Exchange arrangements and economic growth. What relationship is there?

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Abstract

This article provides empirical support for the hypothesis that different exchange rate regimes have an impact on economic growth in advanced, emerging and developing countries. The effects of different exchange rate arrangements on economic growth are examined through least squares dummy variable regressions using panel data on 125 countries during the post-Bretton Woods period (1974-1999). 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 developing countries with fixed regimes tend to have a higher economic growth.

Keywords: Exchange rate regimes, economic growth.

JEL classification: F31, F33, O47.

1. Introduction

Since the breakdown of the Bretton Woods system, almost 50 years ago, adopting a correct exchange rate regime that 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,

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intermediate, and floating exchange arrangements has once again taken centre stage in academic circles. 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 groups of countries. The choice of an exchange rate regime for developed countries is different from that of developing countries or emerging economy countries.

Contrary to many theoretical studies in the literature, relatively few studies attempt to empirically investigate the impact of an exchange rate regime on economic growth 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 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 conclusion emerging from this study is the following: a fixed exchange rate regime is superior to another exchange rate arrangement in delivering better economic performance, particularly in developing countries.

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 economic growth. 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 Economic Growth: 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; the exchange rate regime classification is presented. The second sub-section presents a review of empirical analyses of exchange arrangements and economic growth.

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 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; Garofalo, 2005; 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 and 2019), but these are fundamentally based on data about 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 regimes. On the other hand, some research 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 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[4]. 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

[1] To 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 results of measurement error in the classification of exchange rate arrangements.

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

there is no official announcement of the regime by the authorities[5]. 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 considers 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[7].

[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] 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).

[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.

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).

2.2 Exchange Rate Arrangements and Economic Growth

Contrary to the attention paid on the effects of exchange regimes on inflation in theoretical and empirical literature, only a few studies have attempted to investigate the consequences of exchange arrangements on economic growth. Yet, some studies suggest that the exchange rate arrangement may matter for growth either directly through its effects on the adjustment to shocks and/or indirectly via its impact on other important determinants of growth, such as

investment, international trade, capital flows and financial sector development. However, it is not clear what type of arrangement would be more likely to promote economic growth. For instance, Baxter and Stockman (1989) and Mundell (1997) compare growth between the two periods: the period of the fixed exchange rate system and the one under the generalized floating in the US and four other regions. The first study concluded that exchange-rate arrangements do have little effect on the key macroeconomic variables. The second found that the former period of fixed rates achieved better performance in all respects, including the real per capita growth. On the contrary, Ghosh et al. (1997) found no systematic differences in growth rates or output volatility across exchange rate regimes in a sample of 136 countries over period the 1960-1990, though growth tends to be more variable under fixed exchange rate regimes. According to these authors, countries operating under fixed rates invest more and are more open, while countries under flexible rates enjoy faster residual productivity growth. Similarly, Ghosh et al. (2002) did not find evidence of a strong link between exchange rate regimes and economic growth, especially after controlling the country-specific effects possible from a simultaneity bias. Equally, Moreno (2001) suggests that episodes of pegging are associated with significantly faster (but no volatile) real GDP growth than are episodes of floating.

These results contrast with the work developed by Levy-Yeyati and Sturzenegger (2003), who use their own *de facto* classification of regimes to study the relationship between exchange rate regimes and economic growth for a sample of 183 countries in the post-Bretton Woods' period. They find that, for developing countries (including emerging markets), less flexible exchange rate regimes are associated with slower growth, as well as with greater output volatility. For industrial countries, regimes do not appear to have any significant impact on growth. Likewise, Larraín and Parro (2003), using an earlier version of the *de facto* classification from Levy-Yeyati and Sturzenergger (2005), find that, for non-industrial countries, the floating exchange rate regime leads to a higher per capita growth rate and smaller growth volatility than other exchange rate regimes. Their analysis is based on 147 countries during the period 1975-2000.

Bailliu et al. (2001) estimate the impact of the type of exchange rate regime on growth using a panel data set of 25 emerging market economies for the period 1973-1998, in a framework that controls other determinants of growth, while accounting for country-specific effects and for the presence of global shocks. Using their own exchange rate classification, they find evidence that more flexible exchange rate arrangements are associated with higher economic growth, but only for countries that are relatively open to international capital flows, and, to a lesser extent, that have well developed financial markets. Bailliu et al. (2003) expand their previous study to include industrialised as well as developing countries, using a dynamic Generalized Method of Moments (GMM) model. They estimate the impact of exchange rate arrangements on growth in a panel data set of 60

countries for the period 1973-1998, finding evidence that exchange rate regimes characterised by a monetary policy anchor, whether they are pegged, intermediate, or flexible, exert a positive influence on economic growth. They also find evidence that intermediate/flexible regimes without an anchor are detrimental to growth. Their results thus suggest that it is a presence of a strong monetary policy framework, rather than the type of exchange rate regime per se, that is important for economic growth. While Domac et al. (2001), using *de jure* classification provided by the IMF, examine whether the exchange rate regime has any impact on economic growth performance in 22 transition economies for the period 1991-1998. Based on their results, it is not possible to infer more about one particular exchange rate regime being superior to another in terms of growth performance.

Huang and Malhotra (2005) investigate the link between the *de facto* choice of exchange rate regime and economic growth, paying particular attention to the effects of the level of development on the link. The study uses 12 developing Asian countries and 18 advanced European economies over the period 1976-2001. Their results show that the impact of fixed and intermediate regimes is positive in developing nations. Similarly, De Grauwe and 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 suggest that exchange rate fixity does not reduce economic growth in the (South) Eastern and Central European countries. Also, Coudert and Dubert (2005) analyses interesting aspects of the de facto regimes followed by major Asian countries over the period 1990-2001. Their results show that pegs are associated with weaker growth than floating exchange rate regimes. On the contrary, 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 growth performance is apparently better under soft peg than under other regimes.

On the other hand, Dubas et al. (2005), using their effective exchange rate classification, find that higher growth is associated with fixed exchange rate regimes. Their results suggest that growth in industrial countries is not significantly related to the exchange rate regime. In contrast, Husain et al. (2005), using the natural classification from Reinhart y Rogoff (2004), suggest that floating regimes appear to be associated with higher growth in advanced economies.

Bleaney and Francisco (2007) examine the relationship between exchange rate 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, while hard pegs, in which adjustment

of the parity is inhibited either by legal barriers (currency boards) or the need for the agreement of other countries (a common currency), are associated with slower growth than other regimes. On contrary, Petreski (2009b), applying dynamic system-GMM panel estimation on 169 countries over the period 1976-2006, investigate the relationship between exchange rate regime and economic growth[8]. His results suggest that the exchange rate regime does not have explanatory power over growth.

Klein and Shambaugh (2010) present an empirical analysis of the effects of the exchange rate regime on long-run economic growth using a standard cross-country growth regression framework. The sample includes 92 countries (22 industrial countries and 70 nonindustrial countries) over the period 1980 to 1999. They find that pegged exchange rates are associated with slower growth in developing and emerging market countries. On contrary, Rose (2011) employs a panel regression including 178 countries from 1974 to 2007. He finds economies with narrow crawling band regimes grow significantly faster than those in fixed regimes.

Ihnatova and Capraru (2012) studied on Central and Eastern European countries to see the economic growth and exchange rate regimes relation. They applied an Ordinary Least Square and Generalized Maximum Method and used dummy variables. The study covers 16 central and Eastern European countries for the period 1999-2010, using the IMF *de jure* classification. While comparing growth effects with floating, intermediate regimes and fixed arrangements, it was found that there was a superior effect on economic growth from floating and intermediate regimes. Coulibaly and Davis (2013), using de jure and de facto regime classification schemes and a sample of 35 Sub-Saharan African (SSA) countries over the 1985-2009 period, evaluate the importance and impact of CFA zone membership by distinguishing between the effects of being in monetary union from those which arose from anchoring the CFA franc. Their results show that a greater performance in terms of economic growth of the CFA zone compared to other SSA countries.

Zdravkovic, et al. (2014) examine the impact of exchange rate regime on macroeconomic performance (inflation, current account, and real growth) in emerging European countries for the period 2003-2012. They suggest that fixed exchange rate regimes contribute to lower inflation and higher current accounts, while impact of regime on real growth is ambiguous. Sosvilla-Rivero and Ramos-Herrera (2014), based on a dataset of 123 economies, both developed and developing countries, investigate the relation between exchange rate regimes and economic growth. They use *de facto* classification of Reinhart and Rogoff, and their results show that growth performance is best under intermediate exchange

[8] Petreski (2009a) presents a literature review on exchange rate regime and economic growth.

rate regimes, while the smallest growth rates are associated with flexible exchange rates.

Lasarte Navamuel and Pérez Rivero (2015) analysed the relationship between exchange rate regimes and economic growth by using a panel data of 147 developing countries over the years from 1970 to 2007. They develop a consensus classification using data from the most influential classifications in the literature (International Monetary Fund, 2010; Levy- Yeyati and Sturzenegger, 2005; Reinhart and Rogoff, 2004; Klein and Shambaugh, 2010, and Ghosh et al., 2002), in which the observations are divided in a dichotomous criterion between pegged and non-pegged. By applying a dynamic system-GMM panel estimation in a growth equation, no statistically significant evidence was found of a relationship between pegged exchange rate regimes and economic growth in developing countries.

Obi et al. (2016) examine the relationship between exchange rate regimes and output growth in Nigeria from 1970 to 2014. Their results reveal that deregulated exchange spur economic growth. Similarly, Guellil, et al. (2017) examine the impact of the exchange rate regimes on economic growth in 38 developing countries during the period from 1980 to 2013 relying on two types of exchange rate regimes: fixed and intermediate regimes according to the classification of Reinhart and Rogoff. To estimate their model, authors used the Panel Fully Modified Least Squares (FMOLS) in order to know if any regime is the best in terms of economic growth. Their results suggest that there is a positive relation between exchange rate regime and economic growth with a preference for fixed exchange rate regimes in achieving the highest growth rate. Equally, the results of Ashour and Chen (2018) indicate that economic growth under fixed regimes performs better than under intermediate or flexible regimes. Contrary, Rao (2019) examines the effects of exchange rate regimes on growth of BRICS countries (Brazil, Russia, India, China, and South Africa). The data used covers over the period from 1970 to 2012. The author finds that the pegged exchange rate regimes are not much associated with better performance in terms of growth. Frankel, Ma and Xie (2019), based on the empirical approaches of Frankel and Wei (2008) and Frankel and Xie (2010), construct a new database characterizing the *de facto* exchange rate regime for 145 countries during the full post-Bretton Woods period. Their results show that economic growth is significantly positively correlated with the intermediate exchange rate regimes.

De Almeida Cardoso and Vilela Vieira (2020) investigate the relevance of exchange rate regimes for long-run economic growth using a sample of 82 countries for the period of 1970 to 2009. They use a System-GMM estimation and indicate that countries with flexible and intermediate exchange rate regimes have higher growth rates when compared to those with fixed exchange rate regimes. Contrary, Dao and Nga (2020) use the exchange rate database constructed by Reinhart and

Rogoff and employ the Generalized Method of Moments technique on unbalanced panel data to analyse the effect of the exchange rate regime on economic growth in Asian countries (23 economies) from 1994 to 2016. Their results suggest that a country with a less flexible exchange rate regime will have a higher growth rate.

Hadj Fraj et al. (2020) analyse the direct and indirect effects of political stability on the economic growth of 50 emerging and developed countries for the period 1996-2013. They use the exchange rate classification originally developed by Reinhart and Rogoff (2004) and updated of Ilzetzki, Reinhart and Rogoff (2019). Their results showed that the flexible exchange rate regime destabilizes the economic activity of emerging countries while the fixed exchange rate regime favours the economic growth of these countries. As a result, the fixed exchange rate regime stimulates economic growth in emerging countries. However, for developed countries, the floating exchange rate regime stimulates economic growth. Boucheta, et al. (2021) examine empirically the existence of a link between exchange rate regime and economic growth, by using panel data of five MENA countries (Algeria, Egypt, Jordan, Morocco, and Tunisia) over the period 1984-2019 and based on the classification method of Levy-Yeyati and Stuezenegger (2002). Their results show that the flexible exchange rate regime positively influences economic growth.

3. Empirical Methodology

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

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

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 tth 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 growth 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 effects as being fixed or random[9].

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 markets 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 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. Consequently, our panel data set is unbalanced.

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 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 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 and capital revenue and official grants received, less total expenditure and lending minus repayments. This variable considers central governments only. Some variables 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.

[9] 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.

[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 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	Czech Republic	Botswana	Kenya	Saudi Arabia
Finland	Egypt	Burkina Faso	Kyrgyz Rep.	Senegal
France	Hungary	Burundi	Lao Dem.	Slovak Rep.
Germany	India	Cameron	Rep.	Sri Lanka
Greece	Indonesia	Chad	Latvia	St. Lucia
Iceland	Israel	Congo, Rep. of	Lebanon	St. Kitt & Nevis
Ireland	Jordan	Costa Rica	Lesotho	St. Vicent &
Italy	Korea, Rep.	Croatia	Liberia	Grenadines
Japan	Malaysia	Dominica	Libya	Suriname
Kuwait	Mexico	Dominican Rep.	Lithuania	Swaziland
Luxembourg	Morocco	Ecuador	Macedonia	Tanzania
Netherlands	Pakistan	El Salvador	Madagascar	Togo
Norway	Peru	Equatorial Guinea	Malawi	Tunisia
Portugal	Philippines	Estonia	Mali	Uganda
Singapore	Poland	Gabon	Malta	Ukraine
Slovenia	Rusia	Gambia, the	Mauritius	Uruguay
Spain	South Africa	Georgia	Moldova	Zambia
Sweden	Thailand	Ghana	Mongolia	Zimbabwe
Switzerland	Turkey	Grenada	Myanmar	
United	Venezuela	Guatemala	Nepal	
Kingdom		Guinea-Bissau	New Zealand	
United States		Guyana	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: List of variables used in the estimations

Variable	Description
Per capita GDP	Per capita real GDP growth (%)
Openness	Exports plus imports of goods and services (% GDP)
TT growth	Terms of trade growth (%)
Invest. Ratio	Gross fixed investment (% of GDP)
Schooling	Averages number of years of schooling of total population age 25 and older (per 5
Tax ratio	years)
Gov. Balance	General government revenue (% of GDP)
Initial GDP	Central government balance (% of GDP)
Pop. Size	Average of per capita GDP over each five-year period
Pop. growth	Population size (logarithm)
Floating	Population growth (%)
Intermediate	Dummy variable capturing float exchange rate regimes
	Dummy variable capturing intermediate arrangements

Note: The table does not include the dependent variables, which are explained in the text.

5. Estimation Results

In this section, we explore how per capita output growth varies across exchange rate regimes in our sample, using the percentage change in real per capita GDP as the dependent variable and two dummies for floating and intermediate regimes. We have dropped fixed arrangements from the equation. The rest of the independent variables are investment ratio, trade openness, terms of trade growth, average years of schooling, general government revenue, government balance, initial GDP, population growth and population size. The expected sign for the investment ratio is positive since capital accumulation is expected to lead to higher real per capita GDP growth. The literature on endogenous growth has established a positive link between openness to international trade and economic growth. Countries that are more open to international trade tend to grow more rapidly because they have developed a greater ability to absorb technical knowledge and can take advantage of larger markets (Barro y Sala-i-Martin, 1995). On the other hand, the effects of terms trade development on economic growth are expected to be positive. We also use the average years of schooling in the population 25 years of age and over as a proxy for the stock of human capital. According to growth theory predictions, whether neo-classical or endogenous, the coefficient on the stock of human capital should be positive, since countries that have more human capital tend to grow faster.

The initial per capita GDP (in natural log form) is measured as averages over each five-year period and represents initial conditions in a neo-classical growth model. According to neo-classical theory, the coefficient on per capita GDP represents the convergence effect and should be negative[11]. In endogenous growth models, there is no convergence effect (since economies do not depart from their steady states) and therefore the coefficient is expected to be zero. Larger countries (as measured by population size) tend to have higher growth rates, but faster population growth itself is associated with lower per capita GDP growth.

The Hausman test suggests that the preferred model is the fixed effects, as we reject the null hypothesis in most of cases at 5% and 10% level (see Table 4). However, in advanced economies using the LYS classification and in developing countries using the *de jure* classification, the random effects model was preferred. In addition, in some cases the random effects estimator has degenerated into a pooled Ordinary Least Squares (OLS) estimator; in those cases, we used a fixed effects because the assumption of common slope parameters would become

[11] If convergence holds, the economy of a country will grow faster with a relatively lower level of initial per capital GDP, since it is that much further aways from its steady state and must catch up.

unreasonable[12]. Also, using the traditional restricted F-test, which is based on loss of goodness-of-fit, to testing group effects: $F_{(n-1,nT-n-k)} = \frac{(R^2_{LSDV} - R^2_{Pooled})/(n-1)}{(1-R^2_{LSDV})/(nT-n-k)}$, where LSDV is the unrestricted model, we reject the null hypothesis of a common intercept for all countries. In other words, we may conclude that the fixed effects model is better than the pooled OLS.

In Tables 5 and 6 we report the impact of exchange rate regimes on economic growth. The adjusted R^2 displays that the model explains between 10% to 59% of the variation in the growth rates in our sample.

Table 4: Hausman Specification Test

Classification	All Countries	Advanced	Emerging	Developing
Natural	χ^2 (11) = 36.9(0.00)	-	χ^2 (11) = 65.1(0.00)	χ^2 (11) = 23.8(0.02)
LYS	χ^2 (11) = 28.6(0.00)	χ^2 (11) = 12.2(0.35)	-	χ^2 (11) = 19.1(0.06)
HMR	χ^2 (11) = 33.5(0.00)	-	-	-
De Jure	χ^2 (11) = 26.3(0.01)	-	χ^2 (11) = 18.5(0.07)	χ^2 (11) = 17.1(0.11)

Note: In advanced economies with Natural, HMR and *De jure* classifications, in emerging with LYS and HMR classifications; and in developing countries with HMR classification the random-effects estimator has degenerated to pooled OLS and the Hausman test may not be appropriate.
Source: Author's estimates.

The signs of coefficients are mostly statistically significant and consistent with growth theory. According to our results, investment ratio, openness and terms of trade growth have a positive influence on the GDP per capita growth. On the contrary, the coefficients on the proxy for human capital are not statistically significant or do not present the expected signs.

As shown in Tables 5 and 6, we do not find support that general government revenue influences economic growth; its coefficient is not statistically significant for either classification scheme or groups of countries. On the contrary, government balance shows positive and statistically significant coefficients in most cases. The initial per capita GDP shows a negative and statistically significant coefficient, mainly in emerging economies. Moreover, population growth shows the expected negative relations with per capita GDP growth, while population size shows a positive coefficient.

[12] The statistical significance of the estimated coefficients, the R^2 valued and the Durbin-Watson value, are higher in the LSDV than pooled OLS.

Table 5: The Impact of Exchange Rate Arrangements on Per Capita Growth in All Countries and Advanced Economies

	All Countries				Advanced Economies			
	Natural	LYS	HMR	*De jure*	Natural	LYS	HMR	*De jure*
Constant	0.19	0.12	0.01	0.16	-0.08	0.07	-0.01	-0.10
	(2.15)#	(1.22)	(0.15)	(1.81)^	(-0.44)	(1.38)	(-0.07)	(-0.61)
Invest. ratio	0.09	0.07	0.13	00.9	0.12	0.14	0.09	0.13
	(0.01)#	(1.96)#	(2.75)*	(2.95)*	(1.81)^	(2.68)*	(1.83)^	(1.94)^
Openness	0.03	0.02	0.02	0.03	0.05	0.03	0.06	0.05
	(2.08)#	(1.57)	(0.96)	(2.14)#	(2.57)#	(5.16)*	(3.43)*	(3.03)*
TT growth	0.02	0.02	0.02	0.02	0.004	-0.01	0.2	0.02
	(1.26)	(1.57)	(1.30)^	(1.39)	(0.14)	(-0.34)	(0.76)	)0.05)
Schooling	0.001	0.001	-0.01	0.001	-0.003	-0.0002	-0.01	-0.003
	(0.22)	(0.25)	(-1.78)^	(0.17)	(-1.15)	(-0.15)	(-1.90)^	(-1.00)
Tax ratio	-0.01	0.004	0.01	-0.01	-0.04	-0.02	-0.02	-0.03
	(-0.38)	(0.13)	(0.30)	(-0.34)	(-1.24)	(-0.94)	(-0.77)	(-1.11)
Gov. balance	0.18	0.19	0.27	0.20	0.06	0.12	0.07	0.07
	(4.91)*	(5.03)*	(5.64)*	(5.67)*	81.44)	(2.77)*	(1.76)^	(1.58)
Initial GDP	-0.3	-0.02	0.003	-0.02	0.01	-0.01	0.003	0.01
	(-1.79)^	(-1.04)	(0.29)	(-1.46)	(0.53)	(-1.44)	(0.16)	(0.59)
Pop. growth	-0.52	-0.21	-1.40	-0.52	-0.96	-0.80	-1.06	-0.96
	(-0.82)	(-0.27)	(-4.06)*	(-0.82)	(-4.09)*	(-3.35)*	(-4.02)*	(-3.92)*
Pop. size	$7.29e^{-05}$	$2.65e^{-05}$	$9.77e^{-06}$	$6.24e^{-05}$	$-2.27e^{-05}$	$7.23e^{-05}$	0.0001	$8.31e^{-05}$
	(1.36)	(0.34)	(0.28)	(1.26)	(-0.08)	(2.37)#	(0.53)	(0.31)
Floating	-0.02	-0.003	0.01	-0.001	0.01	0.002	0.01	0.004
	(-3.42)*	(-0.70)	(1.57)	(-0.27)	(0.85)	(0.74)	(1.62)	(1.10)
Intermediate	-0.004	-0.016	0.01	-0.002	-0.003	-0.004	0.01	0.004
	(-0.62)	(-5.94)*	(1.24)	(-0.78)	(-0.93)	(-1.46)	(1.46)	(1.63)
Observations	1690	1367	1141	1673	515	412	451	515
F-test prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj. R^2	0.25	0.21	0.38	0.25	0.49	0.41	0.59	0.48

Note: The table reports the least squares dummy variables results of unbalanced panels with fixed effects. Dependent variable is Per capita real GDP. 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 Arrangements on Per Capita Growth in Emerging and developing Countries

	All Countries				Advanced Economies			
	Natural	LYS	HMR	*De jure*	Natural	LYS	HMR	*De jure*
Constant	0.27	0.27	0.17	0.23	0.22	0.06	0.05	0.004
	(1.73)^	(1.49)	(0.98)	(1.54)	(2.75)*	(0.62)	(0.47)	(0.09)
Invest. ratio	0.15	0.19	0.23	0.17	0.07	0.05	0.16	0.11
	(2.49)#	(2.82)*	(2.58)#	(2.88)*	(1.83)^	(1.07)	(2.35)#	(2.28)#
Openness	0.07	0.03	0.03	0.07	0.01	0.004	-0.02	0.01
	(1.75)^	(0.62)	(1.05)	(1.80){	(0.32)	(0.22)	(-0.33)	(0.85)
TT growth	0.05	0.06	0.01	0.05	0.001	0.01	0.03	0.001
	(1.69)^	(1.64)	(0.46)	(1.69)^	(0.07)	(0.80)	(1.22)	(0.13)
Schooling	0.002	0.01	-0.01	0.004	-0.01	-0.01	-0.01	-0.01
	(0.28)	(0.98)	(-1.26)	(0.54)	(-1.96)^	(-1.67)^	(-0.98)	(-2.27)#
Tax ratio	0.01	0.06	0.08	0.06	-0.004	-0.003	0.002	-0.03
	(0.16)	(0.80)	(1.63)	(0.75)	(-0.07)	(-0.05)	(0.04)	(-0.73)
Gov. balance	0.08	-0.03	0.34	0.11	0.24	0.27	0.45	0.22
	(0.59)	(-0.19)	(4.13)*	(0.81)	(5.07)*	(6.31)*	(3.82)*	84.88)*
Initial GDP	-0.05	-0.05	-0.03	-0.04	-0.02	0.0003	0.01	0.01
	(-2.39)#	(-1.77)^	(-1.01)	(-1.90)^	(-1.78)^	(0.02)	(0.37)	(1.03)
Pop. growth	0.35	0.57	-0.95	0.33	-1.30	-1.12	-2.21	-1.12
	(0.28)	(0.40)	(-4.89)*	(0.25)	(-3.20)*	(-4.12)*	(-3.10)*	(-2.81)*
Pop. size	0.001	$5.52e^{-05}$	0.0001	0.0002	0.002	0.001	-0.002	$9.92e^{-06}$
	(1.56)	(0.45)	(1.57)	(2.03)#	(1.94)^	(1.20)	(-1.06)	(0.02)
Floating	-0.02	-0.003	-0.01	-0.03	-0.04	-0.002	0.01	0.01
	(-1.42)	(-0.35)	(-0.38)	(-3.06)*	(-4.03)*	(-0.44)	(0.46)	(1.51)
Intermediate	0.01	-0.03	-0.01	-0.01	-0.01	-0.01	0.02	0.002
	(0.95)	(-5.18)*	(-1.26)	(-1.63)	(-1.22)	(-2.48)#	(2.27)#	(0.41)
Observations	447	357	317	424	728	598	371	734
F-test prob.	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Adj. R^2	0.26	0.18	0.40	0.22	0.22	0.14	0.28	0.10

Note: The table reports the least squares dummy variables results of unbalanced panels with fixed effects. Dependent variable is Per capita real GDP. 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 7: Exchange Arrangements Performance on GDP Per Capita Growth

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

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

Our empirical evidence suggests that real per capita GDP growth in developing countries with floating regimes is 3.5% lower than developing countries using fixed regimes when we use the natural classification. Similarly, in emerging economies floating regimes show a negative sign, but only the *de jure* classification is significant. That is, per capita income growth in emerging economies using floating regimes is 3% lower than in emerging countries using fixed arrangements. However, our results in emerging economies, like previous studies from Husain et al. (2005), do not find a strong link between particular exchange rate regimes and economic growth.

In advanced economies, floating regimes show a positive association with per capita GDP growth, regardless of which classification scheme is used, but coefficients are not statistically significant (see Table 7).

In developing countries, when the natural classification is used our results are more in line with the earlier findings of Husain et al. (2005) on fixed regimes being associated with higher economic growth. On the other hand, intermediate exchange rate regimes appear to offer higher growth than floating and fixed regimes but only when we use the HMR classification in developing countries (see Table 8). Using the *de jure* classification, fixed exchange rate regimes are connected with slower growth rates in developing countries. This result is similar

to previous findings by Levy-Yeyati y Sturzenegger (2003). Conversely, fixed arrangements are associated with higher economic growth in developing countries when we use the LYS classification.

To summarise, our empirical results, in contrast to the previous research from Levy-Yeyati y Sturzenegger (2001); Levy-Yeyati and Sturzenegger (2003), Larraín and Parro (2003) and Bailliu et al. (2001), document that fixed regimes can lead to higher per capita growth rates than floating and intermediate regimes particularly in developing countries, but this finding is valid only when we use Natural and LYS classifications. This study also finds evidence to suggest that floating exchange rate regimes could be associated with higher economic growth only in advanced economies, but this is less robust than our other results. Moreover, the results on floating and intermediate regimes are sensitive to regime classification; different classifications can lead to very different results. In all the samples, the results present that both the *de jure* and *de facto* classifications show virtually no relationship between floating exchange rate regimes and economic growth.

Table 8: Economic Growth and Exchange Rate Arrangements in Developing Countries

	Ghosh 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	956	1029	1228	731	589	304	727
Method	Pool	Pool	Pool	LSDV	LSDV	LSDV	LSDV
Ranking	Floating	Floating	Fixed	Fixed	Fixed	Intermediate	Floating*
	Fixed*	Inter-Fixed	Intermediate*	Intermediate*	Floating*	Floating*	Intermediate*
	Intermediate		Floating	Floating	Intermediate	Fixed	Fixed

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

6. Concluding Remarks

The academic debate on the most appropriate exchange rate arrangement 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 economic growth in developed, emerging, and developing countries, separately. This article has provided an empirical analysis of the impact of different exchange rate regimes on economic growth 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 considering external shocks and revaluations.

Secondly, we have used a Least Squares Dummy Variables regression technique to study whether a particular exchange rate arrangement affects economic growth. Our empirical findings indicate clear support for fixed regimes to developing countries. Moreover, the results present that both the *de jure* and *de facto* classifications show virtually no relationship between floating exchange rate regimes and economic growth.

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