# The Survival of Intermediate Exchange Rate Regimes

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**ABSTRACT**

We propose a model of exchange-rate regime choice which accounts for the existence of a continuous range of regimes, the need for real exchange-rate adjustment in response to shocks, the existence of capital account shocks and of balance-sheet effects, the sensitivity of prices to the nominal exchange rate, and the need for a commitment to make any given regime sustainable. Non-ordered Logit estimations on a cross-section sample of 126 emerging and developed countries before and after 1997-1998 currency crises broadly support our approach. We characterize those countries for which there is still a case for intermediate exchange rate regimes.

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*Key Words*: Exchange rate regime, Developing countries, Logit model

It is now part of the conventional wisdom of international policymaking that economies open to international capital flows should not try to fix their nominal exchange rate, unless they adopt a currency board or they move to full dollarization, "euroization" or currency union. This advice is rooted in the experience of the 1992-1993 collapse of the European exchange rate mechanism and the 1997-1998 emerging markets crises (Eichengreen, 1999 p. 105, Fischer, 2001). Accordingly, there is empirical evidence of a "hollowing out" of the distribution of exchange rate regimes in recent years, away from intermediate regimes and towards free floats or hard pegs (IMF, 1997, Caramazza and Aziz, 1998, Eichengreen, 1999 p. 108, Fischer, 2001).

Recently, the argument has been tilted toward the "hard peg" corner by focusing on financial structure and asset markets channels. Domestic risk premia, liability dollarization and vulnerability to international contagion all favor dollarization against floating, at least for economies which are already partially dollarized – see Calvo (2001) or Eichengreen and Hausmann (1999).

Therefore, "intermediate" exchange rate regimes, as defined as managed floats or pegs to reference rates which are not backed by an institutional commitment, are increasingly out of fashion. At a closer look, however, the picture appears much less clear. First, no existing theoretical model produces hard pegs or free floating as optimal solutions of a welfare maximizing exercise where the full range of exchange rate regimes would be available as policy options. Second, there is growing empirical evidence that intermediate exchange rate regimes are alive, under the form of dirty floats or unofficial pegs (Calvo and Reinhart, 2000; Levi-Yeyati and Sturzenegger, 2000; Bénassy-Quéré and Coeuré, 2001). Even drawing on the official classification, Masson (2001) has shown that the dynamics of exchange rate regime switches does not support the hypothesis that intermediate regimes will vanish in the long run.

Calvo and Reinhart (2000) have suggested explanations for this *fear of floating:* exchange rate pass-through, liability dollarization, dollar invoicing of domestic and external transactions, and an underdeveloped market for currency hedging make more desirable to stabilize the nominal exchange rate. Most scholars of exchange rate regime choice now follow Frankel (1999) in concluding that « no single currency regime is right for all countries at all times ». The present paper aims at incorporating these various arguments into a unified theoretical framework (Section 1). The analysis is then assessed on a sample of countries before and after the 1997-1998 currency crises (Section 2). Section 3 concludes.

## 1. EXCHANGE RATE REGIME CHOICE: DISINFLATION, STABILIZATION, AND CREDIBILITY

### 1.1. Existing literature

Popular models of exchange-rate regime choice are open economy extensions of a Barro-Gordon trade-off between stabilization and disinflation.[1] Most of them concentrate on two simplified cases: fixed pegs and free floating, without making a difference between conventional and hard pegs or considering "intermediate" regimes as an option (see e.g. Edwards, 1996; Ghosh et al., 1997; Berger et al., 2000; Méon and Rizzo, 2002). An important but isolated contribution is Aizenman and Frenkel (1985) where the degree of exchange rate flexibility is introduced as the elasticity of the money supply to the nominal exchange rate. Lahiri and Végh (2001) propose a model of optimal choice among four policy options: nominal exchange rate peg, pure floating, dirty floating, and sterilized intervention. Concentrating on monetary shocks, they find that the optimal rule depends on the size of the shock: policymakers should let the exchange rate adjust for small negative monetary shocks, while for larger shocks they should intervene to stabilize it.

This literature misses several important dimensions of the ongoing policy debate. First, it does not distinguish between the degree of flexibility, which ranges from a fixed peg to a free floating regime, and the degree of institutional commitment, which differentiates hard pegs from intermediate regimes in a broad sense. Second, these models usually do not capture the financial channels which are at the heart of the most recent discussion on exchange rate regimes. In particular, they fail to describe how the credibility of the regime may impact balance sheets and thereby the real economy, through the domestic interest rate.[2] Finally, they assume purchasing power parity, whereas all recent crises have included at some point real exchange rate misalignments.[3] In the next sections, we show how all these ingredients interplay with the traditional inflation/stabilization trade-off in open economies.

### 1.2. A comprehensive model of exchange-rate regime choice

Consider a small, open economy. In the long run (Period 2), prices are fully flexible and the real exchange rate balances the current account. The exchange rate regime is therefore neutral for the real economy and the only difference between a fixed and a floating regime is the amount of price adjustment. In the short run (Period 1), prices are sticky; they only partially react to the nominal exchange-rate variation. This pass-through[4] effect captures pricing to market, imported inflation/disinflation, short term wage indexation and/or the degree of de facto dollarization. All shocks are permanent and observed as from Period 1: the model is thus deterministic. The two periods are linked both forward by rational expectations, and backward by an inflation reputation effect (meaning that Period 1 inflation has a lasting impact). Finally, Period 3 represents the long run steady state as anticipated from Period 2.

The authorities choose for each period an optimal degree of exchange rate flexibility, after the realization of permanent shocks to the economy, which everybody can observe. They can use the real exchange rate as an instrument in order to stabilize short-run aggregate demand, but to a certain extent only, depending on how much they weight price stability. They face a commitment problem which they can solve by putting in place a commitment technology such as a currency board, a political commitment, a regional arrangement or a particular central banking design. In the model, the cost of reneging the commitment is proportional to the rise in exchange-rate flexibility.

***The real economy***

The real side of the economy is described by three equations (with t = 1,2):

$$y_t = b_t - a\, r_t + u \qquad a > 0 \tag{1}$$

$$b_t = n\,(q_t + v) \quad n > 0 \tag{2}$$

$$r_t = E_t q_{t+1} - q_t + w \tag{3}$$

Equation (1) gives aggregate demand $\boldsymbol{y_t}$ as the sum of the trade account $\boldsymbol{b_t}$ and of domestic demand, the latter depending on the real interest rate $\boldsymbol{r_t}$ and on a permanent domestic demand shock $\boldsymbol{u}$.

Equation (2) gives the trade account $\boldsymbol{b_t}$ as a function of the (log-) real exchange rate $\boldsymbol{q_t}$ and of a permanent foreign demand shock $\boldsymbol{v}$. $\boldsymbol{n}$ is the openness ratio: the more open the country, the larger the impact of a foreign demand shock, and the larger the stabilizing role of the real exchange rate.

Equation (3) is the financial account equilibrium condition. It relates the real interest rate $\boldsymbol{r_t}$ to the expected real exchange rate depreciation and to a shock $\boldsymbol{w}$ on the country risk premium. $E_t q_{t+1}$ is the real exchange rate which is rationally expected in period t for period t+1. As shocks are permanent and already observed in period 1, we have $E_1 q_2 = q_2$ and $E_2 q_3 = q_2$ (the real exchange rate is constant in the long run).

In the ***long run***, the real exchange rate adjusts to balance the trade account; aggregate demand only depends on domestic demand and interest rate shocks:

$q_2 = -v$,

$r_2 = w$,

$y_2 = u - aw$.

In the ***short run***, the real exchange rate can adjust to stabilize output (in a flexible exchange-rate regime); or it can stay constant (fixed exchange-rate regime with price stickiness); or it can be

somewhere in between (intermediate regime). Let $\tilde{q}_1$ be the "shadow" flexible exchange rate in Period 1, i.e. the real exchange rate that would stabilize output in a flexible regime. We have $\tilde{q}_1 = -(u-aw)/(a+n)-v$. This means that the shadow flexible exchange rate depreciates ($\tilde{q}_1$ rises) in the case of a negative demand shock or of a positive interest rate shock. Let $g_1$ be the actual degree of exchange rate adjustment allowed by the authorities in Period 1 ( $0 \leq g_1 \leq 1$). We have:

$q_1 = g_1 \tilde{q}_1 = g_1 [ - v + (aw - u)/(a + n) ]$

$q_2 - q_1 = - (1-g_1)v + g_1 (u - aw)/(a + n).$

$r_1 = g_1 u/(a+n) - (1-g_1)v + (1-ag_1/(a+n))w$

$y_1 = (1- g_1)x.$

Suppose the exchange-rate regime in Period 1 is *a free float* ($g_1 = 1$). In case of a negative demand shock (**u** or **v < 0**) or of a rise in the risk premium (**w > 0**), the real exchange rate depreciates in the short run to stabilize aggregate demand; in case of a foreign demand shock (**v < 0**), the real exchange rate then remains at this depreciated level which ensures a balanced current account. For both other shocks, the real exchange rate appreciates back to its initial level in the long run. Since it is expected, this appreciation lowers the real interest rate in the short run, which helps to stabilize aggregate demand. Hence, the real exchange rate adjustment stabilizes aggregate demand in the short run through both the trade channel and the interest rate channel.

Suppose now that the exchange-rate regime in Period 1 is a *fixed peg* ($g_1 = 0$). In the case of a negative shock on domestic demand ($u < 0$) or of a positive shock on the risk premium ($w > 0$), the real exchange rate stays constant in both periods and aggregate demand is not stabilized. However in the case of a negative foreign demand shock ($v < 0$), the real exchange rate has to depreciate in the long run. Since this depreciation is expected by the market, the real interest rate rises in the short run, which accentuates the fall in aggregate demand. Hence a fixed peg is especially costly for a country facing large foreign demand shocks, since the expectation of an inevitable real exchange-rate adjustment in the long run will destabilize aggregate demand in the short run, while having a fixed peg makes no difference compared to a flexible regime for long-run aggregate demand.

***Nominal variables***

The breakdown of real exchange rate movements between nominal exchange rates and prices depends on the nature of the exchange-rate regime and on the intensity of exchange-rate pass-through. Let $q_t = s_t - p_t$ where $s_t$ is the nominal exchange rate and $p_t$ the price level, both in logarithms.

In the ***short run***, the price level adjusts to the nominal exchange rate up to a pass-through coefficient ***m***: one can think of ***m*** as describing the degree of *de facto* dollarization (i.e. the proportion of transactions denominated in a foreign currency), the proportion of imported inputs and/or wage indexation. The nominal exchange rate moves so as to let the real exchange rate adjust in the required proportion $g_1$:

$$p_1 = ms_1 \qquad 0 \le m \le 1 \tag{4}$$

$$s_1 = \frac{g_1 \tilde{q}_1}{1-m} \tag{5}$$

The larger the pass-through, the more volatile nominal variables, meaning that exchange rate flexibility yields more price instability in highly indexed or dollarized economies: demand stabilization through exchange-rate flexibility is more costly in terms of price instability.

In the ***long run***, the nominal exchange rate can only account for a proportion $g_2$ of the real exchange rate adjustment and price adjustment therefore accounts for the remaining $(1-g_2)$. In addition, we suppose that nominal variables keep a memory of what happened in the short run through a reputation (or disinflation credibility) effect:

$$p_2 - p_1 = -(1-g_2)(q_2 - q_1) + hs_1 \qquad 0 < h < 1 \tag{6}$$

$$s_2 - s_1 = g_2(q_2 - q_1) + hs_1 \tag{7}$$

Note that exchange rate movements are the only source of price movements in the short run, as in a standard open-economy version of the Barro-Gordon framework, but not in the long run, because the real exchange rate can adjust through a change in the price level. This setting is consistent with the monetary view of the balance of payments in a fixed exchange rate regime, where current account surpluses generate inflation through reserve accumulation.

In a ***fixed peg*** ($g_1 = g_2 = 0$), real exchange rate adjustment in the long run is achieved through price adjustment. In the case of a negative shock to foreign demand ($v < 0$), the real exchange rate remains constant in the short run, but long-run depreciation is achieved through deflation. Hence, a fixed exchange rate does not guarantee price stability in the long run. This result captures an important feature of recent emerging market crises (e.g. the deflation observed in HongKong after the 1997 crisis). It contrasts with conventional extensions of the Barro-Gordon framework, which always assume PPP.

In a ***free float*** ($g_1 = g_2 = 1$), real exchange rate adjustment in the long run is realized through nominal exchange rate adjustment, inflation in period 2 being determined by the amount of depreciation in

period 1. For instance, a negative domestic demand shock (***u*** < ***0***) is accommodated by a nominal exchange rate depreciation in the short run; in the long run, the real exchange rate appreciates back to its initial level through nominal appreciation while the short run depreciation feeds both inflation and nominal depreciation. If such reputation effect is low (for instance, if price expectations are forward looking), the flexible regime insulates the long run from the short run while allowing demand stabilization in the short run. Conversely, refraining from depreciating the currency in the short run yields no benefit in terms of inflation in the long run.

### 1.3. The optimal exchange rate regime

The monetary authorities minimize a quadratic loss function which depends on aggregate demand and inflation variability in both periods. When announcing an exchange rate regime in Period 1, they have to convince the market that they will not renege on their commitment. They do so by putting in place a commitment technology which can take the form of central bank independence or of a currency board, for instance. Changing regimes bears a reputation cost *à la* Drazen and Masson (1994). Here the cost $C = q(g_2 - g_1)$ depends on the amount of added flexibility and on a parameter $q>0$. Moving from a fixed peg to a free float will bear a higher cost than moving from a fixed peg to a crawling peg. The loss function is $L = L_1 + bE_1L_2$ with:

$$L_1 = 0.5\left(y_1^2 + l p_1^2\right) \qquad \text{(assuming } p_0 = 0\text{)} \qquad (8)$$

$$L_2 = 0.5\left(y_2^2 + l (p_2 - p_1)^2\right) + q\left(g_2 - g_1\right) \qquad (9)$$

***The commitment technology***

The optimization program is first solved for Period 1 under the hypothesis that the exchange rate regime will be the same for both periods: $g_1 = g_2 = g$. Then, the proper commitment technology $q$ is defined so as to ensure the credibility of the regime, in the sense that re-optimizing in Period 2 would not lead to a regime change. Given Period 1 exchange rate regime $g_1$, the optimal Period 2 regime $g_2^*$ is derived from the minimization of Period 2 loss function. Finally, equalizing $g_2^*$ to $g_1 = g$ in the first order condition yields the degree of commitment $q$: Assuming that the three shocks (***u***, ***v*** and ***w***) are orthogonal[F], we have:

$$q = l(1-g)\left[(1-g)^2 + \frac{hg}{1-m}\right]v^2 + \frac{l g^2}{(a+n)^2}\left[1-g - \frac{h}{1-m}\right]\left(u^2 + a^2 w^2\right) \qquad (10)$$

In close-to-the-corners regimes, we have $g(1-g) \sim 0$, ($g \sim 0$ or $g \sim 1$), hence:

$$\theta = \lambda\left[(1-\gamma)^3\nu^2 - \frac{\gamma^2\eta}{(1-\mu)(\alpha+\nu)^2}\left(\upsilon^2 + \alpha\omega^2\right)\right] \qquad (10')$$

Unsurprisingly, there is no need for a commitment ($\theta = 0$) if monetary authorities do not care about inflation ($\lambda = 0$). In this case, they unambiguously choose a free floating regime ($\gamma = 1$) which will provide demand stabilization in the short run while being neutral in the long run, and there is no incentive to move towards more flexibility in Period 2.

In the general case where $\lambda > 0$, the necessary commitment is negative ($\theta < 0$, meaning that an incentive is needed in order to fix the exchange rate) for a free float ($\gamma \sim 1$). For a peg ($\gamma \sim 0$), the commitment depends on the amount of foreign demand shocks. In the extreme case where there are no foreign demand shocks ($\nu^2 = 0$), there is no incentive for abandonning the peg in Period 2 since no real exchange-rate adjustment is required in the long run. Conversely, if foreign demand shocks are prominent, there is high incentive to use the nominal exchange rate to alleviate the price adjustment in Period 2, which reduces the credibility of a fixed peg.

It is important to note that an intermediate regime such as a crawling peg or a fluctuation band ($0 < \gamma < 1$) is not necessarily more credible *per se* than a fixed peg: the required commitment depends on the relative amount of foreign demand shocks and of other shocks, and on the amount of the reputation effect (see Eq. 10). We now look in more detail into the relation between exchange rate flexibility $\gamma$ and the required degree of commitment $\theta$. If $\eta > 3(1-\mu)$, i.e. in the case of strong reputation effects and/or high pass-through, $\theta(\gamma)$ is a concave function which reaches a maximum at some point between 0 and 1, thus for an intermediate regime. If $\eta < 3(1-\mu)$, $\theta(\gamma)$ can be either decreasing (hence with a maximum in $\gamma = 0$) or a non-linear function with a maximum at some points between 0 and 1, thus for some intermediate regimes. The latter case applies when foreign demand shocks are prominent.

It can be noted that foreign demand shocks make a stronger commitment necessary for all kinds of pegs. The reason is that limiting the exchange-rate depreciation in case of a negative shock ($\nu<0$) leads to deflation in Period 2, which monetary authorities may try to avoid by allowing more flexibility in the exchange rate. To some extent, reputation effects and pass-through mechanisms dampen the credibility problem by creating inherited inflation from Period 1 (limited) depreciation, hence allowing real exchange-rate depreciation in period 2 without a fall in prices.[6]

***The optimal degree of exchange rate flexibility***

We finally assume that monetary authorities commit so that the exchange-rate regime is consistently credible, i.e. $g_1 = g_2 = g$. The optimal degree of flexibility is given by:

$$\underset{g}{Min}\, L = L_1 + b\, E_1 L_2 \qquad (11)$$

Assuming that all shocks are orthogonal we get the following derivative:

$$\frac{\partial L_1}{\partial g} = \left[ -(1-g) + \frac{g\ l}{(a+n)^2}\left(\frac{m}{1-m}\right)^2 \right]\left[u^2 + (a+n)^2 v^2 + a^2 w^2\right] \qquad (12)$$

For ***a very short sighted government*** ($b = 0$), the optimal exchange-rate regime is thus:

$$g_0^* = \frac{1}{1 + \left(\frac{l}{(a+n)^2}\right)\left(\frac{m}{1-m}\right)^2} \qquad (14)$$

We can check that $g_0^*$ is bounded by 0 (fixed peg) and 1 (free floating). Not surprisingly, a government with low aversion to inflation ($l$ small) will choose a flexible regime ($g$ close to 1). This will also be the choice if there is little pass-through (***m*** low), or if foreign demand shocks have a great impact on the short run economy either directly (***n*** large) or through the real interest rate (***a*** high). Conversely, a short-sighted government will try to stabilize its exchange rate if it cares inflation, suffers from high pass-through but appears relatively immune to foreign demand shocks and interest-rate variations.

With $g(1-g) \sim 0$, i.e. $g \sim 0$ or $g \sim 1$, we also have:

$$\frac{\partial L_2}{\partial g} = l\left[ -2(1-g)^3 + g\left(\frac{h}{1-m}\right)^2\left(\frac{x}{a+n}\right)^2 \right] \qquad (13)$$

For ***a very patient government*** ($b \to \infty$), the optimal exchange-rate regime is such as:

$$\boxed{\frac{(1-g_\infty^*)^3}{g_\infty^*} = \frac{1}{2}\left(\frac{h}{1-m}\right)^2 z^2} \quad \text{with } z^2 = 1 + \frac{u^2 + a^2 w^2}{(a+n)^2 v^2} \qquad (15)$$

Note that this formula only applies to close-to-the-corners regimes ($g \sim 0$ or $g \sim 1$). It can be concluded that a high reputation effect (***h***) or a high degree of pass through (***m***) will be consistent with a close-to-fixity regime ($g \sim 0$) provided the government is patient. This is because refraining from letting the

exchange rate adjust in the first period will yield high benefits in terms of price stability in the second period while stabilization losses of the first period are not weighted. This prescription is enhanced if domestic demand shocks ($u^2$) or shocks to the risk premium ($w^2$) dominate foreign demand shocks ($(a+n)^2v^2$). On the contrary, a country which is mainly vulnerable to foreign demand shocks will prefer a more flexible regime because such regime will avoid adjusting the real exchange rate through price adjustment in the long run. Hence a distinction must be made between the pass-through effect (which favors a peg) and the vulnerability to foreign demand shocks (which favors a float). This distinction is not easy in small, open economies. Finally, the relative impact of capital account shocks ($w^2$) and trade shocks ($(a+n)^2v^2$) is crucial: the rising role of the former relative to the latter would seem to favor more stable exchange-rate regimes. A patient government will prefer a flexible regime ($g \sim 1$) if foreign shocks are prominent, inflationary memory is low and exchange-rate pass-through is weak.

### 1.4. Summary of the results

The main conclusions of the model are the following:

When monetary authorities weight inflation variability against output variability, the optimal exchange rate regime is typically an intermediate one. The optimal degree of exchange rate flexibility depends on the structure of the economy, the nature of the shocks it faces, and the preferences of authorities.

All things being equal, the following patterns will tend to favor less exchange rate flexibility: a higher aversion to inflation and/or a longer time horizon; a higher degree of pass-through (for instance in the case of a *de facto* dollarized economy or in an economy with high dependence on imported inputs or flexible wage contracts); a more persistent inflationary reputation; an aggregate demand less reactive to real interest rates, for instance due to lower indebtedness or longer debt contracts. Also, harder pegs are more likely to be chosen by economies facing shocks to domestic demand or to interest rates than by economies facing shocks on foreign demand.

The authorities face a commitment problem when they choose an exchange rate regime. This problem can be addressed by increasing ex-ante the cost of changing regimes. It turns out that a fixed peg does not necessarily require a stronger commitment than an intermediate regime such as a crawling peg or a band. Soft pegs are particularly difficult to maintain in countries facing relatively large foreign demand shocks, because there is a strong incentive for the authorities to use the nominal exchange rate to alleviate the role of prices in real exchange-rate adjustment in the long run. To some extent, however, reputation effects and pass-through mechanisms can alleviate the commitment problem of a soft peg in countries facing large foreign demand shocks, because inherited inflation reduces the case for deflation after a negative foreign demand shock.[7]

On the whole, the model attributes the "fear of floating" to strong pass-through effects and to the magnitude of capital account shocks relatively to trade shocks. It also attributes the hollowing out of intermediate regimes to rising world demand shocks and to a higher vulnerability of the economies to interest rate variations, which make it more difficult to commit to a given exchange rate regime.

## 2. EXCHANGE RATE REGIME CHOICE: EMPIRICS

### 2.1. Existing literature

Recent studies of the determinants of exchange rate regime choice[8] have concentrated on the impact of political instability (Edwards, 1996; Méon and Rizzo, 2002) and/or on specific geographic areas (Latin America in Frieden et al., 2000; transition countries in von Hagen and Zhou, 2002). They highlight the role of variables suggested by the optimum currency area literature, such as trade openness or product differentiation, and also conclude that political instability makes fixed pegs more difficult to sustain, consistently with the seminal study by Klein and Marion (1997).

Other recent contributions are Rizzo (1998), Berger et al. (2000), Poirson (2001), Juhn and Mauro (2002), Cartapanis and Dropsy (2002), Masson and Ruge-Murcia (2002). Rizzo finds a significant role for optimal currency area criteria: country size, level of development, openness and geographical diversification of trade. Berger et al. (2000) concentrate on the volatility and correlation of domestic and foreign output. Poirson (2001) evidences the role of country size, external shock vulnerability, inflation performance, capital mobility, level of reserves, political risk, partial dollarization and foreign currency borrowing. Cartapanis and Dropsy focus on "macro-financial" criteria such as capital openness and the external financing structure. Finally, Masson and Ruge-Murcia work on regime shifts rather than regime choice and find that high inflation and (to a lesser extent) low growth and low trade openness tend to increase exits from prevailing regimes.

We want to improve on these studies in three directions. First, all of them (except Juhn and Mauro, and Masson and Ruge-Murcia) use a binomial or an ordered multinomial discrete choice model, or even a linear relationship between an exchange rate flexibility index and the explanatory variables (Poirson; Cartapanis and Dropsy). In so doing, they impose an implicit pecking order on exchange rate regime choice. They are therefore not suited to identify factors which may favor intermediate regimes against corner solutions, and they are not consistent with the empirical finding of Masson (2001) that transitions are symmetrical between the three types of regimes. In the following, we give the three categories the same status by estimating a multinomial logit model. The second innovation is the use of a consistent classification of exchange-rate regimes which allows to identify hard pegs, free floats

and intermediate regimes. Since the conventional wisdom has been changing following the 1997-1998 crises, we use two sets of regimes corresponding to the pre-crises and to the post-crises period. Finally, our theoretical analysis suggests that the choice of an exchange-rate regime should depend on structural variables that are more country-dependent than time-dependent. Hence we carry out cross-section rather than panel data estimations.[9]

### 2.2. Identifying exchange rate regimes

Two classifications of exchange-rate regimes are alternatively used here: official and *de facto*. In the official IMF classification (IMF, 1997 and 2000), we break regimes down to three categories: adjustable pegs, crawling pegs, regimes with fluctuation bands and managed floats are grouped into "intermediate regimes", while currency boards, dollarized regimes and currency unions are grouped into "hard pegs".

Several methods are available to identify *de facto* exchange rate pegs (see Bénassy-Quéré and Coeuré, 2001, for a discussion). Most authors regress the bilateral exchange rate against some numeraire currency (or a commodity, or a basket of currencies) on the exchange rates of reference currencies against the same numeraire (see e.g. Frankel and Wei, 1995). This approach is not satisfactory since the numeraire is likely to be correlated with one or all of the reference currencies. Recently, Levi-Yeyati and Sturzenegger (2000) have suggested using cluster analysis to classify countries according to the volatility of exchange-rate variations and of official reserves. However their classification does not discriminate hard pegs from more traditional fixed pegs, which makes it unsuitable to test for the choice of corner solutions against intermediate regimes.

As for *de facto* regimes, we use our own classification which gives a symmetrical role to reference currencies (Bénassy-Quéré and Coeuré, 2001). A currency is said to be freely floating over some period of time if there exists no stable combination of its bilateral exchange rates against the US dollar, the euro and the yen. Unsurprisingly, such situations are less frequent than reported by the IMF.[10] Our approach is complementary to Levy-Yeyati and Sturzenegger and others in the sense that we do not measure exchange rate *policies* but the ex-post behavior of the exchange rate. We define intermediate regimes as those regimes where a *de facto* basket peg (or single currency peg) is identified but not reported to the IMF as a hard peg, and we define hard pegs the same way as the IMF. The estimation is run separately for each country on weekly data on the pre-crises (January 1994-June 1997) on post-crises (October 1998-March 2001) periods.[11]

### 2.3. The empirical specification

In order to draw the lessons of the 1997-1998 emerging markets crises and to allow for a possible structural break, we run the estimation separately on the same sample of countries before and after the crises. Given the availability of the data (see below), this leaves us with 126 countries (IMF classification) or 91 countries (de facto classification) which comprise industrial, emerging and less developed economies. The estimated logit model is:

$$P(Y_i=1|X_i) = f^1 ( a_0^1 + a_1^1 OPEN_i + a_2^1 IND_i + a_3^1 M2_i + a_4^1 DEBT_i + a_5^1 CAPC_i + a_6^1 POL_i + u_i ) \quad (16)$$

$$P(Y_i=2|X_i) = f^2 ( a_0^2 + a_1^2 OPEN_i + a_2^2 IND_i + a_3^2 M2_i + a_4^2 DEBT_i + a_5^2 CAPC_i + a_6^2 POL_i + v_i ) \quad (17)$$

$$P(Y_i=0|X_i) = 1- P(Y_i=1|X_i) - P(Y_i=2|X_i) \quad (18)$$

$Y_i$ is the exchange rate regime of country i: $Y_i = 0$ for a free float, 1 for an intermediate regime and 2 for a hard peg. Contrary to an ordered logit, the two probabilities $P(Y_i=1)$ and $P(Y_i=2)$ are not nested. The normalized functional form $f^j$ (j = 1,2) is:

$$f^j(X_i) = \frac{e^{aj' X_i}}{1 + \sum_{s=1}^{2} e^{as' X_i}} \quad (19)$$

where *aj* is the vector of the parameters (see Greene, 1997 p. 915). The explanatory variables included in $X_i$ can be grouped into three categories covering the three types of country characteristics highlighted by the theoretical analysis (data sources are provided in Appendix):

- Demand and supply effects of openness: *OPEN* is the ratio of exports to GDP in 1996 or 1999. One problem with this variable is that it may capture both demand and supply effects: high openness means large exposure to foreign demand shocks; but it also means that the nominal exchange rate has little impact on real variables (hence exchange-rate flexibility is of little use). In order to disentangle the two effects, we supplemented *OPEN* with the share of manufacturing in value–added, *IND*, as a rough proxy of sectoral diversification.[12] Openness is also supplemented with *M2* which is the ratio of the money aggregate M2 over GDP, in percentage, in 1996 and 1999. This variable is used as a proxy of dollarization: a highly dollarized country will little use domestic money as both a means of payments and a reserve item. A potential problem with M2 is that its World bank definition includes foreign currency deposits. However foreign banknotes are not included. In addition, we have checked that there is a strong relationship between this variable and a dollarization index constructed by Baliño, Bennett and Borensztein (1999) for a limited subset of countries. The relationship is not stronger with M1 instead of M2. As M1 is available for a smaller number of countries, we decided to work with the M2/GDP ratio.[13]

- Interest-rate channel: *DEBT* is the ratio of total (domestic + foreign) debt to GDP in 1996 or 1999. This variable catches the importance of the interest-rate channel in the economy. It includes foreign debt since an interest rate rise due to depreciation expectations will lead domestic agents to expect a re-evaluation of foreign currency debt. This variable is equal to the public debt ratio for industrial countries due to data limitations. Shocks to the risk premium are captured through *CAPC* which is an index of capital controls taken in 1996 (pre crises) or 1999 (post crises) from the corresponding IMF exchange arrangements and exchange restrictions reports (IMF, 1997 and 2000).[14] Capital controls reduce the likeliness of financial account shocks, hence of shocks to the risk premium.

- Political channel: *POL* is the number of changes of dominant party over 1990-1994. This variable is used as a proxy for the discount factor: more political instability will induce policy authorities to reduce their time horizon. Because it is not available for all countries, this variable is not included in the first, baseline estimation.[15]

### 2.4. Estimation results

The maximum-likelihood estimation results are presented in Table 1 (baseline model) and Table 2 (adding political instability).

The first four columns give the estimates and corresponding p-values for the coefficients of the probabilities of intermediate regimes $P(Y_i=1|X_i)$ and of hard pegs $P(Y_i=2|X_i)$. The last four columns report the derivatives of the three probabilities with respect to the explanatory variables.[16] Note that the level of significance and sign of the coefficients are robust to estimating the logit model on the same sub-sample of countries.[17]

**< Tables 1 and 2 about here >**

The rate of correctly predicted observations goes from to 56% (baseline model, IMF classification, post-crises) to 83% (model with political instability, de facto regimes, pre-crises). This rate, as well as the log-likelihood, are systematically higher when using the de facto classification rather than the IMF one. This feature is robust to estimating on the same sub-sample of countries.[18] The performance is also higher when using the augmented model rather than the baseline one, and higher before the 1997-1998 crises, perhaps suggesting that the relationship between exchange rate regimes and structural features of the economies have not yet settled back to a "stable" configuration in 1999. We now turn to the interpretation of the estimated coefficients.

- Demand and supply effects of openness: trade openness (OPEN) significantly raises the probability of an intermediate regime and even more of a hard peg, relatively to a free float.[19] As

OPEN captures both the extent of foreign demand shocks (which is expected to favor flexibility) and the impact of the exchange-rate on prices (which is expected to favor fixing), the result suggests that the latter tends to dominate. The same interpretation applies to the coefficient on the manufacturing share IND which is highly significant too: hard pegs are less likely (intermediate regimes are more likely) when IND is higher, thus when the economy is more immune to global shocks and less dependent on dollar-denominated exports of commodities.[20] Finally, the M2/GDP ratio also has a significant negative impact on the probability of a hard peg. Given that this ratio is negatively correlated with the extent of dollarization, it can be concluded that a lowly dollarized economy displays lower probability to choose a hard peg. Interestingly, low dollarization favors intermediate regimes, whereas the extent of dollarization has little impact on the probability of a float. On the whole, hence, supply effects seem to dominate demand effects, higher openness, dependence on commodities and dollarization favoring hard pegs.

- Interest rate channel: although the coefficient is not always significant, a higher debt ratio DEBT seems to reduce the probability of an intermediate regime. This is consistent with the fact that intermediate regimes lead to more unstable interest rates (which are all the more costly that debt is higher), and with the fact that a more powerful interest-rate channel raises the needs for backing the intermediate regime with a strong commitment (see the theoretical model). Note that the debt ratio does not clearly favor hard pegs over free floats. Hence it is simply a cause of the hollowing out of intermediate regimes. Finally, capital controls CAPC seem to lower the probability of an intermediate regime using the official classification, while having an ambiguous effect when using the de facto classification. Savvides (1990), finding greater capital mobility to be associated with a fixed exchange-rate regime over 1976-1984, explains this result as "an effort by policymakers to employ exchange-rate policy to offset the effects of capital movements on the current account" (p. 448). This interpretation makes sense for East-Asian countries which have been fighting exchange-rate appreciation through reserve accumulation before the crisis. Of course, it stays inconsistent with the impossible trinity, and this inconsistency has been one major explanation of 1990 currency crises.[21]

- Political channel: political instability (POL) reduces the probability of a hard peg, consistent with the theoretical outcome with a relatively impatient government. This result, which is robust to the use of another proxy of political instability, is in line with Poirson (2000) Frieden et al. (2000) and Méon and Rizzo (2002) showing that more instability favors floats. Note that the coefficient rises after the crises, suggesting that hard pegs are increasingly choices of stable (possibly non democratic) political regimes.

- Lastly, the constant is significant only on the post-crises samples. It is positive for the hard peg regime, meaning that the probability of choosing a hard peg became higher than would have said the explanatory variables, perhaps reflecting the popularity of hard pegs during this period.

## 3. CONCLUSION

In this paper, we have brought together several features of the current policy debate on exchange rate regime choice, namely the existence of a continuous range of exchange rate regimes, the needs for real exchange-rate adjustment in any exchange-rate regime, the existence of shocks to the financial account and of an interest-rate channel, the importance of the impact of exchange-rate variations on prices, and the need for a commitment technology to ensure the credibility of any exchange rate regime. We end with a "road map" which helps clarify Jeffrey Frankel's assessment that "no single currency regime is right for all countries at all times" (1999). On this road map, there is some room for intermediate regimes provided that trade shocks and shocks to the capital account are not prominent, and that the interest-rate channel is not too powerful.

These theoretical results are broadly supported by Logit estimations carried out on a large cross-country sample before and after the 1997-1998 currency crises. However the empirical results suggest that the pass-through effect tends to dominate the needs to accommodate trade shocks, favoring hard pegs rather than flexible regimes in the case of relatively open economies; and that exchange-rate regimes have generally not been consistent with the degree of capital account liberalization over the past. Finally, they show that political instability is detrimental to hard pegs but not to intermediate regimes

Some important issues were not addressed in this paper. First, we treat every country in isolation, while it has been increasingly recognized that the regional environment and trading partners exchange-rate regime choice do matter.[22] Also, we do not discuss how to organize the transition between regimes so that it takes place without disruption.[23] Finally, we do not explore the possibility that some of the factors favoring hard pegs, such as partial dollarization and interest rate sensitivity (not to mention trade invoicing and the market for currency hedging), may be endogenous to the exchange rate regime.

## FOOTNOTES

[1] See Edwards (2000) or Mussa et al. (2000) for a general overview of exchange rate regime choice.

[2] An exception is Cukierman et al. (2002) who analyze the choice of a regime within the class of exchange-rate bands when the monetary authorities have to account for possible speculative attacks. In their model, however, the authorities are assumed to value exchange-rate stability for itself, and the cost of reneging the commitment is exogenous.

[3] A different strand of the literature concentrates on deviations from PPP based on pricing-to-market and compares free floats to fixed pegs through welfare analysis (see Devereux and Engel, 2000). However this type of setting does not perfectly fit the policy debate concerning developing countries. The latter often emphasizes the *lack* of pricing-to-market from foreign suppliers, leading to large exchange-rate pass through on the import side.

[4] Here we call pass-through the impact of exchange-rate variations on domestic prices, although pricing-to-market is likely to be small in developing countries.

[5] For the sake of simplicity, our model is deterministic. In reality, the monetary authorities need to anticipate the various sources of shocks u, v and w before choosing the exchange-rate regime *g*.

[6] Symmetrically, reputation effects and pass-through reduce Period 2 inflation in case of a positive trade shock in the context of a soft peg. The analysis of $q$ as a function of $g$ is available upon request to the authors.

[7] The strength of reputation to back a commitment has been discussed by Canavan and Tommasi (1997) who argue that a peg yields more reputation effects than price stability because it is a less noisy signal, and by Frankel et al. (2001) who underline the lack of verifiability of intermediate regimes as compared to corner solutions.

[8] See Juhn and Mauro (2002) for a recent survey.

[9] Juhn and Mauro also use cross-section estimations. The time dimension is misleading since explanatory variables are likely to be auto-correlated and/or linked to unobserved factors.

[10] On a sample of 92 countries, we find that the proportion of true floats has increased only from 10% to 11% after 1997/98, while the official proportions are 24 % and 28 %, see Bénassy-Quéré and Coeuré (2001).

[11] The method is detailed in Bénassy-Quéré and Coeuré (2001). A spreadsheet with complete estimation results, including basket coefficients for each country, is available on http://www.cepii.fr/anglaisgraph/pagepers/Webabq/ongoing.htm.

[12] This follows Poirson (2000). The idea is that a larger weight of manufacturing, thus a smaller weight of primary goods, makes an emerging market economy less dependent on commodity market fluctuations, which are especially large. However it makes it also less dependent on exports of dollar-denominated commodities which are clearly a source of pass-through.

[13] In the literature, M2/GDP is sometimes used as a proxy of financial sector development. For instance, von Hagen and Zhou (2002) interpret the positive relationship between M2/GDP and the probability of a flexible regime as the ability of financially developed countries to conduct domestic open market operations and to avoid banking crises when the exchange rate varies. This interpretation is complementary to ours, although it is not possible to discriminate between both.

[14] Namely, CAPC is the proportion of financial transactions categories subject to government restrictions.

[15] Another possibility could have been to use the inflation record as a proxy of the discount factor, on the ground that high inflation will increase the incentive for the central bank to build credibility. However high past inflation can also lead a fixed exchange rate regime to collapse. Indeed, past inflation is is not significant in Frieden et al. (2000) and hardly so in Poirson (2000).

[16] The coefficients are estimated on the assumption that that *Xi* does not impact on the residual probability of a free floating regime. All coefficients need not be significant at the same time for the two alternatives to a free float. In order to calculate the partial derivatives, the coefficients arethen normalized in the way described by Equation (2) with $f^0(X_i) = 1/\left(1+\sum_{s=1}^{2} e^{\alpha s' X_i}\right)$.

[17] See Bénassy-Quéré and Cœuré (2002).

[18] This feature is robust to estimating the model on the same sub-sample of countries, see Bénassy-Quéré and Cœeuré (2002).

[19] This result is consistent with Edwards (1996), Frieden et al. (2000), Cartapanis and Dropsy (2002), von Hagen and Zhou (2002), but it contrasts with Rizzo (1998), Méon and Rizzo (2001), Poirson (2001) Berger et al. (2000) who find either no significant relationship or a positive relationship between openness and exchange rate flexibility. One possible explanation for the discrepancy relative to the two groups of results is that the latter studies include country size along with trade openness,

and larger countries are more likely to be found floating. Von Hagen and Zhou work on a smaller, specific sample of transition countries.

[20] Lower vulnerability to foreign demand shocks (due to output diversification) also reduces the commitment requirement, as highlighted by the theoretical model.

[21] Other empirical studies have generally failed to evidence a strong relationship between capital mobility and the exchange-rate regime (see Juhn and Mauro, 2002).

[22] See Ito et al. (1998), Bénassy-Quéré and Coeuré (2000) or Braga de Macedo et al. (2001). Here we only consider regional monetary cooperation as a means of commitment.

[23] See the study by Eichengreen et al. (1998) for the particular case of exits from fixed to floating.

## APPENDIX

## Definition of variables and data sources

| Variable | Definition | Source |
|---|---|---|
| IMF | Official regime at end year 1996 or 1999 | IMF, Exchange Arrangements and Exchange Restrictions, yearbook xx+1 |
| BQCPRE | Official/de facto regime according to BQC before 97-98 crisis | Bénassy-Quéré, A., and B. Coeuré (2001), "On the identification of de facto currency baskets" http://www.cepii.fr/anglaisgraph/pagepers/Webabq/ongoing.htm. |
| BQCPOST | Official/de facto regime according to BQC after 97-98 crisis | Bénassy-Quéré, A., and B. Coeuré (2001), "On the identification of de facto currency baskets" http://www.cepii.fr/anglaisgraph/pagepers/Webabq/ongoing.htm. |
| CAPC | Capital controls index at end 1996 or 1999, calculated over at least 7 of the 9 capital controls items | IMF, Exchange Arrangements and Exchange Restrictions, yearbook xx+1 |
| OPEN | Openness ratio in 1996 or 1999 (exports/GDP in %) | World Bank, World Development Indicators, 2001. |
| DOL | Dollarization ratio, last year available (1995). Foreign currency deposits/broad money, in %. | Balino, T., A. Bennett, and E. Borensztein (1999), Monetary Policy in Dollarized Economies, IMF Occasional Paper, 171. |
| POL | Number of changes in the dominant party over 1990-1994 | Political Handbook. |
| IND | Share of industry in value added (%), 1996 or 1999 | World Bank, World Development Indicators, 2001. |
| M2 | M2/GDP ratio in %., 1996 or 1999 | World Bank, World Development Indicators, 2001. |
| DEBT | total debt/GDP at end 1996 or 1999 (domestic+foreign debt) | World Bank, World Development Indicators, 2001 |
| | for OECD countries: public debt ratio. | OECD |

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## Table 1 : Baseline regression results

| | Estimations | | | | $dP(Y_i=s)/dX_i$ | | | |
|---|---|---|---|---|---|---|---|---|
| | Official regimes | | De facto regimes | | Official regimes | | De facto regimes | |
| | 1996 | 1999 | Before crises | after crises | 1996 | 1999 | before crises | After crises |
| **$P(Y_i=0\|X_i)$ free float** | | | | | | | | |
| Const. | - | - | - | - | .252 | -.164 | -.007 | -0.214 |
| OPEN | - | - | - | - | -.009 | -.009 | -.006 | -0.008 |
| IND | - | - | - | - | .002 | .001 | .006 | 0.008 |
| M2 | - | - | - | - | .001 | .002 | -.001 | 0.001 |
| DEBT | - | - | - | - | .076 | .022 | .025 | 0.079 |
| CAPC | - | - | - | - | -.246 | .002 | -.250 | -0.100 |
| **$P(Y_i=1\|X_i)$ soft peg** | | | | | | | | |
| Const. | -1.409 (.158) | .569 (.540) | .065 (.973) | 2.653 (.153) | -.213 | -.021 | -.038 | -.152 |
| OPEN | **.036 (.014)** | **0.040 (.005)** | **.084 (.051)** | **.116 (.010)** | .002 | .003 | -.001 | .002 |
| IND | .021 (.427) | **-.041 (.088)** | -.085 (.153) | **-.096 (.099)** | .011 | .001 | .009 | .010 |
| M2 | .004 (.643) | -.003 (.697) | .020 (.238) | -.009 (.463) | .003 | .002 | .007 | .004 |
| DEBT | **-.539 (.054)** | -.198 (.417) | -.410 (.368) | **-1.472 (.005)** | -.109 | -.050 | -.049 | -.188 |
| CAPC | .724 (.251) | -.057 (.926) | **3.509 (.023)** | 1.696 (.194) | -.047 | -.022 | -.102 | .151 |
| **$P(Y_i=2\|X_i)$ hard peg** | | | | | | | | |
| Const | -1.140 (.414) | 1.442 (.199) | .471 (.852) | **4.560 (.028)** | -.096 | .184 | .044 | .367 |
| OPEN | **.0759 (.000)** | **0.056 (0.001)** | **.137 (.003)** | **.142 (.002)** | .007 | .005 | .006 | .007 |
| IND | **-.101 (.007)** | **-.100 (.002)** | **-.218 (.002)** | **-.194 (.002)** | -.013 | -.013 | -.015 | -.018 |
| M2 | **-.038 (.027)** | **-.021 (.060)** | -.038 (.151) | **-.040 (.023)** | -.005 | -.003 | -.006 | -.005 |
| DEBT | -.039 (.869) | 0.045 (.843) | -.169 (.733) | **-.613 (.050)** | .032 | .029 | .023 | .109 |
| CAPC | **2.877 (.005)** | .081 (.911) | **6.535 (.001)** | 1.165 (.403) | .294 | .020 | .352 | -.051 |
| Log-likelihood | -105.8 | -122.4 | -50.7 | -62.0 | - | - | - | - |
| % of correct predictions | 63% | 56% | 73% | 69% | - | - | - | - |
| Nb of observations | 126 | 126 | 91 | 91 | - | - | - | - |

P-values in parenthesis.

## Table 2 : Results with political instability

| | Estimations | | | | $dP(Y_i=s)/dX_i$ | | | |
|---|---|---|---|---|---|---|---|---|
| | Official regimes | | De facto regimes | | Official regimes | | De facto regimes | |
| | 1996 | 1999 | before crises | after crises | 1996 | 1999 | before crises | after crises |
| **$P(Y_i=0\|X_i)$ free float** | | | | | | | | |
| Const. | - | - | - | - | -.087 | -.600 | -.044 | -.317 |
| OPEN | - | - | - | - | -.006 | -.006 | -.009 | -.010 |
| IND | - | - | - | - | -.002 | .012 | .007 | .009 |
| M2 | - | - | - | - | .005 | .005 | -.000 | .024 |
| DEBT | - | - | - | - | .006 | -.067 | .033 | .135 |
| CAPC | - | - | - | - | .024 | .357 | -.202 | -.094 |
| POL | - | - | - | - | .108 | .115 | .046 | .029 |
| **$P(Y_i=1\|X_i)$ soft peg** | | | | | | | | |
| Const. | -.159 (.915) | 2.461 (.112) | .380 (.884) | 2.725 (.190) | -.242 | -.173 | -.278 | -.398 |
| OPEN | .028 (.205) | **.031 (.095)** | **.158 (.025)** | **.131 (.006)** | .001 | .002 | .003 | .005 |
| IND | .039 (.362) | -.044 (.313) | -.115 (.165) | -.085 (.153) | .014 | .005 | .005 | .010 |
| M2 | -.010 (.419) | -.014 (.250) | .019 (.357) | -.014 (.360) | .005 | .003 | .011 | .005 |
| DEBT | -.093 (.820) | .293 (.573) | -.636 (.308) | **-2.395 (.001)** | -.032 | -.010 | -.058 | -.296 |
| CAPC | -.415 (.646) | **-1.979 (.045)** | **3.510 (.052)** | 2.116 (.133) | -.145 | -.130 | .091 | .372 |
| POL | -.554 (.231) | -.355 (.476) | -.754 (.335) | .193 (.797) | -.048 | .087 | .020 | .200 |
| **$P(Yi=2\|X_i)$ hard peg** | | | | | | | | |
| Const. | 3.801 (.264) | **7.386 (.001)** | 4.182 (.309) | **8.704 (.002)** | .328 | .774 | .322 | .716 |
| OPEN | **.083 (.009)** | **.049 (.032)** | **.215 (.004)** | **.152 (.002)** | .005 | .004 | .006 | .005 |
| IND | **-.118 (.067)** | **-.156 (.005)** | **-.255 (.010)** | **-.249 (.001)** | -.012 | -.017 | -.013 | -.020 |
| M2 | **-.129 (.018)** | **-.067 (.005)** | **-.107 (.062)** | **-.075 (.006)** | -.010 | -.008 | -.010 | -.007 |
| DEBT | .255 (.586) | .768 (.169) | -.301 (.653) | -.499 (.228) | .027 | .077 | .024 | .005 |
| CAPC | 1.171 (.514) | **-3.024 (.019)** | **4.574 (.056)** | -.785 (.643) | .121 | -.227 | .111 | .161 |
| POL | -1.080 (.169) | **-1.733 (.013)** | -1.487 (.150) | **-1.915 (.043)** | -.060 | -.202 | -.066 | -.229 |
| Log-likelihood | -54.78 | -62.47 | -34.30 | -41.86 | - | - | - | - |
| % of correct predictions | 74% | 61% | 83% | 78% | - | - | - | - |
| Nb of observations | 76 | 76 | 76 | 76 | - | - | - | - |

P-values in parenthesis.