Banco de México

Documentos de Investigación

Banco de México

Working Papers

N° 2012-08

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September 2012

Documento de Investigación
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Capital Controls and Exchange Rate Expectations in Emerging Markets*

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Abstract: This article examines changes in the exchange rate expectations associated with capital controls and banking regulations in a group of emerging countries that implemented these measures to control the adverse effects of sudden capital flows on their currencies. The evidence suggests that for most countries the effects of this type of policies are limited. Moreover, in some cases they appear to have an opposite effect from the one intended. In particular, for some currencies our results suggest there were changes in the extremes of their exchange rate distributions, which make their tails heavier and signal that the market allocates a greater probability to extreme movements. In the same way, evidence is found that this type of measures increases the levels of currency risk premium.
Keywords: Capital Controls, banking regulation, exchange rate expectations, emerging economies, Generalized Extreme Value.
JEL Classification: C14, E44, E58, F31, G15.

Resumen: Este artículo examina los cambios en las expectativas de tipo de cambio asociados a los controles de capital y regulaciones bancarias de un grupo de países emergentes que aplicaron estas medidas para controlar los efectos adversos en sus monedas de flujos de capital repentinos. La evidencia sugiere que para la mayoría de los países los efectos de este tipo de políticas son limitados. Adicionalmente, en algunos casos parecen tener un efecto opuesto al que se pretende. En particular, nuestros resultados sugieren para algunas monedas hubo cambios en los extremos de las distribuciones de tipo de cambio, que hacen que sus colas sean más pesadas, indicando que el mercado asigna una probabilidad mayor a movimientos extremos. De la misma manera, se encuentra evidencia de que este tipo de medidas aumenta los niveles de prima de riesgo cambiario.
Palabras Clave: Mercados de dos lados, servicios financieros, formación de redes.

*The authors thank Santiago García Verdú, anonymous CEMLA referees, anonymous referees from Banco de México Working Papers Series, Alberto Torres, Ana María Aguilar, and Banco de Mexico's Seminar participants for their useful comments. Thelma Armendáriz provided us with excellent research assistance. This paper was written while José Gonzalo Rangel and Gustavo Abarca were working at Banco de México. The opinions expressed in this article are solely those of the authors and do not necessarily re ect the views of Banco de México or Goldman Sachs Group, Inc.

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Introduction

In general, the literature has associated both advantages and disadvantages to capital inflows. On one hand, the literature considers that through capital inflows it is possible to finance more investment than only through domestic savings and that these might generate new opportunities for investors who can obtain higher returns and lower their risks. Thus, it could be possible to increase the number of potential investors, decreasing the costs of acquiring capital, and encourage better financial sectors.

On the other hand, some drawbacks of huge capital inflows mentioned in the literature consider that these could destabilize financial markets, especially in emerging economies; they can also cause currency appreciations generating a loss of competitiveness, stimulate asset price bubbles, and encourage domestic investors to take excessive risks. These inflows can also increase the financial system's vulnerability to external shocks, or increase the risk of being subject to "sudden stops" that are usually followed by adverse effects on output, decreases in private spending and in credit to the private sector, among others.

In the current context, where the effects of the 2008 global financial crisis and the fiscal problems observed in certain European countries during 2010 and 2011 continue influencing variations in risk appetite and global financial volatility, as well as growth prospects of several economies, it is crucial to follow up and evaluate the evidence on the effects of policy actions aimed at counteracting the undesirable effects of capital flows.

The aim of this work is to contribute to this area of research by analyzing structural changes in different distributional features that characterize the exchange rate behavior in economies which implemented capital controls and banking regulations, such as taxes or restrictions on the amount of exchange rate transactions, to control undesired effects of capital flows.[2] In particular, recent measures implemented by certain emerging countries are used to construct events and examine if

[2] Currencies' purchases or sales by central banks are not considered as part of the measures to be analyzed in this research because of their transitory character. However, there is extensive literature on the impact of this type of measures on the exchange rate that suggests short-term effects that function through different channels such as portfolio balance and signaling (see, for example, Lewis (1995), Kaminsky and Lewis (1996), and Neely (2001)). Studies that have focused on controls of capital flows as long-term measures include Frankel (1996), Edwards (1998), Reinhart and Smith (1998), and Frenkel et al. (2001), among others.

there is evidence of significant changes in the risk-neutral densities (RNDs) associated with their exchange rate (against the USD). Likewise, the paper studies if there is an impact on the risk premium following the implementation of measures to control capital flows. In line with the recent experience in discretionary policies, the cases of Brazil, Chile, Colombia, Indonesia, South Korea, and Turkey are analyzed.

Exchange rate expectations of the abovementioned countries are measured based on implied risk-neutral densities. These measures are useful since they provide a forward-looking view on the behavior of the corresponding currencies. Thus, information of spot and derivatives markets are used to infer whether there are persistent changes in the perception of the market regarding the currencies of countries that implemented capital control policies in their economies.[3]

Daily risk-neutral densities are estimated for each country using samples that include data from before and after the measures were announced. The method of Generalized Extreme Value (GEV) proposed by Figlewski (2009) is used. The application of this approach is motivated by the analysis of the exchange rate MXN-USD presented by Abarca, Benavides and Rangel (2012), who give evidence of this method behaves favorably in comparison with a more traditional model suggested by Malz (1997) to estimate risk-neutral densities in exchange rate markets. In particular, Abarca et al. (2012) find that during the days close to monetary policy announcements, the GEV method provides more robust estimates of the parameters that characterize the extremes of the distribution without deteriorating the behavior in the center. Thus, we use this method to estimate the parameters characterizing risk-neutral distributions of the considered emerging markets' exchange rates for each day of a sample covering the period from January 2010 to April 2011. Based on these estimations, we obtain time series of these parameters, which include the following: 1) mean, 2) volatility, 3) skewness, 4) kurtosis, and 5) shape of the tails. This methodology allows us to extract parameters from option prices in the market that are unobservable but contain important information regarding market expectations and risk preferences, as well as changes in their dynamics associated to policy actions, in this case the announcements of capital controls and banking regulations. Subsequently, the time series of parameters describing the abovementioned characteristics are analyzed for each country, testing for structural changes in such parameters

[3] Most of the studies of capital controls or banking regulations focus on the first two moments of the observed distribution, which describes the exchange rate behavior (see, for example, Frenkel et al. (2001) and Buch et al. (1998)).

associated to the announcement of capital controls or banking regulation measures. Controls are included to filter the effects of global factors which can influence all currencies.

Additionally, this paper examines the possibility of structural changes in the expected value of the risk premium once the measures are announced. In particular, assuming that spot rates follow standard stochastic random walk processes, the conditional expectation under the observed distribution is estimated and these values are compared to the means obtained from risk-neutral densities. As a result, we obtain time series that characterize the risk premium and we examine possible structural changes associated to the policy actions. Controls to capture the effect of the global tendencies are also included, as well as the behavior of the short-term interest rate spreads.

The results vary among the analyzed emerging countries and suggest different patterns depending on the analyzed period, in the "short-term" (which refers to those days right after the measures were announced) and in the "long-term" (which refers to the whole sample period).[4] In general, it can be observed that long-term effects, measured as persistent changes in the characteristics of the exchange rate distributions, seem to indicate limited effects for most countries in terms of the first moments of the distribution, which implies that in general these measures are ineffective. In contrast, and only for some countries, short-term effects seem to be closer to the pursued policy objective, by containing exchange rate appreciation in the days close to the announcement of the measure during the periods of capital inflows.[5] Additionally, evidence is found that distribution tails become wider in those countries where these measures were implemented more intensively, suggesting that the market assigns a greater probability to extreme events (ceteris paribus macroeconomic risk conditions). Our results imply that the risk premium increases in these cases following the announcement of the measures, i.e., investors demand greater returns for holding these currencies in their portfolios. These results are relevant, since they provide information about

[4] Given the nature of the data, short term is considered as those days close to the announcement of the measure while long term refers to longer periods like months or years.

[5] The abovementioned is consistent with Disyatat and Galati (2007), who, based on the Czech Republic data, find that the measures have a very marginal effect on the spot rate. However, our study considers even more distribution characteristics and a bigger number of countries.

persistent effects of a certain type of policy actions on the market expectations regarding future exchange rate behavior.[6]

The present study is structured in the following way. The next section presents a literature review of the impacts of capital control policies. In the second section we describe the types of measures observed in emerging markets during the last two years and classify the measures into two groups, capital controls and banking regulations, discussing their operation mechanisms and implementation dates. The third section explains the methodology used to estimate risk-neutral densities for the cases under study. This section also describes the exchange rate market data used to measure changes in the exchange rate expectations. In the fourth section we present empirical specifications used to examine the changes in the characteristics of risk-neutral exchange rate distributions and risk premia associated to the implementation of capital controls or banking regulations, and discuss the empirical results. Section five concludes.

1 Literature Review

Literature regarding capital controls is very extensive. Theoretical and empirical studies have tried to explore whether capital controls reduce capital flows volume, change the composition of capital flows, and/or reduce exchange rate movements, among others. Thus, the present work is an empirical analysis that, by using statistical tools, explores how exchange rate pressures are associated with capital controls and banking regulations.

Following Magud et al. (2011), the literature on capital controls presents some problems: i) there is no unique framework or theory to analyze their effects, ii) methodologies used in empirical studies are very diverse, thus, it is difficult to compare results, iii) the mechanisms and timing at which capital controls are imposed vary among countries, and iv) it is hard to find a consensus regarding what constitutes a "successful" mechanism.

In terms of theoretical literature, following Eichengreen (2001), a number of studies have examined capital controls from different perspectives, some from a macroeconomic point of view and others from a microeconomic one. Additionally, a variety of studies have focused on how capital controls

[6] Controlling for short-term interest rate spreads does not imply qualitative changes in our empirical results.

are associated with income and development, as well as with different exchange rate regimes. In turn, other documents have studied capital controls as instruments used by governments for revenue-related purposes. Regarding per capita income and the implementation of controls, a number of papers find a negative association, which can be explained in the context of economic development where more developed countries are more likely to remove capital controls (see Rodrik (1998), Quinn (1997), Edwards (2001), among others).

In terms of using capital controls as policy instruments, the theoretical approaches varied within the existing literature. Some have analyzed capital controls in a context of Tobin taxes (1974),[7] who suggested imposing taxes on transactions that would require converting currencies into other currencies. If Tobin tax cannot be avoided, then it would have effects similar to an increase in foreign currency transactions' costs. Hence, these costs would be expected to reduce the volume of short-term capital flows, which are generally considered destabilizing, as mentioned by Frankel (1996). Others have studied them from the perspective of Pigouvian taxes addressing externalities where restricting capital inflows during boom times decreases potential outputs during busts (Jeanne O. and Korinek A. (2010) and Korinek (2011)).

Empirical studies, which are of interest for this document, have, in general, not produced definite results regarding transitory and more persistent effects of policy actions such as capital controls and banking regulations. A survey carried out by Magud et al. (2011) explores a number of empirical studies trying to standardize their results in order to compare the evidence. They could not find definite conclusions about the effectiveness of capital controls in reducing both the volume of capital flows nor exchange rate pressures.

Other studies found that, despite the generalized use of this type of measures in various countries, their effectiveness is not guaranteed. For instance, Ostry et al. (2011) point out that using capital controls might be useful in addressing macroeconomic and financial stability issues, but that in order to implement them, countries should need to explore other policy options because capital controls might create important distortions generating ambiguity in terms of welfare.[8] In some

[7] A Tobin tax is applied to all the transactions, both incoming and outgoing.

[8] See also Ostry et al (2010) and other IMF studies such as the document "Recent Experiences in Managing Capital Inflows-Cross-Cutting Themes and Possible Policy Framework" published in 2011.

cases, discrepancies arise because of the type of analysis realized and the way in which the channels, through which these measures function, are introduced in the models. Additionally, results may vary depending on the analyzed horizon of effectiveness, countries, and time periods studied, among others.

In this context, Edwards (1998) carries out a historical analysis of the experience in Latin American countries that implemented capital controls and banking regulations. In particular, he analyzes the experience of Chile, establishing that the effects of capital controls in form of reserve requirements are mixed. It stands out that they did not manage to contain the real exchange rate appreciation. Reinhart and Reinhart (1999) analyze the experience of ten emerging economies that changed their reserve requirements (considered a tax) to mitigate the impact of foreign exchange interventions. They find that the effect of these measures on output, real exchange rate and capital and current accounts depend on who pays the "tax". Additionally they find that foreign exchange intervention together with changes in reserve requirements that maintain the money supply fixed, impact the exchange rate in the short and, sometimes, the long run. Montoro and Moreno (2011) analyze the use of reserve requirements, as a banking regulation measure, in three Latin American countries: Peru, Colombia and Brazil. The authors suggest that these requirements may have helped to stabilize interbank rates and influence market rates such that these moderated capital flows; however they also acknowledge that there are trade-offs in the use of reserve requirements, leading to distortions in the financial system. Reinhart and Smith (1998) analyze the macroeconomic effects of a temporary tax on capital inflows using an intertemporal model with representative agent. Additionally, they study the stylized facts in various countries to identify if the measures implemented in these countries indeed reduced the amount of transactions and/or expanded the maturity of the flows. The study finds that measures were effective in those countries, which implemented them to contain short-term capital flows, either because they reduced the volume of capital inflows and/or because they affected the composition of portfolios in a relatively short-time period. This would suggest that measures are effective in the short term if it is believed that capital flows will be temporary. On the other hand, Frenkel et al. (2001) analyze the effect of capital controls on exchange rate volatility and output. This study finds that the implementation of these measures increases volatility in the short term and has repercussions in the real sector, such that equilibrium output reaches lower levels. As it can be observed, given the theoretical and empirical analysis that has been carried out, it is difficult to find a definite result regarding the effectiveness of

the implemented measures in reducing capital flows' volatility and their impact on the exchange market, however there are some areas in which capital controls have had an impact.

The following section describes measures implemented by the countries analyzed in this study such as capital controls and banking regulation measures.

2 Description of Measures

Diverse emerging economies have experienced significant capital inflows as a result of investors' search for yields, which has favored the appreciation of various currencies against the USD. These capital inflows can have both advantages and disadvantages. On the one hand, these capital inflows could be perceived as cheaper and easily-available financing to encourage domestic demand. However, it can also be associated with an overheating of the national economy and with a relative loss of competitiveness as compared to foreign economies, due to the exchange rate appreciation.[9] Given these capital inflows to various economies and the consequent appreciation of their currencies, diverse types of policy actions have been implemented by central banks and other authorities in these emerging markets in order to reduce to a certain degree the volatility of capital flows.

In this context and in order to identify if there is a persisting impact of the implementation of measures such as capital controls and banking regulations on the characteristics of the probability distribution of exchange rate expectations implicit in financial instruments, in this section we describe and analyze the main measures implemented by 6 countries (Brazil, Chile, Colombia, Indonesia, South Korea, and Turkey) from January 2010 to April 2011.

The key mechanisms used by these countries are characterized by great heterogeneity, which not only depends on global factors, but also on the particularities of each country's situation. For this reason, it is relevant to analyze them from different viewpoints. First, the measures are analyzed in a general manner, by means of grouping them into two categories, i) capital controls, and ii) banking regulations. Second, the implemented measures are described for each country and are

[9] See "World Economic Outlook: Recovery, Risk, and Rebalancing" of the IMF, Oct. 2010.

classified in the corresponding category, according to the description or justification provided by each country at the moment of the announcement. [10] [11]

i) **Direct Capital Controls:** The purpose of these measures is to generate incentives that would affect certain type of behavior of both foreign and national investors. Direct capital controls are mainly imposed via taxes. Certain emerging economies have imposed these taxes in order to discourage foreign loans, and thus, reduce capital inflows and credit supply. Some of these controls include taxes on investment inflows, taxes on earnings from interests, and modifications in the limits on overseas investments, among others.

ii) **Banking Regulations:** These measures include the increase in reserve requirements and other measures of banking regulation. In this case, policies aim at assuring that national banks and local branches of international banks maintain certain discipline, at strengthening macroeconomic conditions and the development of the financial markets, but mainly at attracting more stable medium- and long-term capital flows.

Taking into consideration this classification, we can group the recent policy actions of the six countries analyzed here, as shown in Table 1. In general, Brazil, Chile, Colombia, and South Korea have been the countries that recently implemented capital controls, with the noteworthy case of Brazil, where they were most used. Some banking regulation measures were implemented mainly by Brazil, Indonesia, South Korea, and Turkey.

[10] These measures' classification is based on the definition provided by the authorities at the moment of the announcement, as well as the markets' interpretation analyzed through the commentaries of some private analysts and the IMF reports.

[11] It is noteworthy that other measures that do not fall under any of the described categories were implemented in countries such as Brazil, Chile, Colombia, Thailand, and Turkey.

Table 1. Measures in Selected Countries

		Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Capital Controls	Direct tax on incoming fixed-income investment	✓					
	Direct tax on foreign loans	✓					
	Tax on guarantees for derivatives operations in the futures market	✓					
	Tax on profits of foreign investors					✓	
	Change in the maximum limit of investments abroad of pension funds		✓				
	Tax changes			✓			
	Reduction of the general average tariff			✓			
Banking Regulations	Increase in the domestic currency required reserve ratio	✓					✓1/
	Increase in the foreign currency required reserve ratio						✓1/
	New banking regulations	✓				✓	
	Measures related to Central Bank securities (certificates)				✓2/		
	Regulation on net open position of the liquidity in foreign currency				✓		

1/ In the case of Turkey, it includes changes on the reserve requirement base.

2/ It includes the measures: Minimum holding period, securities auction frequency, issuance of long - term securities, short-term securities, and term deposits.

According to this classification, during the analyzed period, Indonesia is the country that implemented most banking regulations (mainly related to Central Bank securities), while Brazil implemented most capital controls. This information is summarized in Table 2.

Table 2. Type of Measures by Country

Country	Type of Measure		Total
	Capital Controls	Banking Regulations	
Indonesia	-	7	7
Brazil	3	1	4
Colombia	2	-	2
Turkey	-	2	2
South Korea	1	1	2
Chile	1	-	1

Taking into account both classifications, we can point out that the countries that, in general, implemented measures in a more aggressive way are Brazil, and Indonesia, which implemented a greater number of new measures. In particular, Brazil focused on capital controls through taxes, Chile was less aggressive, but facilitated capital outflows by means of modifying maximum

investment limits on pension funds in international markets. In turn, Colombia focused on tax modifications and tariff reductions. South Korea mainly implemented capital controls through certain taxes, as well as banking regulations in order to reduce capital flow and exchange rate volatility. Indonesia implemented these measures in a preventive way, mainly implementing banking regulations like limits on net open foreign currency positions, as well as modifications of central bank's securities measures. Finally, Turkey also implemented banking regulation measures increasing foreign currency reserve requirements.

To sum up, the policy actions implemented during the sample period by different central banks and other authorities in Brazil, Chile, Colombia, Indonesia, South Korea, and Turkey concentrated in two categories: capital controls and banking regulations. The countries that most actively implemented capital controls and/or banking regulations are Indonesia and Brazil, while some other countries, such as Chile, acted to a lesser degree.

In Appendix 1 we present a more detailed description of the mechanisms implemented by each country during the sample period. Table 3 summarizes this information.

With the purpose of analyzing whether capital controls or banking regulations are associated to changes on the characteristics of risk-neutral distributions of the exchange rates, in the following sections we use the information presented on Table 3. It is important to point out that the first two measures are chosen for each country, such that they are the first ones within the whole sample period.[12]

[12] In those cases where the first two measures were very close to each other we decided to use the next one, i.e. when the second measure was announced only some days after the first one.

Table 3. Summary of Main Measures Implemented by Selected Countries[1/]

	Category	Intervention Measures	Implementation Horizon	Description	Relevant Dates
Brazil	Capital Controls	Financial Operations Tax (IOF)			
		a) IOF on incoming fixed-income investment	Long-term	Increase from 2% to 4%	Announcement: Oct 4, 2010 In force since: Oct 5, 2010
				Increase from 4% to 6%.	Oct 18, 2010
		b) IOF on foreign loans	Long-term	- Increase from 5.38% to 6% of the tax on short-term (up to one year of maturity) foreign corporate loans and debt sold abroad by banks and companies. - Transactions subject to the tax will now include loans of up to one year from the previous 90-day limit.	Mar 29, 2011
				- Transactions subject to the tax will now include loans of up to two years.	Apr 6, 2011
		c) IOF on guarantees for derivatives operations in the futures market	Long-term	Increase from 0.38% to 6% of the IOF on guarantees for external investment in the futures market (derivatives operations).	Oct 18, 2010
	Banking Regulations	Reserve requirements	Long-term	Reserve requirement of 60% on local banks' short USD positions that exceed USD 3 billion or their capital base (whichever is the smallest), these reserves will not generate interests.	Announcement: Jan 6, 2011 In force since: Apr 4, 2011
				Verbal interventions of the monetary policy authorities.	
Chile	Capital Controls	Foreign Investment Pension Funds (PFs)	Long-term	The Council of the Central Bank of Chile agreed to extend the total maximum foreign investment limit of Pension Funds from 60% to 80%.	Announcement: Nov 4, 2010 In force since: Dec 1, 2010
				Verbal interventions of the monetary policy authorities.	
Colombia	Capital Controls	Tax exemptions	Long-term	The Ministry of Finance and Public Credit (MHCP) eliminated existing tax exemptions on the payment of interests for credits granted by foreign entities. It was also established an exemption from accrued interests by Colombian credit institutions, short-term interests accumulated by bank overdrafts and those corresponding to foreign trade.	Announcement: Oct 29, 2010
		Tariff reforms	Long-term	The MHCP and the Customs Superior Council launched a customs reform in which the general average tariff was reduced from 12% to 8.2%. This measure will stimulate imports, thus increasing the demand of foreign currency and thereby supporting the USD appreciation.	Announcement: Oct 29, 2010 In force since: Nov 5, 2010
Indonesia	Banking Regulations	Regulation on net open position of foreign currency liquidity	Long-term	This measure eliminates the maximum limit of the net open position in the balance sheet, which was 20% of the capital, maintaining this limit for the total net open position.	Announcement: Jun 16, 2010 In force since: Jul 1, 2010
		Reserve requirements	Long-term	Increase in the reserve requirements of foreign currency holdings in commercial banks (from 1% to 5%). This requirement is planned to increase to 8% in June 2011.	Announcement: Dec 29, 2010 In force since: Mar – 2011
		Bank Indonesia Certificates (SBI) [2/]: a) Minimum holding period	Long-term	Minimum holding period of 28 days for SBI securities in primary and secondary markets.	Announcement: Jun 16, 2010 In force since: Jul 7, 2010
		b) SBI auction frequency	Long-term	Frequency of SBI auction will be changed gradually from weekly to bi-weekly and eventually to monthly.	Announcement: Mar 5, 2010 3-month gradual transition: Mar 10, 2010 to Jun- 2010
		c) Issuance of long - term SBI	Long-term	Bank Indonesia (BI) started the issuance of 9 and 12-month SBI.	Announcement: Jun 16, 2010 In force: 9- month SBI Aug – 2010 12-month SBI Sep - 2010
		d) Short-term SBI	Long-term	- Suspension of three-month SBI sales. - BI dropped its one-month SBI, replacing it with a six-month tenor.	Nov 10, 2010
		e) Term deposit	Long-term	A three-month term deposit was created by the BI. It works as an alternative debt instrument for banks holding excess liquidity, given the elimination of one-month and three-month SBI.	Nov – 2010

1/ Interventions considered in the analysis are underlined.

2/ Only the minimum holding period is considered by the market as an exchange rate intervention measure out of the five related to the Bank Indonesia Certificates (SBI). However, it is considered that the BI issue SBI to sterilize the liquidity generated by capital inflows. Therefore, all measures related to SBI are analyzed. These measures aim to attract more stable medium and long-term capital inflows, besides decreasing volatility of speculative short-term capital inflows.

Table 3. Summary of Main Measures Implemented by Selected Countries[1/]

	Category	Intervention Measures	Implementation Horizon	Description	Relevant Dates
South Korea	Capital Controls	Tax on profits of foreign investors	Long-term	The Ministry of Finance imposed a tax of 14% on the profits obtained from bonds and obligations of the National Treasury of Korea by foreign investors. It also introduced a tax of 20% on capital profits.	Announcement: Nov 18, 2010 In force since: Jan 1, 2011
	Banking Regulations	New banking regulations	Long-term	- Limits on derivatives operations: limit on domestic bank's FX derivative contracts to 50% of their capital in the previous month and those of foreign banks from 300% to 250%. The limit on derivatives to cover corporate settlements was reduced from 125% to 100%. - Loans in foreign currency granted by financial institutions should be used abroad; only small and medium-size firms can use them inside the country. - The foreign currency liquidity coefficient was increased from 90% to 100% and the ratio of financing in foreign loan portfolios was increased from medium- to long-term.	Announcement: Jun 13, 2010 (Sunday) In force: July 2010 - October 2012
		Audits of national and foreign banks	Transitory	Audits of national and foreign banks in order to ensure that these institutions in Korea maintain the currency derivatives positions in accordance with the regulations introduced in June 2010.	Nov 15, 2010 to Nov 23, 2010
				Audits of national and foreign banks in order to ensure that these institutions in Korea maintain the currency derivatives positions in accordance with the regulations introduced in June 2010.	Oct 19, 2010 to Nov 5, 2010
Turkey	Banking Regulations	Reserve requirements a) Required reserve ratios	Long-term	Several increases of the TRY and foreign currency (FX) required reserve ratios. FX required reserve ratio from 9% to 9.5%, FX required reserve ratio from 9.5% to 10%, FX required reserve ratio from 10% to 11% and, Turkish lira required reserve ratio from 5% to 5.5%, Turkish lira required reserve ratio from 5.5% to 6%.	Apr 26, 2010 Jul 29, 2010 Sep 23, 2010 Nov 12, 2010
				Differentiation of the TRY required reserve ratios according to the maturity structure of deposits: - 8% for demand deposits, notice deposits, private current accounts, deposits/participation accounts up to 1-month maturity and liabilities other than deposits/participation accounts, - 7% for deposits/participation accounts up to 3 and 6-month maturity, - 6% for deposits/participation accounts up to 1-year maturity, - 5% for deposits/participation accounts with 1-year and longer maturity and cumulative deposits/participation accounts.	Dec 17, 2010
				Increase of the TRY required reserve ratios: - 12% for demand deposits, notice deposits and private current accounts, - 10% for deposits/participation accounts up to 1-month maturity (including 1-month), - 9% for deposits/participation accounts up to 3-month maturity (including 3-month), - 9% for liabilities other than deposits/participation funds.	Announcement: Jan 24, 2011 Regulation in force since: Feb 4, 2011 Required reserves started to be maintained: Feb 18, 2011
				Increase of the TRY required reserve ratios: - 15% for demand deposits, notice deposits and private current accounts, - 15% for deposits/participation accounts up to 1-month maturity, - 13% for deposits/participation accounts and special fund pools up to 3-month maturity, - 9% for deposits/participation accounts and special fund pools up to 6-month maturity, - 13% for liabilities other than deposits/participation funds.	Announcement: Mar 23, 2011 Regulation in force since: Apr 1, 2011 Required reserves started to be maintained: Apr 15, 2011
		b) Reserve requirement base	Long-term	The reserve requirement base has been expanded to include funds received by banks through repurchase agreement (repo) transactions from abroad and domestic customers, except for those funds received from repo transactions with the Central Bank and those among domestic banks.	Dec 17, 2010

1/ Interventions considered in the analysis are underlined.

3 Methodology and Market Data

3.1 Risk-Neutral Densities

A risk-neutral measure is a probability measure assuming that the present value of financial assets equals the expected future returns of the asset, discounted at the risk-free interest rate. Probabilities are adjusted according to individual risk preferences perceived by market participants or investors, such that under this measure all assets have the same expected rate of return (the risk-free interest rate).[13] The idea is to evaluate the assets incorporating the same risk aversion observed in a new probability measure. Thus, the use of this measure simplifies the pricing of assets, while having to discount only the expected returns.

To calculate risk-neutral densities, we consider that the value of a Call option under this measure is given by:

$$C = \int_{K}^{\infty} e^{-rT}(X - K)f(X)dX \tag{1}$$

where C refers to the Call option price, r is the risk-free interest rate, T is the time to maturity, X is the underlying asset, K is the exercise price, and $f(\cdot)$ represents the risk-neutral density function. Following Breeden and Litzenberger (1978), the partial derivative of the option price with respect to the exercise price is obtained:

$$\frac{\partial C}{\partial K} = \frac{\partial}{\partial K}\left[\int_{K}^{\infty} e^{-rT}(X - K)f(X)dX\right] = \cdots = -e^{-rT}[1 - F(K)] \tag{2}$$

Solving for the risk-neutral distribution function, $F(K) = \int_{-\infty}^{K} f(z)dz$, we have:

$$F(K) = e^{rT}\frac{\partial C}{\partial K} + 1 \tag{3}$$

[13] The abovementioned does not imply that the investors are risk-neutral.

Taking the second partial derivative with respect to the exercise price we obtain the risk-neutral density function.

$$f(K) = e^{rT} \frac{\partial^2 C}{\partial K^2} \tag{4}$$

Figlewski (2009) suggests approaching this solution by means of finite differences centered on option prices observed in the market. Nevertheless, there should be available options with the same maturity date for N different exercise prices, where K_1 represents the lowest exercise price, and K_N the highest. Therefore, it is possible to approach the density in the following way:

$$f(K) \approx e^{rT} \frac{C_{n+1} - 2C_n + C_{n-1}}{(\Delta K)^2} \quad for\ n = 2, \dots, N-1 \tag{5}$$

In an analogous fashion, it is possible to obtain an approximation by using Put options

$$f(K) \approx e^{rT} \frac{P_{n+1} - 2P_n + P_{n-1}}{(\Delta K)^2} \tag{6}$$

Hence, based on Call and Put options, it is possible to obtain the central part of the risk-neutral density. However, it is necessary to make an interpolation from among the data available in the market in order to generate a smoothed density, given that in practice there are not sufficient options in the market that allow making a smooth approximation for the numerical approximation of the second derivative.

In the exchange market, options are usually negotiated in terms of implied volatilities[14] with respect to deltas. In our case, data are given as implied volatilities. Thus, in order to obtain the central part and the tails of the distribution, the following process is suggested:

- Extract the exercise prices through implied volatilities and the deltas with the Black-Scholes formula.

[14] These express the expectations of the market regarding the volatility of the option's underlying asset, in this case the exchange rate.

- Rule out options that are out-of-the-money.
- Combine Call and Put options to solely use those that are in-the-money and at-the-money, that is, Calls for one tail and Puts for the other.
- Adjust a spline of at least fourth order to implied volatilities to find the smile curve. The aforementioned is carried out in the plane $(X, Y) = (K, implied\ volatility)$.
- Calculate for a dense set of exercise prices, equally spaced, the implied volatilities interpolated with the spline in order to subsequently convert them to prices using the Black-Scholes formula. Thus, it changes to the plane $(X, Y) = (K, option\ price)$. [15]
- Implement the approximation of equations 5 and 6 for the dense set of exercise prices and option prices (obtained in the previous point) to find the central part of the risk-neutral density.
- Add the tails to the distribution through the Generalized Extreme Value Distribution (GEV).

We use implied volatilities because exchange rates are usually traded in terms of implied volatilities, as mentioned above. Thus, this information can be obtained directly from market data. Additionally, it has been broadly studied that using option prices rather than implied volatilities generates other problems that can be more severe than using Black and Scholes. In particular, the resulting risk neutral densities using prices can have unacceptable features, such as regions in which it is negative. Shimko (1993) was the first to propose this transformation using implied volatilities in order to extract risk-neutral densities from the resulting dense set of option prices.[16]

In particular, the GEV distribution that characterizes the tails is given by

$$F(z) = \begin{cases} exp\left(-(1+\xi z)^{-1/\xi}\right), & \xi \neq 0 \\ exp(-e^{-z}), & \xi = 0 \end{cases}, \qquad (7)$$

where $1 + \xi z > 0$. The parameter of ξ determines the shape of the GEV distribution, which is said to be generalized in the sense that, depending on this parameter, it can be associated with three

[15] It should be pointed out that using Black-Scholes in the process makes it less general.

[16] Other studies that have used this methodology include Bliss and Panigirtzoglou (2004), Campa et al. (1997), Clews et al. (2000), among others.

types of families of known distributions. For $\xi > 0$, the distribution is of Fréchet type (with heavier tails than the normal distribution); for $\xi = 0$, the distribution is of Gumbel type (with tails similar to those of the normal distribution) and, for $\xi < 0$, the distribution is of Weibull type (with a finite endpoint).

Besides, two parameters (μ, σ) are introduced to establish the location and scale of the distribution, respectively. Thus, the standardized variable in question is defined as follows:

$$z = \frac{X - \mu}{\sigma} \tag{8}$$

$F_{GEVR}(\cdot)$ and $F_{GEVL}(\cdot)$ denote the approximation of the GEV distribution for the right and left tail, respectively; in turn, $f_{GEVR}(\cdot)$ and $f_{GEVL}(\cdot)$ represent the corresponding density functions. $F_{EMP}(\cdot)$ and $f_{EMP}(\cdot)$ denote the empirical risk-neutral distribution function and the empirical risk-neutral density function, respectively.

Let $K(\alpha)$ denote the exercise price corresponding to the percentile α of the risk-neutral distribution; i.e., $F_{EMP}\big(K(\alpha)\big) = \alpha$. To estimate the distribution tail, a value of α is chosen, according to the desired starting point of the distribution tail GEV, and then the most extreme point, where the tail of the GEV equals the risk-neutral empirical density , is chosen as well. For the right tail, these values will be denoted by α_{0R} and α_{1R}, respectively, and for the left, by α_{0L} and α_{1L}. The choice of these points is flexible. The only condition they must satisfy is that $K_2 \leq K(\alpha_{1L})$ and $K(\alpha_{1R}) \leq K_{N-1}$.

To adjust the right tail of the distribution of the RND, three conditions need to be satisfied. The first condition requires the total probability of the tail to be equal for the RND and the GEV approximation. Additionally, given that the GEV density is required to have the same shape of the RND in the area of the tail (where both distributions overlap), the method defines two conditions in order to set the two densities equal at α_{0R} and α_{1R}.

Therefore, for the right tail we have:

$$F_{GEVR}\left(K(\alpha_{0R})\right) = \alpha_{0R} \tag{9}$$
$$f_{GEVR}\left(K(\alpha_{0R})\right) = f_{EMP}\left(K(\alpha_{0R})\right)$$
$$f_{GEVR}\left(K(\alpha_{1R})\right) = f_{EMP}\left(K(\alpha_{1R})\right)$$

The left tail of the distribution is adjusted in an analogous manner by taking

$$z = \frac{(-\mu_L) - X}{\sigma}, \tag{10}$$

with the following conditions:

$$F_{GEVL}\left(-K(\alpha_{0L})\right) = 1 - \alpha_{0L} \tag{11}$$
$$f_{GEVL}\left(-K(\alpha_{0L})\right) = f_{EMP}\left(K(\alpha_{0L})\right)$$
$$f_{GEVL}\left(-K(\alpha_{1L})\right) = f_{EMP}\left(K(\alpha_{1L})\right)$$

The values we use for the $\alpha's$ are: 1) $F_{EMP}(K_{initial}) + 0.03$ and $F_{EMP}(K_{initial}) + 0.05$, for the left tail and, 2) $F_{EMP}\left(K_{final}\right) - 0.03$ and $F_{EMP}\left(K_{final}\right) - 0.05$, for the right tail.[17]

3.2 Data

The data for the exchange rates against USD consist of the daily average of quotes offered by the banks and other financial intermediaries. This information was obtained from Bloomberg. Implied volatilities of the one-month exchange rate options consist of the weighted average of the operations that financial institutions negotiate in the formal market; the data were obtained from UBS. Besides, to estimate risk-neutral densities, we use the local risk-free interest rate, which consists of the daily observations of the short-term interest rate in the secondary market of the certificates of deposit (CDs), obtained from the same source (UBS). The analysis covers the period from January 2010 to April 2011, with a total of 334 observations. However, implied volatilities are not always available because of the lack of transactions in the market. Thus, the sample includes 327 observations for

[17] Note that distribution tails can be wider due to an increased probability of extreme events or to higher risks associated to these events.

Brazil, 258 for Chile, 227 for Colombia, 328 observations for Indonesia, 330 for South Korea, and 333 for Turkey.[18]

Information regarding currency and instruments of foreign exchange market turnover for the countries analyzed in this document is presented in Table 4. For most emerging economies, the biggest share of foreign exchange market turnover is concentrated in the spot and outright forward transactions. Additionally, turnover of options and other instruments varies among countries with the outstanding cases of Brazil and Turkey, where they account for more than 10 percent of total turnover, while Colombia and Chile are the countries with the lowest share. As we can observe in the Table 4, the average turnover of option transactions for the emerging countries considered in this document are slightly higher than for advanced economies, however this average is lower if Brazil and Turkey are not considered.[19]

[18] The data for Mexico, the Czech Republic, and Hungary are included to estimate a measure that characterizes the global tendency of the characteristics to be analyzed (see equation 12), with the following number of relevant observations: 311 for Mexico, 319 for the Czech Republic, and 332 for Hungary. These countries did not impose capital controls during the sample period.

[19] More information regarding turnover of options is presented in the appendix.

Table 4: Currency and instrument distribution of global foreign exchange market turnover [1/]
Percentage shares of average daily turnover in April 2010

Currency	Spot	Outright forwards	Foreign exchange swaps	Currency swaps	Options and other instruments
Advanced Economies					
US dollar	35.2	11.6	47.4	1.1	4.7
Japanese yen	39.7	15.2	36.9	0.9	7.2
Euro	44.4	9.6	39.2	1.1	5.6
Swiss franc	36.4	7.5	50.2	0.7	5.3
Average	38.9	11.0	43.4	1.0	5.7
Analyzed Emerging Economies					
Brazilian real	31.3	47.3	2.9	1.4	17.1
Chilean peso	38.8	48.2	9.0	3.5	0.5
Colombian peso	43.6	24.3	0.8	30.9	0.4
Indonesian rupiah	40.9	44.2	11.1	1.1	2.7
Korean won	35.1	29.9	27.5	1.6	5.9
Turkish lira	27.2	10.4	43.1	6.5	12.8
Average	36.2	34.1	15.7	7.5	6.6
Other Emerging Economies					
Czech koruna	17.4	8.0	71.3	0.4	2.8
Hungarian forint	24.1	10.6	57.8	0.3	7.2
Mexican peso	36.3	10.8	47.5	0.7	4.6
Average	25.9	9.8	58.9	0.5	4.9

[1/] Adjusted for local and cross-border inter-dealer double-counting (ie "net-net" basis).
Source: BIS, Triennial Central Bank Survey, December 2010.

4 Results

Once we have the time series of the 6 different characteristics that define the form of risk-neutral densities (estimated by the abovementioned method), and a measure of the risk premium for the exchange rates analyzed in this study, we are interested in studying the impact of capital controls or banking regulations on the expectations of the exchange market through the risk-neutral distribution. Therefore, to find whether there is an impact of these types of measures, we estimate a linear regression model in order to test if there is any structural change in the exchange rate expectations of each country associated to policy actions (i.e., direct capital controls and banking regulations):[20]

[20] In this case, since dependent variables were calculated, they present measurement errors; however, this problem might be observed in any variable obtained through latent (unobservable) processes. Following Wooldridge (2009), the measurement error in the dependent variable results in a larger error variance than when no errors occur, generating larger variances of the OLS estimators. Thus, taking into consideration the existence of measurement errors, the results presented in this section are conservative because the significance is underestimated.

$$\Lambda_{p,t}^{j} = \alpha_p + \beta_{p,1}^{\Lambda^j} I_{p_{\{t \geq k\}}} + \beta_{p,2}^{\Lambda^j} \left[\frac{1}{n-1} \sum_{i=1, i \neq p}^{n} \frac{\Lambda_{i,t}^{j} - \Lambda_{i,t-1}^{j}}{\Lambda_{i,t-1}^{j}} \right] + \beta_{p,3}^{\Lambda^j} \Lambda_{p,t-1}^{j} + \epsilon_{p,t}, \qquad (12)$$

$$j = 1, \ldots, 7.$$

where $\Lambda_{p,t}^{j}$ corresponds to the different characteristics of the risk-neutral density: mean, volatility, skewness, kurtosis, right tail parameter, left tail parameter, and risk premium, for the countries where there was a measure at the time k ($p =$ Brazil, Chile, Colombia, Indonesia, South Korea, and Turkey). The first component corresponds to the constant of the model; the second one is an indicator function that takes the value of one starting at the moment of the announcement of the measure (starting from the date k and until the last day of the sample); the third one represents a common component measured as the average of the returns of the measure in question (Λ) of the countries in the sample (without taking into account the reference country), this parameter is a simple statistical tool that allows us to capture global effects that are common within emerging economies;[21] the fourth one is an autoregressive component and, finally, the error term.[22] An assumption behind this model is that markets and authorities incorporate all the available information and there is not information asymmetry, the government acts once the market reacts to the information they have. Thus, it is very unlikely to have a contemporary correlation between the policy measure and the market price, in this case exchange rates.

The risk premium is calculated using an estimator of the conditional expectation of the exchange rate variations under the observed distribution. Assuming that the exchange rates follow random walk processes at high frequencies, it can be assumed that the conditional expectation on the day $t + h$ equals the spot rate on day t. For this reason, the risk premium is calculated as the difference

[21] Besides the countries with capital controls and banking regulations, Mexico, the Czech Republic, and Hungary are included (see note 17). It is important to mention that the inclusion of more emerging economies in order to better control for common factors per country and to find a better match in each case might be relevant and could be developed in further investigations. However, for the purpose of this exercise and given the limited financial data available for emerging markets needed to construct the variables used in this regression, the parameter captures global factors affecting capital flows to emerging markets as mentioned above.

[22] The Schwarz Bayesian Information Criterion (SBIC) was used to identify the adequate number of lags to be included in each regression. For most cases the adequate number was one lag, as presented in the results. For those cases where the number of adequate lags was higher than one such as Brazil, Colombia, and Turkey, the results did not change qualitatively.

between the current spot rate and the risk-neutral mean, which can be considered as a certainty equivalent:

$$Risk\ premium = \frac{TC_{spot} - E^*[K]}{TC_{spot}} \tag{13}$$

Besides the structural impact that these policies can have, we are interested in testing whether they have any temporary impact on the exchange market. Therefore, another model is estimated where the indicator function is modified to identify the temporary impact of the measure, i.e., the function takes the value 1 only in a symmetrical window of 2 working days around the announcement date of the measure, except in the case of Colombia in which a symmetrical window of 4 working days was used due to missing data. Thus, the indicator function takes the following form:[23]

$$\mathrm{I}_{\{k-2\leq t\leq k+2\}} = \begin{cases} 1, & if\ k-2 \leq t \leq k+2 \\ 0, & otherwise \end{cases} \tag{14}$$

Table 5 presents the regression results for the dates when the first measure was announced, considering the indicator function of the persistent structural change in the parameter of interest.[24] The first panel suggests that the risk-neutral mean (unconditional) of the exchange rate has a significant change (at 1% significance level), after the first measure, only in the case of Brazil. In particular, it can be observed that the risk-neutral mean decreases.[25] Although for other countries the results are not statistically significant, it can be observed that the risk-neutral mean decreases in all cases. The effect is not significant with regard to the volatility, skewness, and kurtosis. The direction of the effect is mixed in the former and the latter. However, when the extremes of the distributions are analyzed, it is found that the right tail becomes wider at 10% of statistical significance for the cases of Brazil, Colombia, and Indonesia. For other countries, the effects for the

[23] The window used here was selected to control for the fact that the market could have had information regarding the implementation of the measure some days before the announcement was made. Different symmetrical windows were tested within a range of 5 days. The results did not present qualitative changes. Additionally, an asymmetrical window of 3 working days from the day of the announcement was also tested. For the case of Colombia there is a significant effect for the mean and the skweness, although there is no longer effect on the left tail parameter.

[24] In order to overcome autocorrelation and heteroskedasticity in the error terms in the model, we estimated it using robust methods, i.e. HAC- Newey West estimators.

[25] A decrease in the mean suggests a market expectation towards an exchange rate appreciation.

right tail are not significant. In turn, the left tail only presents positive significant effects for Brazil. This interpretation requires considering that the starting point of the left tail is a negative parameter (like in the Weibull distribution). Thus, the positive effect suggests that the tail is extended. These results are consistent with those presented in the first panel of Table 8 which shows the effects for risk premia, indicating a significant increase after the measure in the same cases of Brazil and Colombia. The effects for the rest of the countries are not significant.

In sum, for most countries the effects of the measures in the characteristics of the risk-neutral densities are not significant. In general, only for those countries that implemented more capital controls and/or banking regulations such as Brazil, Indonesia, and Colombia, the evidence suggests that the extremes of the distributions become wider and the risk premia increases.

Table 5: Estimated coefficients of the first measure for the mean, standard deviation and skewness

Mean

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	-0.010 ***	-0.275	-2.073	-16.002	-0.707	-0.001
	(0.003)	(0.778)	(2.559)	(11.551)	(1.209)	(0.001)
Global factor	1.368 ***	360.171 ***	873.090 ***	2271.432 ***	588.370 ***	1.361 ***
	(0.361)	(48.170)	(194.064)	(832.957)	(184.644)	(0.207)
Autoregressive term	0.926 ***	0.981 ***	0.924 ***	0.976 ***	0.980 ***	0.990 ***
	(0.023)	(0.012)	(0.034)	(0.020)	(0.021)	(0.012)

Standard Deviation

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	-0.0004	-0.029	4.294	1.252	-0.3690	-0.0002
	(0.001)	(0.185)	(3.294)	(2.033)	(0.394)	(0.0004)
Global factor	0.072 ***	5.109	40.961	121.769 **	48.821	0.020 **
	(0.017)	(4.143)	(26.230)	(51.611)	(29.704)	(0.009)
Autoregressive term	0.964 ***	0.954 ***	0.674 ***	0.986 ***	0.985 ***	0.949 ***
	(0.015)	(0.029)	(0.174)	(0.028)	(0.054)	(0.019)

Skweness

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.049	0.010	0.092	0.066	0.003	0.005
	(0.039)	(0.060)	(0.058)	(0.052)	(0.040)	(0.054)
Global factor	-0.002	-0.006	-0.002	-0.008	-0.025 ***	-0.024 ***
	(0.009)	(0.010)	(0.002)	(0.005)	(0.008)	(0.007)
Autoregressive term	0.928 ***	0.954 ***	0.948 ***	0.962 ***	0.916 ***	0.950 ***
	(0.024)	(0.026)	(0.033)	(0.024)	(0.027)	(0.027)

***, ** and * represent statistical significance at 1%, 5% and 10% significance level, respectively.

Table 5 (Continuation): Estimated coefficients of the first measure for the kurtosis and tail parameters

Kurtosis

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.175	-0.116	0.227	0.195	0.033	0.039
	(0.168)	(0.441)	(0.214)	(0.119)	(0.133)	(0.242)
Global factor	2.006	6.852	1.104	0.910 *	3.528 **	6.110 **
	(1.441)	(6.067)	(0.957)	(0.508)	(1.526)	(2.698)
Autoregressive term	0.853 ***	0.966 ***	0.906 ***	0.895 ***	0.955 ***	0.955 ***
	(0.048)	(0.022)	(0.077)	(0.047)	(0.030)	(0.037)

Right Tail Parameter

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.011 *	-0.003	0.158 *	0.033 *	-0.002	0.00003
	(0.006)	(0.009)	(0.085)	(0.019)	(0.008)	(0.010)
Global factor	0.002 *	-0.002	-0.0003	-0.002	-0.0001	0.001
	(0.001)	(0.002)	(0.002)	(0.002)	(0.001)	(0.003)
Autoregressive term	0.947 ***	0.965 ***	0.739 ***	0.942 ***	0.893 ***	0.931 ***
	(0.023)	(0.026)	(0.149)	(0.033)	(0.028)	(0.033)

Left Tail Parameter

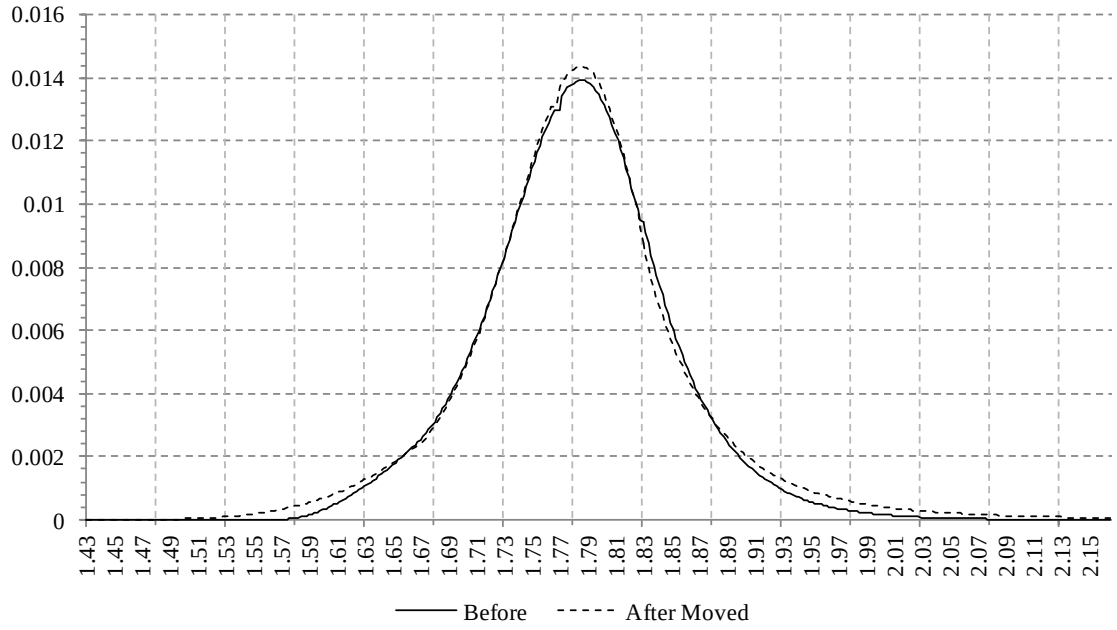
	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.030 *	-0.001	0.008	0.004	0.007	0.002
	(0.018)	(0.008)	(0.005)	(0.008)	(0.006)	(0.008)
Global factor	0.002	-0.002 *	0.002	0.006	-0.001	0.009
	(0.004)	(0.001)	(0.003)	(0.004)	(0.003)	(0.007)
Autoregressive term	0.884 ***	0.926 ***	0.976 ***	0.963 ***	0.950 ***	0.934 ***
	(0.052)	(0.036)	(0.030)	(0.025)	(0.023)	(0.043)

***, ** and * represent statistical significance at 1%, 5% and 10% significance level, respectively.

Results indicate that Brazil has shown a high level of sensitivity in various characteristics of its risk-neutral exchange rate distribution. To illustrate this case, we calculate the average of the characteristics before and after the announcement of the first measure, in order to subsequently choose one day in each subsample, such that the difference between the average values and actual estimates for this day is minimized (controlling for different magnitudes of each characteristic). Graph 1 shows these densities. In the first panel, the mean is preserved to illustrate tails' widening, which presents the average exchange rate distribution of the period previous to the measure. This behavior corresponds to the effects of the measure in these parameters in both tails described in the previous paragraph. In the second panel, the mean moves to illustrate the total effect.

Graph 1: Average risk-neutral densities for Brazil before and after the measure

a) Partial effect (maintaining the mean constant)



b) Total effect

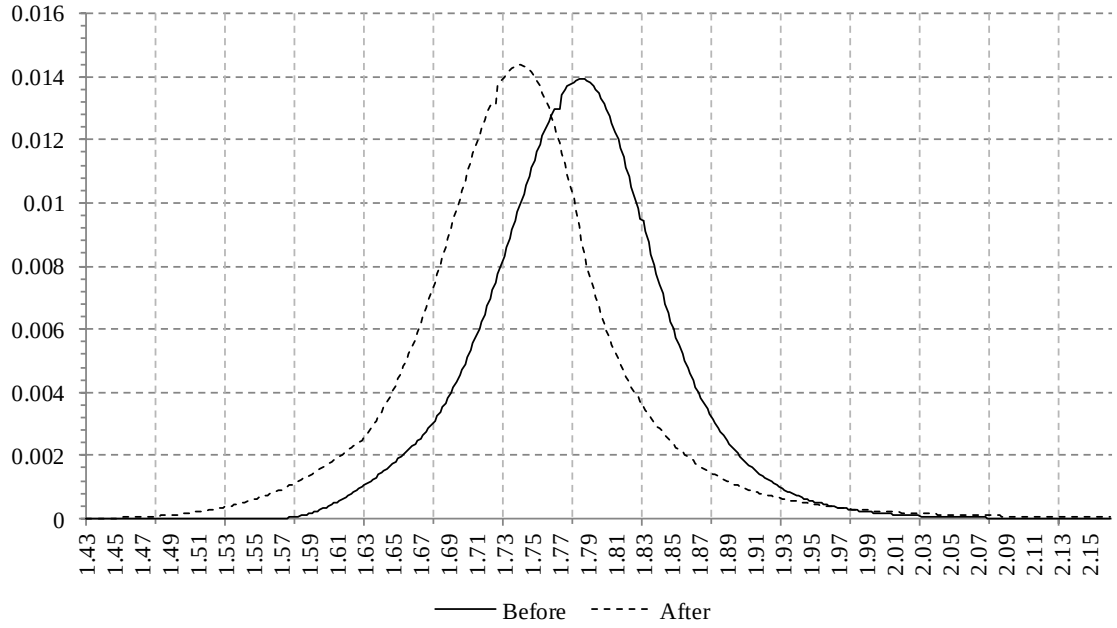


Table 6 shows the results associated to the events where the countries announce a second measure to be implemented. In particular, the right tail presents a significant effect tending to widening for

the exchange rates of Indonesia and Turkey.[26] The left tail also expands for South Korea and Turkey. Finally, a new significant increase is observed in the risk premia of Brazil and Indonesia (see the second panel of Table 8).

Table 6: Estimated coefficients of the second measure for the mean, standard deviation and skewness

Mean

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	-0.006 **			-14.825	-2.280	0.001
	(0.003)			(11.559)	(1.411)	(0.002)
Global factor	1.344 ***			2098.236 **	569.612 ***	1.358 ***
	(0.373)			(842.702)	(192.947)	(0.206)
Autoregressive term	0.963 ***			0.969 ***	0.966 ***	0.985 ***
	(0.019)			(0.026)	(0.024)	(0.013)

Standard Deviation

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	-0.001			0.460	0.228	0.0004
	(0.001)			(1.914)	(0.582)	(0.000)
Global factor	0.072 ***			123.358 **	49.599	0.019 **
	(0.017)			(52.142)	(30.424)	(0.008)
Autoregressive term	0.964 ***			0.984 ***	0.992 ***	0.946 ***
	(0.015)			(0.028)	(0.062)	(0.018)

Skweness

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.061			0.106	0.063	0.047
	(0.048)			(0.070)	(0.058)	(0.049)
Global factor	-0.003			-0.006	-0.023 ***	-0.022 ***
	(0.008)			(0.005)	(0.008)	(0.008)
Autoregressive term	0.928 ***			0.936 ***	0.926 ***	0.946 ***
	(0.024)			(0.036)	(0.029)	(0.029)

***, ** and * represent statistical significance at 1%, 5% and 10% significance level, respectively.

[26] Right tails are associated to market expectations for extreme depreciations.

Table 6 (Continuation): Estimated coefficients of the second measure for the kurtosis and tail parameters

Kurtosis

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.227			0.106	0.263	0.193
	(0.258)			(0.095)	(0.179)	(0.181)
Global factor	2.055			0.766	3.131 **	5.732 **
	(1.397)			(0.550)	(1.551)	(2.652)
Autoregressive term	0.847 ***			0.912 ***	0.959 ***	0.954 ***
	(0.053)			(0.042)	(0.030)	(0.038)

Right Tail Parameter

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.010			0.042 *	0.012	0.019 **
	(0.007)			(0.022)	(0.009)	(0.008)
Global factor	0.002 *			-0.002 *	-0.0002	0.001
	(0.001)			(0.001)	(0.001)	(0.004)
Autoregressive term	0.951 ***			0.910 ***	0.905 ***	0.922 ***
	(0.023)			(0.045)	(0.029)	(0.034)

Left Tail Parameter

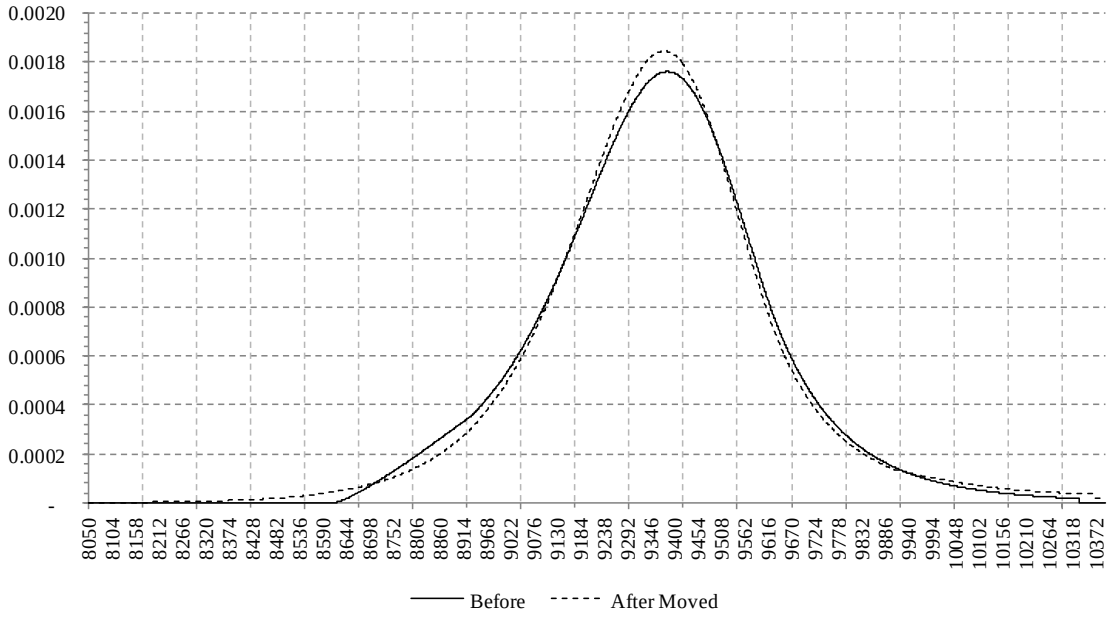
	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.031			0.011	0.023 ***	0.013 **
	(0.024)			(0.010)	(0.007)	(0.005)
Global factor	0.002			0.005	-0.0005	0.0099
	(0.003)			(0.004)	(0.003)	(0.006)
Autoregressive term	0.890 ***			0.951 ***	0.924 ***	0.938 ***
	(0.058)			(0.027)	(0.024)	(0.041)

***, ** and * represent statistical significance at 1%, 5% and 10% significance level, respectively.

For the second measure, a relevant case study is Indonesia. The results of the second measure indicate that this country presented a high degree of in the right tail of the risk-neutral density and in its risk premium. Similar to Graph 1, Graph 2 shows changes in the risk-neutral density for Indonesia, using the subsamples before the first announcement and after the second one. The graph shows widening of the right tail of the exchange rate density of Indonesia, showing that the measures did not have the desired impact.

Graph 2: Average risk-neutral densities for Indonesia before and after the measure

a) Partial effect (maintaining the mean constant)



b) Total effect

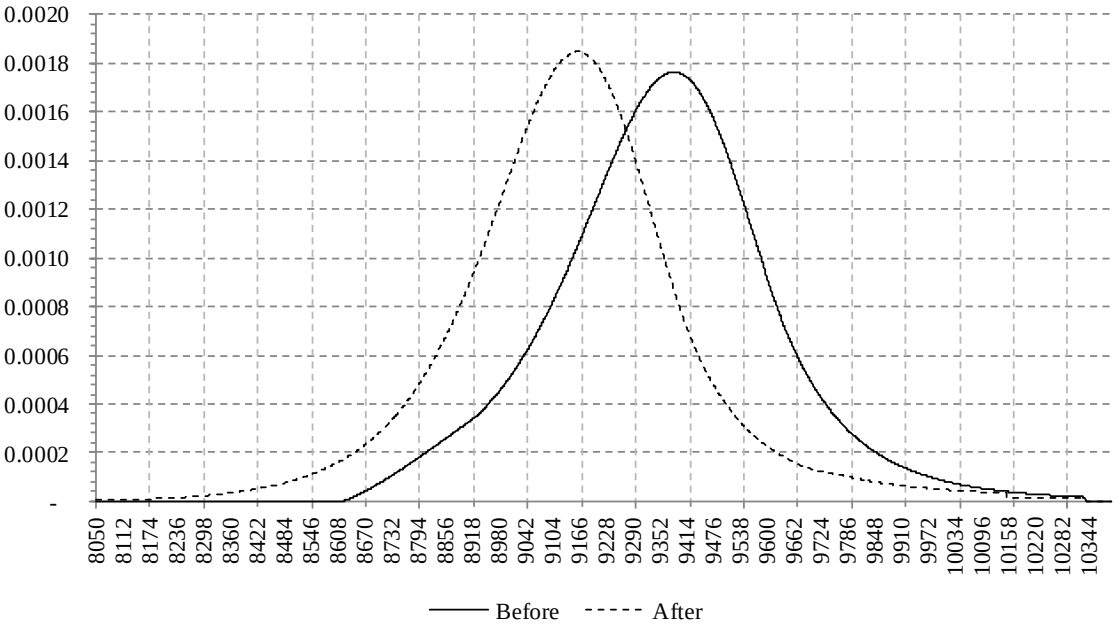


Table 7 shows the results when considering the behavior using the indicator function with a symmetrical window of two working days around each announcement, except in the case of Colombia in which a symmetrical window of 4 working days was used due to missing data.[27] Regarding the mean, market expectations suggest statistically significant effects for Brazil, Chile, and Turkey are obtained. With respect to the second moment, Brazil presents a statistically significant increase in its volatility, while Indonesia shows a significant decrease. In turn, skewness significantly increases (depreciation) for Brazil, but decreases for the case of Indonesia. A significant rise is also observed in the kurtosis for Brazil, and a decrease for Chile. Regarding the shape of the extremes, the results indicate a significant widening of the right tail for the exchange distributions of Brazil; in turn, the right tails for Chile and Indonesia are narrower. The left tail of the density shows a significant narrowing for the case of Chile, Colombia, and Turkey. Finally, the evidence indicates a significant increase of the risk premia corresponding to the exchange rates of Brazil and South Korea, both of which have positive right tail parameters, and a decrease for Chile which presents a narrowing on both tails (see the last panel of Table 8).

In sum, the first moments of risk-neutral densities have mixed results when comparing the effect of the measures in the days close to the announcement and in longer horizons. For example, the estimated market expectations suggest that while Brazil, Chile, and Turkey seem to counteract pressures towards an appreciation of their currencies given the capital inflows in the days close to the announcement, for longer horizons this effect is reverted. Regarding volatility, an opposite effect is found in the short- and long-term for Brazil and Indonesia, the ones that implemented more measures. On the other hand, the results indicate that in the "long-term", the distribution tails tend to widen, whereas in the days close to the announcement the effect is characterized by the narrowing of the distribution tails. Thus, it seems that the implementation of capital controls or banking regulations work in the opposite direction than the one desired by the authorities once the transitory effect passes. Likewise, both in short- and long-term horizons, various cases indicate that the risk premia of the exchange rates tend to show increases after the policy actions are announced.

[27] In this case, first and second measures are not analyzed separately. Different symmetrical windows were tested within a range of 5 days with similar results.

Table 7: Estimated coefficients of the transitory effect of measures for the mean, standard deviation and skewness

Mean

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.006 ***	2.211 ***	-2.941	-5.399	0.102	0.012 ***
	(0.002)	(0.460)	(4.015)	(7.796)	(3.027)	(0.003)
Global factor	1.345 ***	362.937 ***	881.084 ***	2267.748 ***	602.491 ***	1.313 ***
	(0.385)	(47.156)	(190.705)	(823.648)	(184.814)	(0.210)
Autoregressive component	0.984 ***	0.985 ***	0.930 ***	0.997 ***	0.980 ***	0.989 ***
	(0.015)	(0.014)	(0.032)	(0.014)	(0.022)	(0.012)

Standard Deviation

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.003 ***	-0.097	-0.823	-4.178 ***	-2.194	0.000
	(0.000)	(0.103)	(2.020)	(1.441)	(2.036)	(0.000)
Global factor	0.072 ***	5.113	39.824	118.025 **	46.846	0.019 **
	(0.017)	(4.130)	(25.028)	(52.749)	(28.940)	(0.009)
Autoregressive component	0.971 ***	0.954 ***	0.698 ***	0.982 ***	1.003 ***	0.950 ***
	(0.012)	(0.029)	(0.167)	(0.024)	(0.053)	(0.019)

Skewness

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.317 ***	-0.106	0.010	-0.094 ***	-0.036	-0.094
	(0.024)	(0.026)	(0.014)	(0.050)	(0.118)	(0.019)
Global factor	-0.004 ***	-0.006	-0.003	-0.008 **	-0.025	-0.024 **
	(0.008)	(0.010)	(0.002)	(0.005)	(0.008)	(0.007)
Autoregressive component	0.926 ***	0.955 ***	0.989 ***	0.961 ***	0.914 ***	0.949 ***
	(0.024)	(0.024)	(0.016)	(0.023)	(0.029)	(0.028)

Note: Given the coefficient of the autoregressive term greater than one, this model was estimated in differences.
The sign and significance of the intervention do not present changes.
***, ** and * represent statistical significance at 1%, 5% and 10% significance level, respectively.

Table 7 (Continuation): Estimated coefficients of the transitory effect of measures for the kurtosis and tails' parameters

Kurtosis

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	1.129 ***	-1.026 ***	-0.119	0.007	0.063	-0.120
	(0.075)	(0.263)	(0.086)	(0.068)	(0.314)	(0.113)
Global factor	2.322 *	6.693	1.574	0.883 *	3.577 **	6.086 **
	(1.390)	(6.013)	(0.956)	(0.462)	(1.529)	(2.716)
Autoregressive component	0.866 ***	0.962 ***	0.949 ***	0.944 ***	0.954 ***	0.954 ***
	(0.039)	(0.020)	(0.049)	(0.024)	(0.031)	(0.039)

Right Tail Parameter

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.035 ***	-0.019 ***	-0.004	-0.026 **	0.010	-0.016
	(0.003)	(0.004)	(0.007)	(0.013)	(0.021)	(0.012)
Global factor	0.002 *	-0.002	0.000	-0.002	0.000	0.000
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.004)
Autoregressive component	0.957 ***	0.961 ***	0.896 ***	0.952 ***	0.898 ***	0.931 ***
	(0.020)	(0.026)	(0.091)	(0.030)	(0.029)	(0.032)

Left Tail Parameter

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	-0.003	-0.017 **	-0.023 *	-0.025	-0.003	-0.018 ***
	(0.008)	(0.008)	(0.013)	(0.030)	(0.020)	(0.003)
Global factor	0.000	-0.002 *	0.002	0.006	0.000	0.010
	(0.004)	(0.001)	(0.003)	(0.004)	(0.003)	(0.007)
Autoregressive component	0.937 ***	0.922 ***	0.978 ***	0.959 ***	0.950 ***	0.933 ***
	(0.025)	(0.038)	(0.033)	(0.028)	(0.025)	(0.045)

***, ** and * represent statistical significance at 1%, 5% and 10% significance level, respectively.

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Table 8: Estimated coefficients for the analyzed measures in the risk premium

First measure (long-term horizon of implementation)

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.002 ***	-0.00005	0.011 **	0.001	0.00001	0.00002
	(0.001)	(0.000)	(0.004)	(0.000)	(0.000)	(0.000)
Global factor	-0.00001 **	0.000	0.000 ***	0.000 ***	0.000 **	0.000002 ***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Autoregressive component	0.378	0.974 ***	0.618 ***	0.975 ***	0.930 ***	0.907 ***
	(0.234)	(0.016)	(0.174)	(0.020)	(0.043)	(0.045)

Second measure (long-term horizon of implementation)

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.001 **	-	-	0.001 *	-0.00002	0.00011
	(0.001)			(0.000)	(0.000)	(0.000)
Global factor	-0.00001 *	-	-	-0.00001 ***	-0.000003 **	0.0000013 **
	(0.000)			(0.000)	(0.000)	(0.000)
Autoregressive component	0.481 **	-	-	0.956 ***	0.929 ***	0.875 ***
	(0.228)			(0.024)	(0.046)	(0.055)

Transitory effect (days close to the announcement)

	Brazil	Chile	Colombia	Indonesia	South Korea	Turkey
Intervention	0.001 ***	-0.034 *	-1.351	-2.299	0.706 **	-0.0001
	(0.000)	(0.020)	(1.422)	(2.391)	(0.350)	(0.000)
Global factor	-0.00001 **	-0.001 ***	0.038 *	-0.097 ***	-0.003 **	0.000001
	(0.000)	(0.000)	(0.020)	(0.030)	(0.001)	(0.000)
Autoregressive component	0.944 ***	0.980 ***	0.769 ***	0.978 ***	0.961 ***	0.899 ***
	(0.027)	(0.015)	(0.147)	(0.019)	(0.040)	(0.044)

***, ** and * represent statistical significance at 1%, 5% and 10% significance level, respectively.

5 Conclusions

During 2010 and 2011 diverse emerging economies experienced significant capital inflows as a result of investors' search for yields which favored the appreciation of various currencies against the USD. These capital inflows can have both advantages and disadvantages. On one hand, capital inflows could be perceived as cheaper and easily-available financing to encourage domestic demand. On the other hand, they can also be associated with an overheating of the national economy and with a relative loss of competitiveness as compared to foreign economies due to the exchange rate appreciation. As a response, many countries implemented capital controls and banking regulations.

This article examines the link of the announcements of capital controls and banking regulations implemented in a number of emerging economies from January 2010 to April 2011 on risk-neutral densities that characterize market exchange rate expectations. These expectations are measured based on risk-neutral densities estimated with options markets information. The evidence suggests that for most countries the effects of this type of policies are limited for long horizons implying that capital controls are ineffective, whereas only in the days close to the announcement of the measures, and for some currencies, the effect seems to go in the direction desired by authorities (in terms of containing a sudden appreciation of the exchange rate given the massive inflows of capital).

It is noteworthy however, that the results indicate that the measures have had a persistent effect making the distribution tails wider and increasing the probabilities allocated to extreme events mainly in those countries that implemented these type of measures more aggressively: Brazil, Indonesia, and Colombia. This result might suggest that the market allocates more probability to extreme movements in those currencies where governments were implementing capital controls or banking regulations more intensively. This is consistent with the possibility of the market allocating a higher risk premium when adopting positions with respect to these countries' currencies. Moreover, in general, it is found that in various analyzed cases exchange rate risk premia tend to increase after announcements of capital controls or banking regulations, both in short- and in long-term horizons. In this context, given the interest rate parity, if controls are successfully imposed, an increase in risk premium on local currency is expected to occur in line with slower appreciation expectations, thus further investigation regarding this topic could be explored.

References

Abarca, G.L., G.Benavides, and J.G. Rangel, (2012). Exchange Rate Market Expectations and Central Bank Policy: The case of the Mexican Peso-US Dollar from 2005-2009. The Journal of Derivatives, Vol. 19, No. 4 pp 70-90.

Bank of International Settlements (2010) Triennial Central Bank Survey: Report on global foreign exchange market activity in 2010. Monetary and Economic Department. December 2010.

Bliss, R., and Panigirtzoglou, N., (2004). Option-Implied Risk Aversion Estimates. Journal of Finance, 59 (1), 407-446.

Breeden, D., and R. Litzenberger, (1978). Prices of State-Contingent Claims Implied in Option Prices. Journal of Business, 51, 621-651.

Buch, CM., R.P. Heinrich, and C. Pierdzioch. (1998). Taxing Short-Term Capital Flows An Option for. Transition Economies? Kiel Discussion Papers 321.

Campa, J., K. Chang, R. Reidner. (1997). Implied Exchange Rate Distributions: Evidence from the OTC Option Markets, NBER Working paper no. 6179.

Clews R., N. Panigirtzoglou and J. Proudman (2000). Recent Developments in Extracting Information from Option Markets. Bank of England Quarterly Bulletin, February pp. 50-60.

Disyatat, P., and G.Galati (2007). The Effectiveness of Foreign Exchange Market: Intervention in Emerging Market Countries: Evidence from the Czech Koruna. Journal of International Money and Finance, 26, 383–402.

Edwards, S. (1998). Capital Flows, Real Exchange Rates and Capital Controls: Some Latin American Experiences. NBER Working Paper 6800.

Edwards, S. (2001), Capital Flows and Economic Performance: Are Emerging Economies Different? NBER Working Paper no. 8076 (January).

Eichengreen, B. (2001). Capital account liberalization: What do the cross-country studies tell us? World Bank Economic Review, 15:341-365.

Figlewski, S. (2009). Estimating the Implied Risk-Neutral Density for the U.S. Market Portfolio.Volatility and Time Series Econometrics: Essays in Honor of Robert F. Engle (Eds. Tim Bollerslev, Jeffrey Rusell and Mark Watson). Oxford, UK: Oxford University Press.

Frankel, J. (1996). How Well Do Foreign Exchange Market Works: Might a Tobin Tax Help? In The Tobin Tax: Coping with Financial Volatility, Haq, M. ul, I. Kaul and I. Grunberg, eds., Oxford University Press, pp. 41-81.

Frenkel, M., C.Nickel, G. Schmidt, and G. Stadmann. (2001). The Effects of Capital Controls on Exchange Rate Volatility and Output. IMF Working Paper.

International Monetary Fund: Strategy, Policy, and Review Department. (2011). Recent Experiences in Managing Capital Inflows—Cross-Cutting Themes and Possible Policy Framework. IMF Working Paper.

International Monetary Fund. (2010). World Economic Outlook: Recovery, Risk, and Rebalancing. World Economic and Financial Surveys.

Jeanne O. and A. Korinek. (2010). Excessive Volatility in Capital Flows: A Pigouvian Taxation Approach, American Economic Review, American Economic Association, vol. 100(2), pages 403-07, May

Kaminsky, G. L. and Lewis, K. K. (1996). Does Foreign Exchange Intervention Signal Future Monetary Policy?, Federal Reserve Bank of Philadelphia.Working Paper No. 96-7.

Korinek A. (2011). Systemic Risk-taking: Amplification Effects, Externalities, and Regulatory Responses, Working Paper Series 1345, European Central Bank.

Lewis, K. K. (1995). Occasional Intervention to Target Rates. American Economic Review, 84(5):691–715.

Malz, A. M. (1997). Estimating the Probability Distribution of the Future Exchange Rate from Option Prices. Journal of Derivatives, 5, 18-36.

Magud, N., C. Reinhart, and K. Rogoff. (2011). Capital Controls: Myth and Reality – A Portfolio Balance Approach, PIIE Working Papers No. 11-7.

Montoro, C., and Moreno R. (2011). The Use of Reserve Requirements as a Policy Instrument in Latin America, BIS Quarterly Review, March 2011.

Neely, C. J. (2001). The Practice of Central Bank Intervention: Looking under the Hood. Federal Reserve Bank of St. Louis Review, 83(3):1–10.

Ostry, J., A. Ghosh, K. Habermeier, M. Chamon, M. Qureshi, and D. Reinhardt. (2010). Capital Inflows: The Role of Controls, IMF Staff Position Note. Washington, DC: IMF.

Ostry, J., A. Ghosh, K. Habermeier, L. Laeven, M. Chamon, M. Qureshi, and A. Kokenyne. (2011). Managing Capital Inflows: What Tools to Use? IMF Staff Discussion Note. Washington, DC: IMF.

Quinn, P. (1997), The Correlates of Changes in International Financial Regulation, American Political Science Review 91, pp. 531-551.

Reinhart C. and V. Reinhart, (1999). On the Use of Reserve Requirements to Deal with the Capital Flow Problem. International Journal of Finance and Economics, 41, pp. 27–54.

Reinhart, C., and T. Smith. (1998). Too Much of a Good Thing. The Macroeconomic Effects of Taxing Capital Inflows. In Managing Capital Flows and Exchange Rates: Perspectives from the Pacific Basin, R. Glick, ed., Cambridge: Cambridge University Press, pp. 436-464.

Rodrik, D. (1998), Who Needs Capital-Account Convertibility? in Peter Kenen (ed), Should the IMF Pursue Capital Account Convertibility? Essays in International Finance no. 207, Princeton: Princeton University Press (May).

Shimko, D., (1993), Bounds of Probability, Risk 6, 33-37.

Tobin, J. (1974). The New Economics One Decade Older. The Elliot Janeway Lectures on Historical Economics in Honor of Joseph Schumpeter. Princeton: Princeton University Press.

Wooldridge, J. (2009). Introductory Econometrics: a Modern Approach, South-Western Cengage Learning, edition 4, volume 1, number 1234567121110090. Pages 316-318.

Appendix 1: Description of Measures Implemented by Selected Emerging Economies

A.1 Brazil

Brazil implemented various measures, including mechanisms such as tax modifications. The measures taken during the sample period are the following:

Capital controls: There are three capital control measures that Brazil implemented. First, the Ministry of Finance increased twice the tax on incoming fixed-income investment (IOF), thereby manifesting the government's intention of reducing the difference between the interest rate of Brazil and other countries, whose currencies were depreciated and maintained lower interest rates. Second, a tax on short-term foreign corporate loans and overseas bond sales (by banks and firms) has been increased from 5.38% to 6% applicable to loans up to one year from the previous 90-day limit. The Central Bank declared that the increase in this tax is aimed at reducing the number of loans in foreign currency with a maturity longer than three months, which have grown approximately 39% since the end of 2008 (loans subject to the tax later included loans of up to two years). Besides, the Ministry of Finance declared that the objective of the measure was to discourage short-term foreign loans, and, thus, reduce capital inflows and credit supply in Brazil. Finally, the Ministry of Finance increased the tax on guarantees for derivatives operations in the futures market.

Banking regulations: Only one measure within this category was implemented: a reserve requirement on short USD positions held by local banks. Under this measure, Brazilian banks have to deposit at the Central Bank the equivalent of 60% of the short USD positions that exceed USD 3 billion or their capital base (whichever is smaller). These reserves will not generate interests.

A.2 Chile

As a response to the strong appreciation of the Chilean peso (CPL) observed in 2009, Chile has taken the following steps:

Capital controls: A measure agreed on by the Council of the Central Bank of Chile was an extension of the total maximum foreign investment limit of Pension Funds from 60% to 80%. This limit differs among different types of Funds, i.e., Fund Type A = 100%, Fund Type B = 90%, Fund Type C=75%, Fund Type D = 45%, and Fund Type E =35%. Each fund invests in fixed income and

equity instruments. The different types of Pension Funds are differentiated by the share of their resources invested in equity financial assets, which are characterized by higher risk and greater expected returns. The Fund Type A has a greater share of its investments in equity; this proportion is progressively decreasing in Funds B, C, D, and E.

A.3 Colombia

To contain the continued appreciation of the Colombian peso (COP) and to reduce capital flows volatility, this country implemented the following measures during the sample period:

Capital controls: Colombia implemented some measures to control capital flows. First, the Ministry of Finance and Public Credit (MHCP, for its acronym in Spanish) eliminated existing tax exemptions on the payment of interests for credits granted by foreign entities. Additionally, an exemption on accrued interests by Colombian credit institutions, short-term interests accumulated by bank overdrafts and those corresponding to foreign trade, was established. The objective of these measures was to level up tax conditions governing foreign and domestic credit operations; in addition to discouraging external debt operations, and reducing the exchange rate pressures. Second, the MHCP and *El Consejo Superior Arancelario* (the Customs Superior Council) launched a tariff reform by changing the tariffs for 3,600 subdivisions, half of which existed. The general average tariff was reduced from 12% to 8.2%. In particular, consumer goods obtained a tariff of 15%, while raw materials and capital goods of the industrial area, 5%. None of the goods presented a reduction greater than 10 percentage points.

A.4 Indonesia

As an answer to the strong capital inflow experienced by Indonesia during the analyzed period, some banking regulations were implemented. The measures constituted an effort to attract more stable medium- and long-term capital flows and to reduce the volatility of short-term speculative flows.

Banking Regulations: First, Bank of Indonesia (BI) established the regulation on net open position of foreign currency liquidity, directed at commercial banks with the purpose of supporting the deepening of the domestic currency market, while it also covers macro-prudential aspects. This measure eliminates the maximum limit of the net open position in the balance sheet, which was

20% of the capital, maintaining this limit for the total net open position. Second, Bank of Indonesia increased the reserve requirements on foreign currency holdings in commercial banks (from 1% to 5%).[28] Third, Bank of Indonesia issued Securities of the Bank of Indonesia (SBI) to sterilize the liquidity generated by capital inflows with some particularities: i) it established a minimum holding period of 28 days for SBI in primary and secondary markets; ii) it reduced the SBI auction frequency from weekly to monthly; iii) it started the issuance of 9- and 12-month SBI; iv) it suspended the one- and three-month SBI sale, substituting them with a six–month tenor; and, v) it created a three-month term deposit that functions as alternative debt instrument for banks holding excess liquidity, given the elimination of one-month and three–month SBI. These measures were implemented with the purpose of directing capital flows to long-term investments, besides softening the volatility of short-term instruments that could represent a threat to financial stability. In the same way, efforts were made to support the deepening of the domestic money market, in terms of instruments' availability, maturity, and formation of a structure of short-term interest rates, motivating the banks to manage their liquidity in a long-term horizon.

A.5 South Korea

South Korea concentrated on the two categories of policies during the sample period:

Capital controls: The Ministry of Finance implemented a tax on profits of foreign investors, with the exception of those coming from the countries with an agreement to avoid double taxation, who will continue being exempt from the tax. This measure imposed a tax of 14% on the profits obtained from bonds and obligations of the National Treasury of Korea by foreign investors. In the same way, it introduced a tax of 20% on capital profits.

Banking Regulations: The Bank of Korea and the Financial Supervision Service (FSS) implemented new banking regulations applicable to national banks and international banks' branches in South Korea, such as the establishment of a limit on domestic bank's foreign exchange derivative contracts of 50% of their capital in the previous month, foreign banks limit was lowered from 300% to 250%. Likewise, the limit for the use of derivatives to cover corporate settlements was decreased from 125% to 100%. Additionally, it was agreed that loans in foreign currency granted by financial institutions should be used abroad; only small and medium-size firms can use them inside the

[28] This requirement is planned to increase to 8% in June 2011.

country. Finally, the foreign currency liquidity coefficient was increased from 90% to 100% and the ratio of financing in foreign loan portfolios was increased from medium- to long-term. Moreover, Bank of Korea and FSS implemented audits of national and foreign banks to ensure that these institutions located in South Korea maintain the currency derivatives positions in accordance with the regulations introduced in June 2010, described previously.

A.6 Turkey

Turkey mainly implemented banking regulations.

Banking Regulations: The main banking regulations implemented by Turkey refer to the reserve requirement ratio and the reserve requirement base. First, the CBRT increased on several occasions the reserve requirements in foreign currency, changing from 9% to 11%, while for the local currency, from 5% to 6%, afterwards it increased to a range from 9% to 15% according to the type of deposit. It is noteworthy that the CBRT struck the market by aggressively raising the reserves requirements ratio between 300 and 500 basis points, depending on the type of deposit and on its length of maturity (measure established on December 17, 2010). Additionally, from December 2010 onwards, the CBRT has carried out an unorthodox monetary policy (called CBT's Policy Mix) of cutting the reference interest rate and increasing the reserve requirement ratios, as an effort to maintain financial and price stability. In the second case, the introduction of changes in the reserve requirement base had the purpose of assuring the effectiveness of the policy of reserve requirements differentiated according to the maturity of the deposits' structure. In this case, the reserve requirement base was expanded to include funds obtained from repurchase agreements with foreign and local clients, except for agreements with the Central Bank and those obtained among local banks.

Appendix 2: OTC foreign exchange turnover in April 2010 [1/]

Total reported transactions in all currencies

Daily averages, in millions of US dollars

	US dollar	Brazilian real	Czech koruna	Forint	Rupiah	Won	Mexican peso	Turkish lira
Options sold	105529	3040	148	825	120	2521	1595	2559
with reporting dealers	47216	1506	69	360	70	1467	839	1090
local	16349	637	12	136	8	525	231	431
cross-border	30867	869	57	223	62	942	608	658
with other financial institutions	47221	1389	47	366	38	836	613	1286
local	27862	457	6	147	1	341	225	714
cross-border	19359	932	41	218	37	495	387	572
with non-financial customers	11092	145	32	100	12	217	144	183
local	4552	59	10	30	0	81	44	97
cross-border	6540	86	22	70	12	136	100	87
Options bought	101003	3187	127	804	107	2438	1531	2260
with reporting dealers	45459	1634	49	413	64	1341	783	1033
local	15463	631	0	210	8	484	253	468
cross-border	29996	1004	49	204	56	857	530	565
with other financial institutions	42385	1456	28	305	24	838	609	820
local	23627	426	12	100	5	467	253	192
cross-border	18758	1030	16	204	20	371	356	628
with non-financial customers	13159	97	50	86	19	260	139	407
local	5402	41	15	27	1	117	36	330
cross-border	7757	56	35	59	18	143	104	76
Total options	160194	4657	216	1243	160	3555	2316	3757

1/ Adjusted for local and cross-border inter-dealer double-counting. Due to incomplete counterparty breakdown, components do not always sum to totals. While data on total options are shown on a net basis, separate data on options sold and options bought are recorded on a gross basis, ie not adjusted for inter-dealer double-counting.

Source: BIS, Triennial Central Bank Survey, December 2010.