by Mihailov et al. (2011) besides the other difference that we estimate it through the model. Another point we would like to highlight is that literature is skeptic about the empirical significance of forward-looking Phillips curve as documented by Fuhrer (1997) and Jondeau and Le Bihan (2001). However, we find convincing results.

Our next four parameters belong to Taylor rule. These parameters $\rho, \varphi_\pi, \varphi_y$ and φ_e are smoothing term, response of policy rate to inflation deviation, output gap and exchange rate respectively. Intrinsically, Taylor (1993) did not take into account smoothing policy but researchers like Orphanides (1998) and Clarida, Gali and Gertler (1999) did. Broadly speaking the results are in line with theory. The coefficient attached to the inflation deviation is greater than one and significant for all the countries in the sample. The magnitude of this coefficient greater than 1 is necessary for stability condition. This is called Taylor principle. This ensures that nominal rate is increased so much that it leads to an increase in real interest rate. Since an increase in real interest rate is essential as it provides incentive to economic agents to save. The saving of economic agents at high interest rate ensures effectiveness of demand management policy by the monetary authority. Moreover, the high magnitude reveals that central bank is very aggressive toward inflation movements. It is quite natural in inflation targeting regime.

The central bank response to output gap (φ_y) is also positive and significant at conventional 5% level of significance. The response to output gap is in line with flexible inflation targeting theory. We would like to mention here that Minella et al. (2002) find a negative relationship between nominal interest rate and output gap for Brazil but their sample range is only from July 1999 to June 2002. For Chile, we have positive but insignificant response of interest rate to output gap. This looks surprising but if we analyze the data more carefully the answer is there. For example, the interest rate remained high for the first half of the sample but of course it has not been the case with inflation deviation. In the second half of the sample the interest rate remained quite low relative to the first half. The declining trend in interest rate is quite visible. So keeping the output gap fluctuations more or less constant and declining trend in interest rate make the relationship rather week, and estimated coefficient is insignificant. The coefficients for all other countries have positive sign and are significant.

The last term in the Taylor rule is nominal exchange rate (an increase in e means depreciation). As we have discussed earlier, we include this term because of the long association of our sample countries with the fixed exchange rate or managed float. Thus we think that the central banks of these countries might be responding to exchange rate movements. The well documented fear of floating thesis leads us to expect positive sign. Historically high pass-through in these countries might still be haunting economic agents. First explaining first, positive and significant response of central bank of Brazil to exchange rate can be explained due to its long association with the fixed exchange rate regime before embracing the IT regime. Furthermore, the reason may be inertia in the thinking of economic agents or the fact that perhaps the central bank of Brazil has not reached a sufficient level of credibility, where a central bank has less incentive to take exchange rate into account. We think that it is may not only be the pass-through, or credibility but the fact that the financial sector stability also demands stability of exchange rate. In addition, according to Correa and Minella (2006) there exists a short-run pass-through of non-linear nature in Brazil, which necessitates response to exchange rate movements.

According to our estimates, Chile also responds to movements in exchange rate. We were less convinced a priori that this would be the result. As Chile is among the pioneers who adopted inflation targeting, we were expecting that exchange rate would be nowhere in reaction function of central bank of Chile. But the situation is reverse. There is international evidence that pass-through has decline due to trade competition in many countries but in case of Chile in a recent study Alvarez et al (2008) finds high and not declining exchange rate pass-through, which would explain our results.

Furthermore, perhaps the valuation channel of external adjustment has also grown in importance that makes exchange rate a variable to be care about.

So far as the response of the Mexican Central bank to exchange rate is concerned, the results are in line with our expectations, as the response to the exchange rate depreciation is positive and significant. The base of our expectation was the study of Hebbel and Werner (2002) which concludes that for Mexico the nominal depreciation has a statistically significant role for inflation expectation. One might argue that the study is a bit old and things might have changed since the Mexico has gone a long way after inflation adoption.

Our next country in the sample, Korea, is different than other countries in the group. As Korea is among developed economies, the usual assumptions of high pass-through, weak financial system do not apply to her. This is evident from our results. The negative sign indicates that central bank of Korea has no particular regard for exchange rate movements. Our conjecture is that low average of inflation rates helped anchoring firms' expectations on one hand, and on the other hand the more open economy of Korea has fostered competition among firms, thus leaving little space for high exchange rate pass-through.

For Thailand we find significant and positive relationship between nominal exchange rate and nominal interest rate. The results are interesting in the sense that, despite low level of average inflation rates during the sample period, we find significant and positive response to exchange rate. The high import to GDP ratio of Thailand (see Table 1.3 below) may be an incentive for the monetary authority to take care of exchange rate.

Like Korea, the central bank of Czech Republic also does not respond to exchange rate movements. If we look at the graph we observe appreciating trend of Koruna (see figure A 9 in Appendix A). According to Frait (2008), Koruna observed consistent appreciation against US dollar as Czech Republic experienced persistent capital inflows. We find no evidence of response of interest rate to movements in exchange rate.

So Brazil, Chile, Mexico and Thailand clearly respond to exchange rate movements whereas Korea and Czech Republic do not. The study tends to conclude that exchange rate is still an important variable to care about for different reasons so central banks respond to its movements. We would like to reiterate it may not only be the exchange rate pass-through but other factors like financial stability and valuation channel may also be of vital importance. Especially if economies are accumulating reserves, valuation channel becomes also very important.

So far we have estimated and interpreted the parameters like risk aversion, slope of Phillips curve and parameters of the Taylor type rule. But from these parameters we can also recover the underlying structural parameters like, price stickiness. In Table 1.2 below, we report these parameters and interpret them. Table 1.2 shows λ and the Calvo parameter θ. λ is related to $k_{\alpha,}$ and θ is related to λ through the following relationship:

$$k_\alpha = \lambda(\sigma_\alpha + \psi)$$

$$\lambda = \frac{k_\alpha}{(\sigma_\alpha + \psi)}$$

where ψ is elasticity of labour supply. As we know that

$$\lambda \equiv \frac{(1-\theta)(1-\theta\beta)}{\theta}$$

We can recover the value of θ as a function of β and λ.

We do not report the value of λ and θ for the Korea because of our poor estimation of κ_α. As it is insignificant so we do not provide the corresponding values for retrieved parameters.

Table 1.2: Structural parameters of SOENK model

	Estimated		Retrieved		$D = \frac{1}{(1-\theta)}$
	σ_α	k_α	λ	θ	
Brazil	-38(6.52)	0.071(0.035)	0.0017	0.95	20
Chile	-24(11.10)	.55(0.10)	0.0190	0.87	7.69
Mexico	-8.35(0.95)	.98(0.05)	0.0754	0.76	4.16
Korea	-11.34(4.86)	-.06(0.05)*	-	-	-
Thailand	-1.67(0.22)	.41(0.03)	0.0615	0.79	4.76
Czech Republic	-6.25(1.88)	.54(0.52)	0.0479	.80	5.00

Note: Elasticity of labour supply (ψ) was assumed 5.

Well, λ is retrieved slope parameter of Phillips curve. Our values for λ are close to the estimates by Gali et al. (2001), Benigno and Lopez-Salido (2006) and Mihailov et al. (2011). However, a caution is required as the above-mentioned studies concern advanced economies. The structural parameter θ measures the degree of price rigidity. Its estimate is quite convincing for Mexico and Thailand as in calibration literature it is assumed to be .75(see, Gali and Monacelli (2005), Eyquem and Kamber (2010)). The higher the value of θ, the higher the degree of price rigidity. In our sample its value ideally should have been lower as these economies experience high inflation relative to advanced countries. But still the values are not unusual. For Brazil, we find a rather high value of θ, which may be due to aggregation problem or problem of measure in the official statistics[3]. What is required is micro investigation in the matter. However, the researchers confront a high value of θ is not uncommon. Mihailov et al. (2011) find .97 for Netherlands, .96 for Austria and .95 for Switzerland. In the last column we report D, which is the duration of contract i.e., the time for which the price remains unchanged. As this study is using quarterly data so the number correspond to D column should be interpreted as number of quarters for which price remains unchanged.

[3] The size of underground economy in Brazil was 42.3 percent in 2002/2003 Schneider (2004)

After the interpretation our structural parameter θ now we move to Table 1.3 to interpret another structural parameter ω. This is even a more complex, as it depends on some other structural parameter as given below:

$$\omega = \sigma\gamma + (1-\alpha)(\sigma\eta - 1)$$

where γ measures the substitutability between goods produced in different countries. We set its value equal to 1 as Gali and Monacelli (2005). α is our openness index measured as imports to GDP ratio. σ is relative risk aversion and η measures the substitutability between domestic and foreign goods, from the view-point of domestic consumers. To get the value of σ we exploit the following relationship[4].

$$\sigma_\alpha = \frac{\sigma}{(1-\alpha)} + \alpha\omega$$

Table 1.3: Structural Parameters

	Estimated σ_α	Calibrated α	Retrieved ω
Brazil	-38(6.52)	.12	-7.66
Chile	-24(11.10)	.29	-2.52
Mexico	-8.35(0.95)	.28	-2.96
Korea	-11.34(4.86)	.40	-1.56
Thailand	-1.67(.22)	.55	-1.04
Czech Republic	-6.17(1.88)	.38	-1.77

Note: α is import to GDP ratio, γ and η are assumed 1 and 4 respectively.

According to Gali and Monacelli (2005 pp. 722)

"it can be easily checked that contractionary (expansionary) effects dominates whenever $\omega > 1(\omega < 1)$. In special case considered $\omega = 1$, thus implying that a change in world output leaves the terms of trade and domestic output unchanged under DIT policy".

We would like to emphasize that our study does not enjoy the special case and central banks are not under domestic inflation targeting – rather they target CPI. Nevertheless, we think that the line of argument of contraction and expansion of the domestic output as a result of change in world output remains intact. Interestingly, our values of ω for all the countries are less than 1, so we tend to conclude that foreign output growth via real appreciation of domestic exchange rate brings expansionary effects for the domestic economy. It could be due to cost channel or the increase in real wealth due to reduction in overall price level. The former

[4] We do not report the values of σ (Relative Risk Aversion) as it is not well-estimated. It has negative values which imply that agents are risk loving. It is our conjuncture that in developing/ emerging economies consumers faces borrowing constraints and they do not smooth consumption. They increase their consumption when they face positive income shock.

increases investment and the latter boosts domestic consumption and so does the aggregate demand.

The results presented so far are quite forceful. The study has tried to bridge the gap between calibrations and to answer a policy-relevant question in a small open economy canonical model instead of just estimating single Taylor rule equation. In the next section, we conduct a robustness check to further strengthen our results that the central banks in our sample respond to exchange rate.

1.6 Robustness Check

To check robustness we estimate equation (1), (7) and (9). To facilitate the reader we write down these equations

$$y_t = E_t y_{t+1} - \frac{1}{\sigma_\alpha}\left(i_t - E_t(\pi_{h,t+1})\right) + \varepsilon_t^y$$

$$\pi_t = \beta E_t \pi_{h,t+1} + \lambda(\sigma_\alpha + \psi) y_t + \frac{\alpha}{(1-\alpha)} \Delta q_t + \varepsilon_t^\pi$$

$$i_t = \rho i_{t-1} + (1-\rho)[\varphi_\pi(\pi_t - \pi^*) + \varphi_y y_t + \varphi_e(\Delta e_t)] + \varepsilon_t^i$$

The difference between this and the model estimated earlier comes through the middle equation of the model. Here we let the elasticity of labour supply and open economy parameter σ_α interact to determine the slope of the Phillips curve. Furthermore, simultaneity of σ_α is quite visible.

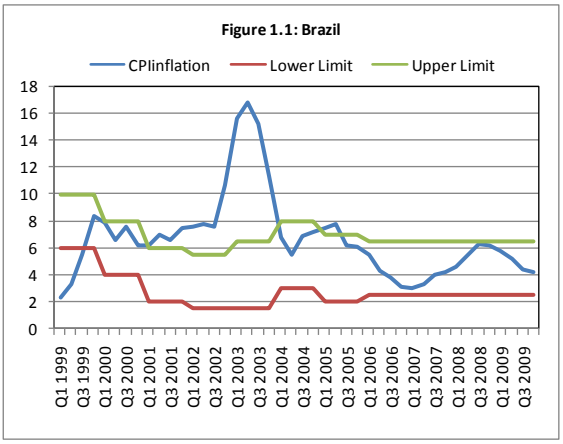
We present the results below Table 1.4; overall the results remain almost the same. Particularly, when it comes to the Taylor rule – that directly answers our research question – the results remain the same qualitatively. The results are broadly in line with the Table 1.1. The Taylor Principle holds as the response to inflation is greater than 1. The response to exchange rate is positive and significant for all countries except Korea and Czech Republic.

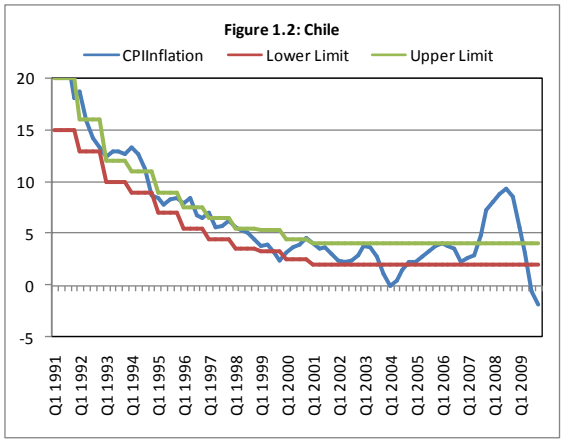
Table 1.4: Estimates of NKSOE model (β and α calibrated)

	σ_α	k_α	ρ	φ_π	φ_y	φ_e	*J(Prob.)*
Brazil	-39(6.52)	.002(.000)**	.96(.002)	3.17(.32)	3.61(.44)	.99(.07)	10.27(.92)
Chile	-30(14.65)	-.02(.01)	.77(.04)	2.01(.80)	5.93(1.25)	1.00(.17)	16.15(.64)
Mexico	-16.9(3.47)	-.06(.02)	.92(.00)	4.74(.19)	1.30(.13)	.13(.05)	9.50(.99)
Korea	-10.90(4.6)	.01(.00)*	.96(.00)	7.75(1.27)	1.31(.13)	-1.11(.15)	11.36(.83)
Thailand	-1.68(.23)	.04(.00)	.97(.00)	4.11(0.80)	.65(.20)	.83(.28)	9.61(.64)
Czech Rep.	-6.60(2.24)	.16(.12)*	.93(.00)	1.08(.24)	.47(.07)	-.17(.03)	11.99(.74)

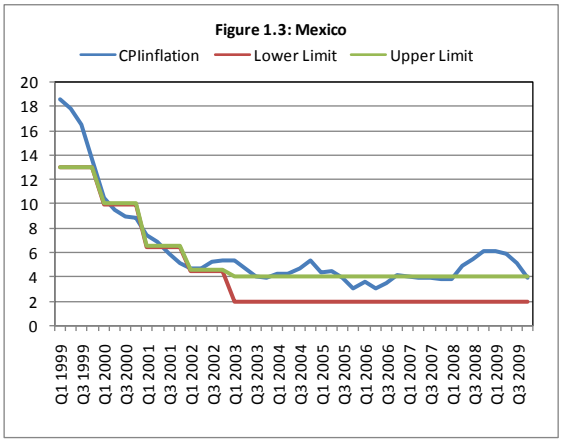
Note: ** indicates significant at 10%. Standard errors in parenthesis. * indicates insignificant. Elasticity of labour supply (ψ) assumed 3 for Brazil, 5 for Chile, 1 for Mexico and Korea, 10 for Thailand and Czech Republic. For details about instruments see appendix.

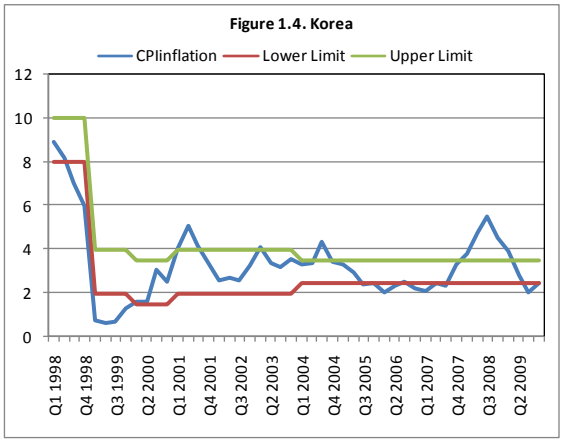
We would like to highlight here an issue that may arise due to response to exchange rate movements –





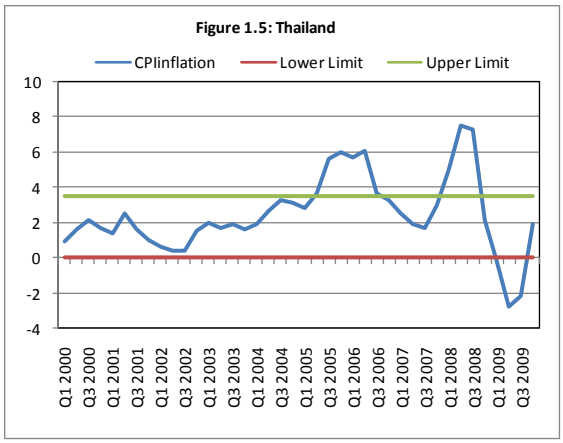
The Time Inconsistency Problem introduced by Kydland and Prescott (1977). The upshot of this problem is *Credibility Problem* which is related to the lack of commitment and thus *inflation bias.* Simply, in inflation bias central bank tries to increase the output above its natural level thus leading to an increase in inflation ultimately. We investigate how many times the central bank has breached the upper limit of the target set by her and the distribution of output gap. Has the output gap been most of the time near zero or in negative zone or positive one? We think that if actual inflation has remained under the upper target and output gap has been frequently near zero then we tend to rule out inflation bias. We will present here

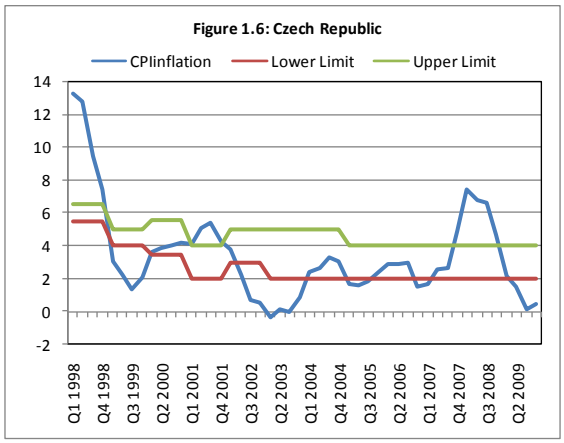




graphs (see figures 1.1 to 1.6) to know how frequently target inflation was breached. As due to time inconsistency when central bank tries to exploit output higher than natural output this lead to increased inflation in the next period since agents are rational and they cannot be fooled time and again.

In the above diagram it is clear that target has been achieved by the central bank most of the time. However, in case of Brazil the target was breached around year 2002 due to energy crisis, whereas in case if Chile it has been under control. However, the Chile surpassed its





target recently (2007-2008) perhaps due to the financial crisis.

Broadly speaking inflation remained within the limits except for Mexico. In case of Thailand it breached during 2005 and 2006. A common feature of almost all the countries is that the around the subprime crisis inflation increased.

One point comes to mind here. Suppose the target band is 4 – 6%. Should we assume that zero output gap corresponds to the midpoint i.e., 5 percent inflation. If this is the case the central bank has incentive to increase output gap till the target is within the announced band. What should we call it, inflation bias or not. The central bank will prefer to have zero output gaps and 5 percent inflation or positive output gap and 6 percent inflation which is also not breaching the announced band. This question is worth exploring question we think. However, one thing seems certain that, IT regime certainly minimizes inflationary bias as central bank will try hard to keep inflation inside the announced limits. As such, central bank cannot increase the magnitude of output gap to an extent that corresponds to the inflation level outside the upper limit. We think that this is what is called "constrained discretion" in literature[5] (see figures A 3 to A 8 in appendix A).

Moreover, discussing the issue of credibility, we should consider that central banks are under "flexible inflation targeting" regime, they do have regards for output. Under the untoward supply shock, fixing the inflation quickly can lead to higher output volatility. Thus talk about

[5] Remarks by Governor Ben Bernanke before the money marketeers, New York University, February 2003.

credibility under inflation targeting also demands a fair analysis of shocks that the economy experienced.

Another issue that can lead to credibility problem is frequent changes (each year) in the target set by central bank. However, this issue can be tackled through the credibility supporting actions like; monthly inflation reports, effective communication and disclosing the minutes of the monetary policy committee.

Although most of the time the inflation remained in the announced limits, there has also been periods where the limit was crossed. This phenomenon may lead to credibility problem down the road. The need is to convince the market in such situations through better communication strategy about the factors that led the inflation exceed the upper limit. On the whole, IT anchored the expectations in a good way as countries like Chile, Brazil and Mexico have experienced a history of very high inflation. It seems that these central banks are targeting inflation taking into account exchange rate movements without exceeding the upper limit altogether. The challenge here is; can central banks design a communication strategy that tells clearly that the exchange rate is a variable that central banks respond to and at the same time, avoid the risk of transforming the exchange rate into a nominal anchor that takes precedence over the inflation target as highlighted by Mishkin and Schimdt-Hebbel (2001).

1.7 Concluding Remarks

The chapter investigates whether the inflation targeting emerging countries respond to exchange rate movements. Our sample includes 6 emerging economies and we use quarterly data. We base our estimation strategy on a small open economy structural NK canonical model that contains an IS curve, a Phillips curve and a Taylor rule. The study uses multi-equation GMM technique. The motivation behind using GMM technique is to tackle the inherent endogeneity among variables. The study employees mixed strategy – estimation, calibration and retrieval of parameters thus bridging the gap between estimation and calibration strands of literature. We also do robustness checks to validate our results more forcefully.

Interestingly, we find mixed evidence. Brazil, Chile, Mexico, and Thailand respond to exchange rate movements whereas Korea and Czech Republic do not. On one hand the theory of inflation targeting says that there should be no response to exchange rate. On the other

hand, the peculiar conditions of emerging economies remind us that, what is true for advanced economies is not necessarily true for emerging markets. De Gregorio et al. (2005) conclude that the pass-through from exchange rate to inflation has declined, which would make unnecessary for the central bank to respond to exchange rate. But our results are different. Our study shows that central bank of Chile responds to exchange rate. The study of De Gregorio et al. (2005) is a bit old, and one might think that the recent developments in the world economy like more integration, financial crisis and worry about the health of financial system, might have led the central bank of Chile to respond to exchange rate. In case of Brazil too, the study find statistically significant response to the exchange rate movements. Possibly, the long association of Brazilian economy with the fixed exchange rate and managed floating exchange rate regime has made the economic agents more considerate toward exchange rate movements and the "inertia" in their thinking towards inflation pressure through the exchange rate pass-through has made it justifiable for the central bank to respond to the exchange rate movements, even in the IT regime. In addition, the situation of fiscal dominance in Brazil demands that exchange rate should be taken care of. The point of fiscal dominance has been highlighted in case of Brazil by Blanchard (2004). Similarly, in case of Mexico and Thailand the response to exchange rate is statistically significant.

The chapter thus concludes that these countries are still under the shadow of "fear of floating". The increasing financial integration has instigated again the debate of "impossible trinity". We call it "compromised impossible trinity" as free float is restricted by response to exchange rate movement (and intervention in the foreign exchange market) and capital movement is also restricted in some countries. For instance, Brazil imposed tax on capital inflows. So the study concludes that these countries have not yet reached the stage where the central bank assigns statistically insignificant value to exchange rate in its reaction function.

However, Czech Republic and Korea do not respond to exchange rate movements. Korea is an advanced economy and thus differs from the so-called emerging or developing economies. The response to Czech Republic is somewhat unusual.

On the intellectual front, the study points to the necessity to formulate a theory that assigns due weight to exchange rate in inflation targeting. On the policy side, the challenge is to design an effective communication strategy that prevents exchange rate to become a nominal anchor as underscored by Mishkin and Schimdt-Hebbel (2001).

Chapter 2

Relative Importance of Monetary Transmission Channels: A Structural Investigation

2.1 Introduction

Monetary transmission mechanism is no less than a riddle even in closed economy but the openness is making it more and more complex a phenomenon. The reason is quite obvious. Monetary policy is transmitted to the economy through different transmission mechanism working simultaneously and with potential lags. Despite this complexity, there is consensus among economists that monetary policy has at least short term effects on consumption and investment as documented by Taylor (1997). A thorough understanding of monetary transmission mechanism is necessary to implement monetary policy and to produce the desired results. Taylor (1995) defines monetary transmission mechanism as "the processes through which monetary policy decisions are transmitted into changes in real GDP and inflation". The ongoing pace of globalization requires a novel examining of the relative importance of transmission channels.

Besides this, an increasing number of countries have been adopting inflation targeting regime. In the wake of increasing financial globalization, it has initiated a debate on how globalization is reshaping the transmission channels, if at all. Woodford (2007) considers three possible mechanisms that might lead to less control of monetary authority on inflation; (i) liquidity premia, a function of global liquidity, (ii) real interest rate dependence on global saving and investment rather than a balance in one country alone and (iii) making inflationary pressure a function of global slack rather than domestic output gap alone. However, the study concludes that there is little reason to expect that globalization should eliminate or even substantially weaken the influence of domestic monetary policy over domestic inflation. In another study, Mumtaz and Surico (2009) conclude that an expansionary policy in foreign block causes an

appreciation in nominal exchange rate of the UK.[1] Expansionary demand shocks in the foreign block increase inflation and output growth in the UK. Boivin and Giannoni (2008) find no strong statistical evidence of significant change in the transmission of monetary policy of USA due to global forces. All these studies are about the co-movement of interest rates, or on the international transmission of shocks. Secondly, these studies concern developed countries.

Against this backdrop, the *objective of this chapter* is to investigate the relative importance of monetary transmission channels in emerging inflation targeting economies from the starting date of inflation targeting regime to the latest data available.

Another relevant question is that what, besides the papers mentioned in above material, motivates us to go for the investigation of the relative importance. Beyond the pressing need of thorough understanding of transmission channels to implement the monetary policy effectively, indeed an additional question is the relative importance of transmission channels.

As financial globalization increases, the currency value may become more responsive to interest rate differentials (see Kamin 2010), thereby reinforcing the exchange rate channel of monetary transmission mechanism. Although there is a vast literature concluding the decline in exchange rate pass-through in many countries in recent decade, the very existence of opposing forces in this regard cannot be ruled out. On the one hand, trade and financial globalization might have strengthened the exchange rate channel, and on the other hand reduction in pass-through due to competition might have weakened exchange rate channel.[2] In addition, the recent literature about the valuation channel makes the question of exchange rate an important question, for instance, Lane and Milesi-Ferretti (2006).

Similarly, financial globalization might be altering the evolution of liquidity and credit conditions. Lending activities of foreign banks might be less affected by the domestic credit conditions. The banks might be receiving from or sending funds to their parent banks offshore. This could weaken the relationship between operating tools and the transmission variables (bank credit) and subsequently weaken the credit channel.

[1] Foreign Block consists of 17 major trading partners of UK.
[2] See Gust et al. (2006) conclude in their theoretical model that simultaneous increase in trade openness and decline in pass-through is due to competition with foreign firms.

As for as interest rate channel is concerned, there may be some signs of weakening interest rate channel if the correlation between domestic saving and investment is weakening.

Further, capital inflows can exert an upward pressure on asset prices thereby making the asset price channel stronger. If assets prices are considered claims on future output then financial globalization may strengthen asset price channel. However, it requires high stock market participation. Another channel that can strengthen the asset price channel is the "collateral channel". The increased price of shares can serve as collateral and thus can strengthen asset price channel.

The rest of the paper is as follows. In section 2, we summarize the theory of transmission channels; section 3 carries the literature review. The model and data issues are explained in section 4. Section 5 reports the effects the monetary policy shock. In section 6, we address the issue of robustness and final section concludes the results.

2.2 Theory of Transmission Channels

In this section we provide theoretical underpinnings of monetary transmission mechanisms. This section will rely heavily on Mishkin (1996). There are many channels of monetary transmission mechanism but we will explain here the four channels that we study.[3] These four channels capture the essence of the transmission mechanism and provide a fair idea about the way these channels operate in the economy. We explain each in turn.

2.2.1 Interest Rate Channel

According to the traditional interest rate channel an increase in the money supply leads to decrease in the short-term nominal interest rate. This is also called liquidity effect.[4] Consequently, due to sticky prices, real interest rate also declines. Thus this channel functions through the Keynesian argument of sticky prices. Although Keynes emphasizes this channel operating through investment channel but later research recognized that consumers' decision about real-estate and durable expenditure are also investment decisions as emphasized by

[3] Mishkin in his book "The Economics of Money, Banking and Financial Markets" discusses the channels like traditional interest rate channel, exchange rate channel, Tobin's q theory, wealth effects, bank lending channel, balance sheet channel, cash flow channel, unanticipated price level channel, household liquidity effects channel. 7th edition, pp-619.

[4] See Bernanke and Mihov (1998) for detailed discussion about liquidity effect.

Mishkin (1996). The depressed level of real interest rate triggers investment (/consumption) and ultimately Gross Domestic Product (GDP). This channel implicitly assumes that central banks have the ability to influence the long-term real interest rate through the manipulation of the short-term nominal interest rate combined with the existence of sticky prices. As the expectation hypothesis states that the long-term interest rate is an average of the expected future short term interest rate. Lower real short term interest rate causes a decline in real long term interest rate thus this theory assumes that expectation hypothesis holds true. Theoretically, this channel also circumvents the potential problem of lower zero bound. For instance, expansion in money supply causes the expected price level to increase, despite the nominal interest rate at zero, increased expected inflation leads to lower real interest rate and stimulates spending. This channel is hallmark of *"money view"*.

The interest rate channel works through the "IS" curve irrespective of the old Keynesian or new-Keynesian (forward looking) nature as Kuttner and Mosser (2002) write. In our study we capture this channel through bank lending rates as we use bank lending rate as our intermediate variable.

The *factors that potentially strengthen the interest rate channel* are as follows: according to Bordon and Weber (2010) the inflation targeting frame work can enhance the potency of interest rate channel. As it works through the bank-lending rate, competitive and strong banking sector also strengthens the interest rate channel. Further, the speed at which policy rate is reflected in the retail rate, charged by commercial banks to their clients, also strengthens this channel. As for as financial globalization is concerned, it is our conjecture that on one hand, it increases competition among the banks while on the other hand it may weaken the interest rate channel as banks operating in certain country can resort to its parent organization to generate funds or the firms can generate offshore funds. Moreover, the size of the shadow banking is also, we think, crucial in this regard as they are not in the ambit of central bank.[5] Another point worth mentioning here is the regime of our sample countries. Our sample includes inflation targeting countries — which respond to inflation deviation and output gap. IT regime brings credibility according to Mishkin and Schmidt-Hebbel (2007),

[5] This point has been highlighted by Lorenzo Bini Smaghi in his speech "monetary policy transmission in a changing financial system: lessons from the recent past, thoughts about the future" delivered at Barclays Global Inflation Conference, New York City, 14 June 2010.

while Hammond (2012) says that IT countries also take steps to develop financial sector thus, IT regimes may improve interest rate channel, though, indirectly.

2.2.2 Credit Channel

The bank lending channel operates through the quantity of loans available to the economic agents (i.e. consumers and investors). Expansionary monetary policy increases supply of loans through the increase in private banks' reserves. This leads to an increase in borrowing. This increased quantity of loans generates economic activity through enhanced consumption and investment and thus GDP. Due to imperfect financial markets – asymmetric information – the role of banks becomes more important and thus comes in the so-called balance sheet channel. Information asymmetries can be of two types: moral hazard and/or adverse selection problem. As emphasized by Mishkin (1996) and Bernanke and Gertler (1995), banks have a comparative advantage in assessing the balance sheets of borrowers and thus have the potential to mitigate adverse selection problem. As the expansionary monetary policy lowers nominal interest rate it reduces the debt servicing burden of firms and households, which brings an improvement in the cash-flow of the borrowers and banks become willing to lend them. This leads to an increase in the quantity of borrowed loans by firms and households and subsequently in aggregate demand and output We emphasize that the earlier mentioned channel works through bank lending rates while this one through quantity of loans.

There are several *factors that determine the strength of this channel*. According to Putkuri (2003) a larger size and a lower degree of bank capitalization are strengthening factors in the bank lending channel. Development of securities market is another factor, it reduces the dependence on bank financing for at least large firms. Obviously, the size of firms in the economy also plays a crucial role as small firms find it difficult to generate funds in the capital market; this point is well documented in the literature, for instance, Watson (1999) finds that small and medium sized firms observe a decline in bank loans following a tight monetary policy. Another issue the identification of loan supply and loan demand. Kashyap and Stein (1995), first highlighted this point to gauge the impact of credit channel.

2.2.3 Exchange Rate Channel

In an economy open to trade and financial operations the exchange rate channel may also be important. According to this channel, monetary policy affects the economic activity (output) through net exports. The channel works through the uncovered interest rate parity condition. A negative interest rate differential (i.e., a lower domestic interest rate) with respect to the rest of the world makes domestic currency deposits less attractive, leading to a fall in the value of domestic currency. Keeping the technicalities of Marshal-Lerner condition and elasticity of substitution between domestic and foreign goods aside, this causes a rise in net exports.

The *factors that determine the strength of this channel* as described by Boivin et al. (2010) are the sensitivity of the exchange rate to interest rate movements, size and openness of the economy. Smaller and more open economies tend to see large impacts of this channel. Though the story is not as simple; for instance, the debate of decreasing pass-through in recent years and the share of net exports in GDP also plays a vital role in determining the strength of ER channel. Moreover, a large body of literature documents that exchange rate pass-through has declined in recent years. This may lead to a decrease in the relative importance of exchange rate channel. Contradictory views are also there, however; as Gudmudsson (2007) highlights.

2.2.4 Asset Price Channel

The asset price channel can be explained through Tobin's (1969) q-theory of investment. According to this theory, q is defined as the stock market value of the firm divided by the replacement cost of capital. A higher value of q means the market price of the firm is high relative to the replacement cost of capital, so the acquisition of new plant and equipment capital, through issuing stock, is cheap relative to the market value of the firm. That is to say, in case of an expansionary monetary policy, the interest rate falls alongside with the required rate of return. The decrease in the discount rate (i.e. required rate of return) increases the current valuation of share prices and consequently the value of Tobin's q. This leads to an increase in investment and in output. Besides firm's perspective, similar reasoning can be extended to households' spending decisions. An expansionary monetary policy boosts share prices and households' wealth, stimulating aggregate demand and output.

The following *factors determine the strength of the asset price channel:* The participation of households in the capital market. The generation of funds by firms through issuance of shares and the level of development of national stock market. We think, as financial globalization can fetch funds from abroad, so the asset price channel may have become relatively more important in recent years. The overall conclusion is however, an empirical question.

We summarize the factors affecting transmission channels below in Table 2.1.

Table 2.1: Factors affecting the different monetary transmission channels

	Interest rate channel	Asset price channel	Exchange rate channel	Credit channel
Interest rate control	✓			✓
Interest rate pass-through	✓			✓
Interest sensitivity of production	✓			
Price and wage rigidities	✓			
Income effect	✓			
Wealth effect	✓			
Depth and scope of financial services	✓	✓	✓	✓
Structure of banking sector	✓			✓
Health of banking sector				✓
Security market		✓		
Terms of financial contracts	✓			
Exchange rate regime			✓	
Ability to borrow from abroad	✓	✓		✓
Dollarization				✓
Bank based	✓			✓
Capital market based	✓	✓		
Investors protection and capital market development		✓		✓
Concentration and Size of banks				✓
Number of small and medium sized firms				✓
Openness to trade			✓	
Openness to financial flows	✓	✓		
Household participation In capital market		✓		
Efficiency of legal system and contract enforcement				✓

Sources: Ihor (2000), Suardi (2001), Juks (2004)

2.3 Literature Review

There exists a lot of literature about monetary transmission mechanism.[6] But the literature itself is very much diverse. Diverse in the sense that some papers talk at the macroeconomic level and try to gauge the transmission mechanism through the macro variables while the others dig further into the micro data and talk specifically about a particular channel but with the disaggregated data.

Cabrera and Lagos (2000) find weak effects of the interest rate on output and inflation for Chile. They use SVAR model and data spans from 1986 to 1997. The study comprises the period before inflation targeting and the inflation targeting regime, but is silent on how the structural break (of regime change) is accounted for. Betancour et al. (2006) use reduced form VAR model. They examine that how "the great moderation", inflation targeting and a target for the structural fiscal surplus have impacted the monetary transmission mechanism in Chile. Their study focuses on interest rate channel, keeping other channels outside its scope.

Gudmudsson (2007) uses a Vector Error Correction (VEC) model and concludes that some evidence of weakening of the interest rate channel and overburdening of exchange rate channel exists. In another study by Catao and Pagan (2010), the authors use expectation-augmented SVAR and conclude that the bank credit channel plays an important role in Chile and Brazil. Furthermore, they conclude that the impact of monetary policy is quite similar to that of advanced economies. The study is about Brazil and Chile. Mukherjee and Bhattachariya (2011) conduct a study for 9 industrial and 17 emerging and developing countries and conclude that the adoption of IT did not significantly alter the traditional keynesian interest rate channel.

Rigobon and Sac (2003) find that stock market movements have significant effects on short-term interest rates and that there exists a positive co-movement between them. This highlights how interest rates can lead to movements in share prices and subsequently to changes in investment. One point of caution is that study is about US economy that is characterized by a high level of market capitalization relative to emerging market economies like Brazile.

[6] See, for instance, Christiano, Eichenbaum and Evans (1999), Kim and Roubini (2000), Gottschalk and Moore (2001), Angeloni, Kashyap, Mojon and Terlizzese (2003), Dabla-Norris and Floerkemeier (2006), Boivin, Kiley and Mishkin (2010) among others.

Nonetheless, the role of the asset price channel might have increased in emerging economies due to an increasing level of globalization, as theory predicts that capital should flow from capital-rich countries to capital scarce countries with globalization.

Poddar et al. (2006) find little evidence that operating targets have an impact on output. The study is about Jordan. However, the study only covers the traditional interest rate channel while other transmission channels are left aside. In the case of Brazil, Minella et al. (2009) argue that interest rate channel plays the most important role in explaining output dynamics. However, in the case of inflation the exchange rate channel along with households' interest rate channel plays an important role. For Chile, Alfaro et al. (2003) conclude that bank lending channel has a significant impact on aggregate output. Using data from 1990 to 2002, the study first identifies the shifts in the loan supply curve, and then estimates VAR to test the significance of bank lending channel.

Against this backdrop, it is relevant to investigate empirically the relative importance of transmission channels. The studies that are close to our studies are Tang (2006), Ludvigson et al. (2002) and Ramey (1993). None of these studies is about inflation targeting economy, however. Secondly, these studies use impulse response functions whereas our study relies on variance decomposition for the quantification and subsequently the ranking of the channels. Furthermore, we deemphasize the role of monetary aggregates on theoretical grounds, unlike these studies. Our study tries to make theoretical link between the changes in the relative importance of channels that we think is missing in the closely related studies mentioned above. So the inflation targeting countries addressing the theoretical link between (financial) globalization and inflation, and the departure from the conventional incorporation of money supply in the model and proposing an integrated framework in which all channels operate simultaneously *distinguishes our study* from the existing literature on this topic. It provides insights about the relative importance of monetary policy transmission channels. The more information central banks have about the how these channels work, the better position in they are to conduct monetary policy.

Contribution to the literature usually deals with one or two monetary transmission channels. To the best of our knowledge there is no study about Brazil, Chile and Korea that takes into account all the transmission channels simultaneously and then ranks the relative importance

of these channels. So the *contribution of this study* is; (i) to takes into account all the four channels simultaneously, to use a Structural VAR and to rank monetary transmission channels according to their impact on GDP and inflation variations. (ii) Not to focus on money supply variables like, M1 or M2, but on the interest rate. The reason is theoretical. As countries in our sample are inflation targeting countries, the role of money demand is minimal.[7] As inflation targeting countries use the interest rate as primary monetary policy instrument, the economy's money demand will change in response to the changes in interest rate. In this case money supply becomes endogenous to the economy. (iii) To rely on the real interest rate channel to explain movements in consumption and investment, thus following the theoretical underpinnings of new Keynesian models.

2.4 The Model and Data Issues

In this section we explain the model and data issues in detail.

2.4.1 The SVAR Model

Vector Autoregression (VAR) models have been extensively used in the literature to measure the response of output and Consumer Price Index (CPI) to shocks in monetary instruments. The pioneer study by Sims (1980) has opened a new era for research in monetary economics. The typical variables included in the monetary VAR are interest rate, output and the CPI and are considered as endogenous.

A relevant issue here is to uncover the parameters in structural form equation from the reduced from estimation. There are several methods to this end. One method imposes restrictions on contemporaneous structural parameters. This method orthogonalizes reduced form disturbances using Choleski decomposition as in Sims (1980). This method demands a recursive structure. Moreover, the identification problem calls for a certain number of restrictions.

[7] Though there is criticism that in NK model that money supply is not explicitly there. So there is strong potential for money market disequilibrium.(source: Book Monetary Economics 2nd Edition Author Jagdish Handa pp-544). However, the proponent of NK model are of the view that interest rate set by the central bank corresponds to the money supply required in the economy and money demand adjusts itself to clear the money market, see Woodford (1998) and Rudebusch et Svensson (1998).

To identify the required restrictions, many studies rely on a *recursive scheme* based on a choleski decomposition. This statistical decomposition separates the estimated residuals from the reduced from representation of the structural model into orthogonal (uncorrelated) by restrictions imposed on the basis of an arbitrary ordering of the variables. This point has been emphasized by McCoy and McMohan (2000) among others. This identification scheme gives birth to a structure that results in being lower triangular, that is, the elements above the principal diagonal are zero. This identification scheme requires the numbers of restrictions to be exactly identified as equal to $n(n-1)/2$. However, a criticism on the recursive ordering is that the results from the VAR can be dependent on the ordering of the variables. As every ordering of the variables brings different factorization, it is almost impossible to examine all of them for system containing more than three variables. To circumvent this problem we use an alternative identification scheme namely Structural VAR.

2.4.2 Identification Scheme

We construct a structural form model to identify the effects of monetary policy on real output and inflation. A Structural VAR is a multivariate, linear representation of a vector of observable variables on its own lag. These models are called structural because of their economic interpretation. In these models the identification restrictions are used according to some economic theory.

Following Kim and Roubini (2000), we assume that the following structural form equation describes the economy

$$A(L)y_t = e_t \qquad 1$$

where $A(L)$ is a matrix polynomial in the lag operator L, y_t is an n x 1 data vector, and e_t is an n x 1 structural disturbances vector. e_t is serially orthogonal (uncorrelated) and $var(e_t) = \Lambda$ while Λ is a diagonal matrix. Diagonal elements are the variances of structural disturbances; therefore, disturbances are assumed to be mutually uncorrelated. e_t is a vector of shocks for each variable that are orthogonal to other shocks in the economy. This property of structural VAR makes it different from reduced from VAR and gives economic interpretation, as it becomes possible to disentangle shocks from each other.

We can estimate the reduced form equation as

$$y_t = B(L)y_t + u_t \qquad 2$$

where $B(L)$ is a matrix polynomial (without constant) in lag operator L and var(u_t) =$\sum$. u_t is a statistical innovation and is a white noise. Shocks in u_t are not orthogonal to each other. That is

$$E(u_t u_t^{'}) = \sum$$

$$E(u_t u_{t+s}) = 0$$

for any non-zero s. $\sum$ is a positive definite matrix and shocks are linearly independent.

The relevant question here is how to recover the parameters in the structural form equation from the estimated parameters in the reduced from equation. The methods impose restrictions on contemporaneous structural parameters only. The Cholesky decomposition is a popular and convenient one, as used by Sims (1980). However, this decomposition method assumes a strict recursive ordering, that is, a Wold-causal chain. This statistical decomposition separates the estimated residuals from the reduced form representation of the structural model into orthogonal (uncorrelated) by restrictions imposed on the basis of an arbitrary ordering of variables. But any ordering of variables is not beyond criticism. To avoid this criticism Blanchard and Watson (1986), Bernanke (1986), and Sims (1986) suggest a generalized method, Structural VAR, which used a *non-recursive* structure while still imposing restrictions only on contemporaneous structural parameters.

Let A_0 be the coefficient matrix, non-singular, on L^0 in $A(L)$, that is, the contemporaneous coefficient matrix in the structural form, and let $A^0(L)$ be the coefficient matrix in $A(L)$ without contemporaneous coefficient A_0. That is,

$$A(L) = A_0 + A^0(L) \qquad 3$$

Following the equation described so for, the parameters in the structural form equation and those in reduced form equation are related by

$$B(L) = -A_0^{-1}A_0(L) \qquad 4$$

Additionally, the structural disturbances and the reduced from (statistical) residuals are related by $e_t = A_0 u_t$, which means

$$\Sigma = A_0^{-1}\Lambda(A_0^{-1})' \quad 5$$

We can estimate the reduced form by maximum likelihood estimates. We can get point estimates of parameters and of the variance-covariance matrix $\sum$, but we need to impose identification restrictions. Since $\sum$ contains $n \times (n+1)/2$ parameters, we need at least $n \times (n+1)/2$ restrictions to recover the structural form parameters. By normalizing the n diagonal elements of A_0 to 1's, we still need at least $n \times (n-1)/2$ restrictions on A_0 to achieve identification. In the *recursive* VAR modeling A_0 is assumed to triangular. However, in non-recursive or SVAR approaches A_0 can be of any structure as long as it has enough restrictions. It is worth mentioning that there are several ways to impose restrictions.[8]

We can now recover the structural innovations e_t from residuals u_t. The next step is to obtain impulse response functions to trace out the effect of structural innovations on observed variables.

$$y_t = C + \sum_{i=0}^{\infty} \Phi i.\, e_{t-1} \quad 6$$

Equation (6) is a moving average representation, where Φ_i are used to generate the effects of structural innovations on the time path of data sequences. The set of these coefficients are called an impulse response functions $\Phi_{jk}(i)$ against i. An Impulse Response function (IRF) gives a visual representation of the behaviour of observed series in response to structural shock. More specifically, $\Phi_{jk}(i)$ represents the response of variable j to one unit impulse in variable k occurring *i-th* period ago. IRFs are used to measure the effectiveness of a policy change. Besides, IRFs we will also be used to compute the *forecast error variance decomposition.* As the objective of the study is to rank the monetary transmission channels according to their relative importance, we will rank these channels on the basis of the structural variance decomposition. The channel that will explain largest share of variations in the target variables (like GDP and CPI) will be ranked highest. According to Watson and Teelucksing (2002), the variance decomposition gives information about relative importance of each of the innovations in the explanation of each variable in the system.

[8] The four types of restrictions are short-run restrictions including Recursive-zero restriction and Non-recursive zero restrictions, then there is long-run restrictions and fourth type includes sign and shape restrictions.

2.4.3 Data Description

We use monthly data from the starting point of the inflation targeting regime to the last month of 2009. The data source is International Financial Statistics (IFS), Bank for International settlements (BIS) and FRED data base. Our sample includes Brazil, Chile and Korea.

As monthly GDP is not available we use the Industrial Production Index (IPI) as a proxy to economic activity, Consumer Price Index (CPI) for prices. Both of these series have 2005 as base year. For loans we use credit to private sector from the banking system. As our sample countries, presumably, have a small shadow banking system we think that credit to private sector advanced by the banking system is a representative variable to gauge the conditions of credit in the economy. This study does not use the nominal value of loans as some studies do, rather it uses real loans. We believe that the amount of real loans better explains variation in GDP and CPI. To make it real, we deflate nominal loans by CPI. Likewise, for the bank lending rate, we use the real bank lending rate. The data of real exchange rate are taken from the BIS. We use the real effective exchange rate, and an increase in the index represents a depreciation of the domestic currency. The other variable in our model is share price. We use the share price in Index to capture developments in the financial market. We use short-term nominal interest rate to capture the monetary policy stance. As we have already mentioned in the text, our choice of short term interest rate instead of monetary aggregate is based (i) on the evidence that inflation targeters use short term interest rate as monetary policy tool, (ii) in the new Keynesian model the traditional money market equilibrium has no role and where each level of interest rate has a corresponding money supply and money demand. We would like to emphasize that the sample period is characterized by single monetary policy regime – the inflation targeting regime. Thus, our results are not contaminated any structural break or regime shift. Besides the variables described above we add world oil price in term of US dollar in the model as a robustness check. All variables, except policy rate and real bank lending rate, are seasonally adjusted and taken in (natural) logarithm from. The IPI for Brazil and Korea are seasonally adjusted at source.

Another issue is whether the Vector Autoregression (VAR) model should be estimated in level or difference. The literature is divided. There are three options: (i) make variables stationary by taking the first difference, (ii) follow the Sims et al. (1990) “The common

practice of attempting to transform models to stationary form by difference or cointegration operators whenever it appears likely that data are integrated in many cases is unnecessary" (pp-136), (iii) use Vector Error Correction Model (VECM) applying cointegration technique. However, according to Ramaswamy and Sloek (1997), in the absence of a priori economic theory to guide for the number of long-run relationships and how to interpret them, it is realistic not to impose the restriction of cointegration on the VAR model. So there is no clear-cut guideline whether stationarity should be forced on the data or VAR in level should be preferred. All three options mentioned earlier in the text have their own pros and cons. Sims, Stock and Watson (1990), Bernanke and Blinder (1992), Sims (1992), Levy and Halikias (1997) estimate VAR model in level, whereas Monticelli and Tristani (1999), use stationary variables. Peersman and Smet (2001) estimate the model in level. We choose to estimate the SVAR model in level. Needless to say that differencing causes a loss of information. Secondly, estimating the VAR model in level allows for implicit cointegration in the data as explained by Peersman and Smet (2001).

We also pay attention to lag selection. Different lag selection criteria provide different lag order. For example, in case of Chile, likelihood ratio test recommends 6 lags, whereas Final Predictor Errors test (FPE) and Akaike Information Criterion (AIC) suggests 3 lags. On the other hand, Schwartz Information Criterion (SIC) and Hannan-Quinn Information Cretion (HQ) suggest 2 lags. Though we have monthly data, yet because of relatively small sample size, we use 4 lags. The motivation for using 4 lags instead of 6 recommended by the likelihood comes from the fact that the large number of parameters work as a penalty. In our case we have 7x7 matrix, which is already very large with respect to the sample size as we are using.

2.4.4 Identification

The objective of this study is to investigate the relative importance of monetary policy transmission channels. In our model, the data vector is {IPI, CPI, RL, RBLR, REER, SP, Discrate}, where IPI is the industrial production index, CPI is the consumer price index, RL is the credit to private sector advanced by banking system, deflated by CPI to make it real so it is the real loans, RBLR is the real bank lending rate, REER is the real effective exchange rate – an increase in index is real depreciation of domestic currency, SP is the share price index

and discount rate stands for the policy rate. For Brazil and Korea, we consider money market rate instead of the discount rate.

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & A_{25} & 0 & 0 \\ 0 & 0 & 1 & A_{34} & 0 & 0 & 0 \\ 0 & A_{42} & 0 & 1 & 0 & 0 & A_{47} \\ A_{51} & A_{52} & 0 & 0 & 1 & A_{56} & A_{57} \\ 0 & A_{62} & A_{63} & A_{64} & A_{65} & 1 & A_{67} \\ A_{71} & A_{72} & 0 & 0 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} u\,IPI \\ u\,CPI \\ u\,RL \\ u\,RBLR \\ u\,REER \\ u\,SP \\ u\,Discrate \end{bmatrix} = \begin{bmatrix} e\,IPI \\ e\,CPI \\ e\,RL \\ e\,RBLR \\ e\,REER \\ e\,SP \\ e\,Discrate \end{bmatrix}$$

First, we justify the choice of these variables in the model, and explain the restrictions imposed in a second step. The first two variables – industrial production index and consumer price index are final target variables. Indeed, to check the relative strength of transmission channels, we need intermediate variables. Each intermediate variable is supposed to represent a certain transmission channel. Our intermediate variables are the real bank lending rate, real bank loans, real exchange rate and the share price index. These variables represent the traditional interest rate channel, credit channel, exchange rate channel and the share price channel respectively. Last but not least, we include the short-term interest rate to measure the monetary policy stance. We reiterate, we do not include typical monetary aggregate variables like M1 or M2 as usually done in literature, for example, Kim and Roubini (2000).

Before coming to the explanation of identifying restrictions, we would like to mention that our restrictions are short term and contemporaneous, like Kim and Roubini (2000). Restrictions concern the structural parameters of A_0 but not the lagged parameters. These contemporaneous restrictions enable us to derive a reasonable economic structure. Furthermore, as lagged values enter each equation, thus all variables are linked together.

The first equation deals with the IPI, it responds to all the domestic variables only with a lag. This is in line with Kim and Roubini (2000), and as our study uses monthly data this restriction is quite intuitive. Take the components of GDP, either it may be consumption or investment both are not instantaneous. Either firms increase the capacity or decide to utilize the existing capacity, in both the cases it takes time in decision making, and keeping the

monthly frequency in mind, it is reasonable to restrict the first equation accordingly. Similarly, the CPI does not respond to domestic variables, except real exchange rate. Even the policy variable does not have any contemporaneous effect on the final target variables; this point has been emphasized by McCoy and McMohan (2000). Furthermore, it is not against the existing norm of modeling, in the sense that rigidity in output and consumer prices is well established, because of existing of time dependent rules, like building and delivery lags, menu cost or staggered price contracts.

After these two target variables, we have four intermediate variables. The third equation describes the function of real loans. Real loans respond to the real bank lending rate. There is a time lag in signing a contract so loans are also quasi-rigid. We let loans respond to the real bank lending rate on the assumption that there are a certain percentage of loan contracts with an adjustable interest rate. In the fourth equation, we contend that the real bank lending rate responds to CPI and policy rate. We think that in inflation targeting countries, in the presence of monthly inflation report and a projected inflation path in published form banks are in position to change their interest rate in response to CPI shocks. We also believe that banks are quick in translating policy rates into their lending rates. Here one thing is worth exploring; banks may be quick in translating policy rates in lending rates but slow in the case of the deposit rate. It depends upon the structure of the market competition etc.

According to our fifth equation in the model, the real exchange rate responds to output, CPI, share price and policy rate. By construction, changes in the CPI bring changes in the real effective exchange rate. In the era of financial globalization, when stock exchanges are well connected, foreign inflows to the domestic capital market appreciate the domestic currency, keeping the discussion of central bank intervention in foreign exchange market aside. Changes in portfolio investment thus translate into nominal exchange rate and subsequently in real exchange rate variations, although one may believe that the real exchange rate is determined by the real side of the economy. However, we are not discussing about the equilibrium value of real exchange rate. Hence, our underlying assumption here is that share price shocks are due to foreign factors.

In our sixth equation share prices are assumed to react in the same month to shocks on CPI, RL, RBLR, REER and the policy rate. As share prices are a financial variable, it reacts

quickly. One question may arise why we should exclude output in this equation? Two reasons come to mind: First, generally when data is released, the data of industrial production index, unemployment and inflation is released simultaneously, and we think that investors use the information in the CPI, that is less likely to be revised relative to IPI. We assume that central banks have more information relative to the market and in our model the central bank reacts to the IPI in the same month, and SP react to the policy rate in the same month. So it is our contention that agents take the clue of IPI from the reaction of the central bank and respond to the policy rate indirectly taking IPI into account. In our opinion, in this way agents avoid the risk of overreaction to the release of data of IPI that is prone to revision.

The last equation describes the reaction function of the central bank. Unlike Kim and Roubini (2000), the central bank responds to the IPI and the CPI as our sample consists of inflation targeting countries. Our assumption is that the central bank is forward looking. In inflation targeting countries, central banks have strong forecasting division, and fan charts about inflation path. Being forward-looking, central banks responds to industrial production index and CPI contemporaneously. One possibility was to peg the coefficient in the last equation according to the usual values in Taylor rules, but we preferred "let the data speak".

In sum, we have two target variables, as it is common in the flexible inflation targeting regime, we have four intermediate variables and each of them representing a monetary transmission channel, and we have a policy variable. Real and nominal rigidities, informational advantage of central bank over private agents and inflation forecast targeting because of inflation targeting regime are our main assumptions to impose restrictions for identification.

In Table 2.2, we report the estimated contemporaneous coefficients in the structural model. Data are monthly and estimated period is 1999:1–2009:12 for Brazil, 1991:1–2009:12 for Chile and 1998:1–2009:12 for Korea. At the bottom of the table we report likelihood test of over-identifying restrictions. For Chile and Korea our identifying restrictions are not rejected at the conventional 5 percent significance level, however, for Brazil it is almost valid at this conventional level.

Table 2.2: Contemporaneous coefficients in the structural model

	Brazil	Chile	Korea
A_{25}	.003(.029)	.26(.12)	.027(.017)
A_{34}	-.0005(.001)	-.0003(.0003)	-.007(.001)
A_{42}	47.27(66.31)	-118.18(2.66)	111.23(9.69)
A_{47}	-.63(.32)	-.69(.039)	-.058(.16)
A_{51}	.008(.15)	.11(.12)	-1.05(.47)
A_{52}	-.28(1.93)	-4.61(2.02)	1.33(2.36)
A_{56}	.63(.17)	.83(.19)	1.70(.63)
A_{57}	-.009(.008)	.0009(.001)	.001(.038)
A_{62}	-2.26(24.86)	16.71(2.51)	1169.85(21.10)
A_{63}	1.88(1.79)	2.13(.53)	573.78(71.05)
A_{64}	.030(.027)	.01(.003)	-1.43(2.56)
A_{65}	-4.26(5.08)	-1.99(.81)	-621.45(46.86)
A_{67}	-.015(.041)	-.007(.002)	11.26(5.40)
A_{71}	.31(1.58)	3.84(7.92)	-.91(.75)
A_{72}	.85(13.38)	43.68(2.47)	.64(5.29)
Likelihood test	$\chi^2(6) = 12.68$	$\chi^2(6) = 8.65$	$\chi^2(6) = 11.80$
Significance Level	0.0483	0.1941	0.0665

Standard Errors in Parenthesis

Coefficients A_{71} and A_{72} are positive which means when there is an increase in output or CPI, central banks increase the policy rate. However, in case of Korea we find a negative sign for output.

2.5 The Effects of Monetary Policy Shocks

In this section we delineate expected dynamic responses after monetary policy shock, empirical results and ranking of monetary transmission channels.

2.5.1 Expected dynamic responses after monetary policy shock

In this section, we discuss the expected movements of macro variables included in the model after different shocks. First we discuss the monetary shock, as we measure the monetary shock with innovation in interest rate, so an increase in the policy rate indicates tighter monetary policy stance. Theories are clear about the effects on inflation. After an increase in the interest rate inflation will decline. However, this clear-cut stance is absent in the case of

GDP. The behaviour of GDP depends upon the money neutrality. Furthermore, there is almost consensus that money is neutral in the long run but empirical evidence required to prove that money is non-neutral in the short-run.

For loans we expect that after tightening the monetary policy the quantity of loans go down as the credit view says. (see Bernanke and Blinder (1988)). The bank lending rate should follow closely the evolution of the policy rate.

The dynamics of exchange rate are complex one after the shock to the policy rate. If the real rate increases after an increase in the nominal interest rate, the domestic currency will appreciate. So it depends upon the Fisherian effects. If the expected inflation increases more than the nominal interest rate, the real interest rate will fall and the domestic currency will depreciate. For share prices it is expected that an increase in the policy rate will decrease share prices, however, there is a hot debate about the extent to which interest rates can have impact on stock prices. According to Bernanke and Kuttner (2004), an unanticipated 25 basis-point cut in the federal funds rate is associated with one percentage point increase in the broad stock index. But question here is, to determine whether this effect is symmetric for both types of shocks? Can we equally assume that an increase in the interest rate brings down the stock index? We will see how this sample behaves in this respect. If an increase in the interest rate reduces the broad stock index, then where do we fit the debate of should central bank target the share prices or not? Secondly, is this line of argument valid for every stage of the business cycle, for example, when the mood of economic agent is vibrant and irrational exuberance prevails, will an increase in interest rates reduce the share price index? These questions, however, are beyond the scope of this study and not directly relevant to our research question. In the remaining we assume that an increase in the interest rate will have some effect on the share prices.

What are the expected effects of a shock on intermediate variables, given that each variable represent a transmission channel. There is almost no controversy that an increase in the loans will increase the economic activity and so does the inflation. Similarly when the bank lending rate increases, it will depress economic activity and inflation. But this is not the case with an exchange rate shock, so we explain the response of GDP and inflation in detail in case of a shock to the exchange rate. The simple text book argument is that real depreciation brings

competitive gains and improves the foreign sector of the economy, but there also exist theoretical foundations according to which depreciation can have contractionary impacts on the economy. First, the redistribution argument documented by Krugman and Taylor (1978) pushes in this direction. Second, the negative real balance effect due to higher price level and third, Marshal-Lerner condition can also come into play. In case of inflation, a real depreciation can lead to increase or a decrease in inflation; depending on the composition of the CPI basket, and on the behaviour of tradables and non-tradables, as the prices for tradable goods and services are affected by changes in international price and exchange rates, whereas non-tradable goods and services are affected by domestic supply and demand condition. If the share of the tradable goods is higher in the consumption basket, real exchange rate depreciation will increase inflation. One can also explain this link through the trade balance dynamics, if real depreciation improves the trade balance, it will strengthen the domestic currency down the road and consequently may reduce imported inflation. If it causes deterioration in the trade balance, and subsequently depreciation spiral will increase imported inflation further.[9]

What about the effects of an increase in share prices on macro variables? As it is generally said, stock exchange is a barometer of economic activity. The price of a stock is a claim on future output, so it can be safely assumed that a positive share price shock will lead to an increase in the future output, and an increase in the inflation.[10] In case of inflation, however, we would like to mention a point highlighted by Palley (2006), according to which there may be a weak relationship between asset prices and inflation.

Overall, we expect that an increase in the policy rate will depresses the inflation as well as output but the effect may be less pronounced in case of latter. Especially, as we have inflation targeting countries, we expect a reasonably strong effect on inflation. Indeed, even in flexible inflation targeting, much weight is assigned to inflation so the guidepost for monetary policy is inflation. Therefore, the shock in the policy rate should be effective enough to control inflation. The additional question of the effectiveness of the different monetary channels will be discussed in the section where we rank the channels.

[9] This whole explanation abstracts from the fiscal health of the economy that also has implications for inflation.
[10] According to Beaudry and Portier (2006) news about technological shock first reflects in stock prices that lead to an increase in output.

2.5.2 Empirical Results

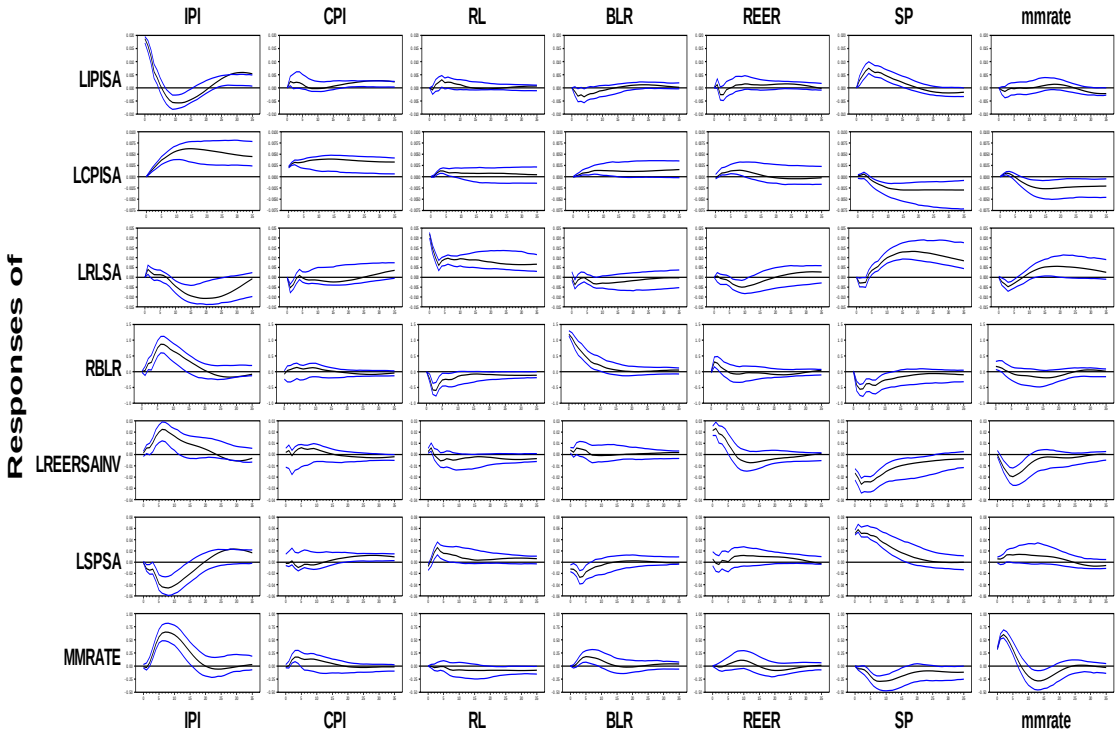
Now we display the estimated impulse responses of Brazil, Chile and Korea in figure 2.1, 2.2 and 2.3 respectively.

Figure 2.1 displays the response of variables to one standard deviation impulse for Brazil. Each column of the figure gives the impulse responses (over 36 months) to a one-standard-deviation positive shock to the variable labeled at the head of the column. The responding variables are named at the far left of each row. The confidence interval band in each graph is one-standard-error bands. We first analyze the positive shock in the money market rate, as we have discussed earlier in the text that theory is skeptic about the response of output to interest rate shocks. Our empirical set of results confirms the absence of clear-cut effects, as industrial production is almost flat and statistically insignificant. It seems that money is neutral even in the short run. However, in the case of inflation, the effect is pronounced. Inflation declines after positive interest rate shock and is statistically significant. Inflation follows a declining trend almost for one year and then becomes flat. Similarly, after the positive shock to the interest rate real effective exchange rate falls, i.e., the domestic currency appreciates. The effect is statistically significant for around 10 months, though after 5 months it starts shedding the gained appreciation and reverts back to the initial value around 30 months. The quantity of loans declines for 5 months, and is statistically significant and then starts increasing while this increase is statistically insignificant. The real bank lending rate increases initially for a short time, and then declines though it remained statistically insignificant. The response of share prices is rather surprising as it increases however insignificant statistically. Summarizing, the response to tight monetary policy is clearly in line with theory and boosts confidence in the restrictions we imposed.

A positive shock in share price leads to an increase in industrial production index as well as the quantity of loans which is quite intuitive. After positive shock to share prices, the domestic currency appreciates in real terms. This can be explained as follows. The increase in inflows being port-folio investments in domestic stock exchange, it leads to a nominal appreciation of the currency. At the same time, a positive response of industrial production and a lower inflation improves the trade balance. These combined effects lead the domestic currency to appreciate in real terms.

Figure 2.1: One S.D. shock with one-standard-error bands, country Brazil

Shocks



The impact of a positive shock either to the real bank lending rate or to real loans are economically significant for industrial production. In both cases, however, inflation is almost statistically insignificant. It can be gleaned from here that the share price channel and the exchange rate channel seem strong relative to interest rate and credit channel, but we will see that later when we analyze the variance decomposition to rank transmission channels.

In Figure 2.2 we display the results of Chile. After positive shock to the discount rate, industrial production decreases. The decline is statistically significant for about 20 months. The level of CPI shows an increase for a very short period of time, and then declines. The fall is economically significant from the beginning, however, but is statistically significant after one year only. The persistent decrease in the level of the CPI after a tight monetary policy reveals that the Chilean economy is characterized by a strong negative relationship between inflation and the interest rate, which makes the central bank of Chile a successful inflation targeter.

Consider the next effect on the level of real bank lending rate and level of real loans. Further a tight monetary policy translates into an increase in the real bank lending rate and a decline in real loans. The lag observed in the initial period before the effects fully take place reminds us that it takes time to negotiate contracts. This pattern is in line with our identifying restrictions, as real loans do not respond to policy rate simultaneously (i.e. within the same month).

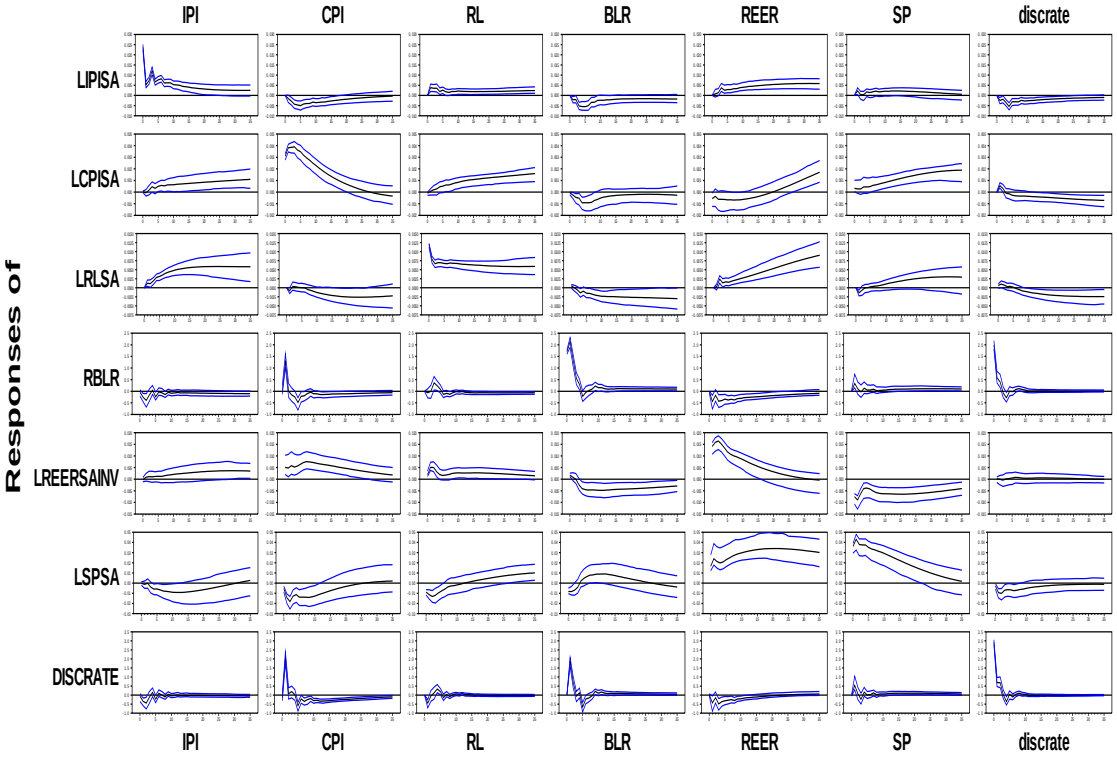
Now we explain the responses of target variables to the shocks in intermediate variables. A positive shock in share prices increases the level of industrial production as well as CPI. The response of the IPI the response is statistically insignificant but that of the CPI is quite significant statistically. Moreover, the appreciation of the domestic currency and the increased level of loans are in line with economic theory, that is, the economy becomes overheated when an economy receives capital inflows.

In the case of a positive shock to the exchange rate a fall (depreciation) of real exchange rate has an expansionary effect on the industrial production. The initial decrease in inflation can be either related to the presence of nominal rigidities or competition among firms due to real globalization that makes firms more reluctant to increase in their prices. Thirdly, the credibility of the central bank gained from the successful inflation targeting may also contribute to some extent. It is our conjecture, observing the significant and persistent response of industrial production, that the ER channel will assume high ranking.

The response of the IPI and CPI to the shock in RL and RBLR is also as the text book economics perceives. In case of a positive shock in real bank lending rate, economic activity decreases and so does the CPI. Both are statistically significant for the first few months, though they remain economically significant for the longer horizon. The decline in the level of real loans and appreciation of the domestic currency are both very intuitive. The one oddity here is an increase in the share prices after the positive shock to the bank lending rate. After a positive shock to the real loans, IPI increases marginally whereas an increase in CPI statistically significant. After a shock to the real loans IPI increases and remain almost significant for a longer horizon, however, for the CPI the impact of shock to the real loan is much pronounced. It is quite intuitive as credit booms generally lead to higher inflation.

Figure 2.2: One S.D . shock with one-standard-error bands, country Chile

Shocks



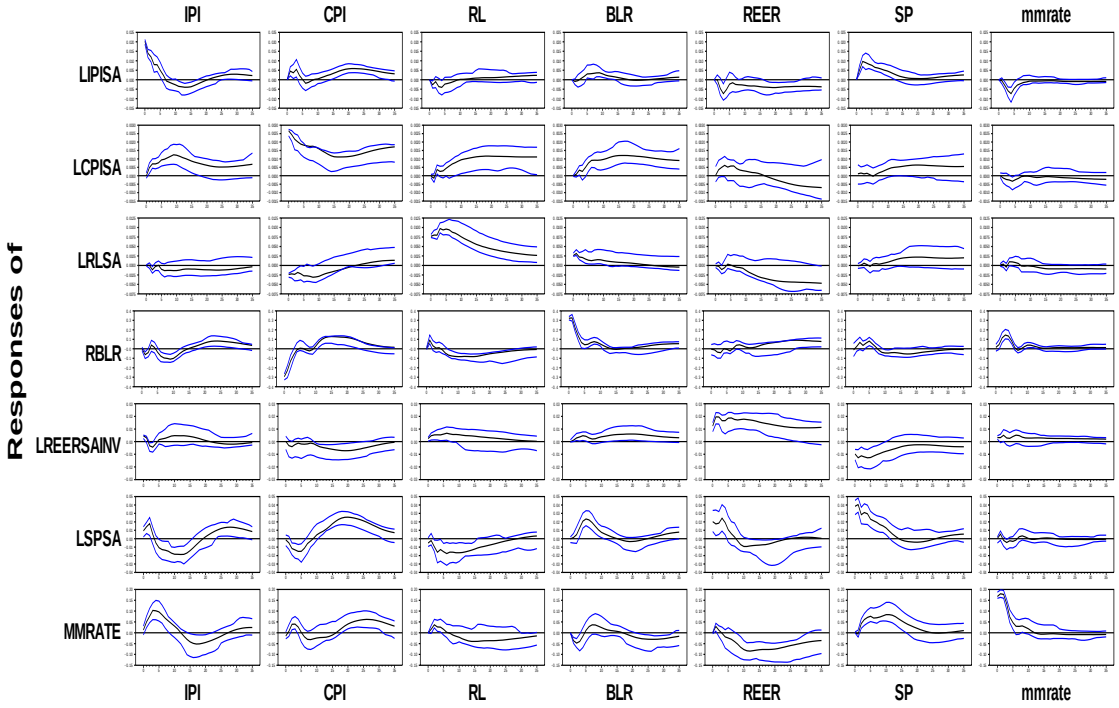
In Figure 2.3, we show the results for Korea. Following a positive interest rate shock, level of industrial production declines, this decline is statistically significant for 5 months and the IPI reverts back to the initial level after 10 months. Interestingly, CPI also declines but remains statically insignificant. Real bank lending rate increases, real loans decrease, whereas, share prices and the exchange rate experience little movements and remain statistically insignificant.

Among the intermediate variables, the response of the IPI to share price shock is statistically significant. After a positive shock in share prices, the IPI increases and reverts back to the initial level after 4 months. A rise in the exchange rate (i.e., Depreciation) is contractionary in Korea, though statistically insignificant, but it is more pronounced than response to real loans and real bank lending rate. We expect from the impulse response that the ER channel be ranked higher than the interest rate channel and the bank lending channel for industrial

production. For the CPI, the response is a little odd, but statistically insignificant. Korea being a developed economy, it is not unusual that inflation is influenced by exchange rate.

Figure 2.3: One S.D . shock with one-standard-error bands, country Korea

Shocks



The response of the CPI to shocks in real loans is statistically significant. After rise in loans, the CPI increases, so we believe that the credit channel will be ranked high ranked higher for the CPI. However, the response of the CPI contradicts the conventional wisdom that a rise real bank lending rate will depress the CPI.

In most cases, our impulse responses are in line with theory, though some odd results do emerge in some cases. The overall behavior of the model confirms that our identification restrictions are very reasonable. In the next section we discuss the ranking of different monetary transmission channels.

2.5.3 Ranking of Monetary Transmission Channels

Sims (1980) introduced the Forecast Error Variance Decomposition (FEVD) technique. Amisano and Giannini (1997) describe it as a basic tool to provide complementary information for the better understanding of the dynamic relationship among the variables jointly analyzed in a VAR model. It determines the extent of the behavior of each variable in the system that relates to the different structural innovations at certain horizons. Thus, it allows us to compare the role of different variables in explaining the variation of other variables; we label this role a relative importance. In this paragraph, we rank the monetary policy transmission channels according to this role. As our final target variables are IPI and CPI, we assess the relative importance of monetary transmission channels on the basis of their share in the variation in these target variables.

Table 2.3 Ranking of monetary transmission channels on the basis of variance decomposition

	Channel			% Contribution at 36th Month		
	Ranking	**IPI**	**CPI**		**IPI**	**CPI**
Brazil	1	SP	SP	Credit Chanel	1.18	1.43
	2	ER	IR	IR Channel	3.10	4.73
	3	IR	ER	ER Channel	10.70	3.16
	4	Credit	Credit	SP Channel	16.76	17.24
Chile	1	ER	SP	Credit Chanel	9.75	12.56
	2	Credit	ER	IR Channel	3.93	6.13
	3	IR	Credit	ER Channel	33.46	20.67
	4	SP	IR	SP Channel	2.84	33.38
Korea	1	SP	IR	Credit Chanel	5.67	15.75
	2	ER	Credit	IR Channel	2.60	17.53
	3	Credit	SP	ER Channel	6.24	2.82
	4	IR	ER	SP Channel	33.19	6.46

In Table 2.3, we report the forecast error variance decomposition of industrial production and the forecast error variance decomposition of consumer price index due to four variables; each of the variable representing a transmission channel. The numbers before the channel indicates the percentage fluctuation in the IPI and CPI at the 36th month respectively. The higher the fluctuation, the higher the relative importance of that channel for that variable. For example, in case of Brazil share price channel explains the 16.76% of industrial production fluctuations, and 17.24% of the changes in the CPI at the horizon of 36-month so we rank it first. There is no hard and fast rule to determine the relevant horizon in the variance decomposition.

However, we think that in inflation targeting countries, even if we assume that the central bank targets the two-year ahead inflation, one more year is sufficient to translate the full impact of a shock. So a 36-month is a reasonable horizon to judge the efficacy of a monetary policy transmission channel. Kim and Roubini (2000) report the result for 48 months whereas Christiano and Eichenbaum (1992) for 10 quarters. Similarly, for Brazil again, the ER channel explains 10.70% of fluctuations in the industrial production, and claims the second place in ranking. The top ranking of share price channel for industrial production, for Brazil, may be due to some big firms raising funds from the stock market, as it is generally assumed that small firms rely heavily on bank-based system whereas large firms can generate funds from capital markets. But this needs further investigation to substantiate the results with firm level data about the portion of equity finance and debt finance firms and their share in total production. This precise question is beyond the scope of the study, but it can be assumed safely that against the backdrop of financial globalization, the share price channel might have gained importance. The second position of the exchange rate channel is understandable, keeping in mind the long association of Brazil with the fixed exchange rate regime.

For the CPI, the share price channel is first and interest rate channel is second in ranking. The highest position of the share price channel may be due to the higher capital inflows which lead to an increase in money supply, despite sterilization, the interest rate goes down and inflationary pressures start to build up. As the clear-cut stance of the central bank towards control of inflation makes a tight link between inflation and the interest rate so the second ranking of the interest rate channel is not queer. However, we were expecting that the exchange rate channel will assume a higher in the ranking because of peculiar characteristics of Brazil. It is notable that the quantitative difference between interest rate channel and the exchange rate channel is not large. Interestingly, the credit channel is the least important in Brazil for both IPI and CPI.

For Chile, the exchange rate channel explains 33.46% fluctuations in industrial production, whereas the credit channel explains 9.75%. The higher real openness ((export + import)/GDP) can explain the high importance of exchange rate channel in Chile. See graph in Appendix for this ratio. Coming to the fluctuations in the CPI, share price channel explains 33.38% and the ER channel 20.67%. When the economy is more open, the rest of the world inflation has

sound impact on domestic inflation. This translates through the channels that are usually attributed to the open economy and those are the share price and exchange rate channel. So the high ranking of share price and exchange rate channel is not particularly surprising in the case of Chile. However, as Chile is a pioneer in inflation targeting and effective interest rate channel is, generally speaking, a key to success in inflation targeting. So this ranking is questionable. But against the backdrop of financial globalization it is also convincing that open economy channels – share price channel and exchange rate channel – can assume relatively high importance. Though literature has been more focused towards traditional interest rate and credit channel, against the backdrop of financial globalization the latter may well shift the focus towards share price and the exchange rate channel.

For Korea, share price channel explains 33.19% fluctuations in the industrial production. The exchange rate channel ranks second and explains 6.24% of fluctuations in industrial production. It is worth mentioning that the quantitative difference between the exchange rate channel and the credit channel is rather small. The credit channel explains 5.67% of the industrial production. Noticeably, in the case of inflation the ranking is totally reverse, and the interest rate channel and the credit channel assume the first and the second position respectively. Korea is an inflation targeter, and a developed economy. It can be assumed that a very sophisticated banking sector will translate the policy interest rate into bank lending rates efficiently thus making the interest rate channel the most important to explain inflation dynamics, but the question is why this argument is not valid in case of industrial production. It is a riddle and demands further research.

Summarizing, we find that the share price and exchange rate channels are more important in explaining the fluctuations in the IPI and CPI. Here we would like to mention the results of Gudmundsson (2007) who finds that the exchange rate channel might have overburdened in the wake of financial globalization. We check the robustness in the next section to be more confident about our results.

2.6 Robustness Check

We add the world price of oil to check the robustness of our model. There is a criticism that monetary authorities follow feedback rule by reacting to the news in the economy when

defining their monetary policy, as mentioned by Kim and Roubini (2000). Therefore, it becomes important to control for the systematic components of the policy rule to identify "exogenous" monetary policy changes. The inclusion of the world oil price serves as a proxy for negative and inflationary supply shock. The identification scheme is unchanged except the addition of world oil price. As economies in our sample are small, it is safe to assume that they have no impact on world oil price. We put the world oil price equation in the beginning of our identification scheme and other restrictions remain the same. Following Kim and Roubini (2000), industrial production, inflation, exchange rate and short term interest rate respond to a shock in world oil price contemporaneously (in the same month). In addition, as we also have share prices in our model we assume that share prices also respond to world oil price shock simultaneously. We believe that it is quite sensible to assume this. We report identification scheme, IRF and estimated structural coefficients in appendix B. The ranking of channels is presented in the Table 2.4 below.

Table 2.4: Ranking of monetary transmission channels on the basis of variance decomposition

	Channel			**% Contribution at 36th Month**		
	Ranking	**IPI**	**CPI**		**IPI**	**CPI**
Brazil	1	ER	SP	Credit Chanel	1.49	3.44
	2	SP	ER	IR Channel	3.48	2.65
	3	IR	IR	ER Channel	12.30	5.05
	4	Credit	Credit	SP Channel	11.50	32.30
Chile	1	ER	SP	Credit Chanel	13.50	14.71
	2	Credit	ER	IR Channel	1.84	3.14
	3	SP	Credit	ER Channel	29.22	19.12
	4	IR	IR	SP Channel	5.65	26.48
Korea	1	SP	Credit	Credit Chanel	5.71	19.95
	2	ER	IR	IR Channel	2.14	11.55
	3	Credit	ER	ER Channel	6.58	2.41
	4	IR	SP	SP Channel	11.96	0.61

As we have concluded earlier that open economy channels are gaining more relative importance, this conclusion in further strengthened by our robustness check. Although, there are some shuffles among the channels in rankings, the general result concerning the high importance of share prices and exchange rate channel is intact. For Brazil, the robustness check changes the ranking of the exchange rate channels. It becomes second for the fluctuations of CPI. This makes sense, as in the presence of oil price shocks, depreciations can put pressure on inflation and consequently making the ER channel stronger. Interestingly, for

Chile, the ranking for the first two positions remains the same both for IPI and CPI. Similarly, for Korea, the open economy channels assume the same ranking for both final target variables.

2.7 Conclusion

In this chapter we address the question; what is the relative importance of the monetary transmission channels? We used monthly data for Brazil, Chile and Korea. The sample ranged from the date of their adoption of an inflation targeting regime to the last month of 2009. The study employed a Structural VAR methodology at level and exploited Structural Variance Decomposition to rank the monetary transmission channels. The study used real loans, the bank lending rate, the real effective exchange rate and share prices as intermediate variables and these variables, representing the credit channel, the interest rate channel, the exchange rate channel and the asset price channel, respectively.

Our identification scheme generated sensible effects of monetary policy shock as the generated responses were in line with economic theory. The qualitative impact of monetary policy shock and other intermediate variables shocks on target variables – IPI and CPI – was conform to our expectations. The response of IPI in case of Chile and Korea to shock in policy variable was statistically significant. It indicated that our identification scheme was not grossly at odds with economics priors. The study used the interest rate as the policy instrument and deviated from the general convention of using monetary aggregates and interest rate simultaneously. It rather followed the new Keynesian literature. Furthermore, in our integrated framework, all transmission channels operated simultaneously while most studies focus on one channel in isolation.

We exploited the forecast error variance decomposition and concluded that the share price channel and the exchange rate channel are the most important. This was in line with economic intuition and relates, we believe, to the increasing financial globalization. One might argue that the high ranking of the exchange rate channel against the backdrop of general consensus of decreasing exchange rate pass-through is at odd. But there is also counter argument that if the share of intermediate goods in the import basket is higher, it may lead to an increase in the inflation. Moreover, when economies are becoming more and more interconnected; (i) due to

real openness, the exchange rate channel can assume a high ranking, (ii) due to financial openness, the share price channel can assume a high ranking and (iii) due to increasing financial globalization, the relationship between domestic saving and domestic investment might be weakening, thus reducing the relative importance of the traditional interest rate channel. Our results are very close to those of Gudmundsson (2007) who finds that the exchange rate channel might be overburdened in the wake of financial globalization.

At this juncture, it seems a theoretical puzzle that share price channel and exchange rate channel presume high relative importance than traditional interest rate and credit channel, it is our conjecture that now is the high time to dig further about open economy channels.

Chapter 3

Impact of Openness on Inflation

3.1 Introduction

To understand the dynamics of inflation has always been an interesting and gigantic task for researchers as well as policy makers. As the economies are becoming more and more open, inflation dynamics are becoming more and more complex. This phenomenon of globalization has initiated two strands of debate: one is about the changing role of external factors, like world interest rate, global slack, world output gap,[1] and the other is about imported inflation, availability of substitutes, disciplining effects in the determination of domestic inflation. In the context of increasing real and financial globalization, in the recent periods certain questions have arisen. For instance, what is the relationship between openness and inflation? Does the increasing globalization lead to an increase or a decrease in the exchange rate pass-through (ERPT)? Does the increasing level of globalization serve as pre-commitment (time-consistency) in monetary policy? These both phenomena — ERPT and pre-commitment — have larger impact on level of inflation.

The discussion about time-consistency dates back to Kydland and Prescott (1977). The authors demonstrate that the absence of pre-commitment in monetary policy can generate high inflation. Romer (1993) uses this theory to interpret the results of his study and concludes that there exist a strong and negative relationship between trade openness and inflation. This conclusion highlights the 'discipline effect' of openness on inflation as the depreciation of the domestic currency is more costly in open economies than in the closed one.

According to this line of argumentation mentioned in the above paragraph, trade openness imposes a discipline on otherwise discretionary policy making. The essence of the Romer's argument is that an unanticipated monetary expansion causes real depreciation in exchange rate and in more open economy the harms of the real depreciation are larger than the benefits.

[1] See Ihrig et al. (2007) for comprehensive literature review on this issue.

Thus more openness rules out the incentive for monetary authority to indulge in surprise inflation and consequently more open economies experience lower levels of inflation. Thus, the trade openness serves as a constraint on the central bank and the incentive for inflation bias disappears.

However, interestingly, the adoption of inflation targeting (IT) regime leaves less room for inflation bias. As a preannounced target of inflation rate is a necessary feature of inflation targeting regime, so the argument that openness serves as a constraint on central bank becomes less relevant for IT regime.

Besides the argument of time inconsistency, the literature identifies two additional arguments – imported inflation (i.e., the cost channel) and competition. The former channel works through the exchange rate pass-through (ERPT) and the latter depends upon the market structure of the economy. The argument of imported inflation and the argument of competition work in opposite direction. The former increases while the latter depresses the rate of inflation. This, among other things, makes understanding of inflation dynamics a more complex task in a globalized world. For example, increasing trade openness may lead to a decrease in ERPT due to increasing competition, or on the contrary can lead to an increase in ERPT due to increased share of intermediate imported goods in the CPI basket. The latter argument runs through internationalized production as discussed by Eyquem and Kamber (2012, forthcoming Macroeconomic Dynamics).

In addition to real openness, the other factor augmenting the complexity of inflation dynamics is the financial globalization. In this vein, Obstfeld (1998) highlights the role of international capital markets as a disciplining factor, thus leaving less incentive for excessive government borrowing. Similarly, Tytell and Wei (2004), and Spiegel (2008) highlight that financial globalization has "disciplining effect".[2] Spiegel further says that, due to this effect, monetary authorities place more weight on inflation stabilization. Against this backdrop, *the motivation of the study* comes from the (i) conflicting theories – cost channel and competition arguments, (ii) "disciplining effect" when the sample countries are already under inflation targeting regime which serves as a "constrained discretion". The *purpose of this chapter* is to investigate empirically the relationship between inflation and trade openness and/or financial openness.

[2] "Disciplining effect" induces governments to pursue better macroeconomic policies. Kose et al. (2006) say that macroeconomic discipline is a potential collateral benefit of financial globalization.

The remainder of the chapter is structured as follows: Section 2 provides brief overview of the literature. In Section 3 we present model. In section 4 we present the data and methodology. Section 5 reports the empirical results and explanations. The final section concludes.

3.2 Literature Review

Among the determinants of inflation, globalization (real and financial) can be considered through ERPT, cost channel and disciplining effects. We divide the literature into two strands: one that deals with the exchange rate pass-through and the other that focuses on time inconsistency (disciplining effect) theory.

Takhtamanova (2010) identifies major determinants of ERPT as (i) the presence of foreign firms, (ii) the proportion of imported goods in the CPI basket, (iii) the credibility of the monetary authority and (iv) the fraction of flexible-price firms in the economy. The study is about 14 OECD countries and concludes that ERPT has declined. The result hinges on the hypothesis that firms have less monopoly power in the 1990s decade. The sample ranges from 1980 to 2007and the data is quarterly.

Zorzi et al. (2007) estimate the degree of ERPT in 12 emerging market economies. The study uses quarterly data and uses short term interest rate instead of M2. The study uses Standard VAR (Recursive VAR), thus employs Cholesky decomposition to identify the shocks. Furthermore, VAR is in first difference, the base line model is with the following ordering: oil price index, output, exchange rate, import price index, CPI Inflation and short-term interest rate or change in interest rate depending upon the stationarity of the variable. In the alternative model interest rate is ordered in the second place, the Alternative 2 model is ordered as: nominal effective exchange rate, import price index, output, producer price index, consumer price index and short term interest rate. The oil price was nominal oil price in US dollar, and ER was NEER. The study finds weak empirical support for the presence of positive link between import openness and ERPT.

Baqueiro et al. (2003) test the Taylor (2000) hypothesis that low and stable inflation leads to lower ERPT. This phenomenon makes a dent in the thesis of "fear of floating". Authors divide the sample into two subsamples corresponding to lower and higher inflation period and then estimate an ERPT coefficient for each sub-sample separately. Then the study uses the

results from the pass-through estimation: ERPT coefficient as dependent variable and average inflation, ER volatility, trade balance, CPI-PPI spread as explanatory variables. The study concludes that Taylor (2000) hypothesis holds.

Mwase (2006) estimates the degree ERPT for Tanzania using a SVAR methodology. The study uses quarterly observations from 1990 to 2005 and concludes that there has been a decline in ERPT for this country. But the paper is silent about openness and attributes the process of ERPT to structural reforms, like, privatization, liberalization and macroeconomic stabilization.

Choudhri and Hakura (2001) use Weighted Least Square Methodology for 71 countries to test the hypothesis of Taylor (2000) and find strong evidence in support of the thesis, that is, positive and significant association between ERPT and average inflation. Furthermore, the study also concludes that the inflation rate dominates other macroeconomic variables in explaining cross-regime differences in the pass-through (cross-regime differences mean high and low inflation regime).

Nogueira and Léon-Ledesma (2009) analyze whether the adoption of IT in Brazil has led to an actual shift in the country's approach to the exchange rate (ER), and present empirical evidence regarding ERPT and fear of floating. The authors are of the view that the intervention in the forex market should not be seen as fear of floating but as means to reach inflation targets. The study uses monthly data from 1995M1 to 2007M12 and comes up with three conclusions: (i) ERPT decreased after adoption of IT, (ii) ER variability has increased after the adoption of the IT regime and the central bank kept on reacting to ER changes (iii) the reaction of the central bank to exchange rate shocks shifted almost completely from the use of International Reserves to using the interest rate as an instrument of monetary policy.

McCarthy (1999) examines the impact of external factors – exchange rate and import prices – on the domestic PPI and CPI in 9 industrialized countries. The study concludes that ERPT is stronger in countries with large import shares. The study uses VAR models in first difference. The ordering of the variable is the following: supply shock (oil price inflation denominated in local currency), demand shock (identified through output gap), ER (identifies external shock), import price index, PPI, CPI, (the order of imports, PPI and CPI is because of distribution chain of pricing).

Gagnon and Ihrig (2004) develop a theoretical model and emphasize that a change in the ERPT is due to increased focus on inflation stabilization by the central banks. The sample includes 20 industrialized countries and ranges from 1971 to 2003.

Campa and Goldberg (2002) dwell upon Producer Currency Pricing and Local Currency Pricing theories and whether ERPT rates are endogenous to country's macroeconomic conditions. The sample consists of 25 OECD countries. In manufacturing industries, the study finds a compelling evidence of partial pass-through in the short-run – rejecting both PCP and LCP. Higher inflation and exchange rate volatility are weakly associated with higher pass-through into import prices. The study finds that microeconomic factor like the composition of country's import bundle the most important. The methodology used is OLS in log difference. The study is at sectoral level.

Goldfajn and Werlang (2000) examine the relationship between exchange rate depreciation and inflation using a sample of 71 countries from 1980 to 1998. The study finds the Real Exchange Rate misalignment is the most important determinant of inflation for emerging market economies, while the initial inflation level is the main factor for developed countries. Other significant determinants include the degree of openness and the cyclical component of output. The real exchange rate misalignments have been calculated through H-P filter. Moreover, the study also uses ERPT as dependent variable and regress other determinants of pass-through on it. The main conclusion is that the ERPT is substantially lower for OECD than for EMEs.

Belaisch (2003) uses VAR model with the following ordering of variables: oil prices, industrial production, exchange rate and Price Index. The study concludes that the significant trend depreciation in Brazil in 2001-02 did not translate into a large increase in inflation. Similarly, Muinhos (2001) conducts a study for Brazil and shows smaller exchange rate pass-through using the same specification as by Goldfajn and Werlang (2000) in their panel study for 71 countries.

Garcia and Restrepo (2001) use quarterly data of Chile from 1986 to the first quarter of 2001 and conclude ERPT is pro-cyclical. Alvarez et al. (2008) estimate the ERPT in Chile using disaggregated import price data at a monthly frequency. The sample ranges from 1996 to 2007. The study uses rich data from the central bank of Chile for consumer goods, intermediate goods and capital goods. The authors distinguish this study from the earlier by

the use of monthly instead of quarterly data, and the use of the import prices at two different levels for market chain and goods-specific differences in ERPT. For the import prices and the wholesale level, the study concludes that ERPT has not declined for both pricing levels (i.e., import prices and whole sale prices). Furthermore, the study also finds weak evidence of asymmetric pass-through from appreciation vs depreciation. It seems that the hypothesis of Taylor (2000) does not apply to Chile, as Chile has been quite successful in keeping inflation at low level.

Correa and Minella (2006) conduct a study for Brazil. The authors estimate Phillips Curve (PC) specification with a threshold. The objective of the paper is to investigate the presence of a nonlinear mechanism of ERPT, whether the short-run magnitude of ERPT is affected by business cycle, the direction and magnitude of exchange rate changes and exchange rate volatility. The threshold is there to capture the non-linearity in the Phillips Curve. The authors use Threshold Model with endogenous variable. The estimation techniques used are 2SLS and GMM, and the study uses quarterly data from 1995 to 2005. The study uses business cycle, exchange rate changes, and exchange rate volatility as the possible sources of nonlinearity of the exchange rate pass-through. The estimation indicates possibility of nonlinear effect. How does the study incorporate the change in policy regime (as Brazil adopts IT in 1999) is an unanswered question in the study.

Ghosh and Rajan (2009) examine the extent and evolution of ERPT into Korea and Thailand's CPI and import prices. The study uses quarterly data from 1980 to 2006 and concludes that ERPT is higher in Thailand relative to Korea. The authors use Dynamic OLS and Recursive OLS. Furthermore, to check the impact of macro variables on ERPT, the authors use inflation rate, ER volatility, trade openness and crisis dummy.

Kohlscheen (2010) uses bivariate VAR – inflation and nominal effective exchange rate – and then they include output data – output, inflation and nominal effective exchange rate – to check the robustness. The paper estimates VAR model in log difference and uses monthly data with 12 lags. To check the causal direction of inflation and exchange rate, the study uses Granger Causality tests. Afterward, the study checks the potential determinants of exchange rate pass-through like, average level of inflation, inflation volatility and nominal effective exchange rate volatility. The study concludes: (i) Causality runs from nominal exchange rate variations to inflation in most of the countries. (ii) ERPT coefficient is related to the volatility of exchange rates. The study is about 8 emerging countries.

Eyquem and Kamber (2012) highlight that internationalized production channel or the cost channel can modify the dynamics of inflation. The study concludes that the exchange rate effects inflation through this additional channel in an open economy.

Benigno and Faia (2010) show that globalization modifies the slope and position of NK aggregate-supply equation, as well as the degree of exchange rate pass-through. The study extends Dornbusch (1987) model. It is based on manufacturing sectors in the US, and uses calibration methods for the extension of the Dornbusch and a SUR model for the exchange rate pass-through. There is evidence of an increase in the degree of ERPT in most of the sectors considered. The study used quarterly data from 1993 to 2008.

Now we turn to the second strand of literature that focuses on policy commitment while delineating the relationship between inflation and openness.

Romer (1993) concludes that openness leads to lower inflation. The line of argument is that cost of real depreciation in more open economies is greater than the benefits that come with unanticipated monetary expansion. Thus, more open is the economy, lesser is the incentive to indulge in inflationary bias.

However, Terra (1998) divides Romer's sample into four groups of countries and found negative relationship between inflation and openness only in severely indebted countries. Romer (1998) replies to Terra, among other things, that indebtedness may just represent a lack of commitment in monetary policy.

Romer's argument runs through the international relative prices. Lane (1997) criticize this argument on the ground that it applies only to countries large enough to affect the structure of international prices. Lane put forward his explanation that the welfare effect of a monetary surprise to openness does not rely only on terms of trade effect of large country rather it is due to imperfect competition and nominal rigidities in the non-traded sector.

The story of Romer (1993) is that the Phillips Curve is steeper in more open economies (trade openness). Interestingly, Razin and Yuen (2002) in their theoretical model conclude that the Phillips Curve becomes flatter as the economy becomes more open. Moreover, Loungani et al. (2000) empirically found that countries with greater controls on capital mobility tend to have steeper Phillips Curve. We have reviewed the literature that highlights the factors that

affect the relationship between inflation and openness. To summarize, we put the main factors, influencing relationship between inflation and openness into one table (Table 3.1).

Against this backdrop, where there exists conflicting arguments regarding the role of ERPT and openness in the determination of inflation, *the objective of this chapter* is to investigate the relationship between openness and inflation. This chapter *contributes to the existing literature in the following ways*: (i) analyzes the role of the financial openness, in addition o the more explored role of trade openness. (ii) The sample period includes only the inflation targeting regime thus better measuring the time consistency argument, as inflation targeting regime imposes constraints on the central bank. (iii) Openness variables are tested together with different measures of exchange rates, and also with exchange rate volatility. It will give us more confidence to conclude about the role of openness in the determination of inflation.

Table 3.1: Factors affecting the relationship between inflation and openness

Trade Openness
• Intermediate goods channel or cost channel (Eyquem and Kamber, 2010). • Imported final goods, more substitutes. • Greater availability of cheaper goods or the so-called direct effect (Wynne and Kersting, 2007). • More foreign firms, (more competition, more technical know-how). • Time-consistency argument (Prescott and Kydland, 1977, Romer, 1993). • Exchange rate pass-through, conflicting arguments, an increase due to intermediate goods, and decline due to competition. • Market structure, pricing policies (LCP, PCP), share of non-tradeables and ER policy • Inflationary environment (Taylor, 2001). • Disciplining effect, real depreciation is costly in more open economy (Romer, 1993)
Financial Openness
• Financial globalization imposes 'disciplining effect' (Kose et al. 2006) • Composition of capital inflows, i.e., portfolio investment or FDI. • Short term capital inflows may undermine central bank's effort to control inflation. • More open capital account, higher the penalty for loose monetary policy. • FDI brings competition, new technology, competition in retail. • ER volatility, the impact on inflation is ambiguous depending on the exporters strategy, i.e., they stabilize export volume or marginal profit. (Froot and Klemerer, 1989) • ERPT is positively related to ER volatility (Devereux and Engel, 2001) • Freer access to substitute currencies raises interest elasticity of money demand thereby reducing the seigniorage maximizing level of inflation (Gruben and McCleod, 2001).

3.3 The Model

The underlying model is a simple Philips Curve equation. It is not structural but it captures the essence of the relationship between openness and level of inflation, so it reasonably tracks the developments in the inflation. Our control variables include lag of inflation and output growth. Both these variables are much in use while estimating the Phillips curve. The lagged inflation captures the persistence of inflation while the latter measure the effects of economic activity – measured here by output growth – on the dynamics of the inflation. We include a second group of variables that we call "conditioning variables". These include exchange rate and exchange rate volatility. We use different measures of exchange rate, for instance, bilateral exchange rate, nominal effective exchange rate, real effective exchange rate and real exchange rate misalignment. Then a third group of variable, we call it a "variable of interest" is considered. Our variable of interest is openness – trade openness and financial openness measured with different indicators. The details about the variables we will discuss in data and methodology section.

The empirical model can be summarized as follows:

$$\pi = \alpha_0 + \beta_1 \pi_{t-i} + \beta_2 y_t + \beta_3 ER_t + \beta_4 Open_t + \varepsilon_i$$

Where π_t is the CPI inflation, y_t is the output growth, ER_t denotes exchange rate and either the bilateral exchange rate, the NEER, the REER or the RER misalignments. The variable $openness$ represents measure of openness, either trade or financial openness. Finally, ε_i is a cost push shock, for example, an adverse supply shock of oil.

The potential additional variables that should be included in the Phillips Curve when tracking the dynamics of inflation in an open economy comprise a long list. For example, Frankel et al. (2012) estimate the exchange rate pass-through into import prices (import price index as dependent variable) and include per capita income, bilateral distance, tariff, country size, and wages. We think that income per capita is captured by growth in income, and so does the pressure of wages, assuming that a high growth will put pressure on the wage level prevailing in the economy. Similarly, openness more or less includes bilateral distance and tariff. So for the sake of parsimony, we keep the model simple and theoretically tight. Terra (1998) divides the sample countries into groups according to the level of indebtedness to highlight the importance of debt burden in determining the role of openness to track inflation rate. As we

are using time series and run separate regression for each country, we need not incorporate the level of indebtedness. The use of budget deficit as an explanatory variable in the determination of inflation has also been used extensively in the literature, for example Metin (1998). As our sample countries are in the inflation targeting regime, it is safe to assume that budget deficit is not as conspicuous as it is in non-inflation targeting regime. Furthermore, Tytell and Wei (2004) use central bank independence as a control variable in the determination of inflation. Again our assumption that central banks in inflation targeting regimes, generally speaking, implies that central banks are more independent than non-inflation targeting regimes. Besides these variables, Borio and Filardo (2007) introduce global slack into the Phillips curve.[3]

As the purpose of this chapter is to investigate the impact of openness on inflation so instead of adding each variable that has been used in the literature, we keep the model simple and focus on our variable of interest, believing that economic activity, proxied by output growth, and lagged inflation capture the dynamics of inflation well and give us reliable results about the role of openness in the determination of inflation although the list in the literature is long.

3.4 Data and Methodology

One potential technique to estimate the effects of globalization on inflation could be Ordinary Least Square (OLS) as it has been used in many papers. However, due the endogeneity problem it seems less suited. As it can be safely argued that the low inflationary environment and other structural reforms open the door of an economy for globalization or the other way round. Due to the inherent problem of endogeneity, this study uses Generalized Method of Moments (GMM). One issue in GMM method is the choice of instruments. There is no hard and fast rule for the selection of instruments. However, lagged values have been used extensively in the literature. An instrument should be orthogonal to error terms but related to the dependent variables. Moreover, to check the validity of instruments we use the J- statistics (Hansen Test).

We use monthly data from the beginning of the inflation targeting regime to the last month of 2009. The considered countries are Brazil, Chile and Korea. Data are taken in natural logarithm growth rates. The variables used in the study are as follows; inflation, output growth, bilateral exchange rate, nominal effective exchange rate, real effective exchange rate,

[3] For interesting debate on this issue see Ihrig et al. (2007)

and real exchange rate misalignment. To measure the openness, we use the following variables: imports to GDP ratio (Topen), foreign assets plus foreign liabilities to GDP ratio, and capital account liberalization index (Keopen).[4] To measure the real openness we use imports to GDP ratio, whereas for financial openness we use two proxies. Our first proxy Keopen index is a *de jure* whereas the second FG, data compiled by Lane and Millessi-Ferretti is a *de facto*. Chin and Ito index focuses the regulatory aspects of capital account openness. Do these measure show similar directions (trends), to check this we have added a table in Appendix C (see Table C 1).

The Augmented Dickey Fuller and KPSS have been used to check the stationarity, for results of stationarity tests we refer the reader to the Appendix C. (see Table C 4)

3.5 Estimation and Results

The overall results can be summarized as follows. In the case of Korea, trade openness has positive and significant relationship with inflation. The same relationship holds for the Chile where the relationship has always emerged as positive and statistically significant (except once when it was positive but remained statistically insignificant). However, in the case of Brazil the results are less clear-cut. In the case of Capital Account Liberalization (Keopen), Korea has positive and statistically significant relationship with inflation. On the contrary, it has negative and statistically significant relationship with inflation in Chile. Here again, for Brazil the empirical evidences are mixed. The other variable of financial openness is FG. For all countries, the relationship between financial globalization and level of inflation is mostly negative and statistically significant. These results contradict the earlier mentioned results with respect to Keopen, in case of Korea, highlighting that the results are sensitive to measurement, which is not unusual.

In Table 3.2 we present the results for Brazil with respect to trade openness. The coefficient of variable of interest (Topen) changes depending on specifications, being sometimes positive and sometimes negative. However, exchange rate volatility and all measures of exchange rates – bilateral, NEER, REER and REER misalignment – have positive sign and statistically

[4] This is Chinn and Ito (2006) index. It is based on the restrictions on the external account for the four major categories. These are (i) presence of multiple exchange rate, (ii) restrictions on the current account, (iii) restrictions on capital account transactions and (iv) requirement of surrendering export receipts. For the detail of construction see Chinn and Ito (2007) "A new measure of financial openness".

Table 3.2 Dependent variable Inflation, Country Brazil

	Eq.1	Eq.2	Eq.3	Eq.4	Eq.5
Constant	-2.83 (1.42)	-0.98 (1.60)	-0.08 (2.13)	10.69 (3.86)	0.30 (2.48)
Inflation(-6)	0.79 (0.05)	0.77 (0.10)	0.86 (0.11)	0.28 (0.10)	0.81 (0.13)
Output	0.06 (0.01)	0.12 (0.03)	0.13 (0.03)	0.15 (0.04)	0.12 (0.03)
ERVol	2.99 (1.40)	3.42 (1.58)	3.21 (1.42)	5.96 (2.14)	4.10 (2.15)
Topen	0.30 (0.10)	0.15 (0.11)*	0.04 (0.17)*	-0.60 (0.31)	0.04 (0.19)*
ER	-	0.02 (0.01)	-	-	-
NEER	-	-	0.03 (0.01)	-	-
REER	-	-	-	0.44 (0.15)	-
REERMis	-	-	-	-	0.08 (0.04)
J-stat (Prob)	7.85 (0.64)	8.48 (0.66)	9.59 (0.56)	8.63 (0.95)	6.47 (0.77)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

Table 3.3 Dependent variable Inflation, Country Brazil

	Eq.6	Eq.7	Eq.8	Eq.9	Eq.10
Constant	3.79 (0.58)	2.37 (0.91)	3.60 (0.77)	3.71 (0.75)	3.91 (0.74)
Inflation(-6)	0.25 (0.09)	0.48 (0.16)	0.25 (0.13)	0.25 (0.13)	0.20 (0.12)
Output	0.03 (0.02)	0.16 (0.05)	0.08 (0.03)	0.06 (0.03)	0.05 (0.03)
ERVol	6.77 (1.09)	3.92 (2.34)	8.49 (2.20)	9.28 (2.09)	10.65 (3.13)
KeOpen	-1.40 (0.27)	0.38 (0.69)*	-0.44 (0.62)*	-0.69 (0.55)*	-1.20 (0.31)
ER	-	0.06 (0.02)	-	-	-
NEER	-	-	0.04 (0.02)	-	-
REER	-	-	-	0.30 (0.22)	-
REERMis	-	-	-	-	0.09 (0.04)
J-stat (Prob)	8.18 (0.96)	3.47 (0.83)	2.24 (0.68)	2.20 (0.69)	1.99 (0.26)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

Table 3.4 Dependent variable Inflation, Country Brazil

	Eq.11	Eq.12	Eq.13	Eq.14	Eq.15
Constant	5.37 (2.66)	12.76 (2.72)	-3.80 (3.05)	8.52 (2.84)	8.91 (2.56)
Inflation(-6)	0.36 (0.13)	0.12 (0.14)	1.13 (0.16)	0.28 (0.13)	0.22 (0.13)
Output	0.11 (0.08)	0.25 (0.10)	0.31 (0.09)	0.15 (0.07)	0.06 (0.06)
ERVol	13.08 (2.97)	11.08 (3.30)	4.63 (2.69)	11.75 (3.03)	10.49 (3.21)
FG	-0.03 (0.02)*	-0.10 (0.02)	0.02 (0.02)*	-0.05 (0.02)	-0.05 (0.02)
ER	-	0.04 (0.01)	-	-	-
NEER	-	-	0.06 (0.02)	-	-
REER	-	-	-	0.22 (0.14)	-
REERMis	-	-	-	-	0.09 (0.04)
J-stat (Prob)	8.10 (0.32)	8.67 (0.27)	10.30 (0.50)	8.53 (0.28)	8.55 (0.28)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

significant. These results – with respect to different exchange rate measures – provide a clue that the exchange rate link, the link via imported inflation, is strong enough, so the theoretical negative relationship between openness and inflation does not show up in the data for Brazil. This is not unexpected as the Brazil has had long association with fixed exchange rate regime.

Secondly, the argument that trade openness increases competition and as result inflation declines seems less strong than the imported inflation argument. In addition, there may also be the issue of credibility of the central bank. In the first chapter of this thesis, we have concluded that central bank of Brazil responds to exchange rate movements.

As the economy of Brazil is not very much open (12 percent imports to GDP ratio), the collateral benefits from openness might demand some threshold level and Brazil might have not crossed that threshold level yet. But this is another theoretical question that does there really exist a threshold level in this regard. Nonetheless, one possible reason could be the inertia in the behaviour of economic agents in Brazil. As inflation has been high historically, the firms do not find it hard to pass the price to the consumer thus despite an increase in openness: the negative relationship between openness and inflation does not realize. We would also like to invoke the argument of Taylor (2001) that a low inflationary environment leads to low ERPT. But if we reverse the argument, we can say that high inflationary environments prevent the ERPT decline with openness. It might thus be hard to reap the benefits of openness if economy has been under the of high inflation era.

Similarly, the results in Table 3.3 are far from conclusive, though in 2 out of 5 regressions the Keopen coefficient has negative sign and is statistically significant. It is worth mentioning that the Brazilian economy is not much open according to the Chinn and Ito Index, that we use here as proxy. In the case of financial globalization measured with total asset plus total liabilities as a percent of GDP, here denoted as FG, the results are more conclusive (see Table 3.4). The coefficient attached with FG turns out statistically significant 3 times out of 5 and also has negative sign. Does it mean that the argument of imported inflation is more at work than competition argument in case of Brazil? Apparently, it seems so. As for as the argument of the ‘disciplining effect’ is concerned which works through the time consistency curbing the discretion. It is an interesting debate: it did not turn the relationship between inflation and openness negative, but looking at the rate on inflation which mostly remained in the target band it seems that the argument is at work.

Overall, for Brazil, it can be concluded that for the sample period from 1999 to 2009 the negative relationship between inflation and openness is not as strong as it is generally pronounced in theory and empirical literature. It is rather positive for trade and negative for financial openness.

In the case of Chile, (Table 3.5) there is strong positive relationship between trade openness and inflation. It means that the imported inflation argument (intermediate goods argument) is stronger than the competition argument in Chile. We would like to highlight that seeing the positive relationship in the perspective of ERPT, our results are consistent with those of Alvarez et al. (2008) as they find high and complete ERPT in the long run.

Contrary to the trade openness (Topen) it is interesting to note that financial globalization, when measured with capital account liberalization (Keopen) has negative relationship with the

Table 3.5 Dependent variable Inflation, Country Chile

	Eq.1	Eq.2	Eq.3	Eq.4	Eq.5
Constant	-5.48 (1.37)	-4.87 (4.29)	-8.28 (3.09)	-5.02 (2.82)	-6.91 (2.30)
Inflation(-6)	0.86 (0.10)	0.77 (0.07)	0.72 (0.10)	0.86 (0.09)	0.81 (0.08)
Output	0.22 (0.06)	0.11 (0.05)	0.15 (0.07)	0.29 (0.05)	0.22 (0.05)
ERVol	-1.43 (6.08)	-9.04 (6.86)	-5.30 (6.48)	.0008 (0.004)	5.20 (4.76)
Topen	16.0 (0.03)	0.17 (0.13)*	0.28 (0.09)	0.14 (0.08)	0.22 (0.07)
ER	-	0.21 (0.07)	-	-	-
NEER	-	-	-0.03 (0.02)	-	-
REER	-	-	-	-0.02 (0.02)	-
REERMis	-	-	-	-	-0.07 (0.05)
J-stat (Prob)	7.33 (0.50)	6.43 (0.59)	12.6 (0.55)	11.86 (0.45)	10.0 (0.52)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

Table 3.6 Dependent variable Inflation, Country Chile

	Eq.6	Eq.7	Eq.8	Eq.9	Eq.10
Constant	0.89 (0.25)	0.66 (0.27)	0.28 (0.86)	-0.03 (.93)	-0.22 (0.82)
Inflation(-6)	0.68 (0.04)	0.74 (0.03)	0.47 (0.20)	0.51 (.13)	0.68 (0.06)
Output	0.14 (0.03)	0.11 (0.03)	0.21 (0.08)	0.16 (.09)	0.18 (0.07)
ERVol	-1.30 (6.93)	1.44 (5.38)	-0.001 (.001)	.002 (.001)	.001 (.009)
KeOpen	-0.27 (0.11)	-0.20 (0.11)	-0.97 (0.53)	-1.06 (0.54)	-0.64 (0.37)*
ER	-	0.44 (0.12)	-	-	-
NEER	-	-	-0.16 (0.17)	-	-
REER	-	-	-	-.29 (0.24)	-
REERMis	-	-	-	-	-0.15 (0.47)
J-stat (Prob)	9.35 (.31)	4.76 (0.68)	2.05 (.84)	1.18 (.94)	3.89 (0.56)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

Table 3.7 Dependent variable Inflation, Country Chile

	Eq.11	Eq.12	Eq.13	Eq.14	Eq.15
Constant	3.35 (0.84)	0.49 (1.51)	3.45 (1.60)	6.69 (1.53)	4.77 (1.41)
Inflation(-6)	0.68 (0.03)	0.80 (0.05)	0.80 (0.07)	0.65 (0.04)	0.66 (0.04)
Output	0.04 (0.02)	0.06 (0.03)	0.08 (0.04)	0.08 (0.04)	-.007 (0.03)
ERVol	-7.39 (8.52)	-.009 (0.01)	-0.01 (.007)	-0.01 (.008)	-.006 (0.01)
FG	-0.01 (.004)	.001 (.008)*	-0.02 (.008)	-0.03 (.008)	-0.02 (.008)
ER	-	0.50 (0.16)	-	-	-
NEER	-	-	0.09 (0.04)	-	-
REER	-	-	-	0.16 (0.05)	-
REERMis	-	-	-	-	0.07 (0.09)
J-stat (Prob)	7.45 (.82)	7.09 (0.71)	8.66 (0.46)	7.86 (0.64)	9.47 (0.57)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

inflation. But when financial liberalization is measured as FG the relationship between financial globalization and inflation is less conclusive. It tells us that this relationship also depends on how one measures the globalization. Summarizing the case of Chile, Topen has positive effect on inflation whereas Keopen has a negative. Like Keopen, FG also has negative and statistically significant relationship with inflation most of the times.

Next we present the results of Korea, (Tables from 3.8 to 3.10). Interestingly, for the Korean economy real openness has positive relationship with inflation, which also indicates a higher strength of intermediate goods argument than the competition argument. Jin (2006) uses quarterly data from 1960 to 1997 and finds, however, a negative relationship as generally predicted and much trumpeted in the theory. As our sample period does not overlap with the study of Jin, direct comparison of results is not possible. However, Wu and Lin (2008) find statistically insignificant relationship between inflation and openness in case of Korea.

We would like to highlight that relationship between openness and inflation may turn opposite over time. In this regard Bleaney (1999) produce very interesting results. His study finds that negative correlation between openness and inflation that was observed in cross-country data for 1973-1988 periods has disappeared from 1989 to 1998. The positive relationship noticed in our study demands micro level investigation of composition of imports.

As far as the relationship between inflation and financial globalization is concerned, it is positive and statistically significant when measured through Keopen. However, the relationship turns out to be negative when measured through financial globalization (FG).

Again, this highlights the fact that results are sensitive to definition of the variable that measures financial openness.

Table 3.8 Dependent variable Inflation, Country Korea

	Eq.1	Eq.2	Eq.3	Eq.4	Eq.5
Constant	-2.06 (1.15)	-0.81 (1.22)	-1.34 (1.05)	-1.41 (1.09)	-1.77 (1.18)
Inflation(-6)	0.82 (0.17)	0.55 (0.11)	0.77 (.11)	0.80 (.11)	0.84 (0.18)
Output	0.06 (0.02)	0.06 (0.02)	0.18 (.01)	0.08 (.01)	0.04 (0.02)
ERVol	-.006 (.001)	-6.77 (3.42)	-1.15 (.09)	-9.24 (9.56)	.0002 (.001)
Topen	0.05 (.02)	0.05 (0.02)	0.04 (.02)	0.04 (.02)	0.05 (0.02)
ER	-	0.09 (0.01)	-	-	-
NEER	-	-	0.04 (.01)	-	-
REER	-	-	-	0.04 (0.01)	-
REERMis	-	-	-	-	-.027 (0.02)
J-stat (Prob)	6.48 (0.88)	8.02 (0.43)	10.21 (.33)	9.18 (0.95)	6.60 (0.76)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

Table 3.9 Dependent variable Inflation, Country Korea

	Eq.6	Eq.7	Eq.8	Eq.9	Eq.10
Constant	1.81 (0.61)	2.07 (0.65)	2.27 (0.36)	0.92 (0.42)	2.07 (0.52)
Inflation(-6)	0.40 (0.16)	0.28 (0.17)	0.31 (0.08)	0.66 (0.09)	0.31 (0.14)
Output	0.05 (0.02)	0.08 (0.04)	0.03 (0.01)	0.07 (0.02)	0.06 (0.02)
ERVol	5.43 (6.07)	-.0009 (.002)	-.004 ((.001)	.028 (.009)	-.0002 (.001)
KeOpen	3.24 (0.57)	3.10 (0.68)	1.85 (0.32)	1.55 (0.33)	3.48 (0.54)
ER	-	0.07 (0.02)	-	-	-
NEER	-	-	0.09 (0.01)	-	-
REER	-	-	-	0.07 (0.01)	-
REERMis	-	-	-	-	0.05 (0.02)
J-stat (Prob)	5.61 (0.77)	7.48 (.48)	9.24 (0.95)	7.62 (0.61)	5.40 (0.86)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

Table 3.10 Dependent variable Inflation, Country Korea

	Eq.11	Eq.12	Eq.13	Eq.14	Eq.15
Constant	4.74 (1.03)	3.70 (1.02)	3.93 (1.05)	0.89 (0.72)	5.78 (0.93)
Inflation(-6)	0.42 (0.17)	0.35 (0.14)	0.37 (0.14)	0.56 (0.12)	0.23 (0.12)
Output	-0.08 (0.03)	-0.03 (0.03)	-0.03 (0.03)	.009 (0.02)	-0.09 (0.01)
ERVol	-.000 (.000)	.0001 (.004)	.0004 (.005)	2.40 (3.64)	-0.01 (.008)
FG	-0.02 (.006)	-0.01 (.006)	-0.01 (.006)	.003 (.003)*	-0.02 (.007)
ER	-	0.06 (.012)	-	-	-
NEER	-	-	0.07 (0.01)	-	-
REER	-	-	-	0.06 (0.01)	-
REERMis	-	-	-	-	0.11 (0.02)
J-stat (Prob)	8.92 (0.70)	7.98 (.53)	8.10 (0.52)	11.15 (0.88)	8.09 (0.83)

For the detail of instruments list see appendix. Standard errors are in parenthesis. * denotes coefficient of variable of interest is insignificant at 10 percent.

3.6 Conclusion

In this chapter we investigate the impact of openness on the dynamics of inflation. Since the paper of Romer (1993), the debate about the relationship between inflation and openness has been active in the literature. Different studies have reached different conclusions. Most of the studies are cross-sectional or panel data studies. We explore this question in the time series context. We use GMM method to estimate the relationship as it deals with endogeneity. Our study also focuses only the sample period that is characterized by inflation targeting regime. We thus keep our sample free from any regime change. This feature allows us to disentangle the effects of openness on inflation with higher certainty, we believe. The study uses the following variables; output growth, CPI inflation, bilateral exchange rate, nominal effective exchange rate, real effective exchange rate, real exchange rate misalignment, exchange rate volatility, imports to GDP ratio, Keopen index, and financial globalization.

We get mixed results. There is no clear-cut conclusion that the relationship between inflation and openness is positive or negative. To a certain extent our results support Temple's (2002) conclusion that the correlation between openness and inflation is something like a puzzle.

In case of trade openness, our study concludes that there exists a positive relationship between openness and inflation. These evidences are quite strong in case of Korea and Chile. On the contrary, for the Brazil these results do not hold for all the estimations. Nevertheless, it can be safely concluded that there does not exist negative relationship between inflation and openness. In a theoretical study using OLG model Evans (2007) also find positive relationship between openness and inflation. It seems that the argument of imported inflation is stronger than the argument of higher competition due to globalization. The argument of Campa and Goldberg (2000) also holds true: if imported goods are energy and raw material then ERPT may not decline. However, it demands a thorough study of the composition of import bundles of these sample countries.

Similarly, for the Keopen Index, the results are robust for Korea, and a strong positive relationship emerges. This indicates that increasing the *de jure* capital account liberalization increases the inflation. Contrary to Korea, Chile exhibits a negative relationship. This highlights the typical phenomenon that one policy that is good for one country is not necessarily good for the other countries too. So the results are country specific. In the case of Brazil, the relationship is murky as either we have negative and statistically significant

relationship or relationship is statistically insignificant. On the whole, we can say that relationship between financial globalization and inflation, when proxied by Keopen index is inconclusive. But it is conclusive for Korea and Chile when we treat these countries separately.

When we measure the financial globalization *de facto* using the dataset of Lane and Mellisi-Ferretti, the relationship between FG and inflation turns out to be negative in the case of Korea, quite contrary to the results attained for Korea through Keopen index. For Chile the *de facto* measure (FG) has negative and statistically significant relationship with inflation most of the times, and similarly, for Brazil mostly it is negative and statistically significant.

The policy implications of this chapter are that one policy that is good for one country does not always fit the other. Secondly, we tend to say that Cross-Sectional and Panel studies usually hide many results therefore, time series studies are necessary to check the impact of a particular policy on a certain variable. Thirdly, we tend to say that one should be careful while taking the results of Romer (1993) and many other studies to formulate a theory that openness leads to decrease in inflation. Rather our study comforts the results of Temple (2002) showing that correlation between openness and inflation is something of a puzzle, and those of Bleaney (1999) showing that the relationship between openness and inflation is time variant. The relationship between openness and inflation is thus a contentious, and it needs further exploration with country-specific and micro level data of imports.

Conclusion

In this thesis, we analyzed the impact of globalization on the dynamics of inflation and monetary policy. We have divided this main question into three more precise questions. Focusing on emerging market economies with an inflation targeting regime, the thesis provides an extensive literature review about each of the three questions. The questions addressed were:

(i) Do inflation targeting central banks respond to the exchange rate movements?
(ii) What is the relative importance of different monetary transmission channels?
(iii) What is the impact of globalization on the dynamics of inflation?

We answered these questions using Multi-equation GMM method, a Structural VAR model and a single equation GMM technique, respectively.

Main Results and Policy Implications

The first chapter used small open economy new-Keynesian model à la Gali and Monacelli (2005). The discussion focused on the role of exchange rate in inflation targeting regime. The sample countries included: Brazil, Chile, Mexico, Korea, Thailand and Czech Republic. The main results were: despite the theoretical underpinnings of IT regimes according to which exchange rate should be neglected, the data shows that central banks of Brazil, Chile, Mexico and Thailand respond to exchange rate movements. The fear of floating and the concern about financial stability compel the central banks to take exchange rate movements into account. On the policy side, the challenge is to design an effective communication strategy that prevents exchange rate to become a nominal anchor as shown by Mishkin and Schimdt-Hebbel (2001). Moreover, we also think that there is a need to incorporate financial stability concerns in the inflation targeting framework. On the intellectual front, the study points to the necessity to formulate a theory that assigns due weight to exchange rate in inflation targeting.

The second chapter estimated the relative importance of main monetary transmission channels: the interest rate channel, the credit channel, the exchange rate channel and the share price channel. We used Structural VAR (SVAR) model in this chapter. The sample countries were Brazil, Chile and Korea. The main results were: the share price and the exchange rate channels are the most important in explaining the fluctuations in Industrial Production and CPI Inflation at a monthly frequency. The policy implications of this result were that there is

need to give more considerations to exchange rate and asset price channels while formulating monetary policy. But at the same time a caution is needed, as share prices also react to "news" and not always reflect actual changes in the fundamentals of the economy. The "irrational exuberance" of investors should not lead the policy-makers to make too frequent swings in the policy rate.

The third chapter estimated the relationship between inflation and openness — trade openness and financial openness. We used a single equation GMM methodology and sample countries were Brazil, Chile and Korea. Our results supported the conclusion of Temple's (2000) that the relationship between inflation and openness is something like a puzzle. However, in the case of trade openness our study concluded that there exists a positive relationship between openness and inflation. These evidences were quite strong in the case of Korea and Chile. On the contrary, for Brazil the results did not hold for all the estimations. Overall, it could be safely concluded that there does not exist a negative relationship between inflation and trade openness. In case of financial globalization, where we used Keopen and FG as proxy, the results were less conclusive.

The conclusions drawn from the three chapters carry important implications for the central banks of inflation targeting emerging economies. It seems that the external factors are gaining more importance in the determination of the dynamics of inflation and economic activity, and that their impact is very complex. The thesis thus calls for a renewed attention paid to these factors in the conduct of monetary policy in IT emerging economies.

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Appendix A

Appendix-Chapter 1

Table A 1: Mandate of Central Banks

Brazil	To endure the stability of currency's purchasing power and a solid and efficient financial system.
Chile	The issuance of bank notes and coins, the regulation of the amount of money in circulation and credit, the regulation of financial system and capital market, faculties to preserve financial system stability.
Mexico	Main function is to provide currency to the domestic economy. Ensure stability of currency's purchasing power. Its other functions are to promote both the sound development of the financial system and the optimal functioning of the payment system.
Korea	The Bank of Korea monitors the financial system and evaluates it stability….. The bank also contributes to maintain financial stability by identifying and providing potential risk factors in the financial sector to prevent them from causing financial system unrest.
Thailand	[Along with the monetary policy] Bank of Thailand supervises, examines and analyzes the financial status and performance, and risk management system of the financial institutions in order to promote financial institutions stability.
Czech Republic	With its primary objective CNB sets monetary policy …… It also performs supervision of the banking sector, capital market……..as well as foreign exchange supervision.

Source: Website of respective Central Bank

Table A 2: Stationarity Test

	Brazil		Chile		Mexico	
	ADF	KPSS	ADF	KPSS	ADF	KPSS
Output gap	-3.90	0.05	-3.36	0.13	-3.05**	0.13
Real interest rate	-10.01	0.14	-8.28@	0.13	-4.51@	0.42
Exchange rate	-3.92*	0.37	-3.40	0.24	-6.18@	0.05
Inflation	-3.73*	0.18	-3.80	0.34	-4.88	0.35
Nominal interest rate	-3.80@	0.31	-2.92	0.06@	-3.86@	0.40
Inflation deviation	-5.70	0.30	-5.49*	0.14	-2.52**	0.28
Real exchange rate	-2.13**	0.43	-2.30**	0.17	-2.32**	0.29

For KPSS I use Bartlett Kernal and Andrews Bandwidth. For ADF I use Schwartz Information criterion. All the results have been reported at conventional 5% significant level.
*stationary with trend and intercept. **stationary without trend and intercept. @ stationary at first difference.

Table A 3: Stationarity Test

	Korea		Thailand		Czech Republic	
	ADF	KPSS	ADF	KPSS	ADF	KPSS
Output gap	-3.51	0.06	-2.66**	0.27	-4.11@	0.40
Real interest rate	-3.47	0.13	-3.50	0.22	-2.25**	0.38
Exchange rate	-3.95	0.14	-2.43**	0.37	-4.05	0.21
Inflation	-6.70	0.14	-3.29	0.07	-6.92@	0.29
Nominal interest rate	-3.08	0.44	-3.81@	0.27	-6.94	0.38
Inflation deviation	-4.85	0.13	-5.49	0.31	-4.23	0.24
Real exchange rate	-4.25	0.13**	-5.81	0.37	-5.66	0.07

For KPSS I use Bartlett Kernal and Andrews Bandwidth. For ADF I use Schwartz Information criterion. All the results have been reported at conventional 5% significant level.
*stationary with trend and intercept. **stationary without trend and intercept. @ stationary at first difference.

Table A 4: Data Description and Sources

Brazil			
Variable	Description	Source	Code
y	Output gap calculated from GDP volume (2005=100)	IFS	22399BVPZF
i	Money market rate	IFS	22360B..ZF
π	National CPI, (2005=100) period average	IFS	22364…ZF
π_h	GDP Deflator (2005=100)	IFS	22399BIPZF
q	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
π^*	Inflation target set by central bank	Central Bank	-
e	Nominal exchange rate, Reais per US $	IFS	223..AEZF
Chile			
Variable	Description	Source	Code
y	Output gap calculated from GDP volume (2005=100)	IFS	22899BVPZF
i	Discount rate	IFS	22860..ZF
π	CPI, (2005=100) period average	IFS	22864A…ZF
π_h	GDP Deflator (2005=100)	IFS	22899BIPZF
q	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
π^*	Inflation target set by central bank	Central Bank	-
e	Nominal exchange rate, Pesos per US $	IFS	228..AE.ZF
Mexico			
Variable	Description	Source	Code
y	Output gap calculated from GDP volume (2005=100)	IFS	27399BVRZF
i	Money market rate	IFS	27360B..ZF
π	CPI, (2005=100) period average	IFS	27364..ZF
π_h	GDP Deflator (2005=100)	IFS	27399BIRZF
q	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
π^*	Inflation target set by central bank	Central Bank	-
e	Nominal exchange rate, Pesos per US $	IFS	273..WE.ZF
Korea			
Variable	Description	Source	Code
y	Output gap calculated from GDP volume (2005=100)	IFS	54299BVPZF
i	Money market rate	IFS	54260B..ZF
π	CPI, (2005=100) period average	IFS	54264..ZF
π_h	GDP Deflator (2005=100)	IFS	54299BIPZF
q	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
π^*	Inflation target set by central bank	Central Bank	-
e	Nominal exchange rate, Won per US $	IFS	542..AE.ZF
Thailand			
Variable	Description	Source	Code
y	Output gap calculated from GDP volume (2005=100)	IFS	57899BVPZF
i	Money market rate	IFS	57860B..ZF
π	CPI, (2005=100) period average	IFS	57864..ZF
π_h	GDP Deflator (2005=100)	IFS	57899BIPZF
q	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
π^*	Inflation target set by central bank	Central Bank	-
e	Nominal exchange rate, Baht per US $	IFS	578..AE.ZF
Czech Republic			
Variable	Description	Source	Code
y	Output gap calculated from GDP volume (2005=100)	IFS	93599BVPZF
i	Money market rate	IFS	93560B..ZF
π	CPI, (2005=100) period average	IFS	93564..ZF
π_h	GDP Deflator (2005=100)	IFS	93599BIPZF
q	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
π^*	Inflation target set by central bank	Central Bank	-
e	Nominal exchange rate, Koruny per US $	IFS	935..AE.ZF

Table A 5: Key facts of sample economies

	Years started Inflation Targeting	Targeted Inflation Concept	Policy/Official Interest Rate
Brazil	1999	CPI	SELIC O/N
Chile	1991	CPI	O/N Discount rate
Mexico	1999	CPI	91 days Cetes
Korea	1998	Core CPI	O/N Call
Thailand	2000	Core CPI	14-day Repo
Czech Republic	1998	CPI	2-Week Repo

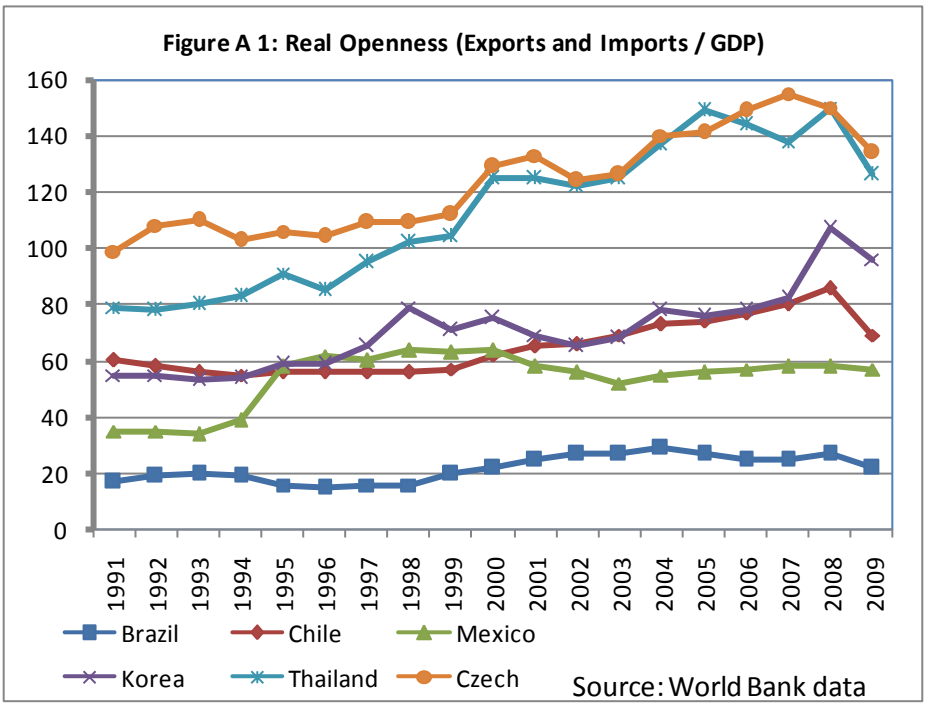
Source: Mishkin and Schimidt-hebbel (2001); Ho and McCualey (2003)

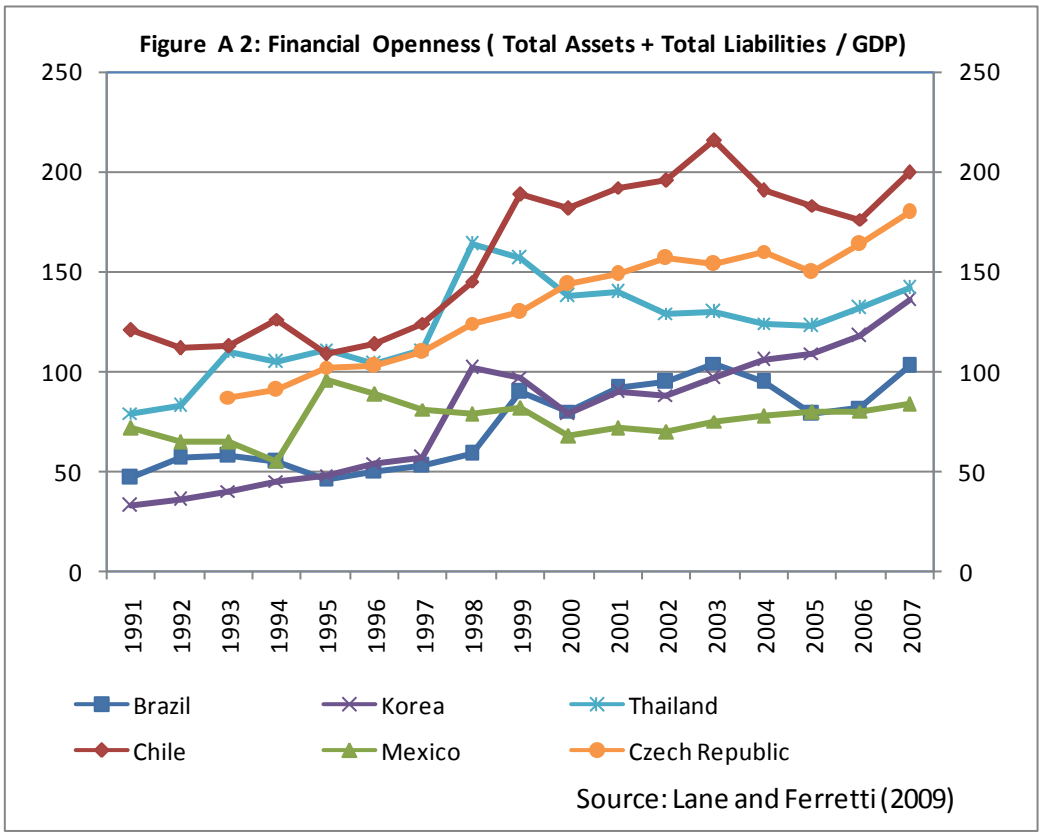
Table A 6:

Descriptive Statistics of Key Variables

Percent

Variable	Brazil	Chile	Mexico	Korea	Thailand	Czech Republic
Inflation	6.79	6.95	6.34	3.29	2.76	3.42
	(2.30 - 16.85)	(.005 - 24.08)	(3.09 - 18.60)	(.59 - 8.93)	(-2.79 - 10.29)	(-.38 - 13.26)
Interest Rate	17.16	10.93	10.84	5.06	3.26	4.37
	(8.65 - 37.80)	(.48 - 36.86)	(5.10 - 31.62)	(1.87 - 23.92)	(1.01 - 20.64)	(1.54 - 15.81)
Exchange Rate	4.55	2.99	2.52	1.39	.42	-4.56
	(-29.44 - 48.28)	(-20.56 - 30.80)	(-9.40 - 29.26)	(-34.20 - 43.56)	(-25.28 -49.51)	(-33.83 - 24.95)
Output Gap	1.90E-11	.14	.23	-.72	-.61	3.19E-11
	(-6.27 - 5.34)	(-7.75 - 5.96)	(-8.16 - 5.36)	(7.88 - 14.46)	(-9.33 - 6.68)	(-6.20 - 3.78)
Real Interets Rate	9.38	3.65	2.18	2.46	.70	1.37
	(3.07 - 30.09)	(-9.98 - 24.23)	(-12.32 - 15.13)	(-4.46 - 17.21)	(-3.41 - 9.35)	(-4.15 - 6.18)





Relationship between Inflation and Output Gap

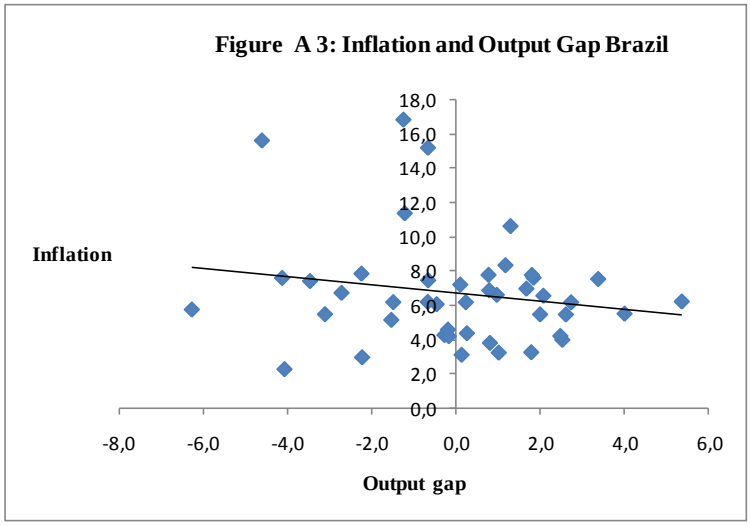


Figure A 4: Inflation and Output Gap Chile

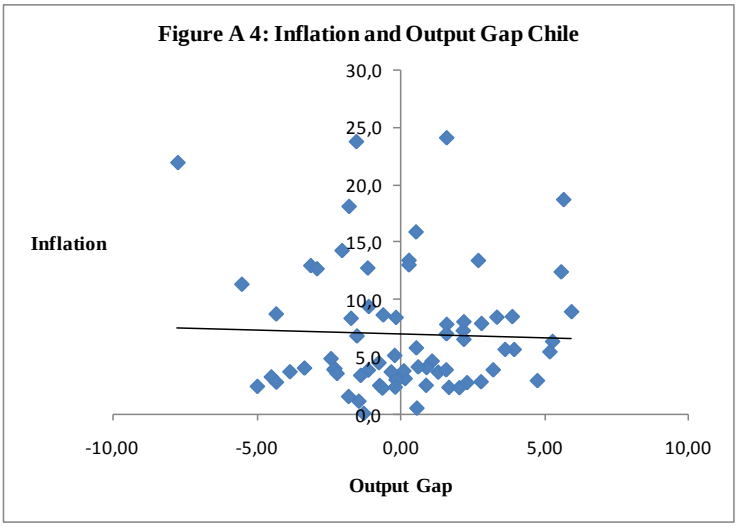


Figure A 5: Inflation and Output Gap Mexico

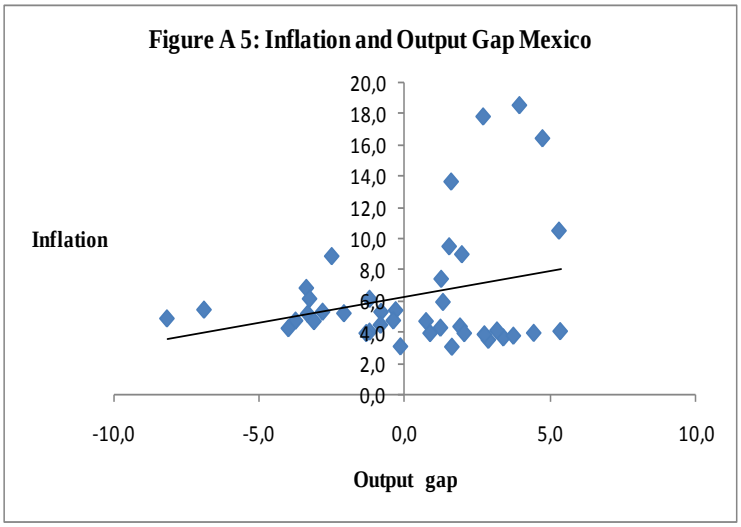
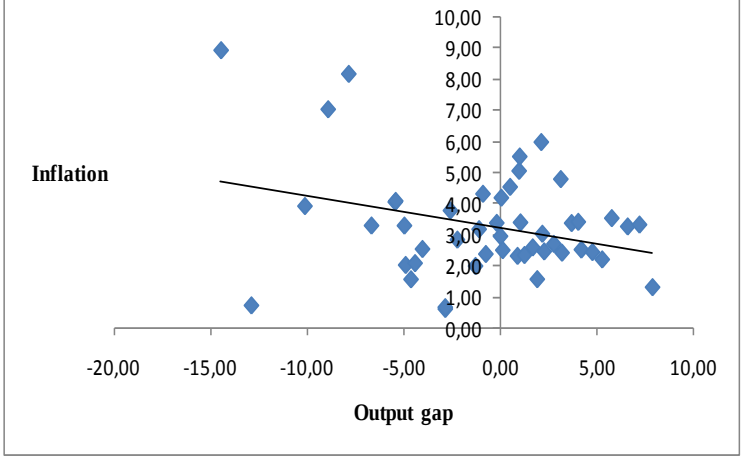


Figure A 6: Inflation and Output gap Korea



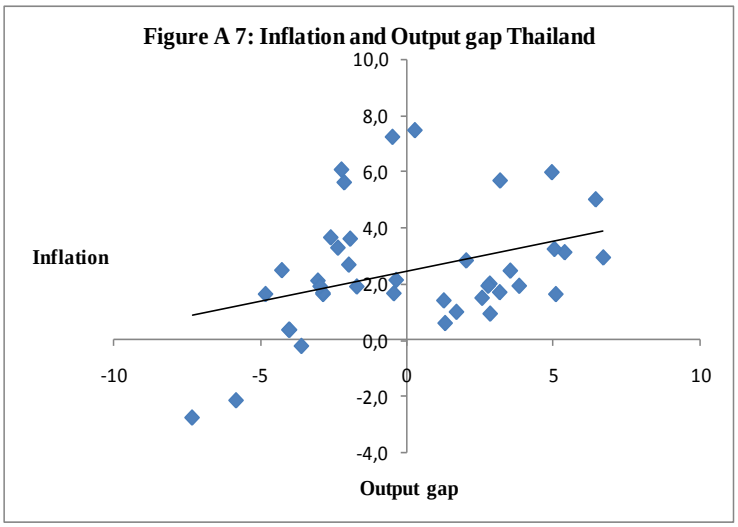


Figure A 7: Inflation and Output gap Thailand
10,0
8,0
6,0
4,0
2,0
0,0
-2,0
-4,0
-10
-5
0
5
10
Inflation
Output gap

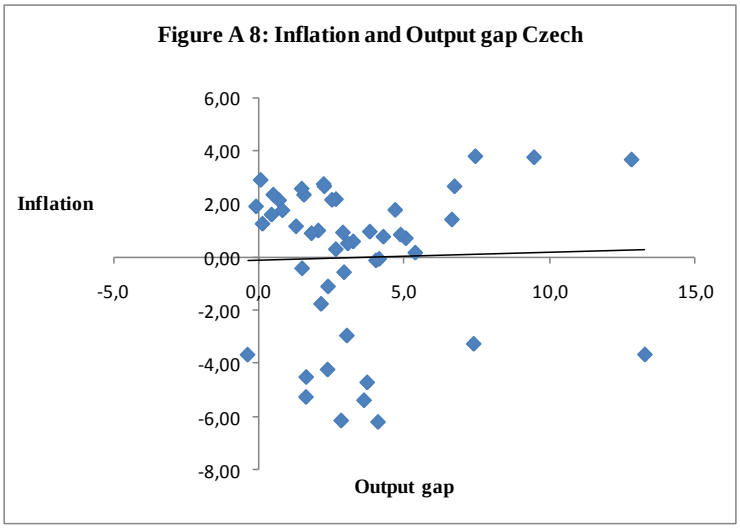


Figure A 8: Inflation and Output gap Czech
6,00
4,00
2,00
0,00
-2,00
-4,00
-6,00
-8,00
-5,0
0,0
5,0
10,0
15,0
Inflation
Output gap

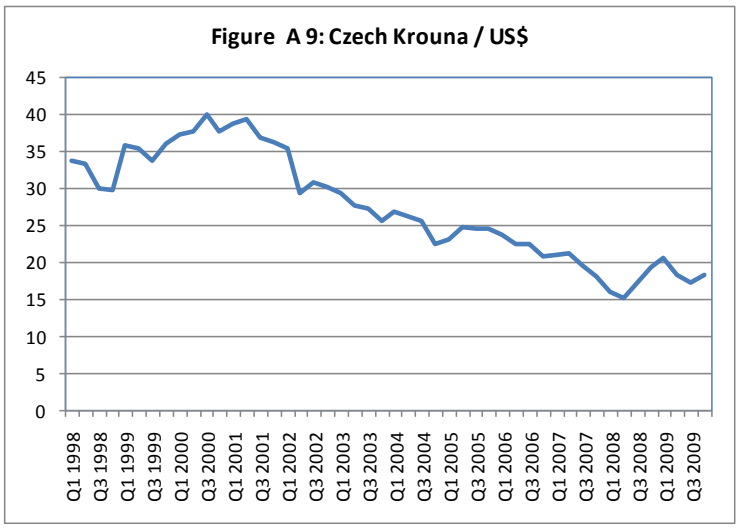
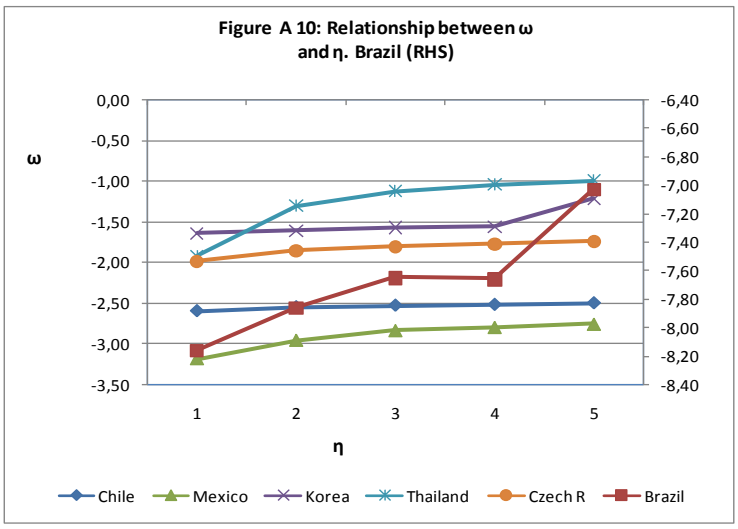


Figure A 9: Czech Krouna / US$
45
40
35
30
25
20
15
10
5
0
Q1 1998
Q3 1998
Q1 1999
Q3 1999
Q1 2000
Q3 2000
Q1 2001
Q3 2001
Q1 2002
Q3 2002
Q1 2003
Q3 2003
Q1 2004
Q3 2004
Q1 2005
Q3 2005
Q1 2006
Q3 2006
Q1 2007
Q3 2007
Q1 2008
Q3 2008
Q1 2009
Q3 2009



List of Instruments Used in Regression:

In Table 1.1:

Brazil:

IS Equation: output gap lag 1 to 4, real interest rate lag 1 to 4, exchange rate lag 1 to 4.

Phillips Curve: inflation 1 to 4, output gap 1 to 4, real exchange rate 1 to 4.

Taylor rule: interest rate 1 to 4, inflation deviation 1 to 4, output gap 1 to 4, Exchange rate 1 to 4.

Chile:

IS Equation: output gap lag 1 to 4, real interest rate lag 1 to 4, real exchange rate lag 1 to 4.

Phillips Curve: inflation 1 to 4, output gap 1 to 4, real exchange rate 1 to 4.

Taylor rule: interest rate 1 to 2, output gap 1 to 3, real exchange rate 1 to 3.

Mexico:

IS Equation: output gap lag 1 to 4, real interest rate lag 1 to 4, exchange rate lag 1 to 4.

Phillips Curve: inflation 1 to 4, output gap 1 to 4, real exchange rate 1 to 4.

Taylor rule: interest rate 1 to 4, output gap 1 to 4, exchange rate 1 to 4, inflation deviation 1 to 4.

Korea:

IS Equation: output gap lag 1 to 4, real interest rate lag 1 to 4.

Phillips Curve: inflation 1 to 4, output gap 1 to 4, real exchange rate 1 to 4.

Taylor rule: interest rate 1 to 4, output gap 1 to 4, real exchange rate 1 to 4, inflation deviation 1 to 4.

Thailand:

IS Equation: output gap lag 1 to 4, real interest rate lag 1 to 4, real exchange rate 1 to 4 lag.

Phillips Curve: inflation 1 to 2, output gap 1 to 2, real exchange rate 1 to 2.

Taylor rule: interest rate 2 to 4, output gap 1 to 2, exchange rate 1 to 2, inflation deviation 1 to 2.

Czech republic:

IS Equation: output gap lag 1 to 2, real interest rate lag 1 to 2, exchange rate 1 to 4 lag.

Phillips Curve: inflation 1 to 2, output gap 1 to 2, real exchange rate 1 to 6.

Taylor rule: interest rate 1 to 2, output gap 1 to 4, exchange rate 1 to 2, inflation deviation 1 to 2.

In Table 1.4:

Brazil: same as in table 2.

Chile:IS Equation: same as in table 2

Phillips Curve: same as in table 2.

Taylor rule: interest rate 1 to 2, output gap 1 to 3, real exchange rate 1 to 3.

Mexico: same as in table 2 except real rate in IS Equation.

Korea: same as in table 2

Thailand: same as in table 2, except real interest rate 1 to 2 instead of nominal interest rate.

Czech Republic: same as in table 2 except in Phillips curve inflation and real exchange rate lag 1 to 6.

Appendix B

Appendix-Chapter 2

Table B 1: Data Description and Sources				
Country	**Variable**	**Description**	**Source**	**Code**
Brazil	IPI	Industrial Production Index (2005=100), Seasonally Adjusted at source	IFS	22366..CZF...
	CPI	CPI (2005=100)	IFS	22364...ZF...
	Loans	Claims on Private Secor, deflated by CPI to make real	IFS	22322D..ZK...
	BLR	Lending rate, we made it real using CPI inflation	IFs	22360P..ZF...
	REER	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
	SP	Share Price Index (2005=100), Period average	IFS	22362...ZF...
	mmrate	money market rate	IFS	22360B..ZF...
	RWTC	Crude oil, WTI Spot Price (Dollars per Barrel)	FRED Database	-
Chile	IPI	Manufacturing Index (2005=100)	IFS	22866EY.ZF...
	CPI	CPI (2005=100)	IFS	22864A..ZF...
	Loans	Claims on Private Secor, deflated by CPI to make real	IFS	22822D..ZK...
	BLR	Lending rate, we made it real using CPI inflation	IFS	22860P..ZF...
	REER	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
	SP	Industrial Share Price Index (2005=100)	IFS	22862A..ZF...
	Discrate	Discount rate, end period per annum	IFS	22860...ZF...
	RWTC	Crude oil, WTI Spot Price (Dollars per Barrel)	FRED Database	-
Korea	IPI	Industrial Production Index (2005=100), Seasonally Adjusted at source	IFS	54266..CZF...
	CPI	CPI all cities (2005=100)	IFS	54264...ZF...
	Loans	Claims on Private Secor, we deflated by CPI to make real	IFS	54222D..ZF...
	BLR	Lending rate, we made it real using CPI inflation	IFS	54260P..ZF...
	REER	Real Effective ER, CPI-based, Broad Indices (2005=100)	BIS	-
	SP	Share Price Index (2005=100), Period average	IFS	54262...ZF...
	mmrate	money market rate (percent per annum)	IFS	54260B..ZF...
	RWTC	Crude oil, WTI Spot Price (Dollars per Barrel)	FRED Database	-

Seasonal Adjustment using X11 Method

Sample Size for Brazil1999:1 - 2009:12, for Chile 1991:1 - 2009:12 and for Korea 1998:1 - 2009:12

Table B 2: Descriptive Statistics Brazil								
	IPI	**CPI**	**LOANS**	**BLR**	**REERINV**	**SP**	**MMRATE**	**RWTC**
Mean	96.06150	91.09793	696552.6	56.50742	1.037898	104.4409	17.16704	48.20394
Median	95.95250	93.54800	532958.9	54.90000	1.014117	80.20950	16.79250	39.68500
Maximum	117.1750	121.7770	1535780.	103.0800	1.651255	258.4310	43.25000	133.8800
Minimum	77.92300	59.27400	305634.9	40.20000	0.711794	25.37000	8.650000	12.01000
Std. Dev.	10.36971	19.26685	386156.3	11.43164	0.207664	65.15893	5.503117	26.25111
Skewness	0.224769	-0.127357	1.007947	1.450761	0.487601	0.767364	1.648067	1.126466
Kurtosis	2.002352	1.662597	2.594671	6.177169	2.699381	2.285562	8.132999	4.005992

Table B 3: Descriptive Statistics Chile								
	IPI	**CPI**	**LOANS**	**BLR**	**REERINV**	**SP**	**DISCRATE**	**RWTC**
Mean	84.26453	84.95219	29331.49	14.25696	0.976487	70.07359	10.60747	35.97689
Median	81.21550	87.91950	24179.66	13.21900	0.983043	53.75000	7.956000	25.62000
Maximum	116.9000	121.9170	74717.61	43.74300	1.173709	168.7000	45.25700	133.8800
Minimum	46.04410	40.22000	4273.029	3.536000	0.814531	15.40000	0.481000	11.35000
Std. Dev.	14.44152	21.05368	20087.81	7.852245	0.079993	38.72773	8.718927	24.64824
Skewness	0.254267	-0.291815	0.809396	1.116563	0.006335	1.009496	1.473465	1.685439
Kurtosis	2.292633	2.295152	2.653482	4.217307	2.337628	2.812728	5.254883	5.638380

Table B 4: Descriptive Statistics Korea								
	IPI	**CPI**	**LOANS**	**BLR**	**REERINV**	**SP**	**MMRATE**	**RWTC**
Mean	90.50833	95.83537	680078.7	7.565694	1.144771	92.43820	5.062986	45.39083
Median	92.00000	95.30000	690663.0	6.720000	1.133209	81.23100	4.330000	34.55500
Maximum	129.3000	113.8000	1149870.	17.53000	1.698370	187.1080	25.63000	133.8800
Minimum	47.40000	81.20000	299427.0	5.400000	0.924385	29.14100	1.770000	11.35000
Std. Dev.	22.21238	9.970107	253656.3	2.686174	0.148269	39.86246	3.703413	26.81623
Skewness	-0.073360	0.187769	0.274451	2.346255	0.680587	0.565126	3.942138	1.115897
Kurtosis	2.050743	1.818813	2.075316	8.233369	3.964628	2.292436	19.15175	3.985604

Table B 5: Cointegration Tests for Brazil				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.429635	226.2041	125.6154	0.0000
At most 1 *	0.396900	154.8963	95.75366	0.0000
At most 2 *	0.253866	90.67601	69.81889	0.0005
At most 3 *	0.209398	53.48404	47.85613	0.0135
At most 4	0.100908	23.64400	29.79707	0.2159
At most 5	0.072031	10.13496	15.49471	0.2705
At most 6	0.005033	0.640861	3.841466	0.4234

Trace test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.429635	71.30781	46.23142	0.0000
At most 1 *	0.396900	64.22031	40.07757	0.0000
At most 2 *	0.253866	37.19197	33.87687	0.0194
At most 3 *	0.209398	29.84005	27.58434	0.0252
At most 4	0.100908	13.50904	21.13162	0.4066
At most 5	0.072031	9.494097	14.26460	0.2473
At most 6	0.005033	0.640861	3.841466	0.4234

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Table B 6: Cointegration Tests for Chile				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.297113	235.4931	125.6154	0.0000
At most 1 *	0.256891	156.8723	95.75366	0.0000
At most 2 *	0.175591	90.66076	69.81889	0.0005
At most 3	0.121984	47.60205	47.85613	0.0528
At most 4	0.049673	18.59184	29.79707	0.5226
At most 5	0.027280	7.230262	15.49471	0.5510
At most 6	0.004752	1.062295	3.841466	0.3027

Trace test indicates 3 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.297113	78.62078	46.23142	0.0000
At most 1 *	0.256891	66.21151	40.07757	0.0000
At most 2 *	0.175591	43.05870	33.87687	0.0031
At most 3 *	0.121984	29.01022	27.58434	0.0326
At most 4	0.049673	11.36157	21.13162	0.6112
At most 5	0.027280	6.167967	14.26460	0.5918
At most 6	0.004752	1.062295	3.841466	0.3027

Max-eigenvalue test indicates 4 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

Table B 7: Cointegration Tests for Korea				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.667658	295.4925	125.6154	0.0000
At most 1 *	0.334960	142.3712	95.75366	0.0000
At most 2 *	0.261044	85.67195	69.81889	0.0016
At most 3	0.141433	43.62219	47.85613	0.1181
At most 4	0.075504	22.42598	29.79707	0.2754
At most 5	0.047729	11.51360	15.49471	0.1818
At most 6 *	0.033357	4.715713	3.841466	0.0299
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.667658	153.1213	46.23142	0.0000
At most 1 *	0.334960	56.69925	40.07757	0.0003
At most 2 *	0.261044	42.04976	33.87687	0.0043
At most 3	0.141433	21.19620	27.58434	0.2645
At most 4	0.075504	10.91239	21.13162	0.6561
At most 5	0.047729	6.797885	14.26460	0.5133
At most 6 *	0.033357	4.715713	3.841466	0.0299
Max-eigenvalue test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Figure B 1: Identification scheme for Robustness Check

$$\begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ A_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ A_{31} & 0 & 1 & 0 & 0 & A_{36} & 0 & 0 \\ 0 & 0 & 0 & 1 & A_{45} & 0 & 0 & 0 \\ 0 & 0 & A_{53} & 0 & 1 & 0 & 0 & A_{58} \\ A_{61} & A_{62} & A_{63} & 0 & 0 & 1 & A_{67} & A_{68} \\ A_{71} & 0 & A_{73} & A_{74} & A_{75} & A_{76} & 1 & A_{78} \\ A_{81} & A_{82} & A_{83} & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} u\ wtc \\ u\ IPI \\ u\ CPI \\ u\ RL \\ u\ RBLR \\ u\ REER \\ u\ SP \\ u\ Discrate \end{bmatrix} = \begin{bmatrix} e\ wtc \\ e\ IPI \\ e\ CPI \\ e\ RL \\ e\ RBLR \\ e\ REER \\ e\ SP \\ e\ Discrate \end{bmatrix}$$

Figure B 2: One S.D. shock with one-standard-error bands, country Brazil

Shocks

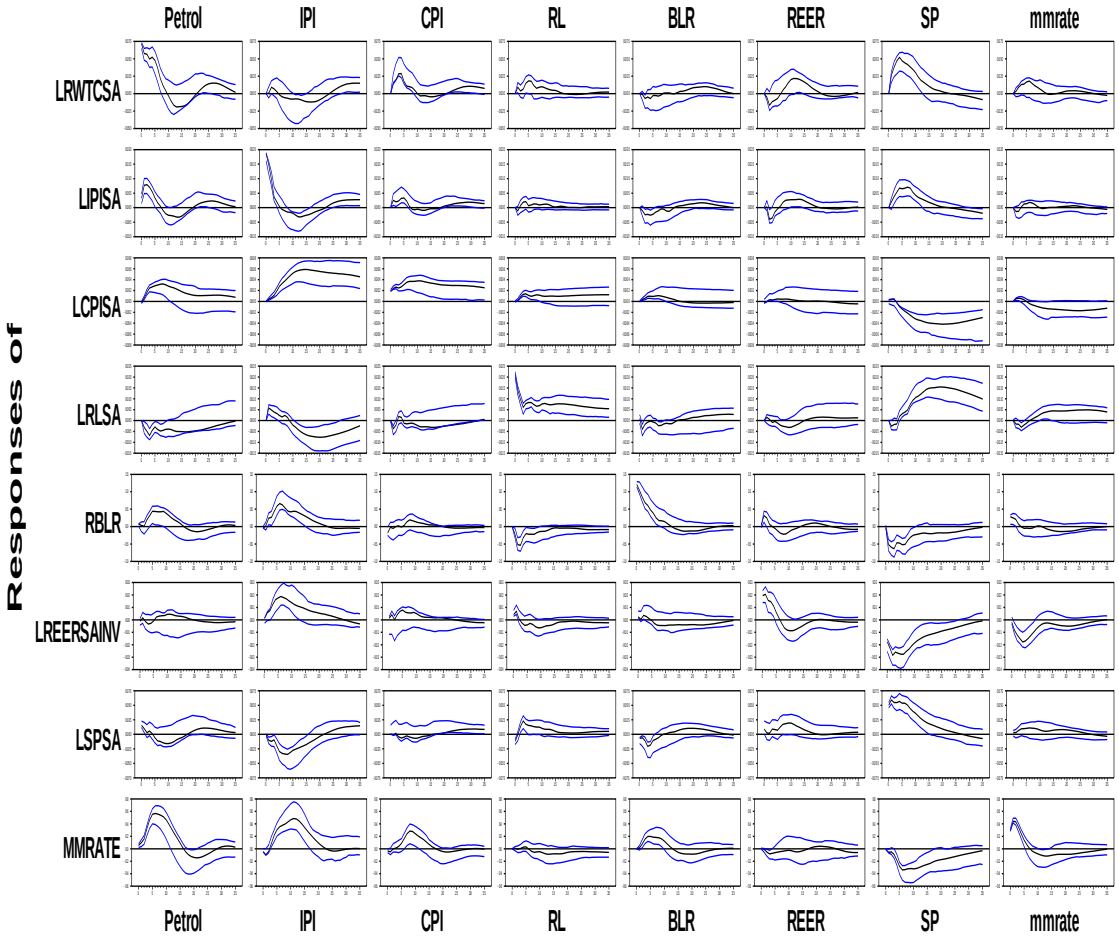


Figure B 3: One S.D . shock with one-standard-error bands, country Chile

Shocks

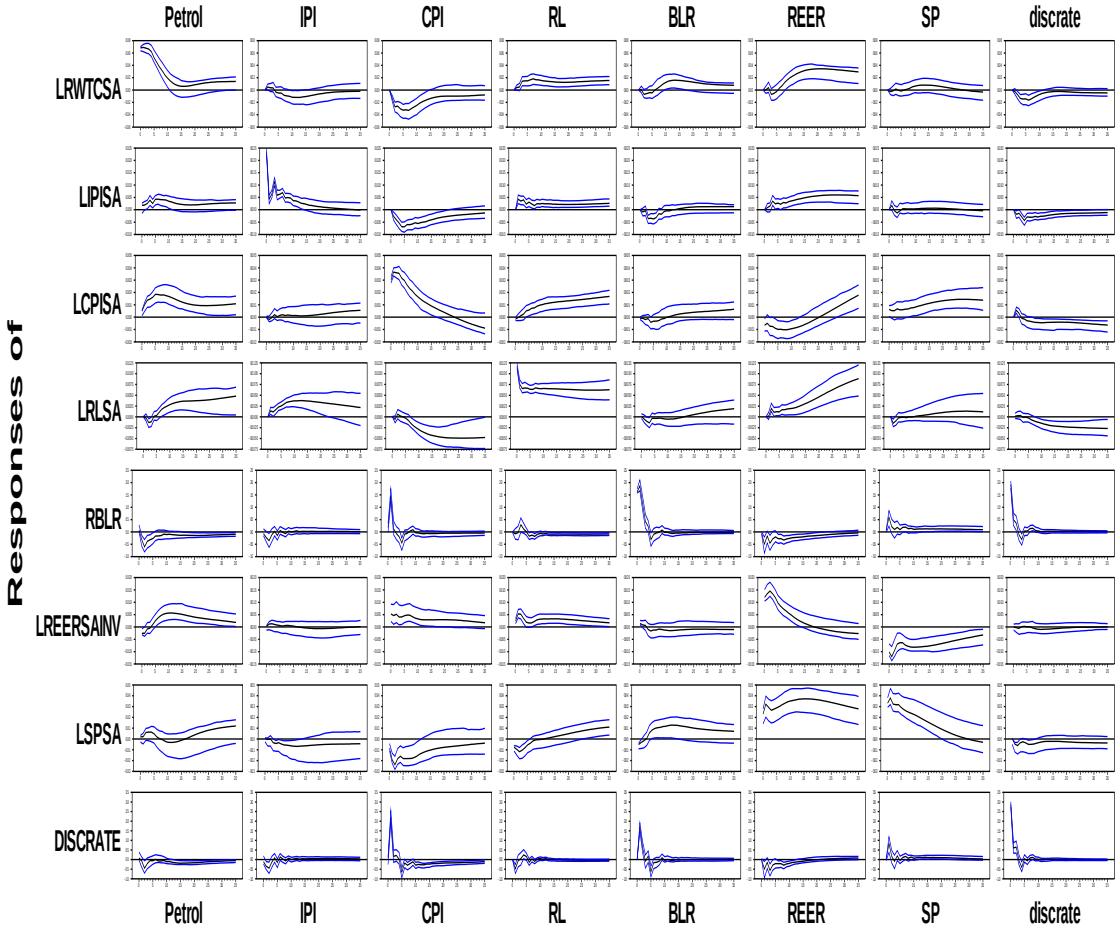


Figure B 4: One S.D . shock with one-standard-error bands, country Korea

Shocks

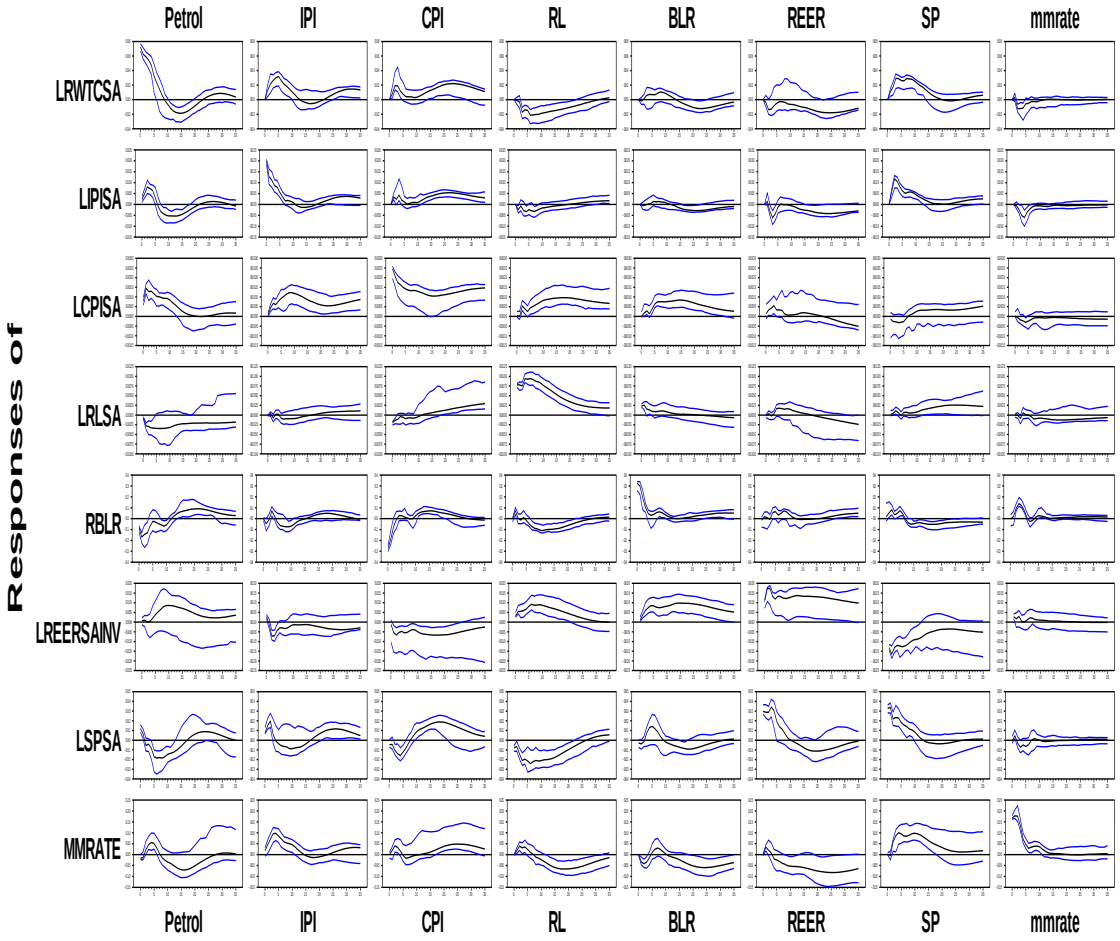
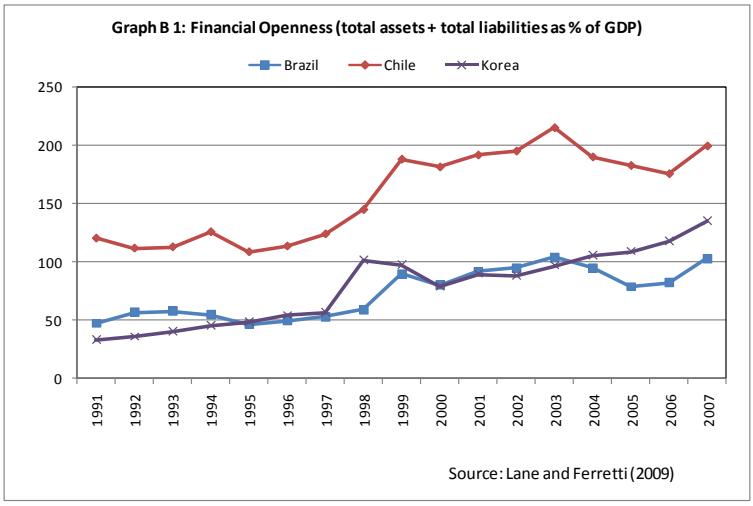


Table B 8: Contemporaneous coefficients in the structural model

	Brazil	Chile	Korea
A_{21}	-0.046 (0.022)	-0.014 (0.023)	-0.0337 (0.022)
A_{31}	0.0015 (.003)	0.0019 (0.006)	-0.010 (0.002)
A_{36}	-0.027 (0.020)	0.218 (0.112)	-0.0013 (0.015)
A_{45}	-0.0008 (0.0015)	-0.0002 (0.0003)	-0.007 (0.002)
A_{53}	99.37 (1.55)	-115.17 (51.89)	111.98 (10.25)
A_{58}	-0.76 (0.35)	-0.67 (0.04)	-0.076 (0.16)
A_{61}	-0.14 (0.059)	0.031 (0.04)	-0.34 (0.17)
A_{62}	0.102 (.16)	0.1065 (0.117)	-1.27 (0.598)
A_{63}	0.76 (2.05)	-3.54 (1.97)	3.93 (3.24)
A_{67}	0.66 (0.15)	0.807 (0.299)	1.944 (0.793)
A_{68}	-0.003 (0.009)	0.0006 (0.001)	-0.0164 (0.0422)
A_{71}	-0.416 (0.26)	-0.145 (0.102)	32.80 (26.80)
A_{73}	-33.90 (31.98)	17.9 (7.20)	1262 (2.45)
A_{74}	2.46 (1.99)	2.31 (0.89)	1366 (134)
A_{75}	0.031(0.026)	0.009 (0.004)	1.05 (5.94)
A_{76}	-4.098 (4.32)	-2.43 (1.31)	-1429 (118)
A_{78}	-0.027 (0.052)	-0.006 (0.004)	20.80 (11.17)
A_{81}	-0.72 (0.39)	-3.43 (2.90)	0.19 (0.20)
A_{82}	1.27 (1.50)	2.31 (8.17)	-0.77 (0.70)
A_{83}	14.08 (13.57)	18.01 (89.02)	-0.34 (5.58)
Likelihood test	$\chi^2(8) = 8.99$	$\chi^2(8) = 18.26$	$\chi^2(8) = 13.51$
Significance Level	0.3428	0.01935	0.0954

Standard Errors in Parenthesis


Graph B 1: Financial Openness (total assets + total liabilities as % of GDP)
Brazil
Chile
Korea
250
200
150
100
50
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
Source: Lane and Ferretti (2009)

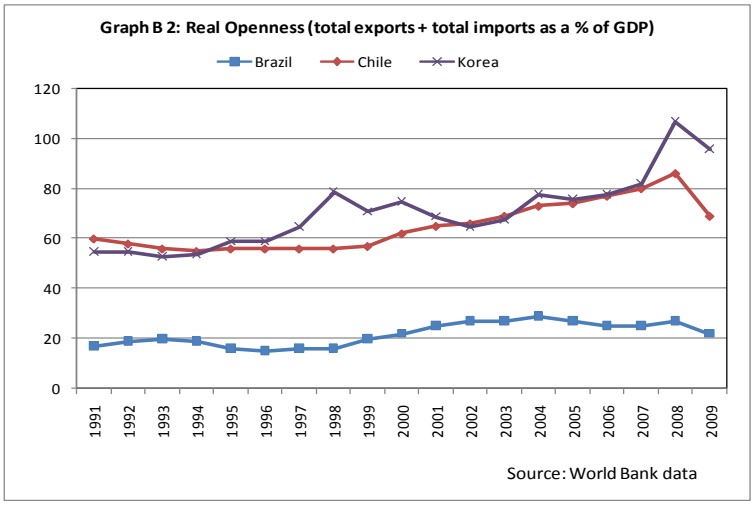

Graph B 2: Real Openness (total exports + total imports as a % of GDP)
Brazil
Chile
Korea
120
100
80
60
40
20
0
1991
1992
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
Source: World Bank data

Table B 9: Market Capitalization as a % of GDP						
Year	**Brazil**	**Chile**	**Korea**	**UK**	**USA**	**France**
1991	10.5	76.9	31.3	93.6	69.0	27.9
1992	11.6	66.6	32.4	84.9	71.7	25.6
1993	22.7	93.5	38.4	117.4	78.0	35.2
1994	34.6	123.7	45.3	114.1	72.5	33.0
1995	19.2	103.5	35.2	121.7	93.4	33.2
1996	25.8	87.0	24.9	142.7	109.5	37.6
1997	29.3	87.0	8.9	146.9	137.0	47.4
1998	19.1	65.3	35.1	163.1	153.9	67.5
1999	38.8	93.5	88.8	195.2	178.9	101.3
2000	35.1	80.3	32.2	174.4	152.6	109.1
2001	33.6	82.1	43.6	147.2	135.4	87.8
2002	24.6	70.7	43.3	115.6	104.8	66.6
2003	42.5	116.6	51.2	132.2	128.7	75.7
2004	49.8	122.4	59.4	127.9	138.2	75.8
2005	53.8	115.4	85.0	134.1	134.9	83.0
2006	65.3	118.9	87.8	155.2	145.7	107.7
2007	100.3	129.6	107.1	137.3	142.5	107.3
2008	35.7	77.7	53.1	69.7	82.1	52.7
2009	73.2	130.2	100.3	128.7	107.4	75.1

Data source: World Bank

Appendix C

Appendix-Chapter 3

Table C 1: Openness Indicators

	Brazil			Chile			Korea		
	Topen	FG	Keopen	Topen	FG	Keopen	Topen	FG	Keopen
1991	8	47	-1.85	28	120	-1.85	29	33	-0.10
1992	8	57	-1.85	28	112	-1.85	28	36	-0.10
1993	9	57	-1.85	29	113	-1.85	26	40	-0.10
1994	9	55	-1.85	27	126	-1.85	27	45	-0.10
1995	9	46	-1.85	27	109	0.43	30	48	-0.10
1996	8	49	-1.85	29	114	-1.85	31	54	-1.15
1997	9	53	-1.85	29	124	-1.85	33	57	-1.15
1998	9	59	-1.15	30	145	-1.85	33	102	-1.15
1999	11	89	-1.15	27	188	-1.15	32	97	-1.15
2000	12	80	-1.15	30	182	-1.15	36	79	-0.10
2001	13	91	-1.15	32	192	1.39	33	90	-0.10
2002	13	95	-0.10	32	195	1.66	32	88	-0.10
2003	12	104	-0.10	32	216	1.92	33	97	-0.10
2004	13	94	-0.10	32	190	2.19	37	106	-0.10
2005	12	79	0.15	33	183	2.45	37	109	-0.10
2006	11	82	0.42	31	176	2.45	38	118	-0.10
2007	12	103	0.42	33	200	2.45	40	135	-0.10
2008	13	-	0.42	41	-	2.19	54	-	0.15
2009	11	-	0.42	30	-	1.92	46	-	0.42

Topen = imports of goods and services/GDP (source World Bank data), FG=Financial liabilities (total assets + total liabilities)/GDP (Source Lane and Milissei Feretti), Keopen = Cinn and Ito Index, the index takes the value from -1.85 to 2.46, The higher the value the more open the economy.

Table C 2: FDI/Portfolio

	Brazil	Chile	Korea
1991	21.32	6.08	4.68
1992	11.23	5.43	1.61
1993	2.50	3.49	0.53
1994	1.63	2.80	0.39
1995	2.08	3.86	0.42
1996	1.49	5.25	0.59
1997	1.35	4.77	1.15
1998	3.18	6.75	1.06
1999	1.75	7.11	0.95
2000	2.36	9.73	0.87
2001	3.00	11.85	0.76
2002	3.52	18.63	0.83
2003	2.13	13.61	0.57
2004	1.91	13.10	0.56
2005	1.45	10.86	0.42
2006	1.19	9.97	0.43
2007	0.86	10.82	0.38

Source: Lane and Milesi-Ferretti (2009)

Table C 3: Data Description and Sources.

Country	Variable	Description	Source	Code
Brazil	IPI	Industrial production index (2005=100), Seasonally adjusted at source	IFS	22366…CZF..
	CPI	National CPI (2005=100)	IFS	22364…ZF..
	ER	Bilateral Exchange rate, Period Average, Reais per US Dollar	IFS	223…RF..ZF..
	NEER	Nominal Effective Exchange Rate, Broad Indices (2005=100)	BIS	-
	REER	Real Effective Exchange Rate, CPI-Based, Broad Indices (2005=100)	BIS	-
	Topen	Imports/GDP (authors calculation, interpolated from Quarterley)	IFS	22398C.ZF/22399 B.ZF
	Kopen	Chinn and Ito KAOPEN Index	-	-
	FG	Lane and Melissi-Ferreti data set (Author's calculation)	-	-
	ERVol	Exchange Rate Volatility (mean squared deviation, Author's calculation)	-	-
Chile	IPI	Manufacturing Production index (2005=100)	IFS	22866EY..ZF
	CPI	CPI (2005=100)	IFS	22864A…ZF
	ER	Bilaterla Exchange Rate, Period Average, Pesos per US Dollar	IFS	228..RF..ZF
	NEER	Nominal Effective Exchange Rate, Broad Indices (2005=100)	BIS	-
	REER	Real Effective Exchange Rate, CPI-Based, Broad Indices (2005=100)	BIS	-
	Topen	Imports/GDP (authors calculation, interpolated from Quarterley)	Central Bank	-
	Kopen	Chinn and Ito KAOPEN Index	-	-
	FG	Lane and Melissi-Ferreti data set (Author's calculation)	-	-
	ERVol	Exchange Rate Volatility (mean squared deviation, Athor's calculation)	-	-
Korea	IPI	Industrial production index (2005=100), Seasonally adjusted at source	IFS	54266C..ZF
	CPI	CPI All cities (2005=100)	IFS	54264…ZF
	ER	Bilaterla Exchange Rate, Period Average, Won per US Dollar	IFS	542..RF..ZF
	NEER	Nominal Effective Exchange Rate, Broad Indices (2005=100)	BIS	-
	REER	Real Effective Exchange Rate, CPI-Based, Broad Indices (2005=100)	BIS	-
	Topen	Imports/GDP (authors calculation, interpolated from Quarterley)	IFS	54298C..ZF/54299 B..ZF
	Kopen	Chinn and Ito KAOPEN Index	-	-
	FG	Lane and Melissi-Ferreti data set (Author's calculation)	-	-
	ERVol	Exchange Rate Volatility (mean squared deviation, Athor's calculation)	-	-

Sample Size for Brazil1999:1 - 2009:12, for Chile 1991:1 - 2009:12 and for Korea 1998:1 - 2009:12
Topen data for Chile starts from 1996M1. Data for FG for all countries ends at 2007.

Table C 4: Stationarity Tests

	Brazil		Chile		Korea	
	ADF	KPSS	ADF	KPSS	ADF	KPSS
IPI	-3.42	.14	-3.16	.25	-18@@	.12
CPI	-2.92	.33	-3.49	.12@@	-3.03	.11
ER	-3.38	.13*	-1.97@	.35	-3.32	.15
NEER	-3.76	.12*	-3.21	.18	-3.25	.16
REER	-3.96	.13*	-4.32	.35	-3.20	.18
REERMis	-4.87	.03	-7.19	.02	-3.98	.04
ERVol	-5.34	.14	-8.49	.07*	-6.17	.20
Topen	-3.48	.34	-4.10*	.04*	-3.46	.10*
KEOPEN	-1.61**	.20@	-4.28@@	.16*	-2.10@	.17*
FG	-3.85@@	.13	-2.86@@	.19*	-6.33@@	.05@@

* Stattionarity with trend and intercept. **stationary with None at 10 percent
@stationary at none. @@ Stationary at first difference

List of Instruments

Table 3.2 Country Brazil

Equation 1:C lipisag (-1, -3, -6, -9), Inflation (-7, -9), Topen(-1 to -3), lerg(-1 to -3), lrwtcg(-1, -3, -6).

Equation 2: C lipisag (-1, -3, -6, -9), Inflation (-7, -9), Topen(-1 to -6), lerg(-1 to -3), volatility(-1, -3, -6), constant added to instrument list.

Equation 3: C lipisag (-1, -3, -6, -9), Inflation (-7, -9), Topen(-1 to -6), lerg(-1 to -3), volatility(-1, -3, -6).

Equation 4: C lipisag (-1, -3, -9, -12), Inflation (-7, -9), lreerinvg(-1 to -6), lneerinvg(-1 to -3), volatility(-1, -3).

Equation 5: C lipisag (-1, -3, -9, -12), Inflation (-7, -9), topen(-1 to -6), lneerinvmis(-1 to -3), volatility(-1, -6), lrwtcg(-1, -3).

Table 3.3 Country Brazil

Equation 6: C lipisag(-1, -6), Inflation(-7, -9), keopen(-1 to -3), lerg(-1 to -3), volatility(-1 to -3), lrwtcg(-1, -3).

Equation 7: lipisag(-1, -6), Inflation(-7, -9), keopen(-1 to -3), lerg(-1 to -3), volatility(-1 to -3), lrwtcg(-1, -3).

Equation 8: C lipisag(-1, -3, -9, -12), Inflation(-7, -9), keopen(-1 to -3), volatility(-,1-3, -6), volatility(-1 to -3), lneerinvg(-1, -3).

Equation 9: C lipisag(-1, -3, -9), Inflation(-7 to -9), keopen(-1 to -3), volatility(-,1-3, -6), volatility(-1 to -3), lreerinvg(-1, -3).

Equation 10: C lipisag(-1, -3, -9), Inflation(-7 to -9), keopen(-1 to -3, -6), volatility(-,1to -3), volatility(-1 to -3), lreerinvmis(-2 to -6).

Table 3.4 Country Brazil

Equation 11: C lipisag(-1, -3, -9), Inflation(-7 to -9), keopen(-1 to -3, -6), volatility(-,1to -3), volatility(-1 to -3), lreerinvmis(-2 to -6).

Equation 12: C lipisag(-1, -3, -9, -12), Inflation(-7 to -9), FG(-1 to -3), volatility(-,1-3, -6), lerg(-1, -3), lerg(-1 to -3).

Equation 13: C lipisag(-1, -3, -9, -12), Inflation(-7 to -9), FG(-1 to -3), volatility(-,1to -3), lneerinvg(-1 to -3), lrwtcg(-1 to -3).

Equation 14: C lipisag(-1, -3, -9), Inflation(-7 to -9), FG(-1 to -3), volatility(-,1-3, -6), lneerinvg(-1 to -3), lrwtcg(-1 to -3).

Equation 15: C lipisag(-1, -3, -9), Inflation(-7 to -9), FG(-1 to -3), volatility(-,1-3, -6), lneerinvg(-1 to -3), lrwtcg(-1 to -3).

Table 3.5 Country Chile

Equation 1: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Volatility(-2 to -3), lerg(-1 to -3), lrwtcg(-1, -3).

Equation 2: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Volatility(-1 to -3), lerg(-1 to -3), lrwtcg(-1, -3).

Equation 3: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Volatility(-1 to -3), lneerinvg(-1 to -6), lrwtcg(-1 to -3).

Equation 4: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Volatility(-1 to -6), lneerinvg(-1 to -6), lrwtcg(-1 to -3, 6).

Equation 5: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Volatility(-1 to -6), lreerinvmis(-1 to -3), lrwtcg(-1 to -3, 6).

Table 3.6 Country Chile

Equation 6: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Keopen(-1 to -3), Volatility(-2 to -3), lrwtcg(-1 to -3, 6).

Equation 7: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Keopen(-1 to -3), Volatility(-2 to -3), lrwtcg(-1 to -3, 6).

Equation 8: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Keopen(-1 to -3), Volatility(-2 to -3), lrwtcg(-1 to -3, 6).

Equation 9: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Keopen(-1 to -3), lrwtcg(-1 to -3, -6).

Equation 10: C lipig(-1, -3, -6), Inflation(-7 to -9), Keopen(-1 to -3), lrwtcg(-1 to -3, -6).

Table 3.7 Country Chile

Equation 11: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), FG(-1), lrwtcg(-1 to -6).

Equation 12: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), FG(-1 to -3), lrwtcg(-1 to -3), Volatility(-2 to -6).

Equation 13: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), FG(-1 to -3), lrwtcg(-1 to -3, -6), Volatility(-2 , -3, -6).

Equation 14: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), FG(-1 to -3), lrwtcg(-1 to -3), Volatility(-2 to -6).

Equation 15: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), FG(-1 to -6), lrwtcg(-1 to -3), Volatility(-2, -3, -6).

Table 3.8 Country Korea

Equation 1: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Topen(-1 to -6), Volatility(-1 to -3)(-1 to -3), lrwtcg(-1 to -3).

Equation 2: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Topen(-1 to -3), lrwtcg(-1 to -3).

Equation 3: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lneerinvg(-1 to -6) Topen(-1 to -3), lrwtcg(-1 to -3, 6), Volatility(-1 to -6).

Equation 4: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lreerinvg(-1 to -6) Topen(-1 to -3), lrwtcg(-1 to -3, 6), Volatility(-1 to -6).

Equation 5: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lreermisinvg(-1 to -3) Topen(-1 to -3), lrwtcg(-1 to -3), Volatility(-1 to -3).

Table 3.9 Country Korea

Equation 6: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), Keopen(-1 to -3), lrwtcg(-1 to -3), Volatility(-1 to -3).

Equation 7: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lerg(-1 to -3) Keopen(-1 to -3), lrwtcg(-1 to -3).

Equation 8: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lneerinvg(-1 to -6) Keopen(-1 to -3), lrwtcg(-1 to -3), volatility(-1 to -6).

Equation 9: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lreerinvg(-1 to -3) Keopen(-1 to -3), lrwtcg(-1 to -3, -6), volatility(-1 to -3).

Equation 10: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lreerinvmis(-2 to -3) Keopen(-1 to -3), lrwtcg(-1 to -3), volatility(-1 to -3).

Table 3.10 Country Korea

Equation 11: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), FG(-1 to -3), lrwtcg(-1 to -3), volatility(-1 to -3).

Equation 12: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lerg(-1 to -3, -6), lrwtcg(-1 to -3), volatility(-1 to -3), FG(-1 to -3).

Equation 13: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lerg(-1 to -3, -6), lrwtcg(-1 to -3), FG(-1 to -3).

Equation 14: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lreerinvg(-1 to -6), lrwtcg(-1 to -3, -6), FG(-1 to -3), volatility(-1 to -6).

Equation 15: C lipig(-1, -3, -6, -9), Inflation(-7 to -9), lreerinvmis(-2 to -3), lrwtcg(-1 to -3), FG(-1 to -6), volatility(-1 to -3).