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An empirical assessment of exchange arrangements and inflation performance

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Abstract. This article provides empirical support for the hypothesis that different exchange rate regimes have an impact on inflation in advanced, emerging and developing countries. The effects of different exchange rate regimes on inflation performance are examined through least squares dummy variables regressions using panel data on 125 countries for the post-Bretton Woods (1974-1999) period. 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 that countries with fixed regimes tend to have a lower inflation rate compared to floating and intermediate exchange rate regimes, particularly in emerging and developing countries.
Keywords. Exchange rate regimes, Inflation.
JEL. E31, F31, F33.

1. Introduction

Since the breakdown of the Bretton Woods system, adopting a correct exchange rate regime that contributes to low inflation and encourages economic growth, has been a great challenge. A wide variety of exchange rate regimes, ranging from completely flexible to completely fixed (with a wide range of intermediate systems) have been adopted by different countries. The debate over fixed, intermediate and floating exchange rate arrangements has once again taken centre stage in academic circles. Some economists maintain that the first round of this debate was won by those advocating for floating arrangements because all crisis episodes took place in countries that had adopted a variety of mechanisms for pegging their exchange regimes. Conversely, advocates of fixed exchange rate regimes suggest that there are bad fixes and good fixes (like official dollarization) and good or truly fixed arrangements that allow countries to achieve credibility and lower inflation.

An important recent development in the debate over optimal exchange rate regimes is the recognition that the choice of an exchange rate arrangement is different between particular groups of countries. The choice of an exchange rate regime for developed countries is different from that of developing countries or emerging market economies. Developing countries are often beset by a lack of credibility and limited access to international capital markets. Hence, fixed exchange rate regimes play a useful role by providing policymakers with a nominal anchor for monetary policy and by helping to establish a degree of policy credibility. In contrast, emerging market economies are more integrated with global financial markets, but have encountered more currency crises under pegged exchange rate arrangements (Husain *et al.,* 2005). Developed countries

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have obtained more benefits from flexible exchange rate regimes because they are more developed economically and institutionally, and more integrated with global financial markets (Rogoff *et al.,* 2003).

Contrary to a large number of theoretical studies in the literature, relatively few studies attempt to empirically investigate the impact of an exchange rate regime on inflation performance 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 the exchange rate 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 conclusion emerging from this study is the following: fixed exchange rate arrangements deliver lower inflation particularly in emerging and developing countries. This result supports those views arguing that the credibility associated with fixed regimes helps policy-makers achieve lower inflation outcomes.

The remainder of this article is organised as follows: Section 2 presents a brief literature review focusing on exchange rate arrangement classifications and on the link between exchange rate regimes and inflation. Section 3 describes the empirical framework. A preliminary analysis of the data is presented in Section 4. Section 5 reports empirical findings. Section 6 concludes the findings of this article.

2. Exchange Rate Regimes and Inflation: A Survey of the Literature

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

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 first approach classifies countries by what they say they do (*de jure*). However, countries often act differently than what they declare they do. In particular, a self-declared independent floating regime, in reality, often operates as a managed peg regime. This phenomenon of operating a disguised peg is referred to as "fear of floating" (Calvo & Reinhart, 2002). On the other hand, classifying countries by what they actually do is known as 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 & Otker-Rober, 2002; Reinhart & Rogoff, 2004; Shambaugh, 2004; Garofalo, 2005; Dubas *et al.,* 2005; Levy-Yeyati & Sturzenergger, 2005; Bérnassy-Quéré *et al.,* 2006; Frankel & Wei, 2008; Klein & 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[1].

Some empirical studies simply employ the *de facto* classification because the *de jure* classification may reach incorrect results[2], particularly about floating

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

[2] This could be the result of measurement error in the classification of exchange rate arrangements.

regimes. Some research, however, employs the *de jure* classification arguing that it suffers from less drawbacks than the *de facto* classification[3].

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 & Sturzenergger (2005), henceforth referred to 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 during the period 1974-2000. Secondly, the "natural classification" developed by Reinhart & Rogoff (2004) is employed. Reinhart & 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[4]. These authors examine the chronologies of the exchange rate history for 153 countries during the period 1946-2001. They are able to distinguish between 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[5]. In addition, they define hyper floats 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[6].

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.

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) Hyper floating
De facto Classification by Bailliu, Lafrance and Perrault		

[3] 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.

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

[5] 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.

[6] 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.

(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 & Sturzenergger are not considered in our analysis.
Sources: Bailliu *et al.,* (2001); Bailliu *et al.,* (2003); Ghosh *et al.,* (2002); Reinhart & Rogoff (2004); and Levy-Yeyati & Sturzenergger (2005).

2.2. Exchange Rate Arrangements and Inflation

Theoretical and empirical literature on exchange rate arrangements and inflation suggests that countries using fixed exchange rate regimes and consistent macro policies tend to have lower and more stable rates of inflation. The explanation for this is simply that a fixed exchange rate provides a credible nominal anchor for monetary policy[7] and for the evolution of the price level. Fixed rates also provide a visible commitment, thereby raising the political costs of excessive monetary growth. A credible peg is likely to engender a more robust demand for money, which reduces the inflationary consequences of a given monetary expansion. In this order, the empirical work of Ghosh *et al.,* (1997) shows that inflation under fixed exchange rate regimes is significantly lower than under intermediate or freely floating arrangements. Similarly, Ghosh *et al.,* (2002) find a positive association between the degree of nominal exchange rate regime flexibility and inflation, even after controlling for the effects of money growth.

On the other hand, Levy-Yeyati & Sturzenegger (2001) investigate the impact of exchange rate regimes on inflation, nominal money growth, real interest rates, and GDP growth. These authors show that, for non-industrial economies, "long" (lasting five years or more) pegs are associated with lower inflation than floats, but at the cost of slower GDP growth. Additionally, Moreno (2001), using his own *de facto* classification, examines how pegging is associated with inflation and output in a sample of 98 developing and emerging market economies for the period 1974-1998. His results show that a pegged exchange rate is associated with lower inflation. While, Domac *et al.,* (2001), using *de jure* classification provided by the IMF, examine whether the exchange rate regime has any impact on inflation and growth performance in 22 transition economies for the period 1991-1998. Their findings indicate that transition countries with intermediate arrangements may achieve lower inflation if they were to adopt a fixed regime. The results also suggest that switching from a floating regime to an intermediate arrangement may not deliver lower inflation. Similar results were found by Domac *et al.,* (2003). Theses authors empirically investigate the link between the exchange rate regime and inflation performance in transition economies. Their results suggest that fixed exchange rate regimes tend to deliver lower and more stable rates of inflation.

Rogoff *et al.,* (2003) re-examine the link between exchange rate regimes and economic performance across four dimensions: inflation, output growth, growth volatility, and the incidence of crises. Their results suggest that, for countries at a relatively early stage of financial development and integration, fixed or relatively rigid regimes appear to offer some anti-inflation credibility gain without compromising growth objectives. On the contrary, for developed countries that

[7] One advantage of fixing the exchange rate in terms of a particular major currency like the U.S. dollar is the provision of a nominal anchor to prevent inflationary monetary policies. This means that, over time, domestic price and inflation levels will converge with those of the foreign country. In many developing countries, fixed exchange rates have provided a nominal anchor for so long because domestic anchors cannot be achieved due to a lack of institutional development, experience and stability. They rely on the fixed exchange rate for its clarity and understanding, as well as view it as a sign of commitment from policymakers.

are not in a currency union, relatively flexible exchange rate regimes appear to offer higher GDP growth without any cost on credibility. In the same way, Husain *et al.,* (2005), using the *de facto* classification from Reinhart & Rogoff (2004), find that for developing countries with little exposure to international capital markets, pegs are notable for their durability and relatively low inflation. Similarly, De Grauwe & Schnabl (2005) analyse the impact of the exchange rate regime on inflation and output in South Eastern and Central Europe for the period 1994-2004. Their results reveal a significant impact of fixed exchange rates on low inflation. Also, Coudert & Dubert (2005) analyse interesting aspects of the *de facto* regimes followed by major Asian countries over the period 1990-2001. Their results show that fixed exchange rate regimes are associated with better performances in terms of inflation. While Garofalo (2005), using his *de facto* classification, examines the influence of different exchange rate policies on the Italy's economic performance for the period 1861-1998. His results show that inflation performance is apparently better under the gold standard (pegged) than under other regimes.

In the same way, Bleaney & Francisco (2007) examine the relationship between exchange rate, inflation and growth in 91 developing countries over the period 1984-2001. They distinguish between three exchange rate regime categories: floats, easily adjustable peg (soft peg) and those where adjustment is harder (hard pegs, defined by the use of a shared currency or a currency board system). Their results suggest that floats have growth rates similar to soft pegs and only slightly higher inflation; while hard pegs have lower inflation and slower GDP growth than other regimes. Similarly, Klein & Shambaugh (2010), using the classification scheme from Klein & Shambaugh (2008), study the links between the exchange rate regimen and inflation performance based on a data set representing the experience of 80 countries (22 industrial and 58 nonindustrial) over the period 1980-1999. They find evidence that a peg affects inflation both through a disciplinary role and credibility role. These authors also find that the peg affects average inflation rates over this entire period by disciplining the monetary policy of nonindustrial countries, but it does not have a similarly significant role for industrial economies. On the contrary, Rose (2011) using the data span of 178 economies from 1974 through 2007 and four methodologies to exchange classification (the official IMF; Reinhart & Rogoff, 2004; Shambaugh, 2004 and Levy-Yeyati & Sturzenergger, 2005), evaluates the effect of exchange regime on inflation. His results indicate that there is no clear relationship between inflation and the exchange rate regime that spans all countries.

Ghanem (2012) empirically assesses the relationship between exchange rate regimes and inflation performance for 17 MENA countries over the period 1980-2007. Using the *de jure* IMF and the *de facto* regimes of Reinhart & Rogoff (2004) and Levy-Yeyati & Sturzenegger (2005), and controlling for macroeconomic variables that are conventionally associated with inflation, he finds that a *de jure* fixed exchange rate regime alone does not contribute to a lower inflation rate, while credible pegs were associated with lower inflation. The author identifies credible regimes by matching what is announced and what is observed. Also, when considering *de facto* peg regimes, hefinds that they are strongly associated with lower inflation. Moreover, Toulaboe & Terry (2013) investigate the link between exchange rate regimes and inflation performance in developing countries, using pooled annual data for the period 1985-2006. Based on the *de facto* classification obtained by using different methodologies to assess the volatility of the observed nominal effective exchange rates, their results suggest that flexible exchange rate regimes are more inflationarythan pegged exchange rate regimes. Also, Mohantya & Bhanumurthyb (2014) examine the impact of the *de facto* stable exchange rate regime on inflation in India during 1994-2011. The authors divide the sample into different sub-periods of exchange rate stability. Their results show that the impact of exchange rate regime on inflation is not visible in the Indian case which could be due to the offsetting

sterilization policy undertaken by the India's central bank during expansionary money supply growth resulting from its large-scale intervention to even out exchange rate volatility. Similarly, Lohi (2014), usingthe IMF *de facto* classification[8] and a sample of 36 Sub-Saharan countries over 1980-2007, study whether the fixed exchange rate regime provides lower inflation. His empirical results show that countries with a fixed exchange rate exhibit lower inflation, but support the inflation-growth trade off. In the same way, Sosvilla-Rivero (2014) and Ramos-Herrera (2014) analyse the relationship between exchange-rate regimes and inflation performance in 123 economies, both developed and developing, for the period 1970-2010. The authors use the *de facto* classification from Ilzetski *et al.,* (2010). Their results suggest that those countries with flexible exchange-rate regimes are characterized by higher inflation rates, while the smaller inflation rates are associated with fixed exchange rates and countries with intermediate regimes occupy anintermediate position in their records of inflation rates.On the other hand, Ghosh *et al.,* (2014), based on a novel data set of the IMF' s*de jure* and *de facto* exchange rate regime classifications (Reinhart & Rogoff, 2004; Shambaugh, 2004 and Levy-Yeyati & Sturzenergger, 2005) for 146 emerging and developing economies over 1980–2010, find that inflation is indeed lower, especially in emerging markets, by some four percentage points when the central bank both *de jure* commits and *de facto* pegs the exchange rate than when it *de facto* pegs alone.

3. Empirical Methodology

A panel data model is used to estimate the impact of exchange rate regimes on inflation. The model used is Least Squares Dummy Variables (LSDV) as applied to a static panel dataset. The following equation describes the general specification used:

$$y_{it} = X_{it}\beta + D_i\alpha_i + \varepsilon_{it} \quad (1)$$

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 ith 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 inflation rate 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 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-specific effects as being fixed or random[9].

We employ a panel data estimating method to determine the impact of the exchange rate arrangement on inflation. The dependent variable is inflation scaled, which is a measure robust to hyperinflationary outlier countries. To

[8] 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 & Rogoff, 2004).

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

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.

4. The Data

The sample consists of panel data for 125 countries classified by the World Bank according to their income. Advanced countries are those economies classified as upper income countries. Emerging market countries are defined according to the Morgan Stanley Capital International (MSCI) index[10] at that moment. The rest of the countries are designated as developing. Table 2 provides a list of countries classified in each group.

The dataset is annual, spanning from 1974 through to 1999. Data availability differs across countries, particularly for East-European countries which start from the 1990s. As a consequence, our panel data set is unbalanced.

Table 2. *List of Countries*

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

Note: Emerging market economies are those included in the Morgan Stanley Capital International (MSCI) index. Advanced economies are those 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.

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). The central bank turnover rate, which is the number of central bank governors per five-year period, used as a proxy for aversion to inflation, is taken from Ghosh *et al.,* (2002) and the Cukierman-Webb central bank database.

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

Table 3. *List of variables used in the estimations*

Variable	Description
Gov. Balance	Central government balance (% of GDP)
Money	Broad money growth (% per year)
Real GDP	Real GDP growth (%)
Openness	Exports plus imports of goods and services (% GDP)
CB turnover	Central Bank turnover rate (per 5 years)
TT growth	Terms of trade growth (%)
Floating	Dummy variable capturing floating exchange rate regimes
Intermediate	Dummy variable capturing intermediate arrangements

Notes: The table does not include the dependent variables, which are explained in the text. Variables expressed in US dollars were converted to the natural logarithmic scale for estimation purposes.

The variables used in this analysis and their descriptions are listed in Table 3. These variables were selected on the basis of previous theoretical and empirical literature. Government balance is defined as current revenue, capital revenue and official grants received, less total expenditure and lending minus repayments. This variable considers central governments only. 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. 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 takes the value of one if these regimes prevail in a country during a particular year.

5. Estimation Results

This section presents the results of regressions for the Least Squares Dummy Variables (LSDV). The LSDV models were estimated using an unbalanced panel with robust standard errors. In estimating inflation, following Ghosh *et al.,* (1997), we transform the inflation rate by calculating a scaled measure, $\frac{\pi}{\pi+1}$, to avoid the bias caused by some cases of very high inflation without deleting them from the sample.

To examine the relationship between exchange rate arrangements and inflation we regress the scaled inflation (henceforth inflation) on two exchange rate system dummies for floating and intermediate rate regimes. The dummy takes the value one if a floating or intermediate exchange rate regime prevails in a country during a particular year; otherwise, it takes the value of zero. Fixed exchange rate regimes are the excluded category. Hence, the coefficients on floating and intermediate regimes should be interpreted as the inflation differential relative to a fixed exchange rate arrangement. The independent variables are broad money growth, real per capita GDP growth, trade openness, central bank governor turnover rate, terms of trade growth and government balance. Faster money growth is associated with high inflation (by raising money supply), while higher real GDP growth should reduce inflation (by increasing money demand). Similarly, we expect a negative sign in the trade openness coefficient because greater trade openness increases the cost of a monetary expansion, which should imply lower inflation in more open economies[11].

[11] If a country opens up to trade, the incentive to inflate diminishes because if the price index that monetary authorities seek to stabilise includes foreign goods, real currency depreciation exacerbates the inflation cost of a monetary expansion. Romer (1993) tests the proposition that more open economies have lower inflation rates. He finds that more open countries indeed appear to have lower inflation, and generally finds this conclusion to be quite robust.

The central bank governor turnover rate is a proxy for central bank independence[12]. A higher turnover rate of the central bank governor should be associated with higher inflation. Also, we include terms of trade growth because it contributes to aggregate demand pressures. The government balance (fiscal balance) is closely related to inflation. If the government balance is negative (fiscal deficit), the need to finance this fiscal deficit can lead to an excessive growth in money supply, which causes inflation.

As shown by Table 4, the null hypothesis of the Hausman test (no correlation between the country effects and the explanatory variables) is rejected at a 5% level in most cases and at a 10% level in emerging countries with the LYS de facto classification. As a consequence, we use the fixed effects model except in emerging countries with the HMR de facto schemes, because the Hausman specification test suggests that it is more appropriate to model the country effects as random rather than fixed in this case.

Table 4. Hausman Specification Test

Classification	All Countries	Advanced	Emerging	Developing
Natural	χ^2 (8) = 64.5(0.00)	χ^2 (8) = 83.8(0.00)	χ^2 (8) = 14.4(0.03)	χ^2 (8) = 66.4(0.00)
LYS	χ^2 (8) = 71.4(0.00)	χ^2(8) = 185.3(0.00)	χ^2 (8) = 15.5(0.05)	χ^2(8) = 145.1(0.00)
HMR	χ^2 (8) = 44.7(0.00)	χ^2(8) = 61.2(0.00)	χ^2 (8) = 11.3(0.19)	χ^2(8) = 42.9(0.00)
De Jure	χ^2 (8) = 29.4(0.00)	χ^2(8) = 210.9(0.00)	χ^2 (8) = 17.5(0.03)	χ^2(8) = 102.2(0.00)

Source: Author's calculations.

Tables 5 and 6 report the impact of exchange arrangements on inflation in all countries and advanced economies, and in emerging and developing countries, respectively. As indicated by the adjusted R^2, the model explains between 75 and 87 per cent of the variation in inflation rates observed in our sample.

The sign of the coefficients associated to the explanatory variables are generally statistically significant and consistent with theory. Money growth shows a positive sign in all estimations (not always statistically significant). While real GDP growth shows a negative sign, as expected. Similarly, the openness variable shows a negative sign, so that a more open economy has less inflation[13]. The central bank turnover rate shows a positive association with inflation in almost all samples. However, when we estimate the inflation equation in advanced economies this variable shows a negative and statistically significant relationship with inflation (except in the LYS scheme, but it is statistically insignificant). This negative relationship may capture the fact that these countries are more developed institutionally. Conversely, the central bank turnover rate shows a positive association with inflation in emerging and developing countries. Terms of trade growth shows a negative sign in all, advanced and developing countries, but it shows a positive sign in emerging economies (not statistically significant). Finally, the government balance (fiscal balance) displays a negative sign in most cases, but usually this variable is not statistically significant. In general, these results suggest that higher real GDP growth and trade openness reduces inflation, while faster money growth and central bank governor turnover rates increase inflation, as was expected.

[12] According to the literature on policy credibility, an independent central bank can help solve the time-inconsistency problem. Hence, if central banks are less independent, governors can befired more easily (Cukierman *et al.,* 1992).

[13] These results are interesting because openness is a traditional variable in the Optimal Currency Area (OCA) theory. An increase in trade openness makes a country more likely to adopt a fixed regime, as opposed to an intermediate or floating regime.

Table 5. *The Impact of Exchange Rate Regimes on Inflation in All Countries and Advanced Economies*

	All Countries				Advanced Economies			
	Natural	LYS	HMR	*De jure*	Natural	LYS	HMR	*De jure*
Constant	0.18	0.15	0.17	0.19	0.15	0.14	0.15	0.15
	(8.75)*	(7.92)*	(12.92)*	(9.62)*	(7.61)*	(8.01)*	(7.65)*	(7.97)*
Money	7.14e^{-05}	7.07e^{-05}	0.04	7.78e^{-05}	0.14	0.06	0.14	0.13
	(1.16)	(1.40)	(4.76)#	(1.32)	(3.16)*	(2.26)#	(3.06)*	(3.18)*
Real GDP	-0.51	-0.35	-0.41	-0.52	-0.13	-0.15	-0.22	-0.14
	(-4.03)*	(-3.61)*	(-3.01)*	(-3.75)*	(-1.30)	(-1.65)^	(-1.91)#	(-1.53)
Openness	-0.13	-0.10	-0.12	-0.12	-0.18	-0.17	-0.19	-0.18
	(-6.69)*	(-5.00)*	(-7.39)*	(-6.27)*	(-7.40)*	(-7.39)*	(-7.34)*	(-7.59)*
CB turnover	0.10	0.12	0.02	0.10	-0.51	0.02	-0.06	-0.05
	(7.23)*	(7.12)*	(1.30)	(6.69)*	(-4.27)*	(1.07)	(-4.13)*	(-3.74)*
TT growth	-0.002	0.02	-0.04	-0.01	-0.11	-0.08	-0.10	-0.11
	(-0.13)	(0.76)	(-1.48)	(-0.29)	(-2.75)*	(-2.08)#	(-2.72)*	(-2.52)#
Gov. balance	-0.04	-0.10	-0.06	-0.13	-0.04	0.01	-0.04	-0.04
	(-0.44)	(-1.12)	(-0.80)	(-1.55)	(-0.87)	(0.20)	(-0.78)	(-0.86)
Floating	0.10	0.04	0.04	0.02	-0.001	0.01	0.003	-0.01
	(9.62)*	(5.90)*	(2.58)*	(1.52)	(-0.13)	(0.92)	(0.51)	(-2.33)#
Intermediate	0.004	0.09	0.02	0.03	0.001	0.014	0.01	0.02
	(0.50)	(7.56)*	(2.86)#	(2.35)#	(0.13)	(1.91)^	(2.31)#	(4.08)*
Observations	1806	1442	1147	1778	562	445	486	582
F-test prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj. R^2	0.77	0.78	0.83	0.75	0.82	0.87	0.82	0.82

Notes: The table reports the least squares dummy variables results of unbalanced panels with fixed effects. Dependent variable is inflation. The standard errors of the estimates are robust to cross contemporaneous correlation. t -statistics are displayed in parenthesis. (*) denotes significance at the 1% level, (#) at the 5% level and (^) at the 10% level.
Source: Author's estimates.

Table 6. *The Impact of Exchange Rate Regimes on Inflationin Emerging and Developing Countries*

	Emerging Economies				Developing Countries			
	Natural	LYS	HMR	*De jure*	Natural	LYS	HMR	*De jure*
Constant	0.16	0.11	0.20	0.18	0.23	0.18	0.06	0.22
	(7.18)*	(5.20)*	(4.88)*	(7.39)*	(5.556)*	(4.72)*	(2.89)*	(6.87)*
Money	4.22e^{-05}	3.93e^{-05}	0.03	4.75e^{-05}	0.02	0.01	0.27	0.02
	(1.16)	(1.02)	(5.14)*	(1.07)	(2.85)*	(4.17)*	(7.98)*	(3.33)*
Real GDP	-0.47	-0.39	-0.64	-0.51	-0.54	-0.27	-0.38	-0.57
	(-3.06)*	(-2.45)#	(-3.10)*	(-2.37)#	(-3.23)*	(-2.02)#	(-2.45)#	(-3.46)*
Openness	-0.11	-0.05	-0.13	-0.11	-0.10	-0.09	0.04	-0.09
	(-3.63)*	(-1.96)^	(-4.19)*	(-4.72)*	(-4.09)*	(-3.05)*	(1.07)	(-4.15)*
CB turnover	0.14	0.17	0.08	0.18	0.08	0.10	0.03	0.09
	(4.55)*	(6.156)*	(3.71)*	(5.53)*	(3.95)*	(4.11)*	(1.83)^	(4.37)*
TT growth	0.05	0.05	-0.03	0.03	-0.03	-0.003	-0.08	-0.02
	(1.27)	(1.04)	(-0.58)	(0.71)	(-1.36)	(-0.17)	(-2.89)*	(-1.07)
Gov. balance	0.12	-0.20	-0.03	-0.37	0.12	-0.08	0.06	-0.01
	(-0.88)	(-1.09)	(-0.14)	(-2.51)#	(1.14)	(-0.64)	(0.30)	(-0.08)
Floating	0.17	0.03	0.13	0.04	0.08	0.04	0.01	0.03
	(8.32)*	(2.08)3	(4.19)*	(0.99)	(4.16)*	(3.12)*	(0.09)	(2.60)*
Intermediate	0.02	0.12	0.04	0.04	-0.04	0.081	0.01	0.01
	(1.08)	(5.66)*	(2.18)#	(2.02)#	(-1.63)	(4.64)*	(1.03)	(0.67)
Observations	513	408	357	489	731	589	304	727
F-test prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj. R^2	0.81	0.79	0.80	0.78	0.81	0.79	0.85	0.78

Notes: The table reports the least squares dummy variables results of unbalanced panels with fixed effects. Dependent variable is inflation. The standard errors of the estimates are robust to cross contemporaneous correlation. t -statistics are displayed in parenthesis. (*) denotes significance at the 1% level, (#) at the 5% level and (^) at the 10% level.
Source: Author's estimates.

On the other hand, when the impact on inflation of our main variable of interest is analysed, we find that there are positive and significant associations between inflation and floating and intermediate exchange rate regimes in most classifications. In other words, fixed exchange rate regimes are associated with lower inflation rates, in contrast to floating and intermediate regimes. Particularly, in emerging and developing countries, the *de facto* floating regimes from natural classification show an inflation rate of 16.5% and 8.2% higher than under fixed regimes, respectively. Interestingly, in contrast to the results obtained for the world, emerging and developing samples, fixed regimes are associated

with higher inflation in advanced economies when we use the de jure classification[14]. *De jure* floating in advanced economies is associated with inflation rates that are 1.4% lower than under fixed regimes, while intermediate regimes are associated with higher inflation relative to fixed regimes (about 2.3%).

In addition, our results on intermediate regimes show that the inflation rate is higher in advanced countries using intermediate regimes, compared to those advanced economies using fixed and floating regimes. Conversely, the effects of intermediate regimes on inflation are weaker than the effects of floating regimes in emerging countries. In developing countries, intermediate arrangements display a lower impact on inflation than fixed and floating regimes but the coefficient is not significant. In Table 7 the performance of exchange rate regimes on inflation is reported. In most cases, inflation is lower if the regime is fixed. This finding is in line with De Grauwe & Schnabl (2005), Coudert & Dubert (2005), Bleaney & Francisco (2007) and Sosvilla-Rivero & Ramos-Herrera (2014), among others.

Table 7. *Exchange Rate Arrangements Performance on Inflation*

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

Note: (*) insignificant variables.
Source: Author's calculations.

Table 8. *Inflation and Exchange Rate Arrangements in Developing Countries*

	Gosh *et al.,* (2002)	Levy-Yeyati & Sturzenegger (2001)	Hussain *et al.,* (2005)	Our results			
				Natural	LYS	HMR	De Jure
Period	1970-1999	1974-1999	1970-1999	1974-1999	1974-1999	1974-1999	1974-1999
Observations	967	629	1401	731	589	304	727
Method	Pool	Pool	Pool	LSDV	LSDV	LSDV	LSDV
Ranking	Fixed	Fixed	Fixed	Intermediate*	Fixed	Fixed	Fixed
	Intermediate	Floating	Intermediate*	Fixed	Floating	Floating*	Intermediate*
	Floating	Intermediate	Floating	Floating	Intermediate	Intermediate*	Floating

Note: The results by Husain *et al.,* (2005) are based on their estimate with country fixed effects. (*) insignificant variables.
Source: Gosh *et. al.,* (2002), Levy-yeyati & Sturzenegger (2001), Husain *et. al.,* (2005) and Author's calculations.

Comparing our results for developing countries to earlier studies by Ghosh *et. al.,* (1997, 2002), Levy-Yeyati & Sturzenegger (2001) and Husain *et. al.,* (2005), we notice that they are largely similar. Ghosh *et. al.,* (1997, 2002) find that, in the relatively low income per capita developing countries (based on the World Bank classification), inflation under a fixed exchange rate arrangement is significantly lower than under intermediate or floating exchange rate regimes in the period 1970-1999. Similarly, Levy-Yeyati & Sturzenegger (2001) find that fixed

[14] Similarly, the natural classification shows a positive association between fixed regimes and inflation in advanced economies, but its coefficient is too low and not significant.

exchange rates are associated with lower inflation than floating or intermediate exchange rates in non-industrial countries (both emerging markets and developing countries), but, in contrast with Ghosh *et al.,* (1997, 2002), floating arrangements are associated with lower inflation than intermediate ones (see Table 8). The results obtained by Husain *et al.,* (2005) suggest that developing countries appear to benefit from fixed exchange rates because they deliver lower inflation than floating or intermediate regimes. When we use the *de jure* classification, our results are similar to Ghosh *et al.,* (1997, 2002) and Husain *et al.,* (2005), while our results using the LYS and HMR classifications are similar to Levy-Yeyati & Sturzenegger (2001)[15].

In summary, our results provide some support for the role of fixed exchange rate regimes as credibility enhancing stabilisation devices particularly in emerging and developing economies. The inflation results are quite robust to different exchange rate classifications.

6. 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 inflation performance in developed, emerging and developing countries, separately. This article has provided an empirical analysis of the impact of different exchange rate regimes on inflation in advanced, emerging and developing countries. To this end, we have attempted to make two contributions. Firstly, we distinguish between the *de jure* and the three *de facto* classifications systems. 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.

Secondly, we have used a LSDV regression technique to study whether a particular exchange rate regime affects inflation performance. Our empirical findings indicate clear support for fixed regimes. They provide support for the role of fixed exchange rate regimes as a credible nominal anchor for the evolution of price levels, particularly in emerging and developing countries. Emerging and developing countries with a lower budget deficit, higher central bank independence, higher ratio of exports plus imports to GDP and fixed regimes show better inflation performance than others. Conversely, fixed regimes are associated with more inflation in advanced economies when we use the *de jure* classification only. Fixed exchange rate regimes are associated with lower inflation rates, particularly in emerging and developing countries. Developing countries using *de jure* floating exchange rate regimes show an inflation rate of 2.9% higher than developing countries using *de jure* fixed regimes.

In light of these results, it can be concluded that a fixed exchange rate arrangement is superior to another exchange rate regime in delivering better inflation performance, particularly in developing countries. The credibility associated with fixed exchange rates may play an important role in promoting financial stability since this regime can discipline policy-making and minimises discretion. An important part of literature considers adopting a foreign currency (dollarization) as the domestic currency to buy a credible policy of price stability, eliminating the role of short-run discretionary government policies that can give rise to policy inconsistencies.

[15] Our model was also applied to non-industrial countries (both emerging and developing) and the results are similar to those of developing countries. These results are available upon request.

References

Bailliu, J., Lafrance, R., & Perrault, J.-F.(2001). Exchange rate regimes and economic growthin Emerging Markets. In *Revisiting the Case for Flexible Exchange Rates*. (pp. 317-345), Bank of Canada.

Bailliu, J., Lafrance, R. & Perrault, J.-F. (2003). Does exchange rate policy matter for growth. *International Finance*, 6(3). 381-414. doi. 10.1111/j.1367-0271.2003.00123.x

Bérnassy-Quéré, A., Coeure, B. & Mignon, V. (2006). On the identification of de facto currencypegs.*Journal of the Japanese and International Economies,* 20(1). 112-127. doi. 10.1016/j.jjie.2004.11.002

Bleaney, M., & Francisco, M. (2007). Exchange rate regimes, inflation and growth in developingcountries - An assessment. *The B.E. Journal of Macroeconomics,* 7(1). 1-18. doi. 10.2202/1935-1690.1546

Bubula, A., & Otker-Rober, I. (2002). The evolution of exchange rate regimes since1990: Evidence from de fact policies. International Monetary Fund, *Working Paper*, No.WP/02/155. [Retrieved from].

Calvo, G., & Reinhart, C. (2002). Fear of Floating. *Quarterly Journal of Economics*, 117(2). 379-408. doi. 10.1162/003355302753650274

Coudert, V., & Dubert, M. (2005). Does exchange rate regime explain differences in economicresults for Asian countries? *Journal of Asian Economics*, 16(5). 874-895. doi. 10.1016/j.asieco.2005.08.015

Cruz-Rodríguez, A. (2013). Choosing and assessing exchange rate regimes: A survey of the literature. *Revista de Análisis Económico*, 28(2). 37-61.

Cukierman, A., Webb, S.B., & Neyapti, B. (1992). Measuring the independence of Central Banks and its effects on policy outcomes. *World Bank Economic Review*, 6(3), 353-398.

De Grauwe, P., & Schnabl, G. (2005). Exchange rate stability, inflation and growth in (South)Eastern and Central Europe. *Review of Development Economics*, 12(3), 530-549. doi. 10.1111/j.1467-9361.2008.00470.x

Domac, I., Peters, K., & Yuzefovich, Y.(2001). Does the exchange rate regime affect macroeconomic performance? Evidence from transition economies. World Bank, Policy Research Working Paper Series No.2642. [Retrieved from].

Domac, I., Peters, K., & Yuzefovich, Y.(2003). Does the exchange rate regime matter for inflation? Evidence from transition economies. Central Bank of the Republic of Turkey, Research and Monetary Policy Department, Working Papers, [Retrieved from].

Dubas, J.M., Lee, B.-J., & Mark, N.C. (2005). Effective exchange rate classifications and growth.NBER Working Paper, No.11272. doi. 10.3386/w11272

Frankel, J., & Wei, S.-J. (2008). Estimation of de facto exchange rate regimes: Synthesis of the techniques for inferring flexibility and basket weights. *IMF Staff Papers*, 55(3). 384-416. doi. 10.1057/imfsp.2008.18

Garofalo, P. (2005). Exchange rate regimes and economic performance: The Italian experience. Banca D'Italia Quadernidell' Úfficio Ricerche Storiche, No.10. [Retrieved from].

Ghanem, D. (2012). Fixed Exchange Rate Regimes and Inflation Performance: Evidence from MENA Countries. *Review of Middle East Economics and Finance*, 8(1). 1-30. doi. 10.1515/1475-3693.1354

Ghosh, A.R., Gulde, A.-M., Ostry, J.D., & Wolf, H. (1997). Does the nominal exchange rate regime matter?, *NBER Working Paper Series*, No.5874. doi. 10.3386/w5874

Ghosh, A.R., Gulde, A.-M., & Wolf, H.C. (2002). *Exchange Rate Regimes: Choices and Consequences*. The MIT Press.

Ghosh, A.R., Qureshi, M.S., & Tsangarides, C.G. (2014). On the value of words: Inflation and fixed exchange rate regimes. *IMF Economic Review*, 62(2), 288-322. doi. 10.1057/imfer.2014.14

Habermeier, K. Kokenyne, A. Veyrune, R., & Anderson, H. (2009). Revised system for the classification of exchange rate arrangements. International Monetary Fund, Working Paper No.WP/09/211. [Retrieved from].

Husain, A.M., Mody, A., & Rogoff, K.S. (2005). Exchange rate regime durabilityand performance in developing versus advanced economies. *Journal of Monetary Economics*, 52(1). 35-64. doi. 10.1016/j.jmoneco.2004.07.001

Ilzetski, E., Reinhart, C. & Rogoff, K. (2010). The Country Chronologies and Background Material to Exchange Rate Arrangements into the 21st Century: Will the Anchor Currency Hold? Unpublished manuscript. [Retrieved from].

Klein, M.W., & Shambaugh, J.C. (2008). The dynamics of exchange rate regimes: Fixes, floats, and flips. *Journal of International Economics*, 75(1). 70-92. doi. 10.1016/j.jinteco.2007.10.003

Klein, M.W., & Shambaugh, J.C. (2010). *Exchange Rate Regimes in the Modern Era*.The MIT Press.

Levy-Yeyati, E., & Sturzenegger, F. (2001). Exchange rate regimes and economic performance. *Staff Paper*, 47(S). 62-98. [Retrieved from].

Levy-Yeyati, E., & Sturzenergger, F. (2005). Classifying exchange rate regimes: Deeds vs. words. *European Economic Review*, 49(6). 1603-1635. doi. 10.1016/j.euroecorev.2004.01.001

Lohi, J. (2014). Exchange rate regimes and inflation in Sub-Saharan Africa. *Journal of Economics and International Finance*, 6(8). 173-189. doi. 10.5897/JEIF2013.0561

Mohantya, B., & Bhanumurthyb, N.R. (2014). Exchange rate regimes and inflation: Evidence from India. *International Economic Journal*, 28(2). 311-332. doi. 10.1080/10168737.2014.905618
Moreno, R. (2001). Pegging and stabilization policy in developing countries. *Federal Reserve Bank of San Francisco Economic Review*. 17-29.
Poirson, H. (2002). How do countries choose their exchange rate regime. International Monetary Fund, Working Paper, No.WP/01/46. [Retrieved from].
Reinhart, C., & Rogoff, K.S. (2004). The modern history of exchange rate arrangements: A reinterpretation. *Quarterly Journal of Economics*, 119(1). 1-48. doi. doi. 10.1162/003355304772839515
Rogoff, K.S., Husain, A.M., Mody, A., Brooks, R., & Oomes, N. (2003). Evolutionand performance of exchange rate regimes. International Monetary Fund, *Working Paper*, No. WP/03/243. [Retrieved from].
Romer, D. (1993). Openness and inflation: Theory and evidence. *Quarterly Journal of Economics*, 108(4), 869-903. doi. 10.2307/2118453
Rose, A.K. (2011). Exchange rate regimes in the modern era: Fixed, floating, and flaky. *Journal of Economic Literature*, 49(3). 652-672. doi. 10.1257/jel.49.3.652
Shambaugh, J.C. (2004). The effect of fixed exchange rates on monetary policy. *Quarterly Journal of Economics,* 119(1). 330-357. doi. 10.1162/003355304772839605
Sosvilla-Rivero, S., & Ramos-Herrera, M.C. (2014). Exchange-rate regimes and inflation: An empirical evaluation. WorkingPaperson International Economics and Finance14-02. Asociación Española de Economía y Finanzas Internacionales.
Toulaboe, D., & Terry, R. (2013). Exchange Rate Regime: Does it Matter for Inflation? *Journal of Applied Business and Economics*, 14(1). 56-71.