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Abstract

The purpose of this article is to empirically investigate which exchange rate arrangements are associated with more speculative attacks in the foreign exchange market, a relationship which is estimated using a least squares dummy variables panel data model. Also, this article addresses the issue of measurement errors in the classification of exchange rate regimes by using four different classification schemes. Three de facto and one de jure classifications are used. Consequently, the sensitivity of these results to alternative exchange rate classifications is also tested. The empirical findings indicate clear support for fixed regimes particularly in emerging and developing countries.

Keywords: Exchange rate regimes, speculative attacks, currency crises.

JEL classification: F31, F33.

1 Introduction

Since the early 70s, speculative attacks on the currency markets have become more common than people usually imagine. Currency crisis and speculative attacks are used almost synonymously, but really a speculative attack on government reserves may or may not result in a currency crisis. It depends on the ability or willingness of the government to defend the national

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currency. In this context, a currency crisis happens when the government cannot (or does not want to) support the exchange rate. However, some researchers argue that certain exchange rate regimes are more prone to speculative attacks. In that sense, interest in speculative attacks and exchange rate crisis has led to the development of a body of literature analyzing this phenomenon. Contrary to a large number of studies in the literature, relatively few studies attempt to empirically investigate the relationship between exchange rate regime and exchange market pressure or speculative attacks in developed, emerging and developing countries, separately. This is perhaps, because such an empirical investigation is fraught with difficulties, including the problem concerning the classification of exchange arrangement.

This article addresses the issue of measurement errors in the classification of exchange rate regimes by using four different classification schemes. Three *de facto* and one *de jure* classifications are used. Consequently, the sensitivity of these results to alternative exchange rate classifications is also tested. The principal conclusions emerging from this study are the following: emerging and developing countries adopting fixed exchange rate arrangements experience lower foreign exchange market pressure or speculative attacks.

The remainder of this article is organised in the following way: Section 2 presents a brief literature review focusing on exchange arrangement classifications and on the link between exchange rate regimes and speculative attacks. Section 3 discusses the issues of exchange market pressure indicators. Section 4 describes the empirical framework. A preliminary analysis of the data is presented in Section 5. Section 6 reports empirical findings. Section 7 concludes the findings of this article.

2 Exchange Rate Regimes and Speculative Attacks: A Survey of the Literature

This literature review section is broken down into two sub-sections. The first sub-section constitutes a brief discussion on the different approaches, considered in this study; to exchange rate regime classification is presented. The second sub-section presents a review of empirical analyses of exchange arrangements and speculative attacks.

2.1 Regime Classification

A common problem in the empirical analysis of exchange rate systems is regime classification. The literature identifies two approaches to this problem: the *de jure* classification and the *de facto* classification. The former classifies countries by what they say they do (*de jure*). However, countries often act differently to what they declare they do. In particular, a self-declared independent floating regime, in reality, often operates a managed peg regime. This phenomenon of operating a disguised peg is referred to as "fear of floating" (Calvo and Reinhart, 2002). Classifying countries by what they actually do is a *de facto* classification. Some authors develop *de facto* classifications using various methods (Ghosh et al., 1997; Bailliu et al., 2001; Moreno, 2001; Poirson, 2002; Bubula and Otker-Rober, 2002; Reinhart and Rogoff, 2004; Shambaugh, 2004; Dubas et al., 2005; Levy-Yeyati and Sturzenergger, 2005; Bérnassy-Quéré et al., 2006; Frankel and Wei, 2008; Klein and Shambaugh, 2008; Ilzetski et al., 2010), but these are fundamentally based on data on the behaviour of nominal exchange rates, international reserves and interest rates[2].

[2] To a literature reviews on why many countries follow de facto regimes different from their de jure regimes see Cruz-Rodríguez (2013).

Some empirical studies simply employ the de facto classification because the *de jure* classification may reach incorrect results[3], particularly about floating regimes. On the other hand, some research employs the *de jure* classification arguing that it suffers from less drawbacks than the *de facto* classification[4].

Table 1: Classification of Exchange Rate Regime

Fixed	Intermediate	Floating
De facto Classification by Levy-Yeyati and Sturzenerger		
(1) Fixed	(2) Crawling peg (3) Dirty floats	(4) Float
De facto Classification by Reinhart and Rogoff		
(1) No separate legal tender (2) Pre-announced peg or currency board arrangement (3) Pre-announced horizontal band that is narrower than or equal to ± 2% (4) *De facto* peg	(5) Pre-announced crawling peg (6) Pre-announced crawling band that is narrower than or equal to ± 2% (7) *De facto* crawling peg (8) *De facto* crawling band that is narrower than or equal to ± 2% (9) Pre-announced crawling band that is wide than or equal ± 2% (10) *De facto* crawling band that is narrower than or equal to ± 5% (11) Moving band that is narrower than or equal to ± 2%	(12) Managed floating (13) Freely floating (14) Freely falling (15) Hyperfloating
De facto Classification by Bailliu, Lafrance and Perrault		
(1) Currency boards (2) Single currency peg (3) Basket pegs (4) Crawling pegs with narrow bands	(5) Flexibility index ≤ 1	(6) Flexibility index ≥ 1
De jure Classification by Ghosh, Gulde and Wolf		
(1) Pegged regimes	(2) Intermediate regimes	(4) Floating regimes

Note: Inconclusive classifications from Levy-Yeyati and Sturzenergger are not considered in our analysis.

Sources: Bailliu et al. (2001); Bailliu et al. (2003); Ghosh et al. (2002); Reinhart and Rogoff (2004); and Levy-Yeyati and Sturzenergger (2005).

[3] This could be the results of measurement error in the classification of exchange rate arrangements.

[4] The *de facto* classification has the advantage of being based on observable behaviour, but it does not capture the distinction between stable nominal exchange rates resulting from the absence of shocks, and stability that stems from policy actions offsetting shocks. More importantly, it fails to reflect the commitment of the central bank to intervene in the foreign exchange market. Although the *de jure* classification captures this formal commitment, it falls short of capturing policies inconsistent with the commitment, which lead to a collapse or frequent adjustments of the parity.

In this article we employ a combination of three *de facto* and one *de jure* classifications. Firstly, we use the *de facto* classification developed by Levy-Yeyati and Sturzenergger (2005), henceforth known as the "LYS classification". These authors apply a cluster analysis to a data set with three variables: changes in the nominal exchange rate, the volatility of these changes, and the volatility of international reserves from all IMF reporting countries in the period 1974-2000. Secondly, the "natural classification" developed by Reinhart and Rogoff (2004) is employed. Reinhart and Rogoff (2004) reclassified exchange rate regimes based on market determined dual and parallel exchange rates, and use official rates only if the exchange rates are unified[5]. These authors examine the chronologies of the exchange rate history for 153 countries in the period 1946-2001. They are able to distinguish among floating by high inflation countries (freely falling) from floating by others. They define the category of "freely falling" rates when the 12-month rate of inflation exceeds 40% and when, during these periods of high inflation there is no official announcement of the regime by the authorities[6]. In addition, they define hyperfloats as those episodes of macroeconomic instability that are characterised by hyperinflation where the monthly inflation rate is 50% or more. Thirdly, an alternative classification scheme developed by Bailliu et al. (2001) is used. These authors develop a Hybrid Mechanical Rule (HMR) classification. This system classifies exchange rate regimes in terms of their observed flexibility and takes into account external shocks and revaluations. Their analysis is based on a sample of 60 countries for the period 1973-1998. Finally, the *de jure* classification from the IMF is used[7].

In our analysis all the different classifications are grouped into three broader regimes: fixed, intermediate and floating exchange rate regimes (see Table 1). Managed floating is classified under the floating category because managed, in the context of the Reinhart-Rogoff classification, does not necessarily imply active or frequent foreign exchange market intervention.

2.2 Exchange Rate Arrangements and Speculative Attacks

Earlier contributions to the theoretical literature on speculative attacks and currency crises pointed almost exclusively to deteriorating economic fundamentals as the trigger for speculative attacks. However, few studies have made an attempt to investigate empirically whether a particular exchange rate regime is more prone to a speculative attack. Some empirical research suggests that speculative attacks are more likely to occur under fixed or intermediate exchange regimes. Eichengreen et al. (1994) present an empirical analysis of speculative attacks on pegged exchange rates in 22 countries between 1967 and 1992. The authors define speculative attacks or crises as large movements in exchange rates, interest rates, and international reserves. They develop stylized facts concerning the univariate behavior of a variety of macroeconomic variables, comparing crises with periods of tranquility. For Exchange Rate Mechanism (ERM) of the European Monetary System observations they cannot reject the null hypothesis that there are few significant differences in the behavior of key macroeconomic variables between crises and non-crisis periods. On the contrary, a study developed by the IMF (1997), based on the IMF's *de jure* classifications, finds that close to half of the currency crashes (sharp changes in the exchange rate) occur under floating regimes, implying that crises can arise under both pegged and floating regimes[8]. Similarly, Ghosh et al. (2002) find that *de jure*

[5] In case where there are no dual or multiples rates or parallel markets are not active.

[6] In situations where the currency crisis marks a sudden transition from a fixed or quasi-fixed regime to a managed or independently floating regime, they label an exchange rate as freely falling during the six months immediately following a currency crisis.

[7] The data on the de jure classification of exchange rate regimes is taken from Ghosh et al. (2002) and from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions.

[8] An important observation is that many exchange rate regimes are improperly classified as flexible when they are in fact, pegged regimes.

pegged regimes have the lowest probability of a speculative attacks and therefore of a currency crisis[9]. Likewise, Falcetti and Tudela (2006) show that currency crises in developing and emerging markets are less frequent under *de jure* fixed exchange rates than under *de jure* flexible regimes in the period 1970-1997. On the other hand, Rogoff et al. (2003) find that currency crises tend to occur more frequently in *de facto* intermediate regimes especially in emerging markets. Similar conclusions are drawn by Peltonen (2006) who finds, using the *de facto* classification from Reinhart and Rogoff (2004), that emerging markets with more rigid exchange rate regimes were less prone to speculative attacks and currency crises during the last two decades. Empirical case studies conducted by Jakubiak (2001) demonstrate that a floating exchange rate regime does not guarantee an emerging country avoiding a currency crisis. Haile and Pozo (2006), using the IMF's *de jure* and the LYS *de facto* classifications analyse the incidence of speculative attacks and currency crises in emerging markets according to the exchange regime in place between 1974 and 1998. Their results suggest that the *de facto* exchange regime plays no role in determining currency crisis period. As a consequence, fixed exchange regimes that are not truly fixed appear to invite speculation against the currency, increasing the likelihood of currency crisis.

In the same way, Bubula and Otker-Rober (2003), using their own *de facto* classification[10], find that pegged regimes, as a whole, are more prone to speculative attacks and currency crises compared with floating regimes, particularly for developed and emerging market economies that are integrated with international capital markets, in the period 1990-2001[11]. On the contrary, Coulibaly (2009), using panel data of 192 countries from 1970 through 1999, and 195 currency crisis episodes, examines the effect of membership in a currency union on the probability of experiencing a currency crisis. Both parametric and non-parametric estimates suggest that membership in a currency union reduces the likelihood of a speculative attacks or currency crash. Angkinand et al. (2009), using a logit model and a panel of 90 countries observed annually from 1990 to 2001, show that results from using Reinhart and Rogoff (2004) regime are that middle regimes such as adjustable parities, crawls, and moving bands are relatively prone to crises, while managed floats have the lowest probability of crises among intermediate regimes. However, when authors turn to LYS classification, they do not find any significant result in explaining the correlation between exchange rate regimes and currency crises.

Esaka (2010a) examines the link between *de facto* exchange rate regimes and the incidence of currency crises in 84 countries from 1980 to 2001 using probit models. The author employs the *de facto* classification of Reinhart and Rogoff (2004) and finds no evidence that intermediate regimes have a significantly higher probability of speculative attacks and currency crises than both hard pegs and free floats. Similarly, Esaka (2010b) examines whether *de facto* exchange rate regimes affect the occurrence of currency crises in 84 countries over the 1980–2001 period by using the probit model and the *de facto* classification of Reinhart and Rogoff (2004). His results show that pegged regimes significantly decrease the likelihood of speculative attacks and currency crises compared with floating regimes. On the other hand, Asici (2011) applied a multinomial logit framework to 163 developed and developing countries over the period from 1990 to 2007. His regression results suggest that countries experiencing speculative attacks and currency crisis are those that have chosen regimes inconsistent with their individual features.

Karimi and Voia (2014) analyze the effect of exchange rate regimes and capital account liberalization policies on the occurrence of currency crises for 21 countries over the period of

[9] However, the impact of a currency crisis is more severe under pegged and intermediate regimes than under floating regimes.

[10] For details on this classification, see Bubula and Otker-Rober (2002).

[11] They define currency crises as episodes of severe market pressures, reflected by sharp movements in both exchange rates and interest rates.

1970-1998. The authors examine changes of the likelihood of currency crises under *de jure* IMF classification and two *de facto* exchange rate regimes (Reinhart and Rogoff and LYS). Their results show that the likelihood of speculative attacks and currency crises changes significantly under *de facto* regimes. While Reinhart and Rogoff based models show that fixed exchange rate arrangements are least susceptible to speculative attacks, LYS based models point to the intermediate exchange rate regimes as the least crisis prone. However, Esaka (2014), using data on currency crises and exchange rate regimes from 84 countries for the period of 1980–1998 and the *de jure* IMF classification to identify official announced exchange rate regimes and the *de facto* Reinhart and Rogoff (2004) classification, evaluates the treatment effect of consistent pegs on the occurrence of currency crises to examine whether consistent pegs are indeed more prone to speculative attacks or currency crises than other regimes. Using matching estimators as a control for the self-selection problem of regime adoption, the author finds that countries with consistent pegs have a significantly lower probability of speculative attacks and currency crises than countries with other exchange rate policies. On the other hand, Ghosh et al. (2015) using the IMF *de facto* classification[12] and a sample of 50 emerging economies over 1980-2011, show that macroeconomic and financial vulnerabilities are significantly greater under less flexible intermediate regimes, including hard pegs, as compared to floats. On the contrary, Combes et al. (2016) revisit the link between crises and exchange rate regimes. Using a panel of 90 developed and developing countries over the period 1980-2009, and two *de facto* classifications (the IMF *de facto* classification and the Ilzetski et al., 2010, classification). Their results reject that intermediate regimes are more vulnerable to crises compared to the hard peg and the fully floating regimes.

3 The Exchange Market Pressure Indicator

In any empirical analysis of currency crises, the first issue is to define the nature of a crisis. A currency crisis can be understood as a sudden decline in the confidence to an individual currency usually leading to a speculative attack against it. Since, in a currency crisis situation, a speculative attack may lead to sharp currency depreciation, an increase of interest rates and/or a substantial reserve loss, the most straightforward approach is to employ an index of speculative pressure[13]. This technique is common in the empirical literature on currency crises. The exchange market pressure indicator was originally developed by Girton and Roper (1977) to describe the composite behaviour of nominal exchange rates and international reserves, and later modified by Eichengreen et al. (1994, 1996). In the interest of measuring currency crises Eichengreen et al. (1994, 1996) add a third term: changes in the nominal interest rate. The idea behind this is that an excess demand for foreign exchange can be met through several channels. Depreciation or devaluation occurs if the speculative attack is successful, but monetary authorities may instead accommodate the pressure by running down their international reserves or deter the attack by raising interest rates. This methodology, which identifies currency crises using an exchange market pressure indicator, has been followed, in principle, by Sachs et al.

[12] Critics constantly moved away from the official International Monetary Fund classification to construct a de facto classification system in 1999. The new IMF classification combines the available information on exchange rates and monetary policy frameworks, and the formal or informal policy intentions of authorities, with data on actual exchange rates and reserve movements to reach an assessment of the actual exchange rate regime (Habermeier et al., 2009, provide information on revisions to this classification system in early 2009). However, it can be argued that the new IMF classification system is still one of the de jure regimes, since it still relies heavily on official information and looks mainly at the behaviour of official exchange rates (Reinhart and Rogoff, 2004).

[13] In theoretical literature, a currency crisis is mostly defined only in the case of fixed exchange rate regimes, usually as the official devaluation or abandonment of the fixed exchange rate regime. However, this definition is not flexible enough to serve a use in empirical research, since many currencies are not formally pegged to a specific currency and many countries use various forms of floating exchange rate regimes.

(1996); Kaminsky et al. (1998); Tudela (2004); Peltonen (2006); Haile and Pozo (2006); Falcetti and Tudela (2006), among others.

In this article, the exchange Market Pressure Indicator (MPI) is calculated as the weighted average of percentage changes in the exchange rate (*e*), percentage changes in the interest rate (*i*), and percentage changes in international reserves (*r*)[14], using the United States as the country of reference[15]. The exchange market pressure index is defined as follows:

$$MPI = w_1 \Delta e + w_2 \Delta i - w_3 \Delta r \quad (1)$$

where *e* represents the price of US$1 in domestic currency, *i* the interest rate, and *r* international reserves. Since the volatilities of foreign reserves, exchange rates and interest rates are very different, the weights w_1, w_2 and w_3, attached to each component are used to equalise the volatilities of each of the three MPI components, thereby preventing any one of them from dominating the index, and are defined as the inverse of the standard deviation of each of the individual series. Formally:

$$w_j = \frac{\frac{1}{StDev_j}}{\frac{1}{StDev_e} + \frac{1}{StDev_i} + \frac{1}{StDev_r}} \quad (2)$$

where *j* stands for any of the three variables and *StDev* stands for the standard deviation. According to equation (1), if a country has a fixed exchange rate regime, a speculative attack may lead to sharp currency devaluation, an increase of interest rates and/or a substantial foreign reserve loss. Contrary, if a country has a flexible exchange rate regime, a speculative attack may lead to sharp currency depreciation, and then to an increase of interest rates and/or a substantial international reserve loss, but only if monetary authorities want to deter the attack. The MPI is a continuous variable.

4 Empirical Methodology

A panel data model is used to estimate the impact of exchange rate regimes on the MPI. We employ MPI because a continuous variable generally contains more information than a discrete crisis dummy since this measure captures pressures which reflect the idiosyncrasy of the countries. The model used is a static panel data through Least Squares Dummy Variables (LSDV). The following equation describes the general specification used:

$$y_{it} = X_{it}\beta + D_i\alpha_i + \varepsilon_{it} \quad (3)$$

where i =1,2.....N, t = 1,2....T, y_{it} is the dependent variable in country i and time t, X_{it} is the vector of inputs for the i th variables in the t th period, D_i is a dummy variable, α_i is a country specific effect and ε_{it} is an error term. We also assume $\varepsilon_{it} \sim (0, \sigma^2)$.

The country specific effect, α_i, is designed to capture the determinants of a country's speculative attack that are not already controlled by the other explanatory variables. It thus accounts for unobservable characteristics that vary across countries but not over time. The country specific effect could be either a fixed effect (i.e., a constant that varies for each cross-sectional unit), or a random effect (i.e., a random variable drawn from a common distribution

[14] A decrease rather than increase in international reserves is used, since an increase in speculative pressure tends to increase the exchange rate and the interest rate, but tends to reduce foreign reserves.
[15] Variables in logarithms.

with a mean α and a variance σ^2). We use a Hausman test to decide whether it is more appropriate to model the country effects as being fixed or random[16].

We employ a panel data estimating method to determine the impact of the exchange arrangement on exchange market pressure. The dependent variable is MPI. To ascertain that our results are robust to the regime classifications, we employ both *de jure* and *de facto* classifications in this article. We also use three different *de facto* classifications.

5 The Data

The sample consists of panel data for 125 countries classified by the World Bank according to their income. Advanced or developed countries are those economies classified as upper income countries. Emerging markets countries are defined according to the Morgan Stanley Capital International (MSCI) index[17] at that moment. The rest of the countries are designated as developing. Table 2 provides a list of countries classified in each group.

The data set is annual, spanning from 1974 through to 1999. Data availability differs across countries. Particularly, the data for East-European countries which starts from the 1990s.

Most of the macroeconomic and financial variables used in our analysis are taken from the World Bank's World Development Indicators and the IMF's World Economic Outlook databases. A few series are taken from the CD-ROM version of the International Monetary Fund's International Financial Statistic (IFS). The data from the *de jure* IMF classification can be obtained from the IMF's Annual Report on Exchange Arrangements and Exchange Restrictions and Ghosh et al. (2002). For the Market Pressure Index (MPI) calculations, we employ total non-gold international reserves, average period exchange rates and short-term interest rates. Money market rates were used for all the countries where available, and t-bill rates, bank lending or deposit rates otherwise; in a number of cases, discount rates were used, when no other interest rate data were available (see Table 3).

[16] The null hypothesis of the Hausman test in this context states that there is no correlation between country effects and explanatory variables. Rejection of the null hypothesis indicates that modelling country effects as fixed is more appropriate.

[17] The MSCI index classifies a country into an emerging market in line with a number of factors relating to international capital market access.

Table 2: List of Countries

Advanced Countries	Emerging Markets	Developing Countries		
Australia	Argentina	Algeria	Haiti	Niger
Austria	Brazil	Antigua & Barbuda	Honduras	Nigeria
Belgium	Chile	Benin	Ivory Coast	Panama
Canada	China	Bolivia	Jamaica	Paraguay
Cyprus	Colombia	Botswana	Kazahstan	Romania
Denmark	Czech Republic	Burkina Faso	Kenya	Saudi Arabia
Finland	Egypt	Burundi	Kyrgyz Rep.	Senegal
France	Hungary	Cameron	Lao Dem.	Slovak Rep.
Germany	India	Chad	Rep.	Sri Lanka
Greece	Indonesia	Congo, Rep. of	Latvia	St. Lucia
Iceland	Israel	Costa Rica	Lebanon	St. Kitt & Nevis
Ireland	Jordan	Croatia	Lesotho	St. Vicent & Grenadines
Italy	Korea, Rep.	Dominica	Liberia	Suriname
Japan	Malaysia	Dominican Rep.	Libya	Swaziland
Kuwait	Mexico	Ecuador	Lithuania	Tanzania
Luxembourg	Morocco	El Salvador	Macedonia	Togo
Netherlands	Pakistan	Equatorial Guinea	Madagascar	Tunisia
Norway	Peru	Estonia	Malawi	Uganda
Portugal	Philippines	Gabon	Mali	Ukraine
Singapore	Poland	Gambia, the	Malta	Uruguay
Slovenia	Rusia	Georgia	Mauritius	Zambia
Spain	South Africa	Ghana	Moldova	Zimbabwe
Sweden	Thailand	Grenada	Mongolia	
Switzerland	Turkey	Guatemala	Myanmar	
United	Venezuela	Guinea-Bissau	Nepal	
Kingdom		Guyana	New Zealand	
United States			Nicaragua	

Note: Emerging market economies are those that are included in the Morgan Stanley Capital International (MSCI) index. Advanced economies are those that are classified as upper income economies by the World Bank, with the exception of Israel, which is in an emerging market. The remaining countries were designated as developing countries.

Table 3: Interest Rate Used for the Corresponding Countries

Money Market	T-bill	Bank Lending	Bank Deposit	Discount
Argentina	Belgium	Antigua & Barbuda	Algeria	Benin
Australia	France	Dominica	Bolivia	Botswana
Austria	Guyana	El Salvador	Chile	Burkina Faso
Brazil	Jamaica	Er. Guinea	Dominican Rep.	Burundi
Canada	Kazakhstan	Estonia	Greece	Cameroon
Croatia	Kenya	Gabom	Guatemala	Chad
Czech Rep.	Kyrgyz Rep.	Grenada	Guinea-Bissau	China
Denmark	Lesotho	Honduras	Haiti	Colombia
Finland	Moldova	Israel	Hungary	Congo, Rep. of
Georgia	Romania	Liberia	Iceland	Costa Rica
Germany	St. Kitts & Nevis	Macedonia	Indonesia	Cyprus
Ireland		Nigeria	Korea	Ecuador
Italy		Panama	Lao Dem. Rep.	Egypt
Japan		Poland	Libya	Gambia, The
Latvia		Slovak Rep.	Lithuania	Ghana
Luxembourg		Slovenia	Madagascar	India
Malaysia		St. Lucia	Mexico	Ivory coast
Mauritius		St. Vincent & Grenadines	Mongolia	Jordan
Netherlands		Suriname	Morocco	Kuwait
Norway		Swaziland	Myanmar	Lebanon
Pakistan		Ukraine	Nicaragua	Malawi
Paraguay		Uruguay	Saudi Arabia	Mali
Philippines		Zambia	Turkey	Malta
Russia			Uganda	Nepal
Singapore				New Zealand
South Africa				Niger
Spain				Peru
Sri Lanka				Portugal
Sweden				Senegal
Switzerland				Tanzania
Thailand				Togo
Tunisia				Venezuela
United Kingdom				
United States				
Zimbabwe				

Notes: Money Market is the rate on short-term lending between financial institutions. Treasury bill rate is the rate at which short-term securities are issued or traded in the market. Lending rate is the bank rate that usually meets the short- and medium-term financing needs of the private sector. This rate is normally differentiated according to the creditworthiness of borrowers and objectives of financing. Deposit rate usually refers to rates offered to resident customers for demand, time or saving deposits. Discount rate is the rate at which the central banks lend or discount eligible paper for deposit money banks, typically shown on an end-of-period basis.

The variables used in this analysis and their descriptions are listed in Table 4. These variables were selected on the basis of previous theoretical and empirical literature. Government balance is defined as current and capital revenue and official grants received, less total expenditure and lending minus repayments. This variable considers central governments only. Short-term debt is defined as debt that has an original maturity of one year or less. Available data does not permit a distinction between public and private non-guaranteed short-term debt. The ratio of bank liquid reserves to bank assets is the ratio of domestic currency holding and deposits with the monetary authorities to claims on other governments, nonfinancial public enterprises, the private sector, and other banking institutions. Money and quasi money are defined as the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition of money supply is frequently called M2. Foreign direct investment is the sum of equity capital, reinvestment of earnings, other long-term capital, and

short-term capital as shown in the balance of payments. Current account balance is the sum of the credits less the debits arising from international transactions in goods, service, income, and current transfers. Unemployment refers to the share of the labour force that is without work but available for and seeking employment. International reserves are the sum of a country's monetary authorities' holdings of special drawing rights, its reserve position in the IMF, its holdings of foreign exchange, and its holdings of gold. Variables expressed in US dollar were converted to the natural logarithmic scale. The rest of variables were expressed in percentage. Finally, floating and intermediate exchange rate regimes are identified with a dummy variable that received the value of one in which these regimes prevail in a country in a particular year.

Table 4: List of variables used in the estimations

Variable	Description
Gov. Balance	Central government balance (% of GDP)
Stdebratio	Short-term debt/Total debt (%)
Debt	Total debt/GNI (%)
Domfin	Domestic financing, total (% of GDP)
Debtsx	Debt service/Exports of goods and services (%)
Bnkres	Ratio of bank liquid reserves to bank assets (%)
Dcrep	Domestic credit to private sector (% GDP)
M2gdp	Money and quasi money (% GDP)
M2res	Money and quasi money (% Reserves)
Resdebt	Reserves/Total debt (%)
Resimp	Reserves/Imports of goods and services (%)
Fdigni	Foreign direct investment (% of GNI)
Cagni	Current account balance (% GDP)
Inflation	The consumer price index (%)
Unempl	Unemployment, total (% of total labour force)
Usirate	USA short-term interest rate (%)
Reserves	International reserves (US$)
Per capita GDP	Per capita real GDP growth (%)
Real GDP	Real GDP growth (%)
Openness	Exports plus imports of goods and services (% GDP)
Floating	Dummy variable capturing float exchange rate regimes
Intermediate	Dummy variable capturing intermediate arrangements

Notes: The table does not include the dependent variable, which is explained in the text. Variables expressed in US dollars were converted to the natural logarithmic scale for the purpose of estimation.

6 Estimation Results

This section presents the results of regressions for the Least Squares Dummy Variables (LSDV) models. The LSDV models estimated are an unbalanced panel with robust standard errors. To test which exchange arrangements are also associated with more foreign exchange market pressure, we regress the exchange Market Pressure Indicator (MPI) developed in Section 3 on macroeconomic and financial variables. Independent variables are selected on the basis of observations on theoretical and empirical literature. These independent variables are per capita GDP growth, government balance as a percentage of GDP, the ratio of exports and imports to GDP (Openness), the ratio of short-term debt to total debt (Stdebtratio), the ratio of domestic financing to GDP (Domfin), the ratio of bank liquid reserves to bank assets (Bnkres), the ratio of total debt to Gross National Income (Debt), the ratio of reserves to total debt (Resdebt), the ratio of reserves to imports of goods and services (Resimp), international reserves, the ratio of debt service to export of goods and services (Debtsx), current account

balance (Cagni), the ratio of broad money to GDP (M2gdp), the ratio of money and quasi money to foreign reserves (M2res), the ratio of domestic credit to private sector relative to GDP (Dcrep), the US interest rate (Usirate), inflation, total unemployment (Unempl), and foreign direct investment to GNI (Fdigni). In addition to these explanatory variables, we include a dummy variable to account for the nature of the exchange rate regime and dropped fixed regimes[18]. The vulnerability to crisis is represented by the ratio of total debt to Gross National Income; ratio of reserves to total debt; ratio of reserves to imports of goods and services; international reserves; and ratio of debt service to export of goods and services. Current account balance has also been used as a proxy for macroeconomic conditions and vulnerability to crisis. In addition, the ratio of broad money (M2) to GDP is used like a proxy to financial sector development. Per capita GDP growth is a measure of the level of economic development.

The expected sign for the coefficient of per capita GDP growth is negative, because an increasing rate of growth may generate a rise in the domestic asset markets, attracting capital inflows and, therefore, supporting the currency. Conversely, a decline in per capita GDP growth leads to an increase in the foreign exchange market pressure and the probability of currency crises. Similarly, an increase in fiscal deficit (or decline in the government balance as a percentage of GDP) may generate a rise in the probability of currency crises.

On the other hand, we expect a positive sign in coefficients of the ratio of short-term debt to total debt, the ratio of total debt to Gross National Income and the ratio of debt service to export of goods and services because grater external debt increases the pressure in the foreign exchange market and the probability of a currency crisis. Also, we expect a negative sign in coefficients of the ratio of reserves to total debt. Moreover, for some variables of financial sector development we expect a positive sign (the ratio of domestic financing to GDP, the ratio of broad money to GDP, the ratio money and quasi money to foreign reserves and the ratio of domestic credit to private sector to GDP) particularly because an expansion of domestic credit increases the likelihood of a speculative attack (Krugman's effect)[19], while for the ratio of bank liquid reserves to bank assets we expect a negative sign. In addition, increases in foreign reserves reduce the probability of speculative attacks and currency crises. Also, an import growth increases in advance of a speculative attack, then the expected sign on the ratio of reserves to imports of goods and services is negative. In the same way, the expected sign on trade openness is negative since more open economies are less likely to suffer a currency crisis, the benefits of trade openness outweigh the high vulnerability to external shocks. A positive balance in the current account reduces the probability of a currency crisis.

Foreign direct investment helps to add a productive capacity to the economy, because this type of capital flows goes directly to real investment in plants, equipment and infrastructure. Hence, we expect a negative sign in the ratio of foreign direct investment to GNI. On the contrary, US interest rates can be related to currency crises, because higher US interest rates attract capital outflows and increase the likelihood to suffer a speculative attack particularly in emerging and developing economies. Similarly, high inflation increases the likelihood of exit into a currency crisis. Hence the expected sign is positive[20]. Equally, a high unemployment rate increases the vulnerability to currency crises, because a slump in economic activity, reflected in the rise of unemployment, makes the central bank more attentive to domestic objectives, compromising the exchange rate target.

[18] The dummy takes the value 1 if the exchange rate regime prevails in a country in a particular year; otherwise, it is assigned a value of zero.

[19] The model developed by Krugman (1979) suggests that, prior to a crisis, there will be a rapid growth of domestic credit relative to the demand for money, possibly in response to a need to finance the public sector. As such, credit to the public sector and fiscal imbalances could serve as a precursor to a crisis.

[20] Kumar et al. (2003) suggest that high inflation can increase vulnerability to crises through an impact on resource allocation, competitiveness, and macroeconomic stability. Also, Komulainen and Lukkarila (2003) and Tudela (2004) find that inflation explains currency crises rather well.

Following the approach developed by Bird and Mandilaras (2006) we select a combination of fundamentals that best explains the MPI in each group of countries. We estimate our LSDV model including all the above-mentioned variables simultaneously (not reported), but insignificant variables were gradually eliminated, until the most parsimonious representation of the data was achieved[21]. Using the Hausman test we reject the null hypothesis of no correlation between the country effects and the explanatory variables in most of cases at a 1% level (see Table 5).

Table 5: Hausman Specification Test

Classification	All Countries	Advanced	Emerging	Developing
Natural	χ^2 (9) = 78.4(0.00)	χ^2 (6) = 24.5(0.00)	χ^2 (11) = 37.1(0.00)	χ^2 (6) = 12.4(0.01)
LYS	χ^2 (9) = 80.2(0.00)	χ^2 (6) = 18.0(0.01)	χ^2 (11) = 29.0(0.00)	χ^2 (6) = 23.4(0.00)
HMR	χ^2 (9) = 81.1(0.00)	χ^2 (6) = 22.7(0.00)	χ^2 (11) = 26.9(0.00)	χ^2 (6) = 16.8(0.01)
De Jure	χ^2 (9) = 67.6(0.00)	χ^2 (6) = 20.5(0.00)	χ^2 (11) = 52.4(0.00)	χ^2 (6) = 16.2(0.01)

Source: Author's calculations.

The main results for exchange market pressure indicators are summarized in Tables 6 and 7. The signs of our indicators are mostly as expected. Regarding individual indicators, we find that exchange market pressure increases along with the ratio of domestic credit to private sector to GDP, the ratio of debt service to export of goods and services, the ratio of domestic financing to GDP and inflation. On the contrary, it increases in the rest of the explanatory variables associated with a lower foreign exchange market pressure.

On the other hand, the impact of exchange arrangements on foreign exchange market pressure is analysed we find that there are positive and significant associations between foreign exchange market pressure and floating and intermediate exchange regimes in most classifications. Fixed regimes show the best performance against an increase in the foreign exchange market pressure, particularly in developing countries.

In emerging and developing countries intermediate exchange rate regimes are more prone to increase the foreign exchange market pressure in most classifications. However, when we use natural classification in emerging countries, floating regimes show a positive and statistically significant impact on exchange market pressure as its coefficient is bigger than under fixed and intermediate regimes. Similarly, floating regimes present the worst performance when we use the HMR classification in developing countries (see Table 8).

We identified certain emerging and developing countries which kept floating exchange rate regime, both *de jure* and *de facto*, when speculative attacks and respective currency crises occurred. These countries are Czech Republic in 1997; Ecuador in 1982; Georgia in 1998, Ghana in 1992; Guatemala in 1990; Guinea-Bissau in 1996; Honduras in 1993; Jamaica in 1992; Lebanon in 1986; Madagascar in 1994; Nigeria in 1986 and 1992; Paraguay in 1992; South Africa in 1982 and 1996, among others.

[21] However, in some cases the dummy variables of exchange rates were statistically not significant but they are not excluded.

Table 6: The Impact of Exchange Arrangements on MPI in All Countries and Advanced Economies

	All Countries				Advanced Economies			
	Natural	LYS	HMR	*De jure*	Natural	LYS	HMR	*De jure*
Constant	4.28	8.13	9.69	7.26	0.87	-1.25	0.19	-0.41
	(1.39)	(2.61)*	(2.68)*	(2.72)*	(0.82)	(-0.54)	(0.12)	(-0.35)
Per cap. GDP	-0.32	-0.31	-0.61	-0.37	-0.17	-0.29	-0.31	-0.16
	(-2.97)*	(-3.32)*	(-2.52)#	(-3.52)*	(-2.43)#	(-1.77)#	(-2.53)#	(-2.27)#
Gov. balance	-0.30	-0.45	-0.33	-0.34				
	(-2.62)*	(-2.69)*	(-1.26)	(-2.87)*				
Dcrep	0.21	0.22	0.27	0.21	0.03	0.05	0.03	0.03
	(2.91)*	(3.36)*	(2.73)*	(3.02)*	(2.52)#	(2.60)*	(2.58)#	(2.83)*
Resimp	-0.25	-0.33	-0.39	-0.27	-0.13	-0.13	-0.14	-0.13
	(-5.37)*	(-5.29)*	(-5.19)*	(-5.51)*	(-4.97)*	(-3.98)*	(-4.87)*	(-5.11)*
Resdebt	0.05	0.06	0.10	0.05				
	(3.75)*	(3.15)*	(2.73)*	(3.85)*				
Inflation	0.01	0.004	0.01	0.01	0.13	0.15	0.14	0.13
	(3.04)*	(1.25)	(4.85)*	(3.21)*	(2.26)#	(1.54)	(2.33)#	(2.01)#
Openness	-0.09	-0.12	-0.16	-0.12				
	(-4.91)*	(-5.05)*	(-3.92)*	(-5.76)*				
Floating	6.48	2.51	11.11	1.95	-0.08	-0.43	0.55	0.81
	(4.27)*	(1.74)^	(1.12)	(1.12)	(-0.10)	(-0.42)	(0.55)	(0.68)
Intermediate	2.53	5.81	4.91	4.76	-1.20	-0.35	-0.45	0.02
	(1.65)^	(3.06)*	(3.73)*	(2.21)#	(-1.86)^	(-0.32)	(-0.48)	(0.03)
Observations	1370	1168	706	1345	581	418	472	581
F-test prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj. R^2	0.21	0.17	0.30	0.20	0.13	0.12	0.15	0.13

Notes: The table reports least squares dummy variables results of unbalance panels with fixed effects. The dependent variable is MPI. The standard errors of the estimates are robust to cross contemporaneous correlation. t -statistics are displayed in brackets. (*) denote significance at the 1 per cent level, (#) at the 5 per cent and (^) at the 10 per cent level.

Source: Author's estimates.

To conclude, our results yield positive and significant associations between floating and intermediate regimes and exchange market pressure, particularly in emerging and developing countries. As a consequence, fixed arrangements are less likely to generate pressure in the foreign exchange market. These results are similar to findings by Jakubiak (2001); Ghosh et al. (2002); Peltonen (2006); Falcetti and Tudela (2006); Haile and Pozo (2006); Esaka (2010b); Karimi and Voia (2014) and Esaka (2014).

Table 7: The Impact of Exchange Arrangements on MPI in Emerging and Developing Countries

	Emerging Economies				Developing Countries			
	Natural	LYS	HMR	*De jure*	Natural	LYS	HMR	*De jure*
Constant	11.95	15.63	11.54	14.03	-2.86	-2.13	-0.35	-2.21
	(1.91)^	(2.40)#	(2.51)#	(2.17)#	(-1.88)^	(-1.22)	(-0.07)	(-1.43)
Per cap. GDP	-1.03	-1.08	-0.79	-1.17				
	(-3.47)*	(-2.85)*	(-1.73)^	(-3.60)*				
Gov. balance	0.76	0.14	0.09	0.50	-0.45	-0.33	-0.91	-0.46
	(1.82)^	(0.26)	(0.11)	(1.04)	(-2.58)*	(-1.96)#	(-1.67)^	(-2.76)*
Dcrep	0.22	0.26	0.28	0.23				
	(3.40)*	(3.62)*	(4.64)*	(3.60)*				
Domfin	1.35	1.59	0.78	1.32				
	(2.60)*	(2.50)#	(0.80)	(2.12)#				
Resimp	0.43	-0.56	-0.41	-0.45	-0.06	-0.10	-0.28	-0.07
	(-4.53)*	(-4.22)*	(-5.38)*	(-4.98)*	(-2.53)#	(-2.81)*	(-3.79)*	(-2.88)*
Resdebt	0.15	0.13	0.12	0.12	0.01	-0.03	0.06	0.01
	(2.30)#	(2.65)*	(2.59)#	(2.33)#	(1.07)	(-1.85)^	(1.62)	(1.56)
Debt	-0.94	-0.81	-0.25	-0.50				
	(-2.49)#	(-1.82)^	(-0.80)	(-1.29)				
Debtsx					0.14	0.17	0.16	0.14
					(1.99)#	(2.57)#	(1.17)	(2.15)#
Inflation	0.01	0.001	0.06	0.01				
	(0.96)	(0.67)	(4.04)*	(1.08)				
Openness	-0.12	-0.12	-0.22	-0.13				
	(-2.65)*	(-2.16)#	(-4.80)*	(-2.33)#				
Floating	19.40	4.42	-3.68	2.57	2.01	3.31	15.82	1.60
	(3.50)*	(1.65)^	(-0.47)	(0.47)	(0.82)	(2.36)#	(3.79)*	(1.35)
Intermediate	5.66	6.81	7.43	7.93	1.51	5.18	1.83	2.15
	(2.63)*	(1.81)^	(3.88)*	(2.07)#	(1.24)	(2.46)#	(1.71)^	(1.08)
Observations	388	318	261	377	1210	1021	437	1191
F-test prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj. R^2	0.30	0.28	0.53	0.29	0.06	0.07	0.09	0.06

Notes: The table reports least squares dummy variables results of unbalance panels with fixed effects. The dependent variable is MPI. The standard errors of the estimates are robust to cross contemporaneous correlation. t -statistics are displayed in brackets. (*) denote significance at the 1 per cent level, (#) at the 5 per cent and (^) at the 10 per cent level.

Source: Author's estimates.

Table 8: Exchange Arrangements Performance on Exchange Market Pressure Indicator

	Natural	LYS	HMR	De Jure
Ranking from the best to the worst performance	*All Countries*			
	Fixed Intermediate Floating	Fixed Floating Intermediate	Fixed Intermediate Floating*	Fixed Floating* Intermediate
	Advanced Economies			
	Intermediate Floating* Fixed	Floating* Intermediate* Fixed	Fixed Intermediate* Floating*	Fixed Intermediate* Floating*
	Emerging Economies			
	Fixed Intermediate Floating	Fixed Floating Intermediate	Floating* Fixed Intermediate	Fixed Floating* Intermediate
	Developing Countries			
	Fixed Intermediate* Floating*	Fixed Floating Intermediate	Fixed Intermediate Floating	Fixed Floating* Intermediate*

Note: (*) insignificant variables.

Source: Author's calculations.

7 Concluding Remarks

The academic debate on the most appropriate exchange rate regime for a country or group of countries has been one of the most controversial topics in theoretical and empirical literature. Notwithstanding its increasing relevance to policy, the literature offers relatively few empirical studies about the impact of the exchange rate regime on a speculative attacks and currency crisis in developed, emerging and developing countries, separately. In this article we distinguish between the *de jure* and the three *de facto* classifications system. We have used the IMF *de jure* classification and checked the robustness of our results with three different *de facto* classifications: the LYS classification based on a clustered analysis, the natural classification based mainly on market determined dual and parallel exchange rates, and the HMR classification based on exchange rate regimes and taking into account external shocks and revaluations.

We have used a least squares dummy variables regression technique to study whether a particular exchange rate regime affects the experience of more foreign exchange market pressure. Our empirical findings indicate clear support for fixed regimes. Countries with fixed exchange rate arrangements are associated with significantly lower exchange market pressures than countries with floating or intermediate exchange rate regimes. In emerging and developing countries the intermediate exchange rate regimes are more prone to increase the foreign exchange market pressure in most classifications. Emerging countries using *de jure* intermediate exchange rate regimes show an exchange market pressure rate of 79.3% bigger than emerging countries using *de jure* fixed regimes.

In light of these results, it can be concluded that a fixed exchange rate arrangement provides lower foreign exchange market pressure and lower probability of currency crises. An important part of literature considers adopting a foreign currency (dollarization) as the domestic

currency to buy a credible policy of price stability, eliminate the role of short-run discretionary government policies that can give rise to policy inconsistencies and avoid speculative attacks and currency crises.

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