WP/03/71

IMF Working Paper

The Impact of Monetary Policy on the Bilateral Exchange Rate: Chile Versus the United States

Jeromin Zettelmeyer

INTERNATIONAL MONETARY FUND

 WP/03/71

IMF Working Paper

Research Department

The Impact of Monetary Policy on the Bilateral Exchange Rate: Chile Versus the United States

Prepared by Jeromin Zettelmeyer[1]

Authorized for distribution by Eduardo Borensztein

April 2003

Abstract

This paper examines the reaction of the bilateral Ch$/US$ exchange rate to monetary policy actions in Chile and the United States. The approach is to regress the change in the exchange rate following a policy announcement on changes in market interest rates in response to the same announcement. U.S. monetary policy actions that raise the three-month treasury bill rate by 1 percentage point lead to depreciations of the Chilean peso by about 1.5 to 2 percent. The exchange rate also reacts to monetary policy actions in Chile, but the response appears to be smaller, and cannot be estimated with much precision on the available sample.

JEL Classification Numbers: E52, E58, F31, F41

Keywords: Monetary Policy, Interest Rates, Exchange Rates

Author's Email Address: jzettelmeyer@imf.org

[1] The author is grateful to Luis-Oscar Herrera, Martin Kaufmann, Saul Lizondo, Steven Phillips, Francisco Nadal-de Simone, Alessandro Rebucci, Klaus Schmidt-Hebbel, Raimnundo Soto, two anonymous referees and especially Rodrigo Valdés for helpful comments and suggestions, and to Monica Espinosa and Veronica Astorga of the Central Bank of Chile for help with obtaining interest rate data.

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I. Introduction

How does domestic monetary policy affect the bilateral exchange rate against the U.S. dollar of the currency of a small open economy with floating exchange rates, such as Chile since September 1999? How does this compare with the reaction of the same exchange rate to monetary policy in the United States? From the perspective of macroeconomic policy, these questions are important for two reasons. First, the exchange rate constitutes one of the main channels (along with market interest rates and the supply of credit) through which monetary policy affects output and prices. Thus, predicting the impact of monetary policy actions on the exchange rate is important to gauge their effect on the ultimate targets of policy. For the same reasons, policymakers ought to be concerned about how the exchange rate reacts to foreign shocks, of which monetary policy in the United States is one important source.

Obtaining satisfactory answers is surprisingly hard. While there is a standard view on how monetary policy normally affects the exchange rate—the domestic currency should appreciate after domestic monetary contractions and depreciate after expansions, with some overshooting at the outset—the empirical literature is ambivalent on the issue, particularly for countries other than the United States. Studies based on vector autorregressions (VARs) in the early 1990s that looked at European countries tended to find either insignificant effects, or significant effects in the opposite direction of the standard view.[2] With regard to the impact of monetary policy on exchange rates in times of distress, little consensus exists, even at the theoretical level, and among policy practitioners. Recently, a revisionist view (for example, Furman and Stiglitz, 1998) has pointed out that the standard prediction does not follow from arbitrage arguments alone: even if uncovered interest rate parity holds, an increase in interest rates at home may lead to a depreciation of the domestic currency if there is an expectation that medium-term *future* exchange rates may be more depreciated (for example, if higher interest rates wreak havoc on domestic firms). Empirically, the direction and strength of the effect of monetary policy on exchange rates in times of turbulence is particularly hard to measure, mainly because of the difficulty of disentangling cause and effect in the relationship between monetary policy and exchange rate movements. For example, does a correlation between increased interest rates and exchange rate *de*preciation indicate counterproductive effects of tight money, or merely the fact that central banks tend to tighten policy when the currency comes under pressure? The same interpretational difficulty may arise in a vector autoregression (VAR) which identifies monetary policy by assuming that the central bank's policy variable does not contemporaneously depend on the exchange rate.[3]

In an innovative recent study, Rebucci (2002) estimates the effects of a number of domestic and external factors—the interest rate differential with respect to the United States,

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[2] See Grilli and Roubini (1995, 1996).

[3] For further discussion and references, see Skinner and Zettelmeyer (1995), Bagliano and Favero (1999), Zettelmeyer (2000), and Basurto and Ghosh (2001).

sovereign risk premia for Chile, Argentina, and Brazil, and some international prices—on the daily peso/dollar rate, using a Bayesian estimation approach designed to detect possible structural shifts resulting from "contagion" from regional crises. However, his methodology does not address the identification problems described above. Because of the simultaneity problem, the empirical model is specified such that the interest rate differential enters the estimation model with a one-day lag, controlling for lagged changes in the exchange rate. This implies that the estimated coefficients will not pick up the contemporaneous (same-day) reaction of monetary policy shocks on the exchange rate. To the extent that financial markets are efficient, the effect of policy shocks cannot be estimated in this setup.

This paper takes an alternative approach, which focuses on solving the identification problem. Instead of performing a time-series analysis, it uses a static methodology that examines the impact effect of monetary policy actions on the exchange rate on the day of policy announcements. Because of the structure of monetary policy formulation in both the United States and Chile in our sample period—regular, preannounced policy meetings followed by public announcements—the risk of endogeneity of monetary policy actions to exchange rate movements (or, indeed, any other economic news) *on the same day* is very low. Consequently, in this sample, causality can be assumed to run from interest rates to exchange rates. Of course, this approach is not without costs. First, we loose the ability to track the *dynamic* response of policy through impulse response functions computed using VAR coefficients. Second, and perhaps more importantly, the sample of policy actions available for the period of freely floating exchange rates in Chile is small, and the estimates are consequently imprecise.

The main results are as follows. First, as expected, the bilateral peso/dollar exchange rate exhibits significant and relatively large reactions to monetary policy actions in the United States Policy shocks that raise the U.S. three-month treasury-bill rate by one percentage point lead to a depreciation of the peso by about 1.5 to 2 percent. The reaction of the peso/dollar exchange rate to policy actions in Chile appears to be smaller (about 0.6–1 percent), is somewhat sensitive to outliers, and is not always statistically significant. Several interpretations are discussed. One of them is the lack of a liquid secondary money market in Chile along the lines of the U.S. treasury bill market, which makes it harder to measure—and more likely to mismeasure—the shock associated with a monetary policy announcement.

II. Method

Studies that attempt to regress the exchange rate on measures of monetary policy (say, central bank-controlled interest rates) typically face an "endogeneity problem": do correlations between exchange rates and interest rates reflect the effect of monetary policy on the exchange rate, or the effects of exchange rates on monetary policy (via the central bank's reaction function)? One can try to avoid this problem by focusing on the short-run reaction of exchange rates to monetary policy actions that were not themselves endogenous to exchange rate movements.

Suppose one can identify a list of such actions. Then, one could run a regression of the form:

$$\Delta e_t = \alpha + \beta \Delta i_t + \varepsilon_t \tag{1}$$

where Δi_t is the change in a liquid three month to 1 year money market rate on the day of a policy announcement and Δe_t is the change in the exchange rate on the same day. Δi_t serves as a measure of the "surprise content" of the policy announcement. It is sufficiently short to reflect the policy rates or targets that the authorities set for the immediate future, but at the same time sufficiently "long" to react only to the extent that changes in the policy rate were unanticipated. The problem is that since i_t is a market interest rate, it could of course also pick up shocks other than monetary policy. Even if the policy actions themselves are contemporaneously exogenous, regression (1) could thus be misspecified. In principle, this problem can be addressed by estimating the model via two-stage least squares, using the change in the policy variable of the central bank as an instrument (for example, the Federal Funds target in the United States or the Monetary Policy Rate in Chile). To the extent that the data is available, one can of course also control directly for some of these other shocks, such as changes in commodity prices or in sovereign risk premia.

Whether policy actions can be identified that are "contemporaneously exogenous" in the sense described depends on the structure of the policy process. For example, in a country or period in which changes in the central bank's policy instrument can occur at any time, and the exchange rate plays a central role in the policy maker's reaction function, policy actions could clearly not be assumed to be exogenous to exchange rate movements on the day of policy actions. For example, morning movements in the exchange rate (or other economic news to which the exchange rate is endogenous) could prompt a noon policy announcement which in turn affects the exchange rate prior to market closing. Once again, causes and effects of policy cannot be disentangled using daily data. Instances of this type were relatively frequent, for example, in early inflation targeting regimes such as Canada and New Zealand in the first half of the 1990s (see Zettelmeyer, 2000).

Fortunately, the policy process in both the United States and Chile enables us to assume contemporaneous exogeneity largely on a priori grounds. This is particularly the case in Chile, which after the introduction of formal inflation targeting and free floating adopted a system of monthly monetary policy meetings followed by an announcement after market closing.[4] The announcement thus impacts market interest rates on the day *after* the announcement. Provided we concentrate on the announcement effect of policy only, this timing rules out any endogeneity of interest rates via the policy reaction function except when a decision is taken outside the pre-

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[4] The meeting, usually on a Tuesday or Thursday, starts at 4:00 p.m. A press statement is typically published around 7:00 to 7.30 p.m. Since February of 2000, the schedule of policy meetings has been made public six months in advance.

announced meeting schedule, which happened only once during the period of free floating.[5] For the United States, endogeneity of policy actions to exchange rate movements on the day of the policy announcement cannot be ruled out on the basis of timing alone, since the meeting takes place in the morning, followed by an announcement in the early afternoon which typically precedes market closing. However, the fact that the meetings are scheduled long in advance rules out the possibility that a meeting is *called* in reaction to economic developments on the same day.[6] In addition, U.S. monetary policy is known to pay little attention to the exchange rate in general, and certainly pays no attention to the particular bilateral Ch$/US$ exchange rate that is the focus of this study.

The main difficulty in this paper is thus not the identification of exogenous policy events (as it can be for other countries, see Zettelmeyer, 2000) but the small number of policy events, both in Chile and the United States, during the short period of free floating. This poses a serious problem, because the method outlined above—regressing exchange rate movements on market interest rate movements in reaction to monetary policy, using the change in the policy rate as an instrument—is not necessarily unbiased in small samples, and delivers precise estimates only in sufficiently large samples. An alternative is to estimate equation (1) using OLS, controlling for other important shocks which are observable at the daily frequency. This will lead to unbiased estimates only under the assumption that unobservable shocks to exchange rates on the days selected are uncorrelated with the interest rate (or of negligible magnitude relative to the monetary policy shock), but makes more efficient used of the available data.

III. Reactions to Monetary Policy Events in Chile

A. Policy Actions and Data

In September 1999, the Central Bank of Chile abolished the currency band that had played a role in the conduct of monetary policy, to a greater or lesser extent, over the preceding decade.[7] The Bank's decision was preceded by a gradual widening of the band beginning in late 1998, as the turbulence that had rocked international financial markets in the wake of the Russian crisis began to recede. Table 1 lists the changes in the Central Bank's policy rate that took place during the period of free floating and the preceding months, and the interest rate and exchange rate movements that accompanied them. January 27, 1999 is chosen as a starting point because it is the first policy action that took place after the currency band had been widened to16 percent in late December. The dates reported in the table refer to the first day in which the new policy rate took effect, this is typically one day after the policy meeting.

[5] Namely, on March 2, 2001. See below for a discussion of this policy action.

[6] In the early 1990s, United States policy actions were announced between scheduled Board meetings, but in the period relevant for this study (1999-2003), this did not happen.

[7] See Morandé and Tapia (2003) on the development of the monetary policy regime in Chile over the 1990s.

Table 1 includes the reactions of several alternative interest rate measures to the monetary policy actions. The use of multiple measures reflects two problems or trade-offs that are specific to Chile during our sample period. The first has to do with the fact that until August of 2001, monetary policy in Chile was implemented using an interest rate on a "real" (inflation-adjusted) currency unit, the *unidad de fomento* (UF). In contrast, the bilateral exchange rate refers to (non inflation-adjusted) pesos per U.S. dollar. From the perspective of measuring monetary policy prior to August 2001, it might be preferable to use a "real" interest rate (which exists for various maturities); while from the perspective of obtaining a tight relationship with exchange rates a standard, nominal interest rate might be preferable.

The second, more severe problem is the lack of a secondary money market. As described in the previous section, we would like to use interest rates as an informationally efficient gauge of the "policy shock" associated with a change in the policy rate. The ideal rate for this purpose would be the secondary market yield of a liquid instrument such as a treasury bill. Absent such a market, one could use a primary rate, such as the auction rate on the 90-day PDBC, a nominal central bank instrument auctioned twice a week with occasional gaps. This is presumably informationally efficient, but it is available only for days on which auctions are conducted, namely Tuesdays and Thursdays. Between two auctions, there could thus be as many as three business days, containing news unrelated to policy that might "pollute" the change in the PDBC rate as a policy gauge. As an alternative, one could use changes in an average deposit rate, which has the advantage that it is available daily. The disadvantage is that the informational efficiency of deposit rates, which are set by a small number of banks rather than atomistic markets, is more suspect than that of an auction-determined interest rate.

Faced with these trade-offs, we use four alternative interest rates. First, an average 30–90 day nominal deposit rate available daily. Second, an average 90–365 day deposit rate denominated in UF. Third, the 90–day PDBC rate. Fourth, the 90-day PRBC rate—similar to the PDBC rate except that it is denominated in UF—until August of 2001, supplemented by the PDBC rate for the remainder of the period. Furthermore, for the daily rates we use both one day changes (rate on the day after the policy meeting minus rate on the day of the meeting), and two day changes (rate on the day after the policy meeting minus rate on the day before the meeting), on the grounds that the result of the meeting could have been partly anticipated on the day of the policy meeting, i.e. just prior to the announcement. If this were true, using a two-day change could result in an efficiency gain relative to the one-day change, which might make a difference given our small sample. The cost is that the uncorrelatedness of a two-day change in interest rates with information that might have been used by policy makers not longer follows from the timing of the policy process alone. It requires an additional assumption, which is that the Central Bank Board did not use same-day information in arriving at a policy decision. But this is an assumption that we already have to make for United States monetary policy for the reasons described above, and in order to use primary auction rates, which are observed at an interval of at least two days. For Chile, it is not a strong assumption after January 2000, when the practice of monthly policy meetings scheduled in advance was introduced. It probably holds for all policy actions but one (March 2001, see below).

Table 1. Chile: Changes in Interest Rates and the Exchange Rate at the Time of Monetary Policy Actions, 1999-2003

(percent change for exchange rate, percentage point change for interest rates)

Date		Policy Rate	Ch$ 30-90 rate		UF 90-365 rate		90-day PDBC	90-day PRBC	Exchange rate 1/		
			1-day	2-day	1-day	2-day			1-day	2-day	as PDBC 2/
27-Jan-99		-0.55	-0.96	-1.32	-0.43	-0.38	-0.49	-0.10	0.33	0.79	0.99
10-Mar-99		-0.25	0.12	0.24	-0.18	-0.17	n.a.	n.a	-0.42	-0.72	-2.71
7-Apr-99		-0.50	-0.36	0.00	-0.46	-0.36	n.a.	n.a	0.27	0.10	-1.05
7-May-99		-0.50	-1.08	-1.08	-0.52	-0.56	-0.67	-0.43	0.00	-0.25	0.04
2-Jun-99		-0.25	-0.60	-0.72	-0.41	-0.42	-1.47	-0.29	0.61	0.95	0.45
22-Jun-99		-0.75	-0.36	-0.36	-0.07	0.07	-0.48	-0.12	-1.76	-0.60	0.76
28-Jan-00	3/	0.25	-0.12	0.00	-0.09	-0.21	0.41	0.07	0.05	0.12	0.25
17-Mar-00		0.25	-0.48	-0.12	-0.01	-0.06	0.29	0.03	-0.07	0.11	-0.42
29-Aug-00		-0.50	-0.36	-0.12	-0.24	-0.34	-0.29	-0.36	2.41	2.15	2.10
19-Jan-01		-0.25	0.00	0.00	0.07	-0.06	0.17	-0.01	-0.30	-0.30	-0.94
21-Feb-01		-0.25	-0.24	-0.48	-0.05	0.05	-0.05	-0.06	0.80	0.65	1.20
5-Mar-01		-0.50	-0.84	-2.88	-0.26	-0.40	-2.24	-0.30	1.58	2.43	2.41
11-Apr-01		-0.25	0.00	-0.24	-0.24	-0.29	-0.11	-0.09	0.37	0.03	0.54
13-Jun-01		-0.25	-0.12	0.00	-0.17	0.03	-0.53	-0.14	0.36	0.71	0.41
9-Aug-01	4/	3.00	0.00	0.12	0.15	0.57	0.16	n.a	-0.10	0.18	0.18
11-Jan-02		-0.50	-0.60	-0.48	-0.20	-0.01	-0.06	n.a	-0.82	0.88	-2.15
20-Feb-02		-0.50	-0.12	-0.24	0.17	0.21	-0.04	n.a	0.25	0.21	0.04
13-Mar-02		-0.75	-0.24	-0.24	-0.35	-0.47	-0.38	n.a	-0.83	-0.95	-1.02
10-May-02		-0.75	-0.36	-0.48	-0.18	-0.22	-0.18	n.a	-0.45	0.43	-0.53
12-Jul-02		-0.75	-0.36	-0.60	-0.29	-0.33	-0.30	n.a	-0.35	-0.85	0.06
9-Aug-02		-0.25	-0.24	-0.36	-0.15	-0.11	-0.05	n.a	0.58	0.04	1.15
10-Jan-03		-0.25	-0.60	-0.60	-0.56	-0.10	-0.43	n.a	0.36	0.41	0.31

1/ Defined as Ch$/US$, so positive value denotes depreciation of Ch$.

2/ Changes measured over the same time interval as changes in the PDBC and PRBC rates.

3/ First policy action under free floating.

4/ Switch to nominal monetary policy rate.

Sources: Central Bank of Chile, Bloomberg.

The data of Table 1 is visualized in the two figures that follow, showing first the response of the two market interest rates to changes in the policy rate (Figure 1), and then the joint response of interest rates and exchange rates to the same policy actions (Figure 2). The period prior to the abandonment of the exchange rate band in September of 1999 is shown separately, for two reasons. First, to allow for a possible structural break due to the change in the exchange rate regime—in particular, resulting from direct exchange market intervention by the central bank prior to the regime change.[8] Second, because the monetary policy decision process that enables us to assume contemporaneous exogeneity of policy actions in Chile—policy meetings scheduled publicly in advance, followed by an announcement after market closing—was put in place only after the switch to free floating. Indeed, there are signs that some policy actions in the first half of 1999 may have been endogenous to news that became public at about the same time as the policy action itself. Policy actions often coincided with the release of data on economic activity, and in some cases with events that tended to appreciate the exchange rate, such as large FDI inflows. Since a stated objective of the Central Bank during this period was to ease policy without reigniting pressures on the exchange rate (which had been the main reason for sharply tightening policy during 1998), it is conceivable that some of its measures were timed to coincide with days on which the risk of a sharp depreciation seemed particularly low.

Figure 1 shows that the three measures of the market impact of policy actions are indeed correlated with the changes in the policy rate, but not very closely. For the two deposit rates, the simple correlation is about 0.25, for the PDBC rate it is about 0.3. Only the PRBC is correlated more tightly (around 0.5), as would perhaps be expected on the grounds that monetary policy targeted a "real" rate over most of the period. The fact that the market rates are imperfectly correlated with the policy rate is not necessarily a concern. The whole purpose of using these rates is that the underlying change in the policy rate cannot be taken as a proxy for the information content of a policy announcement, since policy announcements tend to be somewhat anticipated. Indeed, as Table 1 shows, the change in the market rates tends to be smaller in absolute value than the corresponding change in the policy rate. However, there are some outliers in the 2–day change of the Ch$ 30–90 rate as well as in the PDBC rate, particularly on June 2, 1999, and March 5, 2001. These two outliers in part drive the lower correlation of the PDBC with the policy rate when compared to the PRBC; if they are eliminated, the correlation rises to about 0.48.

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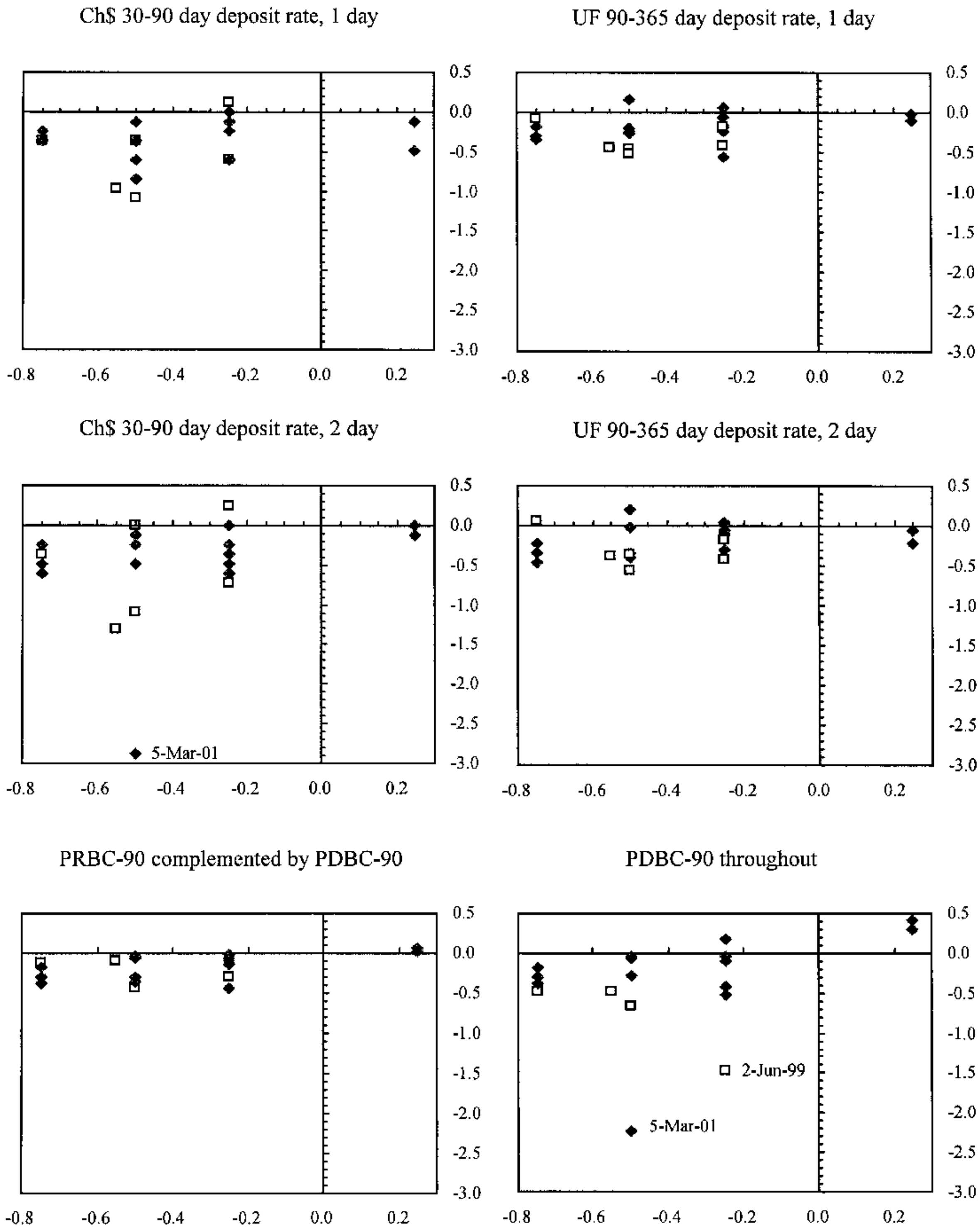
[8] After the switch to free floating, the Central Bank of Chile intervened a number of times during two time periods: from mid-August 2001 until the end of 2001, in response to the Argentina crisis (see Central Bank press release, August 16, 2001) and during a four month period beginning in mid-October 2002, again in reaction to financial market turbulence in the region (press release, October 10, 2002). Only one of the policy actions in our sample (January 10, 2002) occurred during these announced intervention periods. It did not coincide with an actual intervention episode, and the results are not affected if this policy action is excluded.

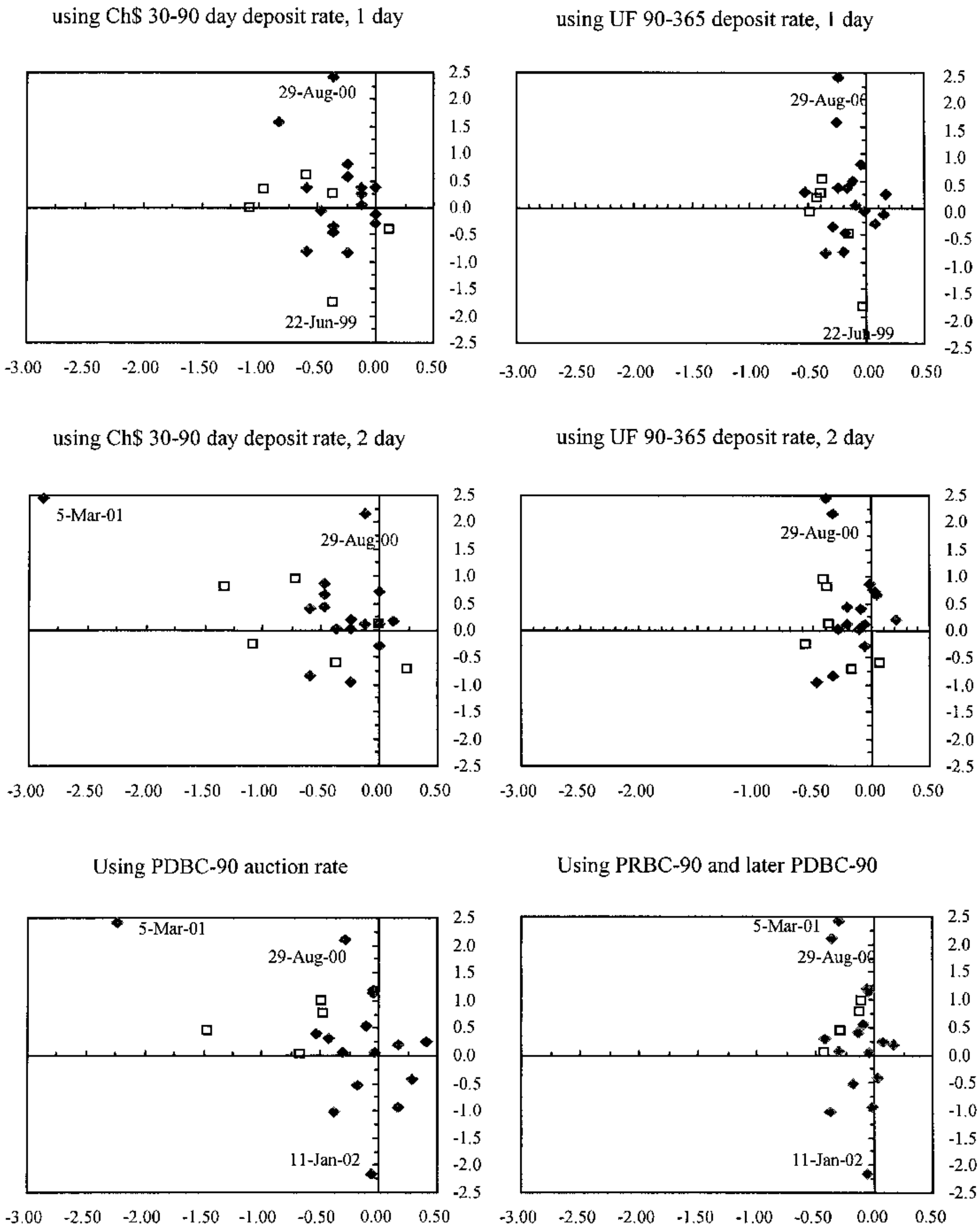
Figure 1. Chile: Reactions of Market Interest Rates to Changes in the TPM
(change in policy rate on X-axis, change in market rate on Y-axis)



Datapoints prior to September 2000 (switch to free floating) marked □
Datapoints after September 2000 (switch to free floating) marked ◆

Source: Banco Central de Chile

Figure 2. Chile: Reactions of Exchange Rate to Monetary Policy Actions
(change in market interest rate on X-axis, change in Ch$/US$ rate on Y-axis)



Datapoints prior to September 2000 (switch to free floating) marked □
Datapoints after September 2000 (switch to free floating) marked ◆

Source: Banco Central de Chile, Bloomberg

Figure 2 shows how the changes in interest rates around policy actions are correlated with the change in the exchange rate measured over the same time interval. As expected, there is a negative correlation, but again, it is not very tight, and there are some large outliers. One that is common to both sets of plots is August 29, 2000, when there was an extraordinarily large depreciation of the exchange rate in combination with a -0.5 point easing, which translated into lower market rates of -0.24 and -0.29 percent, respectively. Newspaper reports show that there were other economic news at the time (mainly fiscal measures to stimulate aggregate demand), but this does not explain the large depreciation.

Another outlier, when using the one-day change in the UF90-365 deposit rate, is June 22, 1999. As it turns out, this was a highly unusual event, when a substantial monetary easing was announced together with a fiscal stimulus package and language stating that this was the last easing of interest rates "in the foreseeable future". The reaction to these announcements was a sharp *appreciation* of the exchange rate together with very little change in short interest rates. The interpretation given to this even in the financial press is that the easing, which followed a June 17th release of data showing the economy in "deep recession" (*El Mercurio*) was fully expected, but the accompanying language was not. Expectations that the fiscal stimulus would boost the economy might also have played a role. The result was both an appreciation of the exchange rate which offset its earlier depreciation in anticipation of the easing, as well as a slight increase in *long* interest rates.

Finally, a particularly interesting outlier in both figures is March 5, 2001. This reflects market reactions to an unusually large easing (by 50 basis points) undertaken on March 2 following some bad unemployment news as well as an unexpected fall in consumer prices, which was announced on the morning of the policy action. The timing of the Central Bank's move came as a surprise, since the easing was decided and announced on a Friday, outside the pre-announced meeting schedule. As such, it is the only policy action during the floating period sample for which endogeneity to same-day economic information (namely, the inflation release for February) seems possible or even likely. The exceptionally large changes of the PDBC rate (Tuesday market close minus Thursday market close) and of the exchange rate and the Ch$ 30-90 rate when measured over two days (Monday market close minus Thursday market close) probably reflect a combination of reactions to the policy action itself and to the underlying inflation surprise. In contrast, the UF 90–365 day rate and PRBC rate measured over the same intervals do not exhibit such large reactions, presumably because—as "real" rates—they would only have reacted to the policy surprise, but not directly to the inflation surprise.

B. Regression Results

Using the data of Table 1, the change in the bilateral exchange rate after a policy announcement was regressed on the change in market interest rates in Chile and the United States over the same days, as well as number of controls, including the price of copper, sovereign risk premia in Argentina and Brazil to capture any spillovers from the crises in those countries, and the Chilean dollar-denominated sovereign bond spread (available since late May of 1999). The price of copper turned out to be insignificant in all specifications and its inclusion made no difference to the other coefficients. In contrast, the sovereign spreads for either Argentina and Brazil or Chile was significant in some specifications and had an effect on the precision of the effect estimated for the Chilean interest rate, our main variable of interest.

Table 2 shows results for the whole sample using sovereign spreads for Argentina and Brazil as controls, and for the sample that comprises the floating period using the spread for Chile as a control (when controlling for the Chilean spread, the spreads for the

Table 2. Regression Results for Monetary Policy Actions in Chile
(dependent variable: percent change of peso/dollar exchange rate)

	Interest rate measure used to measure policy shock:					
Coefficient	Ch$ 30-90		UF 90-365		PDBC	PRBC/
	1-day	2-day	1-day	2-day	all	PDBC
			Full Sample			
Δi	-0.42	-0.75	-0.76	-1.05	-0.93	-1.82
(t value)	-0.66	-3.07	-0.79	-1.23	-2.46	-1.28
Δi_{US}	1.98	-1.15	1.27	-2.14	2.17	-0.43
(t value)	0.49	-0.46	0.32	-0.65	0.66	-0.12
ARG spread	-0.27	-0.16	-0.32	-0.34	-0.25	-0.31
(t value)	-0.80	-0.84	-1.01	-1.42	-1.54	-1.73
BRA spread	0.25	0.66	0.29	0.62	0.27	0.26
(t value)	0.80	1.86	0.90	1.41	1.50	1.25
R^2	0.10	0.43	0.11	0.18	0.40	0.24
Hausman *p*	0.49	0.57	0.48	0.79	0.67	0.85
N	22	22	22	22	20	20
			Floating Period Only			
Δi	-1.30	-0.67	-0.41	-1.50	-0.94	-0.92
(t value)	-1.31	-2.47	-0.33	-1.47	-1.68	-0.48
Δi_{US}	6.43	1.98	4.02	1.15	-0.52	-5.16
(t value)	1.38	0.62	0.88	0.31	-0.09	-0.98
CHL spread	-0.80	6.93	0.18	10.72	-3.67	-6.10
(t value)	-0.22	2.00	0.05	2.43	-0.61	-0.91
R^2	0.18	0.48	0.07	0.34	0.29	0.14
Hausman *p*	0.83	0.58	0.84	0.52	0.23	0.27
N	16	16	16	16	16	16

neighboring countries were not significant in this sample and were eliminated from the model). Our approach was to first conduct a Hausman specification test which in effect compares the OLS results with IV results that use the change in the monetary policy rate as an instrument for the Chilean market interest rate change. This test never rejected the null hypothesis of no misspecification. Since the OLS coefficients are much more precise than the estimated IV coefficients, we only report the former. The table also shows the p-values associated with the Hausman test. All models were estimated with a constant, which turned out to be insignificantly different from zero and is not shown in the table to avoid clutter.

The regressions show (1) a much better fit for the 2-day regressions than for the 1-day regressions when deposit rates are used; (2) a better fit for the nominal interest rate measures (Ch$ 30–90 day rate and PDBC) than for the UF denominated measures. Two sets of models lead to statistically significant coefficients on the interest rate measures: those using the two-day change of the Ch$ 30–90 as a measure, and those using the 90-day PDBC rate. The estimated coefficients on the interest rate variable is between about two thirds and unity in these regressions. This is about half of the strength of the effect found by Zettelmeyer (2000) for Australia, Canada and New Zealand, using a similar methodology.

To what extent are these results robust to the elimination of outliers? After eliminating the two large outliers apparent in Figure 2—March 5, 2001 and August 29, 2000—the estimate for the 2-day Ch$30-90 day rate slightly drops in absolute size (from –0.75 to –0.65) but remains statistically significant (t = –2.04). In contrast, eliminating outliers in the PDBC–90 sample (March 5, 2001 and January 11, 2002, see Figure 2) leads to both smaller and statistically insignificant coefficients. In this sense the coefficient estimates for the PDBC–90 rate are indeed sensitive to outliers, particularly the March 5, 2001 policy action. Since the latter was probably endogenous to same-day economic information (an inflation release, see above) and ought to be excluded on those grounds alone, this finding needs to be taken seriously.

The regressions also show a positive and sometimes significant relationship between the Brazilian bond spread, consistent with the results of Rebucci (2002), who finds a tight link between Brazilian sovereign risk and the Ch$/US$ exchange rate—more so than with respect to Argentine risk. The latter in fact exhibits a negative relationship in our models, although it is insignificant. Note that our sample contains no monetary policy actions during the August–December 2001 period in which, according to Rebucci, there was in fact some contagion from Argentina to Chile.

IV. Reactions to Monetary Policy Events in the United States

We now turn to policy events in the United States. Table 3 lists all changes in the Federal Funds Target for the 1999–2003 period examined in the previous section. The United States three-month treasury bill rate is used as a gauge of their news content (alternatively, we could have used the change in Federal Funds futures rates as in Borensztein, Philippon and Zettelmeyer (2000) and Kuttner (2001), but the three month T-bill rate serves the same purpose, and is easier to compare with the interest rates used for Chile). In addition, the table

Table 3. Chile: Changes in Interest Rates and the Exchange Rate at the Time of Monetary Policy Actions in the U.S., 1999 - 2000 1/
(percent change for exchange rate, percentage point change for interest rates)

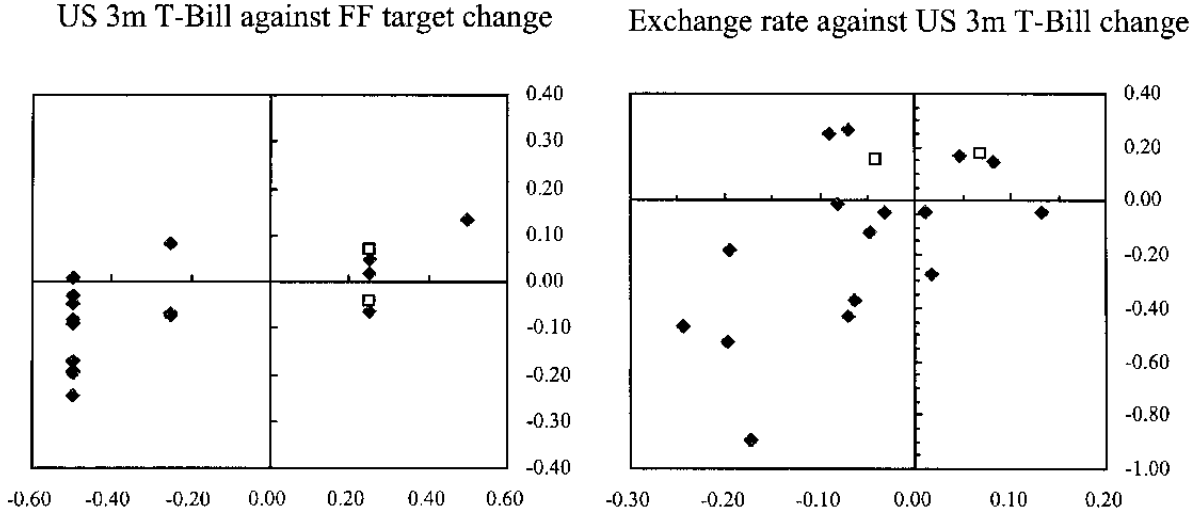
Date	FF Target	US 3m T-Bill	Ch$ 30-90 deposit rate	UF90-365 deposit rate	Exchange rate 2/	Chile Bond Spread
30-Jun-99	0.25	-0.04	-0.12	0.23	0.15	0.14
24-Aug-99	0.25	0.07	0.24	0.04	0.17	0.06
16-Nov-99	0.25	0.05	0.12	0.17	0.17	-0.03
2-Feb-00	0.25	-0.06	-0.12	-0.08	-0.37	0.01
21-Mar-00	0.25	0.02	0.12	0.13	-0.28	0.03
16-May-00	0.50	0.13	-0.12	0.17	-0.04	0.03
3-Jan-01	-0.50	-0.24	-0.12	-0.01	-0.47	-0.19
31-Jan-01	-0.50	-0.03	0.12	-0.04	-0.04	-0.02
20-Mar-01	-0.50	-0.05	0.48	0.05	-0.12	0.05
18-Apr-01	-0.50	-0.20	-0.24	-0.01	-0.53	0.02
15-May-01	-0.50	-0.09	-0.12	0.16	0.25	0.01
27-Jun-01	-0.25	0.08	-0.48	-0.03	0.14	-0.10
21-Aug-01	-0.25	-0.07	0.12	-0.05	-0.43	0.04
17-Sep-01	-0.50	0.01	-0.72	-0.24	-0.04	-0.18
2-Oct-01	-0.50	-0.08	0.00	-0.07	-0.01	0.06
6-Nov-01	-0.50	-0.17	-0.12	0.46	-0.90	-0.02
11-Dec-01	-0.25	-0.07	-0.12	0.01	0.26	0.00
6-Nov-02	-0.50	-0.19	0.00	-0.03	-0.18	-0.02

1/ Refers to first available quote after monetary policy announcement minus last available quote before the announcement.
2/ Defined as Ch$/US$, so positive value denotes depreciation of Ch$.
Sources: Banco Central de Chile for UF90-365 deposit rate, Bloomberg.

shows changes in the two Chilean daily deposit rates we used earlier, and in Chile's dollar denominated sovereign bond spread on days of U.S. policy announcements. As one would expect, monetary contractions in the U.S. are associated with an increase in the bond spread, but the effect is small and not statistically significant.

The key correlations are graphed in Figure 3. As in Figures 1 and 2, reactions to policy actions prior to September 2000 (there are only two) are plotted using squares, while diamonds are used for the remaining period. The left scatter plot shows the reactions of the three month treasury bill rate to changes in the federal funds rate. Reactions of both T-bill and the exchange rates are plotted to the right. Note that since the bilateral exchange rate continues to be expressed as Ch$/US$, we expect an increase in the exchange rate (a depreciation of the peso) in response to monetary contractions in the United States. The plots show the expected correlations, which appear tighter than in the case of figures 1 & 2, and lack the large outliers observed in those figures.

Figure 3. Reactions of U.S. Market Interest Rates and the Exchange Rate to Monetary Policy Actions in the U.S, June 1999 – November 2002



Sources: Bloomberg and The Wall Street Journal

Table 4 shows regression results using either the Ch$ 30–90 or the UF90–365 deposit rate as a control. In addition, the Argentina and Brazilian sovereign bond spread and/or the bond spread for Chile are controlled for. Since there are only two observations prior to the official switch to free floating, we only present regression results for the whole sample; it would not matter if those two observations were eliminated. The results confirm that the impact between monetary policy actions in the United States and the bilateral Ch$/US$ exchange rate is both tighter and larger than was previously found for monetary policy actions in Chile. United States monetary policy announcements that lead to an increase in the three month U.S. treasury bill by one percentage point appreciate the United States dollar relative to the Chilean peso by about 1.7 to 2 percent. This is true not only for all specifications shown in the table, but for any other specification we tried (for example, after including copper prices as a control).

One notable implication of these results is that monetary policy in Chile after mid–1999 appears to be largely free from "fear of floating" (Calvo and Reinhart, 2002), at least with respect to this particular variety of shocks, i.e. international interest shocks due to United States monetary policy. The responsiveness of the bilateral Ch$/US$ exchange rate to U.S. monetary policy is almost as high, for example, as that of the bilateral Cn$/US$ or Au$/US$ exchange rate to Canadian or Australian policy shocks, respectively (see Zettelmeyer, 2000). These provide a useful benchmark, since no one would accuse the Federal Reserve of exhibiting "fear of floating" with respect to Canadian or Australian monetary policy shocks.

Table 4. Regression Results for Monetary Policy Actions in the U.S.
(dependent variable: percent change of peso/dollar exchange rate)

Coefficient	Chile interest rate used as a control:					
	Ch$ 30-90			UF 90-365		
	(1)	(2)	(3)	(1)	(2)	(3)
Δi_{US} 1/	1.74	1.96	1.89	1.69	1.87	1.76
(t value)	2.57	2.89	2.84	2.61	2.83	2.82
Δi 2/	-0.07	0.03	-0.22	-0.52	-0.44	-0.74
(t value)	-0.21	0.11	-0.69	-1.12	-0.97	-1.58
CHL spread	0.39		1.47	0.65		1.52
(t value)	0.38		1.25	0.74		1.65
ARG spread		-0.36	-0.54		-0.36	-0.56
(t value)		-1.36	-1.83		-1.40	-2.08
BRA spread		0.33	0.57		0.22	0.42
(t value)		0.95	1.46		0.62	1.18
R^2	0.35	0.42	0.49	0.40	0.46	0.59
Hausman p	0.37	0.51	0.26	0.50	0.72	0.38
N	18	18	18	18	18	18

1/ Change in the U.S. 3-month T-Bill rate on the day of U.S. policy announcements
2/ Change in Chile Ch$ 30-90 or UF 90-365 on day of U.S. policy announcement

Is the discrepancy between the results for United States policy actions and for Chilean policy actions sufficiently large to be statistically significant? The answer is No. Table 5 shows the results from a battery of structural break tests, applied after pooling the data in Table 1 and that in Table 3, after inverting the sign of the United States interest rate change, so that the coefficients on United States and Chilean actions have the same signs. The model specifications on which these tests are based follow those of Table 2. The line "response to Chile shock" simply reproduces the coefficient and t-value estimated for the variable Δi in that table. The line "response to US shock" reproduces the coefficient and t-value on Δi_{US} in an exactly analogous regression model based on the data of Table 3, using the reaction of the United States 3-month treasury bill rate to measure United States policy shocks and the change in the Ch$ 30-90 deposit rate to control for Chilean interest rate movements at the time of United States policy. The line "Chow p-value" reports the results from an F-test of the hypothesis that the two models are structurally identical. As can be seen from the table, the null hypothesis is rejected in only one case, in which the rejection is driven not by the

Table 5. Structural Stability Tests
(dependent variable: percent change of peso/dollar exchange rate)

Coefficient	Interest rate measure used for Chile: Ch$ 30-90 1-day	Ch$ 30-90 2-day	UF 90-365 1-day	UF 90-365 2-day	PDBC all	PRBC/ PDBC
	Using full Sample for Chile actions, ARG and BRA as controls					
Response to Chile shock	-0.42	-0.75	-0.76	-1.05	-0.93	-1.82
(t value)	-0.66	-3.07	-0.79	-1.23	-2.46	-1.28
Response to US shock	-1.96	-1.96	-1.87	-1.87	-1.96	-1.96
(t value)	-2.89	-2.89	-2.83	-2.83	-2.89	-2.89
Chow p-value	0.93	0.79	0.99	0.74	0.93	1.00
	Using floating period for Chile actions, CHL spread as control					
Response to Chile shock	-1.30	-0.67	-0.41	-1.50	-0.94	-0.92
(t value)	-1.31	-2.47	-0.33	-1.47	-1.68	-0.48
Response to US shock	-1.74	-1.74	-1.69	-1.69	-1.74	-1.74
(t value)	-2.57	-2.57	-2.61	-2.61	-2.57	-2.57
Chow p-value	0.43	0.25	0.74	0.05	0.89	0.70

coefficient on the policy shock variable, but by the discrepancy between the coefficient on the Chilean spread in the two regressions (not shown). If the F-tests are applied only to the coefficient on the policy variables, allowing the coefficients on the other variables to vary across the U.S. and Chilean policy samples, then the hypothesis of identical coefficients on the two policy variables can never be rejected.

V. Conclusion

After about three and a half years of experience with a floating regime, it is still too early to estimate with precision the relationship between monetary policy and the bilateral Chile peso/U.S. dollar exchange rate—at least when using the methodology proposed in this paper, which focuses on market reactions to actual policy events. The following summarizes what can be said at this point.

First, the Ch$/US$ exchange rate exhibits a significant response to monetary policy *in the United States*, in about the same order of magnitude as is observed in countries such as Australia, Canada, and New Zealand, with regard to both their own and United States monetary policy. A policy-induced increase of the U.S. three-month treasury bill rate leads to a depreciation of the Chilean peso by about 1.5 to 2 percent on impact. One implication of this fact is that Chilean monetary policy since 1999 seems to be largely free of "fear of floating". There is apparently no expectation that Chilean monetary policy will necessarily follow policy in the United States in a way that would neutralize the impact of U.S. policy on the bilateral exchange rate.

Second, we also detect a response of the bilateral exchange to monetary policy actions *in Chile*, but this is less robust across specifications and alternative policy measures, and is less precisely estimated. It is also somewhat sensitive to outliers. The estimates suggest that the response of the bilateral exchange rate to policy actions in Chile seems to be in the order of two–thirds to one percent, that is, less than half of the estimates for the United States.

The difference between our findings for U.S. policy actions and for policy actions in Chile should not be overstated. Due to the lack of precision in the Chilean estimates, it is not statistically significant: structural break tests fail to reject, so whether or not it will hold up in larger samples is an open question. To the extent that the apparent difference in the estimates for Chilean and U.S. actions is taken seriously, however, there are several possible interpretations. One is to invoke the "revisionist view" of monetary policy and the exchange rate, in which a monetary easing, for example, does not necessarily depreciate the exchange rate because its effect through the standard interest parity channel may be offset by an effect through risk premia or long–run exchange rate expectations. Zettelmeyer (2000) found some evidence for this effect in circumstances when the economy is depressed and markets view an easing as a necessary step in allowing the economy to recover. However, such effects are rare, and market commentary to the easings in Chile during 2001–02 does not seem to fit this pattern (if anything, skepticism seemed to have prevailed about the power of monetary policy to revive economic growth).

Another explanation is that monetary policy might be expected to be less persistent in Chile than in the United States. Thus, if there is a perception that policy actions could be reversed within weeks or a few months, both exchange rates and interest rates used in this study (the latter with maturity at around 3 months) would react less to surprise policy announcements. This would lower the signal-to-noise ratio in our sample and possibly bias the coefficients downward. In principle, this problem could be addressed using the instrumental variables approach described in previous sections, but in practice, the sample is too small. Moreover, to the extent that the exchange rate picks up expectations about monetary policy beyond a three–month horizon, the expectation of policy reversals after three months would be reflected only in the exchange rate, but not in the three–month interest rate, leading to a lower regression coefficient on the interest rate than would be the case if policy changes were viewed as permanent.

The problem with this story is that, in actual fact, monetary policy in Chile was not much less persistent than U.S. policy during our sample period. In the first half of 1999, there were six successive easings in Chile, followed by two hikes in early 2000, and, again, by 13 successive easings starting in late August of 2000 (interrupted by the *nominalización*, which was intended as a neutral move, but had a moderately contractionary effect, see Table 1). In the United States, there were 6 successive hikes from June 1999 until May 2000, followed by 12 successive easings from early 2001 until late 2002 (Table 3). Thus, to make the story work, one has to argue that markets *expected* Chilean policy to be less persistent, even though it was in fact quite persistent.

Finally, a simple and perhaps more plausible interpretation is that the market interest rates we use to gauge policy in Chile are noisy, and do not reflect monetary policy surprises with sufficient precision. As was said before, this problem can be overcome through an instrumental variables approach, where the instrument is the change in the underlying monetary policy rate, but this requires a larger sample than is available at this point, given the poor correlation between noisy market rates and the instrument. In contrast, if measurement problems are not a big issue, even 18 observations may suffice to say something fairly definite, as seems to be the case for the estimated reaction of the bilateral exchange rate to policy surprises in the United States.

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