

Reassessing capital controls in emerging market economies: a Markovian regime-shifting approach

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February 2014

ABSTRACT

This paper seeks to produce evidence of the role that capital controls may play in emerging market economies. In this study, we intend to identify the features of capital flows over time. To that purpose, we distinguish in our model two Markov-switching regimes corresponding respectively to a normal regime (time-consistent pattern of capital flows) and a stress regime (time-inconsistent pattern of capital flows).

We then analyze the reaction of capital flows during the 2003-2012 decade to leading macroeconomic variables, which are the OIS-3M rate, the VIX index, the differentials of the Nominal GDP growths, Nominal interest rates, and the Stock market returns between advanced economies and two emerging economies, which are Chile and Thailand.

Our findings suggest a long-lasting capital control for both Chile and Thailand. Control devices in specific recipient sectors are to be considered as capital flowing into Chile is highly sensitive to global uncertainty and to the differential of interest rates, while flows toward Thailand are strongly pushed by the global uncertainty and pulled by the differential of growth prospects.

JEL classification: C22; E58; E61; F37

Keywords: Markov switching, regime shifts, Capital flows, Capital controls

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1. Introduction

The experience of successive crises throughout almost twenty years, from the Mexican Tequila crisis in 1994 to the Global Financial crisis of 2007-2009, has irrigated a passionate discussion concerning the rising necessity of emerging market economies¹ to manage cross-border capital flows. This discussion, instead of being treated as bygone by policymakers and economists, only gained interest over years. The compelling evidence of the boom-bust pattern raised hence the question of how, in respect to structural and political constraints, EMEs could manage fickle international capital flows by smoothing the capital flood during the upward slope of the cycle, and averting the sudden capital withdrawal during the downward slope.

The legitimacy of capital controls has mainly been assessed on the basis of two arguments. That is, the theories of the “second-best” and the “multiple equilibria”. According to the former, given the distortionary market mechanism, capital account restrictions contribute to compensate EMEs’ financial market deficiency so as to improve the general welfare². The latter supposes a multitude of equilibria, arguing that circumstantial interventions on capital markets may help reaching the “first best” equilibrium³. At a theoretical level, the common framework for addressing the subject of capital controls is substantially based on the theorem of “Impossible Trinity”⁴.

In their respective articles published in the 1960’s, Mundell (1963) and Fleming (1962) first explored the efficiency of economic policies under different exchange rate regimes. One of the major conclusions of the henceforth famous Mundell-Fleming model is that, for open economies, monetary policy reveals to be irrelevant under fixed exchange rate regime but tends to be efficient under flexible exchange rate regime⁵. Subsequently, on the basis of the Mundell-Fleming model, Krugman (1999) put forth the antinomy of pursuing the three goals at the same time - abiding by binding exchange rate commitments, assuring a full cross-border capital mobility and conducting an independent monetary policy. In other words, any attempt

¹ For notation convenience, the term of “Emerging Market Economies” will be abbreviated to “EMEs” in the subsequent development of the article.

² Tornell and Velasco (1992)

³ Obstfeld (1996)

⁴ The terms of Impossible Trinity and the Trilemma are used interchangeably in this article.

⁵ Under the fixed exchange rate regime, fully mobile international capitals flee to the recipient country which conducts an expansionary monetary policy accompanied by an increase in money supply and a reduction of the nominal interest rate. Facing the downward sloping pressure of the exchange rate, monetary authorities resort to purchasing domestic currency, rarefying thus the money supply contrary to the initial objective.

of monetary authorities to circumvent the Trilemma will be to release one of the three aforementioned objectives.

Mundell and Fleming stressed that the fixed exchange rate regime makes antagonistic the seek of extern and intern equilibria. This assertion leads hence to two supposals. First, there are grounds to consider that the autonomy of the monetary policy is to be preserved for attaining intern equilibrium i.e. domestic economic goals. Second, it can be contended that a managed exchange rate goal constitutes a priority for a great number of EMEs in that they found their growth on export-oriented activities and take generally into account an implicit exchange rate objective⁶. As a corollary, on the basis of what propositions embedded in the Trilemma thesis suggest, fettering the cross-border capital movements reveals to be the most feasible (least imperative) according to the cost/benefit consideration of two other options. However, an assessment of additional motivations of tightening capital account may also be helpful to obtain a deeper understanding of the choice.

Firstly, as stated above, a number of observers drove home the point that, given the imperfection of their capital markets, the neoclassical forecasts only bear little resemblance to the reality in the matter of liberalization virtues in EMEs⁷. Critically, Krugman (1999) observed that the abandon in 1973 of fixed exchange rate regime by developed economies in favor of the domestic policy goals and the capital mobility is motivated on a twofold basis – a confident perception of the international capital markets pertaining to the robustness of Advanced Economies⁸ constitutes an efficient boundary of their currency depreciation. Endogenously, this reinforces the capacity of Developed Economies to cushion (reduced) exchange rate volatility. In stark contrast, the EMEs generally are neither beneficiaries of such a confidence nor have the absorptive capacity of currency instability, as shows the recurrent phenomenon of capital flight accompanied by drastic currency crises⁹.

Secondly, the most common policy response to capital inflows is the sterilization, which aims to offset the growth of monetary aggregates due to liquidity inflows by issuing

⁶ Clarida, Gali and Gertler (2000). In this respect, Aizenman et al. (2008) underlined that a number of EMEs, especially Asian ones, have converged since 2000 toward greater exchange rate flexibility. Nevertheless, empirical reasons suggest that the “fear of floating” (Calvo and Reinhart (2002)) remains prevalent and the “two-corner” (Eichengreen (1999)) solution process reveals to be reversible, given the trade-off behavior between output stimulation and inflation targeting of several EMEs during the post-crisis period.

⁷ Ocampo, Palma, and Stiglitz (2008)

⁸ For notation convenience, the term of “Advanced Economies” will be abbreviated to “AEs” in the subsequent development of the article.

⁹ Eichengreen and Hausmann (1999), Bordo and Flandreau (2001) pointed out that this lack of confidence results in the inability for EMEs to issue domestic currency-denominated international securities. This imperfection leads to what the authors called the “original sin”.

equal-value domestic securities either by the central bank or by the treasury¹⁰. However, sterilization operations may continue on condition that they remain sustainable in view of the monetary sovereignty and of the returns spread level. That is, on the one hand, the autonomy of core money supply is highly contingent on whether the sterilization is complete or partial. In other words, in case the sterilization is incomplete, the money supply in EMEs will become partially exogenous and foster undesired monetary aggregate growth. On the other hand, the spread between the cost of issuing sterilization bonds and the returns on foreign assets should continue to stay profitable to the central bank¹¹.

Given the possible insufficiency of the sterilization in terms of magnitude and sustainability, the “Dilemma” between the autonomy of the monetary policy and the commitment to a fixed exchange rate regime reveals to be another reason in favor of the capital controls. Indeed, facing capital influx, the EMEs usually have no choice but to diminish the interest rate in an effort to stabilize the exchange rate i.e. dampen the upward-sloping strains on the exchange rate¹², while the sterilization operations and the financial stability consideration would rather suggest an increase in the interest rate attracting even more capital inflows. In this respect, many have sided with the view that the conflicting objectives of external stability and capital mobility actually carry with them the seeds of financial crises¹³.

Given the policy objectives in EMEs and the drawbacks in terms of policy consistency entailed by unfettered capital inflows, there are sufficient grounds to deem the “capital mobility limitation” to be the most adequate answer, from both theoretical and pragmatic points of view. The rationale is that it best reconciles the attainment of the two other objectives and it reduces the reliance on sterilization operations at an acceptable level of costs. In sum, to EME having binding exchange rate commitments (e.g. hard peg) or to those abiding by rigorous inflation-targeting framework, the capital controls may actually be the most satisfactory tool.

Our contribution to this discussion can be divided into two points. Firstly, the recent financial crisis and the IMF’s mindset breakthrough have given rise to a revival of interest in

¹⁰ Prasad (2010) found evidence of an implicit exchange rate objective for China, which results in massive sterilization measures. The mopped-up liquidity is mostly transformed in foreign currency denominated assets, usually the US Treasury bonds.

¹¹ Greenwood (2008)

¹² Due to their underlying output objective.

¹³ Taylor (1998), Radelet and Sachs (1998), Stiglitz (2000), Frenkel and Repetti (2009, 2010)

the efficiency of capital controls¹⁴, especially the ones set up by the EMEs who suffered from sudden capital movements in the past. We establish to that purpose a list of two countries - Chile and Thailand – whose experience as regards capital controls covers a relatively long period. Secondly, the research below aims at exploring the opportunity for EMEs to prevent or to manage capital inflows when facing great global economic turbulences. This opportunity can be measured along two dimensions - in terms of “dynamics” (variation of the responsiveness of capital flows) and of “targeting” (recipient sectors of capital flows). The interest of this examination is twofold. First, it helps to determine the duration of capital controls. That is, long-lasting devices will be recommended in case of time-consistent flows and short-lasting devices will be suggested in case flows exhibit sporadic mind shifts. Second, on the basis of the dynamic pattern of capital flows, we could determine the nature of capital control devices. Indeed, the range of capital controls will be contingent upon whether capital flows enter indiscriminately recipient sectors or they are focused on specific sectors. This distinction would be useful when it comes to determine whether actions should be concentrated on a panel of sectors or they should be generally implemented to the whole economy.

The rest of the paper proceeds as follows: Section 2 presents the evolution of the theoretical framework for capital controls and assesses recent measures implemented by the EMEs. Section 3 presents the specification of our estimation model. Section 4 presents the estimates and discusses the results. Section 5 concludes.

2. Background of capital flows and motivations for capital controls

2.1 Four fears of capital inflows

In a comprehensive assessment of existing literature, Magud and Reinhart (2006), Magud, Reinhart and Rogoff (2011) first stated the underlying difficulties that a surge of international capital imposes to policymakers of EMEs. They can be summarized into the “four fears”, which are the fears of appreciation, of hot money, of large inflows and of loss of monetary autonomy. For EMEs who are recipients of cross border funds, an upsurge of international capital represents a daunting challenge for two reasons: capital inflows leave

¹⁴ Independent Evaluation Office (2004). The IMF (2011) first used the term of “ capital flow management measures (CFMs)”

little room for maneuver to the domestic monetary policy, and the complex composition of capital inflows remains difficult to manage.

More precisely, under the term of “four fears”, Magud and Reinhart (2006) asserted that the capital influx may escalate the upward-sloping strain on the value of domestic currency, likely to trigger a loss of competitiveness of domestic manufacturers¹⁵. As a result, the counterpart of the exchange rate stability is often the abdication of monetary policy autonomy, due to an implicit exchange rate goal¹⁶. That is, in order to tame undesirable appreciation of the domestic currency, recipient countries generally translate their “fear of appreciation” i.e. the fear of floating¹⁷ into a binding accumulation of foreign exchange reserves as a self-insurance¹⁸, reducing as a result the domestic monetary autonomy¹⁹.

It is also noteworthy that the composition of capital inflow renders the management of capital flows even more delicate. First, a great volume of capital inflow seeking higher yields in EMEs²⁰ nurtures indiscriminately asset prices (bubbles)²¹, provokes domestic credit loans, elicits currency mismatches of the balance sheets of the private sector²², weakening thus the incipient local financial system development²³. Second, the hot money embedded in overall capital influx is all the more unsettling in that its upsurge remains abrupt and volatile as well as its withdrawal²⁴. The sudden reversal of capital inflows is even considered by some observers as an additional fear, understood as the fear of capital flight²⁵.

In summary, (i) given the structural constraints that capital inflows impose on the ability of EMEs to preserve monetary policy autonomy (one that is consistent with exchange rate objective, flexible monetary supply, and inflation targeting), and (ii) given the potentially hazardous nature of capital inflows, preemptive measures understood as capital controls pertaining to inflows appear to be an approach of great interest.

¹⁵ Kaminsky (2005)

¹⁶ Clarida, Gali and Gertler (2000)

¹⁷ Calvo and Reinhart (2002)

¹⁸ Hernandez and Montiel (2001); McKinnon and Schnabl (2004) and BIS (2006) pointed out that, most eastern Asian EMEs pledge to accumulate foreign exchange reserves in the aim of keeping their exchange rate against abrupt appreciation. Thus, EMEs are supposed to have an implicit exchange rate objective (BIS 2006).

¹⁹ An accumulation of foreign exchange reserves yields an increase in the domestic monetary base through credit growth, which could be inconsistent or even incompatible with monetary policy objectives.

²⁰ Calvo, Leiderman and Reinhart (1994)

²¹ Ocampo and Palma (2008) employed the term of “fear of asset bubbles”.

²² Kaminsky (2005)

²³ Ostry et al. (2011)

²⁴ Schadler (2008) stressed that 15 percent of the capital inflow episodes over the past 20 years ended in crisis.

²⁵ Gabel (2003), Epstein (2005)

2.2 Selected country experiences with capital inflows

The issue of capital controls as temporary capital account tightening is often in the spotlight in the wake of great financial crises. After the Asian crisis of 1997, leading economists have mounted critical concerns about the scourge of abrupt international capital movements and considered the temporal capital account tightening as a full-fledged policy tool²⁶. In this respect, an overview of the experience of Chile and Thailand will be useful for a better understanding of the capital controls' efficiency.

In the run up to the 1980's and until 1990's, a number of EMEs began to experiment the roller coaster of capital flows, both in terms of volume and volatility. In late 2001, in the aftermath of the internet bubble, capital flows dried up then reappeared throughout the mid 2000's. They then decreased suddenly during the crisis of 2008–2009, and resurfaced in early 2010. The EMEs suffered from abrupt capital torrents that they could hardly absorb and they were also highly exposed to sudden withdrawal. Traditionally, EMEs are rather reluctant to restrictions of capital mobility since such a policy response may dissuade haphazardly all foreign investors and may isolate the country from international financial connection. However, a handful of EMEs still decided to have recourse to capital controls. In a remarkable and enlightening way, Chile and Thailand had a rich experience in implementing capital mobility restrictions. In the array of capital control devices against undesirable inflows, the unremunerated reserve requirements (URR) emerged in the 90's to be the privileged instrument to Chile and Thailand.

The reform that Chile undertook in the aftermath of its major financial crisis in the 1980's has been successful: sounder fundamentals, progressive capital account liberalization, trade openness and privatization of public sectors. However, the Chilean objective of fighting inflation created then a considerable interest rates differential between Chilean rates and those prevailing in the AEs. During three years from 1988 to 1990 gross private capital inflows increased from 0,9 billion U.S.D. to 1,8 billion U.S.D. of which hot money represented up to 95% of total inflows by 1989. And in 1997, the amount had reached 2, 8 billion U.S.D.²⁷. In an effort to safeguard the monetary policy autonomy, consistent with a low-inflation objective and a stable exchange rate, Chile resorted to URR which were subject to various extensions.

The first application of the URR in 1991 targeted foreign loans and fixed income securities. The credits were requested to remain in Central Bank deposit accounts for up to a

²⁶ Bhagwati (1998), Rodrik (1998), Eichengreen et al. (1998) Krugman (1999), Stiglitz (2000)

²⁷ Edwards (1999)

year. A year after, the device was extended to trade credits and loans related to FDI. In 1995, the URR covered also bonds and domestic stocks traded in the New York Stock Exchange²⁸.

In sum, the Chilean URR in the 1990's was an overall success that many observers later acknowledged to be a reference tool to other EMEs²⁹. Precisely, studies unanimously found that the Chilean capital controls have not only effectively preserved domestic monetary policy autonomy but also successfully altered the composition of inflows³⁰. Nevertheless, the same studies also pointed out that the effects of URR are rather irrelevant when it comes to the reduction of the volume of net capital inflows and the alleviation of exchange rate pressures.

In April 1990, Thai authorities implemented a ceiling for net foreign exchange positions of banks and finance companies up to 25% of capital. Five years later, the Bank of Thailand introduced for the first time the URR that it applied to short-term non-resident baht accounts. In the following months, the URR up to 7% were extended to finance companies' short-term promissory notes held by non-residents, in an effort of lessening cross-border lending³¹. Given a severe drop in industrial output, a sharp raise of key interest rates, a quick depletion of foreign exchange reserves and a violent loss of half of the value of the Thai baht against U.S.D in the midst of the Asian crisis in 1997, the Bank of Thailand imposed ampler restrictions on capital account transactions, such as a two-tiered exchange rate regime³².

In terms of effectiveness, the capital controls that Thailand implemented during the Asian crisis stir controversy. In their study in 2000, Edison and Reinhart found that Thai policy measures were introduced with a great delay and did not have the time to "make a dent". Furthermore, they might even have exacerbated the problems. Nevertheless, Ariyoshi et al. (2000) found that Thai capital controls in contrary did successfully accomplish their goals: in reducing the volume of net capital inflows; in modifying the composition of flows, in curbing the currency appreciation pressures and in preserving monetary policy flexibility.

Table 1 reproduces the assessment of Magud and Reinhart (2006), which summarized the results of studies that independently addressed the efficiency of capital controls of Chile and Thailand³³.

²⁸ Cordero and Montecino (2010)

²⁹ Stiglitz (1999)

³⁰ Magud and Reinhart (2006)

³¹ Magud and Reinhart (2006)

³² The two-tiered exchange rate regime is an exchange rate system under which authorities set separate rates for capital flows and for current account transactions.

³³ The analyses of Chile cover the period of 1988-1998 (De Gregorio, Edwards and Valdés (2000); Edwards (1999), Edwards and Rigobon (2004), Labán, Larraín and Chumacero (1997), Labán and Larraín (1998), Le Fort

Table 1

(1995-1997) Did capital controls allow to				
	Reduce the volume of net capital inflows	Alter the composition of flows	Tame the real exchange rate pressures	Preserve monetary policy independence
Chile	Unclear	Yes	Unclear	Yes
Thailand	Yes	Yes	Yes	Yes

Source: Magud and Reinhart (2006)

Given the above, the experience of using URR in the 1990's appears to be an overall success for our two sample countries. However, since the dawn of the 21st century the growing interconnectedness between economies and the ease with which international capital penetrates and leaves recipient countries do give us reasons to cast doubt on the effectiveness of the same devices. Indeed, recent studies focusing on the efficiency of countries' intervention during and after the Global Financial Crisis of 2008, such as the works of Baumann and Gallagher (2012) on Chile and of Jittrapanun and Prasartset (2009) on Thailand, drew an alarming conclusion in this regard.

At the end of 2010, the Chilean authorities imposed a limit up to 80% on foreign investment in pension funds. Starting from January 2011, the Chilean central bank took extra action in foreign exchange market by means of daily U.S.D. purchases³⁴. However, the findings show that Chilean intervention only had temporary effects on the Chilean exchange rate and on asset prices: it reduced the level of exchange rate but not its volatility.

In a way analogous to Chile, Thailand conducted restrictive policy regarding international capital. By December 2006, the Bank of Thailand first prohibited financial institutions from selling and buying of all types of debt securities through sell-and-buy-back transactions for all maturities. Given the ineffectiveness of the measures against baht appreciation, on 18th December, Thai authorities deployed URR up to 30% on all capital inflows. In sum, Thai authorities did succeed to reduce the volume of overall inflows. Nevertheless, the capital control unwittingly decreased the productive FDI at the same time and triggered, contrary to what was expected, an immediate decrease of 20% in stock prices on announcement day. Moreover, restrictive measures did not seem to significantly preserve

& Budnevich (1997), Reinhart and Smith (1998) Valdés-Prieto and Soto (1995), Ariyoshi et al. (2000)); and the study of Thailand focuses on the period 1995-1997 (Ariyoshi et al. 2000).

³⁴ At a rate of 50 million U.S.D. a day.

monetary policy autonomy or to alleviate exchange rate pressures. Table 2 resumes the results of aforementioned studies.

Table 2

(2009-2011) Did capital controls allow to				
	Reduce the volume of net capital inflows	Alter the composition of flows	Tame the real exchange rate pressures	Preserve monetary policy independence
Chile	No	No	No-lasting effect	No
Thailand	Yes	Decrease only FDI	No	No

Source: Coelho and Gallagher (2010), Baumann and Gallagher (2012)

In sum, the Chilean and Thai policy measures, albeit more hesitant than that of 1997, failed by far to reach the same performance. This notable discrepancy in terms of results raises thus the critical question why, within a decade, capital control seems to have fallen by the wayside in terms of effectiveness. In response to this interrogation, one may argue that the growing difficulty for EMEs to manage capital movements is actually demonstrative of the increasing depth and the magnitude of the interconnectedness of economies. As a consequence, in an effort to elaborate more efficient capital control devices, the characterization of capital movements' patterns appears to be of key interest.

2.3 Stylized facts and patterns of capital movements

Given the experience of inflows and outflows throughout almost two decades, observers such as Moghadam (2011)³⁵ put forward certain features of international capital movements over the period 1996 – 2009 within which three waves³⁶ of capital flows can be distinguished, that are the periods of 1995–1998, 2006–2008, and the current wave since 2009.

1) Capital inflow episodes begin at different times for different countries, due to country-specific circumstances of EMEs. Nevertheless, observers are witnessing an increasing number of concomitant reversals, as confirmed by the synchronized capital retreat from EMEs in 1997-1998 and 2008-2009.

³⁵ IMF

³⁶ According to the terminology of the author, an episode is a prolonged capital surge and a wave corresponds to the simultaneous occurrence of episodes in a diversity of countries.

2) The destination of capital flows has changed over time. Indeed, prior to the Asian crisis, about half of the international capital targeted Asian EMEs. In the aftermath of the Asian EMEs' downturn until the recent financial crisis, flows rather concentrated on Central and Eastern European economies.

3) The nature of capital inflows into EMEs has been fluctuating. Over 1995-1998, capital flows were significantly compounded by Foreign Direct Investment up to nearly 40%. Over 2006-2008, inflows toward EMEs other than FDI were composed of cross-border bank lending, which represented up to 40% of total inflows. Since 2009, the composition of total inflows has skewed toward portfolio debt assets reaching an unprecedented level by totalizing one half of the flows into EMEs. The tendency of reinforcing role of portfolio flows is likely to persist in the future.

4) Compared with other inflows, the portfolio flows remain the most volatile. Their volatility has amplified since the beginning of the sample period and is likely to persist in the future. Bank lending flows are less volatile but their volatility is generally brutal during crises.

Given the above, one may henceforth note the tremendous strides that international capital has made over the two decades in terms of magnitude and velocity of penetration into the EMEs. This assessment raises thus the question how to explain such movements and how to standardize the explanatory framework.

The capital movements can be understood as the expression of what ones foresee regarding the economic evolution of an economy in comparison with others³⁷. In an effort to account for capital flows, two explanatory frameworks are commonly put forth. That is, the cyclical-structural framework and the push-pull factor framework.

Cyclicity has been the essential explanatory feature of the pattern of capital flows toward EMEs. International capital movements have mainly reflected the discrepancy between the business cycles of the AEs and that of EMEs. In the early 1980's, there has been a sharp drop-off of international liquidity. Capitals rebounded however in the 1990's and ended up massively withdrawn at the dawn of the 2000's. Their return during the recovery period in the aftermath of the internet crisis lasted until withdrawal from EMEs in 2008.

In accordance with the cyclical framework, capital movements over the sample period are simultaneously driven by two incentives. That is, they are cyclically attracted by the gap of interest rates and growth potentials between AEs and the EMEs and they are structurally

³⁷ Hoggarth and Stern (1997)

led by the strategy of diversification and the higher growth potential of a handful of EMEs³⁸. However, although the dynamic-static model stands for a pertinent explanatory framework, it does not fully describe international capital movements. As a result and in an effort to have a deeper understanding of the phenomenon, complementary explanations based on country-specific³⁹ drivers appear to be necessary.

In complement with the cyclical-structural framework stated above, the push-pull factors model subdivides the former model into two categories. No longer based on the periodic gaps of business cycles, the push-pull framework focuses on the determinacy of global (common) and country-specific (idiosyncratic) drivers in characterizing the dynamics of capital movements. More precisely, the push factors stand for global incentives (such as low world interest rate or high global risk appetite) that push capital out of AEs, while pull factors are drivers of attractiveness⁴⁰ that draw international capital seeking investment opportunities out of AEs.

Moghadam (2011) summarized and rendered interdependent the two explanatory schemes. Table 3 assesses the results of the author.

Table 3

	Cyclical	Structural
Push	<ul style="list-style-type: none"> - Low US interest rates - Low global risk aversion - Strained AEs balance sheets 	<ul style="list-style-type: none"> - International portfolio diversification - Low AEs potential growth
Pull	<ul style="list-style-type: none"> - High commodity prices - High domestic interest rates - Low domestic inflation 	<ul style="list-style-type: none"> - Improving EMEs balance sheets - High EMEs potential growth - Trade openness

Source: Moghadam (2011)

Since the emergence of the two explanatory frameworks stated above, contentions have been to ascertain how relevant the two factors have been in accounting for capital movements. Furthermore, which of the push or the pull factors has been more preponderant upon another in describing past and recent crises?

Over the period of 1990-2010 covering the Mexican, Asian, Argentinean and the recent crisis, Moghadam (2011) found that the U.S. interest rates, in the form of the yield of

³⁸ Grenville (2010) underlined that international capital usually concentrates on Eastern Asian and Eastern European EMEs.

³⁹ The term “specific” is understood as referring to identified recipient sectors.

⁴⁰ Levy-Yeyati, Panizza, and Stein (2007), IMF (2007), World Bank (2009) identified a number of constant pull drivers, which are market size, trade openness, the quality of institutions and growth prospects.

U.S. 10-year Treasury bond, constitutes a major determinant of total capital flows toward EMEs. In a manner analogous to the low U.S. interest rate, global risk aversion affects positively total inflows and particularly the component of equity inflows. As for the country-specific determinants, the author noted a significant role played by the EMEs growth prospects in attracting international capital (both the FDI and the cross-border bank lending).

While the findings above are based on a long sample period from 1996 to 2010, Fratzscher (2012)⁴¹ focused on the recent crisis and found a convergent conclusion. The push factors, in the form of shocks to liquidity, risk and to global macroeconomic conditions, as well as the pull factors, in terms of fundamentals' soundness of EMEs have both been relevant as for the description of capital flows toward the EMEs.

Given the increasing interconnectedness of determinants, it has to be acknowledged that capital flows today are driven by both common and country-specific factors in a dynamic way. In other words, international capital movements are believed to no longer occur steadily over time for structural reasons. Instead, pro-cyclical determinants as well as country-specific factors have become the major drivers of capital inflows. And this procyclicality strongly supports the hypothesis of nonlinear dynamics of capital flows with varying responsiveness to drivers over time. As a consequence, the design of capital controls should henceforth be subject to a paradigmatic rebalancing between “walls” and “gates” i.e. between general devices applied to capital flows as a whole⁴² and specific instruments (deployed according to actual recipient sectors).

3. Model specification

In an effort to weigh the choices respectively between general/specific devices and long/short lasting devices, the determination of the drivers of capital flows appears to be the prerequisite step. As the push-pull factor model has set up a benchmark framework to capture capital movements' patterns, one may summarize that all capital inflows consist of three parts, which are permanent capital flows, push-factor driven flows and pull-factor driven flows. Our contribution to this discussion consists of two mutually exclusive supposals. That is, we suppose that the capital flows actually exhibit either a linear pattern (time-consistent) or a nonlinear pattern (time-inconsistent).

⁴¹ ECB

⁴² Terminology from Klein (2012)

Our hypothesis of linearity assumes that capital movements are to follow a permanent pattern with constant responsiveness to a panel of drivers. This responsiveness is “time-consistent” i.e. unvarying whether in the absence of crises or in case of economic turbulences. As for the opposite hypothesis, we suppose that capital movements can be described by nonlinear dynamics. That is, we consider the reaction of capital flows to drivers as falling into a two-state regime: the normal period and the stress period. Under the “stress period”, the responsiveness of capital flows is likely to deviate from the one under the “normal period” and thus to allow us to identify drivers to which capital flows exhibit particular sensitivity in times of great economic turbulences.

In sum, the aim of this examination is twofold. First, we investigate whether there is a “stress pattern” of capital movements toward EMEs, in an effort to consider the duration of control devices. In case capital flows exhibit a time-consistent (linear) pattern, control devices should be accordingly long-lasting. On the contrary, if capital flows exhibit nonlinearity, capital controls should be circumstantial i.e. short-lasting. Second, we purport to identify effective factors of capital flows from an overall perspective. By doing so, we tend to determine the amplitude of controls. That is, in case capital only reacts to a handful of sectors, specific devices would be recommended. Otherwise, general devices with overall extent would be deemed to be better suited. These interrogations could be summarized into a pivot table containing four scenarios (Table 4).

Table 4

	Stress pattern	Absence of stress pattern
Responsiveness to specific drivers	<p>H•1</p> <ul style="list-style-type: none"> - <i>Short-lasting</i> - <i>Specific</i> 	<p>H•3</p> <ul style="list-style-type: none"> - <i>Long-lasting</i> - <i>Specific</i>
Absence of responsiveness to specific drivers	<p>H•2</p> <ul style="list-style-type: none"> - <i>Short-lasting</i> - <i>General</i> 	<p>H•4</p> <ul style="list-style-type: none"> - <i>Long-lasting</i> - <i>General</i>

Source: Author

H•1: In case of validation of the “stress pattern” with responsiveness to specific drivers i.e. capital flows exhibit different sensitivity to a handful of drivers in times of economic turbulences, the results may suggest the implementation of short-lasting and specific control devices. That is, capital control is circumstantial and would be deployed only in periods of stress to a handful of sectors to which capital flows become highly sensitive.

H•2: In case of validation of the “stress pattern” without responsiveness to specific drivers, we may suppose that international capital flows exhibit a “hedge-like” mindset i.e. they enter recipient countries disregarding the attractiveness of individual sectors. As a corollary, short-lasting and general control devices would be better suited. The results may suggest the implementation of temporary and specific control devices. That is, capital control is circumstantial and would only be deployed in periods of stress and for a delimited time horizon in a panel of sectors to which capital flows become highly sensitive.

H•3: In absence of such a “stress pattern” with responsiveness to specific drivers i.e. the proneness of capital flows to react to the factors is supposed to be time-consistent, long-lasting and specific capital controls would be considered to be more adequate.

H•4: In absence of the “stress pattern” without responsiveness to specific drivers i.e. the capital flows’ pattern remains uninterrupted over time reacting indiscriminately to the recipient sectors, we would thus advocate long-lasting and general devices (or understood as a capital account tightening).

3.1 Baseline model specification

We suppose that capital flows toward EMEs could be approximated by equation (1)

$$CF_t = \mu + \sum_{i=1}^k \theta_t \cdot X_{i,t-1} + u_t \quad (1)$$

, where CF_t stands for the total volume of capital flows toward EMEs, μ refers to constant capital flows, and $X_{i,t-1}$ the panel of explanatory variables integrating a list of global and local factors. The variables are all lagged by one period as it is assumed that flows reflect the past observation of the relevant variables⁴³.

Among drivers listed in existing push-pull factor literature, we constructed a list of explanatory variables based on conventional criteria. As for push (global) factors, recent studies recommend a number of global factors, such as credit shock and confidence shock⁴⁴. As for pull (EMEs) factors, we selected a set of conventional local variables, which are the gaps of growth prospects, interest rate and equity return between AEs and EMEs⁴⁵. The data used in this study are monthly for Chile and Thailand. The sample covers the following periods: December 2003 to December 2012, which corresponds to the period during which

⁴³ Lo Duca (2012), Bekaert, Hoerova, and Lo Duca (2011)

⁴⁴ Lo Duca (2012)

⁴⁵ Moghadam (2011)

the recent financial crisis occurred. However, given the annual basis of the computed inflation growth rate (year-to-year), we delay each value with one period. Hence, the sample really covers the periods from January 2004 to December 2012. All estimations are performed with MATLAB.

Detailed presentation of the variables is given as follow, based on the criteria of Moghadam (2011)⁴⁶.

- **Capital flows**: our capital flow tracker is based on the Balance of Payment (BOP) capital flow tracker, recommended by the IMF⁴⁷. The net capital flows could be computed as the differential between change in international reserves and the trade balance. We use monthly variations of the differential as the response variable in our model.
- **Credit shock**: the credit shock could be approximated by the differential between the three month interbank rate and the OIS rate. The proxy appears to be satisfactory since the OIS rate represents the predicted path of the risk-free rate, while the interbank rate is influenced by the credit quality of banks. As a result, the gap between the 3-month interbank rate and the OIS rate can be considered as a gauge of credit risk. We then use the monthly changes of the gap to measure the credit shocks.
- **Confidence shock**: the habitual proxy of the confidence shock is the US VIX index. According to, Fratzscher (2010), Bekaert, Hoerova and Lo Duca (2011), the VIX index consisting of option implied volatility reflects stock market uncertainty and the risk aversion. We use therefore monthly changes of this indicator to measure confidence shocks.
- **Differential between growth prospects**: Recent studies unanimously show that a number of variables are proven to be strong pull factors among which the differential of growth prospects between AEs and EMEs remains particularly relevant⁴⁸. We then use the monthly changes of the difference between the US and our two EMEs' growth prospects, in an effort to outline the role of growth prospects in attracting capital flows.
- **Differential between interest rates**: since interest rate is the primary variable that bears significance for fixed income securities, such as corporate bonds, it is pervasively adopted in existing literature as a pull factor for capital flows⁴⁹. Besides, against the background of increasing capital mobility, widening interest rate gap with those of the AEs is also

⁴⁶ The data are all collected on Datastream.

⁴⁷ The IMF (Moghadam 2011) proposes 2 proxies, which are the BOP data tracker and the "Emerging Portfolio Fund Research" (EPFR) tracker (specifically for portfolio flows).

⁴⁸ Levy-Yeyati, Panizza, and Stein (2007); IMF (2007); World Bank (2009); Moghadam (2011)

⁴⁹ Fama and French (1989, 1993)

considered as a strong incentive for international capital to move into EMEs⁵⁰. We then retain the monthly variations of the differential between the US Federal funds rate and the key rate of our two sample countries in an attempt to measure the effects that interest rate gap may exert on capital flows.

- ***Differential between stock market return***: as one of the major concerns that motivate the use of capital control consists of stabilizing the asset prices, one may reasonably assume that the domestic equity returns (in EMEs) constitutes a full-fledged pull factor drawing international capital. We then use the monthly based differences between the US equity index, approximated by S&P 500 index, and the domestic equity indexes of EMEs to measure the attractiveness of equity return gap.

3.2 Specification of nonlinear equation

In an effort to verify our supposal of a two-state pattern (stress and normal patterns) of capital flows, we then apply a nonlinear estimation method to the equation (1). The model can be rewritten as in equation (2).

$$CF_t = \lambda_0(S_t) + \lambda_1(S_t)[OIS]_{t-1} + \lambda_2(S_t)[VIX]_{t-1} + \lambda_3(S_t)[Gap_GDP]_{t-1} + \lambda_4(S_t)[Gap_Int]_{t-1} + \lambda_5(S_t)[Gap_Return]_{t-1} + \varepsilon(S_t); \varepsilon(S_t) \sim Normal(0, h_t) \quad (2)$$

A number of nonlinear time series models are available for the conduct of our estimations, which are the Smooth Transition Regression model and the Markov-switching model. However, as Petersen stated in his study (2007), the Smooth Transition Regression model provides explanations for endogenous regimes switching i.e. it allows regression coefficients to change smoothly from one regime to another, whereas the Markov-switching model accounts for exogenous regimes switchings i.e. the regression coefficients are subject to abrupt modifications due to straightforward regimes shifting. Consequently, in an attempt to shed light on a possible “stress pattern” of capital flows toward EMEs during the recent financial crisis, the Markov-switching model appears to be well suited to that purpose.

In order to better capture the “stress pattern” i.e. uneven responsiveness of capital flows to drivers in case of great turbulences, we assume in our model that there exists only one status variable, S_t . In this paper, we consider the capital flows’ responsiveness as falling

⁵⁰ Reinhart and Reinhart (2008), Ostry et al. (2010)

into a two-state regime. Our model is specified in a fashion that assumes one common binary-state variable for the whole model ($S_t = 1$ or $S_t = 2$). In other words, there exist only two possible states - the “normal regime” and the “stress regime” - for each variable (driver).

Equally noteworthy is the fact that there exist two ways to determine which regime that the state $S_t = 1$ and the state $S_t = 2$ represent respectively. The first method is to refer to the permanent capital flows, $\lambda_0(S_t)$. Indeed, we suppose that there exist two states in our switching model, $S_t = 1$ or $S_t = 2$. Since $\lambda_0(S_t)$ represents the part of capital flows that is not explained by drivers, if $\lambda_0(S_t = 1) < \lambda_0(S_t = 2)$, we may consider that $S_t = 1$ is the “normal regime” (low volume of permanent capital flows) and $S_t = 2$ is the “stress regime” (high volume of capital that our drivers do not explain).

At a methodological level, the assigned weights of each target variable, ruled by an unobservable state variable, S_t , which indicates the binary state variable subject to two possible states, $S_t \in \{1,2\}$. The switching of the state variable exposes random movements by following in this respect a first-order Markov chain. The transition probability of the state variable, $S_t \in \{1,2\}$, follows in this respect a first-order Markov chain in accordance with the specification of Hamilton’s autoregressive model (1989): $P[S_t = j|S_{t-1} = i, S_{t-2} = k, \dots] = P[S_t = j|S_{t-1} = i]$. We define four transition probabilities for the two state-variables: $P[S1_t = 0|S1_{t-1} = 0] = p_1$; $P[S1_t = 1|S1_{t-1} = 1] = q_1$; $P[S2_t = 0|S2_{t-1} = 0] = p_2$; $P[S2_t = 1|S2_{t-1} = 1] = q_2$. The error term, ε_t , follows a i.i.d. Normal distribution with n degree of freedom, n as the number of samples. Its probability density function can be written as follows: $f(t) = \frac{\Gamma(\frac{v+1}{2})}{\Gamma(\frac{v}{2})} \cdot \frac{1}{v\pi} \cdot (1 + \frac{t^2}{v})^{-(v+1)/2}$; $E(t) = 0, Var(t) = v/(v - 2)$. The maximum log likelihood function is established by: $\log f(Y_T, Y_{T-1}, \dots, Y_1|Y_0, Y_{-1}, \dots, Y_{-r+1}) = \sum_{t=1}^T \log f(Y_t|Y_{t-1}, Y_{t-2}, \dots, Y_{-r+1})$

4. Estimation results and interpretation

The estimates are summarized in Table 4.

Table 4

Coefficients	Chile		Thailand	
	<u>$S_t = 1$</u>	$S_t = 2$	<u>$S_t = 1$</u>	$S_t = 2$
Model's variance	413550.138 (0.00)*	620324.709 (1.00)	6591404 (0.00)*	9887107 (1.00)
λ_0 (constant flows)	599.948 (0.05)**	-613.57 (0.58)	-532.155 (0.56)	537.549 (1.00)
λ_1 (OIS 3m)	-26.102 (0.57)	-117.55 (0.59)	-80.667 (0.70)	-121.281 (1.00)
λ_2 (VIX)	-27.462 (0.02)**	21.843 (0.62)	108.068 (0.00)*	-294.357 (1.00)
λ_3 (Gap_P)	-3.892 (0.74)	6.166 (0.93)	82.347 (0.00)*	-64.901 (1.00)
λ_4 (Gap_I)	119.067 (0.01)**	-247.025 (0.29)	-495.895 (0.11)	576.143 (1.00)
λ_5 (Gap_Y)	-0.121 (0.33)	1.046 (0.20)	9.124 (0.14)	-126.697 (0.14)

***- denotes coefficient significance at the 10 level

** -denotes coefficient significance at the 5 level

* -denotes coefficient significance at the 1 level

For a better comprehension, econometrically significant regime is underlined

4.1 Chile

Table 4 shows the results from running exercises using a Markov-switching method for Chile. First, the findings indicate that only the S_1 is econometrically significant, as the model's variance of S_1 stands at 0.00 and the one of S_2 stands at 1.00. According to Figure 1, there is no glaring sign of regime shifting. In addition, as $\lambda_0(S_t)$ stands for the constant capital flow, in case $\lambda_0(S_t = 1)$ is significant and bears positive value, we may consider that $S_t = 1$ indicates a regime under which capital flows toward the EMEs⁵¹. This statement suggests that, over the sample period, (i) the capital flows exhibited a time-consistent pattern with absence of stress regime⁵²; (ii) the constant capital flows, such as the FDI, constitute an effective component of overall international capital toward the Chilean economy.

Second, the findings show that 2 of the selected explanatory variables account significantly for the capital flows, which are the VIX index and the differential of interest rates. More precisely, the coefficient of the VIX index stands at -27.462 under S_1 . That is, an increase of 1 percent in the U.S. VIX index of the previous period is likely to yield a decrease of 27.462 percent in the capital flows. The coefficient of the interest rates gap stands at

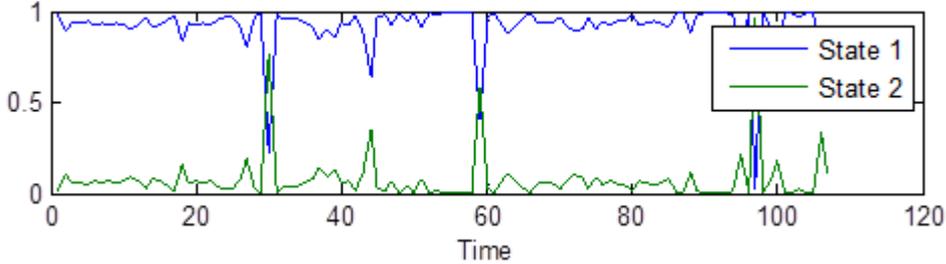
⁵¹ The value is negative for $S_t = 2$, which indicates a general outflow.

⁵² $S_t = 1$ corresponds thus to the normal regime.

119.067 under $S1$. That is, an increase of 1 percent in the interest rates gap of the previous period leads to an increase of roughly 119 percent in the capital inflows.

In sum, (i) an increase in the U.S. VIX index of the previous period triggers generally a diminution of capital flows into Chile; (ii) an increase in the interest rates gap (either a lower Federal funds rate or a raise of the Chilean key interest rate) of the previous period doubles in average the volume of capital flows toward Chile.

Figure 1

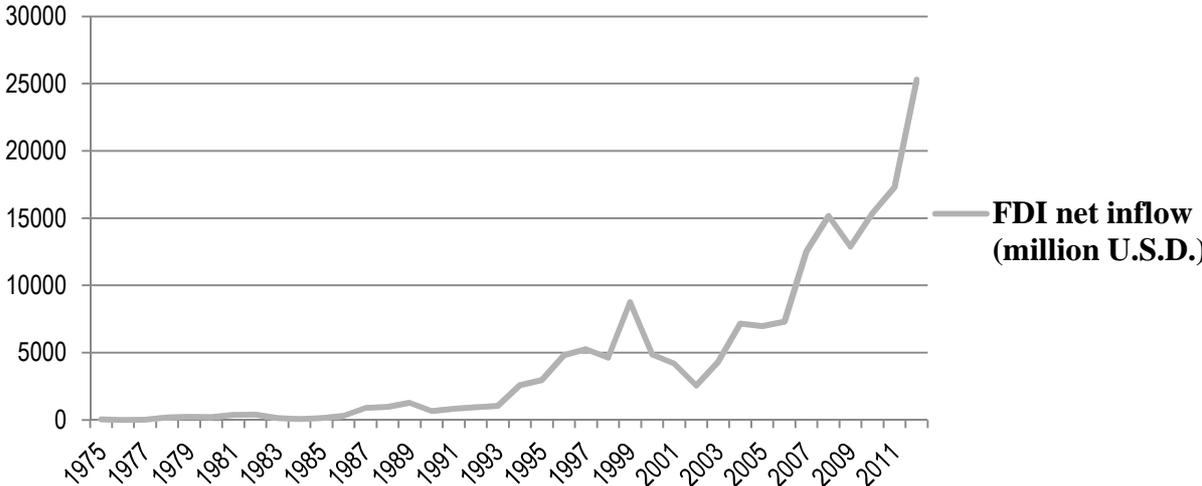


Source: author

Given the results, 4 observations could be put forward. In the first instance, the absence of regime shifting denies the existence of a “stress pattern” of capital flows toward Chile. In other words, international capital flows remain time-consistent and do not exhibit varying responsiveness to drivers in times of turbulences.

In the second instance, over the sample period, the constant capital inflows which are independent of our explanatory variables account significantly for the overall capital flows into Chile. A possible interpretation would be that capital seeking productive opportunities continuously flows into the country, as indicated the upward tendency of FDI net inflows contained in Figure 2.

Figure 2 Chile



Source: Datastream

In the third instance, the findings outline a negative correlation between the VIX index measuring world risk aversion and the capital flows toward Chile. In other words, in case of an increase in the risk aversion of AEs' investors, international capital is likely to be retained in the AEs (less inflow) or even repatriated (outflow) from Chile. The coefficient exhibiting an elasticity of 27 percent indicates a great responsiveness of capital flows to the global risk perception.

In the fourth instance, the results indicate that capital flows toward Chile exhibits a high and positive sensitivity to the differential between the level of world interest rate and the Chilean interest rate. More precisely, the findings outline an elasticity of 119 percent, which strongly suggests (i) a high capital mobility in Chile; and (ii) a great responsiveness of capital flows to either a lessened world interest rate (push) or a higher Chilean interest rate (pull). This result is all the more interesting that it corroborates the observation of the past experience of the country: interest rates gap constitutes the major incentive of capital flows toward Chile⁵³.

Substantially, given the fact that capital flows toward Chile are time-consistent and are sensitive to the global risk aversion and the interest rates gap, the findings better suit the H^o4 described above. Firstly, the results imply the implementation of a long-lasting capital control. Secondly, the strong responsiveness of capital flows to the VIX and to the interest rates gap supports the hypothesis that flows other than FDI (portfolio flows and hot money) could become highly mobile (upsurge or reversal) due to global uncertainty and to the world push factor. In this regard, general devices of preemptive nature appear to be adequate against abrupt outflows in times of increasing global risk aversion. However, in an attempt to safeguard monetary policy autonomy, especially in terms of policy rate flexibility, specific controls may also be considered as an extra instrument deployed to interest rate-related sectors such as remunerated banking accounts, cross-border bank lending (carry trade), and interest rate securities.

4.2 Thailand

Table 4 shows the results for Thailand. First, the findings show that the *S1* is the only econometrically significant regime, as the model's variance of *S1* stands at 0.00 and the one of

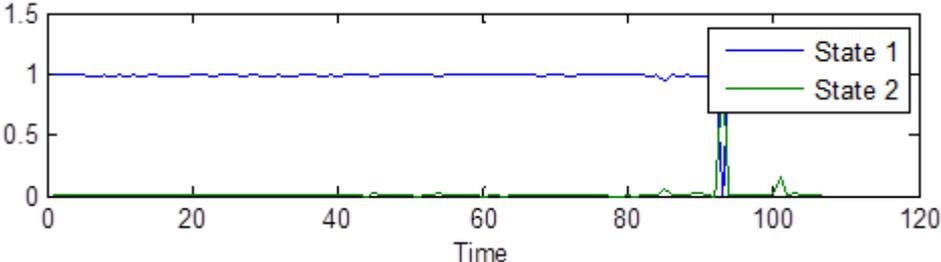
⁵³ Cf. Coelho and Gallagher (2010), Baumann and Gallagher (2012)

S_2 at 1.00⁵⁴. That is, capital flows over the period were time-consistent. Equally noteworthy is the fact that the estimates contained in Figure 3 outline an absence of regime shifting.

According to the Table 4, the constant capital flows are not significant over the sample period. In other words, constant components of capital flows such as the FDI do not explain to a sufficient extent overall capital movements toward Thailand. Second, the findings show that 2 explanatory variables of our set of drivers are significant, which are the VIX index and the differential of growth prospects. Precisely, the coefficient of the VIX index stands at 108.068 under S_1 . That is, an increase of 1 percent in the U.S. VIX index of the previous period is likely to imply an increase of 108.068 percent in the capital inflows. The coefficient of the growth gap stands at 82.347 under S_1 . That is, an increase of 1 percent in the growth gap of the previous period leads to an increase of nearly 82 percent in the capital inflows.

In sum, (i) an increase in the U.S. VIX index of the previous period leads to a rise of capital flows into Thailand; (ii) an increase in the growth gap (either a lower world growth prospect or a raise of the Thai growth outlook) of the previous period approximately doubles the volume of capital flows toward Thailand.

Figure 3



Source: author

According to the estimates, 4 remarks could be outlined. First, the absence of regime shifting invalidates the hypothetical “stress pattern” of capital flows toward Thailand. That is, capital flows are time-consistent and exhibit constant responsiveness to drivers over time.

Second, the constant component of capital inflows over the sample period do not account for the overall capital movements into Thailand. A possible interpretation would be that long-lasting capital flowing into the country, such as the FDI, is episodically volatile over the sample period despite its upward trend, as characterized in Figure 4.

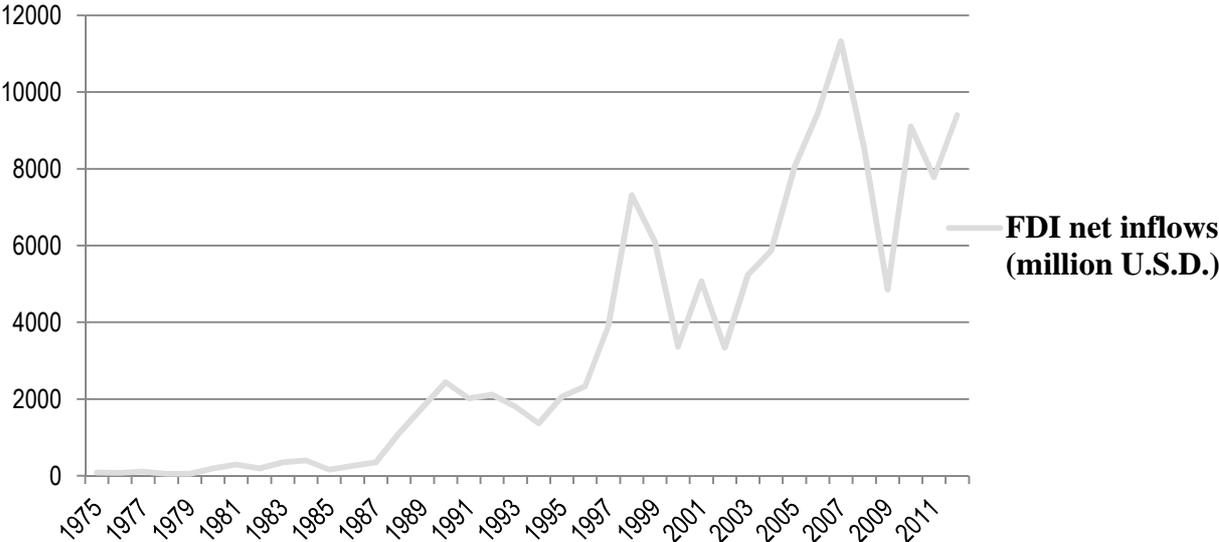
Third, the findings exhibit a positive correlation between the VIX index and the capital flows toward Thailand. That is, in case of an increase in the global uncertainty perceived by international investors, international capital is likely to flow into Thailand. The great

⁵⁴ $S_t = 1$ corresponds thus to the normal regime.

responsiveness of capital flows (of an elasticity of 108 percent) suggests either a massive “hedge” behavior of capital flowing into Thailand in case of increasing global risk aversion or a strong “contagion effect” in the adjacent area.

Forth, the results point out that capital flows toward Thailand are significantly drawn by the differential in terms of level of growth prospects originating either from a lessen world growth outlook (push) or from greater Thai growth prospects (pull).

Figure 4 Thailand



Source: Datastream

Substantially, the findings better suit the H^o4 described above, as capital flows toward Thailand are time-consistent and are drawn by both global risk aversion and the growth prospects gap. Firstly, the results suggest the implementation of a long-lasting capital control. Secondly, the strong sensitivity of capital flows to the VIX and to the growth prospects gap supposes that upsurges could generally be expected in case of global uncertainty and in case of increasing growth prospects. In this regard, general capital controls of preemptive nature may be recommended against “hedge-driven” upsurges in times of great global risk aversion. However, even if the growth prospects gap constitutes an effective factor of capital inflows , the implementation of specific devices in growth-related sectors is not automatically recommended. Indeed, the legitimacy of controls on growth-related sectors remains ambiguous, insofar as international capital either pushed by a low growth outlook in the AEs or drawn by a stronger Thai growth potential may be beneficial to the economy of the recipient country. This caution is in addition motivated by the corroboration of the past

experience of the country: capital controls in 2011 ended up decreasing solely FDI but exerted no effects on other flows⁵⁵.

5. Concluding remarks

This paper investigates the opportunity to implement capital control in Chile and in Thailand. The analysis is conducted on a basis of four hypotheses. Firstly, capital flows toward our sample countries may follow either a time-consistent (normal) pattern or a time-inconsistent (stress) pattern. Secondly, these capital flows may exhibit either responsiveness to a handful of drivers or to all sectors in an indiscriminate fashion. The outcomes of the estimates are supposed to provide arguments as to the type of capital control that Chile and Thailand may deploy in the future. In an attempt to verify the existence of this “stress pattern”, we applied a two-state Markov-switching regression to our model. The estimation outlined interesting results:

(i) There is no evidence of regime shifting over the sample period in Chile, which invalidates the “stress pattern” of capital flows toward Chile. In addition, two results are to be emphasized. For Chile, the findings indicate that capital flows are time-consistent and are sensitive to the global risk aversion (in a negative way) and the interest rates gap. This observation showing constant pattern of capital movements leads thus to a recommendation which is the implementation of a long-lasting capital control. Particular precaution preventing capital reversal could be taken in case of greater global uncertainty and, in order to preserve interest rate flexibility, specific devices could be applied in addition to interest rate-related sectors, such as remunerated banking accounts, cross-border bank lending and interest rate securities.

(ii) There is no glaring sign of regime shifting in Thailand over the sample period, which invalidates the time-inconsistency of capital flows into the country. For Thailand, international capital exhibit constant responsiveness to the global risk aversion (in a positive way) and the growth prospects gap. This assessment suggests as a result the deployment of a long-lasting capital control. Measures against massive “hedge-driven” inflows could be taken into account in case of greater global uncertainty. However, controls in growth-related sectors are not to be systematically recommended. Further analyses shedding light on other recipient sectors in the Thai economy shall conclude whether specific devices are necessary to tame overheating pressures.

⁵⁵ Cf. Magud and Reinhart (2006)

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