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Monetary Independence in Emerging Markets: Does the Exchange Rate Regime Make a Difference?

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Abstract

The views expressed in this Working Paper are those of the author(s) and do not necessarily represent those of the IMF or IMF policy. Working Papers describe research in progress by the author(s) and are published to elicit comments and to further debate.

This paper compares the impact of shocks to U.S. interest rates and emerging market bond spreads on domestic interest rates and exchange rates across several emerging market economies with different exchange rate regimes. Consistent with conventional priors, the results indicate that interest rates in Hong Kong react much more to U.S. interest rate shocks and shocks to international risk premia than interest rates in Singapore. The results are less clearcut in the comparison of Argentina and Mexico: while interest rates (and the exchange rate) in Mexico seem to react less to U.S. interest rate shocks, they react about the same to bond spread shocks, in addition to a significant impact on the exchange rate.

<p style="text-align:center">Contents   Page</p>

I. INTRODUCTION

In this paper we investigate a conventional proposition about exchange rate regimes: that floating exchange rates insulate domestic monetary conditions from international financial shocks because they preserve "monetary independence" for the central bank. We focus on two types of shocks: changes in the monetary stance of the United States and changes in the risk premia attached to emerging market international bonds. As we will see, we find clear empirical support for this conventional proposition—with respect to both types of shocks—in the comparison of Hong Kong and Singapore. The comparison of Argentina and Mexico does not yield such clearcut distinction, as the impact of US monetary policy tends to be in line with the conventional hypothesis but the impact of bond spreads on domestic interest rates is remarkably similar in both Latin American countries.

The highly volatile financial environment of the 1990s challenged the choices of domestic monetary framework that most emerging market economies had made. Many countries had opted for regimes that provided significant exchange rate stability (as an anchor for domestic prices or simply to avoid fluctuations that were considered harmful to international trade) but left some room for current or future changes in the parity. Most, if not all, of the regimes that succumbed to crises (in the sense of suffering large and sudden depreciations in the value of their currencies) were of this "intermediate" type: pegs without restraining rules on central banks, bands, or alleged managed floats with very little exchange rate flexibility in practice. It is not surprising that a significant body of opinion focused on "unsustainable pegs" as an important factor leading to the crises.[1] While this incipient consensus tended to favor floating exchange rates, it also recognized that regimes at the other end of the spectrum, namely hard pegs, might be a viable alternative.

The two allegedly viable regimes, at the two extremes of the continuum of exchange rate systems, differ sharply in some respects, however. The main advantage of floating exchange rate regimes over hard pegs—at least in principle—is that they allow the domestic monetary authority to retain the domestic interest rate as a policy instrument. There is, however, a recent line of thought that considers that emerging market economies subject to sharp changes in international investor confidence cannot benefit from the use of the interest rate instrument and would in fact be worse off by leaving that possibility open.[2] This "fear of floating" school argues that, because of credibility problems, worries about inflation pass-through, and dollarization in the domestic financial system, central banks sharply curtail movements in the exchange rate even if they officially float. The result is "flexible regimes that are managed as if they were fixed, but without the benefits of precommitment."[3] Thus,

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[1] See, among others, Rubin (1999), Lipton (1999), Eichengreen (1999) and Goldstein (1999).

[2] Hausmann et al. (1999), Calvo (2000), Calvo and Reinhart (1999, 2000).

[3] Hausmann et al. (1999), page 11.

the claim is that the benefits of moving to a currency board system or even full dollarization—namely, lower risk premia on both government and private sector liabilities thanks to a reduced risk of depreciation—are not offset by the costs of reduced flexibility, simply because this flexibility cannot be utilized even in supposedly floating regimes. The tests provided in this paper speak to the second part of this claim, by addressing the question of how much "insulation" flexible regimes actually provide in practice.

Some recent empirical studies—including Hausmann et al. (1999), Frankel (1999) and Frankel, Schmukler and Servén (2000)—have raised doubts on the conventional view on how floating exchange rate regimes work in emerging markets. Hausmann et al. find that the reaction of domestic rates to U.S. rates is insignificantly different across regimes using monthly data from 1960 to 1998 for 11 countries. Moreover, using daily data for 1998-99 for Mexico, Venezuela and Argentina, they find that the reaction of domestic interest rates to the international risk premium is highest for Mexico, the country with the most flexible exchange rate regime. Frankel (1999) regresses quarterly and monthly domestic interest rates in several emerging market countries on the U.S. Federal Funds rate, and concludes that interest rates in countries with floating or intermediate regimes (Mexico after 1994 and Brazil before mid-1998) show much higher interest rate responses than Argentina, Hong Kong, or Panama. Frankel, Schmukler and Servén (2000) extend these regressions by considering more countries, controlling for currency crisis episodes and inflation differentials, and running panel regressions in addition to regressions for individual countries. Their results are more ambivalent than those of the other authors: using a long sample from 1970-1999, flexible regimes do seem to have an insulating property, in the sense of a smaller reaction of domestic to international interest rates; however, this result goes away when the sample is restricted to the 1990s and developing countries are considered separately. Although these results are suggestive, they raise questions about robustness, in particular to the way in which international interest rate shocks are measured and the regressions are specified. Some of these questions will be taken up in the next section.

In this paper we follow the following strategy. First, for the most part, we restrict our sample to contrasting Argentina with Mexico in Latin America, and Hong Kong with Singapore in Asia. In our sample period (starting in the early to mid-1990s), these economies represent polar choices of exchange rate regimes, which should allow us to detect differences more easily.[4] Moreover, it allows us to bypass the question of how exchange rate regimes should

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[4] Neither Mexico nor Singapore follow a pure float. Mexico's monetary policy targets domestic inflation but appropriately regards the exchange rate as a source of inflationary pressure so that, for example, it would tighten monetary policy in response to a weakening of the exchange rate (see Carstens and Werner, 1999). Singapore's monetary framework is less explicit, and could be described as monitoring a basket of currencies with the ultimate objective of targeting domestic inflation (Nadal-De Simone, 2000). Despite not being clean floats, the exchange rate regimes of these two countries are typical examples of viable floating exchange rate systems in the emerging market environment.

be properly classified, which tends to arise in larger samples. In addition, we run the test for some more advanced, small open economies: Australia, Canada and New Zealand, and for Chile, where, although formally following a preannounced bands for the exchange rate over the sample period, studies of ex-post exchange market behavior indicate a high degree of exchange rate flexibility (Levy-Yeyati and Sturzenegger, 1999). Second, we pay considerable attention to identifying international interest rate shocks in a way that allows a structural interpretation. In particular, we argue that interest rate shocks due to US monetary policy and shocks to emerging market risk premia should not, ex ante, be expected to enter the reaction function of domestic monetary authorities in the same way. As a result, it is important to distinguish between these two types of shocks, and control for the presence of the other shock when examining the impact on domestic interest rate. Third, we pay attention to short-run dynamics, both because the dynamic response of domestic interest rates to international shocks is itself of interest, and because ignoring these dynamics in a time series context may misspecify the model or raise interpretational difficulties (see next section for details). Finally, we try to test for robustness by looking at different measures of domestic interest rates and US monetary policy shocks.

We undertake two types of tests. First, we conduct an event study that focuses on specific US monetary policy shocks, measured by reactions in federal funds futures rates to changes in the federal funds rate target, and examine their impact on domestic interest rates and exchange rates of the countries in our sample. We also conduct an analogous study that looks at the reactions to large shocks to emerging market bond spreads associated with identifiable events (for example, the Russian default and the Brazil crisis). Second, we run vector autoregressions at the daily frequency, using four-variable VARs that include domestic interest rates, exchange rates, a measure for U.S. interest rate policy, and a measure of emerging market risk premia. Based on these VARs, we compute impulse response functions to both U.S. monetary policy shocks and emerging market risk shocks.

Our main results are summarized as follows. Interest rates in Hong Kong seem to react one-for-one to U.S. monetary policy shocks, while interest rates in Singapore increase by about 0.3 basis points (bp) to a 1 bp increase in U.S. interest rates; there is also a significant (but moderate) depreciation in the exchange rate of Singapore when US interest rates increase. In the period after 1997, we also see a large response of Hong Kong interest rates to shocks in emerging market risk premia, compared with a insignificant reactions of interest rates in Singapore. The results for the comparison between Argentina and Mexico with respect to U.S. interest rate shocks are inconclusive. In line with conventional priors, VAR-based impulse response functions indicate a significant response of interest rates in Argentina but not Mexico; however, this is largely a consequence of imprecise estimates for Mexico, with both the interest rate and the exchange rate effects being not statistically significant. The event study, albeit of limited value because of the small sample of monetary policy shocks, does find a significant effect on Mexican interest rates, but generally of smaller magnitude than in Argentina, where interest rates appear to overreact to US rates. Finally, we find very large reactions of domestic interest rates to emerging market spread shocks, of about the same size, for *both* Mexico and Argentina. Floating exchange rates thus do not seem to have appreciable benefits in insulating a Latin American economy such as Mexico from shocks to

international risk premia. Interestingly, this finding can*not* be easily attributed to a lack of de-facto exchange rate flexibility, as the reactions of Mexican exchange rates to shocks to risk premia is also very large. Note, however, that previous studies that did not control for the exchange rate found a much higher response of interest rates in Mexico than in Argentina (Hausmann et al, 1999).

II. METHODOLOGY

The empirical approach adopted in this paper has three main characteristics: first, a focus on impact reaction and short run dynamics following an international interest rate shock; second, the distinction between shocks attributable to U.S. monetary policy and shocks to emerging market risk premia; and third, the technique used to identify these two types of external shocks. We discuss these in turn.

A. Dynamic Specification

To organize thoughts, consider the standard risk-augmented uncovered interest rate parity condition:

$$r = r^* + E[\tfrac{\dot{e}}{e}] + \rho \tag{1}$$

where r denotes either the instantaneous domestic interest rate, r^* denote the instantaneous foreign interest rate, $E[\tfrac{\dot{e}}{e}]$ denotes the expected instantaneous rate of depreciation of the domestic currency, and ρ denotes the risk premium.

Suppose that ρ and r^* are exogenous. Then, the impact of a shock to ρ or r^* on the domestic interest rate will depend on how the shock affects exchange rate expectations. Under a hard peg, $E[\tfrac{\dot{e}}{e}] = 0$ by definition, so that an increase in ρ or r^* affects r one-for-one. In contrast, in the traditional view, an increase in r^* or ρ under floating exchange rates will lead to an instantaneous depreciation of the exchange rate which, for a given long-run value for the exchange rate, will reduce the expected rate of depreciation from that point on, and thus imply that r increases less than one-for-one with r^*. In the extreme, when the money supply, output and prices are fixed in the short run, r should not react at all, as is the case in the basic Dornbusch overshooting model. Over the long run, however, the assumptions of a fixed money supply, long-run neutrality of money and a fixed long run real exchange rate imply that the nominal exchange rate will eventually revert to its steady-state level, at which point $E[\tfrac{\dot{e}}{e}] = 0$, and r must adjust one-for-one with r^*.

It follows that a simple contemporaneous regression of domestic interest rates on international interest rates using time series data—i.e., ignoring any short-run dynamics, as captured by lags of r, r^* and ρ—is probably not a good way of testing the conventional view. Suppose first that r^* and ρ are stationary. Then, the coefficients in a simple levels

regression in r, r^* and ρ would be interpreted as reflecting the impact reaction of r^* and ρ on domestic interest rates. However, the movement of r in any given period should depend not only on the contemporaneous movements of r^* and ρ but on its out-of-equilibrium position at in that period. This could easily bias the estimated contemporaneous reaction: for example, over a period when international interest rates have been rising, one would expect to see a positive co-movement of r and r^* owing to delayed adjustment of r to previous increases in r^*, even if the contemporaneous reaction of r to shocks to r^* was in fact zero. Next, suppose that r^* and/or ρ are integrated, so that equation (1) describes a co-integrating relationship between r^* (and/or ρ) and r. Then, the coefficients in a simple levels regression in r, r^* and ρ would be interpreted as reflecting the long run relationship between r^* and domestic interest rates. In that case, consistent estimation would not be an issue; however, it is no longer clear that the exchange rate regime should make any difference to the relationship between r and r^*. With long-run neutrality, one would expect a one-for-one relationship, regardless of the regime.

The conclusion is that testing the insulating properties of floating exchange rate regimes using time-series data is likely to require a full dynamic specification, in the sense of allowing for lags in the dependent variable, r^* and ρ. Alternatively, if one is willing to restrict attention to the impact effect of shocks to r^* and ρ on domestic interest rates, one could focus on the immediate reaction of interest rates to well-identified exogenous events that lead to changes in r^* or ρ, so that delayed reactions of r through the adjustment of money, output or prices to previous shocks to r^* or ρ are not an issue. In this paper, we pursue both approaches, as described in more detail below.

B. Shocks to International Interest Rates Versus Shocks to Risk Premia

In our regressions below, we examine the effect of both shocks to the international interest rate, r^*, and exogenous shocks to risk premia, ρ (for example, due to an emerging market crisis elsewhere) on domestic interest rates and exchange rates. One reason is that since the two variables are quite possibly correlated, one generally needs to control for one when estimating the effect of the other. In addition, there are a-priori reasons to believe that the insulating property of floating exchange rate regimes, if it exists at all, could differ depending on the origin of the shock. In particular, arguments that monetary authorities in emerging market countries may be reluctant to let the exchange rate adjust in response to an external shock would generally seem to apply with greater force for shocks to ρ than for shocks to r^*:

One reason, stressed by Calvo and Reinhart (2000), may be that the monetary authorities in emerging market countries are unlikely to let the exchange rate go at times when they are cut-off from international capital markets, because depreciations may have contractionary

effects in such times.[5] To the extent that shocks to ρ are driven by emerging market crises, they are much more likely to be associated with a temporary loss of access to international finance than shocks to r^*.

Another argument focuses on non-linearities in the effect of a currency depreciation on output. This may arise from credibility and reputation issues, as also argued by Calvo and Reinhart (2000), among others:[6] a large depreciation may be a bad signal about the domestic authorities' willingness to keep inflation under control, and thus make future inflation control more difficult and perhaps invite further outflows. Allowing the exchange rate to depreciate following a ρ-shock may create a bigger credibility problem than after a r^*-shock, for several reasons. For example, ρ might not be generally observable while r^* is, or shocks in ρ might simply be larger on average and require a larger depreciation, which would raise eyebrows and damage credibility.

A third story, that gained much prominence after the Asian crises, focuses on multiple equilibria arising from dollar-denominated liabilities, as argued informally by Fischer (1998) and more formally by Aghion, Bacchetta and Banerjee (2000) and Hausmann, Panizza and Stein (2000). In the presence of dollar-denominated corporate debt, the economy could either be in an equilibrium where the exchange rate is appreciated, debt service burdens are low, and future output is high, or in an equilibrium with a depreciated exchange rate, high debt burden, and low output. Shocks to either r^* or ρ could cause a switch from the good to the bad equilibrium if either (1) the resulting depreciation is so large that it removes the good equilibrium, or (2) they trigger a shift in expectations. However, ρ-shocks appear more dangerous on both counts, since they tend to be much larger, on average; and since contagion during the Tequila, Asia and Russia crises suggests that they influence investor sentiment vis à vis emerging markets to a much greater extent than U.S. interest rate shocks. Thus, depreciation following ρ-shocks is more likely to be resisted by policy-makers.

Consequently, it as important to examine the effects of r^*-shocks and ρ-shocks separately. This will enable us to see whether there are any differences in the way in which domestic interest rates react to the two types of shocks, and in the extent to which the exchange rate regime modifies this effect.

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[5] The basic intuition is that devaluations generally have both an income effect, which tends to reduce the demand for home goods and thus aggregate demand, and a substitution effects, which works in the opposite direction. The less a country can borrow from abroad after a devaluation, the stronger the contractionary income effect.

[6] For example, the initial determination of the Brazilian authorities to defend the exchange rate in 1998 arose mainly from the desire to safeguard the "culture of stability" built under the *Real Plan*.

C. Identifying Shocks to International Interest Rates

The existing empirical literature—in particular, Hausmann et al. (1999) and Frankel, Schmukler and Servén (2000)—tends to focus on U.S. market interest rates (90-day T-bill or LIBOR US dollar rates), usually at the monthly frequency, to examine how the link between international and domestic interest rates depends on the exchange rate regime. This choice can be defended on the following grounds. First, in the traditional view, floating exchange rates should help insulate domestic interest rate with respect to any movement in international interest rates, regardless of whether this is driven by money demand or money supply shocks. Second, since domestic financial markets are small relative to the U.S. money market, it is fair to assume that U.S. T-bill rates are exogenous, or at the very least contemporaneously uncorrelated with the error term in the context of a regression of domestic rates on international rates.

However, the second argument need not be true. While the small size of domestic financial markets in emerging market countries makes it unlikely that reverse causality is an issue, there may be common shocks that affect both U.S. and domestic interest rates, leading to a potential endogeneity problem. Two examples come to mind. First, shocks to emerging market risk premia that have a "safe haven" effect, i.e. prompt a flight into U.S. instruments; this would tend to bias the estimated effect of U.S. interest rates on domestic interest rates downwards. Second, shocks related to U.S. activity (for example, unexpectedly high quarterly growth figures) that affect both U.S. interest rates and domestic interest rates directly, through an expectation of higher domestic growth; this would tend to bias the estimated effect of U.S. interest rates up. The latter would seem to be mainly an issue for countries with strong U.S. trade links, such as Mexico. In the context of regressions at the monthly or quarterly frequency, however, it may be a broader problem: to the extent that business cycles are synchronized across countries, unexpected movements in U.S. output might be correlated with shocks to domestic output. To the extent that monetary policy both in the U.S. and the domestic economy react to these changes, this might generate a correlation between interest rate movements that does not reflect the reaction of domestic interest rates to U.S. policy shocks, but rather the endogenous reaction (via the monetary policy reaction function) of both U.S. interest rates and domestic interest rates to common shocks.

In our view, there are three ways of meeting these challenges, depending on whether one merely wishes to identify the shock associated with a particular event, such a change in the Federal Funds rate target, or whether one requires a time series which assigns a policy surprise measure to each period.

(1) In the context of standard-size VAR systems, one can identify U.S. monetary policy shocks in a separate VAR using U.S. data alone, and include these shocks as exogenous inputs in a VAR using data from an emerging market economy. This requires the use of *monthly or quarterly time series data.* For a recent paper that implements this approach in a somewhat different context, see Canova (2000).

(2) In the context of *daily time series* data, VAR-based identification of U.S. monetary policy shocks is not possible since this requires monthly or quarterly data. However, one can infer daily "monetary policy surprises"—or more accurately, shocks to *expectations* about U.S. monetary policy—directly from observed changes in federal funds futures rates.[7] Importantly, these will reflect shocks to the *arguments* in the monetary policy reaction function (for example, news about output or employment) as well as monetary policy shocks in a strict sense, i.e. the random component of policy-driven changes in interest rates. However, at the daily frequency it may be acceptable to assume that, for example, to the extent that a jump in the federal funds futures rate is driven by, say, a shock to employment growth in the U.S., this shock does not affect interest rates in Argentina *other* than through its implications for future U.S. monetary policy. Even for a country like Mexico, it is plausible to assume that *most* of the effect goes through that channel.

(3) Finally, to identify the surprise content of a *particular change in the federal funds target*, one can again use federal funds futures data (for example, the difference in the same-month federal funds futures rate, adjusted by the proportion of days remaining in the month, as suggested by Kuttner (2000), or related measures based on 2 and 3-month ahead futures contracts, see below). Alternatively, following Skinner and Zettelmeyer (1995), one could also use the jump in the U.S. three-month T-bill rate on the day of the policy announcement. Since any day-to-day change in the three-month T-bill rate is unexpected to a first approximation, this would constitute a set of U.S. interest rate shocks *attributable to U.S. monetary policy* (assuming that there were no other major news that might have influenced the three-month T-Bill on the same day).

In this paper we use the second and third of the three approaches outlined. The latter is most likely to produce a measure that truly reflects exogenous policy shocks, as supposed to just policy surprises. The former, however, has the advantage that it compares dynamic paths, rather than just instantaneous responses, and allows us to use a much richer dataset.[8] We

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[7] The federal funds futures rate is based on a futures contract that calls for delivery of interest paid on a principal amount of $5 million in overnight funds. Payments are made whenever the futures contract settlement price changes during the contract month. This, in turn, is calculated based on the arithmetic average of the daily effective federal funds rate reported by the Fed for each day of the contract (calendar) month. This implies that the one-month ahead Federal Funds futures rate will represent the market expectation of the average federal funds rate during the next full calendar month; the two-month federal funds rate the market expectation of the average federal funds rate during the calendar month after that, etc. For details, see Carlson, McIntire and Thomson (1994).

[8] This is true both because there were only 45 changes in the Federal Funds rate target from 1989 until mid-2000 (see Appendix I for details), and because the information content of these events is relatively small, since many were highly anticipated (particularly after 1994, when the Fed almost always changed the target on FOMC meetings that were scheduled in advance). Moreover, not all events can be used for all countries because of either data

refrain from the first approach—estimating the effects of monetary policy shocks identified via a U.S. VAR at the monthly or quarterly frequency—mainly because it is likely to be sensitive to alternative identification assumptions in the U.S. VAR, and thus raises a set of distinct methodological issues which are better dealt with in the context of a separate paper.

D. Identifying Shocks to Emerging Market Risk Premia

The risk premium ρ defined in equation (1) compensates risk-averse investors for depreciation risk and default risk associated with holding domestic financial assets. Since neither $E[\frac{\dot{e}}{e}]$ nor default probabilities are directly observable, ρ cannot be backed out of observable variables such as domestic and international interest rates. However, our concern is not with measuring ρ itself but with identifying *exogenous shocks to* ρ, i.e. shocks to the risk premium that are not the result of domestic economic or political shocks, which one would expect to affect interest rates regardless of the exchange rate regime. Such shocks include contagion from crises in *other* emerging market countries that would have insignificant *direct* repercussions on the country, and changes in the appetite for risk of international investors.

A measure that can reasonably be assumed to reflect such shocks is a broad index of emerging market bond spreads, such as J.P. Morgan's Emerging Market Bond Index (EMBI), and more recent versions of that index which have broader regional coverage (the Emerging Market Bond Index Global, or EMBIG). However, to the extent that the bonds of the country we are considering are still part of the index, an endogeneity problem continues to exist, albeit in weaker form than if we had used country-specific sovereign bond spreads as a measure of risk.[9] For this reason, we pursue a two-track approach, just as in the context of identifying U.S. monetary policy shocks. On the one hand, we estimate daily VARs that include an emerging market bond index, and compute impulse response functions with respect to innovations in this index. On the other, we look at the response of domestic interest rates to specific shocks that are sufficiently important to be discussed in the financial press, and thus allow us to pinpoint the regional origin of that shock. This enables one to compile a set of ρ-shocks for each country which excludes domestic shocks as well as shocks in countries with strong direct economic links. For example, the run on Hong Kong in October of 1997 is part of the sample of events used to examine interest responses in Argentina and Mexico but not in Hong Kong itself. Similarly, the event-set for Argentina excludes both events originating in Argentina and in neighboring Brazil. This enables us to compare the

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problems in the domestic interest rate variable (Argentina), or because of changes in the exchange rate regime (Mexico).

[9] In principle, one could address this by removing the spreads of the country bonds in question from the emerging market average. Unfortunately, however, the weights used to compute the index change daily depending on market volume, and are not publicly available.

reactions of domestic interest rates to shocks in risk premia that are not related to domestic developments.

III. RESULTS

A. Impact Effects of U.S. Monetary Policy Shocks

We start out by comparing immediate reactions of domestic interest rates to U.S. monetary policy for the five emerging market and three advanced economies mentioned in the introduction. U.S. monetary policy shocks are identified in three ways: (1) the change in 3 month U.S. T-Bill rate in reaction to a (publicly announced or at least publicly understood) change in the federal funds target, (2) Kuttner's (2000) measure of monetary policy surprises based on the reaction of the same-month federal fund futures rate to the policy action; (3) an analogous measure based on the reaction of a weighted average of the two-month ahead and three-month ahead federal funds futures rate, which we dub "FF2CONT", and which is described in detail in the appendix. The latter measure captures not only the policy surprise associated with the meeting itself, but also the impact of the meeting on expectations about monetary policy actions in meetings over the next 2-3-months, which corresponds to the maturity of the interest rate data we typical use on the left hand side.[10] All three measures of policy are highly correlated (see Appendix Table A1), so in practice, it does not matter much which one is used. Figures 1 through 3 use the change in FF2CONT as our preferred measure, but the regressions that follow are based on all three.

Figures 1 and 2 compare the reactions of interest rates and exchange rates to U.S. monetary policy shocks for the three advanced economies, Hong Kong, Singapore and Chile. The horizontal axis of each plot shows U.S. monetary policy shocks. In the plots on the left column, the vertical axis shows the change of a domestic interest rate on the same dates (adjusted for the time difference in the case of the Pacific markets);[11] in the plots on the right column, the vertical axis shows the percentage change in the exchange rate (where a depreciation is defined as an increase). As an interest rate measure, we picked the most liquid money market rate of approximately three-month maturity that was available at the daily frequency during the 1990s (see Appendix for details about the data). For Chile, there is no

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[10] For example, suppose that an interest rate hike is expected with some probability for either today's meeting or the next meeting (but not for both). If the hike materializes today, then Kuttner's measure will only pick up the shock associated with today's action, while FF2CONT will pick up the sum of today's shock and the revision of expectations for the next meeting, in the opposite direction.

[11] In other words, for Hong Kong, Singapore, Australia and New Zealand, the dates were moved forward by one day to take account of the fact that a date t announcement in Washington would impact these markets at date $t+1$.

Figure 1. Australia, Canada and New Zealand: Reaction of Interest and
Exchange Rates to U.S. Monetary Policy Shocks
(FF2CONT as measure of shock in percentage points, on X-axis)

Australia: Bank Bill Rate, 1989-2000

Australia: Exchange Rate

Canada: 3-month TBill Rate, 1990-2000

Canada: Exchange Rate

New Zealand: Bank Bill Rate, 1989-2000

New Zealand: Exchange Rate

Figure 2. Hong Kong, Singapore, and Chile: Reaction of Interest and
Exchange Rates to U.S. Monetary Policy Shocks
(FF2CONT as measure of shock in percentage points, on X-axis)

Hong Kong: 3-month Interbank Rate, 1989-2000

Singapore: 3m Interbank Rate, 1989-2000

Singapore: Exchange Rate

Chile: 90-365-day UF Deposits, 1989-2000

Chile: Exchange Rate

Figure 3. Mexico and Argentina: Reaction of Interest and
Exchange Rates to U.S. Monetary Policy Shocks
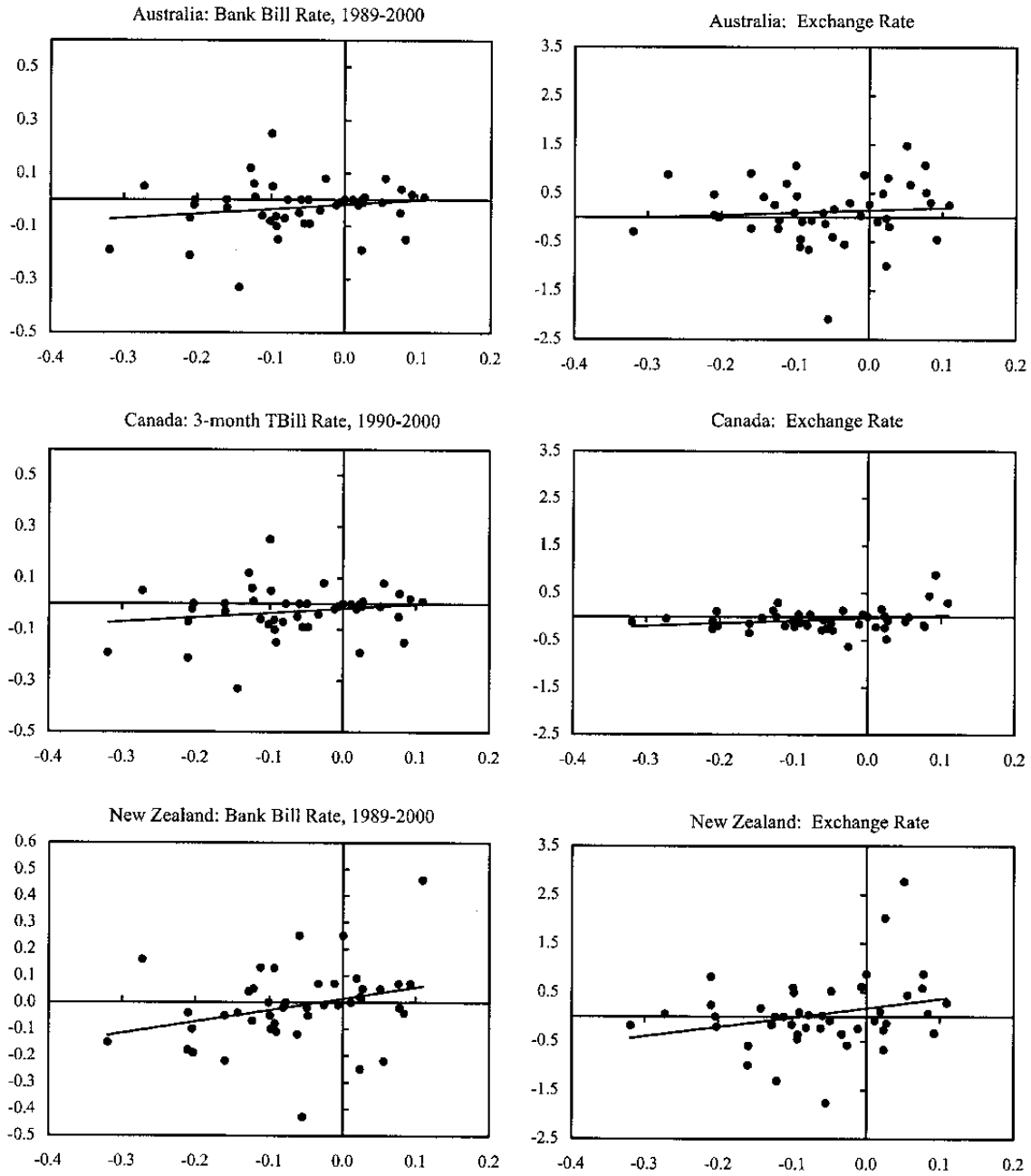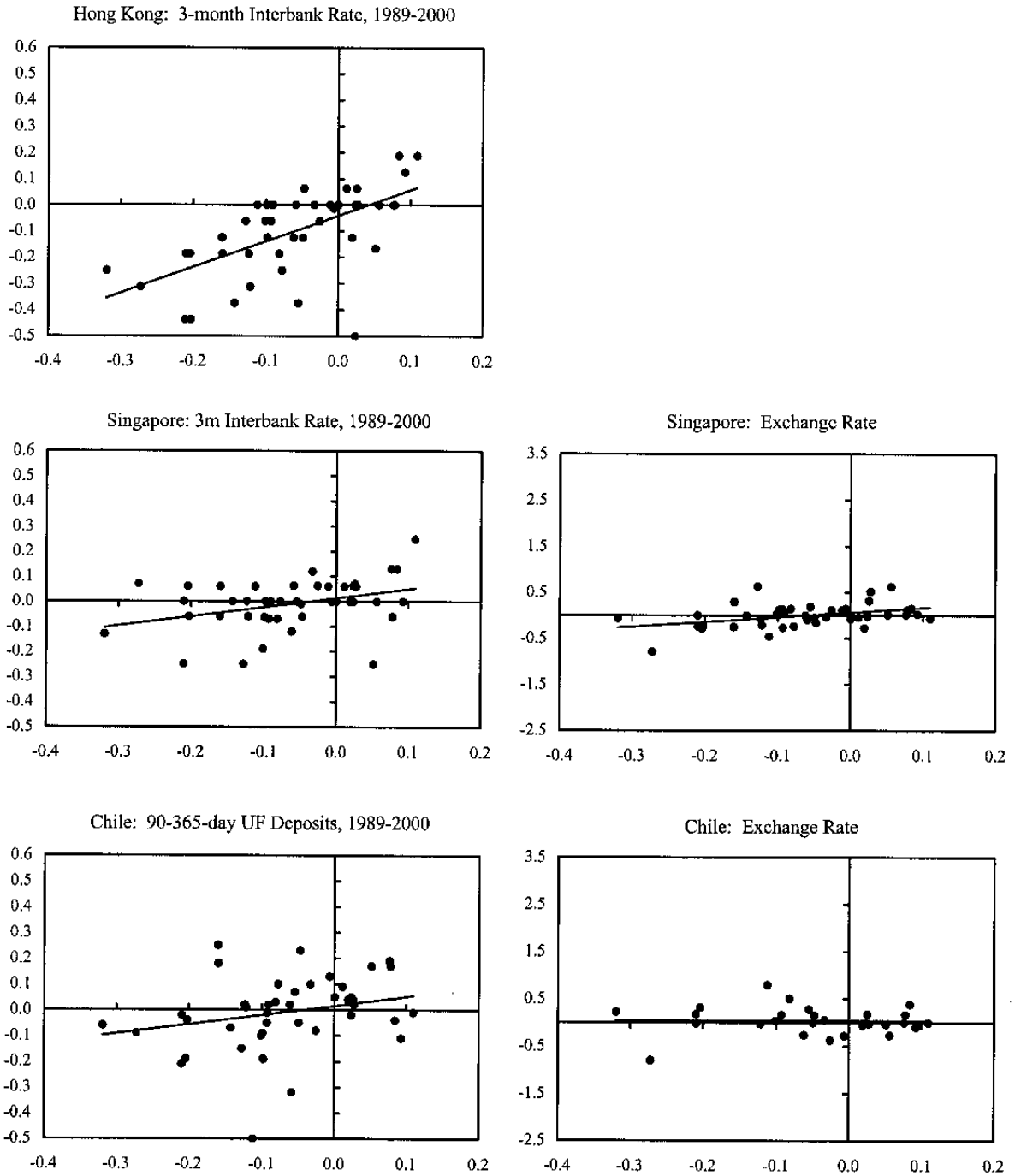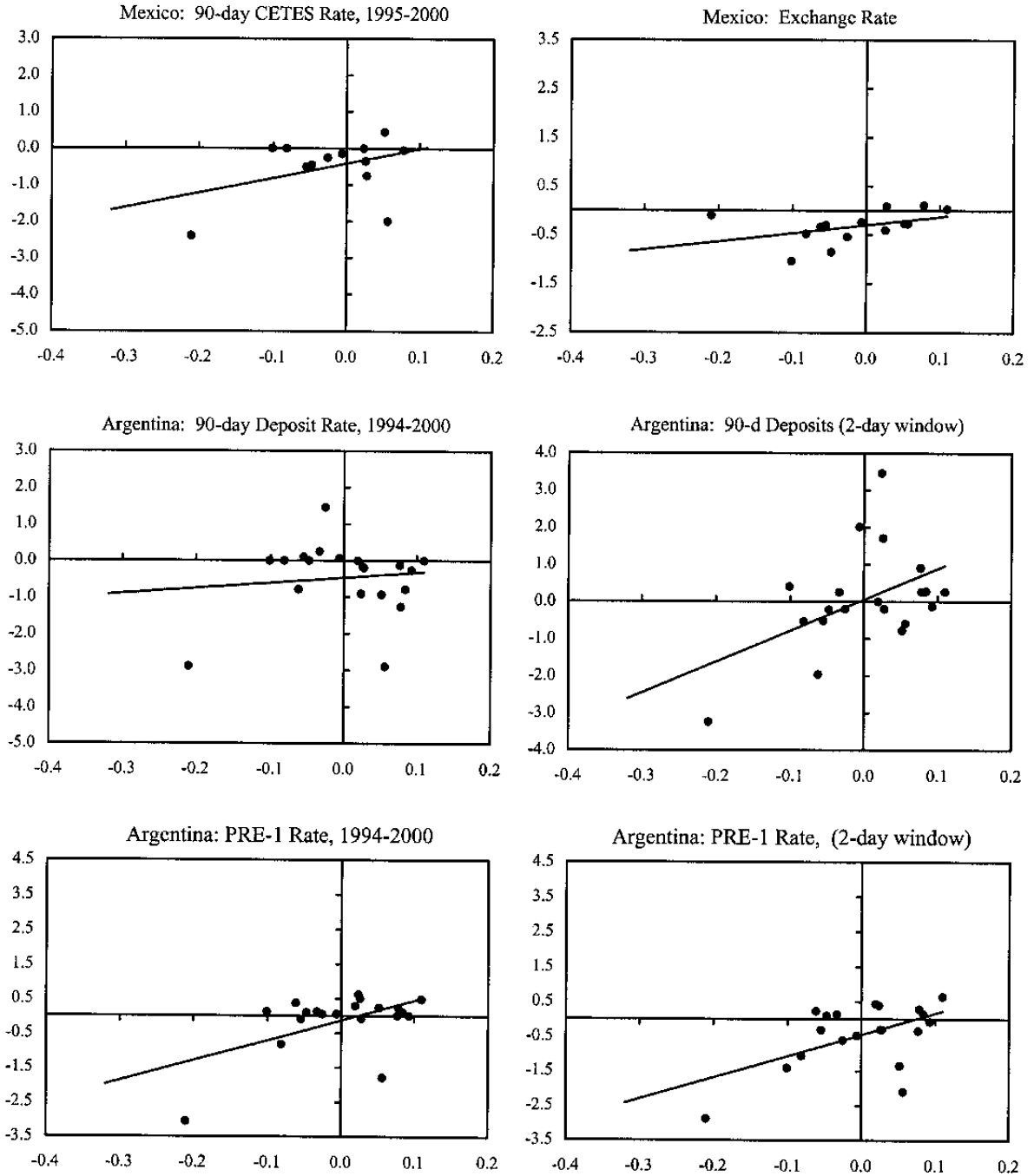(FF2CONT as measure of shock in percentage points, on X-axis)

liquid instrument which trades daily, and we therefore used a 90-365 day time-deposit rate provided by the central bank.[12]

Three main insights emerge from this exercise. First, *all* countries show positive correlations between domestic interest movements and U.S. monetary policy shocks, and, with the exceptions of Chile and obviously Hong Kong, exchange rate changes and U.S. shocks. Perhaps surprisingly, the correlation between domestic interest rates and U.S. shocks mostly appears tighter than that between exchange rates and U.S. shocks. Second, the reaction of interest rates in Hong Kong, the only fixed exchange rate regime in this group, is substantially larger than for the other countries. Third, with respect to the correlation between domestic interest rate changes and U.S. monetary policy shocks, the two emerging markets floaters in the sample—Chile and Singapore—seem to respond no differently than the three industrialized economies.

These results are basically consistent with conventional priors. In small open economies with floating regimes, one would expect monetary authorities, particularly if they target inflation, to "lean against" nominal exchange rate appreciations or depreciations. This would generate a positive correlation between domestic and international interest rate movements, but obviously less so than in the case of a currency board regime.

Figure 3 shows analogous plots for Argentina and Mexico. For Argentina, a liquid money market rate is only available beginning in 1997, which would have rendered the sample too short. Consequently, we used two alternative interest rates: a 90-day deposit rate which is available consistently since 1993, and yields on longer term domestic government bonds (PRE1) that have a liquid market.[13] To deal with the time zone difference—which implies that U.S. announcements may sometimes arrive after markets have closed in Argentina—as well as possible stickiness in the Argentinian deposit rate, we show the change of domestic interest rates both over the same dates as for the US t-bill rate (i.e. t minus t-1, where t indicates the day of the US announcement), and an extended the time window to give the domestic rate one extra day to react (i.e., t+1 minus t-1). For Mexico, we use a treasury-bill type rate, the 91 day secondary market CETES rate, although it occasionally has missing data points, and does not appear to be very liquid over some subperiods.

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[12] The contracts underlying this rate are expressed in an inflation-indexed currency unit, the "unidad de fomento" (UF) rather than in Chilean pesos. However, for the purpose of measuring daily reactions, this is almost as good as a nominal instrument since the day-to-day changes in the value of the UF relative to the Chilean peso are very small.

[13] The PRE1 ("Previsional 1") bond was issued to settle debts with pensioners with an original maturity of 8 years, and is actively traded by domestic and foreign investors. A similar, PRE2, bond was issued in dollars. The remaining maturity of these bonds, of course, declines steadily over our sample.

For Mexico, although the magnitude of the reaction of the exchange rate to U.S. monetary policy shocks seems to be broadly in line with that of the industrial countries, the correlation of domestic interest rates appears much larger (note the difference in the scale of the vertical axis in Figure 3). The reaction of interest rates in Argentina are also of very large magnitude, and appear to be generally larger than in Mexico. Note, however, that this impression is based on very few data points, since we have no reliable interest rate data for Argentina prior to 1993, and that the floating regime for Mexico only started in 1995. Also, note that the interest rate correlations for both Mexico and Argentina may be driven by just one or two outliers. The regression results give a better sense of the magnitude and statistical significance of the correlations suggested by the plots, and permit to check the robustness of the results to excluding outliers. Table1 shows simple static regressions of domestic interest rate changes on U.S. monetary policy shocks occurring on the same day, using three alternative measures for the U.S. shocks, while Table 2 shows corresponding regressions with changes in the exchange rate on the left hand side. In the appendix, we also show a set of analogous regressions in which we additionally control for changes in J.P. Morgan's EMBI on the day of U.S. policy announcements (Tables A3a and A3b). In the discussion that follows, we focus on Tables 1 and 2 because the inclusion of the change in the EMBI reduces the sample in half (many U.S. policy actions occurred in the early 1990s, before the EMBI became available). However, a comparison of the results with those of Table A3 shows that this is of no consequence for the main conclusions of this section.

The results mostly confirm the preceding discussion, and can be summarized in four points:

(i) The sensitivity of domestic interest rates to U.S. policy shocks is remarkably similar for the three industrial countries, Singapore and Chile. In most cases, a one basis point U.S. policy shock leads to a change of about 0.2 to 0.4 basis points in the domestic interest rate. This relationship is statistically significant for all countries except Australia and Chile.

(ii) For Hong Kong, interest rates rise about one-for-one with U.S. policy, in line with a textbook model of a currency board regime.

(iii) For both Argentina and Mexico, interest rate responses are much higher than one-for-one, although somewhat larger for Argentina. The estimated coefficients are, however, highly sensitive to outliers. After dropping outliers, all coefficients substantially decline in magnitude, although they are generally still larger than one. For Argentina, most coefficients remain significantly larger than zero, while in the case of Mexico, coefficients become insignificantly different from zero after dropping outliers. However, given the large standard errors and small sample, the comparison between Argentina and Mexico is clearly not conclusive based on these findings.

(iv) Finally, the results also confirm the expected positive response of exchange rates to U.S. interest rate shocks for the floating regime countries, although the coefficients are not always statistically significant. This time, the coefficient for Mexico appears more or less in line with that for the other floaters in the sample.

Table 1. Impact Effect of U.S. Monetary Policy Shocks on Domestic Interest Rates
(Dependent variable: changes in domestic interest rate; t values in italics)

	Policy measure					
	Change in FF2CONT 1/		Kuttner (2000) 2/		Change in US 3m T-Bill	
	policy measure	regression constant	policy measure	regression constant	policy measure	regression constant
Hong Kong	0.98	-0.04	0.64	-0.06	0.90	-0.05
(N=44)	*4.90*	*-1.76*	*3.83*	*-2.35*	*4.81*	*-2.05*
Singapore	0.37	0.01	0.23	0.01	0.36	0.01
(N=44)	*2.54*	*0.75*	*2.05*	*0.38*	*2.72*	*0.73*
Australia	0.17	-0.02	0.14	-0.02	0.15	-0.02
(N=44)	*1.19*	*-1.14*	*1.28*	*-1.23*	*1.11*	*-1.26*
Canada	0.40	0.01	0.27	0.01	0.37	0.01
(N=38)	*3.99*	*0.94*	*3.33*	*0.57*	*3.89*	*0.77*
New Zealand	0.43	0.01	0.31	0.01	0.44	0.01
(N=44)	*1.99*	*0.53*	*1.87*	*0.35*	*2.26*	*0.57*
Chile	0.358	0.016	-0.021	-0.009	0.45	0.02
(N=44)	*1.27*	*0.47*	*-0.10*	*-0.26*	*1.75*	*0.66*
Argentina (90-d deposit)	8.36	0.05	6.88	-0.02	8.36	0.13
(N=20) 3/	*2.33*	*0.18*	*2.40*	*-0.07*	*3.57*	*0.55*
Argentina (PRE-1)	6.20	-0.45	5.87	-0.51	5.63	-0.39
(N=20) 3/	*2.73*	*-2.55*	*3.51*	*-3.13*	*3.70*	*-2.47*
Mexico	4.04	-0.41	5.61	-0.36	4.82	-0.28
(N=13)	*1.42*	*-1.84*	*2.54*	*-1.86*	*2.39*	*-1.33*
Memorandum Item: Results for Argentina and Mexico after excluding outliers 4/						
Argentina (90-d deposit)	3.70	-0.11	3.49	-0.16	4.59	-0.07
(N=17) 3/	*1.31*	*-0.59*	*1.50*	*-0.83*	*2.41*	*-0.43*
Argentina (PRE-1)	4.01	-0.25	3.19	-0.30	2.96	-0.24
(N=18) 3/	*1.93*	*-1.92*	*1.87*	*-2.16*	*1.91*	*-1.83*
Mexico	0.77	-0.18	1.37	-0.18	0.28	-0.18
(N=11)	*0.41*	*-1.72*	*0.75*	*-1.80*	*0.18*	*-1.68*

1/ Change in weighted average between 2-month ahead and 3-month ahead federal funds futures rate (see Appendix).
2/ Unexpected change in the federal funds target, based on change in the current-month federal funds futures rate.
3/ Two-day window.
4/ Defined as changes of domestic interest rates of 200 basis points or more on one day.

Table 2. Impact Effect of U.S. Monetary Policy Shocks on Bilateral Exchange Rates
(dependent variable: percentage change in bilateral exchange rate; t values in italics)

| | Policy measure | | | | | |
| | Change in FF2CONT 1/ | | Kuttner 2/ | | Change in US 3m T-Bill | |
	policy measure	regression constant	policy measure	regression constant	policy measure	regression constant
Australia	0.48	0.15	0.29	0.14	1.11	0.18
(N=44)	*0.50*	*1.30*	*0.40*	*1.26*	*1.28*	*1.71*
Canada	0.56	-0.03	0.50	-0.03	0.49	-0.03
(N=44)	*1.53*	*-0.69*	*1.82*	*-0.69*	*1.45*	*-0.81*
New Zealand	1.92	0.17	1.43	0.15	0.74	0.04
(N=44)	*1.75*	*1.33*	*1.70*	*1.23*	*2.17*	*1.04*
Singapore	1.03	0.06	0.48	0.03	1.03	0.05
(N=44)	*2.89*	*1.50*	*1.64*	*0.75*	*2.70*	*1.43*
Chile	-0.04	0.04	0.15	0.05	0.11	0.05
(N=28)	*-0.08*	*0.64*	*0.34*	*0.80*	*0.25*	*0.77*
Mexico	1.69	-0.30	1.24	-0.30	0.82	-0.29
(N=14) 2/	*1.65*	*-3.52*	*1.24*	*-3.34*	*0.88*	*-2.98*

1/ Change in weighted average between 2-month ahead and 3-month ahead federal funds futures rate (see
2/ Unexpected change in the federal funds target, based on change in the current-month federal funds futures
3/ Sample begins in July 1995.

B. Impact Effects of Large Shocks to Emerging Market Risk Premia

We performed an analogous study of the reactions of domestic interest rates and exchange rates to large movements in emerging market risk premia. To define a suitable set of "events", we proceeded as follows. First, we identified all days on which J.P. Morgan's EMBI Global, or EMBIG, composite bond index moved by at least 3 percent. The EMBIG is a broad-based index of emerging market bond prices which is available since January 1994. The 3-percent threshold was chosen because it is sufficiently high so that the financial press would usually notice and attempt to interpret the "jump" in emerging market bonds; however, it is still sufficiently low to yield a reasonably-sized event set (40 events in the period between January 1994 and mid-2000, of which about half occur after the Asia crisis; see Appendix Table A2 for a full listing). Second, the background to each event was checked using the *Financial Times*, in particular with a view to identifying the market or markets in which the shock originated. This turned out to be relatively easy in all but two cases. Finally, for each country, we examined the reaction of domestic interest rates to the shocks, both on the entire sample and—to disentangle the effect of domestic and international shocks, as discussed previously—excluding the shocks that appear to have "originated" in the country or in a neighboring country with strong real linkages (e.g., Brazil for the case of Argentina).

Shocks were measured as the change in the EMBI spread over the day, this being the only general measure of emerging market bond spreads that is available since the early 1990s.[15] For the sample period after 1997, we also used the broader-based EMBI Global spread index, which becomes available in 1998, as an alternative measure. For Argentina and Mexico, where dollar-denominated sovereign bond yields are available over the entire sample period, we also examined the reaction of domestic interest rates to the change in the dollar-denominated bond yield on that date (the idea being that the latter is likely to be a better measure of how the international shock affects the *country-specific* risk premium). For similar reasons, we also used the EMBIG regional subindex for Asia in some of the regressions involving Hong Kong and Singapore.

Figures 4-6 plot changes in domestic interest rate and (if applicable) the exchange rates against the full sample of 40 large changes in the EMBI spread. Tables 3 and 4 show regression results both for the full sample and for the event-subsamples that are deemed exogenous for each country. The tables also distinguish between regression results that are based on the entire 1994-2000 period and those that apply only to the period after the Asia crisis. This turns out to make a big difference for the Asian economies, particularly Hong Kong.

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[15] J.P. Morgan publishes the "EMBI Global" bond *price* index beginning in 1994, but unfortunately not the corresponding index of bond *spreads*, which starts only in 1998.

Figure 4. Australia, New Zealand, Canada, and Chile:
Reaction of Interest and Exchange Rates to EMBI Shocks, 1994-2000
(measure of shock, in percentage points, on X-axis)

Figure 5. Hong Kong and Singapore: Reaction of Interest and Exchange
Rates to Emerging Market Risk Premia Shocks
(measure of shock, in percentage points, on X-axis)

Hong Kong: Int. Rate, EMBI Shocks, 1994-2000

Singapore: Int. Rate, EMBI Shocks , 1994-2000

Singapore: Exch. Rate, EMBI Shocks, 1994-2000

Hong Kong: Int.Rt, EMBIG Asia Subindex, 98-00

Singapore: Int.Rt, EMBIG Asia Subindex, 98-00

Singapore: Exch.Rt, EMBI Asia Subindex, 98-00

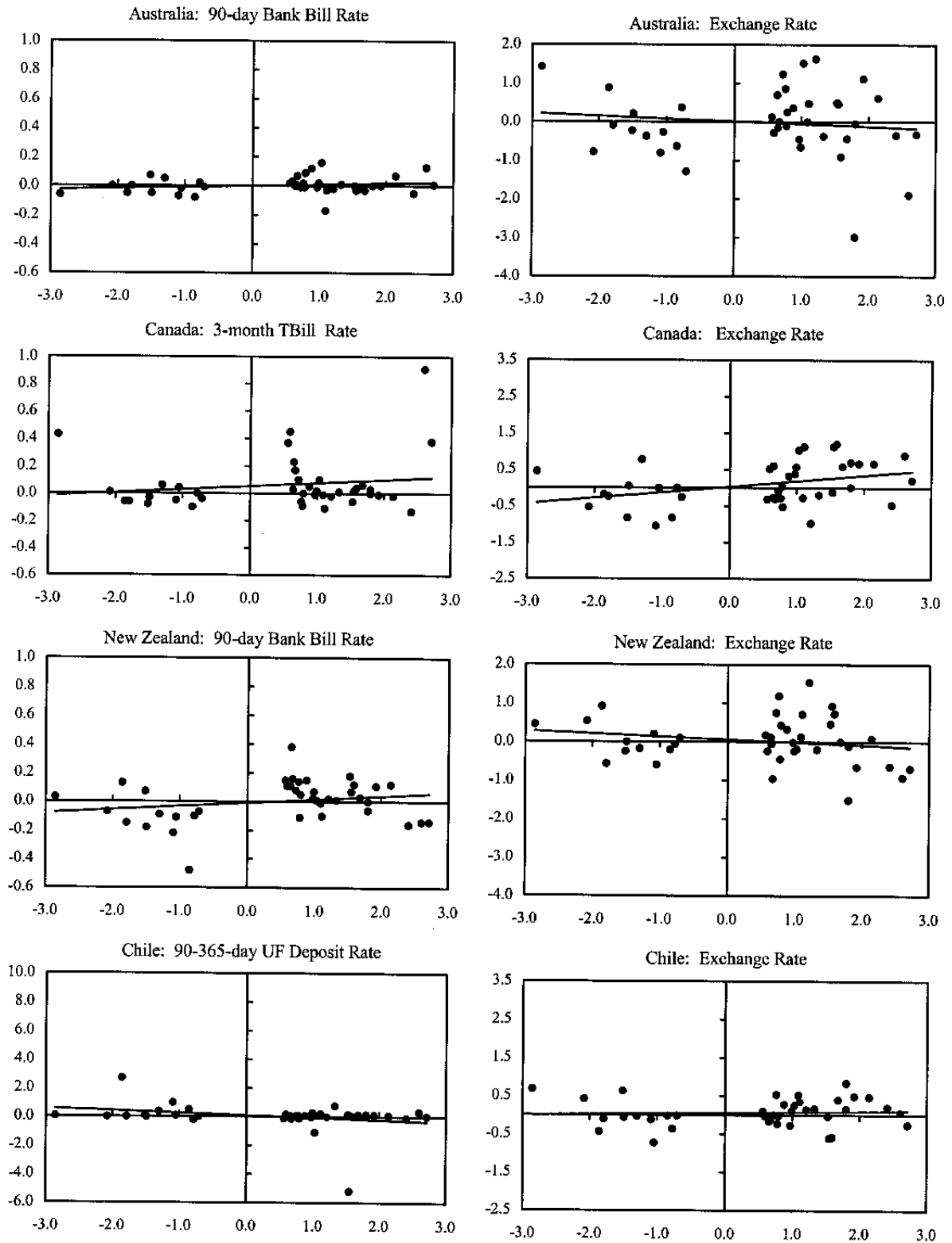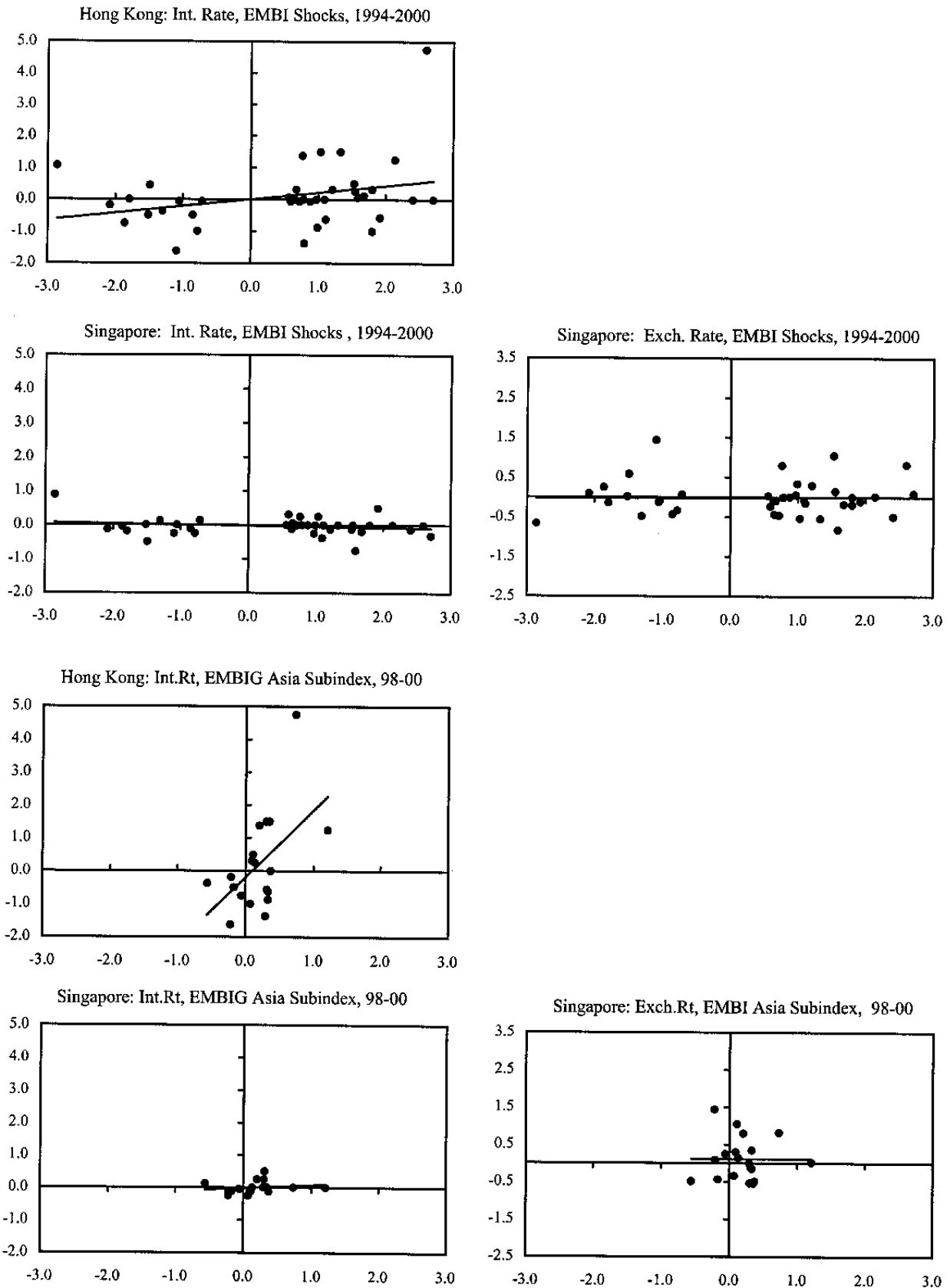Figure 6. Mexico and Argentina: Reaction of Interest and Exchange
Rates to Emerging Market Risk Premia Shocks, 1994-2000
(measure of shock, percentage points, on X-axis)

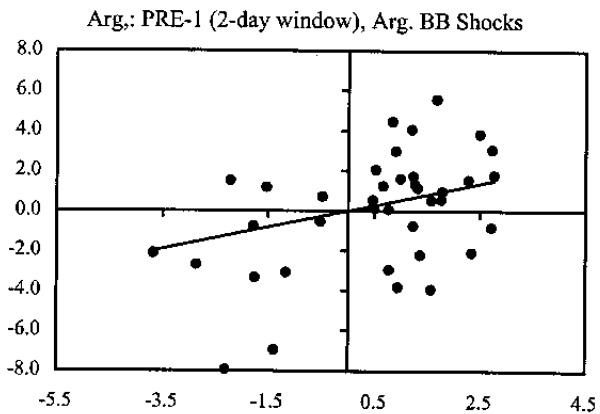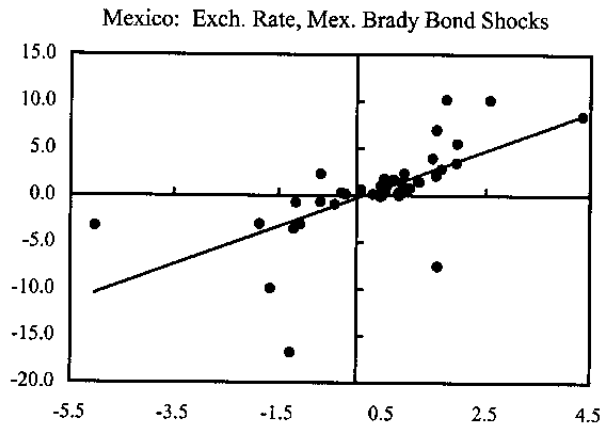Mexico: 90-day CETES Rate, EMBI Shocks

Mexico: Exchange Rate, EMBI Shocks

Arg.: PRE-1 (2-day window), EMBI Shocks

MexIco.: 90-d CETES, Mex. Brady Bond Shocks

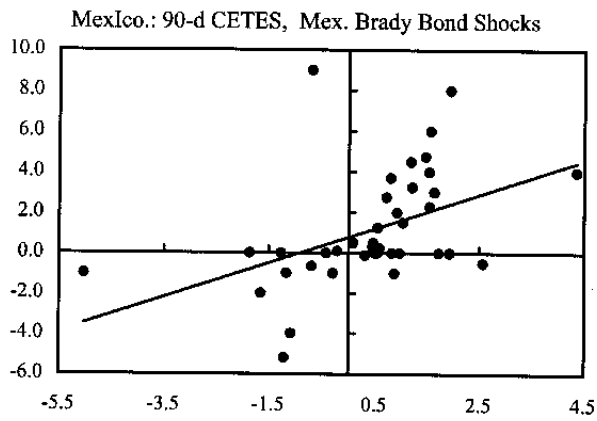Mexico: Exch. Rate, Mex. Brady Bond Shocks

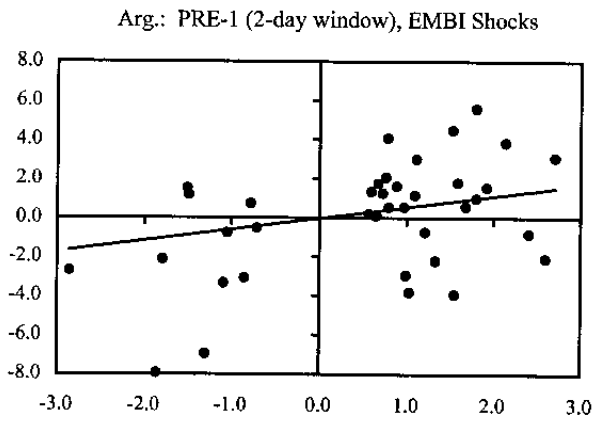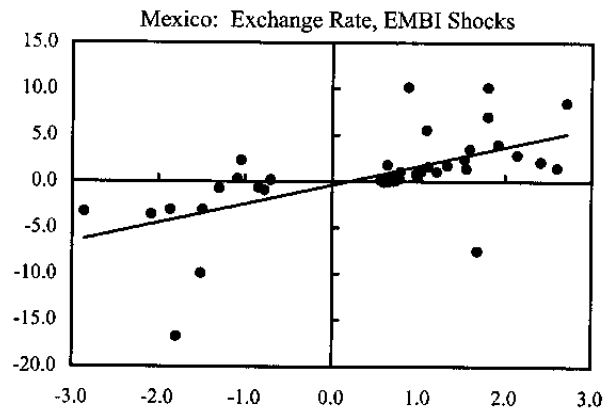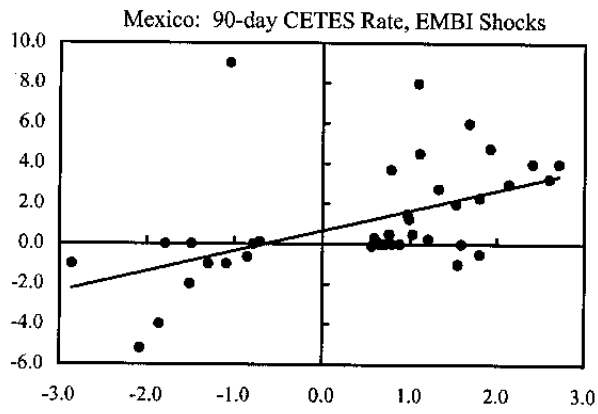Arg,: PRE-1 (2-day window), Arg. BB Shocks

Table 3. Impact Effect of Shocks to International Risk Premia on Domestic Interest Rates

(Dependent variable: changes in domestic interest rate; t-values in italics, number of observations in parentheses)

	Using EMBI to measure shock								Using EMBIG to measure shock,				Using Country Bond or Subindex, 2/			
	Sample Period: 1994 - 2000				Sample Period: 1998 - 2000				Sample Period: 1998 - 2000				Sample Period: varies by country 3/			
	Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/	
	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant
Hong Kong	0.22	0.00	0.27	0.06	0.53	-0.13	0.60	-0.02	0.72	-0.15	0.82	-0.03	2.04	-0.20	2.17	-0.14
	1.93	*0.00*	*2.38*	*0.34*	*2.61*	*-0.42*	*2.87*	*-0.05*	*2.74*	*-0.49*	*3.04*	*-0.09*	*2.58*	*-0.61*	*2.68*	*-0.38*
	(40)		(35)		(19)		(15)		(19)		(15)		(19)		(15)	
Singapore	-0.03	-0.02	-0.04	-0.04	0.04	-0.03	0.02	-0.06	0.06	-0.03	0.04	-0.06	0.09	-0.02	0.06	-0.06
	-0.95	*-0.48*	*-1.44*	*-0.94*	*1.43*	*-0.63*		*-1.61*	*1.64*	*-0.73*	*1.29*	*-1.69*	*0.81*	*-0.44*	*0.75*	*-1.52*
	(40)		(35)		(19)		(15)		(19)		(15)		(19)		(15)	
Australia	0.01	0.00	...	...	0.01	0.00	...	...	0.02	0.00	...	...	...	...	...	...
	1.35	*0.02*			*1.44*	*0.25*			*1.69*	*0.15*						
	(40)				(19)				(19)							
Canada	0.02	0.05	...	...	0.04	0.00	...	...	0.06	0.00	...	...	...	...	...	...
	1.06	*1.61*			*1.28*	*0.00*			*1.37*	*-0.05*						
	(40)				(19)				(19)							
New Zealand	0.02	-0.01	...	...	0.03	-0.04	...	...	0.05	-0.05	...	...	...	...	...	...
	1.47	*-0.34*			*1.32*	*-1.12*			*1.54*	*-1.23*						
	(40)				(19)				(19)							
Chile	-0.17	0.09	-0.03	0.09	-0.34	0.19	-0.12	0.18	-0.41	0.18	-0.15	0.18	...	...	...	...
	-1.48	*0.55*	*-0.67*	*1.36*	*-1.50*	*0.55*	*-0.94*	*1.07*	*-1.39*	*0.51*	*-1.03*	*1.11*				
	(40)		(26)		(19)		(11)		(19)		(11)					
Argentina 4/	0.57	-0.04	0.95	-0.10	0.37	-0.82	1.26	-1.72	0.50	-0.84	1.48	-1.70	0.55	0.00	0.96	-0.08
	1.56	*-0.07*	*2.56*	*-0.19*	*0.52*	*-0.75*	*1.72*	*-1.73*	*0.55*	*-0.76*	*1.68*	*-1.71*	*1.80*	*-0.01*	*2.86*	*-0.16*
	(40)		(26)		(19)		(11)		(19)		(11)		(40)		(26)	
Mexico	1.01	0.65	0.90	0.48	1.54	-0.19	1.46	-0.08	1.96	-0.19	1.83	-0.04	0.85	0.77	1.16	0.51
	3.64	*1.58*	*2.24*	*0.86*	*6.41*	*-0.52*	*5.48*	*-0.20*	*5.96*	*-0.49*	*5.18*	*-0.10*	*3.14*	*1.83*	*1.98*	*0.88*
	(40)		(26)		(19)		(18)		(19)		(18)		(40)		(26)	

1/ Excludes events originating in Asia for Hong Kong and Singapore; Argentina and Brazil for Chile and Argentina

2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Change in Brady Bond Yield for Argentina and Mexico.

3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore

4/ PRE-1 rate, 2-day window.

Table 4. Impact Effect of Shocks to International Risk Premia on Exchange Rates

(Dependent variable: percentage change in domestic currency per US$; t values in italics, number of observations in parentheses)

	Using EMBI to measure shock								Using EMBIG to measure shock, Sample Period: 1998 - 2000				Using Country Bond or Subindex, 2/ Sample Period: varies by country 3/			
	Sample Period: 1994 - 2000				Sample Period: 1998 - 2000											
	Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/		Full sample		excluding country-specific events 1/	
	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant	RP shock	constant
Singapore	0.00	0.00	0.01	0.00	0.00	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	-0.02	0.00	-0.02	0.00
	1.30	*-0.79*	*1.36*	*-0.67*	*-1.01*	*-0.10*	*-1.09*	*-0.44*	*-1.02*	*-0.09*	*-1.09*	*-0.43*	*-1.31*	*0.11*	*-1.20*	*-0.23*
	(40)		(35)		(19)		(15)		(19)		(15)		(19)		(15)	
Australia	-0.07	0.01	...	...	0.07	0.10	...	...	0.11	0.10	...	...	...	...	...	...
	-0.67	*0.09*			*0.50*	*0.44*			*0.56*	*0.42*						
	(40)				(19)				(19)							
Canada	0.16	0.03	...	...	0.20	-0.03	...	...	0.28	-0.04	...	...	...	...	...	...
	2.45	*0.34*			*1.74*	*-0.15*			*1.93*	*-0.23*						
	(40)				(19)				(19)							
New Zealand	-0.07	0.06	...	...	-0.12	0.27	...	...	-0.15	0.27	...	...	...	...	...	...
	-1.05	*0.61*			*-1.10*	*1.63*			*-1.08*	*1.62*						
	(40)				(19)				(19)							
Chile	0.02	0.06	0.01	0.14	0.07	0.04	0.13	0.05	0.10	0.04	0.16	0.05	...	...	...	...
	0.51	*0.91*	*0.20*	*2.13*	*1.39*	*0.54*	*2.36*	*0.67*	*1.55*	*0.48*	*2.46*	*0.66*				
	(40)		(26)		(19)		(18)		(19)		(11)					
Mexico	2.04	-0.39	1.09	0.41	1.13	0.00	1.06	0.11	1.44	0.00	1.32	0.14	2.02	-0.29	1.67	0.31
	4.70	*-0.61*	*4.62*	*1.25*	*8.19*	*0.00*	*7.09*	*0.48*	*7.21*	*0.01*	*6.43*	*0.59*	*5.13*	*-0.47*	*5.35*	*1.00*
	(40)		(26)		(19)		(18)		(19)		(18)		(40)		(26)	

1/ Excludes events originating in Asia for Singapore, Argentina and Brazil for Chile.

2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Brady Bond Yields for Argentina and Mexico.

3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore

The results show that, for the three industrial countries and Chile, the response of interest rates and exchange rates to the large EMBI shocks is mostly not significant. The main exception is a significant reaction of the Canadian *exchange* rate to EMBI/EMBIG shocks, both for the entire sample period and in the post-Asia sample period. The latter is somewhat surprising, particularly since we do not see the same kind of reactions for Australia and New Zealand. For the post-Asia sample period, we also see a significant reaction of Chilean exchange rates to EMBI and EMBIG shocks once country-specific events are excluded; however, this result is based on a very small event set.

For the Asian countries, there is a small but significant and robust reaction of interest rates to EMBI shocks over the entire sample period for Hong Kong (coefficient of about 0.25), but not for Singapore, where the corresponding coefficient is insignificant (and in fact negative). If one restricts attention to the period after the Asia crisis, both the coefficients for Hong Kong and Singapore become much larger, and the latter is now borderline significant. Note also that the coefficients are larger the higher the weight of Asia in the measure of emerging market risk that is used in the regression, as one would expect. However, the reaction of Hong Kong interest rates is much larger regardless of the subsample and measure of risk used. This accords with conventional priors about the potentially insulating effects of Singapore's exchange rate regime. However, this interpretation appears to conflict with the behavior of Singapore's exchange rate, which also shows no sign of depreciating in response to EMBI/EMBIG shocks, and often has the wrong sign. Thus, the evidence might simply suggest that Hong Kong is more vulnerable to speculative attacks than Singapore when there are crises elsewhere.

Finally, for Mexico and Argentina, one observes virtually the same reaction of the interest rates to shocks to international risk premia as long as (1) the PRE-1 rate is used for Argentina (domestic deposit rates, which are not shown in the figures and tables, show very little response); and (2) events originating in Argentina or Brazil are removed from the sample for Argentina (Table 3).[15] The coefficient is about 1 on the long (1994-2000) sample, regardless whether the EMBI or a Brady bond yield is used to measure the shocks, and slightly higher if the post-Asia sample is used. If deposit rates are used for Argentina and/or shocks originating in Argentina or Brazil are not removed, then interest rate reactions to EMBI shocks actually appear smaller for Argentina than for Mexico. Thus, there is no evidence that the floating

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[15] On closer inspection, it turns out that the latter hinges mainly on one outlier for Argentina, namely the sharp drop in the EMBI spread on January 15, 1999, when emerging markets and particularly Brady bonds recovered from an initial over-reaction to the Brazil devaluation two days earlier. While Argentinean Brady bonds followed the general trend toward lower spreads, the PRE-1 did not, and the yield on the PRE-1 rose sharply. A possible interpretation is that at this point markets may have realized that the crisis was under control and the *real* would stabilize at the depreciated level. While reducing the chance of a further deepening of the Brazilian crisis, this my have increased doubts about the sustainability of the exchange rate regime in Argentina.

exchange rate regime helped insulate Mexico from EMBI shocks, in line with earlier claims by Hausmann et al. (1999).

Interestingly, however, this finding can*not* easily be attributed to "fear of floating", as the Mexican exchange rate did in fact exhibit large, highly significant responses to EMBI shocks (see Table 4). According to these estimates, the elasticity of exchange rates with respect to an exogenous 100 basis point EMBI or Brady Bond shocks is in the order 1-2 percent. This is roughly in line with exchange rate elasticities with respect to changes in *domestic* interest rates estimated by Zettelmeyer (2000) for several industrial countries with floating regimes. If anything, the results seem in line with a stylized fact in advanced open economies, namely that the increase in exchange rate volatility associated with floating exchange rate regimes is not necessarily offset by a reduction in volatility elsewhere in the domestic economy.[17] In our case, Mexican interest rates seem at least as volatile as interest rates in Argentina.

As with US monetary policy shocks, we checked that these results are robust if *both* changes in emerging market risk premia and U.S. interest rates are included in the regressions (Table A4a and A4b in the Appendix). As one would expect —given how the event-days underlying the regressions were selected) the coefficient on changes in U.S. interest rates is usually insignificant in these regressions, and the coefficient on the variables measuring risk premia change very little. The exceptions are Australia, Canada, and New Zealand, where we previously saw the smallest effect of EMBI/EMBIG shocks; here, the impact of U.S. interest rates on domestic interest rates is significant in spite of the short samples. Thus, in emerging market countries, large shocks to emerging market risk premia seem to overshadow changes in U.S. interest rates (which, as Table A2 documents, are usually triggered by events other than U.S. interest rate changes themselves), while this is not true for the advanced countries in our sample.

C. Vector Autoregressions

We ran country-specific vector autoregressions, using daily data, on the variables FF2CONT as measure of U.S. monetary policy, a measure of emerging market risk (either the EMBI or the EMBI Global spread), the natural logarithm of the exchange rate (when applicable) and the corresponding domestic interest rate. We ran two main sets of regressions. The first is based on a long sample, which uses the EMBI and generally begins in 1992—except for Argentina, where we begin in 1994 due to lack of reliable domestic interest data for the earlier years, and Mexico, where it begins in 1995. The second set of VARs is based on a post-Asia crisis sample and uses the EMBIG. This second sample is motivated mainly by the fact that the responses of Hong Kong and Singapore to emerging market shocks seem to have changed after the Asia crisis, as suggested in the results of the previous section. However,

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[17] See in particular, Flood and Rose (1995). Related results are presented in Baxter and Stockman (1989) and Jeanne and Rose (2000).

the longer sample is appropriate and more informative for most other countries, thus, in what follows we only discuss the shorter sample when it yielded significantly different results.

We identified the system by imposing an ordering on the contemporaneous relationship that assumes that FF2CONT contemporaneously affects all other variables but is not itself affected by any of them, that the emerging market risk measure is contemporaneously only affected by FF2CONT but affects the other two, and so forth. In addition, we test, accept, and impose full exogeneity of FF2CONT. Note that the results that follow are not sensitive to changes in the relative ordering of exchange rates and domestic interest rates or to using the alternative U.S. policy measures shown in Tables 1 and 2.

In what follows, we show two sets of impulse response functions, one with respect to a one percentage point U.S. interest rate shock and one with respect to a one percentage point EMBI or EMBIG shock. One can view these models as extensions of the impact regressions presented earlier, where we now use a much broader data set, consider short-run dynamics in addition to impact effects, and take into account the dynamic endogeneity of all variables except the U.S. interest rate variable. The main downside, as argued before, is that the identification of the underlying shocks is less clean than in the previous section. In the case of EMBI shocks, endogeneity may be an important issue with regard to Mexico and Argentina, which are included in the EMBI with large weights. To deal with this problem in at least a rudimentary fashion, we excluded subperiods from the sample in which there is a presumption that the EMBI might be driven by domestic shocks affecting the country whose interest rate we are examining; thus, the sample used in the regressions for Mexico begins in June of 1995. The samples for Hong Kong and Singapore do not include the period after July 1997 in our baseline regression, and they only start in January 1998 in the shorter regression which uses the EMBIG. As it turns out, the impulse response functions to EMBI and EMBIG shocks are almost entirely consistent with the results from the impact regressions, lending some credibility to our identification assumptions.

Because the VAR systems do not include variables such as output, money and prices which one would expect to adjust after the very short run, we limit ourselves to showing the impulse responses for about 3-weeks after each shock. To help interpret the results, it is useful to understand what the shocks do to the underlying variables themselves, in other words, how much persistence there is in the series we are shocking. This is answered in Figure 7, which shows the two impulse responses with respect to a shock to themselves based on our long regression sample. As one would expect, both shocks are highly persistent over the short run that we are considering, especially U.S. interest rate shocks. After 30 days, about 90 percent of the initial U.S. interest rate shock is still present. This must be borne in mind when interpreting the short-run persistence of some of the reactions in domestic interest rates and exchange rates. For the EMBI shock, about 80 percent is still present after 30 days. Note also the slight overshooting of the EMBI at the outset. This overshooting is even more pronounced (and persistent) in the short (post-Asia) regression sample, and may explain some of the overshooting we see in the corresponding impulse response functions below.

Figure 7. Impulse Response Functions of U.S. Interest Rates and EMBI Spread
with Respect to a One-Percentage Point Shock to Themselves, 1992-2000
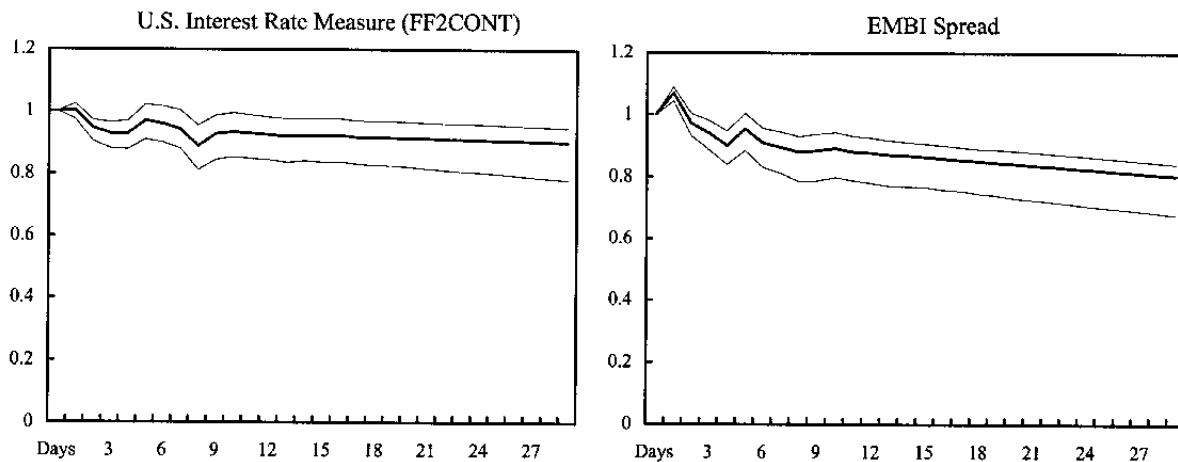
Short run effects of U.S. interest rate shocks

Figures 8 through 10 display impulse response functions for both domestic interest rates and exchange rates with respect to a one percentage point shock to U.S. interest rates. Beginning again with the industrial countries to define a "baseline" with which to compare the results for the emerging markets, the main results are summarized as follows.

- For Australia, Canada and New Zealand, the results are in line with conventional expectations, and broadly consistent with those of the previous section. Broadly, a 1 basis point shock leads to a 0.5 basis point interest pass through and a 0.2 percent depreciation on impact. As in the previous section, the responses of interest rates are estimated much more tightly than the exchange rate responses, which are statistically significant in only one case (Canada).

- For Singapore, the interest rate reaction is more or less in line with that of the industrialized countries (0.2-0.4 basis points on impact for a 1 bp shock, later rising to about 0.6). For Hong Kong, the response is approximately three times as large: about 1 basis point on impact, later rising to about 1.5. Note also the significant response of exchange rates in the case of Singapore. In sum, a foreign interest rate shock seems to be reflected one-for-one (or even slightly more than one-for-one) in Hong-Kong interest rates, whereas in the case of Singapore it seems to be absorbed by interest rates and exchange rates in about equal proportion.

Figure 8. Australia, New Zealand, and Canada: Impulse Response Functions of Interest Rates
(Percentage Points) and Exchange Rates (Logs) to 1 Percentage Point Shock to U.S. Interest Rate

Australia: 90-day Bank Bill Rate, 1992-2000

Australia: Exchange Rate, 1992-2000

Canada: 3-month TBill Rate, 1992-2000

Canada: Exchange Rate, 1992-2000

New Zealand: Bank Bill Rate, 1992-2000

New Zealand: Exchange Rate, 1992-2000

Figure 9. Hong Kong and Singapore: Impulse Response Functions of Interest Rates
(Percentage Points) and Exchange Rates (Logs) to 1 Percentage Point Shock to U.S. Interest
Rate

Hong Kong: 3-month Interbank Rate, 1992-1997

Singapore: 3-month Interbank Rate, 1992-1997

Singapore: Exchange Rate, 1992-1997

Figure 10. Chile, Mexico, and Argentina: Daily Impulse Response Functions of Interest Rates
(Percentage Points) and Exchange Rates (Logs)
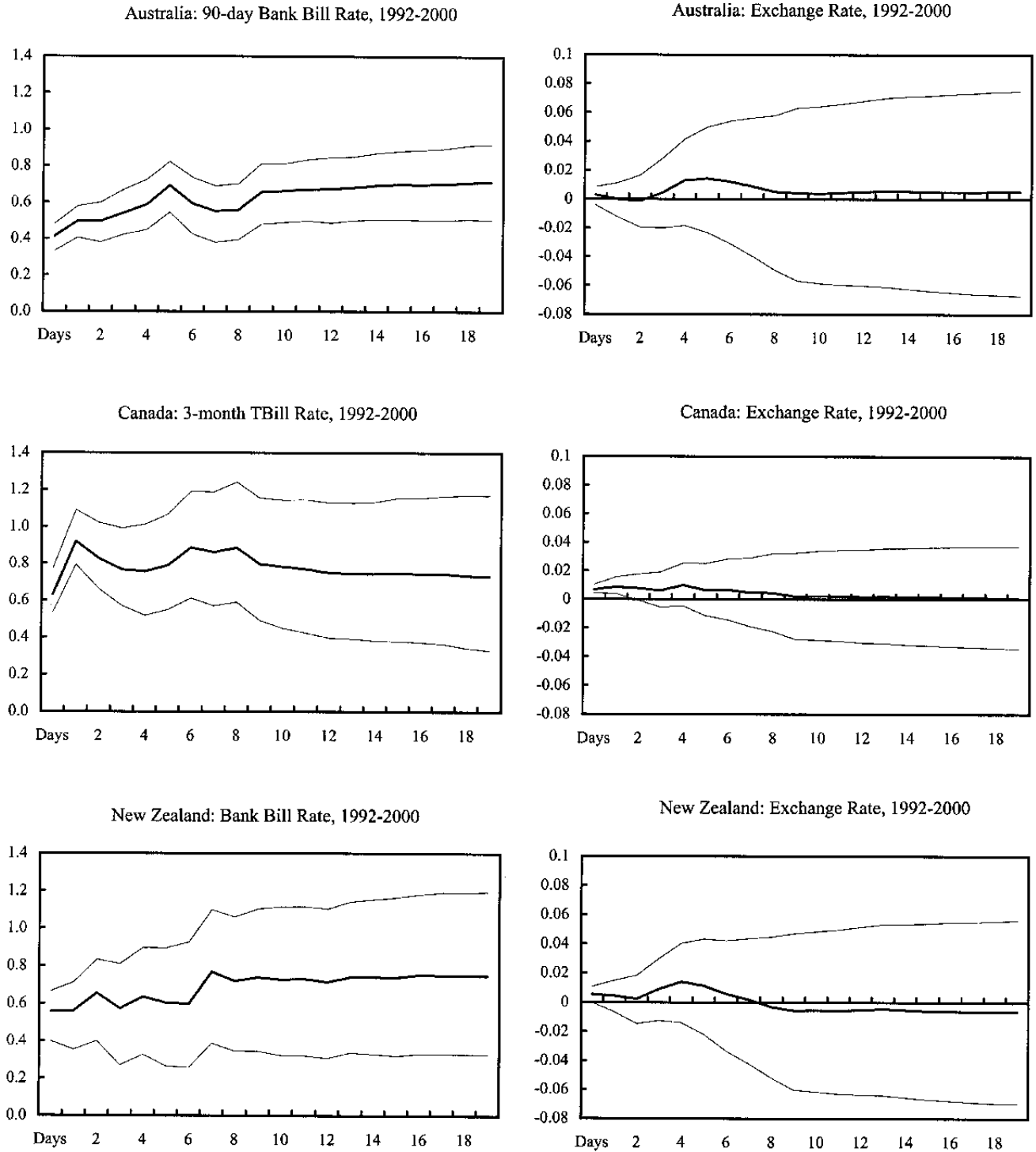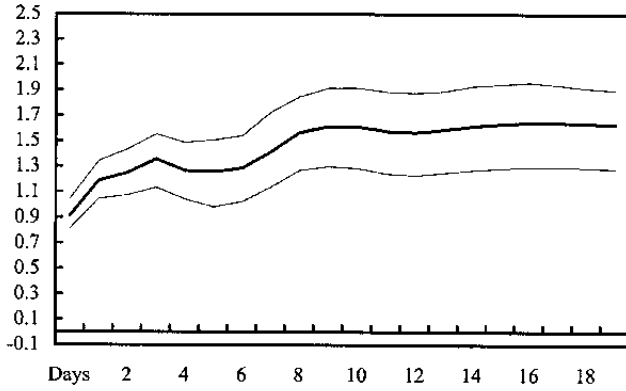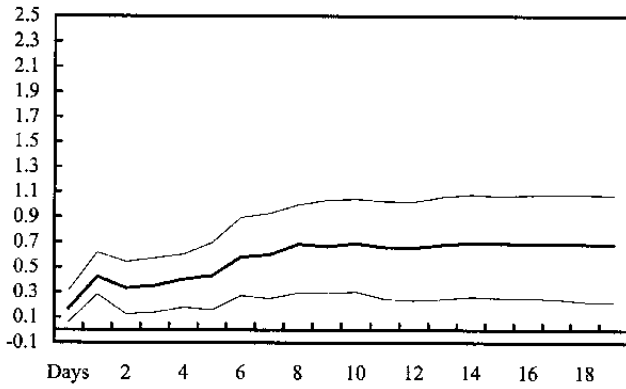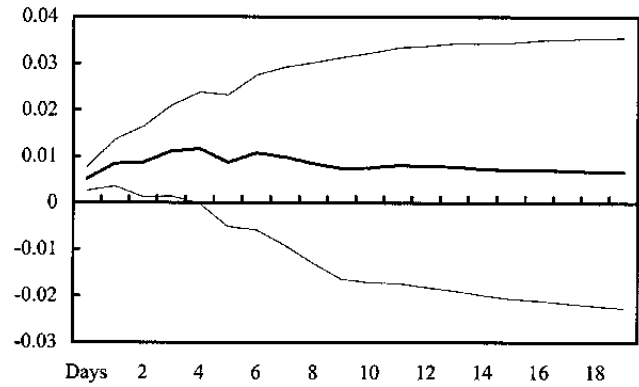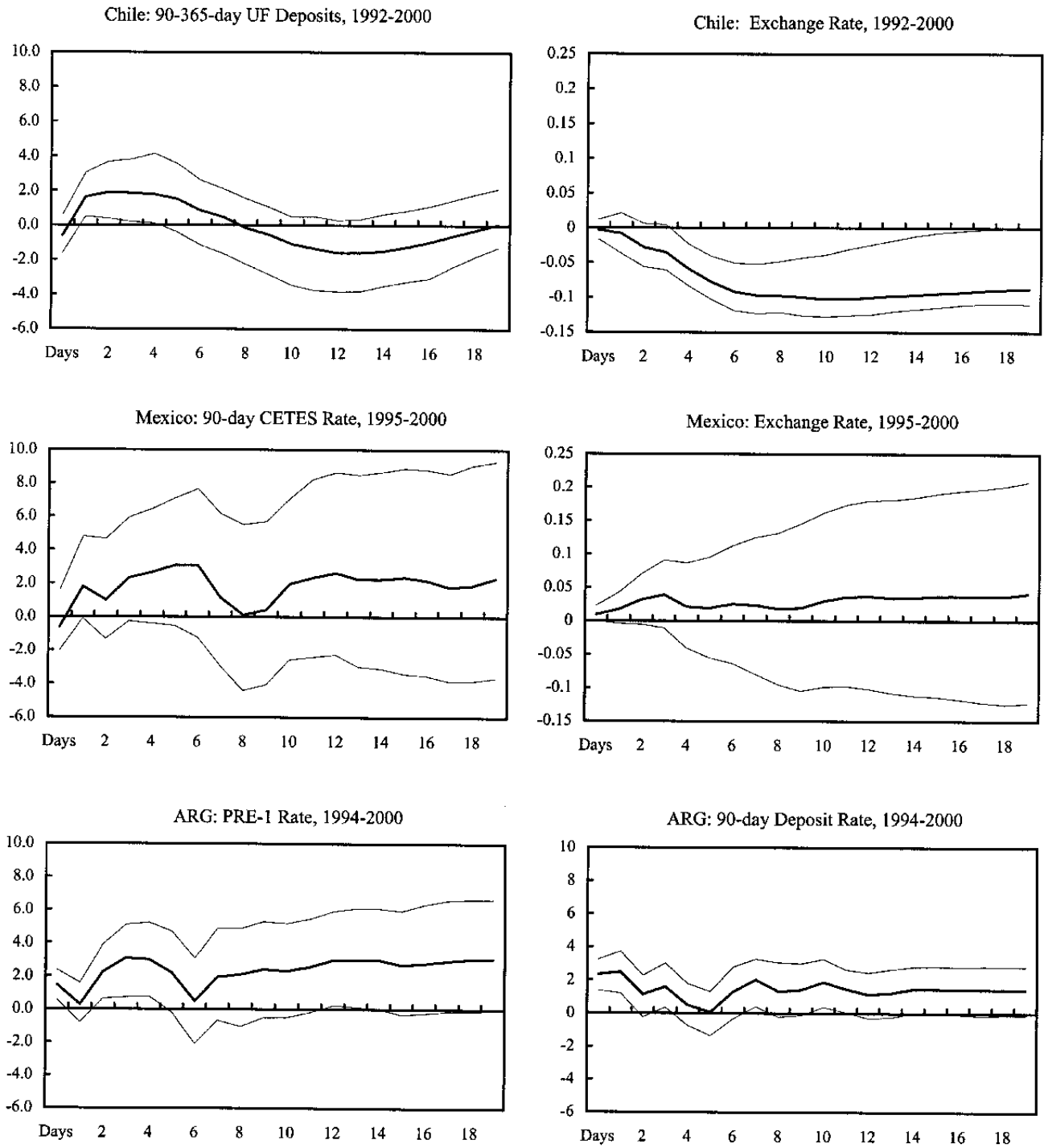to 1 Percentage Point Shock to U.S. Interest Rate

Chile: 90-365-day UF Deposits, 1992-2000

Chile: Exchange Rate, 1992-2000

Mexico: 90-day CETES Rate, 1995-2000

Mexico: Exchange Rate, 1995-2000

ARG: PRE-1 Rate, 1994-2000

ARG: 90-day Deposit Rate, 1994-2000

- In the cases of Argentina, Mexico, and Chile, the estimation results are much noisier and thus harder to compare. For Argentina, the results again show a consistent, significant over-reaction of the interest rate on impact, roughly 1-3 basis points per basis point of U.S. shock. The estimated impact effect on Mexican interest rates appears smaller, but the standard errors are too large to reach a definite conclusion.

Short run effects of shocks to emerging market risk premia

Next, consider impulse responses with respect to a one percentage point shock to the EMBI or EMBIG spread (Figures 5a through 5c). In interpreting these results, it is important to keep in mind that the typical EMBI shock is about ten times larger than the typical U.S. interest rate shock (the standard deviation of the orthogonalized error is about 2.6 basis points for the latter, and 28 basis points for the former). Thus, relative to the standard volatility of both measures, a one percentage point EMBI shock represents a much smaller shock than a one percentage point U.S. interest rate shock. The results are summarized as follows:

- All three industrialized countries show some response to EMBI shocks (in terms of both interest rates and exchange rates, see Figure 5a). However, these are very small for Australia and New Zealand. For Canada, the estimated effect on interest rates is somewhat larger: approximately a 4 basis point increase for a 100 basis point jump in the EMBI spread. The relatively large effect for Canada may be driven by "contagion" during the Tequila crisis (see Zettelmeyer (2000)).
- Based on the 1992-1997 sample (i.e. before the Asia crisis, see upper panel of Figure 5b), Hong Kong shows no significant reaction to EMBI shocks. For Singapore, the reaction, if anything, appears to be *negative*, suggesting a "safe haven" effect.
- Based on the post-Asia crisis sample, however, Hong Kong shows a very large, significant response to EMBIG shocks, while Singapore shows a much smaller, but still positive and significant response (see lower panel of Figure 5b). The estimated short-run responses (about 0.4 – 0.7 for Hong Kong and about 0.05 – 0.1 for Singapore) are in line with the impact coefficients estimated in the previous section (Table 3). Note also that, unlike in Figure 5, we do seem to get a significant impact response of the Singapore exchange rate in the expected direction, although it is small (about 0.2 percent for a 100 point EMBIG shock).
- Both Mexico and Argentina exhibit very large reactions to EMBI shocks which are of about the same order of magnitude if the PRE-1 rate is used for Argentina. The point estimates indicate an "overreaction" between about 1.5:1 and 2:1. This is slightly larger than the impact reactions estimated in the previous sections, which were in the order of 1:1. Note again that the large reaction of the Mexican interest rate occurs in spite of a large, significant response of the exchange rate (about 1.5 percent depreciation in response to a 100 basis point EMBI shock, consistent with our earlier findings. Chile seems much less sensitive to EMBI shocks than Argentina and Mexico, both in terms of interest rate pass through and in terms of exchange rate fluctuations.

Finally, it is interesting to note that the EMBI itself shows a large, significant response with respect to U.S. monetary policy shocks, of more than one for one (not shown).

Figure 11. Australia, New Zealand, and Canada: Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (Logs) to 1 Percentage Point Shock to EMBI

Australia: 90-day Bank Bill Rate, 1992-2000

Australia: Exchange Rate, 1992-2000

Canada: 3-month TBill Rate, 1992-2000

Canada: Exchange Rate, 1992-2000

New Zealand: Bank Bill Rate, 1992-2000

New Zealand: Exchange Rate, 1992-2000

Figure 12. Hong Kong and Singapore: Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (Logs) to 1 Percentage Point Shock to Emerging Market Risk Premia Shocks

Hong Kong: Int. Rate, EMBI Shocks, 1992-1997
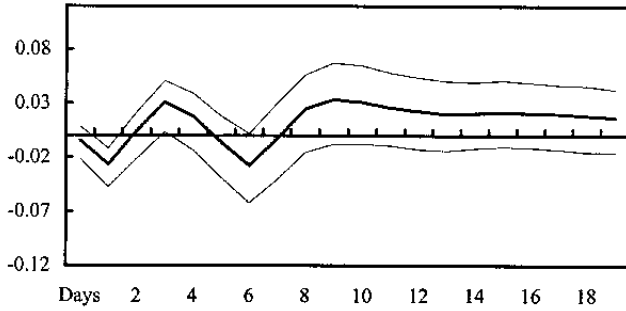
Singapore: Int. Rate, EMBI Shocks, 1992-1997

Singapore: Exch. Rate, EMBI Shocks 1992-1997

Hong Kong: Int. Rate, EMBIG Shocks, 1998-00
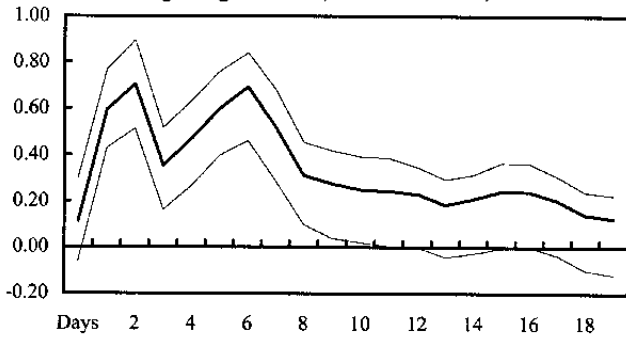
Singapore: Int. Rate, EMBIG Shocks, 1998-2000
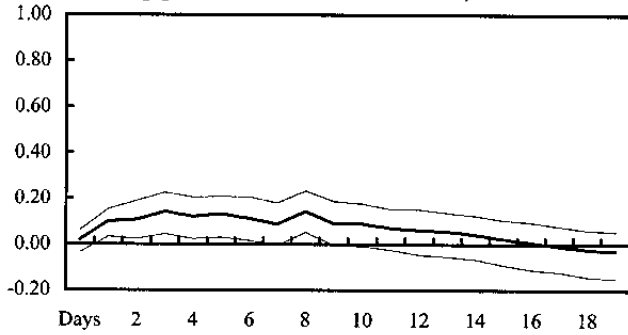
Singapore: Exch. Rate, EMBIG Shocks, 1998-00
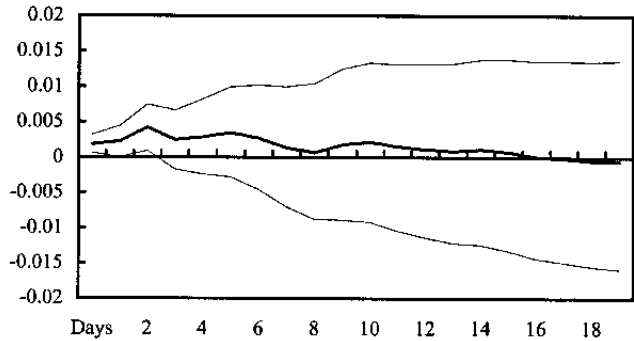
Figure 13. Chile, Mexico, and Argentina: Impulse Response Functions of Interest Rates (Percentage Points) and Exchange Rates (Logs) to 1 Percentage Point Shock to Emerging Market Premia Shocks
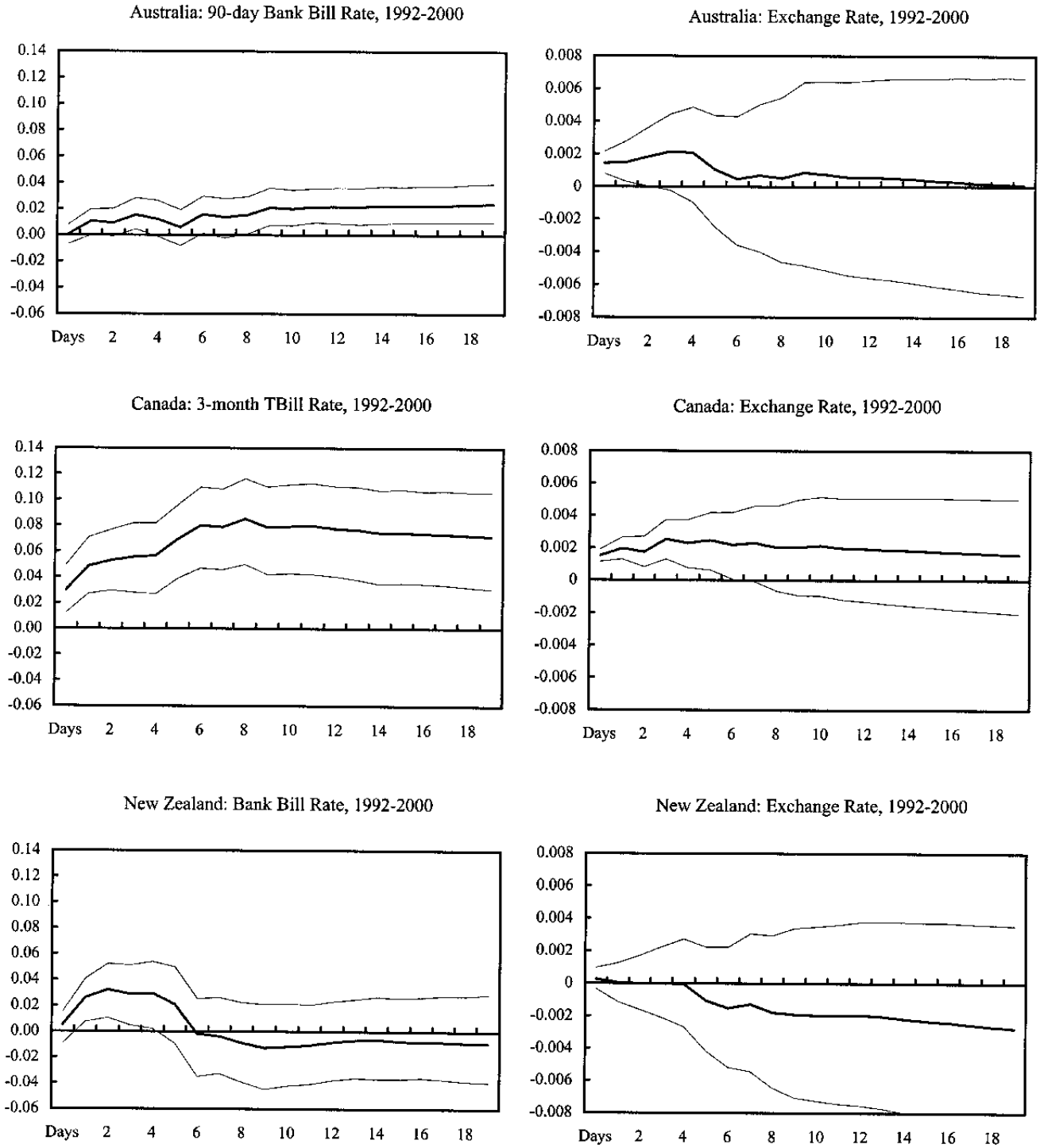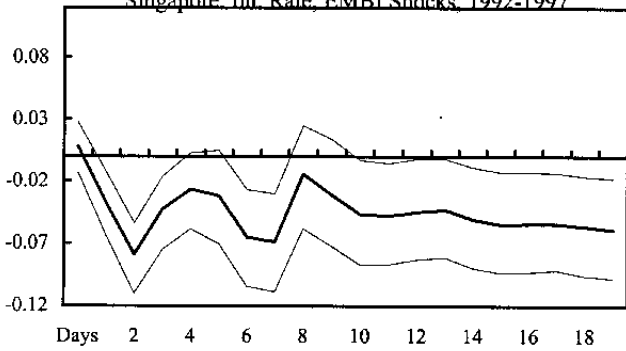

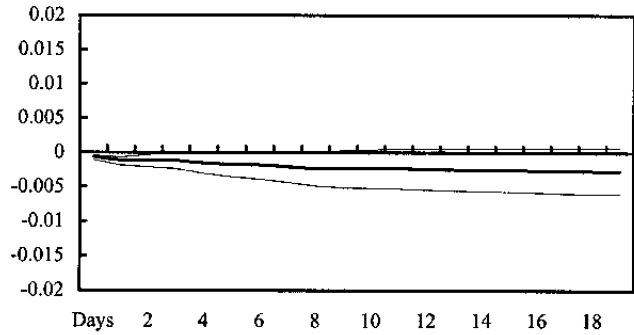Mexico: 90-day CETES Rate, 1995-2000

Mexico: Exchange Rate, 1995-2000

ARG: PRE-1 Rate, 1994-2000

ARG: 90-day Deposit Rate, 1994-2000

Chile: 90-365-day UF Deposits, 1992-2000

Chile: Exchange Rate, 1992-2000

IV. CONCLUSIONS

The exchange rate regime in emerging market economies is at the center of the design of an international monetary and financial system that performs with efficiency and stability. It is an old issue but has a new edge to it in the current international economic environment. For emerging markets at least, concerns about international capital movements now dominate considerations of "optimal currency areas."

This paper focused on studying empirically the proposition that floating exchange rate systems have the advantage that they permit the central bank to retain the use of the domestic interest rate as an economic policy instrument. While true in conventional analytical models, this weak form of "monetary independence" may not be valid in a context in which the credibility of the central bank is tenuous and the reactions of international investors are unpredictable. There is, in fact, a growing body of literature that states that floating exchange rate regimes weaken credibility to the point where central banks cannot allow the exchange rate to move much and in fact do not have much leeway to make monetary policy decisions.

In this paper, we investigate this "monetary independence" proposition with respect to two types of shocks emanating from the international monetary and financial markets: changes in US dollar interest rates and changes in the risk premium attached to emerging markets debt. We focused on economies that have broad similarities but are at the polar ends of exchange rate systems: Hong Kong and Singapore, and Mexico and Argentina. That is, we compare currency board systems with floating, although not without intervention, exchange rate systems. Being at the ends of the spectrum, the contrast should be sharper and the conclusions more clearcut. Moreover, there is a growing presumption that these two extreme exchange rate systems will in the end be adopted by most emerging market economies because they are the most robust to international financial markets volatility.
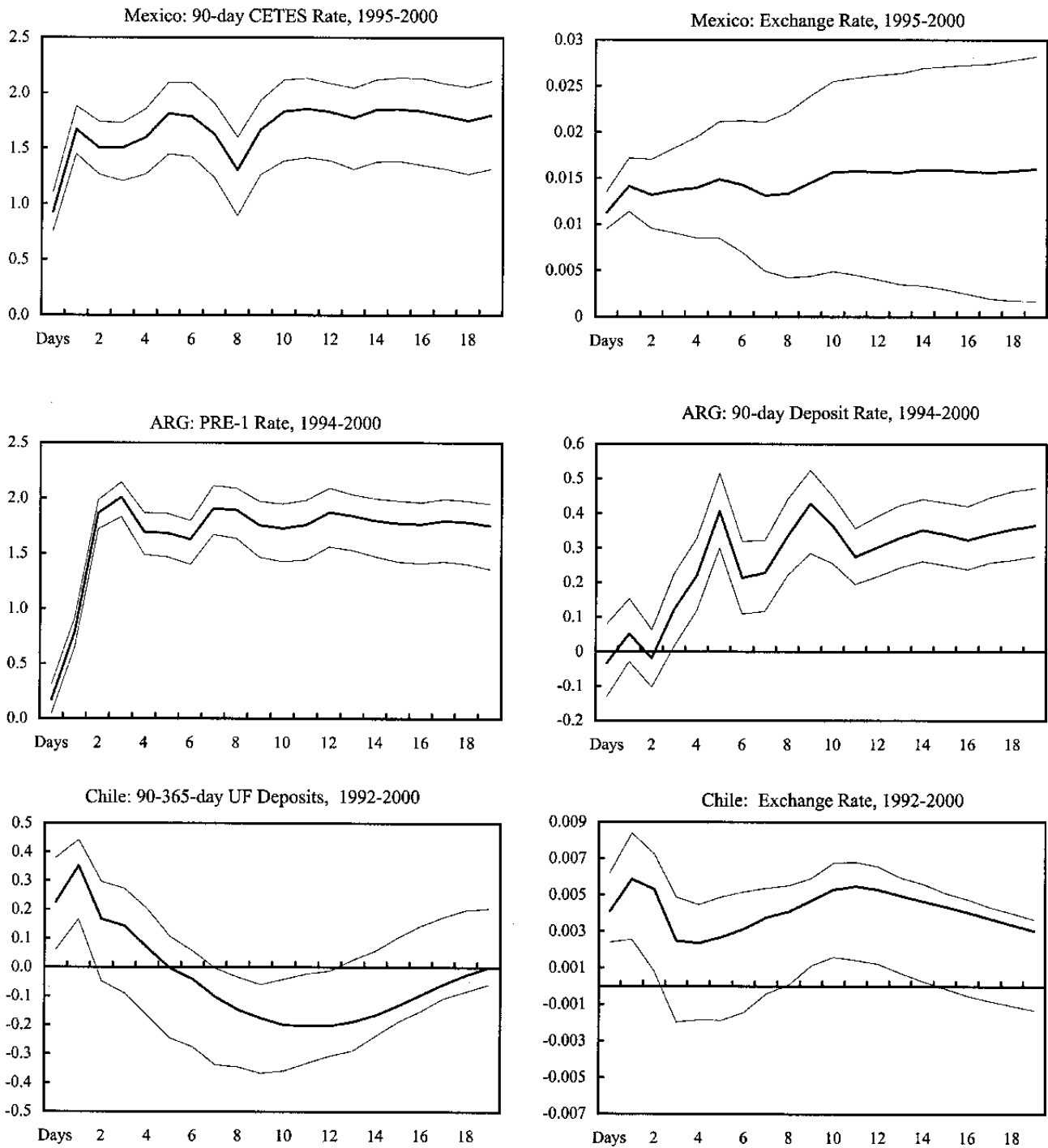
Our study yielded somewhat different results in the comparison of the Asian and Latin American pairs. Results from the comparison between Hong Kong and Singapore are consistent with the conventional view about monetary autonomy under floating exchange rates. Domestic interest rates in Hong Kong are much more sensitive to both shocks to emerging market risk premia and U.S. monetary policy shocks than domestic interest rates in Singapore. Results from the comparison between Argentina and Mexico with respect to US monetary shocks, while arguably consistent with the monetary autonomy proposition, are not quite as persuasive because the estimation is not very precise; for example, neither interest rates nor the exchange rate in Mexico show a statistically significant reaction to US monetary policy shocks. We suspect that this is due to the fact that the comparison between Mexico and Argentina is confined to a relatively short sample, the second half of the 1990s, during which U.S. monetary policy shocks were comparatively few and small. Revisiting the evidence in a few years may result in a clearer picture. Results from the reaction to shocks to the risk premium, by contrast, are in conflict with the conventional prediction. We found large effects on domestic interest rates of about the same order of magnitude in Argentina

and Mexico. Interestingly, however, this does *not* seem to be due to a lack of exchange rate flexibility in Mexico: *both* Mexican interest rates *and* the exchange rate display very large, statistically significant reactions to shocks to emerging markets risk premia.

In sum, our findings restore some capital for the hypothesis of monetary independence under floating exchange rate regimes, at least compared to some of the recent literature. At the same time, they raise new questions: principally, why the floating exchange rate regime in Mexico do not seem to have an insulating effect with respect to shocks to international risk premia, in spite of the fact that the exchange rate shows very large reactions to such shocks. Clearly, this question cannot be easily answered by a "fear of floating" argument, and constitutes an intriguing topic for future research.

A. Data Sources

Domestic Interest Rate Data:

- Argentina: (1) "PRE-1" , the interest rate on an Argentinean domestic peso-denominated bond (Source: Central Bank of Argentina). (2) 90 day interbank deposit rate, paid on deposits of more than 1 million pesos for a fixed time period (Source: Bloomberg); (3) 90 day deposit rate (Source: Datastream).
- Australia: 3 month bank bill rate, (Source: Datastream).
- Canada: 3 month treasury bill rate (Source: Datastream).
- Chile: 90-365 day time deposit rate provided by the central bank, denominated in an inflation-indexed currency unit, the "unidad de fomento" (UF). This data was kindly provided by the Central Bank of Chile.
- Hong Kong: Hong Kong's 3 month interbank rate. This data was kindly provided to us by the Hong Kong Monetary Authority (HKMA).
- Mexico: (1) 91-day CETES rate, a weekly auction rate determined in the primary market (Source: Datastream). (2) 91-day CETES rate determined daily in the secondary market (Source: Bloomberg). (3) 28-day CETES rate, determined daily in the secondary market (Source: Bloomberg).
- New Zealand: 3 month bank bill rate (Source: Datastream).
- Singapore: 3 month interbank rate (Source: Datastream).

Exchange rate data was downloaded from Datastream.

Emerging Market Bond Spread data (EMBI and EMBI Global) was downloaded from J.P. Morgan.

US interest rate data was downloaded from Datastream. We use the Federal Funds Futures as an indicator of market's expectations of future US monetary policy. Given that the domestic interest rates we use have an horizon of 3 months, we use the Fed Futures rates with corresponding maturity. At the monthly frequency, we simply use the 2 months ahead futures. At the daily frequency however, we need to construct our own indicator. The traded contract is based on the average monthly federal funds rate for some given future month, so it changes discontinuously at the end of each calendar month. More precisely, let FF2(m,d) be the k-calendar months ahead futures rate at day d of month m. For instance, let m=1, and k=2 so that FF2(1,d) is what the market expects, on day d of January, the average fed funds rate will be in March. Thus, FF2(1,1) is effectively a 3 months ahead expected rate, whereas FF2(1,31) is effectively a 2 months ahead rate. Moreover, between January 31 and February 1, the so called two months ahead rate jumps since FF2(1,31) refers to the expected rate for March whereas FF2(2,1) refers to April. To deal with those calendar effects, we construct a rate that is an average of the two and three calendar months ahead rates: on the first day of any given month, it is simply the FF2 rate and on the last day it is FF3. Between those two extremes, the weights vary linearly, so that the exact formula is:
FF2CONT(m,d)=(1-d/31)*FF2(m,d)+d/31*FF3(m,d).

FF2CONT has the two properties we were looking for: it has a constant horizon and it is "continuous" in m (in the sense that there are no spurious jumps at the end of the month). It is possible to construct other well behaved rates, for instance by mixing FF3 and FF4. However, those rates happen to be extremely correlated and our results are insensitive to the particular choice, as long as the horizon we are considering is in line with the horizon of the domestic interest rate.

Missing Values. It turns out that EMBI and domestic interest rates series contain missing values at the daily frequency. Given the rich lag structure of the daily VARs, each missing value forced us to drop 10 observations. We therefore decided to interpolate the missing values by drawing a straight line between the previous and next non missing values. This amounts to replace 8,9,NA,11 by 8,9,10,11 for few observations. The point estimates are not affected, but of course the estimated standard errors become smaller (significantly smaller in the case of Mexico).

Sample exclusions. For the reasons explained in the text, regressions involving Mexico start only in June 95. Those involving Hong Kong and Singapore either do not include the period after July 97 (in the VARs using the EMBI) or do not include the period before January 1998 (in the VARs using the EMBIG).

B. Notes on Methodology

Exogeneity of US monetary Policy : for both the monthly and daily VARs, we test, accept and impose the condition that US interest rates are not affected by other variables in the VAR. This is clearly a non-controversial assumption, except for the case of the Russia/LTCM crisis. The point estimates of the impulse functions are not affected, but the restriction helps narrowing the error bands.

Daily VARs and impulse response functions: All the impulse responses were constructed for 30 periods using 10 lags. The ordering of the vector autoregression (VAR) was as follows: i) FF2CONT (constructed 2-3 months ahead federal fund futures, see above for details), ii) EMBI (emerging market bonds spreads) iii) natural logarithm (ln) of the exchange rate iv) domestic interest rate. In the case of Argentina and Hong Kong, the VAR excludes the exchange rate. In the case of Canada, FF2CONT is the closing value of the day. For Hong Kong, Singapore, Australia and New Zealand, it is lagged once. For Argentina and Mexico, we experimented with both and chose the lagged rate.

Table A1. Shocks Associated with US Monetary Policy Actions
During the 1990s

Date understood	DR change	FFT change	US 3mTB change	Kuttner (2000) change	FF2cont change
06/06/89	0.00	-0.25	-0.02	-0.01	0.00
07/07/89	0.00	-0.25	-0.10	-0.03	-0.06
07/27/89	0.00	-0.25	0.05	0.00	-0.10
10/18/89	0.00	-0.25	0.00	0.00	0.02
11/07/89	0.00	-0.25	-0.11	0.04	-0.12
12/20/89	0.00	-0.25	-0.12	-0.17	-0.08
07/13/90	0.00	-0.25	-0.08	-0.14	-0.09
10/29/90	0.00	-0.25	0.02	-0.31	-0.01
11/16/90	0.00	-0.25	-0.01	0.04	0.01
12/07/90	0.00	-0.25	-0.11	-0.27	-0.16
12/18/90	-0.50	-0.25	-0.18	-0.21	-0.16
01/08/91	0.00	-0.25	-0.07	-0.18	-0.10
02/01/91	-0.50	-0.50	-0.19	-0.25	-0.20
03/08/91	0.00	-0.25	-0.11	-0.16	-0.13
04/30/91	-0.50	-0.25	-0.07	-0.17	-0.14
08/06/91	0.00	-0.25	-0.08	-0.15	-0.09
09/13/91	-0.50	-0.25	-0.06	-0.05	-0.05
10/30/91	0.00	-0.25	-0.07	-0.05	-0.09
11/06/91	-0.50	-0.25	-0.14	-0.12	-0.12
12/06/91	0.00	-0.25	-0.07	-0.09	-0.11
12/20/91	-1.00	-0.50	-0.30	-0.28	-0.27
04/09/92	0.00	-0.25	-0.21	-0.24	-0.21
07/02/92	-0.50	-0.50	-0.31	-0.36	-0.32
09/04/92	0.00	-0.25	-0.22	-0.22	-0.20
02/04/94	0.00	0.25	0.10	0.12	0.09
03/22/94	0.00	0.25	-0.05	-0.03	-0.03
04/18/94	0.00	0.25	0.11	0.10	0.11
05/17/94	0.50	0.50	0.05	0.13	0.02
08/16/94	0.50	0.50	0.17	0.14	0.08
11/15/94	0.75	0.75	0.10	0.14	0.08
02/01/95	0.50	0.50	0.07	0.05	0.02
07/06/95	0.00	-0.25	-0.14	-0.01	-0.08
12/19/95	0.00	-0.25	-0.11	-0.10	-0.10
01/31/96	-0.25	-0.25	-0.08	-0.07	-0.06
03/25/97	0.00	0.25	0.00	0.03	0.03
09/29/98	0.00	-0.25	-0.05	0.00	0.06
10/15/98	-0.25	-0.25	-0.29	-0.26	-0.21
11/17/98	-0.25	-0.25	-0.08	-0.06	-0.06
06/30/99	0.00	0.25	-0.04	-0.04	-0.05
08/24/99	0.25	0.25	0.08	0.02	0.03
11/16/99	0.25	0.25	0.01	0.09	0.08
02/02/00	0.25	0.25	-0.07	-0.05	-0.03
03/21/00	0.25	0.25	0.01	-0.03	-0.01
05/16/00	0.00	0.50	0.03	0.05	0.00

Table A2. Shocks Associated with jumps in the EMBI Spread

Event Date	EMBI Spread Change (bp)	Interpretation	Regional Origin
02/24/1994	64	Investors worried about effects of reforms in Brazil. Argentina hit also.	Brazil
03/21/1994	56	Interest rates rise in Brazil. Asian markets down also, but mostly for individual reasons.	Brazil
03/24/1994	65	DK	DK
03/28/1994	72	Assassination of Mexican presidential candidate. Effects felt in Argentina and Venezuela	Mexico
04/04/1994	59	Interest rates rise in the US, Dow falls. Markets hit in Asia, possibly in Latin America as well.	U.S.
04/07/1994	-71	Mexican interest rates increase.	Mexico
12/21/1994	78	Mexico devalues. Argentina and Brazil both react strongly.	Mexico
12/27/1994	180	Concerns over rising interest rates and further currency problems in Mexico hit Mexico, Brazil, and Argentina. Possible banking problems in Argentina as well.	Mexico
01/04/1995	109	More peso problems and interest rate increases in Mexico, general nervousness about the future of the Mexican economy. Argentina and Brazil fall sharply.	Mexico
01/09/1995	168	DK	DK
01/10/1995	271	Downgrade in Mexico's credit rating sinks Brady bonds in Mexico, Brazil, Argentina, and Venezuela.	Mexico
01/11/1995	-149	Clinton announces plan to help Mexico. Stocks in Mexico increase, as well as in Brazil and Argentina. Argentina also pushed by government assurances of strength of peso and solid growth.	Mexico
01/12/1995	-286	Morgan Stanley says that things will look up for Mexico. Clinton makes more assurances. Reserve requirements are relaxed in Brazil and Argentina. Argentine government makes more assurances about strength of peso.	Mexico
01/30/1995	88	Concers over whether Clinton's Mexican aid package will go through. Equities in Mexico and Brazil fall.	Mexico
01/31/1995	-151	Clinton announces new international aid plan for Mexico. Shares in Mexico, Brazil, and Argentina rise sharply.	Mexico
03/07/1995	159	Credit squeeze pushes Argentina equities lower. Brazil also falls due to uncertainty about Brazil's exchange rate policy, and from spillover from Argentina.	Argentina
03/10/1995	-179	Brazil stocks rise sharply as reaction to government measures aimed at stopping outflows of foreign capital. Mexico rises on satisfaction with new economic plan.	Brazil, Mexico
03/14/1995	-105	Argentina reaches agreement with IMF. Causes stocks to rise in Brazil as well.	Argentina
06/09/1995	97	Concerns over exchange rates in Brazil and general economic uncertainty in Venezuela and Argentina pushes markets down in Brazil, Venezuela, and Argentina.	Brazil, Argentina, Mexico
03/08/1996	67	Markets in Mexico, Argentina, and Brazil fall because US will most likely not lower interest rates.	U.S.
10/27/1997	180	In the midst of the Asian crisis, markets in that region suffer modest losses. Asian crisis causes US markets to drop sharply. US and Asian losses cause nosedives in Mexico, Argentina, Peru, Venezuela, Chile, and South Africa.	Asia

Table A2 (continued)

Event Date	EMBI Spread Change (bp)	Interpretation	Regional Origin
08/07/1998	79	Asian markets sink due to general uncertainty about the economic stability in the region. Brazilian and Mexican markets fall on uncertainty regarding the Chinese currency. Russia falls on speculation that it will be unable to pay off debt.	Asia
08/10/1998	76	Asian currency fears hurt markets in Thailand, Malaysia, and Taiwan, as well as Turkey. Russia continues to sink as debt crisis looms.	Asia, Russia
08/13/1998	-78	George Soros suggests Russian devaluation. Russia drops, pulls down South Africa, Poland, Hungary. Asia slides, on ruble and other regional developments.	Russia
08/17/1998	99	Russia devalues, pulls down South Africa, Mexico, Venezuela, Singapore, Malaysia, China, and Thailand (although Asian markets also suffer from regional and specific country problems.).	Russia
08/20/1998	153	Fears of devaluation in Venezuela. Markets drop in Brazil, Argentina,	Russia,
08/21/1998	214	Continued fears of devaluation in Venezuela. Shares in Argentina, Mexico, and Brazil decline. Problems in Russia and Latin America push Malaysian markets lower.	Venezuela, Russia
08/26/1998	103	More Russian debt problems. Stocks drop in Mexico and Argentina, South Africa, Hungary and Turkey.	Russia
08/27/1998	260	Still more fallout from Russia. Brings down Turkey, Hungary, Poland, Argentina, Brazil, Mexico, and South Africa.	Russia
09/01/1998	-109	US markets rally. Argentina and Chile react with gains.	U.S.
09/03/1998	133	Moody's downgrades Brazil's credit rating. Economic uncertainty in Venezuela. Argentina falls on news from Venezuela and Brazil. Russian markets also fall on rouble weakness.	Russia, Brazil, Venezuela
09/10/1998	241	Devaluation fears hit Brazil. Shares drop in Mexico, Argentina, Venezuela, and Chile. Global turmoil also affects South Africa.	Brazil
09/15/1998	-186	IMF negotiations with Brazil cause markets in Brazil, Argentina, and Mexico to rise (Good bank news from Mexico as well.)	Brazil, Mexico
09/16/1998	-130	Greenspan decides not to cut interest rates. Uncertainty over Brazil. Brazil, Argentina, and Chile suffer.	U.S.
09/17/1998	155	More uncertainty over Brazil. Mexico comes back from holiday and drops. Brazilian and Argentine markets also decrease.	Brazil
09/23/1998	-85	Hopes revive for a US interest rate cut. Brazil, Mexico, Argentina, and Venezuela all rally.	U.S.
10/01/1998	111	Fears about Japanese economy and general global instability hit markets around the world. Latin America drops sharply.	Japan
01/13/1999	192	Brazilian devaluation. Latin American shares plummet, as well as shares in South Africa and Asia. (Asia also worries about economic problems in China).	Brazil, China
01/15/1999	-208	Brazil floats. Latin American markets recover some.	Brazil
01/21/1999	121	Sharp depreciation in Briazil's currency. Brazil, Argentina, Mexico, and South Africa drop. Asian markets fall on economic uncertainty over China.	Brazil, China

Table A3a. Impact effect of US Monetary Policy Shocks on Domestic Interest Rates,
Controlling for Changes in EMBI
(dependent variable: changes in domestic interest rate; t values in italics)

	Policy measure								
	Change in FF2CONT 1/			Kuttner 2/			Change in US 3m T-Bill		
	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant
Hong Kong	0.89	0.09	-0.06	0.70	0.15	-0.06	0.77	0.13	-0.05
(N=44)	*3.03*	*0.56*	*-1.67*	*2.82*	*0.92*	*-1.84*	*2.99*	*0.83*	*-1.49*
Singapore	0.48	0.00	0.00	0.40	0.03	0.001	0.49	0.02	0.01
(N=44)	*2.23*	*0.01*	*0.17*	*2.21*	*0.28*	*0.049*	*2.73*	*0.19*	*0.41*
Australia	0.33	0.13	-0.03	0.24	0.15	-0.03	0.22	0.15	-0.03
(N=44)	*2.63*	*2.01*	*-2.17*	*2.25*	*2.27*	*-2.30*	*1.86*	*2.15*	*-2.03*
Canada	0.51	0.11	0.01	0.39	0.14	0.01	0.44	0.13	0.02
(N=38)	*3.46*	*1.35*	*0.83*	*3.06*	*1.72*	*0.59*	*3.43*	*1.67*	*1.00*
New Zealand	0.63	0.032	-0.0004	0.56	0.07	0.00	0.64	0.06	0.01
(N=44)	*2.29*	*0.22*	*-0.014*	*2.47*	*0.50*	*-0.11*	*2.80*	*0.42*	*0.23*
Chile	0.41	-0.340	-0.008	0.390	-0.315	-0.010	0.50	-0.33	0.00
(N=44)	*1.47*	*-2.29*	*-0.26*	*1.73*	*-2.19*	*-0.31*	*2.19*	*-2.35*	*-0.01*
Argentina (90-d deposit)	10.15	-1.45	-0.05	7.22	-0.64	-0.06	8.76	-0.83	0.08
(N=20) 3/	*2.56*	*-1.04*	*-0.16*	*2.39*	*-0.48*	*-0.21*	*3.60*	*-0.73*	*0.33*
Argentina (PRE-1)	7.63	-1.16	-0.52	6.20	-0.62	-0.55	5.92	-0.62	-0.43
(N=20) 3/	*3.10*	*-1.34*	*-2.90*	*3.57*	*-0.82*	*-3.20*	*3.77*	*-0.84*	*-2.59*
Mexico	9.47	-3.00	-0.43	8.35	-2.33	-0.40	6.69	-2.00	-0.29
(N=13)	*3.11*	*-2.69*	*-2.41*	*4.32*	*-2.95*	*-2.66*	*3.56*	*-2.33*	*-1.60*

Memorandum Item: Results for Argentina and Mexico after excluding outliers 4/

Argentina (90-d deposit)	5.88	-1.59	-0.23	3.87	-1.10	-0.23	4.90	-1.14	-0.14
(N=17) 3/	*2.12*	*-2.04*	*-1.27*	*1.72*	*-1.46*	*-1.21*	*2.71*	*-1.69*	*-0.85*
Argentina (PRE-1)	3.70	0.29	-0.23	2.96	0.49	-0.25	2.73	0.43	-0.20
(N=18) 3/	*1.62*	*0.37*	*-1.47*	*1.67*	*0.67*	*-1.60*	*1.67*	*0.58*	*-1.36*
Mexico	0.84	-0.04	-0.18	1.62	-0.18	-0.19	0.12	0.13	-0.17
(N=11)	*0.33*	*-0.04*	*-1.49*	*0.70*	*-0.20*	*-1.60*	*0.06*	*0.14*	*-1.44*

1/ Change in weighted average between 2-month ahead and three-month ahead federal funds futures rate (see Appendix).
2/ Unexpected change in the federal funds rate target, based on change in the current-month federal funds futures rate (see Kuttner
3/ Two-day window.
4/ Defined as changes of domestic interest rates of 200 basis points or more on one day.

Table A3b. Impact Effect of US Monetary Policy Shocks on Bilateral Exchange Rates,
Controlling for Changes in EMBI
(dependent variable: percentage change in bilateral exchange rate; t values in italics)

	Policy measure								
	Change in FF2CONT 1/			Kuttner 2/			Change in US 3m T-Bill		
	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant	policy measure	change in EMBI	regression constant
Australia	1.50	1.09	0.25	1.19	1.19	0.24	1.61	1.15	0.27
(N=23)	*1.18*	*1.61*	*1.69*	*1.13*	*1.76*	*1.64*	*1.48*	*1.74*	*1.84*
Canada	0.88	-0.10	-0.03	0.80	-0.05	-0.03	0.80	-0.06	-0.02
(N=23)	*1.50*	*-0.33*	*-0.41*	*1.65*	*-0.16*	*-0.47*	*1.57*	*-0.20*	*-0.30*
New Zealand	1.40	0.88	0.31	0.95	0.97	0.30	1.39	0.94	0.33
(N=23)	*0.83*	*0.98*	*1.58*	*0.68*	*1.09*	*1.52*	*0.96*	*1.06*	*1.65*
Singapore	0.71	0.19	0.09	0.41	0.24	0.08	0.36	0.23	0.08
(N=23)	*1.81*	*0.89*	*1.89*	*1.23*	*1.09*	*1.65*	*0.99*	*1.05*	*1.66*
Chile	-0.43	-0.42	0.01	-0.22	-0.44	0.02	-0.36	-0.44	0.01
(N=23)	*-1.11*	*-2.02*	*0.23*	*-0.69*	*-2.15*	*0.36*	*-1.08*	*-2.14*	*0.18*
Mexico	1.78	-0.05	-0.30	1.01	0.18	-0.30	0.52	0.28	-0.30
(N=14)	*1.26*	*-0.10*	*-3.36*	*0.85*	*0.38*	*-3.23*	*0.48*	*0.57*	*-2.94*

1/ Change in weighted average between 2-month ahead and 3-month ahead federal funds futures rate (see Appendix).
2/ Unexpected change in the federal funds target, based on change in the current-month federal funds futures rate.
3/ Sample begins in July 1995.

Table A4a. Impact Effect of Shocks to International Risk Premia on Domestic Interest Rates, Controlling for US Interest Rate Shocks (measured by FF2CONT)
(Dependent Variable: Changes in Domestic Interest Rate; t-values in italics, number of observations in parentheses)

	Using EMBI to measure shock												Using Country Bond or Subindex, 2/					
	Sample Period: 1994 - 2000						Sample Period: 1998 - 2000						Sample Period: varies by country 3/					
	Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/		
	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant
Hong Kong	0.21	-0.81	-0.01	0.26	-1.49	0.05	0.56	3.87	-0.08	0.66	6.42	0.09	2.08	1.99	-0.17	2.24	3.19	-0.09
	1.88	*-0.18*	*-0.03*	*2.32*	*-0.34*	*0.28*	*2.57*	*0.44*	*-0.25*	*2.90*	*0.71*	*0.23*	*2.50*	*0.23*	*-0.49*	*2.60*	*0.35*	*-0.22*
		(40)			(35)			(19)			(15)			(19)			(15)	
Singapore	-0.03	0.66	-0.02	-0.04	0.67	-0.04	0.05	1.77	-0.01	0.03	1.27	-0.04	0.12	1.43	0.00	0.08	1.03	-0.04
	-0.89	*0.56*	*-0.38*	*-1.38*	*0.58*	*-0.84*	*1.85*	*1.52*	*-0.12*	*1.55*	*1.46*	*-0.99*	*1.05*	*1.17*	*-0.05*	*1.00*	*1.16*	*-1.02*
		(40)			(35)			(19)			(15)			(19)			(15)	
Australia	0.01	0.70	0.00	...	...	...	0.02	0.85	0.01	...	...	...	...	...	...	...	...	...
	1.71	*2.86*	*0.48*				*2.16*	*2.20*	*0.97*									
		(40)						(19)										
Canada	0.03	0.86	0.06	...	...	...	0.05	0.77	0.01	...	...	...	...	...	...	...	...	...
	1.14	*0.97*	*1.74*				*1.34*	*0.51*	*0.16*									
		(40)						(19)										
New Zealand	0.03	2.74	0.01	...	...	...	0.06	3.55	0.00	...	...	...	...	...	...	...	...	...
	2.48	*5.75*	*0.46*				*3.65*	*5.51*	*0.03*									
		(40)						(19)										
Chile	-0.17	-3.30	0.07	-0.03	-1.85	0.07	-0.41	-10.29	0.06	-0.13	-3.97	0.11	...	...	...	...	...	...
	-1.53	*-0.75*	*0.42*	*-0.64*	*-1.06*	*1.03*	*-1.75*	*-1.08*	*0.17*	*-1.00*	*-0.91*	*0.57*						
		(40)			(26)			(19)			(11)							
Argentina 4/	0.58	4.79	-0.01	0.95	-0.92	-0.11	0.40	3.94	-0.77	1.25	-7.53	-1.86	0.55	3.60	0.02	0.97	-3.55	-0.12
	1.57	*0.33*	*-0.02*	*2.51*	*-0.07*	*-0.19*	*0.52*	*0.13*	*-0.65*	*1.60*	*-0.28*	*-1.60*	*1.78*	*0.25*	*0.04*	*2.82*	*-0.26*	*-0.23*
		(40)			(26)			(19)			(11)			(40)			(26)	
Mexico	0.96	-25.15	0.50	0.79	-19.35	0.45	1.43	-14.91	-0.38	1.37	-14.57	-0.28	0.83	-27.59	0.58	1.09	-21.94	0.43
	3.64	*-2.42*	*1.27*	*2.00*	*-1.59*	*0.83*	*5.95*	*-1.53*	*-1.00*	*5.15*	*-1.46*	*-0.67*	*3.31*	*-2.60*	*1.46*	*1.94*	*-1.82*	*0.77*
		(40)			(26)			(19)			(11)			(40)			(26)	

1/ Excludes events originating in Asia for Hong Kong and Singapore; Argentina and Brazil for Chile and Argentina

2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Change in Brady Bond Yield for Argentina and Mexico.

3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore

4/ PRE-1 rate, 2-day window.

Table A4b. Impact Effect of Shocks to International Risk Premia on Exchange Rates, Controlling for US Interest Rate Shocks (measured by FF2CONT)
(Dependent variable: percentage change in bilateral exchange rate (domestic currency per US$); t values in italics, number of observations in parentheses)

	Using EMBI to measure shock												Using Country Bond or Subindex, 2/					
	Sample Period: 1994 - 2000						Sample Period: 1998 - 2000						Sample Period: varies by country 3/					
	Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/			Full sample			excluding country-specific events 1/		
	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant	RP shock	US shock	constant
Singapore	0.00	0.10	0.00	0.01	0.08	0.00	0.00	-0.08	0.00	-0.01	-0.13	-0.01	-0.02	-0.08	0.00	-0.02	-0.11	0.00
	1.34	*0.65*	*-0.67*	*1.38*	*0.49*	*-0.58*	*-1.07*	*-0.44*	*-0.24*	*-1.21*	*-0.63*	*-0.64*	*-1.34*	*-0.42*	*-0.03*	*-1.25*	*-0.52*	*-0.40*
	(40)			(35)			(19)			(15)			(19)			(15)		
Australia	-0.06	3.74	0.04	...	...	...	0.13	8.50	0.21	...	...	...	...	...	...	...	...	...
	-0.59	*0.92*	*0.24*				*0.89*	*1.39*	*0.88*									
	(40)						(19)											
Canada	0.16	2.89	0.05	...	...	...	0.25	7.65	0.07	...	...	...	...	...	...	...	...	...
	2.55	*1.15*	*0.52*				*2.24*	*1.70*	*0.40*									
	(40)						(19)											
New Zealand	-0.07	1.81	0.07	...	...	...	-0.08	5.45	0.34	...	...	...	...	...	...	...	...	...
	-0.99	*0.65*	*0.70*				*-0.72*	*1.23*	*1.96*									
	(40)						(19)											
Chile	0.02	-2.26	0.04	0.01	-1.30	0.13	0.06	-0.67	0.03	0.13	0.14	0.05	...	...	...	...	...	...
	0.39	*-1.41*	*0.69*	*0.22*	*-0.75*	*1.83*	*1.21*	*-0.31*	*0.40*	*2.22*	*0.07*	*0.60*						
	(40)			(26)			(19)			(11)								
Mexico	2.01	-13.78	-0.48	1.07	-3.24	0.41	1.14	0.85	0.01	1.07	1.23	0.12	2.01	-18.65	-0.42	1.65	-6.45	0.28
	4.59	*-0.79*	*-0.73*	*4.39*	*-0.44*	*1.22*	*7.66*	*0.14*	*0.05*	*6.72*	*0.21*	*0.51*	*5.12*	*-1.13*	*-0.67*	*5.26*	*-0.96*	*0.91*
	(40)			(26)			(19)			(18)			(40)			(26)		

1/ Excludes events originating in Asia for Singapore, Argentina and Brazil for Chile.
2/ Change EMBIG Asia Subindex Spreads for Singapore and Hong Kong, Brady Bond Yields for Argentina and Mexico.
3/ 1994-2000 for Argentina and Mexico, 1998-2000 for Singpore

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