BANK OF GREECE
EUROSYSTEM

Working Paper

The classification and performance of alternative exchange-rate systems

George Tavlas
Harris Dellas
Alan Stockman

90

SEPTEMBER 2008

WORKINKPAPERWORKINKPAPERWORKINKPAPERWO

BANK OF GREECE
Economic Research Department – Special Studies Division
21, E. Venizelos Avenue
GR-102 50 Athens
Tel: +30210-320 3610
Fax: +30210-320 2432

www.bankofgreece.gr

Printed in Athens, Greece
at the Bank of Greece Printing Works.
All rights reserved. Reproduction for educational and non-commercial purposes is permitted provided that the source is acknowledged.

ISSN 1109-6691

THE CLASSIFICATION AND PERFORMANCE OF ALTERNATIVE EXCHANGE-RATE SYSTEMS

George Tavlas
Bank of Greece

Harris Dellas
University of Bern

Alan Stockman
University of Rochester

ABSTRACT

Owing to dissatisfaction with the IMF's *de jure* classification of exchange-rate regimes, a substantial literature has emerged presenting *de facto* classifications of exchange-rate systems and using the latter classifications to compare performances of alternative regimes in terms of key macroeconomic variables. This paper critically reviews the literature on *de facto* regimes. In particular the paper (1) describes the main methodologies that have been used to construct *de facto* codings, (2) surveys the empirical literature generated by *de facto* regime codings, and (3) lays-out the problems inherent in constructing *de facto* classifications. The empirical literature is found to yield few robust findings. We argue that the as-yet unfulfilled objective of this literature, and the major research agenda for the future in this area, lies in the need of a more thorough investigation of the degree of monetary-policy independence without relying exclusively on movements in exchange rates, an agenda the attainment of which is made especially challenging because of the lack of comprehensive and reliable data on reserves and interest rates.

Keywords: Exchange-rate regimes; Economic growth; Inflation; Bipolar hypothesis
JEL Classification: F3

Acknowledgments: We thank Heather Gibson, George Hondroyiannis, Inci Otker-Robe, Pavlos Petroulas, Michael Ulan, and Hari Vittas for helpful comments. We are also grateful to Juergen von Hagen for many penetrating comments and suggestions. We wish to thank the following individuals for supplying us with their data samples: Herald Anderson, Jeannine Bailliu, Barry Eichengreen, Rex Ghosh, David Leblang, and Nelson Mark. We have benefited from research assistance from Konstantina Manou. The views expressed are the authors' own and should not be interpreted as those of their respective institutions.

Correspondence:
George Tavlas,
Economic Research Department,
Bank of Greece, 21, E. Venizelos Ave.,
102 50 Athens, Greece
Tel. +30210-320 2370
Fax +30210-320 2432
email: gtavlas@bankofgreece.gr

1. Introduction

The classification and assessment of the performance of exchange-rate regimes have been a central focus of recent research in international economics. A substantial empirical literature has emerged presenting alternative codings of exchange-rate systems and comparing the performance of these systems in terms of key macroeconomic variables, including economic growth, inflation, and output variability. Such has been the extent to which the use of these codings has permeated the literature that Genberg and Swoboda (2004, p. 5) commented that "the classifications have rapidly become the new standard in research on exchange-rate regimes". The purpose of this essay is to set-out what we know about the consequences of the choice of the exchange-rate regime and to critically review the proliferating literature on the classification and the performance of alternative regimes.

The recent interest in assessing the functioning of exchange-rate systems stems from several factors. First, it is a natural outgrowth of the long-standing debate about the merits of floating versus fixed exchange rates. [1] The more than thirty-years' experience with managed floating and other currency arrangements following the demise of the Bretton-Woods system of pegged-but-adjustable exchange rates has provided ample data with which to compare the performance of fixed-rate systems with the varieties of more-flexible regimes that have sprung up in the post-Bretton-Woods era. Second, for many years empirical work on exchange-rate regimes relied on the *de jure* coding reported by the IMF, which classified regimes according to what the authorities said they did.[2] However, in an influential article, Calvo and Reinhart (2002) found that, in practice, many exchange-rate regimes did not function according to the *de jure* rules, so that empirical analyses of the relationship between economic performance and regime choice based on the *de jure* classification risked yielding results that led to misleading statistical inferences (Edwards and Savastano, 1999; Rogoff *et al.*, 2004). In the light of these problems, a main area of recent research has involved the construction of alternative, *de facto*, regime classifications, which attempt more accurately to capture the authorities' practices. Third, the fact that the

[1] Frankel (2003, p. 13) commented that "the choice of currency regime … is perhaps the most widely studied topic in international economics".
[2] The *de jure* codings were published until 1999 by the IMF in its *Annual Report on Exchange-Rate Arrangements and Exchange Restrictions.*

exchange-rate crises during the 1990s were concentrated heavily among intermediate regimes - - or soft pegs - - led to what has become known as "the hypothesis of the vanishing-middle regime" (Frankel, 2003). According to this bipolar hypothesis, for countries well-integrated into world capital markets, intermediate regimes are crisis-prone so that there is little, if any, feasible middle ground between floating exchange rates and monetary unification (Eichengreen, 1994; Fischer, 2001). Consequently, a main thrust of recent research has been to compare the performance of intermediate regimes with those of the corner options of floating and hard pegs and to assess whether a retreat from the middle ground has, in fact, occurred.

The remainder of this paper is structured as follows. To set the stage, Section 2 describes alternative exchange-rate systems. Section 3 describes the coding approaches that have been put forward in the recent literature and assesses the alternative codings in terms of their reliability. Section 4 begins with a brief discussion of some analytic aspects of exchange-rate systems and considers the earlier empirical literature dealing with macro-economic performance under different regimes. It then takes stock of the recent empirical results that have been derived from the various coding approaches. We focus on the empirical results pertaining to real per-capita growth, inflation, and output volatility across regimes and the evolution of regimes over time. Section 5 concludes with a discussion of problems that remain to be addressed and the research tasks ahead for devisers and users of coding schemes.

2. Types of regimes: a primer

There is a continuum of exchange-rate regimes that runs from free floating to hard fixes (Frankel, 1999). The following taxonomy begins with flexible arrangements and progresses to increasingly-rigid regimes.[3]

(i) Free Floating. Under free-floating rates there is no commitment to a specific exchange-rate target. Supply and demand in the market determine the exchange rate. The authorities do not intervene in the foreign-exchange market and do not set interest rates for the purpose of "affecting the level or path of the exchange rate" (Kenen, 2001, p. 75).

[3] See Corden (2002), Goldstein (2002), and Tavlas and Ulan (2002, and the articles contained therein) for detailed discussions of exchange-rate regimes.

(ii) Managed Floating. In this regime, although there is no specific exchange-rate target, the authorities may intervene in the foreign-exchange market and/or set interest rates to influence the exchange rate. The authorities' objective may be to smooth short-term (monthly, weekly, or even hourly) volatility if there is a concern that, in thin foreign-exchange markets, excessive volatility may lead to disorderly and illiquid markets, a situation often characterized by wide bid-ask spreads and sudden jumps in prices (*i.e.,* successive transaction prices outside the previous bid-ask spread) (Ho and McCauley, 2003, pp. 18-19). The authorities may also aim to reverse long-term "misalignment", defined as a sustained departure of the exchange rate from the authorities' perception of its equilibrium value.

(iii) *Soft Pegs*. Pegged-exchange-rate regimes can be unilateral or part of a systems' arrangement (as under the euro area's exchange rate mechanism, or ERM II). The peg can be against a single currency or against a basket of currencies.[4] All pegged-exchange-rate commitments entail contingencies under which the exchange-rate target may be altered (Eichengreen, 1994, pp. 21-22). Under an *adjustable peg*, the authorities target a particular value of the exchange rate. The bands tend to be narrow (less than or equal to ±2.25 per cent), and the target rate is adjusted if the authorities perceive a discrepancy to arise between the target exchange rate and the equilibrium rate. The target rate tends to be adjusted infrequently and by large amounts (Kenen, 2001, p. 75). Typically, the central bank's foreign-currency reserves do not cover all domestic monetary liabilities, allowing the use of monetary-policy instruments to some degree to smooth swings in domestic interest rates and/or to support domestic financial institutions on a temporary basis (Ghosh, Gulde, and Wolf, 2000, p. 277). Under a *crawling peg* (or *crawling band*), the authorities target a preset path for the exchange rate instead of a level. The bands tend to be somewhat wider than the bands around the adjustable pegs because they must accommodate crawling of the pegs. The target rate is altered frequently and by relatively small amounts (Kenen, 2001).[5]

[4] The weights of the currencies in the basket often reflect an economy's geographical distribution of trade and/or capital flows.

[5] Mussa *et al*. (2000, p. 26) pointed-out that "the distinction between a [crawling] band and a peg is somewhat arbitrary, but a peg is often understood as a band in which the margins on either side of the central parity are less than or equal to 2.25 per cent". Crawling bands are also referred to as *target zones* (Williamson, 1996 p. 2).

(iv) *Currency boards*. A currency board issues notes and coins convertible on demand under all circumstances, at a fixed rate of exchange, against a foreign anchor currency (Humpage and McIntire, 1995, p. 2). It guarantees this commitment by fully backing the domestic monetary base - - but not the domestic money supply - - with the foreign anchor currency and by setting the exchange rate as a matter of public law.

(v) *Dollarisation* (or *Euroisation*). Under dollarisation, a country officially adopts a foreign currency as its legal tender. Unlike the situation pertaining under a currency-board arrangement, the local currency is completely replaced by the foreign currency adopted, rather than limited in quantity by the number of units of anchor currency held by the currency board.

(vi) *Monetary Union.* This arrangement involves the adoption of a single currency and a common central bank by a group of economies. Monetary unification implies that responsibility for exchange-rate policy and for the balance of payments of the entire community with the rest of the world must be assigned to the community. The monetary authority of the community controls the pool of foreign-exchange reserves (Robson, 1998).

In the following sections, currency boards, dollarisation, and monetary unions are considered "hard pegs". The distinction between hard pegs and soft pegs is that, under the former, the policy to fix the exchange rate (or adopt a common currency) is an institutional commitment (*e.g.,* a law mandating a currency board that requires a legislative supermajority to reverse it), whereas, under the latter, the policy to peg is a conditional promise (Frankel, 2003; Bordo, 2004). The difference between soft pegs and floating (freely floating and managed floating) is that, under the former, there is a target zone (or band) near the boundaries of which the authorities are normally expected to intervene whereas, under the latter, there is neither an explicit nor an implicit target zone (Bordo, 2004).

The key distinctive characteristic of a regime is the extent to which it constrains domestic monetary policy. Under free floating, the exchange rate does not constrain monetary policy, whereas, under a soft peg, the authorities adopt a particular exchange-rate target and use monetary policy to prevent the foreign-exchange market's straying too far from the target. Operational meaning is given to the phrase "too far" by the announcement of a target rate and the width of a band around it

(Kenen, 2001, p. 75). By design, currency boards have no discretionary monetary powers and cannot extend credit. The quantity of domestic currency in circulation is determined solely by market forces (Hanke, 2002, p. 88). In the case of monetary unions, the use of the standard instruments of monetary policy is consigned to the community and exercised solely by its monetary authority, leaving no room for the exercise of monetary policy by the individual member economies (Robson, 1998).

3. Alternative classifications

3.1. Classification approaches

Ideally, an exchange rate system classification ought to be based on the degree to which a system in a particular category constraints the independent conduct of domestic monetary policy. Unfortunately, this goal has so far proved elusive. The *de jure* classification, compiled and published until 1999 by the IMF, distinguished among three broad exchange-rate-regime categories - - pegged regimes (hard pegs, conventional pegs, horizontal bands), intermediate regimes (crawling pegs, crawling bands, target zones), and floating arrangements (free floats, managed floats).[6] Several advantages were attributed to the *de jure* classification. It was considered to be comprehensive in terms of (i) the coverage of economies, (ii) observations over time (extending back to 1970), and (iii) frequency of updating (Bubula and Ötker-Robe, 2002). Additionally, to the extent that intentions could be viewed as a good indicator of future actions, it was said to convey information about future policy actions, thereby influencing expectations and outcomes (Ghosh, Gulde and Wolf, 2002 p. 42).

As noted, however, Calvo and Reinhart (2002) found that, in practice, many exchange-rate regimes deviated substantially from their *de jure* codings.[7] For example, the currencies of some economies, the regimes of which were officially reported as pegs, often underwent frequent devaluations as the exchange rate was used as a tool to try to maintain or to enhance competitiveness; thus, the regime resembled a flexible one more than a pegged one. Conversely, the currencies of other economies, the regimes of which were officially classified as flexible under the *de jure*

[6] Based on footnotes provided in the IMF's *Exchange Arrangements and Exchange Restrictions*, these three classifications could, in turn, be divided into as many as 15 subcategories.
[7] See, also, Ghosh, Gulde, Ostry, and Wolf (1997) and Frankel (1999) for earlier formulations of this view.

classification, exhibited what Calvo and Reinhart (2002) called a "fear of floating", relying on interest-rate adjustments and changes in reserves to limit movements in the exchange rate.

De facto regime classifications attempt to rectify the deficiencies of the *de jure* coding. The primary aim of these undertakings has been to compare the performance of regimes and to shed light on the validity of the hypothesis of the vanishing-middle regime. Studies in this genre tend to share several common features. (1) Regimes are arranged according to both coarse (*e.g.,* three, five) and fine (*e.g.,* 15) categories. (2) Performance under alternative regimes is measured using both unconditional means (and/or medians) and conditional means (based on multiple-regression estimation). (3) Results are reported for the aggregate of all economies considered and for subgroups of economies (*i.e.,* industrial, emerging markets, developing). As discussed below, to classify regimes a number of judgmental decisions need to be taken (*e.g.,* the choice of reference currency against which the degree of exchange-rate flexibility is assessed, whether to incorporate changes in reserves and/or interest rates in the classification algorithm). Studies differ in terms of the methodologies used to classify regimes, with most studies relying (to differing extents) on the IMF *de jure* classification, so that the resulting coding is, in fact, a mixed *de jure-de facto* classification. Studies also differ in terms of sample periods, data frequency, definitions of regimes (for both coarse and fine categories), definitions of subcategories used to analyse economies (*e.g.,* industrial, advanced), and conditioning variables, so that the results are not strictly comparable. Interpretation is made more difficult because some authors report large numbers of regressions, differentiated by, among other things, the choice of conditioning variables, with sometimes conflicting results both across regressions and studies.

In what follows, the construction of thirteen mixed and pure *de facto* categories is considered, and the main thrust of the empirical results is presented and analyzed. To help identify the main dividing lines running through the literature, the classification schemes are grouped into two broad methodological approaches: (1) mixed *de jure-de facto* codings based on revisions to, and/or corrections of, the IMF *de jure* classification (eight schemes); and (2) pure *de facto* codings (five schemes). Although the schemes in the first category rely on the IMF *de jure* coding, they do so

in different ways, and there is a wide range of differences across the codings. The codings in the second category are independent of the *de jure* coding.

1. *Mixed de jure-de facto approaches*. The codings in this group can be viewed as "mixed" classifications because the self-declared regimes are adjusted by the divisers for anomalies (*e.g.*, floating rates that display no exchange-rate volatility) on the basis of such factors as judgment, statistical algorithms, and developments in parallel (black) markets. An initial attempt to construct a *de facto* classification was made by Ghosh, Gulde, Ostry and Wolf (GGOW). Employing the sample period 1960-90 [8] for 136 countries, these authors (1997) rearranged the *de jure* pegged grouping into two (*de facto*) subgroups - - "infrequent" and "frequent" pegged adjusters - - based on whether an economy changed the value of the declared peg within a particular year. They placed *de jure* intermediate and floating regimes in a single (*de jure*) group. Frieden, Ghezzi and Stein (2001) also modified the *de jure* coding, doing so for a group of 26 Latin American and Caribbean countries. Using information provided in the IMF's *Exchange Arrangements and Exchange Restrictions*, they reclassified regimes into four course groupings that distinguished among regimes in terms of their abilities to provide credibility and competitiveness.[9]

In studies by the IMF (1999; 2003) and Bubula and Ötker-Robe (2002), 190 self-described (by the national authorities) regimes, covering the (monthly) period 1990-2001, were amended by IMF economists based on their assessments of movements in reserves and official exchange rates or, in cases where there are multiple rates, secondary-market exchange rates. To illustrate the judgment involved, when the *de jure* regime was a peg, but the currency underwent frequent devaluations within "very short periods of time" (within several months), the regime was reclassified as a managed float, while evidence of intervention aimed at countering the long-trend in the exchange rate was used to draw the line between "managed floating" and "independently floating" regimes. From 1999, this *de facto* coding replaced the IMF *de jure* coding in IMF publications. The information is available at a monthly frequency beginning in 1990.

[8] The authors extended the IMF's *de jure* classification backward to 1960 (from 1970).
[9] The purpose of the study by Frieden, Ghezzi and Stein (2001) was to investigate the *determinants* of alternative regimes, as opposed to assessing their performance. We refer to their results in Section 3.2.

The remaining studies in the mixed *de jure-de facto* group supplement the judgment of researchers with statistical algorithms. Bailliu, Lafrance and Perrault (BLP, 2003) and Ghosh, Gulde and Wolf (GGW, 2002) modified the *de jure* coding based on observed exchange-rate volatility. BLP developed a two-step approach to classify 60 regimes over the period 1973-98. The first step involved the classification of regimes as pegged if they were so-classified under the *de jure* coding although some regimes not classified as pegs under the *de jure* coding were classified as pegs by BLP if the volatility of their exchange rates (against the US dollar) was less than a specified amount. The remaining regimes were placed into either the intermediate or flexible categories on the basis of an index of exchange-rate volatility. To control for the impact of the use of a domestic nominal anchor (*e.g.*, inflation targeting, monetary targeting) under floating and intermediate regimes, the authors used a dummy variable to capture potential effects of the nominal anchor arrangement on GDP growth.[10] GGW created a *de facto* measure for 150 countries covering the period 1970-99 using what they called a "z-score", based on changes of the nominal exchange rate and the variance of those changes.[11] The *de facto* measure was converted into a discrete three-way classification (pegged, intermediate, floating) by using the relative frequency distribution of the *de jure* classification. The intersections of the *de facto* and the *de jure* codings (65 per cent of all observations) formed a "consensus" classification while the remaining observations were discarded.

Reinhart and Rogoff (RR, 2003, 2004) performed a radical revision of the *de jure* coding. The construction of what the authors called a "natural" classification for 153 countries over the period 1946-2001 included the following elements. (1) Using five-year intervals to assess the degree of flexibility of the longer-term regime, they defined a "freely-falling" regime category if (i) the 12-month rate of inflation exceeded forty per cent[12], or (ii) the six months following an exchange-rate crisis were accompanied by a transition from a fixed or quasi-fixed regime to a managed or independently floating regime. (2) They gave separate treatment to countries with either official dual or multiple rates or active parallel (black) markets. (3) In cases

[10] To control for the effects of the business cycle, variables were measured as five-year averages. In cases where a classification changed during the five-year period, the regime was classified as the one that prevailed during most of the period.

[11] The "z-score" was defined as the square root of the sum of (1) the square of changes in the exchange rate and (2) the variance of those changes.

[12] If the 12-month rate of inflation exceeded forty per cent, but the market rate followed a confirmed, preannounced crawl, the preannounced regime took precedence.

where an announced peg was to an undisclosed basket of currencies, they conducted tests to examine whether the peg was, in fact, against a single dominant currency. (4) They computed probabilities that the monthly change in the exchange rate remained within a ±1 per cent band over a rolling five-year period. If the probability was eighty per cent or higher that the change remained within this band, they classified the regime as a *de facto* peg or *de facto* crawling peg over the entire period.[13] (5) The approach regarding *de facto* bands (as well as preannounced bands) followed a similar procedure as in step (4). (6) Regimes that were not classified under steps (1)-(5) became candidates for managed and freely-floating arrangements. To distinguish between the two, the degree of exchange-rate flexibility was gauged using statistical tests. For many economies the RR classification extends back to 1946. It consists of five categories: peg, limited flexibility, managed flexibility, freely floating, and freely falling. In terms of these five categories, Reinhart and Rogoff (2004) found that, over the period 1970-99, only about half the observations - - where each observation corresponded to a given economy's regime in a particular year - - were classified in the same category by both the natural and the *de jure* classifications.

An alternative statistical procedure that has been employed in the mixed classiciation approach is probit analysis. Studies by Eichengreen and Leblang (EL, 2003) and Dubas, Lee and Mark (DLM, 2005) used probit-type models in which the dependent variable was the *de jure* regime. The fitted values were used as the *de facto* regime, imposing the assumption the *de facto* regimes reflect transitory deviations from the self-described regimes. Under the EL scheme, the regimes were modelled as a vector of economic and political variables and period fixed effects. Annual frequencies for a sample of 21 middle-income and high-income countries (covering the period 1870-1997) were converted into five-year frequencies to derive the *de facto* coding for pegged and flexible regimes used in growth equations. DLM modelled the exchange-rate regime as:

$$R^{*}_{ijt} = x'_{it}\beta_{j} + \varepsilon_{ijt}$$

where R^{*}_{ijt} is the *de jure* regime, x'_{it} is a vector of country characteristics, ε_{ijt} is an error term, i corresponds to country i, t=time, and j = the exchange-rate regime.

[13] The authors distinguished between pegs and crawling pegs by the existence (or lack thereof) in drift in exchange-rate changes.

The country characteristics used were the volatilities of the exchange rate and reserves. The probabilities of being in each regime generated by the multinomial logit model were used to construct six fine and three coarse regime codings for 172 countries over the period 1971-2002.

2. *Pure de facto approaches*. Codings in this group are independent of the official classification. The authors of two studies in this group aim to capture the effect of intervention on the exchange rate. (i) Levy-Yeyati and Sturzenegger (LYS, 2005) used cluster analysis[14] to construct a three-way classification of pegs, intermediate regimes, and floats for 183 countries; under cluster analysis, once the number of classifications is determined *ex ante* by the researcher, economies are placed into groups according to similarity of behaviour. Using the sample period, 1974-2000, LYS analysed the behaviour of three variables, changes in the nominal exchange rate, the volatility of these changes, and the volatility of the ratio of net-reserves-to-the monetary base.[15] For base currency, LYS used either the legal peg (for fixed-rate regimes) or the currency against which the exchange-rate exhibited lowest volatility. (ii) A similar approach was used by Poirson (2001), who constructed a rigidity index on the basis of the ratio of exchange-volatility to reserves for a sample of 93 countries during 1990-98.[16]

Other authors that constructed entirely *de facto* regimes are Shambaugh (2004), De Grauwe and Schnabl (DGS, 2005) and Bénassy-Quéré and Coeuré (BQC, 2006). Shambaugh divided regimes into pegs and non-pegs based on whether exchange-rate changes were within pre-specified bands. DGS calculated "z-scores" for a (limited) sample of 18 South Eastern European and Central European economies over the period 1994-2004, using both the euro and the US dollar as reference currencies. Two course classifications were constructed: (1) a two-way coding of "relatively-fixed" rates and "relatively-flexible" rates and (2) a three-way coding consisting of hard pegs, intermediate regimes, and floating regimes. BQC used

[14] Cluster analysis is a technique that identifies groups of observations whereby groups are constructed according to similarities among sample elements.
[15] Although the final version of their paper describing their classification was not published until 2005, an initial version of their paper appeared in 1999. Thus, their coding was available to, and used by, other researchers prior to 2005. LYS (2007) updated their dataset to cover the period 1974-2004, and examined the relationship between exchange rate depreciations and growth and productivity in developing countries.
[16] Poirson did not use her classification to examine the effects of exchange-rate regimes on economic performance.

regression analysis to estimate implicit basket pegs as linear combinations of bilateral exchange-rate variations against the U.S. dollar, the yen, and the euro. Their dataset included 165 countries and covered the period 1994-2001. Regimes were classified as pegged when at least one of the basket coefficients was different from zero. All other regimes were classified as floating regimes.[17]

3.2 Assessing the Classifications

With the development of alternative regime codings a literature that uses the classifications to investigate issues other than macroeconomic performance and the evolution of regimes is rapidly emerging. One research area that has received considerable attention concerns the determinants of the choice of exchange-rate regime.[18] Examples in this genre include the following. (1) Frieden, Ghezzi and Stein (2001) applied their four-way coding to a group of 26 Latin American and Caribbean economies. They found that the authorities of economies with governments that had strong support in the legislature tended to choose pegged regimes while the authorities of economies with an important manufacturing sector tended to choose either floating or backward-looking crawling pegs. The authors attributed the latter finding to the authorities' view that non-flexible regimes delivered more-competitive exchange rates than did pegged regimes. (2) Poirson (2001) used her three-way coding and the *de jure* coding to determine exchange-rate regime choice for a group of 93 countries. She found economic and political factors influenced the three regimes differently and that there were significant discrepancies between the determinants of her three codings and those of the three-way *de jure* coding. (3) von Hagen and Zhou (2005a, 2005b) studied a group of transition economies over the period 1990-97. Using both the *de jure* and the LYS codings,[19] the authors (2005a) found that official regimes were more persistent and changed less frequently (but in larger steps) than *de facto* regimes, a finding consistent with the view that the cost of changing *de jure* regimes exceeded the costs of changing *de facto* regimes. Additionally, applying an eight-way variation

[17] Neither Shambaugh (2004) nor BQC used their respective classifications to examine the relationship between exchange-rate regimes and economic performance, so we refer to their results here. Shambaugh dealt with the issue of monetary autonomy in pegged and non-pegged regimes, finding that pegged-rate countries ceded much of their monetary-policy autonomy to the base country; interest rates in non-pegged countries were correlated with those in the base country to some extent, but not as much as rates in pegged regimes. BQC investigated whether the 1997-98 Asian crisis reduced the percentage of intermediate regimes; the authors found a switch from intermediate regimes to hard pegs.

[18] For an overview of recent studies, see von Hagen and Zhou (2007).

[19] Von Hagen and Zhou (2005a) extended the LYS coding to 25 transition economies, from the 20 such economies classified by LYS.

of the *de jure* coding, the authors (2005b) found that many of the factors identified in the optimum-currency-area literature, including the geographic concentration of trade, product diversification, and openness, were important regime determinants. (4) In a further study, von Hagen and Zhou (2007) used both the (three-way) IMF *de jure* and IMF *de facto* codings to investigate the determinants of regime choice for over 100 developing economies. The authors found that, in addition to optimum-currency-area fundamentals, stabilisation strategies, currency-crises risks, and political and institutional variables were determinants of exchange-rate regimes. These findings highlight the importance of accounting for simultaneity in the assessment of the macroeconomic properties of alternative exchange rate systems.

Other recent examples of the use of the codings include studies by Masson (2001), who used both the GGOW coding and the LYS coding to investigate whether a change in the frequency of transitions between regimes has taken place over time; Frankel, Schmukler and Serven (2004), who used the *de jure* and LYS codings to assess the way that the exchange-rate regime affects monetary-policy autonomy; Alesina and Wagner (2006), who used the IMF *de facto* and RR classifications to explore the relationship between institutions and commitments to exchange-rate regimes; Bubula and Ötker-Robe (2003), who used their coding to study whether pegged regimes are more crisis-prone than other regimes and whether certain types of pegged regimes are more crisis-prone than others; Razin and Rubinstein (2006), who used the *de jure* and the RR codings to investigate the relationship among the probability of a crisis, balance-of-payment policy, and growth; Levy Yeyati (2006), who used the GGW and LYS classifications to estimate the correlation between the exchange-rate regime and financial dollarisation in developing economies, and Genberg and Swoboda (2004), who used the *de jure* and the RR codings to examine the information content about policies provided by those two codings. In the light of the emerging literature using these codings, the question arises, "How reliable are those classifications for analyzing characteristics of exchange-rate regimes?" We now turn to an appraisal, focusing on the IMF *de facto*, Bailliu, Lafrance and Perrault (BLP), Dubas, Lee and Mark, (DLM), Eichengreen and Leblang (EL), Ghosh, Gulde

and Wolf (GGW), Levy-Yeyati and Sturzenegger (LYS), and Reinhart and Rogoff (RR) codings.[20]

3.3 Data issues

With the exception of the EL coding, which used a bivariate probit model to regress the *de jure* regime on a large number of political and economic variables (but not measures of exchange-rate movements or reserves), all coding is based on assessments of exchange-rate movements and, in a few cases, on changes in reserves. Devisers of coding schemes confront the following data problems.

(1) Apart from the problem of choosing a relevant base currency, devisers of coding schemes confront the problem that identical shocks may affect two economies very differently even if the authorities of both employ the same exchange-rate system (Ghosh, Gulde and Wolf, 2002, pp. 42-43). Consider the case of two floating-exchange-rate systems confronted with an identical external shock; economy A is small, relatively-open, and has a narrow export base while economy B is large, relatively-closed and has a highly-diversified export sector. The external shock may lead to large exchange-rate changes during a particular period in economy A while the currency of economy B exhibits small changes in its exchange rate. In this situation, economy A may correctly be classified as floating while economy B may incorrectly be assigned to an intermediate category or even the fixed category (Ghosh, Gulde and Wolf, 2002).

(2) The BLP, DLM, GGW, LYS and RR algorithms use measures of exchange-rate variances to capture exchange-rate behavior. A high sample volatility could, however, be attributable to a one-time large devaluation in a pegged regime. Codings that use short frequencies (annual) may be particularly susceptible to this problem of classification. Rogoff and Reinhart (2004) dealt with this issue by using (i) a five-year window to classify regimes and (ii) mean absolute deviations as a measure of exchange-rate behavior to minimize the impact of outliers. Those devisers (*e.g.,* BLP, GGW, RR), who rely exclusively on exchange-rate behavior, essentially correlate growth, inflation and growth volatility with regime indeces that are non-

[20] As will become apparent below, we focus on those classifications for which codings for a common set of countries are available over an overlapping time period (*i.e.,* the period 1990-97).

linear transformations of exchange-rate changes.[21] If the regime can be characterized solely on the basis of exchange-rate behavior, the following question arises: why not use the exchange rate, instead of a transformation of the exchange rate, as the control variable? Devisers of codings based solely on exchange-rate movements have not addressed this issue.

(3) A few codings (DLM, IMF *de* facto, LYS) use information on reserves. Clearly, changes in reserves can be a key indicator of foreign-exchange-market intervention. Nevertheless, data on reserves can be highly unreliable. As Bubula and Ötker-Robe (2002, pp. 10-11) pointed-out, these data can be distorted by valuation changes and by official borrowings or repayments. Moreover, official data, even if they are not distorted by those factors, make no allowance for the fact that intervention by the authorities of other countries may negate the need of intervention by the country concerned. In some economies, foreign-exchange intervention is conducted through purchases and sales of domestic foreign-currency-linked debt. In other economies, intervention is carried-out in the forward market. In cases where the intervention is conducted through debt denominated in local currency but indexed to foreign currency and/or is conducted in the forward market, the extent of the intervention may not be reflected in official-reserve data (Rogoff *et al.* 2004, p. 27).

(4) Movements in interest rates (as well as other, less-conventional types of intervention) are the dog-that-didn't-bark variable of *de facto* codings based on statistical algorithms. The primary reason that algorithms leave out the interest rate is the unavailability of official interest-rate series for many economies over long-time periods. Clearly, to the extent that the interest-rate instrument is used to influence the exchange-rate, codings that omit this instrument are subject to measurement error in the construction of variables purporting to represent alternative exchange-rate-regimes.

(5) The IMF *de facto* and the RR codings use information in parallel exchange markets. To the extent that exchange rates in such markets are determined by supply and demand factors alone, there is no buyer- or seller-of-last-resort to keep the exchange rate fixed. It is difficult to support the contention that a pegged regime is a feasible option in such a situation.

[21] The RR "free-falling" category, however, is based on inflation. The GGOW, DGS and Shambaugh codings also rely exclusively on measures of exchange-rate changes.

Role of monetary policy. As noted in Section 2, the key distinctive characteristic of a regime is the extent to which it constrains domestic monetary policy. This situation presents the following definitional problems. (1) Consider an economy the currency of which is pegged to an anchor currency, but which has followed a monetary policy inconsistent with that of the monetary authorities governing the anchor currency, resulting in an exchange-rate devaluation in a particular year. How should the regime of the devalued currency be classified in the year during which the devaluation took place? An example is that of the 13 CFA franc zone countries, which had a one-time devaluation against the French franc in 1994 - - the only realignment since the establishment of the CFA zone in 1948.[22] Most devisers classified the regimes of the CFA zone countries as pegged in 1994. Levy-Yeyati and Sturzenegger (2005), however, classified those regimes as intermediate; the latter classification is consistent with the (plausible) view that it was inconsistent monetary policies that led (at least in part) to the 1994 devaluation of the CFA currencies. (2) A distinction should be drawn between those monetary unions, the currencies of which are allowed to float - - *e.g.,* the euro area - - and those monetary unions that peg their currencies to another currency - - *e.g.,* the CFA franc zone. In the case of the former, the monetary policy of the union is not constrained by the exchange rate whereas, in the case of the latter, the monetary policy of the union (and not just that of a particular country) is constrained.

Role of judgment. The IMF *de facto* and the RR codings involve substantial amounts of judgment - - *e.g.,* whether to use the parallel-market rate or the official rate. This situation presents the following problems. A situation such as that of the RR coding, under which a few devisers are responsible for tracking regimes for 153 economies over a sample period that begins in 1946, can lead to errors and inconsistencies. An example of the former is RR's coding of Greece. RR date the entry of Greece into EMU as January 1, 1999; in fact, the entry date was January 1, 2001. An example of the latter is given below in the discussion of RR's coding of Italy. In contrast to the foregoing situation, the IMF *de facto* coding involves the judgment of (literally) hundreds of Fund economists. While the monitoring of developments by a large group of economists can help guard against

[22] The French currency reform of 1968 introduced a new French franc at a rate of one new franc per 100 old francs. Although the new French franc involved a revaluation of the CFA franc, the value of the latter was left unchanged against the old French franc.

misclassifications, it can lead to heterogeneously-generated classifications - - one group of country-desk economists may judge evidence of intervention by the authorities of country A as excessive (so that the regime is classified as "managed floating"), whereas another group may judge the same amount of intervention by the authorities of country B as not excessive (so that the regime is classified as "independently floating").

Missing observations. Many algorithms result in missing observations, the number of which can be substantial. Consider the following examples. (i) The GGW coding retains only those observations for which the *de facto* and the *de jure* classifications are identical. This procedure reduced the sample by about 35 per cent during the 1970-99 period. (ii) The LYS coding discards regimes pegged to an undisclosed basket. This situation, combined with missing data on reserves and/or exchange rates, caused about 33 per cent of the observations in their sample to be unclassifiable. (iii) As noted, the RR coding relies on evidence suggesting the presence of a significant parallel market. About 30 per cent of *de facto* free floats were not classified under the RR coding because, although evidence indicated that such a market existed, the parallel exchange-rate data were not available. We provide specific country examples below.

Coding methodologies. The way currency regimes are analyzed and classified can affect the results obtained. To illustrate, in what follows, we present correlations among three coarse regimes - - hard pegs, intermediates and floats - - for six *de facto* classifications: those of the IMF, BLP, DLM, GGW, LYS, and RR. With the exception of the RR classification, devisers of codings provide three-way regime arrangements.[23] For the RR classification, we dropped the freely-falling category, unique to RR, from consideration. Using their fine 15-way coding, we put the categories "no separate legal tender" and "preannounced peg or currency board arrangement" into a single hard-peg category. We also put RR's "managed floating" and "freely floating" regimes into a single floating category. RR classified the remaining regimes for which they provided codings as intermediates. Because the IMF *de facto* scheme is available only from 1990, the sample covers the period 1990-

[23] The EL classification was not used because it separates regimes into only two coarse categories. The IMF *de jure* coding was not used because it coincides with the GGW classification for those regimes classified by GGW.

99.[24] Using annual data, a total of 190 countries, *i.e.,* all the members of the IMF, were considered. For each correlation, two panels were considered: (1) a balanced panel, so that if an observation was missing, or not classified, in one classification, it was dropped from the other, and (2) and unbalanced panel that put unclassified regimes into a separate category.

The correlations are presented in Table 1. Panel A shows correlations using the balanced panel. The highest correlation, at 0.83, is between those of the IMF *de facto* and the GGW classifications. The correlations between the RR classification and the IMF *de facto* and the GGW codings are 0.75 and 0.72, respectively. The extent of correlation between the IMF *de facto* and the GGW codings probably reflects the fact that both are modifications of the *de jure* classification. All other correlations are very low (*i.e.,* below 0.5). Panel B reports correlations using missing values as a separate category. The highest correlation, at 0.79, is again between those of the IMF and the GGW codings. All other correlations are below 0.55.

3.4. Two specific examples

We next consider the specific cases of two advanced economies - - Germany and Italy during the period 1990-2001, comparing the regime classifications of these economies among the IMF *de jure*, the IMF *de facto*, BLP, DLM, EL, GGW, LYS and RR, codings. Again, we focus on this particular period because the IMF *de facto* coding is available only beginning in 1990.[25] We choose these particular economies mainly because (1) as advanced economies, information about their exchange-rate policies is likely to be more-readily available than it is for some developing economies (therefore, it should be easier to classify their regimes than those of developing economies), (2) during the 1990s each participated to varying degrees in the European Monetary System's (EMS's) exchange-rate mechanism (ERM), and (3) at the end of the decade these economies became members of the euro area.[26]

Several points are worth mentioning. First, the diversity of classifications is considerable. The case of Germany illustrates. The *de jure* and IMF *de facto* codings classify the regime in the intermediate category for each of the years, 1990-98. The

[24] As noted, the BLP coding ends in 1997.
[25] The IMF *de jure* coding is available only through 1999. In cases where regime codings were available for the years 2000-01, we use these years as well.
[26] The founding members of the EMS were Belgium, Denmark, France, Germany, Italy, Ireland, Luxembourg, and the Netherlands.

BLP coding does not classify the regime in any year although the devisers of that coding do not explain this circumstance. The EL coding classifies the regime as a peg for each of the years, 1990-97. The GGW coding places the regime alternatively in the intermediate (for two years) and not-classified (for seven years) categories in 1990-98. The LYS and RR schemes classify the regime as a float throughout the period 1990-98. The DLM coding places the regime either in the floating (for two years) or intermediate (for 12 years) during the period 1990-2001. Second, algorithms sometimes do not pick up any regimes. The BLP scheme does not classify Germany in any year during the entire sample period, 1973-98, while the GGW scheme does not classify Germany during 1990-95 and in 1998. The GGW scheme does not classify Italy during 1990-91 and in 1994. Third, in the case of the GGW classification, missing observations may reflect the omission of those regimes that are difficult to classify from the data sample. This inference follows from the way that the GGW "consensus" classification was constructed - - *i.e.,* as the intersection of a first-step *de facto* coding based on z-scores and the *de jure* coding, with the aim of excluding outliers - - *i.e.,* those *de jure* regimes that did not conform to policy announcements. Fourth, the RR freely-falling regime, while primarily aimed at isolating economies undergoing very-high inflation rates, can produce odd results.[27] As mentioned in Section 3.1, two criteria were used to place regimes in the freely-falling category: (i) a 12-month rate of inflation exceeding 40 per cent, or (ii) a transition from a fixed or quasi-fixed regime to a managed or independently floating regime during the six months following an exchange-rate crisis. This definition led RR to code Italy's regime as freely-falling over the period September 1992-March 1993.[28] The RR scheme assigns the same coding to some of the Asian currency regimes in the aftermath of Asian crisis of 1997-98, including those of South Korea and Thailand. The assignment of such regimes to the same category as the regimes of

[27] In a study of the growth effects of exchange-rate regimes, Harms and Kretschmann (2007) found that differences between the LYS and RR codings reflected differences in which high-inflation episodes were classified; because such episodes are typically associated with the collapse of a peg and accompanied by substantial foreign-exchange intervention, LYS group them as fixers, whereas RR leave most of them in the freely-falling category. Harms and Kretschmann (2007) found that exclusion of RR's free-falling countries from the LYS classification brought the results of the two codings more in line. A similar conclusion was reached by Aghion *et al*. (2006).

[28] In September 1992, some ERM currencies came under speculative attack, and the Italian authorities took the lira out of the ERM.

economies that underwent episodes of hyperinflation seems to provide a biased sample with which to compare performance of regimes.[29]

3.5 German problems

The case of Germany illustrates two basic problems that researchers face in attempting to classify exchange-rate regimes. The first problem concerns the deutsche mark's role as an anchor currency in the ERM during the 1980s and for most of the 1990s. Within the ERM, the mark operated in a fashion similar to that of the U.S. dollar under Bretton Woods. Also, as was the case with the dollar under Bretton Woods, German monetary policy was, to a sifnificant extent, independent in the 1990s, with the monetary authorities of the other EMS countries tying their policies to those of the Bundesbank. In contrast to the case of the dollar in the Bretton Woods system, however, during the 1990s the mark floated against other key currencies. Therefore, if a particular coding scheme uses the French franc, for example, as the relevant base currency for gauging the degree of exchange-rate volatility in Germany, it is probable that Germany's exchange-rate regime will be classified as a peg or an intermediate regime. Many devisers of coding schemes rely (somewhat mechanically) on the degree of exchange-rate volatility against a particular base currency (or currencies) to determine regime classifications. Yet, as we have stressed, the key distinctive characteristic of a regime is the extent to which it constrains monetary policy. Using the monetary-policy-independence criterion, Germany's regime would probably be classified as a float during 1990s, as under the LYS and RR codings.[30] Second, coding systems may not pick-up all regime transitions. German reunification involved a monetary union between two large (in terms of population), formerly-separate currency areas.[31] While the economy of the former East Germany was relatively small, reunification imposed a long-lasting fiscal burden on the former West Germany; reunification is widely considered to have been a contributing factor to

[29] Indeed, the RR freely-falling category was devised to avoid problems resulting from putting together floating regimes with those associated with episodes of hyperinflation. Thus, Rogoff and Reinhart (2004, p. 16), argued: "In our view, regimes associated with an utter lack of monetary control and the attendant very high inflation should not be automatically lumped under the same exchange rate arrangement as low inflation floating regimes. On these grounds, freely falling needs to be treated as a separate category…" It is also worth pointing out that, unlike the case of Italy, the United Kingdom's regime is not classified under the RR system as freely-falling as of September 1992, although sterling left the ERM under similar circumstances to those of the lira in that same month.

[30] On the problems that arise with anchor currencies of regional pegs, within the context of the mark's role in the EMS, see von Hagen (1989).

[31] In 1990, the population of the former West Germany was about 60 million and that of the former East Germany was about 17 million.

relatively weak economic growth in (the unified) Germany for 15 years. Yet, this monetary union, the most significant in the 1990s prior to EMU, is not taken into account in any of the coding schemes.

4. Regime performance

4.1. Analytical considerations and earlier literature

In models without nominal rigidities, the exchange rate system does not matter for real variables (except for real money balances). This consequence is the direct result of the neutrality or super-neutrality properties of such models, even in the short run (Stockman, 1999, p. 1485). The situation is very different in the presence of nominal frictions (price and/or wage rigidities). In general, nominal frictions introduce a non-equivalence across different monetary regimes. Alternative exchange rate systems have different shock absorbing properties and are thus associated with differences in macroeconomic volatility and relative prices. In models in which certainty equivalence does not hold, alternative systems may even be associated with differences in the long term allocation of resources.

The earlier (*i.e.,* pre-late 1990s) empirical literature on the performance of alternative exchange-rate systems focused mainly on comparing unconditional variances of nominal and real exchange rates under the Bretton-Woods system and the successor (beginning in 1973) system of managed-floating exchange rates. Stockman (1983) and Mussa (1986), for example, found that the post-1973 period was characterized by increases in the volatility of real exchange rates compared with that of the Bretton-Woods era. These findings were corroborated in studies by Baxter and Stockman (1989) and Flood and Rose (1995). The latter two studies also examined the volatilities of other macroeconomic variables under the respective regimes. Apart from the greater variability of real exchange rates under the managed floating regime, Baxter and Stockman found little evidence of systematic differences in the behavior of macroeconomic aggregates (consumption and industrial production) under the two regimes. A similar result was obtained by Flood and Rose, who found that the unconditional volatilities of such macroeconomic variables as industrial production, money, consumer prices, and interest rates did not change very much across the two regimes. Additionally, in their study, Baxter and Stockman (1989) presaged the

subsequent literature in that they also used the IMF *de jure* classification to assess the performance of three exchange-rate regimes - - pegged, intermediate, and flexible - - in the post-Bretton Woods period. Extending the list of macroeconomic variables to include trade flows, the authors again found that the behavior (*i.e.,* volatilities, correlations) of real aggregates did not appear to change in any systematic way as a result of the exchange-rate system while changes in real-exchange-rate variability and real trade variability appeared to be independent of each other.

The finding emerging from the earlier empirical literature that the volatility of many key macroeconomic variables is invariant to the exchange-rate system while that of the key relative price --the real exchange rate—is not, creates a major conundrum. Recall that the neoclassical model with flexible prices implies the absence of an effect on any real variable. Therefore, it is consistent with the finding that the volatility of most macroeconomic variables is independent of the exchange rate regime in place, but inconsistent with the finding that the volatility of the real exchange rate is not. Models with nominal rigidities, on the other hand, can account for the latter result, but are inconsistent with the former finding. These inconsistencies between the empirical evidence and the implications of the main theories of exchange rates strongly suggest that the classification of exchange rate regimes used in this literature is problematic. Consequently, even before the empirical evidence can be utilized by the authorities to select among alternative exchange-rate regimes - - and Stockman (1999, p. 1492) commented that, while empirical evidence may eventually help, "we remain a long way from having that evidence now"- - progress must first be achieved at the classification front. A considerable amount of research has been devoted to this issue during the last few years.

4.2 Empirical methodology

Several key differences distinguish the empirical methodology followed by authors of the recent literature from the general approach adopted in the pre-late 1990s literature. First, whereas the earlier literature was based solely on the *de jure* coding, the recent literature investigates the possible relationship between macroeconomic aggregates and exchange-rate regimes using the *de facto* codings described above, sometimes in conjunction with results based on the *de jure* coding. Second, earlier studies mainly compared differences in time-series properties between the Bretton-Woods pegged-but-adjustable exchange-rate system and the subsequent

managed-floating exchange-rate system while recent studies assess performance of the variety of systems that have sprung up in the post-Bretton Woods era.[32] Third, whereas authors of earlier studies focused exclusively on comparisons of unconditional moments of macroeconomic variables to assess differences in behaviour, authors of subsequent studies have also reported conditional first and second moments of per-capita growth and inflation derived from panel-data regression analysis.

Real per-capita growth. A general formulation, which captures the framework used in the exchange-rate regime literature to determine conditional behaviour, specifies a country's per-capita growth rate at time, t, as a function of vectors of control variable and initial values of state variables (Barro and Sala-i-Martin, 2004, pp. 511-520).

$$y_{it} = \alpha_i + \gamma_t + R_{itk} + V_{it}\beta + X_{it}\delta + \varepsilon_{it} \qquad (1)$$

where y_{it} is the growth rate of real per-capita GDP[33] in country i in period t, α_i are country-specific (fixed or random) effects, γ_t are time dummies (as opposed to a time trend)[34], V_{it} is a vector of state variables measured at the beginning of period t, X_{it} is a vector of control variables measured as averages over period t, and ε_{it} is an error term. Most authors use annual data, but some use five-year frequencies on the supposition that the latter help eliminate business-cycle effects. The country-specific (fixed or random) effects, α_i, control for unobserved differences among countries while the time dummies γ_t, are intended to capture the effects of global shocks common to all countries considered. Exchange-rate regime effects are investigated by augmenting equation (1) with a vector of variables, R_{itk}, that aim to capture the regime, k for country i at period t. The exchange-rate regime can be represented either through a regime-specific dummy if a statistical algorithm is used or via the probability of having a particular regime if a logit or probit model is used.

[32] As noted, however, Baxter and Stockman (1989) also investigated differences among three alternative *de jure* systems in the post-Bretton Woods period. Also, Eichengreen and Leblang (2003) compared the performance of regimes over the period 1880-1997.

[33] Most authors use the log of per-capita GDP growth.

[34] A time dummy is common across the panel. If the panel includes, for example, observations at 25 different times, it includes 24 separate time dummies.

To deal with potential simultaneity effects - - *e.g.,* the possibility that a country with a history of relatively-low inflation may be more apt than a country with a history of relatively-high inflation to adopt pegged rates - - most authors report results based on some form of instrumental-variable estimation (*e.g.,* Two-Stage Least Squares, 2SLS, dynamic Generalised Method-of-Moments, GMM). The "estimated" second-stage exchange-rate regimes, even for *de facto* codings generated from a statistical algorithm, are typically the probabilities derived from a logit or probit model. The basic binomial or multinomial logit model takes the following form. Let Y_{it} be a discreet choice variable indicating if country i at time t is in regime 1,2,..n. Then, the general multinomial regression is of the form

$$Y_{it} = \beta_t X_{it} + e_{it} \tag{2}$$

The probability of being in regime k at time t for country i is then given by

$$P_{itk} = \Pr[Y_{it} = K] = \frac{\exp(\beta_i X_{it})}{\sum_{j=1}^{n} \exp(\beta_j X_{it})} \tag{3}$$

P_{itk} then become a set of variables which measure the probability of being in each regime at each point in time for each country. These variables may then be entered into a GMM or 2SLS regression.

In selecting the relevant control variables in equation (1), authors seek guidance from the empirical growth literature. In doing so, authors confront the following problems, which though typically overlooked, nevertheless need to be mentioned. First, because there does not appear to be a consensus theoretical framework on growth to guide empirical work in the area, a diverse and sometimes unwieldy empirical growth literature has been produced, in which over fifty variables have been found to be correlated with growth in at least one regression but also in which few studies control for the variables analysed by other researchers (Levine and Renelt, 1992, p. 943.) This situation has carried over to the exchange-rate-regime literature, making it difficult to isolate the effect of the regime on growth from the effects of other factors, such as omitted-variable bias when a control variable included in one study has been omitted from another. Second, following the work of Kormandi and Maguire (1985), a common feature of most cross-country growth regressions, including those used in the exchange-rate-regime literature, is that the explanatory variables are entered linearly, independently, and are assumed to have coefficients

that are invariant both over time and cross-sectionally. These assumptions can be overly-restrictive, biasing the results obtained. For example, the effects of a particular exchange-rate regime on growth during the 1970s, when capital mobility was relatively low, may have been quite different from the effect of that regime during the 1990s, when capital mobility was greater, so that, because of the effect of other factors over time, the coefficients for a given regime may be time-variant.[35] Third, in an evaluation of the empirical growth literature, Levine and Renelt (1992) found that the empirical linkages between long-run growth rates and a broad array of economic-policy, political, and institutional variables used in cross-country regressions are not robustly-correlated with growth; small alterations on the conditioning set overturn previous results.[36] The authors interpreted their findings as suggesting that the results of cross-country studies are sensitive to the conditioning information set. Consequently, the conditional results below pertaining to the exchange-rate-regime literature need to be interpreted in the light of these estimation problems.

Growth volatility. To determine the conditional volatility of output, a measure of volatility (*e.g.*, the standard deviation of real-GDP growth, the percentage deviation of real GDP from a filtered trend) is regressed on a set of variables as in equation (1). Typically, the variables selected are a sub-set of the variables used in the growth regression.

Inflation and inflation volatility. The basic set-up for regressions of inflation and inflation volatility are essentially the same as equation (1), incorporating, in addition to the exchange-rate regime, control and state variables, country-specific (fixed and/or random) effects, and time dummies. The particular control and state variables are chosen to reflect factors considered to influence inflation, such as money growth, trade openness, and measures of central-bank independence.

4.3 The empirical evidence

We now summarize the main empirical results (both unconditional and conditional).[37] Typically, three coarse regimes - - floats, intermediates, and pegs - -

[35] For a formal treatment of these issues see Swamy and Tavlas (2001, 2007).

[36] Levine and Renelt (1992) found that only the share of investment in GDP and the initial level of income had a robust, statistically-significant correlation with cross-country growth differentials. They also pointed-out that many of the variables used in the conditioning set of growth regressions likely contain measurement error.

[37] For growth and inflation, the mean values are discussed. Average values can be skewed by outliers, a circumstance that applies especially to the case of inflation (*e.g.,* during hyperinflationary episodes), so

are considered, but in the case of studies that use the Reinhart and Rogoff classification, up to five coarse codings - - freely floating, managed floats, limited flexibility, pegs, and freely falling - - are considered. Included in what follows are studies that compare more-specific regimes (*e.g.*, dollarization, currency boards) with other regimes.

Growth. The literature does not provide clear-cut support for the hypothesis that any particular regime enhances growth. Unconditionally, Ghosh, Gulde and Wolf (2002), Dubas, Lee and Mark (2005), Reinhart and Rogoff (2004), and Rogoff *et al*. (2004, using the RR coding) found that intermediate regimes grow faster than other regimes. However, Bailliu, Lafrance and Perraut (2003) and Levy-Yeyati and Sturzenegger (2003), using their respective codings, found that floating regimes registered the highest growth rates, while De Grauwe and Schnabl (2005) found that pegs grew faster than flexible regimes. A similar, mixed picture applies to the results of growth regressions. For example, Ghosh, Gulde, Ostry and Wolf (1997), De Grauwe and Schnabl (2005), and Rogoff *et al*. (2004) found that differences among regimes were mainly small. In contrast, Levy-Yeyati and Sturzenegger (2003) and Eichengreen and Leblang (2003) found that floating regimes had the highest growth rates, whereas Ghosh, Gulde and Wolf (2002) found that intermediate regimes were associated with higher growth; Bailliu, Lafrance and Perrault (2003), Dubas, Lee and Mark (2005) and De Grauwe and Schnabl (2005) found that pegged regimes had the highest growth rates.

Studies comparing unconditional results for more-specific regimes, using the *de jure* coding, do not shed much light on this. Several studies show that currency boards recorded high growth rates compared with other pegged regimes and floats among all IMF members (Ghosh, Gulde, and Wolf, 2000) and with developing economies that had their own central banks, regardless of the currency regime pursued (Hanke, 2002). However, Edwards (2001), in comparing a group of dollarised economies with a control group consisting of all other regimes among both advanced and emerging-market economies, found that dollarised regimes recorded much lower growth rates. Similar results were obtained by Edwards and Magendzo (2006), who compared the performances of 16 dollarised developing economies with those of 132

---

that the median may be a more appropriate measure. While only some studies report median values, all report the means. Accordingly, we focus on means here.

non-dollarised developing economies; These sets of results appear to be conflicting. Currency boards and dollarised economies are close relatives in the hard-peg category; analytically, the reason that growth performance relative to other regimes should diverge so sharply is unclear.[38]

Regression studies comparing more specific regimes using the *de jure* coding also yield mixed results. Ghosh, Gulde, and Wolf (2000) provided evidence indicating that currency boards tended to grow faster than other pegged regimes and floats; however, the regime dummy for the currency board was statistically significant in only in two of four regressions. Edwards and Magendzo (2003) compared the performance of (1) own-currency regimes, (2) dollarised economies, and (3) economies that were part of a common-currency area in which the common-currency was not issued by any of the members.[39] The authors found that the growth differential between the first two groups was not statistically significant. They also showed that economies that were part of a common-currency area grew much faster than own-currency economies. Edwards and Magendzo (2003) noted that many members of common-currency areas tend to have very-small, open (*e.g.,* island) economies. Therefore, they inferred that their results concerning the growth performance of such areas cannot be generalised to other regions. In a further study comparing dollarised with non-dollarised developing economies, using the IMF *de jure* coding, Edwards and Magendzo (2006) found that the dollarisation effect on yearly GDP growth was slightly negative on average, but not statistically significant.[40]

Despite the wide disparity of results, several common threads among the regression studies can be discerned. First, in studying the connection between the exchange-rate system and growth, it appears that the level of country aggregation matters. Studies that disaggregated countries into subgroups of advanced and developing economies often found that, for the former group, the exchange-rate

[38] Part of the explanation may be attributable to the fact that Hanke's (2002) sample, which begins in 1950 and ends in 1993, contains many observations that do not overlap with those in the sample used by Edwards (2001), which covers the period 1970-97, and the sample used by Edwards and Magendzo (2006), which runs from 1970-98. This circumstance does not explain the differences between the results of Edwards (2001) and Edwards and Magendzo (2006), and those of Ghosh, Gulde, and Wolf (2000), who used similar time periods (1970-97, 1970-98 and 1975-96, respectively). Most studies assessed the performance of currency boards using data samples that ended prior to the collapse of Argentina's currency board in December 2001.

[39] An example of a common-currency area cited by the authors is the Central African Franc Zone.

[40] Consistent with these results, Edwards (2006) found that developing economies with currency unions experienced larger negative impacts on GDP growth from external shocks.

system either made little difference or that floats registered higher growth rates than other regimes, whereas, for the latter group, pegs were associated with higher growth (Ghosh, Gulde and Wolf, 2002; Rogoff *et al*., 2004; De Grauwe and Schnabl, 2005; Dubas, Lee and Mark, 2005).[41] Levy-Yeyati and Sturzenegger (2003), however, found that, while growth rates were significantly higher under floats than pegs for all countries in their sample, the negative impact of pegs on growth was entirely accounted for by their group of non-industrial economies; for industrial economies, the exchange-rate regime was found to be largely irrelevant.[42] Second, the presence of a strong monetary-policy framework, rather than the exchange-rate system *per se*, appears to be an important determinant of growth. Bailliu, Lafrance and Perrault (2003) provided direct evidence in support of this view. They regrouped regimes into three categories of (1) pegged, (2) more flexible (including both intermediate and flexible regimes) with a nominal anchor, and (3) more flexible without a nominal anchor. Their results indicated that the "more flexible with-an-anchor regime" and the pegged regime - - which, as the authors noted, contains a built-in anchor (the peg) - - were associated positively with growth, compared with the "more flexible without-a-nominal-anchor regime". This view is also consistent with Rogoff *et al.*'s (2004) interpretation of their result regarding the statistical association between pegged regimes and growth; the authors inferred that developing economies, which sometimes lack sound institutions and a strong anti-inflation track record, may have gained credibility and enhanced policy discipline (thereby, lowering interest rates) by adopting pegged rates.

Third, the evidence indicates that country-specific factors matter. Analysing an array of regressions, Ghosh, Gulde and Wolf (2002, p. 106) concluded that their finding of higher growth for economies with intermediate and pegged regimes was attributable not so much to that regime *per se*, but to variables such as size, openness, and terms-of-trade growth, and the existence of simultaneity bias. Correspondingly, Edwards and Magendzo (2003) argued that the superior growth performance they

[41] Rogoff *et al*. (2004, p. 32) found that "for developing economies…growth appears to decline with increased flexibility, though the effect is not statistically significant". Ghosh, Gulde and Wolf (2002, pp. 94-95) distinguished between upper income and lower income country groups. Conditionally, they found that pegged regimes were associated with higher growth among lower income countries; for upper income countries, the effect of the regime was not statistically significant.

[42] The authors (2003, pp 1178-79) attributed the differences between their finding and the finding under the *de jure* coding that pegs are associated with higher growth for non-industrial economies to the tendency of the *de jure* coding to misclassify regimes.

detected in the group of common-currency economies was driven mainly by the inclusion of very-small and highly-open economies within that group. This argument, in turn, is consistent with the above interpretation that a strong monetary framework, rather than any particular exchange-rate system, is related to growth; small, highly-open economies are typically the primary beneficiaries of the monetary anchor provided by pegged rates. Fourth, the sample period seems to matter. Most studies use sample periods beginning around 1970. As noted above, however, Eichengreen and Leblang (2003) created a data base extending back to 1880 for 21 countries and found that flexible rates were associated with higher growth rates than pegged regimes. These authors also found that the relationship between growth and exchange-rate regime was driven by the period between the two World Wars; after 1972, there was no statistically significant relation between the exchange-rate regime and growth.

Inflation. A finding that emerges from much of the literature, applying to both unconditional and conditional results, is that pegged exchange-rate systems tend to be associated with lower inflation rates. The study by Ghosh, Gulde and Wolf (2002) is representative of the results reported in the literature. Using the *de jure* coding over the period 1970-99 for a group of one hundred fifty (advanced and developing) economies, they found that inflation averaged 13.3 per cent under pegs, 22.0 per cent under intermediate regimes, and 24.3 per cent under floats. Using their coding, the differences were more pronounced: 9.4 per cent under pegs, 30.2 per cent under intermediate systems, and 58.8 per cent under floating regimes.

Moreover, within the group of pegged currencies, the literature points to the following results: (i) regimes that underwent "frequent" adjustments in central parity and, for basket pegs, in the composition and/or the weights of the basket, generated higher inflation than did "infrequent" adjusters (Ghosh, Gulde, Ostry, and Wolf, 1997; Levy-Yeyati and Sturzenegger, 2001),[43] (ii) single-currency pegs, which tend to be easier to verify than other pegs, had lower inflation rates than other-pegged arrangements (Bleaney and Fielding, 2002), and (iii) the harder the peg, the lower the inflation rate (Edwards, 2001; Ghosh, Gulde and Wolf, 2000; Hanke, 2002; Edwards and Magendzo, 2003; Bleaney and Francisco, 2005; Alfero, 2005).

[43] Ghosh, Gulde, Ostry and Wolf (1997) defined "frequent adjusters" as those regimes that changed either the central parity, or, for basket pegs, the composition of the basket and/or the weights, more than once a year. Levy-Yeyati and Sturzenegger (2001) found that, for non-industrial economies, "long" pegs (lasting more than five years) and hard pegs provided lower inflation than "short" pegs (under five years).

The foregoing discussion nevertheless warrants several comments. First, as is the case with *per capita* growth, the results appear to be sensitive to the grouping of economies. When Ghosh, Gulde and Wolf (2002) sub-divided their sample into three groups - - upper-income, upper-middle income, and lower and lower-middle income - - they found that the association of pegged regimes with the lowest inflation outcomes applied to only the latter two groups. For upper-income economies, floating regimes produced the lowest inflation, followed (in order) by intermediate systems and pegged systems; these results held for both the *de jure* coding and the authors' coding, and for conditional and unconditional estimates. Regressions by Rogoff *et al.* (2004), using the RR coding, support these findings. Separating economies into three groups - - developing, emerging markets, and advanced - - Rogoff *et al.* found that inflation rose with increased exchange-rate flexibility in developing economies. The authors also found that inflation performance in emerging markets did not exhibit a significant relationship with the degree of exchange-rate flexibility. For advanced economies, their evidence indicates that inflation declined with increased exchange-rate flexibility. The authors attributed this latter finding to the existence of strong institutions, including an independent central bank with a clear anti-inflation mandate, in such economies; they argued that as economies and their institutions mature, the value of exchange-rate flexibility appears to rise. Second, results showing that pegged systems are associated with lower inflation than other systems are sensitive to the fact that many high-inflation economies tend to have floating rates because of the need for frequent adjustments of exchange rates. Correspondingly, most *de facto* codings tend to place those economies that have pegged systems and high inflation rates in the flexible-rate category because of the frequent - - and often large - - changes in parity.

Output volatility. Authors of empirical studies have used various standard-deviation measures to gauge the volatility of output. The literature suggests that pegged systems are associated with higher growth volatility. A representative example is the study by Levy-Yeyati and Sturzenegger (2003); using their coding they found that the standard deviation of growth over a centered five-year rolling period was 4.3 per cent under pegs, 4.0 per cent under intermediate regimes, and 3.4 per cent under floats. Rogoff *et al.* (2004), using the RR five-way classification, calculated a centered three-year moving standard deviation of growth: pegged regimes recorded the second-highest volatility (after freely-falling regimes), while freely-floating

regimes registered the lowest volatility. Bleaney and Fielding (2002) obtained similar results in their study of eighty developing economies using the *de jure* coding. The relationship between output volatility and exchange-rate fixity also applies to the studies of dollarised economies by Edwards (2001) and Edwards and Magendzo (2006); these authors found that dollarised economies were associated with higher growth volatility than other regimes, including other pegged arrangements. In the light of these findings, an issue that arises is whether the variation that cannot be reflected in relative prices under fixed rates is forced into the real economy.

Bipolar hypothesis. Several studies found that a move to the corner regimes of floating and hard pegs has taken place. Ghosh, Gulde and Wolf (2002) applied a six-way *de jure* coding, which permits monetary unions, dollarised economies, and currency boards to be placed into a single hard-peg category to a sample of 150 IMF member countries over the period 1975-99. They found that the proportion of intermediate regimes declined from about 84 per cent in the 1975 to about 50 per cent in 1999; the share of pure floats rose from about five per cent to 27 per cent while the share of hard pegs rose from about 12 per cent to about 23 per cent.[44] Levy-Yeyati and Sturzenegger (2005), using an adjusted (see below) variant of their three-way coding, obtained broadly similar results; for the group of non-emerging market developing economies, however, the move away from the corners was much less pronounced.

Bubula and Ötker (2002) used the fine (15-way) IMF *de facto* coding for 190 IMF members, which also puts dollarised economies, currency boards, and monetary unions into a single, hard-peg category to study the bipolar hypothesis; they put "independently-floating" and "managed floats with no predetermined exchange-rate path" into a single floating-regime category, and all other regimes into an intermediate group. They found that the share of intermediate regimes fell from about 70 per cent in 1990 to around 40 per cent in 2001; the shares of hard pegs and floating regimes gained 10 percentage points (to 25 per cent) and 20 percentage points (to 35 per cent), respectively.[45] The authors also found, however, that the move toward the corner regimes was less-pronounced for the group of non-emerging-market developing

[44] Intermediate regimes consist of the following categories: single-currency pegs, basket pegs, floats with rule-based intervention and floats with discretionary intervention.
[45] See, also, Fischer (2001), who applied the IMF *de facto* coding, using 185 economies, to the period 1991-99.

economies, which tend to be less-integrated into global capital markets than other economies.

The vanishing-middle hypothesis did not, however, receive support in the studies by Bailliu, Lafrance and Perrault (2003), using the BLP coding, Rogoff *et al*. (2004), using the RR five-way coding, and Dubas, Lee and Mark (2005), using their three-way coding. The former authors found that during 1974-98, the share of intermediate regimes rose from about 20 per cent to about 45 per cent; the share of pegs fell from about 75 per cent to about 40 per cent, and the share of floats rose from about five per cent to about 15 per cent. Rogoff *et al*. found that the share of intermediate regimes remained at about one-half between the mid-1970s and 2000. Dubas, Lee and Mark (2005) found that, while there was some movement away from pegs and toward intermediate regimes in the 1970s, the respective shares of the three main regimes was essentially unchanged since the early 1980s.

The following issues merit comment with regard to the above investigations. First, the six-way *de jure* coding, used by Ghosh, Gulde and Wolf (2002), while permitting a distinction among hard pegs, free floats, and other regimes, runs into the Calvo and Reinhart "fear-of-floating problem". That is, since the six-way classification used by Ghosh, Gulde and Wolf was the IMF *de jure* coding, that coding may have included as floats those regimes under which the authorities intervened frequently to stabilise exchange rates, imparting a bias in favour of finding more regimes in the freely-floating category than in the other categories. A similar argument applies to those regimes classified as *de jure* pegs, the currencies of which underwent frequent devaluations. Second, differences among studies in definitions of regimes can matter for results obtained. To provide an example, Bubula and Ötker-Robe (2002) - - as well as Fischer (2001), who used the IMF *de facto* coding - - defined the floating-corner regime to include both "independently floating" and "managed floating" arrangements. Bubula and Ötker-Robe found that, during their 1990-2001 sample period, the share of managed floats rose by 8.1 percentage points, helping account for their finding in support of the bipolar hypothesis. In contrast, when Rogoff *et al.* (2004) investigated the hypothesis, they put managed floats, along with the "limited flexibility" and "other pegs" category, into the intermediate regime category. Third, tests of the bipolar hypothesis require that a distinction be made between hard pegs and other pegs since the hypothesis concerns a move to the corner

regimes of floating and institutional hard pegs (monetary unions, dollarised economies and currency boards). Studies that use coarse codings based on statistical algorithms, such as the LYS and BLP codings, may not provide sufficient fineness among regime classifications to serve as an adequate basis for testing the bipolar view. Levy-Yeyati and Sturzenegger recognized that a potential problem existed with the use of their coding to test the bipolar view. Therefore, they used what they termed "other sources" (presumably official) to identify hard pegs and to place other (conventional) pegs in the intermediate-regime category, finding strong support for the bipolar view. Bailliu, Lafrance and Perrault (2003) did not make a corresponding adjustment to their three-way classification and found strong evidence against the bipolar hypothesis.

5. Conclusions

Most economists recognize that we lack a generally-accepted and well-corroborated theory of exchange-rate determination. This circumstance carries over to the absence of a generally-accepted theory of the real and nominal effects of exchange-rate systems. In the presence of genuine scientific uncertainty concerning exchange-rate determination, it is often difficult to interpret whether movements in real exchange rates reflect changes in underlying fundamentals or non-fundamental noise. Presumably, the productive and allocative consequences of the former movements would be quite different from those of the latter.

Devisers of the *de facto* codings of exchange-rate regimes have sought to construct codings that are "optimal" in the sense of capturing the underlying structure of a country's exchange-rate regime, taking account of country characteristics (*e.g.*, openness to trade) and the practices of the monetary authorities (as reflected, for example, in the bilateral exchange-rate volatility against the currency of a major trading partner) and, on the basis of the *de facto* coding, provide evidence that can help discriminate among the performance of alternative systems. Our review of this rapidly-growing literature points to some general, but far from conclusive, empirical findings regarding the effects of alternative exchange-rate systems. We briefly summarise these findings as follows.

(1) Unconditionally and conditionally, it is difficult to discern a clear-cut relationship between per-capita growth and the exchange-rate regime. Conditionally, there is some evidence that for advanced economies the exchange-rate system either made little difference for growth or that floats registered higher growth rates than other regimes. For developing economies there is some positive association between pegs and growth. Those authors who examined the effects of a strong monetary policy framework found that such a framework, rather than the presence of a particular exchange-rate system *per se*, appeared to be a determinant of growth. (2) Both unconditionally and conditionally, pegged exchange-rate systems tend to be associated with lower inflation than other types of regimes, but the results are sensitive to the grouping of economies and the fact that many high-inflation economies have had floating rates because of the need of frequent adjustments of exchange rates. For upper income or advanced economies, floating regimes tend to produce the lowest inflation. For lower income or developing economies, pegged regimes are associated with lower growth. (3) Unconditionally, *all* studies using *de facto* codings found that pegged regimes were associated with higher output volatility. (4) The evidence on the bipolar hypothesis is mixed, with several studies providing strong evidence that a generalized move to the corner regimes has taken place while several other studies showing that such a movement has not taken place.

The major source of uncertainty associated with the above results is that relatively little is yet known about the robustness of regime comparisons to a number of factors, including, *inter alia*, sample periods, data frequency, conditioning variables, definitions of regimes, empirical methodologies used to classify regimes, the level of details in the regime classification, the kinds of countries included in the sample, the influence of shocks on the outcomes, and the treatment of endogeneity. The difficulty in making comparisons among codings reflects the lack of knowledge of the "true" regime. Indeed, it is worth recalling that the majority of *de facto* regimes devised so far and applied to large groups of economies are essentially revisions and/or modifications of the *de jure* coding (with the LYS coding being an exception). In the absence of data on the true regime, devisers of codings have produced sets of estimates of an unobservable variable, creating the problem of discriminating among the codings.

Returning to Stockman's (1999) assessment about what was known about the effects of the exchange-rate regime *circa* the late-1990s, we believe that we remain a long way from having reliable empirical evidence that can help us choose among alternative systems. Nevertheless, devisers of *de facto* codings have made a meaningful contribution toward distinguishing between the exchange-rate regimes that are officially pronounced and those that are actually practiced. In our view, the as-yet unfulfilled objective of this literature, and the major research agenda for the future in this area, lies in the need of a more thorough investigation of the degree of monetary-policy independence without relying exclusively on movements in exchange rates, an agenda the attainment of which is made especially challenging because of the lack of comprehensive and reliable data on reserves and interest rates. The extension of the analysis to include a more complete assessment of the degree of monetary-policy autonomy would have the potential to provide more-relevant information about regime behavior than the empirical results produced thus far.

References

Aghion P., Bacchetta P., Romain, R., Rogoff K., 2006. "Exchange Rate Volatility and Growth: The Role of Financial Development." NBER Working Paper no. 12117 (March)

Alesina, A., Wagner, A., 2006. "Choosing and Reneging on Exchange Rate Regimes." *Journal of the European Economic Association,* 4, no.1: 770-799.

Alfaro, L., 2005. "Inflation, Openness, and Exchange Rate Regimes". *Journal of Development Economics* 77, no. 1: 229-49.

Bailliu, J., Lafrance, R., Perrault, J. F., 2003. "Does Exchange Rate Policy Matter for Growth?" *International Finance* 6, no. 3: 381-414.

Barro, R., Sala-i-Martin, X., 2004. *Economic Growth*. Cambridge, MA: MIT Press.

Baxter, M., Stockman, A., 1989. "Business Cycles and the Exchange-Rate Regime: Some International Evidence". *Journal of Monetary Economics* 23, no. 3: 377-400.

Bénassy-Quéré, A., Coeuré, B., 2006. "On the Identification of *De Facto* Currency Pegs." *Journal of the Japanese and International Economies* 20, no. 1: 112-27.

Bleaney, M., Fielding, D., 2002. "Exchange Rate Regimes, Inflation and Output Volatility in Developing Economies." *Journal of Development Economics* 68, no. 1:233-45.

Bleaney, M., Mongelli, F., 2005. "Exchange Rate Regimes and Inflation: Only Hard Pegs make a Difference." *Canadian Journal of Economics* 38, no. 4: 1453-71.

Bordo, M., 2004. "Exchange-Rate Regimes for the Twenty-First Century: An Historical Perspective," mimeo, Rutgers University.

Bubula, A., Otker-Robe, I., 2002. "The Evolution of Exchange Rate Regimes Since 1990: Evidence From *De Facto* Policies". IMF Working Paper, no. 02/155.

————. 2003. "Are Pegged and Intermediate Exchange Rate Regimes Crisis Prone?" IMF Working Paper, no. 03/229

Calvo, G., Reinhart, C., 2002. "Fear of Floating." *Quarterly Journal of Economics* 117, no.2: 379-408.

Corden, W. M., 2002. *Too Sensational: On the Choice of Exchange Rate Regimes*. Cambridge, MA.: MIT Press.

De Grauwe, P., Schanble, G., 2005. "Exchange Rate Stability, Inflation and Growth in (South) Eastern and Central Europe," Katholieke University Leuven, mimeo (June).

Dellas, H., Tavlas S., G., 2005a. "Mixed Exchange Rate Systems." *Journal of International Money and Finance* 24, no. 2: 243-55.

————. 2005b. "Wage Rigidity and Monetary Union." *Economic Journal*, 115, no. 506: 907-27.

Dubas, J., Lee, B. J., Mark N., 2005. "Effective Exchange Rate Classifications and Growth." NBER Working Paper no. 11272 (April).

Edwards, S., 2001. "Dollarisation: Myths and Realities." *Journal of Policy Modeling* 23: 249-66.

Edwards, S., 2006. "Monetary Union, External Shocks and Economic Performance: A Latin American Perspective". *International Economics and Economic Policy*, 3, no. 3, p. 225-247.

Edwards, S., Magendzo, I., 2003. "A Currency of One's Own? An Empirical Investigation on Dollarisation and Independent Currency Unions". NBER Working Paper no. 9514.

———. 2006. "Strict Dollarisation and Economic Performance: An Empirical Investigation". *Journal of Money, Credit and Banking*, 38, 1: 269-282.

Edwards, S., Savastano, M. 1999. "Exchange Rates in Emerging Markets: What Do We Know?" NBER Working Paper, no. 7278 (July).

Eichengreen, B., 1994. *International Monetary Arrangements for the 21st Century*. Washington D.C.: Brookings.

Eichengreen, B., Leblang, D., 2003. "Exchange Rates and Cohesion". *Journal of Common Market Studies* 41, no. 5: 797-822.

Fischer, S., 2001. "Exchange-Rate Regimes: Is the Bipolar View Correct?" *Journal of Economic Perspectives* 15, no.2: 3-24.

Flood, R., Rose, A., 1995. "Fixed Exchange Rates: A Virtual Quest for Fundamentals". *Journal of Monetary Economics* 36, no. 1:3-37.

Frankel, J., 1999. *No Single Currency Regime is Right for All Countries or at all Times.* Essays in International Finance, 215. Princeton, N.J.: Princeton University Press.

———. 2003. "Experience of and Lessons from Exchange Rate Regimes in Emerging Markets". Kennedy School of Government Working Paper 03-011.

Frankel, J., Schmuckler, S., Serven, L., 2004. "Global Transmission of Interest Rates: Monetary Independence and Exchange Rate Regimes". *Journal of International Money and Finance* 23, no.5: 701-33.

Frieden, J., Ghezzi, P., Stein, E., 2001. "Politics and Exchange Rates: A Cross Country Approach". In *Politics and Exchange Rates: A Cross Country Approach to Latin America*, edited by Jeffrey Frieden and Ernesto Stein. Baltimore: Johns Hopkins Press.

Genberg, H., and Swoboda, A., 2004. "Exchange Rate Regimes: Does What Countries Say Matter?" Graduate Institute of International Studies, Geneva, Working Paper (May).

Ghosh, A., Gulde, A. M., Ostry, J. and Wolf, H., 1997. "Does the Nominal Exchange Rate Regime Matter?" NBER Working Paper no. 5874 (January).

Ghosh, A., Gulde, A. M., and Wolf, H., 2000. "Currency Boards: More than a Quick Fix?" *Economic Policy* 31: 269-335.

———. 2002. *Exchange Rate Regimes: Choices and Consequences*. Cambridge, M.A.: MIT Press.

Goldstein, M., 2002. *Managed Floating Plus*. Washinghon, D.C.: Institute for International Economics.

Hanke, S., 2002. "Currency Boards." *The Annals of the American Academy of Political and Social Science* 579, January: 87:105.

Harms, P., and Kretschmann, M., 2007. "Words, Deeds, and Outcomes: A Survey on the Growth Effects of Exchange Rate Regimes." Swiss National Bank Working Paper no. 07.03.

Ho, C., and McCauley, R., 2003. "Living with Flexible Exchange Rates: Issues and Recent Experience in Inflation Targeting Emerging Market Economies." Bank for International Settlements, Working paper no. 130 (February).

Humpage, O., and McIntire, J., 1995. "An Introduction to Currency Boards." Federal Reserve Bank of Cleveland, *Economic Review* 31: 2-11.

International Monetary Fund. 1999. "Exchange Arrangements and Currency Convertibility: Developments and Issues". *World Economic and Financial Surveys*.

———. 2003. "Exchange Arrangements and Foreign Exchange Markets: Developments and Issues". *World Economic and Financial Surveys*.

Kenen, P., 2001. *The International Financial Architecture: What's New? What's Missing?* Washington D.C.: Institute for International Economics.

Kormendi, R., and Meguire, P., 1985. "Macroeconomic Determinants of Growth: Cross-Country Evidence." *Journal of Monetary Economics* 16 (September): 141-63.

Levine, R., and Renelt, D., 1992 "A Sensitivity Analysis of Cross-Country Growth Regressions." *American Economic Review* 82, no. 4: 942-63.

Levy-Yeyati, E., 2006. "Financial Dollarisation: Evaluating the Consequences." *Economic Policy* 21, no. 45: 41-118

Levy-Yeyati, E. and Sturzenegger, F., 2001. "Exchange Rate Regimes and Economic Performance". IMF *Staff Papers* 47, Special Issue:" 69-98.

_____. 2003. "To Float or to Fix: Evidence on the Impact of Exchange Rate Regimes on Growth". *American Economic Review* 93, no. 3: 1173-93.

———. 2005. "Classifying Exchange Rate Regimes: Deeds vs Words". *European Economic Review* 49, no. 3: 1603-35.

———. 2007. "Fear of Appreciation". World Bank Policy Research Working Paper no. 4387 (November).

Masson, P., 2001. "Exchange Rate Regimes Transitions". *Journal of Development Economics* 64: 571-86.

Mussa, M., 1986. "Nominal Exchange Rate Regimes and the Behaviour of Real Exchange Rates: Evidence and Implications". *Carnegie-Rochester Series on Public Policy* 25 (Autumn): 117-214.

Mussa, M., Masson, P., Swoboda, A., Jadresic, E., Mauro, P. and Berg, A., 2000. *"Exchange Rate Regimes in an Increasingly Integrated World Economy"*. IMF Occasional Paper 193. Washington D.C.: IMF.

Poirson, H., 2001. "How Do Countries Choose Their Exchange-Rate Regime?" IMF Working Papers WP/01/46.

Razin, A., and Rubinstein, Y., 2006. "Evaluation of Currency Regimes: The Unique Role of Sudden Stops". *Economic Policy* 21, no. 45: 119-52.

Reinhart, C., and Rogoff, K., 2003. "The Country Chronologies and Chart book Background Material to a Modern History of Exchange Rate Arrangements: A Reinterpretation", mimeo (March).

———. 2004. "A Modern History of Exchange Rate Regimes: A Reinterpretation". *Quarterly Journal of Economics* 119, no. 1: 1-48.

Robson, P., 1998. *The Economics of International Integration*. London: Routledge.

Rogoff, K., Husain, A., Mody, A., Brooks, R. and Oomes, N.. *Evolution and Performance of Exchange Rate Regimes*. IMF Occasional Paper 229. Washington, D.C.: IMF.

Shambaugh, J., 2004. "The Effect of Fixed Exchange Rates on Monetary Policy". *Quarterly Journal of Economics* 119, no.1: 301-52.

Stockman, A., 1983. "Real Exchange Rates Under Alternate Nominal Exchange Rate Systems". *Journal of International Money and Finance* 2: 147-66.

———. 1999. "Choosing an Exchange-Rate System". *Journal of Banking and Finance* 29, no. 10: 1483-98.

Swamy, P.A.V.B. and Tavlas, G. S., 2001. "Random Coefficient Models". In *A Companion to Theoretical Econometrics*, edited by B. Baltagi. Malden, M.A. :Blackwell.

——— , 2007. "The New Keynesian Phillips Curve and Inflation Expectations: Re-specification and Interpretation." *Economic Theory* 31, no. 2: 293-306.

Tavlas, G. S., and Ulan, M., eds. 2001. "Exchange Rate Regimes and Capital Flows". *The Annals of the American Academy of Political and Social Science*. 579.

von Hagen, J., 1989. "Monetary Targeting with Exchange-Rate Constraints: The Bundesbank in the 1980s." Federal Reserve Bank of St. Louis *Review* 71, no.5: 53-69.

von Hagen, J., and Zhou, J., 2005a. "*De Facto* and Official Exchange-Rate Regimes in Transition Economies." *Economic Systems* 29:256-75.

———, 2005b. "The Choice of Exchange-Rate Regime: An Empirical Analysis for Transition Economies." *Economics of Transition* 13, no. 4: 679-703.

———, 2007. "The Choice of Exchange-Rate Regime in Developing Countries: A Multinominal Panel Analysis." *Journal of International Money and Finance,* 26:1071-94.

Williamson, J., 1996. *The Crawling Band as an Exchange Rate Regime*. Washington, D.C.: Institute for International Economics.

World Bank, 2004. *World Development Indicators*. Washington, D.C.: The World Bank.

Table 1: Pair wise Correlations Among *De facto* Coding Schemes, 1990-99

Panel A: Balanced Panel

Coding	BLP	DLM	GGW	IMF	LYS	RR
BLP	1.000					
DLM	0.1886	1.000				
GGW	0.3831	0.3377	1.000			
IMF	0.3378	0.3534	0.8305	1.000		
LYS	0.1736	0.4035	0.4154	0.4781	1.000	
RR	0.3491	0.2796	0.7203	0.7542	0.4828	1.000

Panel B: Missing values included as a separate category

Coding	BLP	DLM	GGW	IMF	LYS	RR
BLP	1.000					
DLM	0.5098	1.000				
GGW	0.4085	0.5151	1.000			
IMF	0.3521	0.4564	0.7930	1.000		
LYS	0.4191	0.5211	0.5358	0.5455	1.000	
RR	0.4758	0.4893	0.4954	0.4292	0.4648	1.000

Note 1: Based on annual data. For the RR coding, those authors' 15-way classification was converted into a three-way classification dropping the "freely-falling" category all other three-way codings are from the original sources. Since we consider pair wise correlations, the BLP data that end in 1997 do not affect the results.

Abbreviations:
Bailliu, Lafrance and Perrault (BLP), Dubas, Lee and Mark, (DLM),, Ghosh, Gulde and Wolf (GGW), International Monetary Fund (IMF), Levy-Yeyati and Sturzenegger (LYS), and Reinhart and Rogoff (RR)

BANK OF GREECE WORKING PAPERS

61. Hall, S. G., G. Hondroyiannis, P.A.V.B. Swamy and G. S. Tavlas, "A Portfolio Balance Approach to Euro-area Money Demand in a Time-Varying Environment", October 2007.

62. Brissimis, S. N. and I. Skotida, "Optimal Monetary Policy in the Euro Area in the Presence of Heterogeneity", November 2007.

63. Gibson, H. D. and J. Malley, "The Contribution of Sector Productivity Differentials to Inflation in Greece", November 2007.

64. Sideris, D., "Wagner's Law in 19th Century Greece: A Cointegration and Causality Analysis", November 2007.

65. Kalyvitis, S. and I. Skotida, "Some Empirical Evidence on the Effects of U.S. Monetary Policy Shocks on Cross Exchange Rates", January 2008.

66. Sideris, D., "Real Exchange Rates over a Century: The Case of Drachma/Sterling Rate", January 2008.

67. Petroulas, P. and S. G. Hall, "Spatial Interdependencies of FDI Locations: A Lessening of the Tyranny of Distance?", February 2008.

68. Matsaganis, M., T. Mitrakos and P. Tsakloglou, "Modelling Household Expenditure on Health Care in Greece", March 2008.

69. Athanasoglou, P. P. and I. C. Bardaka, "Price and Non-Price Competitiveness of Exports of Manufactures", April 2008.

70. Tavlas, G., "The Benefits and Costs of Monetary Union in Southern Africa: A Critical Survey of the Literature", April 2008.

71. Chronis, P. and A. Strantzalou, "Monetary and Fiscal Policy Interaction: What is the Role of the Transaction Cost of the Tax System in Stabilisation Policies?, May 2008.

72. Balfoussia, H., "An Affine Factor Model of the Greek Term Structure", May 2008.

73. Brissimis, S. N., D. D. Delis and N. I Papanikolaou, "Exploring the Nexus between Banking Sector Reform and Performance: Evidence from Newly Acceded EU Countries", June 2008.

74. Bernholz, P., "Government Bankruptcy of Balkan Nations and their Consequences for Money and Inflation before 1914: A Comparative Analysis", June 2008.

75. Oosterlinck, K. and U. R. Loredana, "Multiple Potential Payers and Sovereign Bond Prices", June 2008.

76. Kossev, K. D., “The Banking Sector and the Great Depression in Bulgaria, 1924-1938: Interlocking and Financial Sector Profitability”, June 2008.

77. Buyst, E. and I. Maes, “The Regulation and Supervision of the Belgian Financial System (1830-2005)”, June 2008.

78. Barisitz, S., “Banking Transformation (1989-2006) in Central and Eastern Europe – with Special Reference to Balkans”, June 2008.

79. Lazarević, Ž., “Banking Performance in South-Eastern Europe during the Interwar Period”, July 2008.

80. Apostolides, A., “How Similar to South-Eastern Europe were the Islands of Cyprus and Malta in terms of Agricultural Output and Credit? Evidence during the Interwar Period”, July 2008.

81. Avramov, R. and D. Gnjatović, “Stabilization Policies in Bulgaria and Yugoslavia during Communism’s Terminal Years: 1980s Economic Visions in Retrospect”, July 2008.

82. Nenovsky, N., M. Ivanov and G. Mihaylova, “The Evolution of Bulgarian Banks’ Efficiency during the Twenties: A DEA Approach”, July 2008.

83. Görmez, Y., “Banking in Turkey: History and Evolution ”, July 2008.

84. Ceca, K., K. Rexha and E. Orhan, “Banking and Finance in South-Eastern Europe: The Albanian Case”, July 2008.

85. Bordo, M., “Growing up to Financial Stability”, July 2008.

86. Lazaretou, S., “Banking and Central Banking in Pre-WWII Greece: Money and Currency Developments”, July 2008.

87. Sojic, M. and L. Djurdjevic, “Monetary Policy Objectives and Instruments Used by the Privileged National Bank of the Kingdom of Serbia (1884-1914)”, July 2008.

88. Stoenescu. G.V., E. Blejan, B. Costache and A. I. Aloman, “The National Bank of Romania and its Issue of Banknotes between Necessity and Possibility, 1880-1914”, July 2008.

89. Masciandaro, D. and M. Quintyn, “Institutions Matter: Financial Supervision Architecture, Central Bank and Path Dependence. General Trends and the South Eastern European Countries”, September 2008.