Comments and Discussion

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Verifiability and the Vanishing Intermediate Exchange Rate Regime

When it comes to international monetary economics, it is said that the exam questions stay the same over time, but the correct answers to them change. In the debate over the merits of fixed versus floating exchange rates, the preponderance of learned opinion has experienced several swings of the pendulum. At the time of Bretton Woods (1944), the architects of the postwar system favored fixed rates, attributing the economic instability of the interwar period in part to flexible exchange rates. During the 1960s, a growing number of economists came to favor floating rates, responding in particular to the widening U.S. balance-of-payments disequilibrium, a view that events in the early 1970s forcibly ratified by the breakdown of the Bretton Woods system.

During the 1980s, the accumulating experience with high inflation in many parts of the world brought the pendulum back, at least in an intellectual sense. Setting a target for the exchange rate came to be viewed as one way for central banks to put some steel behind attempts at monetary stabilization. New theories of rational expectations and dynamic consistency concluded that a

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commitment to such a nominal anchor, if credible, would even allow disinflation without the usual costs of lost output and employment. In the late 1990s we in a sense saw the completion of the half-century's second complete roundtrip of the pendulum, as the conventional wisdom blames exchange rate targets for crises in Mexico (1994–95), East Asia (1997–98), Russia (1998), and Brazil (1999). Thus the new language of speculative attacks, multiple equilibria, and moral hazard is in many ways simply a new overlay on an old debate.

And yet, a genuinely new element has recently been thrown into the mix. This is the proposition that countries are—or should be—moving to the corner solutions. They are said to be opting either, on the one hand, for full flexibility, or, on the other, for rigid institutional commitments to fixed exchanges in the form of currency boards or full monetary union with the dollar or euro. It is said that the intermediate exchange rate regimes—the target zones, crawls, basket pegs, and pegs-adjustable-under-an-implicit-escape-clause—are no longer feasible and are going the way of the dinosaur. A corollary of this theory is that the number of independent currencies in the world is declining, perhaps with a rising fraction of the world accounted for by a few large regional blocs built around the dollar, the euro, and perhaps the yen or some other third currency in Asia.

One motivation of this paper is the observation that, as fashionable as this proposition has become, few of its proponents, if any, have offered an analytical rationale for it, let alone a fully worked out theoretical model. The aim is to offer a possible theoretical rationale. We seek to introduce the notion of *verifiability* and to suggest that a simple peg or a simple float may be more verifiable by market participants than a more complicated intermediate regime. Verifiability can be thought of as a concrete instance of the more general principle of *transparency* that is so often invoked in recent discussions of the new international financial architecture but so seldom made precise.

Consider the exchange rate regime that Chile had during most of the 1980s and 1990s: a band around a central parity that itself is a basket with a rate of crawl.

Insofar as existing theory is concerned, the complexity of this arrangement has no implications for its credibility. But, in truth, when a central bank announces a regime of this type, the public has no way of verifying quickly, by observing the exchange rate, whether the central bank is doing what it claims to be doing.

A central bank does not earn credibility merely by announcing a monetary regime with a nominal anchor such as the exchange rate, even if its intentions

are sincere. The public will judge credibility from data available to it. Indeed, a major motivation for announcing an intermediate target—whether it is phrased in terms of an exchange rate, money supply, price level, or nominal gross domestic product (GDP)—is precisely to give the public a basis on which to be able to monitor or verify the central bank's performance. Our key point is that the corner regimes may be easier to monitor than the intermediate regimes. If the announced exchange rate regime is a simple dollar peg, a market participant need only check that the exchange rate today is the same as the exchange rate yesterday, in order to verify that the central bank is indeed following its announced policy. If the announced regime is a pure float, a participant can essentially check every month whether the central bank has intervened in the market by seeing whether its foreign exchange reserve holdings have changed. Furthermore, on a more timely basis, the banking community is likely to have a good idea whether or not the central bank is in the foreign exchange market. (Admittedly, the free-float corner is not as instantly verifiable as the firm-fix corner.) Under the basket band, by contrast, the market participant needs several months of data in order to verify that the central bank is indeed implementing the announced policy. How many months of data he or she needs is the central analytical exercise of this paper.

We do not claim that verifiability is the complete story behind the purported nonviability of intermediate regimes, and we certainly do not claim that it is the sole criterion, or even the most important criterion, in the larger debate about fixed and floating exchange rate regimes. Many other factors, whether from the traditional optimum currency area literature or the newer criteria associated with credibility and financial markets, need to be taken into account.[1] The goal is rather to offer an attempt at what, so far as we are aware, may be the first explicit analytical rationale for the corners hypothesis. Or, more modestly, we offer verifiability as another on an existing list of drawbacks to intermediate regimes.

In this paper, we study the verifiability of exchange rate regimes by analyzing the case of Chile and by performing Monte Carlo simulations. Simple pegs, and even basket pegs, are easy to verify. But as we will see from the case of Chile, a band around a peg makes the verification more difficult. Under a narrow band, the weights on the central parity can be estimated fairly well with fifty days of data.[2] Wider bands, however, make impossible the verifi-

1. Two recent reviews are Larrain and Velasco (1999) and Frankel (1999).

2. Even fifty days may be too long, however, in the midst of a full-fledged speculative attack, which is the circumstance in which intermediate regimes have been abandoned in recent years.

cation of the central parity. More precisely, verification would require many years of data, in excess of the length of the time period that a given exchange rate regime typically lasts. The Monte Carlo exercise shows the role of a number of factors in determining verifiability: the band size, number of currencies in the basket, the rate of crawl, sample period, and periodic adjustments of the central parity. The results confirm the intuition that the amount of information necessary to verify the exchange rate regimes increases with the complexity of the regime.

Verifiability is a partial means to the Holy Grail of credibility. During the 1980s, central banks wanted, above all, credibility with those who set wages and prices in the economy. The essence of the nominal anchor argument was that one would get less inflation in wages and prices, for any given level of real economic activity, if the central bank's commitment not to inflate was credible with these people. The 1990s was a period during which high inflation was no longer such a big problem as previously in most places. Currently, central banks desire, above all, credibility with those who participate in financial markets. It is the credibility of the commitment not to devalue (or default) that is seen as key. In models that assume purchasing power parity, inflation and devaluation or depreciation are the same thing. But we know that purchasing power parity does not in fact hold over the span of a decade. Indeed, it is striking how little inflation was generated by the massive devaluations in East Asia and other emerging markets. In any case, whatever the correlation between alternative measures of the value of a currency, the focus is now more on establishing in the financial markets credibility that the local currency will not lose value against the dollar, than on credibility in the labor and goods markets that the currency will not lose value in terms of wages and prices.

The easiest way to measure imperfect credibility is by looking at nominal interest rates. When speculators perceive a danger of devaluation against the dollar, they demand higher interest rates in compensation. The latter part of this paper looks at interest rates in some emerging markets, and their sensitivity to international conditions, as a way of assessing the credibility of different exchange rate regimes. We will see that, contrary to traditional views regarding monetary independence, local interest rates in emerging markets may be more sensitive to U.S. interest rates under an intermediate regime than under a currency board or currency union. If this finding holds up, it suggests that countries are not gaining much when they give up the advantages of the firm-flex corner.

In the midst of a currency crisis, the central bank needs to regain the confidence of market participants in a matter of days, not a matter of months.

Interestingly, it is not just that investors demand an extra return for holding assets denominated in local currencies—the currency premium that is the obvious counterpart to devaluation fears. Investors also seem to demand an extra return for holding claims on emerging market countries when they are expressed in dollars—the country premium that is compensation for the risk of default. One of the clear lessons of the crises of recent years is that the danger of default has an effect on default risk. It does the international investor little good to have taken care to invest only in dollar-denominated assets, if the bank or corporation that issues those dollar liabilities is unable to service its debt in the event of a devaluation because its earnings are in local currency. In this way, currency risk creates default risk.

The rest of the paper is organized as follows. The next section elaborates on the corners hypothesis and its dearth of theoretical foundations. The discussion following introduces the analytical framework used to verify exchange rate regimes. We then present estimations for the case of Chile. After performing Monte Carlo exercises to study the verification time under simulated models, we summarize. the results on verifiability and then step back to review the factors that traditionally are said to determine the choice between fixed and floating exchange rates (the optimum currency area criteria). We conclude with a discussion of the fixed-rate corner, including currency boards and dollarization, presenting some of the new criteria that suit a country for these institutional commitments and some results on how local interest rate sensitivity seems to vary across exchange rate regimes. The appendix describes in detail the recent history of the Chilean exchange rate policy corresponding to the estimations for Chile.

The Corners Hypothesis

Surely a proposition that has become such conventional wisdom as the vanishing intermediate regime has a long intellectual pedigree? Apparently not.

Intellectual Origins

What is known about the origins of the hypothesis of the vanishing intermediate regime? The Bible says "There is nothing new under the sun."[3] Eventually someone will come up with an early historical antecedent,[4] but, as

3. Eccl.1:9.

4. Perhaps the best precursor is Friedman (1953, p. 164): "In short, the system of occasional

of yet, the earliest known explicit reference is Barry Eichengreen's 1994 study.[5] The context was not emerging markets but rather the European exchange rate mechanism (ERM). In the ERM crisis of 1992–93, Italy, the United Kingdom, and others had been forced to devalue their currency or drop out of the ERM altogether, and the bands were subsequently widened substantially so that France could stay in. This crisis suggested to some that the strategy that had been planned previously[6]—a gradual transition to European economic and monetary union, where the width of the target zone was narrowed in a few steps—might not be the best way to proceed after all. Maurice Obstfeld and Kenneth Rogoff concluded, "A careful examination of the genesis of speculative attacks suggests that even broad-band systems in the current [European monetary system (EMS)] style pose difficulties, and that there is little, if any, comfortable middle ground between floating rates and the adoption by countries of a common currency."[7] The lesson that "the best way to cross a chasm is in a single jump" was seemingly borne out subsequently, when the leap from wide bands to European monetary union proved successful in 1998–99.

After the East Asian crises of 1997–98, the hypothesis of the vanishing intermediate regime was applied to emerging markets. In the effort to reform the financial architecture so as to minimize the frequency and severity of crisis in the future, the proposition was rapidly adopted by the financial establishment as the new conventional wisdom.

For example, Lawrence Summers argued:

> There is no single answer, but in light of recent experience what is perhaps becoming increasingly clear—and will probably be increasingly reflected in the advice that the international community offers—is that in a world of freely flowing capital there is shrinking scope for countries to occupy the middle ground of fixed but adjustable pegs. As we go forward from the events of the past eighteen months, I expect that countries will be increasingly wary about committing themselves to fixed exchange rates, whatever the temptations these may offer in the short run, unless they are also prepared to dedicate policy wholeheartedly to their support and establish extra-ordinary domestic safeguards to keep them in place.[8]

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changes in temporarily rigid exchange rates seems to me the worst of two worlds: it provides neither the stability of expectations that a genuinely rigid and stable exchange rate could provide in a world of unrestricted trade . . . nor the continuous sensitivity of a flexible exchange rate."

5. Eichengreen (1994, chap. 7 and pp. 77–78).

6. See, among others, Crockett (1994).

7. Obstfeld and Rogoff (1995, p. 2).

8. Summers (1999a). Other high-profile examples include Eichengreen (1999), Minton-Beddoes (1999) and Goldstein (1999).

The International Monetary Fund (IMF) has now agreed that countries that get into trouble by following an intermediate regime will in the future not be bailed out, though it qualified the scope of the generalization a bit, for example, by allowing a possible exception for "systemically" important countries.

It is not only the international financial establishment that has decided intermediate regimes are nonviable. The recent Meltzer report, commissioned by the U.S. Congress to recommend fundamental reform of the International Financial Institutions, has adopted the proposition as well: "The Commission recommends that . . . the IMF should use its policy consultations to recommend either firmly fixed rates (currency board, dollarization) or fluctuating rates."[9]

Apparently the *Economist* is right that "most academics now believe that only radical solutions will work: either currencies must float freely, or they must be tightly tied (through a currency board or, even better, currency unions)."[10] But the proposition remains yet to be modeled, let alone proven.

What Do Countries Actually Do?

Out of 185 economies, the IMF, as of December 30, 1999, classifies 51 as independently floating and 45 as following rigid pegs (currency boards or monetary unions, including the Communauté Financière Africaine [CFA] franc zone in Africa). This leaves 89 following intermediate regimes—almost half the total (of which 32 follow conventional pegs against a single currency).

Most of those listed as floating in fact intervene in the foreign exchange market frequently. As Carmen Reinhart correctly observes, "countries that say they allow their exchange rate to float mostly do not."[11] Only the United States floats so purely that intervention is relatively rare.

At the other end of the spectrum, most of those classified as pegged have in fact had realignments within the last ten years. Obstfeld and Rogoff report that only six major economies with open capital markets, in addition to a number of very small economies, had maintained a fixed exchange rate for five years or more, as of 1995.[12] Michael Klein and Nancy Marion report that the median duration of pegs among Western Hemisphere countries is about ten months.[13] The implication is that conventional pegs should be called "adjustable pegs" and classified as intermediate regimes.

9. Meltzer (2000, p. 8).
10. "Global Finance: Time for a Redesign?" *Economist*, January 30, 1999, p. S15.
11. Reinhart (2000, p. 65).
12. Obstfeld and Rogoff (1995, p. 21).
13. Klein and Marion (1997, p. 392).

Only thirty-seven countries have altogether given up an independent currency as legal tender: the euro-eleven, the fourteen members of the CFA franc zone,[14] Panama, San Marino, and some tiny island states. Of these, only the euro-eleven have given up national currencies recently; the others never had independent currencies in the first place. (Ecuador decided to dollarize in 2000.) True, six economies have adopted currency boards: Hong Kong (1983), Argentina (1991), Estonia (1992), Lithuania (1994), Bulgaria (1997), and Bosnia (1998.)[15] That adds up to almost twenty countries that have chosen ultra-fixed exchange rate arrangements in the past decade. But this does not constitute evidence that the heralded world trend toward a smaller number of currencies has begun. The missing fact is that, as the result of the breakup of the Soviet Union and of Czechoslovakia and Yugoslavia, roughly as many independent currencies were created in the 1990s as disappeared. One might assert a sort of Markov stasis, in which independent currencies are always being created and disappearing, but the overall pool remains roughly steady. Paul Masson statistically rejects the hypothesis that "hard fix" and "hard float" are absorbing states, thus concluding empirically that intermediate regimes are not in fact vanishing.[16]

Many countries still choose something in between rigid fixity and free float. The intermediate regimes in the IMF classification scheme break down as follows: In addition to the thirty-two pegged to a single currency, there are thirteen pegged to a composite, five to crawling pegs, six to horizontal bands, seven to crawling bands, and twenty-six to managed floats.[17] In short, the facts do not support the claim that countries are rapidly moving toward the corners and vacating the middle. Figure 1 plots the evolution of exchange rate regimes since the Bretton Woods system of pegged exchange rates broke up in 1971.

This leaves the question whether countries *should* be moving toward the corners, the question that the remainder of this paper considers. Do those countries that still follow intermediate regimes have good reasons for their choices? Close to the center of the economist's creed is that interior solutions are more likely to be optimal—for the interesting questions—than corner solutions.

But it is true that for the middle-income emerging market countries, all of which have been exposed to substantial financial volatility in recent years, the

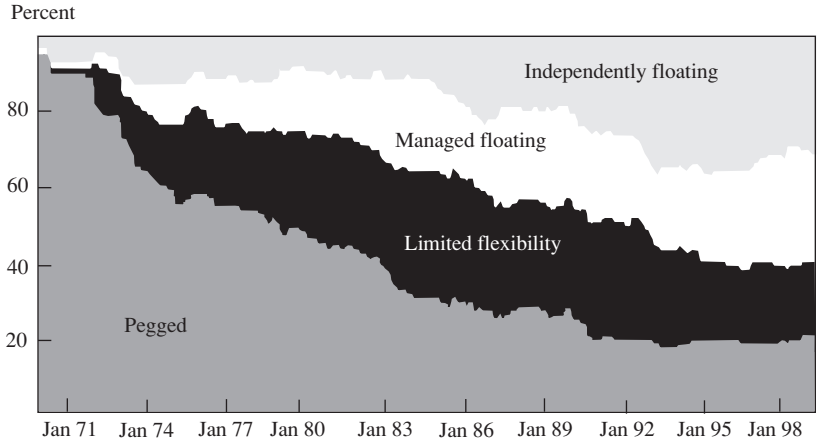
14. Even the francophone countries of Africa finally devalued against the French franc in 1994 (though they have retained their currency union among themselves).

15. Two smaller countries, Brunei and Djibouti, and some even smaller Caribbean islands, have had currency boards since independence. Montenegro as well is now said to be adopting a currency board or even declaring marks legal tender.

16. Masson (2000).

17. These totals reflect the fact that Colombia and Chile abandoned their crawling bands in mid-1999. Angola as well dropped its crawling peg and Croatia its horizontal band. All moved toward increased flexibility.

Figure 1. Evolution of Exchange Rate Regime Categories, 1970–99



Source: IMF, *International Financial Statistics*, various years.

casualties among intermediate regimes have been high. Mexico, Thailand, South Korea, Indonesia, and Brazil had not in fact been following explicit tight dollar pegs when they were hit by speculative crises and were forced to move in the direction of floating. Each had a sort of basket or band that they were forced to abandon.[18] At the same time, Hong Kong and Argentina, the two countries with currency boards, were the two that got through the period successfully, judged by the (very particular) criterion of avoiding being forced into increased exchange rate flexibility. As a statement of observed trends, at least, the set of emerging market countries in the late 1990s does seem to bear out the claimed movement toward the corners.

The countries that have abandoned band arrangements in recent years include the Czech Republic (May 26, 1997), Indonesia (August 4, 1997), Russia (August 17, 1998), Brazil (January 15, 1999), Ecuador (February 12, 1999), Chile (September 3, 1999) and Colombia (September 25, 1999).[19]

18. Even in the case of Thailand, where the baht had been de facto linked closely to the dollar in the last two years before the crisis of July 1997, the official policy was still a basket peg.

19. For the Czech Republic, David Fondler and Jiri Kominek, "Crown Kicked Out of the Band," *Prague Post,* May 28, 1997; for Indonesia, "Indonesia Floats Rupiah," *Jakarta Post*, August 15, 1997, p. 1; for Russia, Andrew Fisher and John Thornhill, "Russia Ends Rouble-Dollar Peg: Startling Change of Economic Policy as Government is Forced to Bow to Market Pressure," *Financial Times*, August 18, 1998, p. 1; for Brazil, John Authers, "Contagion: The Word That Inspires Fear," *Financial Times*, January 16, 1999, p. 2; for Ecuador, Justine Newsome, "Ecuador Finance Minister Named," *Financial Times*, February 16, 1999, p. 3; for Chile, Mark Mulligan, "Chile Floats the Peso," *Financial Times*, September 4, 1999, p. 4; and for Colombia, "Colombia Will Allow Its Currency to Float Freely," *Wall Street Journal*, September 27, 1999, p. A27.

Although most of these policy changes took place under great pressure, Chile was not facing tremendous speculative pressure when it made its recent switch, and Indonesia abandoned the bands before the full crisis hit. (This move won praise at the time. Even though the country was soon thereafter hit with the worst of the Asian crises, commentators today tend to include Indonesia on the list of data points that is supposed to demonstrate the superiority of the floating option over the band option.)[20]

It seems intuitively right that these countries, facing finicky international investors and rapidly disappearing foreign exchange reserves, had little alternative but to abandon their pegs and baskets and bands and crawls and move to a float, unless they were prepared to go to the opposite corner. But what this proposition needs is a rationale.

Lack of Theoretical Foundations for the Corners Hypothesis

What is the analytical rationale for the hypothesis of the disappearing intermediate regime (or the "missing middle")? Surprisingly, none currently exists, to our knowledge.

At first glance, it appears to be a corollary to the principle of the Impossible Trinity.[21] That principle says that a country must give up one of three goals: exchange rate stability, monetary independence, and financial market integration. It cannot have all three simultaneously. If one adds the observation that financial markets are steadily becoming more and more integrated internationally, that forces the choice down to giving up on exchange rate stability or giving up on monetary independence.

This is not the same thing, however, as saying one cannot give up on *both*, that one cannot have half-stability and half-independence in monetary policy. Economists tend to believe in interior solutions for most problems. In the closed-economy context, Rogoff derived the optimal intermediate degree of commitment to a nominal target for monetary policy, balancing the advan-

20. The conventional wisdom now is that it is far worse to be forced to abandon an exchange rate target late into a speculative episode than early. Indonesia is one counterexample, a country that abandoned early, and suffered a severe crisis anyway. (Perhaps political instability made this inevitable.)

21. Summers (1999b, p. 326) is explicit: "the core proposition of monetary economics is a trilemma: that capital mobility, an independent monetary policy, and the maintenance of a fixed exchange-rate objective are mutually incompatible. I suspect this means that as capital market integration increases, countries will be forced increasingly to more pure floating or more purely fixed regimes."

tages of precommitment against the advantages of discretionary response to shocks.[22]

There is nothing in existing theory, for example, that prevents a country from pursuing an exchange rate target zone of moderate width. The elegant line of target-zone theory begun by Paul Krugman,[23] in which speculation helps stabilize the currency, always assumed perfect capital mobility. Similarly, there is nothing that prevents the government from pursuing a managed float in which half of every fluctuation in demand for its currency is accommodated by intervention and half is allowed to be reflected in the exchange rate. (To model this, one need only introduce a "leaning against the wind" central bank reaction function into a standard monetary model of exchange rate determination.) And nothing prevents a country from pursuing a peg with an escape clause contingent on exogenous shocks or, more practically, a peg that is abandoned whenever there is a shock large enough to use up half its reserves.

Another justification that has been offered is that when a government establishes any sort of exchange rate target, as did the East Asian countries, its banks and corporations foolishly underestimate the possibility of a future break in the currency value.[24] As a result, they incur large unhedged dollar liabilities abroad. When a devaluation occurs, their domestic-currency revenues are inadequate for servicing their debts, and so they go bankrupt with devastating consequences for the economy:

> It follows that in a world of high capital mobility there are only two feasible approaches to exchange rate policy. One is not just to peg the exchange rate, but to lock it in—the Argentine strategy. . . . The vast majority of countries will . . . have to follow the other alternative of allowing their currencies to fluctuate. If the exchange rate moves regularly, banks and firms will have an incentive to hedge their foreign exposures."[25]

There is little doubt that the focus on unhedged foreign-currency debt describes accurately why the 1997–98 devaluations were economically devastating to East Asia. But the argument, as stated, has some weaknesses. First, it appears to depend on irrationality on the part of banks and corporations. Second, it appears to imply that a country would be better off by gratuitously

22. Rogoff (1985).

23. Krugman (1991).

24. The version of this argument in Eichengreen (1999, p. 104) overstates the extent to which the East Asians had "a stated commitment to the peg," as most commentators have done as well. In fact, few of the East Asian countries had explicit dollar pegs.

25. Eichengreen (1999, p. 105).

introducing extra noise into the exchange rate to deter borrowers from incurring unhedged dollar liabilities. This seems unlikely to be right. Third is the point emphasized by Barry Eichengreen and Ricardo Hausmann: foreigners are unwilling to take open positions in the currencies of emerging market countries.[26] Thus the admonition to avoid borrowing in dollars is to some extent an admonition to avoid borrowing at all. (An admonition to hedge the dollar exposure is not helpful; someone has to take the other side of the futures contract, and this will be difficult in the aggregate if foreigners are unwilling to take the open position.) It may well be that this is the right road to go down, that exchange-rate volatility is a way to put some sand in the wheels of the excessive capital movements, and that a lower volume of total debt is a good outcome. But if this is the argument, the proponents should be explicit about it. In any case, it seems doubtful that this argument could be captured by conventional models. Recall that James Tobin's original motivation for proposing to put sand in the wheels of international capital movement was to *reduce* exchange rate volatility!

A third possible justification is that governments that adopt an exchange rate target, and sometime later experience a major reversal of capital inflows, tend to wait too long before abandoning the target. As of 1998, we thought we had learned that the one thing an emerging market government can do to minimize the eventual pain from a currency crisis is to try to devalue early enough (or else raise interest rates early enough, as would happen automatically under a currency board—anything to adjust, rather than try to finance an ongoing deficit). Mexico, Thailand, and South Korea made the mistake of waiting too long, until reserves ran so low that by the time of the devaluation there was no good way out of the crisis—no combination of interest rates and exchange rate that would simultaneously satisfy the financing constraint externally and prevent recession domestically. But exiting from an exchange rate target can be difficult politically. The lesson is drawn that, to avoid this difficulty, governments should either adopt a rigid institutional fixed-rate commitment (as have Hong Kong and Argentina) or, if not prepared to do that, abandon the peg early.[27]

On this basis, when Brazil in the autumn of 1998 delayed the seemingly inevitable jettisoning of the exchange rate target that remained from its *real* plan, many thought this would be a repeat of the earlier mistakes. Instead,

26. Eichengreen and Hausmann (1999, p. 330) call this the "original sin." The term is not meant to imply that the fault lies in policy failings of the local government.

27. Taiwan, for example, devalued promptly and suffered less than the others.

when the devaluation finally came in January 1999, Brazil's trade balance improved sharply, the lack of confidence subsided, and output and employment subsequently performed far better than in neighboring Argentina. Thus it is more difficult to generalize from recent experience than widely believed. Furthermore, if we are to use government reluctance to exit a target arrangement as the basis of a model of the nonviability of intermediate regimes, it seems that we would again require some sort of irrationality (or political constraints)[28] on the part of policymakers.

Thus each of the three arguments offered—the Impossible Trinity, the dangers of unhedged dollar liabilities, and the political difficulty of exiting—contains some important truth. But none seems able to stand as a theoretical rationale for the superiority of the corner solutions over the intermediate regimes. Is the corners hypothesis, then, simply a misplaced manifestation of the temptation to believe that the grass is always greener somewhere else?

Verifiability

The idea behind verifiability is that the government's announcement of an exchange rate regime is more likely to be credible if market participants can check for themselves from observable data that the announced regime is in fact in operation. This process of verification can be modeled along the lines of the process of statistical inference familiar to econometricians. We are not suggesting that market participants will necessarily run ordinary least squares (OLS) regressions literally but rather that they must do something similar implicitly.

In this paper we concentrate on the case of the basket peg with a band and perhaps with a crawl. One could pursue analogous exercises with other intermediate regimes—a managed float or a peg with an escape clause—to show that they are similarly difficult to verify. We intend the basket-peg exercise to be illustrative of the more general difficulty in verifying intermediate regimes.

If a country follows a precise basket peg, with no band, the problem of statistical inference is of limited interest. In that case, the announcement of a basket of n major currencies can be verified with $n + 1$ observations. But in practice there is almost always some range of variation in the observed exchange rate data, even if it is only within a narrow bid-ask spread quoted

28. Governments may have an incentive to postpone devaluations until after elections. See Stein and Streb (1998, 1999).

by the banking system, or within the ± 1 percent range that constituted a fixed exchange rate under the rules of the Bretton Woods system. Then the problem of statistical inference is not trivial, especially if nervous speculators need to be reassured in a matter of days rather than months. For bands of substantial width, the statistical inference can in fact be difficult, as we shall see. This is all the more true if one allows for the ever-present possibility of shifts in the parameters—basket weights, band width, rate of crawl, or level of parity—or changes in the regime altogether, especially if some of these shifts are not announced.

We start with an analysis of the actual basket band followed by Chile during most of the 1990s and then move on to Monte Carlo results.[29] If the currency in question is in truth following a basket band, the question of interest is how many data-points are necessary—that is, how much time must elapse—in order to verify that the data support the hypothesis. In general, we consider an anchored exchange rate regime to have been verified if it passes three tests: (1) we can find statistically significant basket parameters, that is, can reject the hypothesis that the currency is behaving like any "random" currency; (2) we fail to reject the null hypothesis that the exchange rate is following a basket peg; and (3) we have reason to believe that the second test has power to reject the null hypothesis when applied to a times series of equal length for which the null hypothesis is false. In cases where the weights are publicly announced, then we may also apply related test criteria: (4) we fail to reject that the exhibited weights are the same as those announced; and (5) we reject that the exhibited weights are equal to other possible arbitrary values, such as the weights on the special drawing rights (SDRs) or ½, ½, ½ on the three major currencies. We want to see how the ability to confirm the announced nominal regime is affected statistically by the width of the band, by the presence of more than one foreign currency in the basket, by the presence of a non-zero rate of crawl, by the government's decision whether to announce these parameters, and by the frequency of changes in the parameters. Clearly these complications slow down the attempt to verify the regime; the question is how important is this effect.

Throughout, we focus on 95 percent confidence levels. If the time required to collect data for a currency to pass these tests at 95 percent confidence levels or 5 percent significance levels is long (relative, for example, to the average length of time that these regimes tend to last), then we pronounce the regime

29. We have also begun to study other currencies. An alternative approach to the same problem would be to derive some purely analytical results.

not verifiable. If it is not verifiable, we suspect that the country cannot reap the credibility gains that an anchored exchange rate regime theoretically offers—credibility in the eyes of workers and producers who set wages and prices, and in the eyes of speculators who have the ability to attack the central bank's reserves and bring about a crisis. Verifiability contributes to viability.

The goal of our paper is to study how long it takes financial markets to learn from observable data the rules guiding the intervention behavior of monetary authorities in the foreign exchange markets. To perform both the analytical and empirical analysis, we need a basic framework and testing procedure. This section introduces the analytical framework used in the subsequent sections to verify exchange rate systems.

Basic Framework

We assume that the exchange rate for a given small country is given by a geometrical average of n foreign currencies, with a possible rate of crawl d and an error term. The log exchange rate is:

$$\log s_t = c + \log(1+d) \times t + \sum_{i}^{n} w_i \times \log s_{i,t} + \log \varepsilon_t . \qquad (1)$$

The dependent variable is the log of s_t, the spot exchange rate of the domestic currency with its value measured in terms of a numeraire that we will explain momentarily. On the right-hand side, $s_{i,t}$ are the spot exchange rates of major "strong currency countries" with the values measured vis-à-vis the same numeraire,and i denoting currency. As major currencies, we use the U.S. dollar, the Japanese yen, and the deutsche mark. The parameter d is the rate of crawl, which for now is assumed to be fixed during a given sample period. (One alternative would be to use past domestic or future inflation rates relative to international inflation rates, where the authorities are believed to be following an indexation policy.) The coefficients w_i are the weights given to the currencies included in the basket.

This general case captures many possible regimes, including simple pegs, basket pegs, crawling pegs, crawling baskets, target zones, certain forms of managed floating, and free floating. In the case of a precise basket peg, the error term vanishes, and an OLS regression can be expected to have an R^2 near 1. A dollar peg is of course the special case where the weight on the dollar is 1 and on other currencies 0. For most currencies, the error term will be important. In the case of a pure float, the error term may constitute the entire variance of the exchange rate, and the other parameters may be equal to zero. We use daily data in our empirical research, both for estimation and Monte Carlo simulations.

The question of what to use as the numeraire to measure the values of the domestic and foreign currencies is a surprisingly subtle one. In the case of precise basket pegs (or dollar pegs), the choice of numeraire makes no difference, so long as the same one is used for both dependent and independent variables alike; the correct weights should emerge, with a perfect statistical fit, regardless of the numeraire. The reason is that if equation (1) holds in terms of numeraire x, then it also holds after multiplying through by exchange rate y/x. But in the general case, the choice of numeraire will make a difference. Past studies have used a variety of different numeraires; they include the consumer basket of domestic goods,[30] the SDR,[31] the Swiss franc,[32] and the dollar.[33]

Upon further reflection, these measures are not quite right. We wish to consider regimes where the central bank monitors a central parity but routinely allows appreciations or depreciations relative to that parity in response to such factors as inflation, unemployment, trade deficits or surpluses, various market pressures, and so on. These factors are only partially accommodated under an intermediate regime such as a band or managed float, but they have a role nonetheless. We have not yet chosen to model these factors explicitly; they are subsumed in the error term. We are assigning them a log normal distribution. The authorities are presumed to be trading off the long-term credibility benefits of sticking relatively close to their central nominal parity against the monetary-independence benefits of responding to short-term developments. But in framing this trade-off, there is no reason for them to think of the departure above or below the central parity in terms of dollars or a basket of goods, and still less reason to think in terms of Swiss francs. The most useful way to phrase these appreciations and depreciations is, rather, in terms of an effective exchange rate—that is, a weighted average of trading partners' currencies.

Our central results are based on measuring values of currencies in terms of a weighted basket of the five major currency countries. (The number of currencies in the numeraire basket, representing partners that matter for the domestic country, must be greater than the number of candidate currencies in the target basket that we test for. The result, otherwise, will be perfect multicollinearity.) One possible set of weights is the bilateral trade shares of the smaller country in question. This has a drawback: it leaves out the role of all

30. Frankel (1993), emphasizing Asian currencies.
31. Frankel and Wei (1995), emphasizing policies of European currencies.
32. Frankel and Wei (1994); Ohno (1999).
33. Benassy-Quere (1999).

the other bilateral trade partners, as well as third-country markets and competitors. But most of those are linked to some combination of the major currencies. Here we adopt the simple approach of using the five countries' weights in gross world production. In this way it is hoped that, for example, the large weight of the United States will roughly reflect the importance of dollar-linked countries in the trade of Chile or Indonesia beyond the share of the United States in bilateral trade of those two countries. (A second advantage of using GDP weights is that one need not obtain the full set of bilateral trade data and recompute a new set of weights for each country. But using bilateral trade weights is a possible extension for future research.) To repeat, our choice of numeraire is the output-weighted basket of the five major currencies.

PEGS: SIMPLE PEGS, BASKET PEGS, CRAWLING PEGS, CRAWLING BASKETS

In the first case, the value of the currency follows the exchange rates of the currencies to which it is pegged, plus the crawling rule, and a stochastic error. The error is the error allowed by the government when setting the exchange rate, but it is hypothesized to be very small in these regimes. The error term is: $\log\varepsilon_t$ is *iid* $\mathbf{N}(0,\sigma^2)$. In the case of simple pegs, $n = 1$ in equation 1. Under basket pegs, $n > 1$. Crawling pegs imply $d > 0$. Under crawling baskets, $n > 1$ and $d > 0$.

TARGET ZONES

Beyond the special case of pegs is the broader case of bands or target zones. There is a central parity that could be a single peg or a basket peg. In addition, there is a band around the central parity. The government intervenes to keep the exchange rate inside the band.

In a target zone, the observed spot exchange rate s_t^* behaves as follows:

$$s_t^* = \begin{cases} -b & \text{if } s_t < -b \\ b & \text{if } s_t > b \\ v_t & \text{otherwise,} \end{cases}$$

where s_t is defined by equation (1) above and b is the upper bound of the band. We will assume that inside the band, the exchange follows $\log v_t = \rho \times \log v_{t-1} + \log u_t$, such that $\log u_t \sim \mathbf{N}(0,\sigma^2)$. If the floating exchange rate is a random walk, $\rho = 1$. If not, $\rho < 1$.

We will concentrate on the random walk case, since most exchange rate time series cannot reject the unit root hypothesis. In reality, the distribution is

likely to be somewhat more complicated than this. Even under two simplifying assumptions made by Krugman, in the famous article that generated a subfield of research on target zones—that the band is 100 percent credible and that the authorities intervene only at the boundaries—the distribution is not normal, but rather follows a particular S-shape.[34] But extensive empirical investigation of the European exchange rate mechanism (ERM) in the 1980s and early 1990s established that the spot rate does not in fact obey the predicted distribution. One reason is clearly that speculators did not have 100 percent faith that the target zones would prevail. This imperfect credibility was in the event justified by realignments in the early 1980s, and especially by the ERM crises of 1992–93. It is also relevant to the present exercise, which is based entirely on a starting point that assumes imperfect credibility. (Another explanation for why the ERM data did not fit the Krugman distribution was the prevalence of intramarginal intervention.) One extension for further research would be to use statistical distributions implied by more sophisticated versions of the target-zone theory. Another would be to take the observed statistical distribution from historical episodes such as the ERM currencies in the 1980s or 1990s. But to start with we assume the log normal distribution indicated.

Managed floating and independently floating

There are many possible patterns of exchange rate intervention. Our basic framework allows us only to test the cases when d or w_i are different from 0. In other words, the government is using some form of nominal anchor or crawling peg rule to guide its operations. All other forms of intervention are not nested in our specification. Therefore, we would not be able to reject them. Pure floating takes place when $d = 0$ and $w_i = 0$.

Testing Strategies

We apply a number of tests. Some are set up with a null hypothesis that should be rejected if the country in question is in fact following an exchange rate target, and some where the null hypothesis should not be rejected.

34. Krugman (1991). When the spot rate draws close to one edge, speculators are aware that there is a limit on how far it can continue to move in that direction. The expected value will show a regression back toward the central parity. As speculators respond to that expectation, they will push the spot rate away from the margin, even without any intervention.

HYPOTHESIS TESTING

Test 1 (T1): The first case tests whether the government uses some sort of exchange rate target as a nominal anchor and whether the rate of crawl is zero. We assume that market participants do not know what the government is doing or they do not believe the announced exchange rate regime. The null hypothesis is that the exchange rate follows a random walk with no drift. Therefore, we think of market participants as testing whether all the weights on the major currencies are jointly equal to zero. In other terms,

$$H_0: w_1 = 0 \ldots \text{and} \ldots w_n = 0 \text{ and } d = 0$$
$$H_A: w_1 \neq 0 \ldots \text{or} \ldots w_n \neq 0 \text{ or } d \neq 0.$$

Test 2 (T2): The second case is a slight modification of the base case. In this case, market participants only test whether the weights are jointly equal to zero. The null and alternative hypotheses are:

$$H_0: w_1 = 0 \ldots \text{and} \ldots w_n = 0$$
$$H_A: w_1 \neq 0 \ldots \text{or} \ldots w_n \neq 0.$$

Test 3 (T3): We complement T2 with another test. To show that T2 has size we replace the dependent (left-hand side) variable by white noise. In this case, we expect to fail to reject the null hypothesis specified in T2.

$$H_0: w'_1 = 0 \ldots \text{and} \ldots w'_n = 0$$
$$H_A: w'_1 \neq 0 \ldots \text{or} \ldots w'_n \neq 0,$$

where w'_i are the weights.

Test 4 (T4): In the third case, market participants test whether the observed weights are equal to the announced weights. Conditional on the announcement being true, we expect that this null will not be rejected. The null and alternative hypotheses are as follows,

$$H_0: w_i = \text{announced weights}$$
$$H_A: w_i \neq \text{announced weights}.$$

Test 5 (T5): T4 might raise a problem. T4 might fail to reject the null simply because we work with a short time-sample. Market participants know instinctively that a failure to reject the regime is an impressive finding only when that test would be capable of rejecting the regime in the case where it was false. In other words, we want the test to have power. To show that T4 has power, we complement the above test with another experiment in which the

same test is capable of rejecting the null hypothesis. To do this, we replace the left-hand side variable with white noise. The hypotheses tested are:

$$H_0: w'_i = \text{announced weight on currency } i$$
$$H_A: w'_i \neq \text{announced weights on currency } i.$$

ESTIMATION PROCEDURES

A variety of estimation or testing procedures are potentially applicable. Results using OLS in first differences are reported elsewhere.[35] Here, we assume that financial markets estimate error-correction models (ECMs). In fact, we also use ECMs to estimate simple and basket pegs with bands. These models simultaneously estimate the long-term and short-term relationship of the domestic exchange rates. The long-term relationship links the level of the domestic exchange rate with the level of the strong currency exchange rates. The domestic exchange rate adjusts in the short term to deviations from the long-term relationship. The ECM is estimated by the following equation, which yields estimates of w_i under T1–T5:

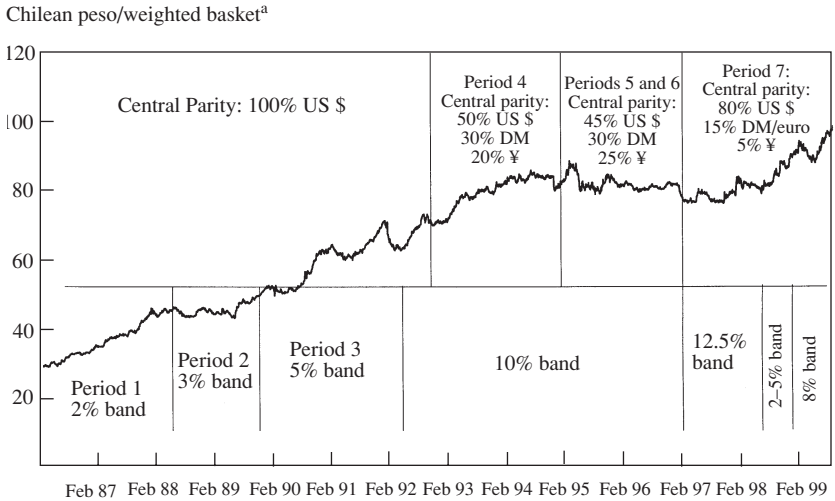
$$\Delta \log s_t = c + \gamma\left(\log s_{t-1} - \log(1+d)\times t - \sum_i^n w_i \times \log s_{i,t-1}\right) + \sum_{h=1}^{L} \beta_h \Delta \log s_{t-h} + \sum_i^n \sum_{h=1}^{L} \beta_{i,h} \times \Delta \log s_{i,t-h} + \log \varepsilon'_t. \quad (2)$$

The Case of Chile

To provide a background and provide a motivation for our Monte Carlo results below, we first focus on the particular case of the Chilean peso. We select the case of Chile because during most of the 1990s it provided a relatively transparent example of a basket peg with a band. The parameters configuring the basket peg and the band width were publicly announced. Thus if we conclude that the Chilean exchange rate regime was not verifiable, such a conclusion is likely to apply even more strongly to other countries in Latin America or Asia, where governments often have not announced explicit regimes or the parameters in them, or in some cases have not for long abided by the regime they announced.

35. Frankel, Fajnzylber, Schmukler, and Servén (2000).

Figure 2. Chilean Exchange Rate Arrangements, 1986–99



Source: Authors' calculations based on data from Bloomberg and Central Bank of Chile.
a. U.S. dollar (US $), deutsche mark (DM), Japanese yen (¥).

Data Description

A number of successive exchange rate regimes have been in place in Chile since the early 1980s. In 1982 Chile had a crawling peg vis-à-vis the U.S. dollar, with daily devaluations following the difference between domestic and external inflation. The peg to the dollar continued until 1992, with bands of varying width around the central parity and with realignments of the central parity. In 1992 the government decided to adopt a target zone around a basket peg. The weights in the central parity changed over time and there were realignments, but the central parity was always tied to the U.S. dollar (US $), the deutsche mark (DM), and the Japanese yen (¥). In September 1999 the central bank decided to float the peso. A full chronology of the exchange rate system in Chile is displayed in appendix table A1. Figure 2 illustrates the band arrangements.[36]

We analyze the case of Chile by looking at seven subperiods, selected on the basis of a minimum duration (specifically, those comprising at least 249 daily observations, amounting to approximately one year). The first three subperiods involve a peg to the U.S. dollar with a band. The last four involve a basket peg with a band. For each of the seven subperiods, figure 2 lists the

36. See Ffrench-Davis, Agosin, and Uthoff (1995); Williamson (1996); and Vergara (1994).

announced weights in the central parity and the band around the central parity. The figure summarizes the main aspects of the evolution of the exchange rate regimes in Chile and shows that the trend of the peso has been to depreciate over time, with significant appreciations and depreciations on several occasions.

The dolar acuerdo or central parity

On July 3, 1992, the Chilean central bank established a basket of three foreign currencies, the U.S. dollar, the deutsche mark, and the Japanese yen, with weights of 50 percent, 30 percent, and 20 percent, respectively. The so-called *dolar acuerdo* (or central parity given by the basket rule) is computed as a function of two bilateral exchange rates. This rule establishes that the peso-U.S. dollar exchange rate is a function of the peso-deutsche mark and the peso-yen exchange rates.

The Chilean exchange rate vis-à-vis the U.S. dollar is calculated using the formula

$$X_t = \frac{C_t}{C_0} \times X_0 \times \frac{1}{w_1 + w_2 \frac{D_0}{D_t} + w_3 \frac{J_0}{J_t}}.$$

As this is not a linear function of the parameters, a more convenient representation is:

$$\frac{X_0}{X_t} = w_1 \frac{C_0}{C_t} + w_2 \frac{D_0}{D_t} \frac{C_0}{C_t} + w_3 \frac{J_0}{J_t} \frac{C_0}{C_t}, \tag{3}$$

where

C_t: value of basket at time t (in Chilean pesos)
C_0: value of basket at the beginning of the period (in Chilean pesos)
X_t: exchange rate of Chilean peso vis-à-vis the U.S. dollar at time t
X_0: exchange rate of Chilean peso vis-à-vis the U.S. dollar at time 0
w_1, w_2, w_3: weights in the basket
D_t: exchange rate of Chilean peso vis-à-vis the deutsche mark at time t
D_0: exchange rate of Chilean peso vis-à-vis the deutsche mark at time 0
J_t: exchange rate of Chilean peso vis-à-vis the Japanese yen at time t
J_0: exchange rate of Chilean peso vis-à-vis the Japanese yen at time 0.

The Chilean authorities used to report daily the *dolar acuerdo,* or central parity. This central parity is determined ex ante by the announced weights of the peg. The central bank simply computes the central parity according to the

spot exchange rate of the strong currencies. The actual Chilean peso could not be outside a predetermined distance of the central parity if the band was not to be violated. As already noted (see figure 2), the central parity is a simple peg during the first three periods we analyze and a basket peg during the last four periods.

As a benchmark, we apply the same tests mentioned above to the central parity. This helps us determine the effect of the width of the band on our verifiability assessment, since the tests on the central parity amount to testing the identifiability of a zero-width band. In addition, the case of Chile also helps us determine the effect of one versus more currencies in the basket, as the central parity in the first three periods contains only one currency (the U.S. dollar), while the last three periods involve three currencies.

THE CONSTRUCTION OF THE NUMERAIRE

All exchange rates are measured relative to a numeraire. As explained above, the numeraire is based on a weighted basket of major currencies. The weights are based on the 1991 GDP shares of five countries: the United States, France, Germany, Japan, and the United Kingdom. The shares are 39.2 percent, 9.2 percent, 14.3 percent, 31 percent, and 6.4 percent, respectively. Specifically, we use the GDP at market prices (constant 1995 U.S. dollars) obtained from the World Bank World Development Indicators 2000.

The above equation is rewritten and expressed in terms of the numeraire. The equation we estimate is the following:

$$s_t = c + w_{US\$} \times s_{US\$,t} + w_{DM} \times s_{DM,t} + w_{¥} \times s_{¥,t} + v_t. \qquad (4)$$

The exchange rates are defined as follows:

s : spot exchange rate between the Chilean peso and the numeraire (US$/*N*)

$s_{US\$}$: spot exchange rate between the U.S. dollar and the numeraire (US$/*N*)

s_{DM} : spot exchange rate between the deutsche mark and the numeraire (DM/*N*)

$s_{¥}$: spot exchange rate between the Japanese yen and the numeraire (¥/*N*).

The exchange rates, both of the major currencies and the Chilean peso, are calculated as the number of units of the currency necessary to purchase a geometrically weighted basket of strong currencies. Table 1 reports the summary statistics of the currencies under consideration.

Table 1. Changes in Currency Values, February 1986–August 1999
Daily data, log differences (percent)

	Summary statistics			
Statistic	*Chilean peso*	*U.S. dollar*	*Deutsche mark*	*Japanese yen*
Mean	0.036	0.006	0.000	-0.009
Standard deviation	0.488	0.362	0.462	0.434
Minimum	-4.585	-2.069	-2.526	-4.863
Maximum	3.784	2.822	3.415	2.602
	Correlation matrix[a]			
Currency	*Chilean peso*	*U.S. dollar*	*Deutsche mark*	*Japanese yen*
Chilean peso	1	…	…	…
U.S. dollar	0.72	1	…	…
Deutsche mark	-0.32	-0.42	1	…
Japanese yen	-0.58	-0.81	-0.15	1

Source: Authors' calculations
a. All exchange rates are relative to the weighted basket. Weights for deutsche mark, Japanese yen, British pound, U.S. dollar: 15.7 percent, 34.1 percent, 7.0 percent, 43.2 percent, respectively.

Results

All estimations and tests are performed using each of three series as dependent variable: the actual peso exchange rate, a randomly generated series, and the daily announced central parity. The estimations are reported on each of the seven exchange rate regimes. We focus on two types of results: point estimates of the weights composing the central-parity basket; and Wald tests of the hypotheses that the estimated coefficients equal those announced by the authorities or, alternatively, equal zero.

We first review the point estimates of each model's parameters at sample sizes of fifty and one hundred observations. These estimates tell us how well market participants can estimate the weight of the central parity when the regimes are fifty and one hundred days old. The results are displayed in table 2, which presents both the point estimates of the U.S. dollar weight and their reported standard errors. (To save space, we do not report the point estimates of the other currencies' weights.) When using the central parity as dependent variable, the estimates of the U.S. dollar weight converge to the announced values fairly quickly.

Next, when using the randomly generated series as dependent variable, we find that the coefficient estimates are almost invariably small relative to their reported standard errors. The error-correction estimates are fairly close to zero in most cases. Perhaps more important, when using the actual exchange rate as dependent variable, a contrast emerges between subperiods 1–3 and 4–7.

Table 2. Chilean Exchange Rate Regime: Point Estimates of U.S. Dollar Weight, Error-Correction Model[a]

		Fifty observations			*One hundred observations*		
Period	*Announced weight*	*Chilean peso*	*White Noise*	*Central parity*	*Chilean peso*	*White Noise*	*Central parity*
1	1	0.93	-0.03	1.00	1.00	0.00	1.00
		(0.23)	(0.02)	(0.00)	(0.01)	(0.01)	(0.00)
2	1	1.01	-0.04	1.00	1.01	0.01	1.00
		(0.00)	(0.15)	(0.00)	(0.00)	(0.08)	(0.00)
3	1	0.95	0.08	1.00	0.95	0.01	1.00
		(0.00)	(0.06)	(0.00)	(0.00)	(0.03)	(0.00)
4	0.50	1.80	-0.04	0.49	0.68	-0.04	0.48
		(0.21)	(0.02)	(0.01)	(0.54)	(0.02)	(0.01)
5	0.45	5.15	-0.13	0.45	3.57	0.01	0.44
		(2.67)	(0.09)	(0.03)	(7.56)	(0.01)	(0.00)
6	0.45	-3.06	-0.11	0.46	-1.61	-0.21	0.46
		(1.20)	(0.49)	(0.01)	(0.58)	(0.28)	(0.01)
7	0.80	4.80	-0.07	0.81	3.07	-0.02	0.81
		-3.66	(0.05)	(0.00)	(0.85)	(0.04)	(0.00)

Source: Authors' calculations based on data from Bloomberg and Central Bank of Chile.

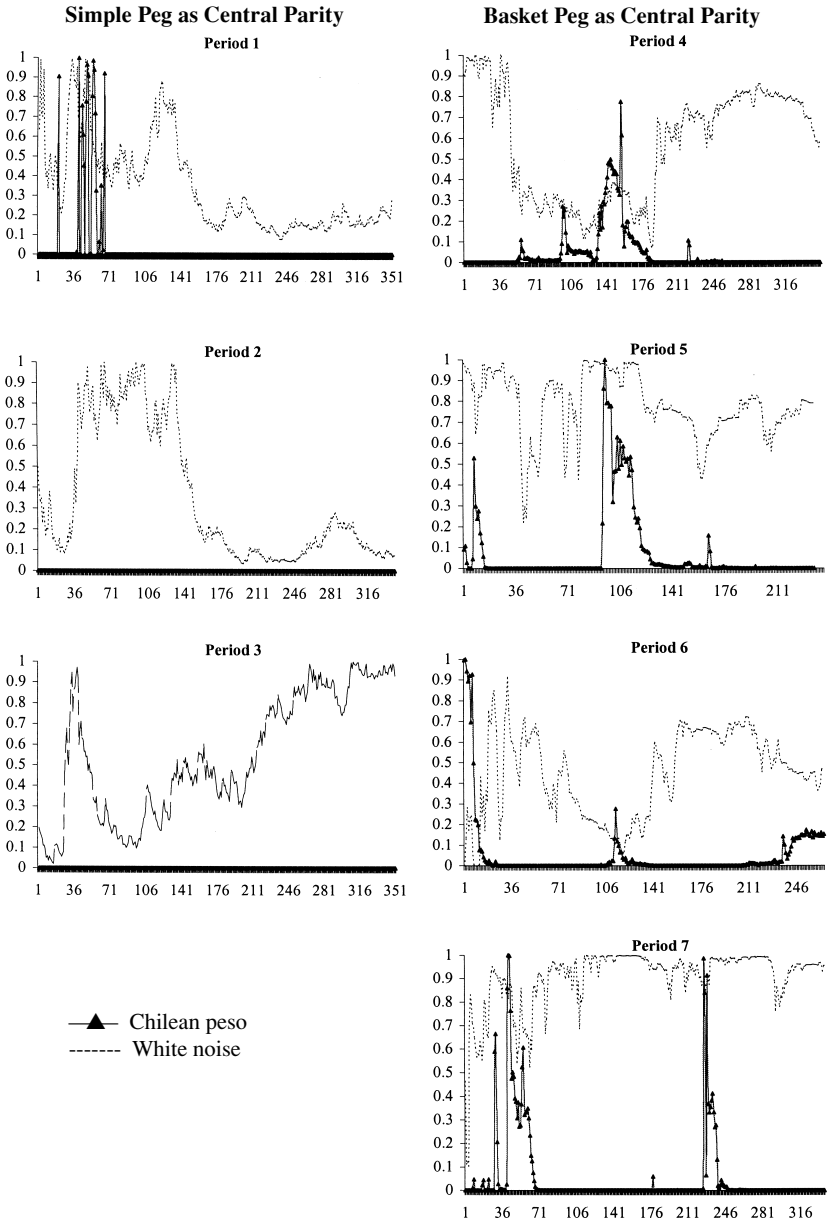
a. Standard errors are in parenthesis. Error-correction model estimates are obtained using maximum likelihood, with one lag structure.

In the former subperiods, the error-correction estimates approach the announced value rather quickly—by observation fifty, they are not more than 5 percent apart from it.

In contrast, for subperiods 4–7 the estimates do not appear close to the announced values. Indeed, some point estimates are negative and large, and precision is in general much poorer according to the reported standard errors. The estimates for the true peso value are, if anything, farther off than the estimates for the white noise variable. The only exception is subperiod 4 using one hundred observations; the estimate becomes closer to the announced value. Thus the conclusion is that in subperiods 4–7 none of these simple estimators comes close to the true basket weights, even after a reasonably large number of observations, except in one case.

We next turn to formal hypothesis tests on the parameter estimates. Specifically, we test the null hypotheses that (a) the estimates of the weights on the various currencies are jointly different from zero (Test 2 above), and (b) the estimates equal the announced weights (Test 4 above). We report the tests only for the estimates obtained using as dependent variable the actual exchange rate and the randomly generated series. (Comparable tests using instead the central parity yielded trivial results—rejection of the zero-weights and nonrejection of the announced weights in every subperiod and for every sample size.)

Figure 3. Chilean Exchange Rate Regime[a]
P-Value—Test 2 and 3[b] Error Correction Model



Source: Authors' calculations based on data from Bloomberg and Central Bank of Chile.

a. The results for central parity as a dependent variable are not reported, since they always fail to reject the null hypothesis of weight = 0. The error-correction model is estimated with one lag structure.

b. H_0: Weight = 0.

Figure 3 reports marginal significance levels for the null of zero weights, corresponding to the error-correction estimates. The graph plots the p-values against sample size for each of the seven subperiods under consideration. It is apparent that the null can be rejected even at small sample sizes in the case of the actual exchange rate—with the exception of a couple of brief intervals—and cannot be rejected in the case of the randomly generated series, again excepting a brief stretch in subperiod 2.

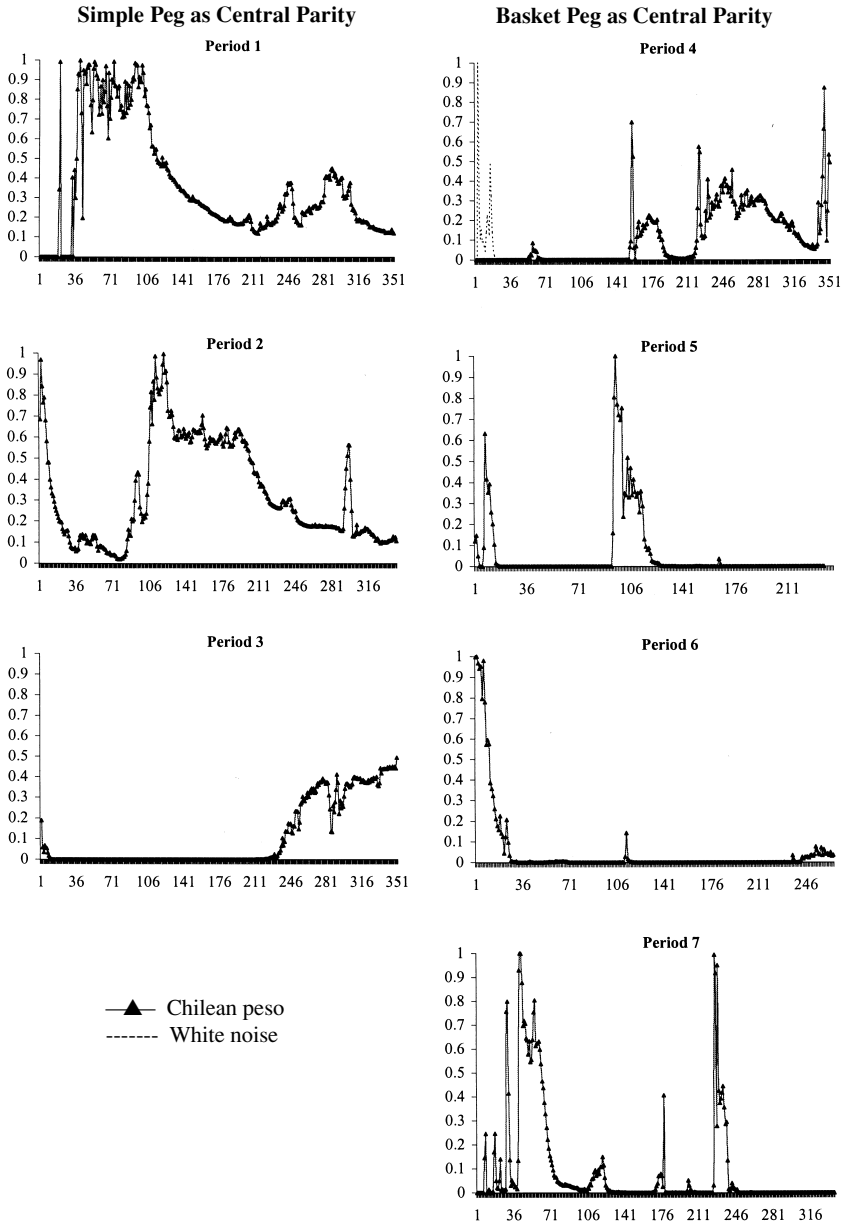
Next, figure 4 reports marginal significance levels for the null that the estimates equal the announced weights for each regime. Thus the goal is now to fail to reject the null hypothesis. The figure reveals a stark contrast between subperiods 1–4 and 5–7. The error-correction estimates from the actual exchange rate series reject the null in subperiods 5–7 (except for some brief intervals) and fail to reject in subperiods 1–4. This latter result is achieved after a considerable stretch of consecutive rejections, especially in subperiods 3 and 4 (and to a more limited extent in period 2 as well). For the randomly generated series, the error-correction estimates clearly reject the announced weights for every sample size and subperiod.

On the whole, these results strongly suggest that the widening of the band, as well as the adoption of multiple instead of simple pegs—the two features that characterize the evolution of Chile's exchange regime between subperiods 1 and 7— appear to make more difficult the verification of the announced regime using simple econometric estimates.

By way of summary of our results, we present in table 3 a rough and somewhat subjective estimate of "verification time"—that is, the sample size required to reject *irreversibly* the (false) null hypothesis that the currency weights are zero, or to stop *irreversibly* rejecting the (true) null that the currency weights equal their announced values. By *irreversibly* here we mean that the test outcome is not reversed at larger sample sizes. If this irreversible outcome is never obtained at any sample size, we enter a ∞ in the corresponding column in the table. The table presents this information for each subperiod. Finally, we also note in the table their overall precision, defined as high (H) if the confidence region extends no farther than 25 percent above or below the parameter's true value, and as low (L) otherwise.

The table shows that the null of zero weights can be rejected from the start only in subperiods 2 and 3. In subperiod 6, it cannot be rejected even with the full sample. Likewise, it takes some time to stop rejecting the announced weights—from a moderate sample size of forty in subperiod 1 to more than two hundred observations in subperiods 3–4. In the last three subperiods, the

Figure 4. Chilean Exchange Rate Regime[a]
Wald Statistic—Test 4 and 5[b] Error-Correction Model



Source: Authors' calculations based on data from Bloomberg and Central Bank of Chile.

a. The results for central parity as a dependent variable are not reported, since they always fail to reject the null hypothesis of weight = 0. The error-correction model is estimated with one lag structure.

b. H_0: Weight = 0.

Table 3. Chilean Exchange Rate Regime: Number of Observations Necessary to Reject the Null Hypothesis

	OLS in First Differences *Dependent variable: Spot exchange rate*		
Period	*Weights (0)*	*Weights (announcement)*	*Precision*[a]
1	1	1	L
2	1	1	L
3	1	1	L
4	1	∞	L
5	1	∞	L
6	1	∞	L
7	1	∞	L
	Error-Correction Model *Dependent variable: Spot exchange rate*		
Period	*Weights (0)*	*Weights (announcement)*	*Precision*[a]
1	70	40	H
2	1	80	H
3	1	220	H
4	180	220	L
5	130	∞	L
6	∞	∞	L
7	240	∞	L

Source: Authors' calculations based on data from Bloomberg and Central Bank of Chile.
a. Precision of estimates: H: high; L: low; ∞: never.

estimates never converge to the announced values. Precision of the estimates is quite good in the first three subperiods, and quite poor in the last four.

Monte Carlo Simulations

We turn now to the Monte Carlo simulations, which offer a more general testing ground for verifiability of intermediate regimes. For our experiments, we generate 1,000 samples according to the simple model described by equation 1, using for the baskets actual data on the exchange rates of the major currencies (valued in terms of the GDP-weighted numeraire). We use daily data between February 1986 and August 1999. The parameters of the data-generating process are c (level of exchange rate), d (yearly rate of crawl), $w_1 \ldots w_3$ (weights on U.S. dollar, deutsche mark, and Japanese yen), σ (standard deviation of the error term), and t_0 (initial observation). In the Monte Carlo simulation, the log error term is generated as *iid* normal with mean zero. On

the basis of this framework, we study the effect of different model specifications on the amount of time required to reject our proposed null hypotheses.

Role of Band Size

Clearly, it should be harder to verify a basket regime with a wide band than one with a narrow band, and harder to verify a basket regime with a loosely managed float (that is, a small tendency to intervene when the exchange rate drifts from the parity) than another with a tightly managed float (a strong tendency to intervene). To verify the role of band size in determining the amount of information needed to reject the proposed null hypotheses, we generate sets of 1,000 samples, according to equation 1. Each set has a different standard deviation of the underlying disturbance (σ), representing different band sizes.

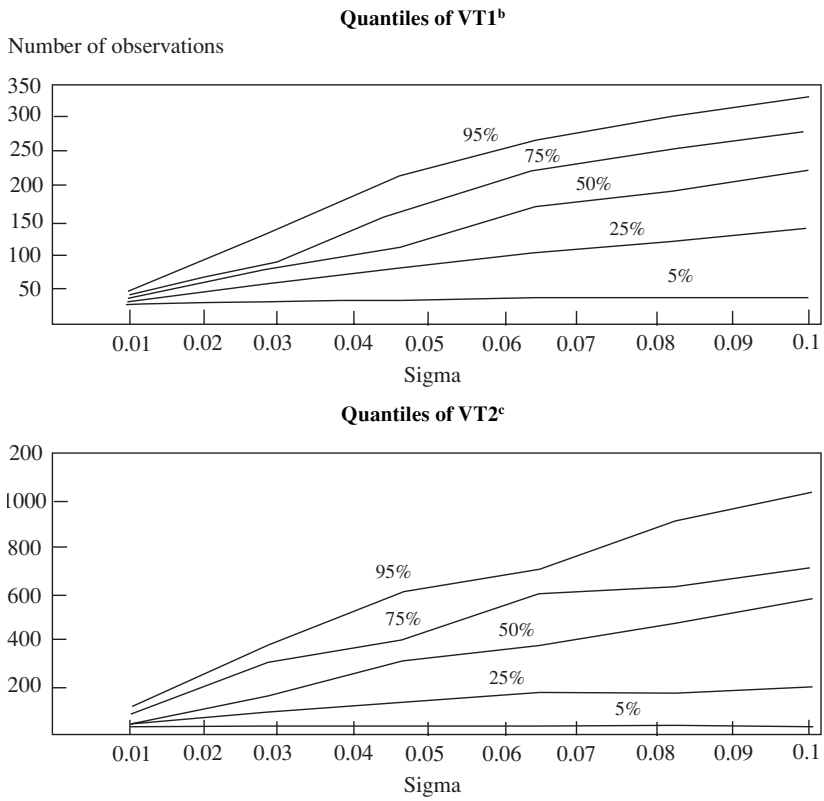
For each sample, we calculate the number of observations necessary to obtain ten rejections of the null hypothesis that both the weights and the rate of crawl are zero (test 1), and the null hypothesis that the weights are zero (test 2). We label these sample sizes VT1 and VT2, respectively, where VT stands for *verification time*.

For this exercise, we generate the samples using a level parameter equal to 1, a rate of crawl of 1 percent a year, and equal weights for all major currencies, and starting from observation 1 (February 24, 1986). We let the standard deviation σ vary from 1 percent to 10 percent. In this regard, recall that 2 percent was the width of Chile's band from mid-1985 to January 1988, and 10 percent was the width of the band during the period 1992–97. For purposes of comparison, 2.25 percent was the width of the ERM target zone followed by many European countries up until 1992 (and still followed today by Denmark), 6 percent is the width of the ERM target zone followed by Italy and the United Kingdom up to 1992, and 15 percent is the width of the ERM zone for France and others from 1992 until the beginning of European monetary union (EMU) in January 1999.

The results appear in figure 5. The graphs plot the quantiles of VT1 and VT2 against the standard error (σ) used to generate the samples. Each line corresponds to one quantile and depicts the number of observations needed to achieve rejection of the null hypothesis (at the 5 percent level) in x percent of the 1,000 samples—where x is the quantile in question.

As expected, the graphs show that, for both tests, the number of observations needed to reject the null of zero weights and rate of crawl in any given percentage of the samples rises steadily with σ. This is reflected by the fact

Figure 5. Monte Carlo Simulations—Role of Band Size[a]



Source: Authors' calculations based on Bloomberg data.

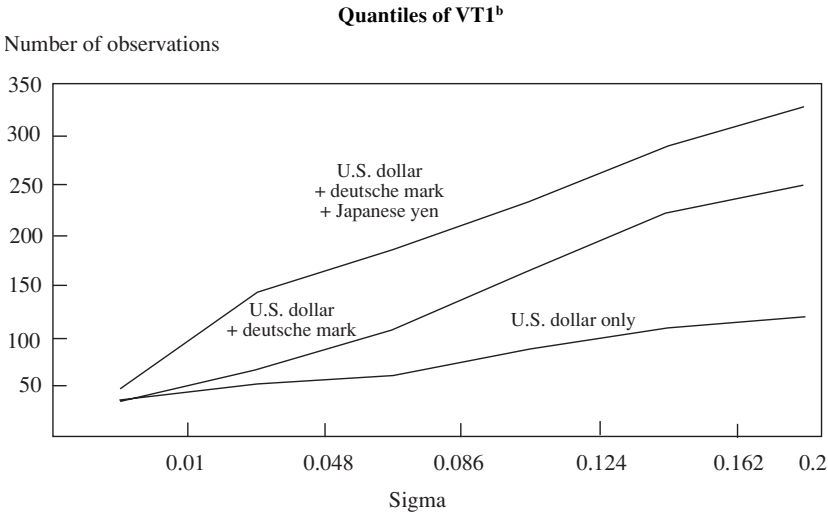
a. Parameters of estimations: 1,000 samples; weights on dependent variables 1/3 for U.S. dollar, deutsche mark, and Japanese yen; initial observation February 24, 1986; constant = 1; rate of crawl = 0.10; sigma = {0.01; 0.028; 0.046; 0.064; 0.082; 0.1}. Quantile values are calculated for the first ten rejections.

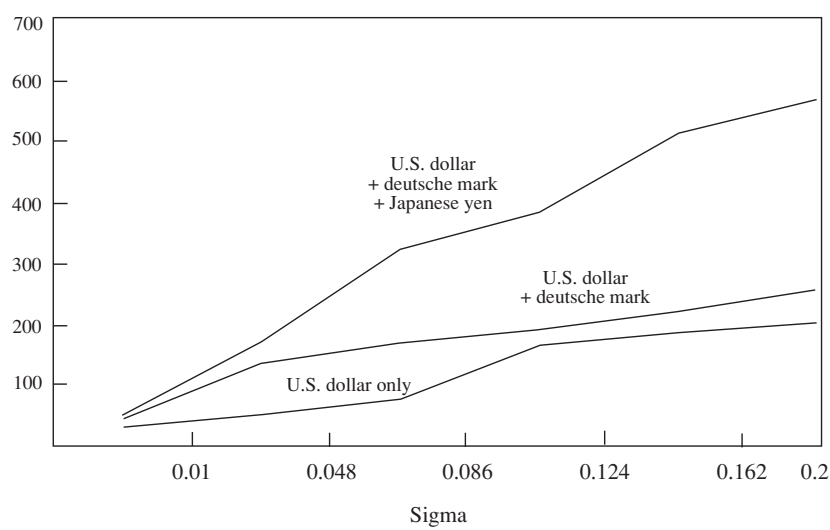
b. Weights = Rate of Crawl

c. Weights = 0

that the lines corresponding to the various quantiles have positive slopes. In other words, wider bands make it more difficult for investors to reject specific hypotheses concerning the weights of the central parity—they need more time to get an accurate assessment of the parameter values. And the additional time needed is not negligible. For test 2, for example, the number of observations needed to reject the null in 50 percent of the samples ranges from less than 100 days for an ERM-sized band (2 percent width) to more than 500 for a Chilean-sized one (10 percent width).

Figure 6. Monte Carlo Simulations—Role of Number of Currencies in Basket[a]





Source: Authors' calculations based on Bloomberg data.

a. Parameters of estimations: 1,000 samples; initial observation February 24, 1986; constant = 1; rate of crawl = 0.10; sigma = {0.01; 0.048; 0.086; 0.124; 0.162; 0.2}; weights on dependent variables are 1, 1/2, and 1/3 for one, two, and three currencies in the basket, respectively. Quantile values are calculated for the first ten rejections.

b. Weights = Rate of Crawl = 0 =b.

c. Weights = 0 = NC.

Role of Number of Currencies in Basket

Intuitively, the larger the number of unknown parameters that need to be estimated, the harder it should be to verify that the data match the announced policy regime.

To verify this assertion, we next examine the impact of different basket sizes on the amount of information needed to reject the nulls underlying T1 and T2. For this purpose, different numbers of currencies were included in the data generating process. We construct a simple peg (the U.S. dollar), a two-currency basket (the U.S. dollar and the deutsche mark), and a three-currency basket (the U.S. dollar, the deutsche mark, and the Japanese yen). In each basket the currencies are equally weighted. The other assumptions are as in the previous exercise.

The results are portrayed in figure 6. To avoid cluttering the pictures, only the medians of VT1 and VT2 (defined as before) are presented. They are plotted against alternative values of the standard deviation of the random disturbance assumed in the simulation.

As expected, increasing the number of currencies in the basket shifts the quantile lines upward, reflecting the fact that for any given value of the standard deviation more observations become necessary to reject the null hypotheses. As before, the increase in information requirements is sometimes substantial. For example, with a band width of 10 percent (as observed in Chile in recent times), moving from a single- to a three-currency basket raises the 50 percent quantile of T2 by more than two hundred observations—implying that an extra year of data becomes necessary to reject the null hypothesis.[37]

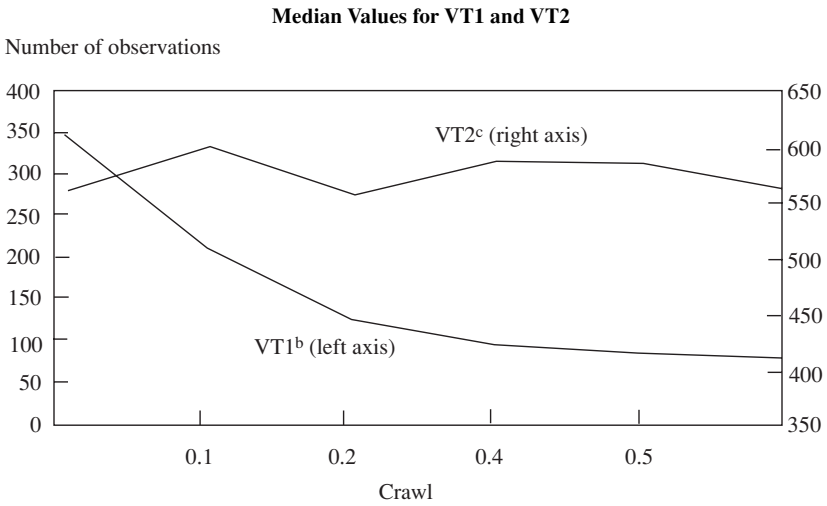
Role of Rate of Crawl

What about the rate of crawl? Simply introducing a new parameter should not make verification more difficult. Its value should have little consequence for T2, which is concerned only with the basket weights. However, for T1 it can make a big difference—rates of crawl further away from zero must help reject the null hypothesis more quickly, since the latter involves a zero rate of crawl.

This is verified in figure 7, which shows the effects of different rates of crawl on the verification time, as reflected by the 50 percent quantile of VT1 and VT2. For a given value of σ ($\sigma = 0.1$), we generate different samples assuming increasing rates of crawl. As expected, VT1 (measured by the left scale)

37. There are approximately 261 trading days a year.

Figure 7. Monte Carlo Simulations—Role of Rate of Crawl[a]



Source: authors' calculations based on Bloomberg data.

a. Parameters of estimations: 1,000 samples; initial observation February 24, 1986; constant = 1; rate of crawl = {0.01; 0.108; 0.206; 0.304; 0.402; 0.5}; sigma = 0.1; weights on dependent variables are equal to 1/3 for each currency in the basket. Median values are calculated for the first ten rejections.

b. VT1: Weights = Rate of Crawl = 0 = b.

c. VT2: Weights = 0.

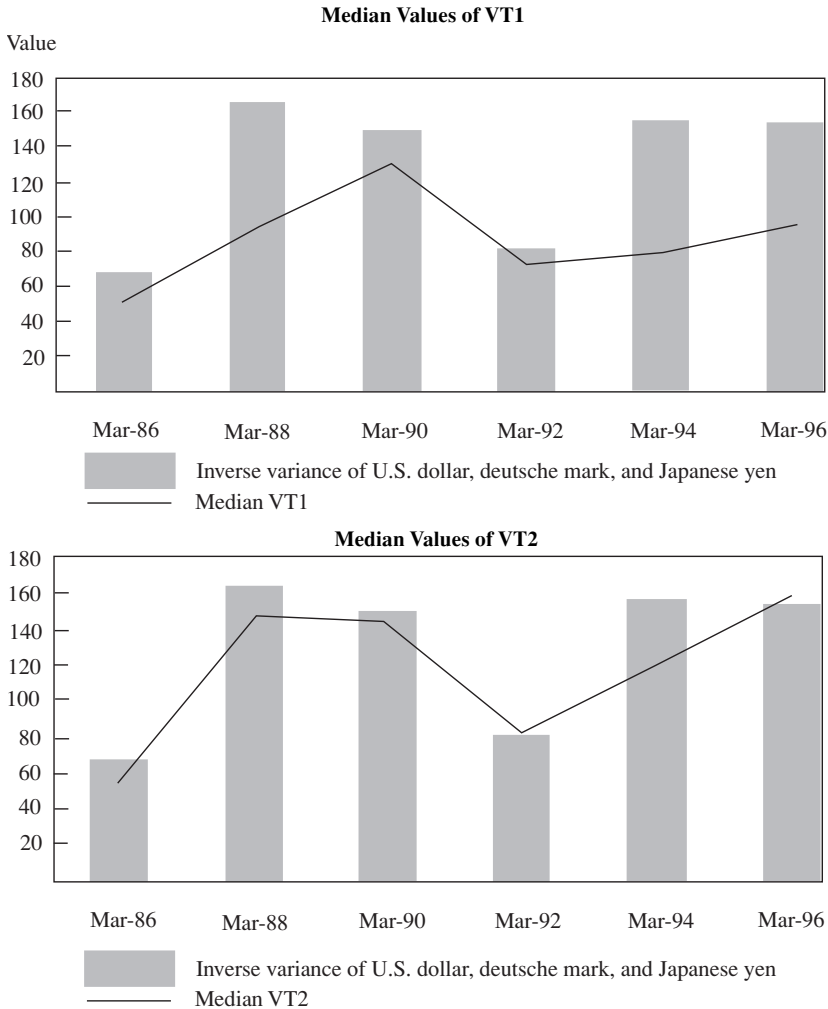
declines steadily as the rate of crawl rises away from zero, while VT2 (measured by the right scale) shows only modest variation.

Role of Period

The power of these tests depends on the precision of the parameter estimates, itself given by the noise-to-signal ratio—or the relative size of the variances of the dependent and independent variables. When the variance of the dependent variable is large relative to the variance of the independent variable, the estimates are imprecise and it is difficult to reject a given null hypothesis. Since these relative variances are not constant over time, the verifiability of a given model may depend on the specific time period over which it is observed.

This can be assessed using data from different time periods to carry out T1 and T2. Since our experiments use actual data on the hard currencies, any differences in VT1 and VT2 across replications using hard-currency data from different time periods should be attributed to changes over time in the variance-covariance matrix of the hard currencies.

Figure 8. Monte Carlo Simulations—Role of Period and Variability of Regressors[a]



Source: authors' calculations based on Bloomberg data.

a. Parameters of estimations: 1,000 samples; weights on dependent variables 1/3 for U.S. dollar, deutsche mark, and Japanese yen; constant = 1; rate of crawl = 0.10; sigma = 0.005. Median values are calculated every two years for the first ten rejections. Inverse Variance is the inverse of the average standard error of the three currencies, for the first fifty observations of each respective period.

The results of such an experiment are reported in figure 8, which shows the median values of VT1 and VT2 obtained when the simulations use hard-currency data from different periods in 1986–96, assuming a three-currency basket with equal weights.

To facilitate the interpretation of the results, we also show in the figure a measure of the variance of the values of the hard currencies—specifically, the inverse of the average of their standard deviations. As the graph shows, variability of the hard-currency exchange rates was particularly high in the first and fourth periods considered. This results in a clear reduction in VT1 and VT2 in such periods, relative to the rest.

Summary of Conclusions Regarding Verifiability

The new conventional wisdom is that intermediate exchange rate regimes, such as baskets, crawls, and bands, are no longer viable. According to this proposition, countries are being pushed to the "corners," the extremes of either free floating or firm fixing. We have argued that a theoretical rationale for this proposition is currently lacking; none of the candidates offered—the Impossible Trinity, the dangers of unhedged foreign liabilities, or government reluctance to abandon ship in time—is quite up to the job. We offered a possible rationale by introducing the notion of *verifiability*. By verifiability we mean the ability of a market participant to infer statistically from observed data that the exchange rate regime announced by the authority is in fact in operation. Verifiability is an instance of transparency, a means to credibility. Our point is that a simple regime such as a clear dollar peg or free float may be more verifiable by market participants than a complicated intermediate regime.

We began the analysis with the case of Chile, which has followed various combinations of basket pegs, crawls, and bands over the last two decades. From 1982 to 1992, when the band was relatively narrow and the peg was simply to the dollar, fifty observations was generally a large enough sample to achieve some sort of statistical verification. But from 1992 to 1999, when the band was relatively wide and the peg was to a basket of currencies, verification was not possible. On the whole, the results suggest that both the widening of the band and the adoption of multiple pegs make the verification of the announced regime by simple econometric estimates more difficult.

We continued the analysis by means of Monte Carlo tests. We began with the effect of the width of the band on verifiability. As expected, when the range of variability is small, the number of observations needed to reject that the weights and the rate of crawl are zero is relatively small. For larger variances, the number of observations needed to reject the null hypothesis increase. The number of observations needed to differentiate the crawling basket from a ran-

dom currency in at least half of the samples is less than one hundred days when the band width is 2 percent (as it was for Chile from 1985 to 1988), but is more than five hundred days when the band width is 10 percent (as it was for Chile from 1992 to 1997). In other words, wider bands make it more difficult for investors to verify the regime.

Second, we looked at the role of the number of currencies in the basket. Moving from a single-currency parity to a three-currency basket increases the amount of data needed to distinguish the basket from a random currency by an extra year's worth of observations (assuming a 10 percent band and again using the criterion of finding statistically significant weights at least half the time).

If we are right that it is hard for a central bank to establish credibility for its proclaimed monetary regime without verifiability, then our results confirm that complicated combinations of baskets, crawls, and bands are less likely to satisfy skeptical investors than are simpler regimes. We thus offer a possible and much-needed rationale for the hypothesis of the vanishing intermediate exchange rate regime. If it is not verifiable, it may not be viable.

The Traditional Criteria for Choosing Between Fixed and Flexible Rates

We will turn from considerations relevant for producing credibility to empirical evidence relevant for measuring credibility. But before we look at the empirical evidence on interest rate sensitivity, we note a proposition that is fundamental to the traditional framework for thinking about exchange rate regimes: It is usually presumed that the ability to set interest rates in line with local macroeconomic conditions is a major advantage of intermediate regimes, relative to rigid pegs. If this presumed advantage in fact does not exist for emerging market countries, then the traditional advantages of a firm peg would seem to dominate. This section of the paper reviews the traditional advantages of flexible versus fixed exchange rates, as background for the interest rate tests.

This is not the place to enter into an extended discussion of the advantages of fixed and floating exchange rates. The main traditional points from the textbooks can be recalled succinctly. The two most significant advantages of fixing the exchange rate, for any country, are (1) to reduce transaction costs and exchange rate risk that can discourage trade and investment, and (2) to provide a credible nominal anchor for monetary policy. The most significant advantage

of a floating exchange rate, on the other hand, is the ability to pursue an independent monetary policy: only by decoupling its currency from those of large trade partners can it decouple its interest rate from those of large partners.[38]

The Advantages of Fixed Exchange Rates and Flexible Exchange Rates

Twenty or thirty years ago, the argument most often made against floating currencies was that higher exchange rate variability would create uncertainty; this risk would in turn discourage international trade and investment. Fixing the exchange rate in terms of a large neighbor would eliminate exchange rate risk and so encourage international trade and investment. Going one step further and actually adopting the neighbor's currency as one's own would eliminate transaction costs as well and thus promote trade and investment still more.

Most academic economists have tended to downplay this argument. One reason is that exchange rate risk can be hedged through the use of the forward exchange market and other instruments. Another reason is that there have been quite a few empirical studies of the effect of exchange rate volatility on trade and some on investment; most of them find small adverse effects, if they find any at all.[39]

Nevertheless, this argument still carries weight. It looms large in the minds of European policymakers and businesspeople. Furthermore, there is new evidence on the proposition that trade and investment are substantially boosted by full monetary union, in which circumstance even the possibility of a future change in the exchange rate is eliminated, along with all transaction costs. Some recent tests of economic geography suggest that Canadian provinces are far more closely linked to each other then they are to nearby U.S. states, whether the links are measured by prices or quantities of trade. High on the list of reasons why integration seems to be so much higher between provinces

38. To be sure, other factors enter as well. Two other advantages of flexible exchange rates are that the government retains seignorage and that floating allows smooth adjustment to real shocks even in the presence of price frictions. Most of the important factors, however, are subsumed in the major arguments presented in the text.

39. Surveys of the literature, which consists primarily of time-series tests, are included in Edison and Melvin (1990) and Goldstein (1995). A more recent cross-section approach that finds statistically significant effects of bilateral exchange rate variability on bilateral trade in the 1960s and 1970s is Frankel and Wei (1995) or Frankel (1997). The negative effect disappears, however, after 1980.

within a federation such as Canada than between neighboring countries is the fact that the provinces share a common currency.[40]

Regarding the advantages of fixed exchange rates, academic economists tend to focus most on the nominal anchor for monetary policy. The argument is that there can be an inflationary bias when monetary policy is set with full discretion. A central bank that wants to fight inflation can commit more credibly by fixing the exchange rate or even by giving up its currency altogether. Workers, corporation managers, and others who set wages and prices then perceive that inflation will be low in the future, because the currency peg will prevent the central bank from expanding its monetary policy even if it wanted to (without soon jeopardizing the viability of the exchange rate peg). When workers and corporation managers have low expectations of inflation, they set their wages and prices accordingly. The result is that the country is able to attain a lower level of inflation for any given level of output. The nominal anchor argument of course presupposes that one is pegging to a hard currency, one that exhibits strong monetary discipline. After the breakup of the Soviet Union, most of the fifteen newly independent states wisely reached the judgment that the Russian ruble did not offer a good nominal anchor. The strength of the argument for basing monetary policy on an exchange rate target will also depend on what alternative nominal anchors might be available (money supply, nominal income, or price level).

The advantages of a flexible exchange rate can all be grouped under one major property: it allows the country to pursue independent monetary policy. The argument in favor of monetary independence, instead of constraining monetary policy by the fixed exchange rate, is the classic argument for discretion in place of rules. When the economy is hit by a disturbance, such as a shift in worldwide demand away from the goods it produces, the government would like to be able to respond, so that the country does not go into recession. Under fixed exchange rates, monetary policy is always diverted, at least to some extent, to dealing with the balance of payments. The combination of fixed exchange rates *and complete integration of financial markets*, which characterizes European monetary union, renders monetary policy completely powerless. Under

40. See McCallum (1995) for a quantity-based measure of trade integration and Engel and Rogers (1996, 1998) for a price-based measure. The most direct test yet of the effect of a common currency on bilateral trade is Rose (2000). Apparently, there is a discontinuous effect on trade if a pair of countries goes beyond reducing exchange rate variability to zero and eliminates the difference in currencies altogether. (This is another possible argument for the corner hypothesis.) Frankel and Rose (2000) find that the effect of a currency union is to raise openness and thereby, in the long run, real income.

these conditions, the domestic interest rate is tied to the foreign interest rate, and an expansion in the money supply has no effect. The new money flows out of the country, via a balance-of-payments deficit, just as quickly as it is created. In the face of an adverse disturbance, the country must simply live with the effects. After the fall in demand, for example, the recession may last until wages and prices are bid down, or until some other automatic mechanism of adjustment takes hold. By freeing up the currency, on the other hand, the country can respond to a recession by means of monetary expansion and depreciation of the currency. This stimulates demand for domestic products and returns the economy to desired levels of employment and output more rapidly than would the case under the automatic adjustment mechanisms on which a fixed-rate country must rely.

The argument for stabilizing the exchange rate is sometimes buttressed by reference to an increasingly evident disadvantage of free floating: a tendency toward volatility that does not always derive from macroeconomic fundamentals, including occasional speculative bubbles (possibly rational, possibly not) and crashes. The argument for flexibility, however, is correspondingly sometimes buttressed by reference to an increasingly evident disadvantage of pegging: a tendency toward borrowers' effectively unhedged exposure in foreign currency (possibly rational, possibly not), ending badly in speculative attacks and multiple equilibrium. Overvaluation and excessive volatility are possible in either regime.

Which factors are likely to dominate: the advantages of fixed exchange rates or the advantages of floating? There is no one right answer for all countries. The answer must depend, in large part, on characteristics of the country in question. If the country is subject to many external disturbances, for example, such as fluctuations in foreigners' eagerness to buy domestic goods and domestic assets (perhaps arising from business cycle fluctuations among the country's neighbors), then it is more likely to want to float its currency. In this way it can insulate itself from the foreign disturbances to some degree. On the other hand, if the country is subject to many internal disturbances, then it is more likely to want to peg its currency.

Definition of Optimum Currency Area

Many of the country characteristics that are most important to the fixed-versus-floating question are closely related to the size and openness of the country. This observation brings us to the theory of the Optimum Currency Area (OCA).[41]

41. A survey is Tavlas (1993). The issues are also reviewed by Bayoumi and Eichengreen (1994).

Countries that are highly integrated with each other, with respect to trade and other economic relationships, are more likely to constitute an optimum currency area. An optimum currency area, or OCA, is a region for which it is optimal to have its own currency and its own monetary policy. This definition, though in common use, may be too broad to be of optimum usefulness. It can be given some more content by asserting the generalization that smaller units tend to be more open and integrated with their neighbors than larger units.[42] Then an OCA can be defined as *a region that is neither so small and open that it would be better off pegging its currency to a neighbor, nor so large that it would be better off splitting into subregions with different currencies*. Even to the extent that corner solutions are appropriate for given countries, the optimal geographic coverage for a common currency is likely to be intermediate in size: larger than a city and smaller than the entire planet.

The Traditional OCA Criteria

Why do the OCA criteria depend on integration? The advantages of fixed exchange rates increase with the degree of economic integration, while the advantages of flexible exchange rates diminish. This is clearest when integration is defined in terms of trade but is also true for several other country characteristics:

—*Openness*. Recall the two principal advantages of fixing the exchange rate that we identified above: (1) to reduce transaction costs and exchange rate risk that can discourage trade and investment, and (2) to provide a credible nominal anchor for monetary policy. If traded goods constitute a large proportion of the economy, then exchange rate uncertainty is a more serious issue for the country in the aggregate.[43] Such an economy may be too small and too open to have an independently floating currency.

—*Labor mobility*. The OCA criterion originally offered by Robert Mundell was labor mobility,[44] here defined as the ease of labor movement between the country in question and its neighbors. If the economy is highly integrated with its neighbors by this criterion, then workers may be able to respond to a local recession by moving across the border to get jobs, so there is less need for a local monetary expansion or devaluation.

42. Gravity model estimates suggest that for every 1 percent increase in the size of a country's economy, its ratio of trade to GDP falls by about 0.3 percent. (Frankel [1997, pp. 58, 62, 64–65]).

43. This is the rationale for the openness criterion originally suggested by McKinnon (1963).

44. Mundell (1961).

—*Fiscal cushions*. The existence of a federal fiscal system to transfer funds to regions that suffer adverse shocks offers another way to help mitigate macroeconomic fluctuations in the absence of an independent currency.

—*Symmetry*. To the extent that shocks to the two economies are positively correlated, monetary independence is not needed in any case: the two can share a monetary expansion in tandem.

—*Political willingness to accept neighbors' policies*. To the extent that domestic residents have economic priorities, especially on fighting inflation versus unemployment, that are similar to those of their neighbors, there will be less need for a differentiated response to common shocks.

Currency Boards and Dollarization: Do They Make Interest Rates More Sensitive, or Less?

A popular hypothesis is that countries are abandoning their independent currencies in favor of the firmest institutional constraints possible: either a currency board or outright monetary union with one of the major-currency countries.

Currency Boards

A currency board is a monetary institution that issues only currency that is fully backed by foreign assets. Its principal attributes include the following:

—an exchange rate that is fixed not just by policy, but by law,

—a reserve requirement stipulating that each dollar's worth of domestic currency is backed by a dollar's worth of foreign exchange reserves, and

—a self-correcting balance-of-payments mechanism, in which a payments deficit automatically contracts the money supply, resulting in a contraction of spending.

The introduction of currency board–like arrangements in Hong Kong (1983), Argentina (1991), Estonia (1992), Lithuania (1994), Bulgaria (1997), Bosnia (1998) and two smaller countries constitutes a resurgence in their use worldwide. A currency board can help to create a credible policy environment by removing from the monetary authorities the option of printing money to finance government deficits. Argentina, for example, has benefited from such credibility. Argentina was prompted to adopt a currency board (which it calls the convertibility plan) because of a dramatic hyperinflation in the 1980s and the absence of a credible monetary authority. Since 1991, Argentina has

become a model of price stability and has achieved laudable growth rates, aside from setbacks such as the Mexican peso "Tequila"–induced recession in 1995, from which Argentina soon rebounded strongly. By most accounts, the currency board has worked for Argentina.

And yet Argentina does not fit well the traditional OCA criteria. It is not particularly small or open, or subject to high labor mobility or close correlation with the U.S. economy. Although the traditional OCA criteria are still relevant, we have become aware of a new set of criteria that is also relevant, particularly to the decision to adopt an institutional commitment to a fixed rate. The new characteristics have to do with credibility and the need to satisfy international financial markets. The additional criteria are:

—a strong (even desperate) need to import monetary stability due to either a history of hyperinflation, an absence of credible public institutions, or unusually large exposure to nervous international investors,

—a desire for further close integration with a particular neighbor or trading partner (which has the added advantage of enhancing the political credibility of the commitment),

—an economy in which the foreign currency is already widely used,[45]

—access to an adequate level of reserves,

—rule of law, and

—a strong, well-supervised, and regulated financial system.[46]

Currency board supporters have recently pushed for their wider use—in particular, for Indonesia, Russia, and Ukraine. Proclaiming a currency board does not automatically guarantee the credibility of the fixed rate peg. Little credibility is gained from putting an exchange rate peg into the law in a country where laws are not heeded or are changed at will. A currency board is unlikely to be successful without the solid fundamentals of adequate reserves, fiscal discipline, and a strong and well-supervised financial system, in addition to the rule of law.[47]

45. In a country that is already partially dollarized, devaluation is of little use. If many wages and prices are already tied to the dollar, they will simply rise by the same amount as the exchange rate. If liabilities are already denominated in dollars—and, in the case of international liabilities, foreign creditors generally insist on this—then devaluation may bankrupt domestic borrowers. Such initial conditions are discussed as criteria for dollarization by Guillermo Calvo (1999) and Ricardo Hausmann and others (1999).

46. Similar lists are also offered by Williamson (1995) and Larrain and Velasco (1999).

47. For a balanced evaluation, see Williamson (1995). Atish Ghosh, Anne-Marie Gulde, and Holger Wolf (1998) look at the statistical record and find that currency board countries have lower inflation rates than countries with other fixed and floating exchange rate regimes.

The Alternative of Dollarization

Currency boards, which not long ago appeared a radical straightjacket, are now in some quarters deemed an insufficiently firm commitment. In January 1999, at the request of Argentina's president, the central bank submitted a report spelling out ways to complete the dollarization of that country, that is, to replace the peso fully with the dollar as the legal currency. This plan may never come to fruition. The timing of the initiative—immediately after the downfall of the real in neighboring Brazil and in advance of a presidential election in Argentina—suggested possible short-term objectives: impressing contagion-prone speculators and stability-craving voters. Nevertheless, many Latin Americans are suddenly taking the dollarization alternative seriously, and at least two countries, El Salvador and Ecuador, may actually go ahead.

The reasons why most countries would not want to adopt the currency of the United States or any other foreign power as its own are clear. It is a total surrender of monetary independence. Also, it adds the insult of surrendering a symbol of national political sovereignty, which is demonstrably important to most people. Notwithstanding that in theory the boundaries of political units and OCAs need not coincide, it is striking that in practice they almost always do. In Israel in 1983, adverse popular reaction to the idea of dollarization was severe, and the finance minister who had proposed it resigned.

Yet consider a country that already has demonstrated sufficient political support for monetary discipline to go as far as a currency board (and where the foreign currency already plays a large role in the economy). Is there anything further to be lost by going the rest of the way and giving up its currency altogether, beyond the symbolic loss of sovereignty?

The conventional interpretation is that such a country still retains a degree of monetary independence that, though small, is not zero and that it would be giving up that independence completely if it were to dollarize fully. Argentina, for example, could always change the convertibility law if it wanted to, or short of that, could switch its peg from the dollar to the euro when it no longer felt comfortable with U. S. monetary policy.[48]

The unfortunate truth is that most developing countries have been unable to make good use of whatever monetary independence they possess. Perhaps the additional loss of discretionary monetary policy for Argentina would be not just small, but zero. Perhaps an emerging market country is in a worse

48. Furthermore, Argentina actually has a "quasi" currency board, which can in effect sterilize a certain proportion of reserve outflows (by allowing banks to acquire domestic dollar-denominated bonds as reserves).

position under a fixed exchange rate or currency board than under dollarization, as regards having to accept an interest rate that may not be appropriate to its current domestic cyclical conditions. Under the current regime, when the Federal Reserve Board raises U.S. interest rates, emerging market interest rates often rise *more than* one-for-one.

Tests of the Sensitivity of Local Interest Rates to U.S. Interest Rates

The differential between Argentine and U.S. interest rates declined after the April 1991 convertibility plan and has been relatively small most of the time since 1993. Nevertheless, the differential is still not negligible. It is sensitive to external disturbances—contagion from crises in other emerging markets as well as changes in U.S. interest rates. Renewed sharp spikes following the Tequila crisis of December 1994 and Russian crisis of August 1998 illustrated the point dramatically. When the U.S. interest rate increases, the Argentine interest rate increases more than one-for-one. A regression produces the result that when the U.S. federal funds rate rises 1 basis point, the Argentine dollar interest rate on average rises an estimated 2.73 basis points (see table 4). The result is statistically significant.[49]

The interest rate differential consists primarily of a country premium, supplemented by a small currency premium. The country premium is compensation for perceived risk of default, measured as the Argentine interest rate on dollar-denominated deposits or interbank loans minus the U.S. Treasury bill rate. The currency premium is compensation for perceived risk of change in exchange rate policy, measured as the Argentine interest rate on peso-denominated deposits or interbank loans minus that of dollar-denominated Argentine deposits or interbank loans. We used to think of countries' currency premiums and country premiums as independent factors. But we have learned that when there are lingering fears of devaluation, it affects not only the currency premium, but the country premium as well, because investors know that domestic banks and corporations may not be able to service their dollar debts in the event of a devaluation.

49. The sample period runs from November 1994, when the dollar-denominated instrument is first available, to December 1998. If one responds to borderline serial correlation by taking first differences, the estimated coefficient drops to 0.88. For Hong Kong the estimated coefficient is just above one (though insignificantly so), regardless of whether taking first differences or not. (For each currency considered, one cannot reject the hypothesis of a unit root. A need for first differences is conventionally indicated by this result, which, however, could instead be due to low explanatory power.)

Table 4. Regressions of Local Interest Rates Against the U.S. Federal Funds Rate

Country	*Period*	*Specification*	*Constant*[a]	*Coefficient*[a]	*Durbin-Watson*	R^2	*Mean of dependent variable*	*SER*
Panama	1986:I–1998:II quarterly	Deposit rate level	4.47 (0.29)	0.44*** (0.05)	0.82	0.64	6.99	0.58
Panama	1986:II–1998:II quarterly	Deposit rate first difference	… …	0.40** (0.16)	2.93	0.12	0.02	0.52
Argentina	1994:10–1998:12 monthly	Money market rate (U.S. dollar) level	-8.11 (4.38)	2.73*** (0.80)	1.48	0.19	6.83	1.66
Argentina	1994:11–1998:12 monthly	Money market rate (U.S. dollar) first difference	… …	0.88 (1.90)	2.91	0.00	0.01	2.00
Hong Kong	1993:12–1998:12 monthly	Money market rate level	0.27 (1.57)	1.03*** (0.30)	1.70	0.17	5.63	1.68
Hong Kong	1994:1–1998:12 monthly	Money market rate first difference	… …	1.09 (1.73)	2.97	0.01	0.03	2.19
Brazil	1995:1–1998:6 monthly	Treasury bill rate level	-221.13 (7.36)	45.93*** (5.43)	1.12	0.64	32.78	8.42
Brazil	1995:2–1998:6 monthly	Treasury bill rate first difference	… …	12.96 (11.15)	2.61	0.03	-0.49	8.08

Mexico	1994:10–1998:12 monthly	Money market rate level	-112.65 (35.67)	26.65*** (6.51)	0.43	0.25	33.07	13.50
Mexico	1994:10–1998:12 monthly	Money market rate first difference	… …	15.77* (8.17)	1.78	0.07	0.40	8.63
Mexico	1994:10–1998:12 monthly	Treasury bill rate level	-98.98 (31.81)	23.62*** (5.81)	0.34	0.25	30.17	12.04
Mexico	1994:10–1998:12 monthly	Treasury bill rate first difference	… …	14.21** (6.46)	1.61	0.09	0.39	6.82

Source: Authors' calculations. The data are from the IMF's *International Financial Statistics*.
a. Standard errors are reported in parentheses.
* Coefficient significant at the 10 percent level
** Coefficient significant at the 5 percent level
*** Coefficient significant at the 1 percent level.

The currency premium would by definition vanish if Argentina dollarized. It is true that the country premium would not vanish. But it might diminish, or become less sensitive to foreign disturbances, when the possibility of devaluation vanishes.

The interesting hypothesis in table 4 is that under dollarization the regression coefficient on foreign interest rates would be smaller. For purposes of comparison, we look at Panama. The hypothesis is borne out. When the U.S. federal funds rate rises 1 basis point, the Panamanian interest rate on average rises by only an estimated 0.44 basis points.[50] The suggested implication is that, somewhat paradoxically, Argentina might be less at the mercy of the Federal Reserve if it went on the dollar standard. But a drawback would be that increases in Argentine interest rates would bear U.S. fingerprints more visibly from a political standpoint. As shown in the table, although the average effect of a given increase in U.S. interest rates might be no higher than before, the standard error in the relationship would be smaller, making it easier for people to identify the relationship—good for econometricians, bad for politicians. The statistical fit is tighter for the dollarized country than for the currency board country.

The same pattern holds when the tests are extended to two Latin American countries with a less firm tie to the dollar. When short-term interest rates in Brazil and Mexico are regressed against the U.S. federal funds rate, the estimated coefficients are substantially higher, even, than they were for Argentina.[51] But, again, the standard errors are also larger. It seems, unusually, as if the looser the relationship, the higher the regression coefficient. This supports the notion that the presence of exchange rate uncertainty exacerbates swings in the risk premium. Elsewhere we report results for more countries and longer time periods.[52]

Conclusion

We have offered a theoretical rationale for the hypothesis that intermediate exchange regimes, such as basket pegs with bands, are less likely to inspire

50. In terms of first differences, the coefficient is 0.40.

51. Similar results regarding the behavior of interest rates in fixed versus flexible regimes are found by Hausmann and others (1999). The finding that interest rates in emerging markets react more than one-for-one to U.S. short-term interest rates is not new. More results and references are given in Frankel and Okongwu (1996). Tests of monetary stability under various exchange rate regimes are found in Ghosh and others (1997).

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

credibility than simple firm fixes. This theoretical rationale is the notion of verifiability. Although we have demonstrated the verifiability issue only for the case of basket pegs with bands, we believe that the same point applies to other intermediate regimes such as managed floating or pegs with escape clauses. We have also offered some empirical evidence that intermediate regimes do in fact inspire less credibility than institutional arrangements such as dollarization. This empirical evidence is the sensitivity of local interest rates to U.S. interest rates, which is even greater for Latin American countries with flexible exchange rates than for currency board or (especially) countries. If lack of credibility prevents emerging market countries from taking advantage of a modicum of monetary independence under intermediate regimes, then they might as well reap the advantages of the fixed-rate corner.

Both the theoretical rationale and the empirical evidence we have offered are far from complete or without shortcomings. But our view is that the hypothesis of the vanishing intermediate regime is new, undeveloped, and as yet lacking in theoretical and empirical support, so that even our humble contribution may be useful.

APPENDIX

Exchange Rate Policy in Chile

Date	*Policy*
September 1982	Daily devaluations in line with domestic inflation in the preceding month minus an estimate of external inflation
August 1, 1984	A band of ± 0.5 percent
June 1985	. . . widening to 2 percent
January 5, 1988	. . . widening to 3 percent
June 6, 1989	. . . widening to 5 percent Acceleration of the rate of real depreciation, which was achieved by reducing the estimate of international inflation Adjustment of central parity: previous month inflation minus estimated international inflation
April 3, 1991	2 percent revaluation of central parity
January 23, 1992	Band widened to 10 percent (from ±5 percent) Discrete 5 percent revaluation of central parity
March 1992	Managed floating is authorized

Date	*Policy*
July 1992	Central parity: 50 percent U.S. dollar, 30 percent deutsche mark, 20 percent Japanese yen
November 1994	Central parity: 45 percent U.S. dollar, 30 percent deutsche mark, 25 percent Japanese yen
November 30, 1994	9.66 percent revaluation of central parity
December 1995	2 percent revaluation 2 percent annual revaluation
January 21, 1997	4 percent revaluation of central parity New band: ±12.5 percent New weight: 80 percent U.S. dollar, 15 percent deutsche mark, 5 percent Japanese yen
June 25, 1998	2 percent annual revaluation New asymmetric band: +2 percent, -3.5 percent
September 16, 1998	New band: ± 3.5 percent Between September 17 and December 31, 1998 the band will be widened progressively until it accumulates an additional 1.5 percent in each extreme, such that by the end of the year the band would be ±5 percent New estimates of annual international inflation from 0 to 2.4 percent for the rest of the year The relevant internal inflation rate is the inflation target and not past inflation
December 23, 1998	New band: ±8 percent No change in other parameters (central parity adjusts only with internal inflation, and the band continues widening daily by 0.013575 percent)
January 1, 1999	Deutsche mark is replaced by the euro, with the same weight
September 2, 1999	Free floating with managed intervention only in exceptional cases Release of new information regarding interventions in the foreign exchange markets

Sources: Vergara (1994); Hussey and Morande (1996); Central Bank of Chile; and authors' conversations with Klaus Schmidt-Hebbel, Matias Tapia Gonzalez, and Roberto Zahler.

Comments and Discussion

Alan Blinder: Jeffrey Frankel, Sergio Schmukler, and Luis Servén offer up not one but two fascinating and creative papers here. The first, contained in the opening and closing parts of the paper, is conceptual. It examines each of the popular explanations for the recommendation that countries choose exchange rate regimes at the corners—and finds them wanting. It then proposes a new reason: Verifiability is necessary to establish credibility, and credibility is essential. The second paper is empirical. It investigates how much data market participants need in order to verify—with 95 percent confidence—that the putative exchange rate regime is the actual one.

There is much of interest in each of the papers. But I will confine my discussion to the first—except for one brief remark about the second. That remark is that I don't believe the standard 95 percent confidence interval is appropriate in this context. Unlike econometricians, market participants cannot and do not insist on such a high degree of statistical significance. If the relevant question is "What does the market believe about the exchange rate regime?" then 19-to-1 odds are too much to ask for. I'd have thought that something like 2-to-1 odds—that is, a 67 percent confidence interval—would be more than enough. In that case, much less information would be required for "verifiability."

Regarding the first paper, I would like to offer a variety of friendly amendments, beginning with the case for verifiability.

The authors base their argument on two ideas: first, that governments want their chosen exchange rate regimes to be credible, and, second, that "verifiability is a partial means to the Holy Grail of credibility" (p. 62). I certainly endorse both of these claims—especially given the important word *partial* in the second. Furthermore, the authors state at the outset that verifiability is not

the only, nor even the most important, criterion in choosing an exchange rate regime. Nonetheless, writing a fifty-page paper that pokes holes in conventional explanations and boosts your own certainly invites the inference that you think your candidate is in the big leagues in terms of importance. Is it?

To think about this claim, let's imagine a hypothetical dialogue with a finance minister who is wondering about the proper exchange rate regime for his country. Some economists recommend that he either float the moolah or establish a currency board. Either of these two extremes, they argue, shares with the other an important virtue that intermediate regimes lack: both are easily verified by market participants. And verifiability, the authors assert, is crucial to establishing the credibility of any currency regime.

The minister thinks a moment. "Hmmm. Wasn't old-fashioned Bretton Woods–style pegging highly verifiable—as long as it lasted? Wasn't the real credibility issue how long the peg would or could be maintained? Similarly today, wouldn't a simple peg to the dollar, with minuscule bands, be extremely easy for market participants to verify by observation—though not necessarily the most credible? But that is the very system that proved catastrophic in East Asia in 1997. It seems to me," the minister says, "that the credibility of the peg will be judged by how many dollar reserves we have and by how much we are willing to subordinate our domestic monetary and fiscal policies to the exchange rate objective—-not by how verifiable our exchange rate regime is. So even extremely high verifiability may not establish credibility."

Warming to the task, the minister continues. "Furthermore, you economists are too fixated on credibility—or commitment, as you like to call it—as a criterion. Let me remind you that governments can and do commit themselves to bad policies now and then. Your own government has on several occasions come close to writing a balanced budget requirement into the Constitution. I would argue that a currency board is a terrible idea for my country, irrespective of how credible or verifiable it might be. As James Duesenberry once said in a very different context, it doesn't inspire confidence to watch a central bank follow a straight line to oblivion."[1]

Implicitly, our minister believes that the best exchange rate regime is the one that minimizes some reasonable loss function, such as the expected discounted present value of the weighted sum of squared deviations of inflation and unemployment from their targets. Credibility contributes positively toward this goal, but it is not the whole story. Thus, while I agree that verifiability is

1. Duesenberry was referring to the Fed's adherence to money-supply targeting in the early 1980s.

a virtue, I question whether it is as important as the authors suggest.

My second mild disagreement is with where the authors draw the lines separating different types of exchange rate regimes. In their eyes, the distinction between verifiable and nonverifiable exchange rate systems maps rather neatly into the distinction between "corners" and intermediate regimes. But does it?

On page {000}, the authors give us the following rundown of all the world's exchange rate regimes, as classified by the International Monetary Fund:

Exchange Rate Regime	*Number of Countries*
Rigid pegs (for example, currency boards)	45
Pegged to a single currency	32
Pegged to a basket	13
Crawling pegs	5
Horizontal bands	6
Crawling bands	7
Managed floats	26
Independent floats	51

They suggest that the top and bottom categories—the corners—are almost perfectly verifiable, while the intermediate regimes are less so. This, they argue, is a reason to head for a corner. As is evident from what my hypothetical minister just said, I don't think that delineation is correct. In particular, a conventional peg to a single currency is extremely easy to verify, but it is not one of the corner solutions.

I come now to the authors' central claim: that three common explanations for the vanishing middle do not stand up to close scrutiny. I think they do, albeit perhaps with some modification. So let me defend the conventional wisdom.

Argument 1 is based on a variant of the Impossible Trinity: If we take high capital mobility as a given in the modern world,[2] then a country can have either a fixed exchange rate or an independent monetary policy (and, implicitly, a floating exchange rate), but not both. The authors cleverly—and correctly—point out that a heavily managed float can in principle achieve some weighted average of the two objectives. But if capital mobility is very high, and capital flows volatile, the exchange rate may dominate monetary policy.

2. Since capital mobility used to be much lower, this explains why the middle was not empty years ago, but is progressively hollowing out as capital markets become more integrated.

And there is an even simpler point, which our imaginary finance minister has already made, and which even beginning students in economics are taught: The sustainability of a currency peg is asymmetric. When a currency is pegged *below* its free-market value, reserves accumulate—which can, in principle, go on indefinitely. But when a currency is pegged *above* its free-market value, the loss of reserves will eventually force the nation to abandon the peg. I believe that this is the most powerful real-world argument for choosing a corner. With high capital mobility, the center will not hold for long.

Argument 2 is that pegging a currency without cementing it in place (for example, via a currency board or dollarization) encourages locals to borrow in foreign currency—and these liabilities become devastating when the currency depreciates. I must admit to being a partisan of this argument; in fact, I have given it a name: *the fixed-exchange rate bubble*.[3] The bubble works as follows. Banks and corporations in emerging markets come to think of the dollar peg as permanent. So, for example, a Thai baht is taken to be just another name for four U.S. cents. With dollar interest rates temptingly low compared to home-currency interest rates, they borrow heavily in dollars and lend the proceeds in local currency (or invest in local assets)—thereby creating a severe currency mismatch. That this process is often called *the carry trade*—one of my least-favorite terms—itself illustrates the delusion. Betting against (uncovered) interest parity is far from riskless.

Now, the authors correctly point out that adherents to this view are imputing a form of irrationality both to emerging market borrowers and to their creditors.[4] It's true. I confess, and I have enrolled in a 12-step program to overcome this personal failing. The only problem is that the more I observe actual financial markets, the harder it is for me to get beyond step one. As Fischer Black pointed out, financial markets look more rational from the banks of the Charles than from the banks of the Hudson.

The authors also observe that folks who urge emerging-market countries to borrow in their own currencies are implicitly urging them to borrow less. That is also true. If the perceived cost of credit is higher, the volume of borrowing will presumably be lower. But, if you believe in the fixed–exchange rate bubble, that's precisely what you want—a return to rationality in which borrowers face up to the true cost of credit.

3. See Blinder (1999), esp. pp. 55–57.

4. Unless they assume they will be bailed out by western governments or the IMF.

However, I do take issue with the more extreme position, mentioned in the paper, that "the admonition to avoid borrowing in dollars is to some extent an admonition to avoid borrowing at all" (page 70). First, some modest borrowing in dollars should not be poisonous; after all, financial institutions and nonfinancial businesses take on all kinds of risks every day. Second, some emerging nations (particularly in Asia) generate so much internal saving that they do not need foreign capital—which serves mainly to create domestic asset bubbles. Third, I believe the capacity of emerging-market nations to borrow in their own currency has been underestimated. Players in global financial markets have taken on all sorts of huge risks over the years. If hedge funds will short palladium to go long on Russian GKOs, why should we believe that they will not, at some price, buy debt denominated in Korean won? South Africa is a prominent example of a poor country that borrows mainly in its own currency. Others can do the same, though certainly not at the U.S. Treasury bill rate.

Argument 3, which is political, pertains to the difficulty of exiting gracefully from a currency peg. The authors point out that early exiters do not always succeed and late exiters do not always fail. That's fine. But we are not dealing in absolutes here; we are playing the percentages. And I do believe that governments with pegged exchange rate arrangements are normally reluctant to develop, or even to think about, exit strategies. In consequence, they typically stick with the peg too long.

The right time to exit is when your currency value is either under upward pressure or no pressure at all. But now let's bring back our hypothetical finance minister and try to convince him to float the moolah under such circumstances. Remember, his government presumably had what it deemed to be good reasons to fix the exchange rate. He probably has pledged repeatedly that the moolah's peg is inviolable; he may well have staked his reputation and political survival on it. Because much borrowing and lending in his economy has been predicated on a fixed exchange rate, changing the rate now will elicit shrieks of pain from various constituencies. And things are going splendidly at the moment. There is no problem defending the moolah; no barbarians have appeared at the gate. Against this backdrop, a group of economists arrives, urging him to abandon the peg. "You want me to do what?" he asks incredulously, before showing them the door.

The authors dismiss this argument as relying on "some sort of irrationality (or political constraints)." Well, political constraints are not irrational to a politician, and my 12-step program has not gotten this far.

Finally, let me offer one additional argument that the authors barely mention.[5] The three issues I have just addressed all argue for going to one corner or the other. My final point argues for choosing the floating corner over, say, the currency board corner.

A currency board (or dollarization) fixes the nominal exchange rate forever. But unless the two economies are substantially identical or totally integrated—that is, unless they constitute an optimum currency area—there will be occasional (and perhaps frequent) shocks that call for changes in the real exchange rate. With a currency board, this can only be accomplished through differential inflation rates, which may require deflation in the home country. That kind of adjustment can be excruciatingly lengthy and painful. A floating exchange rate can accomplish the same objective quickly and (comparatively) easily. Argentina is a recent case in point: After the 1999 Brazilian devaluation, it had a more severe recession than Brazil, which decided to float the real.

So, in sum, I see considerable wisdom in the emerging view that high capital mobility, large-scale speculative activity, limited reserves, and realistic politics are likely to render intermediate exchange rate regimes unsustainable. Verifiability is desirable, for all the reasons that transparency is. But I do not think it is central.

Andrés Velasco: I am under the curse of being the second discussant, not only because Alan Blinder just said many things that I agree with, but also because he said them very well. And he also stole my opening line, which was supposed to be, "Dani Rodrik recruited me to discuss one paper, and I was confronted with two—one of which I like very much, one of which I like slightly less."

The one that I like very much, although I do not fully agree with its interpretation and conclusions, puts forward the concept of verifiability and tries to give it some empirical content. I will have a few things to say about that.

The other paper joins the fixed-versus-flex debate. I was surprised to find that this second paper tends toward the fashionable view that there are great advantages to dollarizing. This is a disease to which Jeff, Sergio, and Luis, I thought, were immune. Perhaps now that Jeff has moved back to Cambridge,

5. In fact, on p. 97 they write: "The advantages of a flexible exchange rate can all be grouped under one major property: it allows the country to pursue an independent monetary policy."

that well-known soft-money place, he will go back to advocating views that are closer to flexibility.

More seriously now: I will start out by discussing the issue of verifiability and credibility. The relevant section of the paper begins with a very good question: How do we know that central banks are, in fact, doing what they say they are doing? The question is relevant because, presumably, if we do not know the answer, how can they be credible? Presumably, credibility has to do with adherence to stated rule, but one needs to be able to evaluate that adherence. In the language of the paper, if a regime is not verifiable, it would seem it cannot be credible.

What does verifiability depend on? On several plausible things, the authors argue. The larger the number of currencies in the basket, the harder it is to verify that particular basket rule. The wider the band, the harder it is; the more frequent realignments are, the harder it is. If there is rate of crawl and the rate of crawl jumps around a lot, then it is hard to verify the rule. I find all of this very compelling.

But this is not tantamount, in my view, to proving that complex rules, because they are less verifiable, cannot be credible. I am reluctant to take the leap and tie verifiability and credibility as tightly as the paper does. Rather than trying to theorize, let me give three examples.

Example 1: Chile. As we saw in those figures, Chile didn't just have a dirty float; it had a *filthy* float. There was a band, and the width of the band changed. The central parity of the band crawled, and the slope of this crawl changed as well. The central parity was initially defined in terms of an exchange rate with the dollar, then with a basket of three currencies, and the weights in the basket also changed. Sometimes the central bank intervened inside the band; at other times, only at the edges. On top of it all, capital account restrictions were relaxed during some intervals, tightened during others.

Pretty much everything that could be tried was tried. Did this mean that the Chilean regime was lacking in credibility? Well, I'm not quite sure. But let me just bring to mind some of the other facts about Chile in the 1990s. There were huge capital inflows amounting, in some years, to 8 percent of gross domestic product (GDP). There was unrelenting pressure toward appreciation (and not depreciation) of the Chilean peso. Inflation during this decade fell from 30 percent to 3 percent, and so did inflationary expectations. There was an investment boom, with investment going from 19 to 29 percent of GDP, and with foreign direct investment leading the way. The average growth rate of the economy over the decade was more than 7 percent. That does not seem

like a country whose monetary or exchange rate regime is lacking in credibility and where market participants are expecting a large depreciation or a burst of inflation around the next corner. Apparently credibility could be present in spite of the absence of verifiability.

Other examples point in the same direction. Example 2: Germany. I think most people would agree that the Bundesbank's performance over the last fifty years is credible. But the question remains: What is the presumably verifiable regime that the Bundesbank has been applying all this time? I have no idea. One learns from most textbooks and from one's elders that the Bundesbank has pursued some kind of rule for targeting monetary aggregates. But recent research from two colleagues of mine at New York University, Mark Gertler and Jordi Galí, together with Richard Clarida from Columbia University, finds that a Taylor rule fits the data generated by the Bundesbank's behavior over the last twenty years very well.[6] If this new research is right, then the Bundesbank was apparently not doing what it claimed it was doing. In the language of Frankel, Schmukler, and Servén, its behavior was not verifiable. Did that matter from the point of view of credibility? Apparently not.

Example 3: We are told by the press that Alan Greenspan gets into the tub with large sheets of paper with lots of data. What rule does Alan Greenspan follow for putting those data in order? Again, we have no idea. He prints lots of money suddenly—when the NASDAQ came down in 2000, when the Dow crashed in 1987—in what seems like highly discretionary behavior. Yet is Alan Greenspan lacking in credibility? Probably not.

In short, I think I would agree with Alan Blinder that credibility and verifiability are fairly different animals.

Let me now say a couple of things about the fixed-versus-flex debate, which the second half of the paper covers. I have to confess I am not sure I understand the so-called corners hypothesis very well. My problem is that there is an asymmetry between the two corners that very seldom gets discussed. A hard peg—think of a currency board—is both an exchange rate rule and a monetary rule. It forces the central bank to peg the value of the currency; in addition, it establishes that the central bank can create and destroy only local currency in exchange for dollars. By contrast, a flexible exchange rate is an exchange rate *rule*, which can be coupled with many monetary rules. In order to make sense of the second corner, we have to be very explicit as to what is happening to monetary policy.

6. Clarida, Galí, and Gertler (1998).

This is not simply an academic point. It has great policy relevance. One key argument against floating is that it never happens cleanly. There is presumably *fear of floating*, in the phrase coined by Guillermo Calvo and Carmen Reinhart.[7] As a result, the argument goes, in reality flexible rates do not provide the insulation textbooks claim they do. But this pattern of behavior begins to make more sense as soon as we begin asking what the monetary rule is that goes hand in hand with the flexible exchange rate. Nowadays countries that float *dirtily* do not necessarily buy and sell reserves but choose to move their interest rates around in response to what happens in the exchange market. In other words, they use an implicit feedback rule that has the nominal exchange rate as one of its arguments.

It is not hard to devise models in which the optimal policy is to float, but in which the feedback rule for the nominal short-term interest rate involves some sensitivity of that interest rate to the nominal exchange rate. Lars Svensson has a model with results that have that flavor; so do Jordi Galí and Tommaso Monacelli;[8] I have been doing work that points in the same direction. There are several reasons for these results: One is that with sticky prices and differentiated goods, high nominal exchange rate variability can mean high variability for the terms of trade and consumption. Another is that small open economies that target inflation have a Consumer Price Index (CPI) with a very large component of traded goods. Clearly, targeting the CPI means targeting the nominal exchange rate to some extent, because of the pass-through to domestic prices of tradables.

In short: the observation that in reality floating is not perfectly clean does not imply that limited monetary independence is an illusion or that exchange rate flexibility cannot provide some welfare-improving insulation. In fact, recent research suggests the precise opposite.

General discussion: Frederic Mishkin argued that although the empirical work in the paper focuses on the issue of verifiability, the real problem with soft pegs is their transparency. A peg to the dollar, for example, may be easily verifiable but can still lead to a crisis if the central bank is involved in such shenanigans as covering up the actually available level of foreign exchange reserves, as happened in Thailand, South Korea, and elsewhere.

Paul Masson was surprised by the degree to which this paper, unlike much of Frankel's previous work, advances the hypothesis that exchange rate regimes

7. Calvo and Reinhart (2000).

8. Svensson (2000); Galí; and Monacelli (1999).

are becoming increasingly concentrated at the corners (the "hollowing-out hypothesis"). Masson described his own recent empirical work, which has found little or no support for this hypothesis. He noted that countries at the corners do not stay there forever but change regimes, often as policy objectives evolve or for noneconomic reasons.

Carmen Reinhart questioned the distinctions being made among different exchange regimes. In her view, it is unclear how intermediate regimes differ from soft pegs. With the exception of a handful of countries with hard pegs and a few industrial countries with true floats, she would classify every regime as in the middle. She noted that there have been some changes in terminology. For instance, what used to be called a *crawling peg* now tends to be labeled a *managed float*. Reinhart believes there has been a shift from countries using reserves in order to smooth exchange rate fluctuations to using interest rates for the same purpose. However, she argued, we have yet to find any conclusive empirical evidence that the latter is preferable to the former.

Ricardo Hausmann disagreed with the claim that flexible exchange rates are verifiable. He argued that flexible rates with inflation targets in particular would be extremely difficult to verify. He also questioned the benefits of flexible exchange rates for developing countries, where, he believes, depreciations are often contractionary. Furthermore, floating rates tend to force such countries to use monetary and fiscal policy pro-cyclically, instead of the more desirable counter-cyclical policy.

Hausmann took issue with Andrés Velasco, who in his comment opposed intermediate regimes because they are subject to multiple equilibria. Hausmann argued that flexible regimes with dollar liabilities are also subject to multiple equilibiria, citing as an example the different experiences in Ecuador in January 1999 versus December 1999. However, both Mishkin and Velasco disagreed with Hausmann's interpretation of what happened in Ecuador. In their view, Ecuador's crisis was caused by a classic situation in which the banking system got into trouble and was bailed out over a period of many months by excessive money creation, leading to a loss of reserves. Hausmann responded that their explanation, unlike his multiple-equilibria view, fails to explain why the announcement of dollarization in the midst of a severe crisis was able to stabilize the situation so quickly.

Some participants asked whether behavior associated with currency crises is irrational. Mishkin argued that "rational bubbles" can and do occur in fixed exchange rate regimes where there is a government safety net with inadequate supervision. Daniel Tarullo suggested an additional reason why failure to

hedge liabilities may not be irrational, noting that borrowing domestically still leaves borrowers exposed to considerable risk because currency crises are associated with economic recessions.

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