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Estimation of De Facto Flexibility Parameter and Basket Weights in Evolving Exchange Rate Regimes

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Abstract

A new technique for estimating countries' de facto exchange rate regimes synthesizes two approaches. One approach estimates the implicit de facto basket weights in an ordinary least squares (OLS) regression of the local currency value rate against major currency values. Here the hypothesis is a basket peg with little flexibility. The second estimates the de facto degree of exchange rate flexibility by observing how exchange market pressure is allowed to show up. Here the hypothesis is an anchor to the dollar or some other single major currency, but with a possibly substantial degree of exchange rate flexibility around that anchor. It is important to have available a technique that can cover both dimensions: inferring anchor weights and the flexibility parameter. We test the synthesis technique on a variety of fixers, floaters, and basket peggers. We find that real world data demand a statistical technique that allows parameters and regimes to shift frequently. Accordingly we estimate de facto exchange rate regimes: endogenous estimation of parameter breakpoints, following Bai and Perron (1998).

JEL Codes: F31, F41

Keywords: basket peg, currency, de facto, de jure, exchange rate, exchange market pressure, regime, peso, weights

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As is by now well known, the exchange rate regimes that countries follow in practice (de facto) often depart from the regimes that they announce officially (de jure). Many countries that say they float in fact intervene heavily in the foreign exchange market.[1] Many that say they fix in fact devalue when trouble arises.[2]And many that say they target a basket of major currencies in fact fiddle with the weights.[3] A number of economists have attempted de facto classifications, placing countries into "true" categories, such as fixed, floating, and intermediate.[4] Unfortunately, these classification schemes disagree with each other as much as they disagree with the de jure classification.[5] Something must be wrong.

I. EXISTING TECHNIQUES FOR ESTIMATING DE FACTO REGIMES AND THEIR DRAWBACKS

Several things are wrong. First, attempts to infer statistically a country's degree of exchange rate flexibility from the variability of its exchange rate alone ignore the fact that some countries experience greater shocks than others.

1. Exchange Market Pressure

This problem can be addressed by comparing exchange rate variability with foreign exchange reserve variability, as do Calvo and Reinhart (2002) and Levy-Yeyati and Sturzenegger (2003, 2005). A useful way to specify this approach is in terms of exchange market pressure, defined as the sum of the change in the value of a currency and the change in its reserves.[6] Exchange market pressure represents shocks in demand for the currency. The flexibility parameter can be estimated from the propensity of the central bank to let these shocks show up in the price of the currency (floating) or the quantity of the currency (fixed), or somewhere in between (intermediate exchange rate regime). But the above-mentioned papers have a second limitation: They generally impose the choice of the major currency around which the country in question defines its value, most often the dollar. For some countries—to whatever extent the authorities seek to stabilize the exchange rate—it is fairly evident what the anchor currency must be (the dollar for countries in the Caribbean and most of Latin America, the euro in most of Central Europe). But for others it is much less evident, especially those with geographically diversified trade

1. Calvo and Reinhart (2001, 2002) and Reinhart (2000).

2. Obstfeld and Rogoff (1995) and Klein and Marion (1997).

3. Frankel, Schmukler, and Servén (2000).

4. Important examples include Ghosh, Gulde, and Wolf (2000); Reinhart and Rogoff (2004); Shambaugh (2004); and those cited in other footnotes. Tavlas, Dellas, and Stockman (2008) survey the literature.

5. Frankel (2004) and Bénassy-Quéré, Coeuré, and Mignon (2004).

6. The progenitors of the exchange market pressure variable, in a rather different context, were Girton and Roper (1977). Here we impose the a priori constraint that a one percentage increase in the foreign exchange value of the currency and a one percentage increase in the supply of the currency (the change in reserves as a share of the monetary base) have equal weights, rather than normalizing by standard deviations as Girton and Roper did.

(Asia, the Pacific, the Middle East, much of Africa, and the Southern Cone of South America). In many cases, one cannot even presume that the anchor is a single major currency. It would be better to *estimate endogenously* whether the anchor currency is the dollar, the euro, some other currency, or some basket of currencies.

2. Basket Weights

A third set of papers is designed precisely to do this, to estimate the anchor currency, or more generally to estimate the currencies in the basket and their respective weights.[7] The approach is simply to run a regression of the change in the value of the local currency against the changes in the values of the dollar, euro, and other major currencies that are potential candidates for the anchor currency or basket of currencies. In the special case where the country in question in fact does follow a perfect basket peg, the technique is an exceptionally apt application of ordinary least squares (OLS) regression. Under the null hypothesis, it should be easy to recover precise estimates of the weights. The fit should be perfect, an extreme rarity in econometrics: The standard error of the regression should be zero, and R^2 = 100 percent.

The reason to work in terms of changes rather than levels is the likelihood of nonstationarity. Concern for nonstationarity in this equation goes beyond the common refrain of modern time series econometrics, the inability to reject statistically a unit root. There is often good reason a priori to consider the possibility that the regime builds in a trend. In the context of countries with a history of high inflation, the hypothesis of interest is that the currency regime is a crawling peg, that is, that there is a steady negative trend in its value.[8] In the context of the Chinese yuan in the years since 1994, the hypothesis of interest is a *positive* trend in its value.[9] Working in terms of first differences is a clean way to allow for nonstationarity. One simply includes a constant term to allow for the possibility of a crawl in the currency, whether against the dollar alone or a broader basket.

Although the equation is very well specified under the null hypothesis of a basket peg or other peg, it is on less firm ground under the alternative hypothesis. The approach neglects to include anything to help make sense out of the error term under the alternative hypothesis that the country is not perfectly

7. Examples include Frankel (1993); Frankel and Wei (1994, 1995, 2007); Bénassy-Quéré (1999); and Bénassy-Quéré, Coeuré, and Mignon (2004), among others.

8. The hypothesis of a constant rate of crawl is readily combined with the hypothesis that the anchor is a basket, even with the hypothesis of variability around the anchor. The combined basket/band/crawl (BBC) regime has been recommended for a variety of countries (Williamson 2001). It was, for example, the regime followed by Chile in the 1990s, de facto as well as de jure (Frankel, Schmukler, and Servén 2000).

9. In 2005, Chinese authorities announced a switch to a new exchange rate regime: The exchange rate would henceforth be set with reference to a basket of other currencies, with numerical weights unannounced, allowing cumulatively a movement of up to +/– 0.3 percent per day. Initial applications of the implicit basket estimation technique to the yuan exchange rate suggested that the de facto regime continued to be essentially a dollar peg in 2005 and 2006—e.g., Ogawa (2006), Frankel and Wei (2007), and other papers cited there.

pegged to a major currency or to a basket, but rather has adopted a degree of flexibility around its anchor. In other words, the limitation of the implicit weights estimation approach is the same as the virtue of the flexibility-parameter estimation approach and vice versa. The latter is well specified to estimate the flexibility parameter only if the anchor is already known, while the former is well specified to estimate the anchor only if there is no flexibility.

Frankel and Wei (2008) synthesize the technique that estimates the flexibility parameter with the technique that estimates the degree of flexibility. The synthesis technique brings the two branches of the literature together to produce a complete equation suitable for use in inferring the de facto regime across the spectrum of flexibility *and* across the array of possible anchors.[10]

3. Regime Change

All these approaches, including the synthesis technique, suffer from a further limitation. In practice many currencies, perhaps the majority, do not maintain a single consistent regime for more than a few years at a time, but rather switch parameters every few years and even switch regimes.[11] The official regime of Chile, for example, changed parameters—basket weights, width of band, rate of crawl—18 times from September 1982 to September 1999 (after which it started floating), an average of once a year. If such changes always fell on January 1, one might have some hope of being able to estimate the equation year by year, though this would be difficult if one were limited to only 12 monthly observations. Since the parameter changes can come any time, the standard strategy of estimating an equation for each year, each interval of two years, or more cannot hope to capture the reality. The frequent changes in regimes and parameters that many countries experience may be the most important reason why different authors' classification schemes give different results among the universe of currencies, and none seems to get fully at the truth.

The next step is to apply statistical techniques that allow for the possibility that the regime and parameter governing a currency shifts, and shifts at irregular intervals. If one knows the hypothesized date of a shift, e.g., because it is officially announced, then one can test that the structural break took place de facto by means of the classic test of Chow (1960). More often, however, the structural breaks could fall at any date. In this paper we adopt the estimation technique developed by Bai and Perron (1998, 2003), who provided estimators, test statistics, and efficient algorithms appropriate to a linear model with multiple possible structural changes at unknown dates.

10. Frankel (2009) applies the synthesis technique to data on the Chinese exchange rate from 2005 to 2008, finding that the yuan during the latter part of this period did move away from the dollar peg, shifting some weight to the euro.

11. Masson (2001).

II. THE SYNTHESIS EQUATION

Algebraically, if the home currency, with value defined as H, is pegged to currencies with values defined as $X1$, $X2$, … and Xn, and weights equal to $w1$, $w2$, … and wn, then

$$\log H(t+s) - \log H(t) = c + \sum w(j) [\log X(j, t+s) - \log X(j, t)] \quad (1)$$

One methodological question must be addressed. How do we define the "value" of each of the currencies? This is the question of the numeraire.[12] If the exchange rate is truly a basket peg, the choice of numeraire currency is immaterial; we estimate the weights accurately regardless.[13] If the true regime is more variable than a rigid basket peg, then the choice of numeraire does make some difference to the estimation. Some authors in the past have used a remote currency, such as the Swiss franc.

A weighted index such as a trade-weighted measure or the special drawing rights (SDR)—an IMF unit composed of a basket of most important major currencies—is probably more appropriate. Here is why. Assume the true regime is a target zone or a managed float centered around a reference basket, where the authorities intervene to an extent that depends on the magnitude of the deviation; this seems the logical alternative hypothesis in which a strict basket peg is nested. The error term in the equation represents shocks in demand for the currency that the authorities allow to be partially reflected in the exchange rate (but only partially, because they intervene if the shocks are large). Then one should use a numeraire that is similar to the yardstick used by the authorities in measuring what constitutes a large deviation. The authorities are unlikely to use the Swiss franc or Canadian dollar in thinking about the size of deviations from their reference point. They are more likely to use a weighted average of major currencies. If we use a similar measure in the equation, it should help minimize the possibility of correlation between the error term and the numeraire. Similarly, if there is a trend in the exchange rate equation (a constant term in the changes equation) representing deliberate gradual appreciation of the currency, then the value of the local currency should be defined in terms of whatever weighted exchange rate index the authorities are likely to use in thinking about the trend. These considerations suggest a numeraire that is itself composed of a basket of currencies. Here, as in Frankel and Wei (1995, 2007), we choose the SDR.[14]

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12. Frankel and Wei (1995) used the SDR as numeraire; Frankel (1993) used purchasing power over a consumer basket of domestic goods; Frankel and Wei (1994, 2006) and Ohno (1999) used the Swiss franc; Bénassy-Quéré (1999), the dollar; Frankel, Schmukler and Servén (2000), a GDP-weighted basket of five major currencies. Bénassy-Quéré, Coeuré, and Mignon (2004) propose a modification of the methodology with a method of moments approach; the advantage of the modification is that it does not depend on the choice of a numeraire currency.

13. If the linear equation holds precisely in terms of any one "correct" numeraire, then add the log exchange rate between that numeraire and any arbitrary unit to see that the equation also holds precisely in terms of the arbitrary numeraire. This assumes the weights add to 1, and there is no error term, constant term, or other noncurrency variable.

14. Among the extensions and robustness checks in Frankel and Wei (2007) was a check whether the results were sensitive

There is a good argument for constraining the weights on the currencies to add up to 1. The easiest way to implement the adding up constraint is to run the regressions with the changes in the log of the local currency value on the left-hand side of the equation transformed by subtracting the changes in the log value of one of the currencies, say the pound, and the changes in the values of the other major currencies on the right-hand side transformed in the same way. To see this, we repeat equation 1:

$$\Delta \log H_t = c + \sum w(j) [\Delta \log X(j)_t]$$
$$= c + \beta(1) \Delta \log \$_t + \beta(2) \Delta \log ¥_t + \beta(3) \Delta \log €_t + \alpha \Delta \log £_t \quad (1')$$

We want to impose the adding up constraint

$$\alpha = 1 - \beta(1) - \beta(2) - \beta(3) \ldots$$

We implement it by running the regression equation 2:

$$[\Delta \log H_t - \Delta \log £_t] = c + \beta(1) [\Delta \log \$_t - \Delta \log £_t]$$
$$+ \beta(2)[\Delta \log ¥_t - \Delta \log £_t] + \beta(3) [\Delta \log €_t - \Delta \log £_t] \quad (2)$$

One can recover the implicit weight on the value of the pound by adding the estimated weights on the nondollar currencies and subtracting the sum from equation 1. (We usually report this residual coefficient estimate in the last row of the tables.) Imposing the constraint sharpens the estimates a bit.[15]

Our synthesis equation is:

$$\Delta \log H_t = c + \sum w(j) \Delta \log X(j)_t + \delta \{\Delta EMP_t\} + u_t \quad (3)$$

where ΔEMP_t denotes the percentage change in exchange market pressure, that is, the increase in international demand for the home currency, which may show up either in its price or its quantity, depending on the policies of the monetary authorities. Here we define the percentage change in total exchange market pressure by

$$\Delta EMP_t \equiv \Delta \log H_t + \Delta Res_t / MB_t$$

where *Res* ≡ foreign exchange reserves and *MB* = monetary base. The *w(j)* coefficients capture the de facto weights on the constituent currencies. The coefficient δ captures the de facto degree of exchange

to the numeraire, as between the SDR and gold.

15. The choice of which currency to drop from the right-hand side in order to impose the adding up constraint, in this case the pound, is completely immaterial to the estimates. The choice of which currency to use as numeraire, by contrast, *can* make a difference to the estimates (to the extent that the true regime differs substantially from a perfect basket peg).

rate flexibility. A high δ means the currency floats purely, because there is little foreign exchange market intervention (few changes in reserves; in the limit, $\Delta Res = 0$, so $\Delta EMP_t = \Delta \log H$ and $\delta = 1$). $\delta = 0$ means the exchange rate is purely fixed, because it never changes in value. A majority of currencies lie somewhere in between.

We repeat equation 3, with the four major basket currencies made explicit:

$$\Delta \log H_t = c + \sum w(j) [\Delta \log X_t] + \delta \{\Delta EMP_t\} + u_t \qquad (3')$$
$$= c + w(1) \Delta \log \$_t + w(2) \Delta \log €_t + w(3) \Delta \log ¥_t + w(4) \Delta \log £_t +$$
$$+ \delta \{\Delta EMP_t\} + u_t.$$

We want to impose the adding up constraint $w(4) = 1 - w(1) - w(2) - w(3) - \ldots$
We implement the constraint by running the regression equation 4:

$$[\Delta \log H_t - \Delta \log £_t] = c + w(1) [\Delta \log \$_t - \Delta \log £_t]$$
$$+ w(2) [\Delta \log €_t - \Delta \log £_t] + w(3) [\Delta \log ¥_t - \Delta \log £_t] + \delta\{\Delta EMP_t\} + u_t \qquad (4)$$

III. ENDOGENOUS ESTIMATION OF STRUCTURAL BREAKS

We embed the above-discussed synthesis technique for estimating de facto exchange rate regime in a multiple structural change model proposed by Bai and Perron (1998).

1. Estimating the Optimal Partition at a Given Number of Breaks

With this integrated inference framework, we can track the shifts in a country's currency regime over time. The baseline multiple break (with m breaks, that is, $m+1$ regimes) of Bai and Perron (1998, 2003) is described in equation 5,

$$y_t = x_t' \cdot \beta + z_t' \cdot \delta_i + u_t \qquad (5)$$
$$t = T_{i-1} + 1, \ldots, T_i; \quad T_0 = 0; \quad T_{m+1} = T; \quad i = 1, \ldots, m+1$$

For convenience, we use the same notation as in Bai and Perron (2003): y_t is the dependent time series variable at time t. This is a general-form partial structural change model. x_t (p x 1) is the covariates vector whose parameter vector β will not evolve over time. z_t (q x 1) is the covariates vector whose parameter vector δ will experience m structural breaks and have $m+1$ set of values in these $m+1$ different regimes: δ_i ($i = 1, \ldots, m+1$). The break points $(T_1, \ldots, T_m)$ are modeled as unknown in advance. With the observed time series data (y_t, x_t, z_t), equation 5 is used to model and derive the break dates $(T_1, \ldots, T_m)$, which split the whole time series into $m+1$ different linear regimes as well as estimate the regime-dependent parameters δ_i in the respective regimes and regime-independent parameters β.

This partial structural change model can save substantial degrees of freedom if some parameters are known to be constant across different regimes. In our case of estimating the exchange rate regime switches, because we do not know which currencies the monetary authority will keep invariant over time, we treat our application to the currency regime as a pure structural change model by assuming *p=0*, which is illustrated by equation 6,

$$\Delta \log H_t = c_i + \sum_{j=1}^{k} w_{i,j} \cdot \Delta \log X_{i,j,t} + \beta_i \cdot \Delta EMP_t + u_t \qquad (6)$$
$$t = T_{i-1}+1,\ldots,T_i; \quad T_0 = 0; \quad T_{m+1} = T; \quad i = 1,\ldots,m+1$$

Specification 6 therefore models *m+1* exchange rate regime switches, with respective basket weights and flexibility parameter in each of the regimes.

Bai and Perron (1998) adopt the general least-squares principle to estimate the break dates: for any of the *m*-partitions $(T_1,\ldots,T_m)$, a set of parameters $\bar{c}_i$, $\bar{w}_{i,j}$ and $\bar{\beta}_i$, and are derived to minimize the sum of squared residuals as represented by equation 7:

$$\sum_{i=1}^{m+1} \sum_{t=T_{i-1}+1}^{T_i} \left[\Delta \log H_t - c_i - \sum_{j=1}^{k} w_{i,j} \Delta \log X_{i,j,t} - \beta_i \cdot \Delta EMP_t \right]^2 \qquad (7)$$

$\bar{c}_i$, $\bar{w}_{i,j}$ and $\bar{\beta}_i$, and are the estimated set of parameters for each possible *m*-partition $(T_1,\ldots,T_m)$, that is, $\bar{c}_i = \bar{c}_i(T_1,\ldots,T_m)$, $\bar{\beta}_i = \bar{\beta}_i(T_1,\ldots,T_m)$, and $\bar{w}_{i,j} = \bar{w}_{i,j}(T_1,\ldots,T_m)$. Corresponding to the specific set of parameters $\bar{c}_i$, $\bar{w}_{i,j}$ and $\bar{\beta}_i$, and for an *m*-partition $(T_1,\ldots,T_m)$, a minimized sum of squared residuals is calculated, i.e., by substituting the values of $\bar{c}_i$, $\bar{w}_{i,j}$ and $\bar{\beta}_i$, and into equation 7, the objective function.

The last step is to search for the best *m*-partition $(T_1,\ldots,T_m)$ that can minimize the partition-dependent objective function globally as shown by equation 8:

$$(\hat{T}_1,\ldots,\hat{T}_m) = \underset{T_1,\ldots,T_m}{\arg\min} \sum_{i=1}^{m+1} \sum_{t=T_{i-1}+1}^{T_i} \left[\Delta \log H_t - \bar{c}_i - \sum_{j=1}^{k} \bar{w}_{i,j} \cdot \Delta \log X_{i,j,t} - \bar{\beta}_i \cdot \Delta EMP_t \right]^2 \qquad (8)$$

Finally, according to the estimated best *m*-partition, $(\hat{T}_1,\ldots,\hat{T}_m)$ we can easily recover the relevant set of coefficients, $\hat{c}_i = \hat{c}_i(\hat{T}_1,\ldots,\hat{T}_m)$, $\hat{w}_{i,j} = \hat{w}_{i,j}(\hat{T}_1,\ldots,\hat{T}_m)$ and $\hat{\beta}_i = \hat{\beta}_i(\hat{T}_1,\ldots,\hat{T}_m)$, which correspond to the parameters for each of the respective regimes.

A grid search algorithm can be used to seek for the global minimizer. However, the computational complexity of the traditional grid search algorithm to estimate a global minimizer like equation 8 is at the order of $O(T^m)$ operations, which is formidable even when *m* just grows moderately larger than 2. The additional innovation of Bai and Perron (2003) is to apply a dynamic programming principle to this

global minimization procedure,[16] which finally limits the cost of computation to $O(T^2)$. We follow their computational approach in this paper.

2. Testing and Estimating the Number of Breaks

The methodology discussed in section III.1 can help us locate the best m-partition and find out the associated regime-specific basket weights and flexibility parameter, assuming we have known the explicit number of m breaks. However, we do not know the accurate break number in advance. Then we also need a reliable way to estimate the break number m.

Bai and Perron (1998) proposed a sequential test supF (ℓ+1/ℓ), i.e., testing ℓ versus ℓ+1 breaks. This testing approach is also based on the general least-squares principle: if the value of the objective function (the minimized least squares) by assuming ℓ+1 breaks is significantly smaller than the case by assuming ℓ breaks, the hypothesis of ℓ breaks will be rejected in favor of a ℓ+1 breaks alternative. The procedure recommended by Bai and Perron (2003) is to first test 0 versus 1 break; if we can reject the hypothesis of 0 break, then go on to test 1 versus 2 break; in other words, we sequentially apply the test of supF (ℓ+1/ℓ), until the hypothesis of m+1 breaks is rejected versus the alternative of m breaks. Then we can make the conclusion that an m-break-partition model is appropriate and derive the corresponding estimates of parameters in each of the m+1 regimes in terms of the methodology of section III.1.

IV. AN ILLUSTRATION: ESTIMATION FOR FIVE CURRENCIES

Exchange rate data are available on a daily basis, but data on foreign exchange reserves and the monetary base have historically been available only on a monthly basis for most developing countries. If structural shifts occur as frequently as once a year, we will have a hard time discerning this with the monthly data, no matter what the econometric technique. We limit the anchor currency or basket to four major candidates—dollar, euro, yen, and pound—but this still requires estimation of five parameters: three currency weights, the flexibility parameter, and the crawl term.

Fortunately, some of the emerging-market currencies of greatest interest now make available their data on reserves on a weekly basis or even daily in the case of a few Latin American countries. We conclude this paper by illustrating the estimation technique for five of these currencies (table 1).

For all five currencies, the statistical estimates suggest managed floats during most of the period 1999–2009. This was a new development for emerging markets. Most of the countries had some variety of a peg before the currency crises of the 1990s. But the Bai-Perron test shows statistically significant structural breaks for every currency, even when the threshold is set high at the 1 percent level of statistical significance.

Panel 1A in table 1 reports estimation for the Mexican peso using weekly data (five structural

16. Detailed discussion on dynamic programming is available in Cormen et al. (2001).

breaks). The peso is known as a floater. To the extent that Mexico intervenes to reduce exchange rate variation, the dollar is the primary anchor, but there also appears to have been some weight on the euro starting in 2003. From August 2006 to December 2008, the coefficient on exchange market pressure is essentially zero, surprisingly, suggesting heavier intervention around a dollar target. But in the period starting December 2008, the peso once again moved away from the currency to the north, when the worst phase of the global liquidity crisis hit and the dollar appreciated.

For the other four currencies, although the exchange rate and reserve data are both available weekly, the monetary base is not. Recall that our way of scaling the change in reserves is to express it as a share of the monetary base. For this purpose, we interpolate between the monthly monetary base data.

Chile (with three estimated structural breaks) appears a managed floater throughout (panel 1B). The anchor is exclusively the dollar in some periods, but it puts significant weight on the euro in other periods. Russia (three structural breaks) is similar, except that the weight on the dollar is always significantly less than 1 (panel 1C). For Thailand (three structural breaks), the share of the dollar in the anchor basket is slightly above 0.6 but usually significantly less than 1 (panel 1D). The euro and yen show weights of about 0.2 each between January 1999 and September 2006. India (five structural breaks) apparently fixed its exchange rate during two of the subperiods but pursued a managed float in the other four subperiods (panel IE). The dollar was always the most important of the anchor currencies, but the euro was also significant in four out of six subperiods, and the yen in two.

The estimation results are no tidier than the reality of these currencies, which do not stick with any one clean regime for long. Applications of the technique to examples of currencies following clean pegs to a basket or to a single currency are available elsewhere.[17] Possible future extensions include providing a classification scheme that includes most or all members of the IMF, attempting to analyze reasons for parameter shifts, and applying a threshold autoregressive technique to capture more accurately the right specification for those countries believed to be following a target zone, rather than more general managed floating.

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Table 1 Estimation of de facto exchange rate regimes: five currencies, weekly data

1A Identifying break points in Mexico's exchange rate regime (1999M1–2009M7)

Variables	(1) 1/21/1999–9/2/2001	(2) 9/9/2001–3/18/2003	(3) 3/25/2003–7/29/2006	(4) 8/5/2006–1/28/2008	(5) 2/4/2008–12/15/2008	(6) 12/22/2008–7/29/2009
US dollar	0.92***	0.88***	0.62***	1.11***	0.96***	0.20
	(0.09)	(0.12)	(0.07)	(0.10)	(0.19)	(0.22)
Euro	0.14	–0.09	0.30***	0.20*	0.51***	0.51***
	(0.08)	(0.14)	(0.09)	(0.11)	(0.16)	(0.18)
Japanese yen	–0.05	0.22***	0.08	–0.34***	–0.33**	0.18
	(0.06)	(0.07)	(0.06)	(0.06)	(0.12)	(0.13)
Δ*EMP*	0.14***	0.32***	0.17***	0.02	0.07	0.28***
	(0.03)	(0.03)	(0.03)	(0.02)	(0.07)	(0.04)
Constant	0.00	–0.00***	–0.00*	–0.00	–0.00	0.00
	(0.00)	0.00	(0.00)	(0.00)	(0.00)	(0.00)
Observations	131.00	78.00	168.00	76.00	46.00	29.00
R-squared	0.62	0.86	0.69	0.67	0.54	0.78
British pound	–0.01	–0.01	–0.01	0.02	–0.14	0.11

1B Identifying break points in Chile's exchange rate regime (1999M1–2009M3)

Variable	(1) 1/28/1999–4/8/2003	(2) 4/15/2003–7/28/2004	(3) 8/4/2004–11/4/2007	(4) 11/11/2007–3/4/2009
US dollar	0.91***	0.25	0.73***	0.46**
	(0.11)	(0.16)	(0.10)	(0.22)
Euro	–0.05	0.54***	0.21	0.94***
	(0.09)	(0.17)	(0.16)	(0.18)
Japanese yen	0.06	0.26*	0.06	–0.24*
	(0.06)	(0.14)	(0.07)	(0.13)
Δ*EMP*	0.05***	0.10***	0.03**	0.18***
	(0.02)	(0.03)	(0.01)	(0.06)
Constant	–0.00**	0.00	0.00**	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	181.00	55.00	139.00	55.00
R-squared	0.55	0.49	0.49	0.37
British pound	0.07	–0.05	0.01	–0.15

(table continues next page)

Table 1 Estimation of de facto exchange rate regimes: five currencies, weekly data
(continued)

1C Identifying break points in Russia's exchange rate regime (1999M1–2009M7)

Variable	(1) 1/14/1999–7/8/1999	(2) 7/15/1999–10/20/2004	(3) 10/27/2004–12/22/2008	(4) 12/31/2008–7/29/2009
US dollar	0.06	0.82***	0.48***	–0.18
	(0.68)	(0.04)	(0.04)	(0.25)
Euro	0.83**	0.06	0.42***	1.61***
	(0.38)	(0.04)	(0.10)	(0.24)
Japanese yen	–0.02	0.07**	–0.00	–0.01
	(0.17)	(0.03)	(0.02)	(0.20)
Δ*EMP*	0.85***	0.11***	0.03***	0.26***
	(0.07)	(0.03)	(0.01)	(0.08)
Constant	0.00	–0.00***	–0.00	–0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	26.00	268.00	213.00	30.00
R-squared	0.80	0.82	0.83	0.69
British pound	0.13	0.06	0.10	–0.42

1D. Identifying break points in Thailand's exchange rate regime (1999M1–2009M5)

Variable	(1) 1/21/1999–8/5/2001	(2) 8/12/2001–9/9/2006	(3) 9/16/2006–3/25/2007	(4) 4/1/2007–5/6/2009
US dollar	0.62***	0.61***	0.80***	0.70***
	(0.09)	(0.04)	(0.28)	(0.05)
Euro	0.26***	0.17***	–0.08	0.19***
	(0.08)	(0.06)	(0.59)	(0.04)
Japanese yen	0.15***	0.25***	0.16	0.04
	(0.04)	(0.03)	(0.30)	(0.03)
Δ*EMP*	0.20***	0.06***	0.50***	0.03**
	(0.05)	(0.02)	(0.17)	(0.01)
Constant	–0.00**	0.00	–0.01	–0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Observations	129.00	257.00	27.00	108.00
R-squared	0.66	0.76	0.64	0.90
British pound	–0.02	–0.04	0.12	0.07

(table continues next page)

Table 1 Estimation of de facto exchange rate regimes: five currencies, weekly data
(continued)

1E Identifying break points in India's exchange rate regime (2000M1–2009M5)						
Variable	**(1) 1/14/2000–10/27/2000**	**(2) 11/3/2000–6/17/2001**	**(3) 6/24/2001–12/31/2001**	**(4) 1/14/2002–9/23/2003**	**(5) 9/30/2003–2/25/2007**	**(6) 3/4/2007–5/6/2009**
US dollar	0.77***	0.92***	0.66***	0.91***	0.72***	0.59***
	(0.06)	(0.04)	(0.08)	(0.04)	(0.06)	–0.10
Euro	0.12***	0.10***	0.23***	0.03	0.06	0.32***
	(0.03)	(0.03)	(0.07)	(0.03)	(0.05)	–0.07
Japanese yen	0.09***	0.04*	0.05	0.03	0.24***	0.02
	(0.02)	(0.02)	(0.05)	(0.02)	(0.06)	–0.07
ΔEMP	0.44***	0.04	0.46***	0.06	0.15***	0.37***
	(0.06)	(0.04)	(0.10)	(0.04)	(0.05)	–0.07
Observations	42.00	32.00	28.00	88.00	172.00	109.00
R–squared	0.98	0.98	0.98	0.98	0.86	0.78
British pound	0.02	–0.06	0.06	0.03	–0.01	0.08

Notes: ΔEMP is the exchange rate market pressure variable, which is defined as the percentage increase in the value of the local currency plus the increase in reserves (scaled by the monetary base).

Definition: $\Delta EMP_t = \Delta \log H_t + \frac{[Reserve_t - Reserve_{t-1}]}{MB_{t-1}}$

All data are weekly.

Robust standard errors in parentheses.

*** p<0.01, ** p<0.05, * p<0.1.