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Selective Asymmetric Interventions

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Abstract

Interventions in foreign exchange markets are commonly used by monetary authorities to influence exchange rates. Whether or not the interventions are symmetrical in response to external shocks representing depreciation or appreciation pressures depends on other objectives of the monetary authority. If the goal of maintaining low inflation is more important than exchange-rate stabilization, then when inflation is considered to be too high asymmetrical interventions are likely to arise with more vigorous interventions to offset depreciation pressures than to offset appreciation pressures. Evidence from Taiwan supports this pattern.

Keywords: Price levels; Inflation; Intervention; Exchange rates

JEL classification: E31; F31

Selective Asymmetric Interventions

1. Introduction

There has been a long-standing policy debate on the issue of whether a fixed or floating exchange-rate regime insulates a small open economy better from various shocks. Researchers believe that, for inflation-prone countries, a fixed exchange rate regime can help to keep inflation down by serving as a discipline on central-bank credit creation. This argument led in the early 1990s to advocacy of currency boards as an approach to achieving price stability. Caprio (1996), Honohan (1997), Jao (1998) and Gulde (1999) are examples. Alternatively, those who favor a floating exchange rate regime argue that the fixed regime imposes an undue constraint on the monetary authority. They believe that more flexibility of exchange rates helps insulate domestic prices particularly from external shocks. For example, under a floating exchange regime, when an economy experiences inflationary pressures from foreign countries, it can offset such pressures by allowing its currency to appreciate at the rate of foreign inflation.

These arguments have stimulated empirical investigations into the experience of developed countries which adopted floating regimes in the 1970s. Genberg, Salemi and Swoboda (1987), Hutchison and Walsh (1992) and Lastrapes and Koray (1990) are such studies. Among these, only Lastrapes and Koray (1990) find some evidence in the case of the United Kingdom to support the hypothesis that there is superior insulation from external shocks under a flexible exchange-rate regime.

This paper examines the case of a developing country-Taiwan. Moreno (1994) uses a small vector autoregression (VAR) model and impulse responses to assess the impact of a set of external disturbances on Taiwan's price levels under alternative exchange rate regimes. The VAR model consists of an external sector and a domestic sector. The external disturbances include a foreign oil price shock and a set of shocks proxied by U.S. macroeconomic variables. The domestic sector is represented by Taiwan's CPI. Moreno's study suggests that Taiwan's price level became more stable after the government adopted the floating exchange-rate regime.

Do relatively stable price levels under the floating regime result from better control of the money supply by Taiwan's monetary authority in this period? Lin and Wu (1994) claim, in an empirical study, that the quantity theory of money does not hold in Taiwan. Since the 1980s, a large gap has existed between annual growth rates of the money supply (M_1 and M_2) and of real GNP without much price inflation. This phenomenon was especially apparent during the period of 1986-1988. Despite growth rates in M_1 and M_2 well in excess of growth rates in GNP, the CPI experienced very low inflation and the WPI actually fell during those three years. According to Lin and Wu (p. 185): "...during the period of 1985-1989, the New Taiwan dollar experienced an appreciation of 33.69 percent against US dollar. Because of this appreciation of the NT dollar, the import price index was decreasing in the later 1980s."

These events clearly show that the exchange rate can be an important element in Taiwan's price level. A high growth rate in the money supply will not necessarily cause a high inflation if at the same time the New Taiwan dollar (NT\$) appreciates

sufficiently. It follows that Taiwan's exchange rate management can have an impact on domestic price levels. Moreno's study (1994) concludes that the Taiwan government managed its exchange rates in the 1980s in a manner that contributed to insulating its domestic price levels from external shocks. This, however, does not answer the further question: What types of government management of exchange rates were used to achieve domestic price stability under the floating exchange regime? Our paper addresses this question.

We focus specifically on how changes in the yen/dollar rate influenced interventions by the Taiwan central bank. Press reports and statistical evidence indicate that changes in the Yen/US\$ rate tend to move the New Taiwan dollar (US\$/NT\$) in the opposite direction. We therefore interpret an increase in the Yen/US\$ rate as creating depreciation pressure on the Taiwanese currency and a decrease in the Yen/US\$ rate as creating appreciation pressure. If a depreciating currency puts upward pressure on domestic prices, then a leaning-against-the-wind policy by the Taiwan central bank of selling dollars when the dollar appreciates against the yen will tend to offset the upward pressure on domestic prices in Taiwan. Similarly, buying dollars by the Taiwan central bank when the dollar depreciates against the yen will tend to offset a downward pressure on domestic prices.

To smooth out these external shocks on domestic prices and maintain international reserves, interventions by the Taiwan central bank can be expected to be relatively symmetrical. However, when the central bank is concerned about an existing inflation problem, we expect interventions to be stronger in reacting to depreciation

pressures, which could aggravate inflation, than to appreciation pressures, which could reduce inflation. Evidence supports this prediction.

The remainder of the paper is organized as follows. Section 2 briefly describes Taiwan's exchange rate policy and economic background. Section 3 presents Granger-causality tests between Yen/US\$ and NT\$/US\$. Section 4 reports regression analyses that support the hypothesis that the asymmetries in responding to depreciation and appreciation pressures arise primarily during periods of relatively high inflation. Section 5 concludes.

2. Taiwan's exchange rate policy and economic background

2.1. Exchange rate policy and intervention operations

Prior to February 1979, the NT\$ was pegged to the U.S. dollar (US\$), and all foreign exchange transactions required government approval. Since February 1979, Taiwan's foreign exchange market has been a managed float. Figure 1 shows the Yen/US\$ and US\$/NT\$ exchange rates from 1971:1 to 1998:12. There is an evident inverse pattern between the two series. We examine the direction of causation below.

In the first half of the 1980s, the U.S. dollar appreciated against the yen and other currencies, including the NT\$. As a result, Taiwan had large trade surpluses with the United States and accumulated substantial foreign assets denominated in US\$. See Figure 2 and 3. These considerable holdings of foreign assets enabled Taiwan to engage later in relatively large interventions. In the second-half of the 1980s, the NT\$ started to appreciate against the US\$ while US\$ depreciated against the Japanese yen.

2.2. *The degree of openness and major trade partners*

An economy with a relatively high degree of openness will be affected more by external shocks than an economy with a low degree of openness. Taiwan is a very open economy. The ratio of its exports plus imports to GDP has been in the range from 71 to 87 percent in the years of active intervention from 1985 to 1998. A good portion of that trade has been with the U.S. and with Japan. This suggests that a change in the Yen/US\$ rate can be an important external shock.

2.3. *Extent of interventions*

The Taiwan monetary authority regularly claims that it will intervene in response to external shocks but does not publish the extent of its interventions. There are end-of-month data on total international reserves valued in U.S. dollars (IR_t). The monthly changes are shown as the solid line in Figure 4. To construct estimates of how much of these changes are the result of interventions, we need to adjust for interest earned and changes in the dollar values of the yen and mark reserves.

In a 1997 *Taiwan Commercial Times*, Mr. Chou A-Ting, who is the president of Taiwan Foreign Exchange Bureau, claims that the rate of return on Taiwan's foreign assets is approximately equal to that of US government bonds. We use concurrent monthly U.S. 1-year Treasury bill rate (TBR) as the proxy of the rate of return on Taiwan's foreign assets to get estimates of increases in reserves as a result of interest earned.¹

Taiwan's foreign assets consist primarily of US\$, Deutsche mark (DM) and Yen assets. There is occasional information about the composition of these reserve assets.

We interpolated between times when relative shares are reported to estimate monthly fractions held in DM and Yen.

The change in the dollar value of DM reserve assets from month $t-1$ to t can be calculated by $(IR_{t-1}) * (\text{share of DM assets}) * [(1 + \text{TBR}) * (\text{DM/US\$})_{t-1} * (\text{US\$/DM})_t - 1]$.

The change in Yen reserve assets from month $t-1$ to t is calculated by the same procedure. Reserve assets other than DM and Yen, mostly US\$ assets, also earn interest from month $t-1$ to t : $(IR_{t-1}) * (\text{total shares of other assets}) * (\text{TBR})$. Adding the changes in the value of DM and Yen assets plus interest earned by other assets from month $t-1$ to t , we obtain the changes in foreign assets without interventions. See Figure 4. Estimates of the monthly net interventions are then obtained by subtracting changes attributable to interest earnings and valuation changes from total change in reserve assets.

Figure 5 depicts the resulting estimated magnitude of Taiwan's net interventions each month from Feb. 1979, when floating began, through Oct. 1998. These will be denoted ΔFA_t in subsequent analysis. As is evident in Figure 5, the Taiwan monetary authority started to impose large and frequent interventions approximately after the 1985 Plaza agreement.

3. Granger causality test

As noted earlier, there are evident inverse movements between Yen/US\$ and US\$/NT\$. A long-existing consensus, among Taiwan monetary authorities, is that the fluctuation of Yen/US\$ is a major influence on the exchange rate between the NT\$ and

the US\$. As indicative of this consensus, we present two statements, from among many prior news accounts. Both have been presidents of the Taiwan Central Bank.

In April, 1989, in the *Taiwan Economic Daily*, Mr. Chang Chi-Cheng, as a former president from 1984-1989, claims: “Currently, the exchange rate of NT\$/US\$ is fundamentally reasonable. The temporary appreciation pressure of NT dollar against US dollar is due to further depreciation of US dollar against yen.”

In the *Commercial Times* in May, 1998, Mr. Peng Huai-Nan, who became president of the central bank in 1998, says: “Recently, NT\$ depreciates against US\$ is the result of US\$ appreciates against yen. A drop in the value of NT\$ against US\$ does not reflect domestic fundamentals.”

Note that both statements indicate a belief that causation runs from the Yen/US\$ to the US\$/NT\$ and not the other way. Since the NT\$ market is very small relative to the yen and dollar markets, one would intuitively expect this. We can examine it more formally by means of Granger-causality tests.

Let the monthly change in Yen/US\$ be denoted by ΔS_t , and the monthly change in US\$/NT\$ be denoted by ΔE_t , for the time period 1982:10-1998:10.² The Schwarz information criteria, denoted as SIC, for choosing the order of the VAR are reported in the upper half of Table 1 together with the Lagrange multiplier test statistics, denoted as LM, for serial correlation. Lag order of 1 is preferred for both single equation and system criteria on the basis of a minimum SIC.

The lower half of Table 1 reports the test statistics for Granger-causation with a lag order of 1. Consider first the hypothesis H_{01} , that ΔS_t does not Granger-cause ΔE_t .

The F statistic of 4.944, with a p-value of .027, calls for rejecting H_{01} and accepting the alternative hypothesis that ΔS_t does cause ΔE_t . In the regression of ΔE_t on ΔE_{t-1} and ΔS_{t-1} , note the significant negative coefficient on ΔS_{t-1} . An appreciation in the US\$ relative to the yen ($\Delta S_{t-1} > 0$) tends to result in a depreciation of NT\$ relative to the US\$ ($\Delta E_t < 0$).

Furthermore, we cannot reject H_{02} : ΔE_t does not Granger-cause ΔS_t . In other words, as would be expected, there is no evidence of an effect of changes in US\$/NT\$ on subsequent changes in Yen/US\$.

On the basis of these results, as well as press reports, we will refer to an increase in Yen/US\$ as generating depreciation pressures in Taiwan and to a decrease in Yen/US\$ as generating appreciation pressures.

In a vector autoregression analysis, similar to one carried out by Moreno (1994), shocks to Yen/US\$ had a smaller impulse-response effect on prices in Taiwan after 1985, when there were substantial interventions, than between 1979 and 1985, when interventions were on a much smaller scale. The implication of this analysis, available on request, is that intervention policy after 1985 somehow mitigated the effects of changes in Yen/US\$ on prices in Taiwan.

4. Empirical analysis of intervention responses to Yen/US\$ changes.

We now investigate how the Taiwan monetary authority responded to appreciation and depreciation pressures. [News reports in the months in which there](#)

were unusually large changes in foreign assets, such as months labeled in Figure 4, reveal a pattern in the intervention strategy.³

When there is not an inflation problem within the economy, the monetary authority focuses on exchange-rate stability and uses lean-against-the-wind interventions to respond to both appreciation and depreciation pressures. Also, interventions are largely sterilized to maintain stable interest-rate levels.⁴

With an existing inflation problem within the economy, however, the use of interventions is crucially influenced by the direction of exchange-rate pressures. When facing depreciation pressures, interventions of selling US\$ are consistently used without being sterilized. The reason for not sterilizing these interventions is to withdraw money from the economy to offset the existing inflation pressures. When facing appreciation pressures, the monetary authority tends not to intervene as actively since an appreciation helps reduce inflation pressures by lowering the prices for imported goods.

This pattern can be subjected to a more formal statistical analysis, using monthly data for the sample period from 1985:10 to 1998:10. As can be seen in Figure 5, these are years in which substantial interventions occurred.

4.1. Test of intervention patterns without inflation criterion

We first examine how the Taiwan monetary authority's interventions responded to fluctuations in the Yen/US\$ exchange rate (ΔS_t). We partition the data into months with depreciation pressures (in which ΔS_t was positive) and into months with appreciation pressures (in which ΔS_t was negative). This is accomplished by defining dummy variables for periods of depreciation pressures ($D_{1,t}$) and appreciation pressures

($D_{2,t}$) and multiplying them by the change in the Yen/US\$ rate. The resulting regression equation takes the form:

$$\Delta FA_t = \alpha + \beta_1 D_{1,t} \times \Delta S_t + \beta_2 D_{2,t} \times \Delta S_t + \beta_3 \Delta FA_{t-1} + \beta_4 \Delta FA_{t-3} + \beta_5 \Delta FA_{t-6} + \varepsilon_t \quad (1)$$

subject to $D_{1,t} = 1$ if $\Delta S_t > 0$; $D_{1,t} = 0$ otherwise, and

$$D_{2,t} = 1 \text{ if } \Delta S_t < 0; D_{2,t} = 0 \text{ otherwise.}$$

where ΔFA_t is the amount of Taiwan's interventions denominated in millions of US dollars; a positive value is a purchase of foreign assets, usually U.S. dollars, and sale of the NT\$. ε_t is an error term. All variables are in logarithms. Three significant lags of the dependent variable (ΔFA_{t-1} , ΔFA_{t-3} , and ΔFA_{t-6}) are included in the regression to eliminate the serial correlation among the residuals⁵.

When $\Delta S_t > 0$ and there is depreciation pressure, we expect any intervention to be a sale of foreign assets ($\Delta FA_t < 0$). This should result in a negative β_1 coefficient. When $\Delta S_t < 0$ and there is appreciation pressure, we expect any intervention to be a purchase of foreign assets ($\Delta FA_t > 0$) and hence give rise to a negative β_2 coefficient.

The results from estimating equation (1) with OLS, reported in the second column of Table 2, indicate that lean-against-the-wind interventions were used in the sample period and that the Taiwan monetary authority may have made somewhat more of an effort to offset depreciation pressures than appreciation pressures ($\beta_1 = -.2045$ and $\beta_2 = -.1157$).

This analysis, however, does not take account inflation concerns. We turn next to an examination of how Taiwan's interventions responded to fluctuations in the Yen/US\$ exchange rate under situations with or without an inflation problem.

4.2. Test of intervention patterns with inflation criterion

Official inflation claims have been taken from two Taiwan local newspapers, *Economic Daily News* and *Commercial Times*, as well as several publications reported by *Dow Jones Interactive*. Concerns about the level of inflation were found in 43 of the 157 months⁶.

We now have four partitions of the data. In equation (1), we had a two-way partition of the data into periods of depreciation pressures (when $\Delta S_t > 0$) and periods of appreciation pressures (when $\Delta S_t < 0$). For equation (2) below, we now split each of those into whether or not inflation is high enough to be considered a problem for the central bank. In the new dummy variables, a subscript 1 denotes depreciation pressure and a subscript 2 denotes appreciation pressures. The superscripts are 1 if there is no inflation problem and 2 if there is an inflation problem.

We ran an OLS regression for the following equation:

$$\begin{aligned} \Delta FA_t = & \alpha + \beta_1 D_{1,t}^1 \times \Delta S_t + \beta_2 D_{2,t}^1 \times \Delta S_t + \beta_3 D_{1,t}^2 \times \Delta S_t + \beta_4 D_{2,t}^2 \times \Delta S_t \\ & + \beta_5 \Delta FA_{t-1} + \beta_6 \Delta FA_{t-3} + \beta_7 \Delta FA_{t-6} + \varepsilon_t \end{aligned} \quad (2)$$

subject to $D_{1,t}^1 = 1$ if no inflation problem *and* $\Delta S_t > 0$; $D_{1,t}^1 = 0$ otherwise,
 $D_{2,t}^1 = 1$ if no inflation problem *and* $\Delta S_t < 0$; $D_{2,t}^1 = 0$ otherwise,
 $D_{1,t}^2 = 1$ if inflation problem *and* $\Delta S_t > 0$; $D_{1,t}^2 = 0$ otherwise, and
 $D_{2,t}^2 = 1$ if inflation problem *and* $\Delta S_t < 0$; $D_{2,t}^2 = 0$ otherwise.

The last column of Table 2 reports OLS regression results. The moderately significant negative coefficients on both $D_{1,t}^1 \times \Delta S_t$ and $D_{2,t}^1 \times \Delta S_t$ in equation (2) show that,

without the presence of an inflation problem in the economy, the Taiwan monetary authority tended to intervene symmetrically to depreciation or appreciation pressures after the Plaza Agreement. The symmetry is reflected in the similar coefficients ($\beta_1 = -.1599$ and $\beta_2 = -.1480$).

Unlike the symmetric results for β_1 and β_2 , the results for β_3 and β_4 show evidence of asymmetric responses between currency depreciation and appreciation pressures when an inflation problem exists in the economy. The highly significant negative sign on $D_{1,t}^2 \times \Delta S_t$ implies that the Taiwan monetary authority used lean-against-the-wind interventions to respond to depreciation pressures when there were inflation concerns. The coefficient on $D_{2,t}^2 \times \Delta S_t$ is very close to zero⁷.

Thus, the slight asymmetry noted for equation (1) is evidently the result of asymmetric interventions during periods when inflation is considered to be too high. The monetary authority does not generally intervene to counter appreciation pressures when there is an existing inflation problem.

4.3. Test of intervention as an anti-inflation policy per se

A natural question is whether this asymmetry simply reflects the use of exchange-rate interventions as a general anti-inflation policy. To check that, we ran three additional regressions. The first is with inflation in the CPI, denoted INF_t^{CPI} , as the explanatory variable:

$$\Delta FA_t = \alpha + \beta_1 \times INF_t^{CPI} + \beta_2 \Delta FA_{t-1} + \beta_3 \Delta FA_{t-3} + \beta_4 \Delta FA_{t-6} + \varepsilon_t \quad (3)$$

The second equation adds the inflation variable to equation (1):

$$\begin{aligned} \Delta FA_t = & \alpha + \beta_1 \times D_{1,t} \times \Delta S_t + \beta_2 \times D_{2,t} \times \Delta S_t + \beta_3 \times INF_t^{cpi} + \beta_4 \Delta FA_{t-1} \\ & + \beta_5 \Delta FA_{t-3} + \beta_6 \Delta FA_{t-6} + \varepsilon_t \end{aligned} \quad (4)$$

subject to $D_{1,t} = 1$ if $\Delta S_t > 0$; $D_{1,t} = 0$ otherwise, and
 $D_{2,t} = 1$ if $\Delta S_t < 0$; $D_{2,t} = 0$ otherwise.

The third equation modifies (4) by considering only periods of inflation concerns:

$$\begin{aligned} \Delta FA_t = & \alpha + \beta_1 \times D_{1,t} \times \Delta S_t + \beta_2 \times D_{2,t} \times \Delta S_t + \beta_3 \times D_{3,t} \times INF_t^{cpi} + \beta_4 \Delta FA_{t-1} \\ & + \beta_5 \Delta FA_{t-3} + \beta_6 \Delta FA_{t-6} + \varepsilon_t \end{aligned} \quad (5)$$

subject to $D_{1,t} = 1$ if $\Delta S_t > 0$; $D_{1,t} = 0$ otherwise;
 $D_{2,t} = 1$ if $\Delta S_t < 0$; $D_{2,t} = 0$ otherwise and
 $D_{3,t} = 1$ if inflation problem; $D_{3,t} = 0$ otherwise.

The OLS results are reported in Table 3. Since the coefficients of INF_t^{cpi} are never significantly different from zero, there is no evidence that the Taiwan monetary authority used interventions to offset inflation alone after the Plaza Agreement.

5. Conclusion

Regression analysis supports the hypothesis that when there is an existing inflation problem, interventions will be much stronger in resisting depreciation pressures, which would aggravate inflation, than appreciation pressures, which would alleviate inflation.

Such asymmetric intervention, resisting depreciation pressures more strongly than appreciation pressures, is somewhat surprising for a highly export-oriented

country. One might expect a bias toward encouraging depreciation in order to maintain greater competitiveness in international markets. In the case of Taiwan, however, a goal of stabilizing domestic price levels is evidently of higher priority than stabilizing exchange rates.

A critical issue for inflation targeting in small open economies is the role of the exchange rate. Mishkin and Savastano (2000) studied Latin American experiences and argued that reluctance to accept exchange rate fluctuations through the use of interventions or currency board would make inflation targeting unsuccessful. This is because responding too frequently to exchange rate fluctuations would run the risk of transforming the exchange rate into a nominal anchor that takes precedence over the inflation target. The evidence from Taiwan is that selective intervention has helped achieve price stability. The experience of Taiwan has not been to use interventions as a general anti-inflation device, nor to peg the exchange rate, but as an aid in insulating domestic price levels from external shocks arising from changes in the Yen/US\$ exchange rate.

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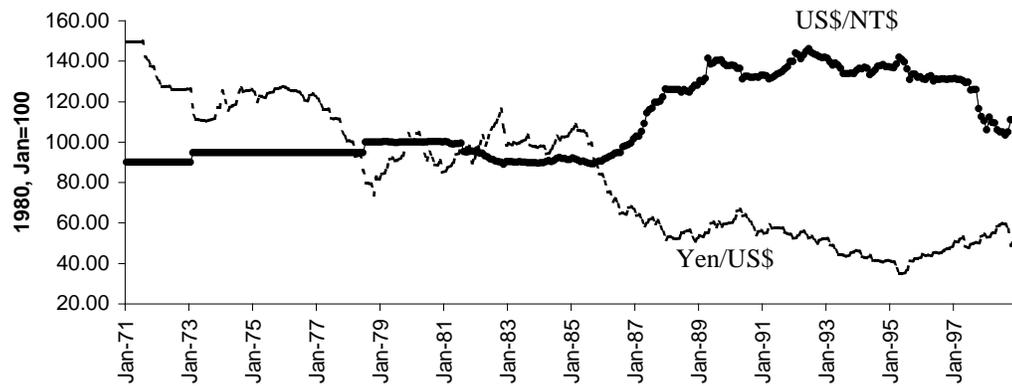


Fig. 1. Exchange rates.

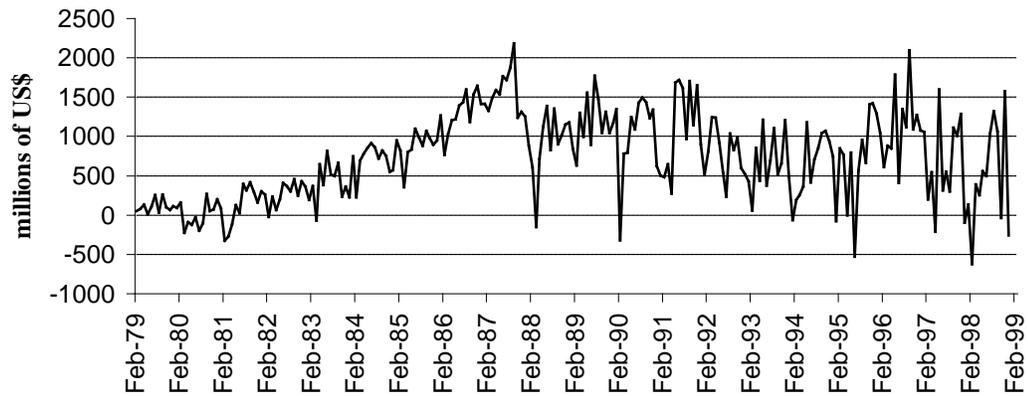


Fig. 2. Taiwan's current account balance.

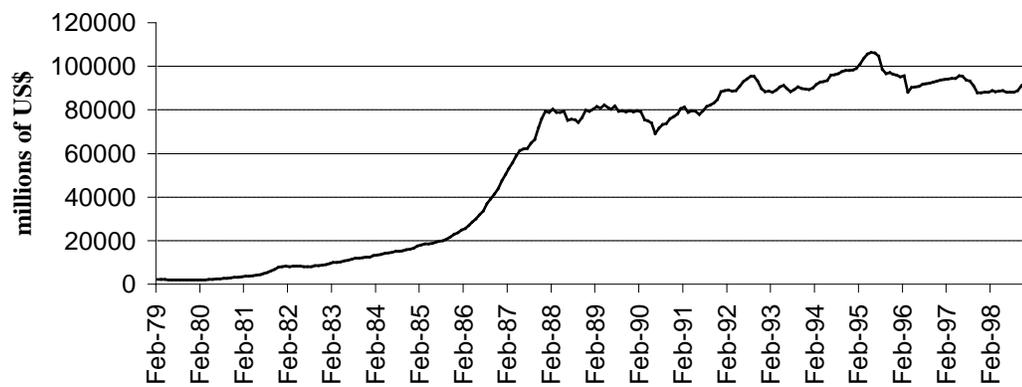


Fig. 3. Taiwan's accumulated foreign assets.

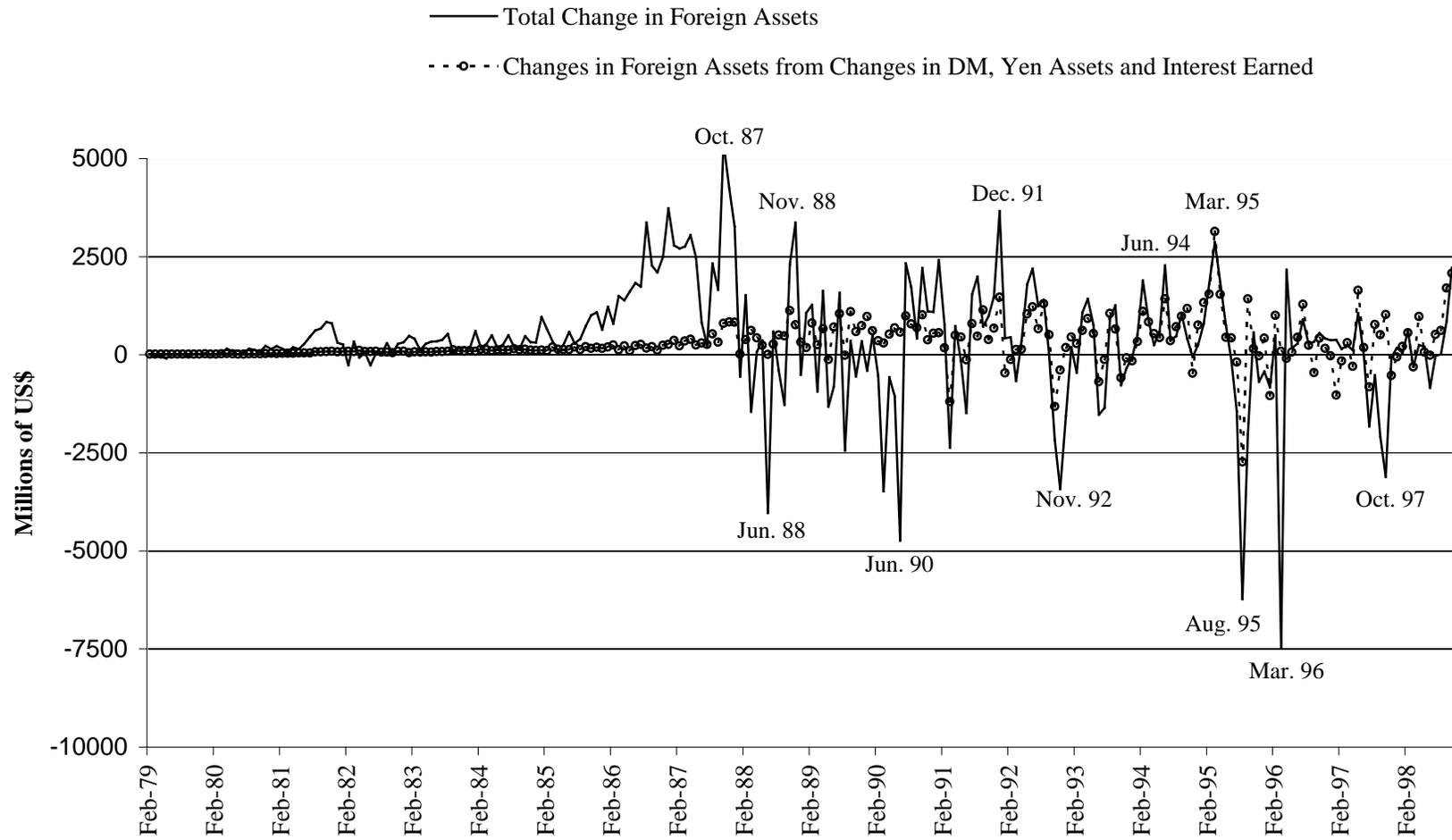


Fig. 4. Changes in Taiwan's foreign assets. Source: Taiwan Central Bank.

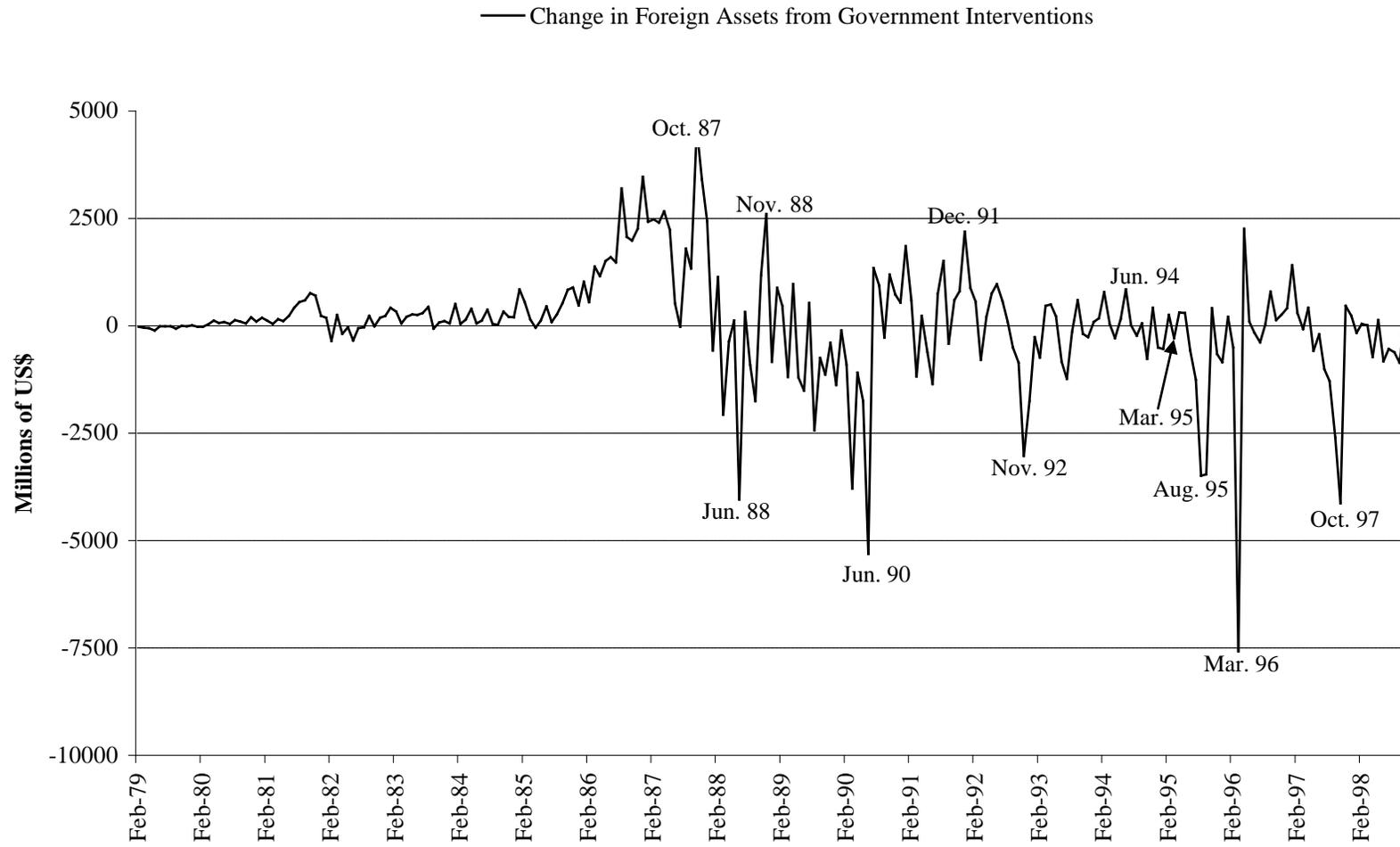


Fig. 5. Taiwan's magnitude of interventions under the floating exchange system. Positive (negative) change in foreign assets represents a class of interventions of buying (selling) US dollars. Source: Taiwan Central Bank.

Table 1

VAR order selection and test statistics for Granger-causality^{a b}

<u>VAR order selection</u>			
Single-equation criteria: ΔE_t			
Lag order	1	2	3
SIC	-10.031	-9.992	-9.988
LM(1:12)	20.677	23.472	24.113
	[0.055]	[0.024]*	[0.020]*
Single-equation criteria: ΔS_t			
Lag order	1	2	3
SIC	-8.373	-8.322	-8.271
LM(1:12)	10.853	8.958	8.736
	[0.542]	[0.707]	[0.725]
System criteria			
Lag order	1	2	3
SIC	-18.450	-18.363	-18.309
<u>Granger-causality test statistics</u>			
<i>H₀₁: ΔS_t does not Granger-cause ΔE_t?</i>			
Lag order	1		
<i>F</i> test	4.944		
	[.027]*		
	$\Delta E_t = -0.0002 + 0.1180 \Delta E_{t-1} - 0.0734 \Delta S_{t-1} + \varepsilon_t$		
	[0.641]	[0.113]	[0.027]*
<i>H₀₂: ΔE_t does not Granger-cause ΔS_t?</i>			
Lag order	1		
<i>F</i> test	.0005		
	[.983]		
	$\Delta S_t = -0.0013 + 0.1753 \Delta S_{t-1} + 0.0036 \Delta E_{t-1} + \varepsilon_t$		
	[0.220]	[0.021]*	[0.983]

^a LM(1:12) is Breusch- Godfrey autocorrelation test of order 1 to 12.^b *P*-values are in [] and * denotes significance at the 95%.

Table 2
 OLS regression on equations (1) and (2): Estimated coefficients and diagnostic test statistics^a

	No price factors		With price factors	
Coefficients of Explanatory Variables and test statistics	Equation (1)		Equation (2)	
Constant	.0003 [.727]		.0003 [.745]	
Depreciation: $D_{1,t} \times \Delta S_t$	-.2045** [.012]			
Appreciation: $D_{2,t} \times \Delta S_t$	-.1157* [.093]			
Depreciation, no inflation problem: $D_{1,t}^1 \times \Delta S_t$			-.1599* [.098]	
Appreciation, no inflation problem: $D_{2,t}^1 \times \Delta S_t$			-.1480** [.049]	
Depreciation, inflation problem: $D_{1,t}^2 \times \Delta S_t$			-.2772** [.016]	
Appreciation, inflation problem: $D_{2,t}^2 \times \Delta S_t$			-.0200 [.868]	
ΔFA_{t-1}	.3091*** [.000]		.3069*** [.000]	
ΔFA_{t-3}	.2832*** [.000]		.2864*** [.000]	
ΔFA_{t-6}	.1727** [.017]		.1564** [.032]	
Durbin-Watson Statistics	2.1451 [.912]		2.1508 [.944]	
Breusch-Godfrey autocorrelation test of order (1 to x):				
LM (1:1) LM (1:3)	2.3778 [.123]	2.3442 [.504]	2.6808 [.102]	3.5620 [.313]
LM (1:12) LM (1:24)	15.2911 [.226]	30.4273 [.171]	15.8926 [.196]	29.6229 [.198]
White's homoskedasticity test	26.3168 [.122]		29.8354 [.422]	
Adjusted R ²	.4771		.4764	

^a P-values are in [] and *, ** and *** denote significance at the 90%, 95% and 99% levels respectively.

Table 3

OLS regressions for equations (3), (4) and (5): Estimated coefficients and diagnostic test statistics^a

Coefficients of Explanatory variables and test statistics	Equation (3)	Equation (4)	Equation (5)
Constant	.0012 [.411]	.0014 [.356]	.0005 [.631]
$(D_{3,t} \times) INF_t^{cpi}$	-.0004 [.309]	-.0003 [.364]	-.0002 [.577]
<i>Cases of depreciation:</i> $D_{1,t} \times \Delta S_t$		-.2080** [.011]	-.2036** [.013]
<i>Cases of appreciation:</i> $D_{2,t} \times \Delta S_t$		-.1091 [.116]	-.1158* [.094]
ΔFA_{t-1}	.3204*** [.000]	.3051*** [.000]	.3094*** [.000]
ΔFA_{t-3}	.2843*** [.000]	.2787*** [.000]	.2828*** [.000]
ΔFA_{t-6}	.1475* [.057]	.1547** [.038]	.1672** [.023]
Durbin-Watson Statistics	2.0990 [.934]	2.1321 [.915]	2.1476 [.929]
Breusch-Godfrey autocorrelation test of order (1 to x):			
LM (1:1) LM (1:3)	1.2847 2.4668 [.257] [.481]	2.1106 2.1422 [.146] [.543]	2.4630 2.4679 [.117] [.481]
LM (1:12) LM (1:24)	18.4179 26.9179 [.104] [.308]	15.2520 31.1269 [.228] [.150]	15.6556 30.6712 [.208] [.163]
White's homoskedasticity test	23.0002 [.060]	35.3844 [.104]	30.1154 [.263]
Adjusted R ²	.4305	.4765	.4741

^a P-values are in [] and *, ** and *** denote significance at the 90%, 95% and 99% levels respectively.

Footnotes:

¹ One could perhaps use 3-year or 10-year Treasury bill rate, but this would make only negligible changes in the estimation.

² Both variables, ΔS_t and ΔE_t , used in the VAR system are stationary, so that the test statistics have standard distributions. Concerning the test period, it is observed, from figure 1, that the value of NT\$ against US\$ has little fluctuation prior to 1982, therefore we perform the test from 1982:01.

³ Notice that a large change in foreign assets is not necessarily associated with a large intervention. This is most notable for March 1995 when valuation changes were substantial. A detailed account of what happened during each of the 11 months labeled in Figures 4 and 5 is available on request.

⁴ Interest rate stability has been one of Taiwan's economic targets, since the government tries to maintain a favorable investment environment. To maintain low and stable interest rates, low and stable inflation rates are necessary. This may partially explain why the Taiwan government always keeps a close watch on its inflation rates.

⁵ This is so-called "general-to-specific" approach, pioneered by David Hendry, and it has been developed at length by its advocates. For general discussions of "general-to-specific" approach, see Hendry (1995).

⁶ In the news accounts four different inflation rates are mentioned at various times. These are inflation rates over the preceding 12 months for the CPI, MPI (imported price index), and WPI as well as monthly inflation rates for the MPI. Annual inflation rate, however, is the dominating factor. The average annual inflation rates from 114 cases (without inflation problem) and from 43 cases (with inflation problem) are 2% and 4.38%, respectively. A statistical analysis shows that CPI inflation was the dominant variable.

⁷ Because of the relatively high standard error on the estimate of β_4 , we cannot decisively reject the hypothesis that $\beta_3 = \beta_4$. The p-value for the test statistic was 0.15.