

IMF Working Paper

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WP/97/115

INTERNATIONAL MONETARY FUND

Research Department

Capital Flows to Brazil: The Endogeneity of Capital Controls

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September 1997

Abstract

This paper creates an index of capital controls to analyze the determinants of capital flows to Brazil, accounting for the endogeneity of capital controls by considering a government that sets controls in response to capital flows. It finds that the government reacts strongly to capital flows by increasing controls on inflows during booms and relaxing them in moments of distress. The paper estimates a vector autoregression with capital flows, controls, and interest differentials. It shows that controls have been temporarily effective in altering levels and composition of capital flows but have had no sustained effects in the long run.

JEL Classification Numbers: F32, F41

Keywords: Capital Flows, Capital Controls

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¹We thank Paul Masson, Alexander Hoffmaister, Joaquim Levy, Leonardo Hernandez, Rodrigo Valdés, and participants in the August 30, 1997 seminar at the World Bank for helpful comments. We thank Márcio Garcia for sharing his data set.

Contents

	Page
Summary	4
I. Introduction	5
II. Capital Flows: Can Theory and Practice Justify Controls?	5
A. Capital Flows and Consumption	6
B. Capital Flows and Production	6
C. Capital Flows and Macroeconomic Management	7
D. The Costs of Capital Controls	8
E. Does Practice Justify Controls?	9
III. The Brazilian Experience: Determinants of Capital Flows and the Effect of Controls	10
A. Capital Flows to Brazil	10
B. Determinants of Capital Flows	13
C. Capital Controls	16
D. Endogeneity of Capital Controls	20
IV. Further Evidence From Vector Autoregressions	24
A. Controls and Total Net Flows	24
B. Controls and the Composition of Flows	29
C. Robustness of the Results	30
V. Conclusions	34
Appendices	
I. Additional Evidence from OLS Regressions	35
A. Total Net Flows After 1991	35
B. Primary Flows	35
C. Composition of Capital Flows	37
II. Changes in Taxes and Restrictions on Capital Flows and on Payments of Invisibles	39
III. Data Sources	46
References	47
Tables	
1. Brazil: Composition of Capital Flows, 1991-95	11
2. Dependent Variable: Ratio of Monthly Total Net Private Capital Flows to GDP	14
3. Dependent Variable: Ratio of Total Net Capital Flows to GDP	20

4.	Dependent Variable: Change in Capital Controls	23
5.	Dependent Variable: Controls	23
6.	Variance Decomposition of Capital Flows	29
7.	Variance Decomposition of Capital Controls	30
8.	Dependent Variable: Ratio of Monthly Total Net Capital Flows to GDP	36
9.	Dependent Variable: Ratio of Primary Flows to GDP	36
10.	Coefficient of Variation of Net Capital Flows	38
11.	SUR Regressions	38

Figures

1.	Composition of Capital Flows: Brazil	12
2.	Treasury Bill Rates and Capital Flows	15
3.	Changes in Restrictions on Capital Flows, Brazil, January 1983 - December 1995	19
4.	VAR Using Restrictions on Inflows	26
5.	VAR Using Restrictions on Outflows	27
6.	VAR Using Controls	28
7.	VAR Using Debt Flows	31
8.	VAR Using Portfolio Flows	32
9.	VAR Using FDI Flows	33

SUMMARY

This paper investigates the determinants of capital flows to Brazil and constructs an index of capital controls that includes restrictions on both outflows and inflows. Using monthly capital flows data from the Central Bank of Brazil, the paper finds that foreign interest rates and contagion effects are important in explaining capital flows to Brazil, confirming previous results in the literature. It also shows that these factors affect mostly equity and debt flows, but not net direct investment.

The paper explicitly takes into account the endogeneity of capital controls through a government reaction function that sets controls in line with capital flows. Using instrumental variables, the paper shows that the government reacts strongly to capital flows by increasing controls in booms and relaxing them in moments of distress.

The paper estimates a vector autoregression with monthly capital flows, controls, and interest differentials. It shows that controls have been temporarily effective in altering the level and composition of capital flows within a 6-month period and have been responsible for up to 30 percent of the forecasted variance of capital flows, but have had no sustained long-run effects. The results are robust to using different data sets (monthly flows from Brazil's central bank and monthly primary flows from Loanware and Bondware) and different frequencies (quarterly capital flows from the International Monetary Fund's *International Financial Statistics*).

I. INTRODUCTION

Brazil, as many other developing countries, has experienced a surge in capital inflows in the 1990s. Initially praised for eliminating a decade of restricted borrowing, the new flows soon raised traditional questions. Are the capital inflows temporary? How should authorities respond to the macroeconomic effects of large capital inflows, such as real appreciation and monetary or debt expansion? Should capital controls be introduced to change the volume and composition of capital flows?

Brazil has answered these questions by introducing a variety of controls over capital flows that have been devised to modify their volume and composition. This paper constructs an index of capital controls to test empirically the determinants of capital flows, their composition, and whether the controls have been effective. The paper explicitly takes into account the reverse causality from capital flows to controls through the government reaction function.

The paper is organized in five sections and four appendices. Following the introduction above, Section II reviews the costs and benefits of capital flows, discusses the reasons why countries may choose to use capital controls, and summarizes the empirical evidence on the effects of controls in industrialized and developing countries. Section III describes capital controls used in Brazil and builds an index that reflects the liberalization measures implemented in the late 1980s and early 1990s, the introduction of taxes after Mexico's December 1994 financial crisis, and the revisions of taxes and other legislation as capital inflows returned to Brazil after May 1995. Evidence on determinants of capital flows to Brazil and their composition is explored using all available information: monthly capital flows from the Central Bank of Brazil and primary flows from Loanware and Bondware. The section also estimates the government reaction function using instrumental variables. Section IV examines the evidence from vector autoregressions and studies the relationship between capital flows and capital controls in the 1980s and 1990s, investigating the effect of controls on both total flows and the composition of capital flows. Conclusions, summarized in Section V, claim that Brazil's capital controls are endogenous and have responded to capital flows. Capital controls have a temporary effect on capital flows with the peak at 6 months after implementation. In addition, capital controls tend to temporarily modify the composition of flows away from equity and debt flows. The four appendices address, respectively: additional evidence from OLS regressions, a different specification, capital control measures between 1983 and 1995, and the data sources used in this paper.

II. CAPITAL FLOWS: CAN THEORY AND PRACTICE JUSTIFY CONTROLS?

Controversy persists on the role of capital flows in boosting development and inducing macroeconomic instability (Cardoso and Dornbusch, 1989). Capital flows affect (1) consumption, (2) production, and (3) macroeconomic management.

A. Capital Flows and Consumption

The consumption-smoothing advantage offered by capital inflows arises under two circumstances: in a context of cyclical fluctuations and in a context of growth where foreign savings are used to initiate growth. In the case of cyclical disturbances to the terms of trade, output, or foreign demand, optimal consumption will fluctuate less than disposable income if there is the possibility to borrow during periods of income shortfalls with subsequent repayment when income recovers. This positive welfare effect of capital flows extends to disturbances that are domestic.

Consumption-smoothing can also arise in a growth context. The case of Korea between 1960 and the mid-1980s provides a striking example of a transition toward a high saving rate, financed initially by external borrowing. Between 1960 and 1969, foreign savings equal to 9 percent of GDP financed half of investment. A growing income per capita increasingly provided the resources to finance investment and by 1986-89 the savings/income ratio had reached 35 percent, the current account had turned toward surplus, and debt started to be retired.

B. Capital Flows and Production

Capital inflows add to an economy's productive capacity and thus potentially increase welfare. Foreign investment may carry more than the traditional neoclassical benefits by adding to competition or improving technology. But because of existing distortions, these factors may also lower welfare.

The traditional analysis of foreign investment considers a barter economy where capital inflows (direct foreign investment) take the form of an increase of the economy's stock of physical capital. The inflow of productive capital raises the economy's output. In the case of constant returns to scale, the foreign factor earns its marginal product, but also adds to national income, i.e., the income of domestic factors of production. This simple analysis facilitates consideration of the choice of optimal borrowing. A country facing a perfectly elastic supply of capital should borrow (rent) capital to the point where the marginal value of capital is equal to the world cost of capital. But if the supply of capital is upward-sloping, the increasing marginal cost of capital calls for restriction of capital inflows below the competitive level. This analysis offers a first rationale for the use of taxes or quantitative restrictions on foreign borrowing.

Much of the discussion about the costs and benefits of foreign capital in developing countries involves departures from the simple neoclassical model sketched above and acknowledges that controls are welfare-reducing unless they are a "second best" policy that mitigates the effects of another market failure. Dooley (1995) offers a survey of the modern literature on market distortions and second best arguments that justify intervention over international capital transactions. The survey reviews the analysis of a wide variety of market failures including sticky prices in goods and labor markets, distortionary tax policies, anticipated trade reforms, and myopic private speculation. A more recent argument for government intervention in international capital markets is based on the literature on multiple

equilibria. Special circumstances, such as a fixed exchange rate regime during transition to a monetary union, may justify capital controls to prevent self-fulfilling speculative attacks. In this situation, if multiple equilibria are possible, the “first-best” equilibrium might be achieved through government intervention in capital markets.

C. Capital Flows and Macroeconomic Management

It is widely recognized that capital flows pose several problems for macroeconomic policy. The most widely cited examples concern the experiences of Latin American countries during the period 1978-82 and the mid-1990s. During these two periods, a number of countries experienced a strong real appreciation of their currencies, followed by balance of payment crises. Economists have interpreted the real appreciation in two distinct ways. Harberger (1986), for instance, highlights the sudden abundance of foreign borrowing and the resulting pressure of capital inflows on the real exchange rate. In this view, capital flows lead to real appreciation, and in that way bring about an inward transfer of resources.

The alternative explanation notices that in all cases of real appreciation in Latin American countries in the early 1980s and mid-1990s, the monetary authorities followed a conscious policy of using reduced rates of exchange depreciation (or even fixing the exchange rate to achieve disinflation, as in Chile in 1979-81). The combination of expected reduced depreciation with high domestic interest rates in relation to interest rates in the United States attracted capital inflows. The real appreciation in turn led to current account deterioration. In the end, each of these experiences of the real appreciation turned out to be very costly, as illustrated by Mexico’s 1994 crisis.

The situation has also been complicated by relatively high domestic rates that have induced banks to incur open foreign exchange positions by financing local currency lending with foreign currency borrowing. Even when rules limit their foreign currency positions, banks still become indirectly exposed to the risk of devaluation. When use of the exchange rate as a nominal anchor leads to relatively high interest rates, combined with little immediate prospect of devaluation, enterprises are encouraged to take up foreign currency-denominated loans. In cases where the borrowers’ revenues are mostly denominated in the domestic currency, the quality of foreign currency loans can also deteriorate in the event of a domestic currency devaluation.

The desire to counteract the pressures to exchange rate appreciation in the face of large capital inflows and to limit inflows that are likely to be reversed has led to central bank intervention. Policies to reduce the impact of capital inflows include direct intervention through controls and taxes and a restrictive monetary policy in the form of sterilization. Sterilization can create significant fiscal costs in financing high levels of reserve holdings depending on the scale of the operation and the size of the interest differential vis-à-vis external rates in reserve centers. The instability caused by heavy inflows and the costs of sterilization seems to give governments a reason to control capital flows.

Perhaps one of the most convincing arguments in favor of the use of capital controls was advanced by Dooley (1996). He argues that large private capital inflows to developing

countries have reflected a chain of official guarantees consisting of a commitment to an open capital account, the adoption of a fixed exchange rate (or limited flexibility), and the guarantee that the authorities will help stabilize the domestic financial system during a crisis. The financial system guarantees include a lender of last resort provision, bank deposit insurance, and interventions in equity markets to limit price declines. Given the incentives created by these guarantees, the size of the capital inflow will be related to the country's perceived net worth (the value of its net international reserves, the credit lines it can obtain from private markets, and the resources that are likely to be available from international financial institutions). If the guarantees lead inflows to a poorly supervised financial system, poor quality investments may occur. The solution to this problem lies in breaking the chain of guarantees offered to international investors. Dooley regards a threat to withdraw the guarantee of the bank deposits or the solvency of the banking system as not credible. This leaves either changing the exchange rate regime or imposing capital controls as the only options, if countries do not want domestic interest rates to be determined by international markets.

D. The Costs of Capital Controls

Controls on capital flows take the form of restrictions on the assets transactions or restrictions on payments related to the acquisition of assets. Restrictions on assets transactions include direct capital controls, such as quantitative limits or prohibition of certain transactions by imposing minimum maturity limits. Price-based capital controls take the form of taxes or reserve requirements.

Recent experiments with controls on capital outflows and inflows have covered a wide variety of instruments. In response to the mid-1990s capital outflows, Venezuela introduced comprehensive exchange controls to limit current and capital account transactions. Romania responded to its balance of payments crisis of early 1996 by effectively closing foreign exchange markets. South Africa postponed the elimination of remaining exchange controls on residents' capital outflows following a run on the rand in early 1996. In response to Mexico's peso crisis in late 1994, Brazil prohibited prepayment of foreign loans and relaxed certain capital inflow controls.

Examples of direct controls by countries that experienced recent surges in capital inflows include, among others, Brazil's prohibition of some nonresident transactions (inflows to futures and options markets) in 1995, and Chile's one-year minimum maintenance period for nonresident capital inflows. These countries also used price-based controls. For instance, Brazil raised the financial transaction tax to discourage inflows in the 1990s. Chile introduced a stamp duty in mid-1990 and extended the tax base to all foreign loans.

Financial regulatory measures and prudential measures can also affect capital movements. China, India, Korea, and Thailand differentiate their reserve requirements between resident and nonresident deposits in a way that can influence capital movements in some cases. Prudential regulations applied for the purposes of controlling banks' open net foreign currency position may include a capital control element. Brazil, responding to capital

outflow surges in 1995, raised banks' short position limit and lowered their long position limit.

Alongside arguments that justify the use of capital controls, a strong tradition argues that government intervention does not accomplish its stated objectives. There is the question whether the costs and distortions generated by controls outweigh potential benefits. These costs include the possibility of retaliation by other countries, evasion, administrative costs, and the inability to quantify the needed tax on capital flow. There is also the risk that controls established to mitigate a temporary distortion may generate interests of their own and outlive their purpose.

E. Does Practice Justify Controls?

Whether controls are welfare-improving or welfare-reducing is an empirical question. The empirical evidence on the effectiveness of controls has concentrated on the effect on interest differentials.² Essentially, capital controls permit a breach between international and domestic interest rates even when expected devaluation and risk premium are factored in. Dooley (1995) surveys the empirical evidence on industrialized and developing economies and concludes that controls have influenced yield differentials across countries although there is no evidence that controls have helped governments achieve policy objectives, such as avoiding real appreciation, or that controls have enhanced welfare as suggested by theory.

Data on capital control is scarce and few empirical papers introduce them directly. Most papers use the International Monetary Fund's *Exchange Arrangements and Restrictions* as the source of capital control data. The exceptions are Johnston and Ryan (1994) and Grilli and Milesi-Ferretti (1995) that use panel data for industrialized and developing countries. Both papers find that the data do not support the hypothesis that control programs affect economic variables, such as the volume and composition of private flows, changes in international reserves, or the level of the exchange rate. Grilli and Milesi-Ferretti also find that capital controls are associated with higher inflation and lower real interest rates.

Chile is generally cited as an example of the effective use of capital controls, but Soto and Valdés-Prieto (1996) find mixed results. The econometric evidence between 1987 and 1995 shows that capital controls were not evaded in Chile where substantial levels of tax revenue were levied on capital market participants. As a matter of fact, the ability to collect tax revenue on capital flows increased over time as the Chilean authorities closed loopholes and the selective capital controls have discouraged significantly particular classes of short-term credits. The results show that the taxed short-term flows were smoothly substituted by other short-term flows without measurable changes in total short-term credits. The taxes were borne by participants who were unable to substitute flows. The authors also find that selective capital controls have failed to achieve other objectives of the Chilean monetary authorities, such as delaying real exchange rate appreciation or improving the mixture of foreign financing between long-and short-term credits.

² See Dooley (1995).

In the case of Colombia, Cárdenas and Barrera (1997) find a relative inability of controls to reduce the level of capital inflows, but suggest that non-remunerated deposits have been successful in inducing a recomposition of foreign liabilities in favor of long-term maturities.

Reinhart and Smith's (1996) findings are consistent with the results mentioned above. After analyzing stylized facts of several recent episodes in Asia, Eastern Europe, and Latin America they agree that capital controls had little effect on consumption, the current account, or the real exchange rate, but that in most cases the measures were capable of either reducing the overall volume of inflows, or in some cases even altering their maturity profile over the short run.

In summary, the evidence seems to be that capital controls can provide temporary breathing room for dealing with balance of payments difficulties and help to reverse capital outflows if combined with policy tightening involving higher interest rates. Controls can also serve to discourage potentially destabilizing short-term capital flows and reduce a country's vulnerability to shifts in market sentiment. But, it seems ineffective in preventing sustained outflows of savings or avoiding a crisis induced by inconsistent macroeconomic policies. Enforcing capital controls over extended periods can reveal itself as a hopeless task in a world of highly integrated international capital markets. The next sections investigate whether these conclusions also apply to the Brazilian experience.

III. THE BRAZILIAN EXPERIENCE: DETERMINANTS OF CAPITAL FLOWS AND THE EFFECT OF CONTROLS

A. Capital Flows to Brazil ³

After the oil shock of 1973, Brazil's reliance on commercial loans to finance both public investment and the more expensive oil led the country to the debt crisis of the early 1980s. Following a trend common to other emerging markets, private capital inflows to Brazil disappeared in the 1980s and increased dramatically after 1991. By 1993, the fall of international interest rates had eased the external debt burden and led to an agreement with creditor banks that was concluded in April 1994 with an exchange of instruments that covered over \$50 billion in debt stocks and arrears.

Monthly private net capital flows averaging \$39 million between 1988 and 1991 increased 25 times, turned into an average monthly net flow of \$970 million between 1992 and 1995. Since 1992, net foreign capital flows to Brazil have been sufficient to finance small current account deficits while contributing to an increase in foreign reserves (Cardoso, 1997). During this period, the capital consisted primarily of short-term resources tied to portfolio investments and other short-term investments. In 1995, for example, net capital flows amounted to more than \$29 billion, of which \$20 billion was short-run capital: \$2.3 billion

³Capital flow figures are denoted in U.S. dollars, unless specified otherwise.

was equity and special investment funds, and approximately \$18 billion consisted of short-run capital not classified under a specific category (Table 1).

Table 1. Brazil: Composition of Capital Flows, 1991-95

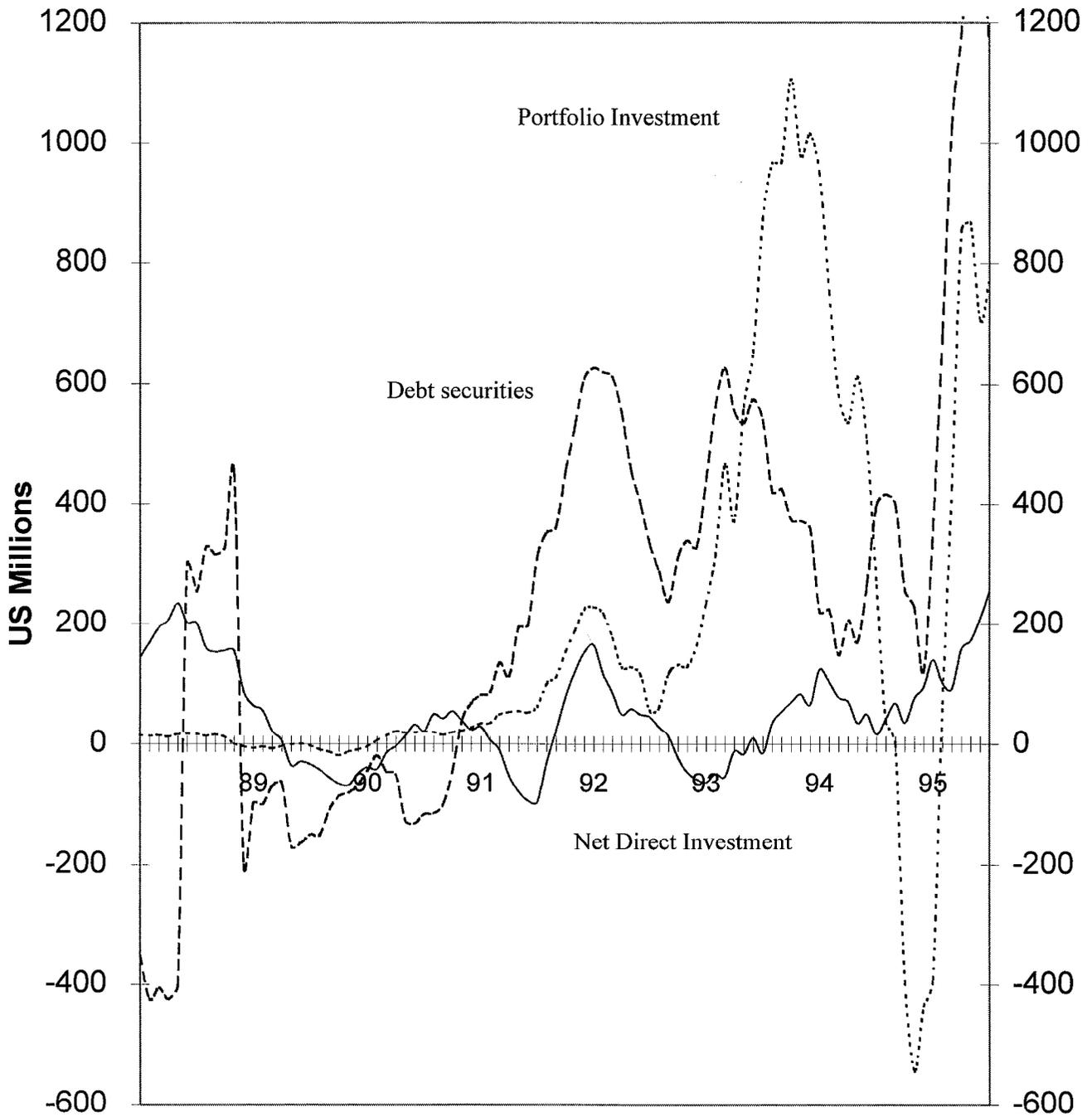
(In millions of U.S. dollars)

Period	1991	1992	1993	1994	1995
(a) Net direct investment	-408	1,268	-481	852	2,376
(b) Reinvested profits	365	175	100	83	200
(c) Equity securities and other funds	578	1,704	6,651	7,280	2,294
(d) Debt securities and loans	2,368	5,761	5,866	3,713	9,113
(e) International organizations, and government agencies	-4,131	-3,425	-2,909	-1,908	-2,227
(f) Short-term capital and others	-2,901	1,033	-1,623	-2,054	17,554
(g) = (a)+(b)+(c)+(d)+(e)+(f) = Financial Account in the <i>IFS</i>	-4,129	6,516	7,604	7,965	29,310
(h) Arrears, other short-term liabilities and exceptional financing	-19	18,755	2,511	6,329	510
(g)+(h) = (i) Capital Account in <i>Boletim do Banco Central</i>	4,148	25,271	10,115	14,294	29,820

Sources: Central Bank of Brazil, *Boletim do Banco Central*, *International Financial Statistics*, International Monetary Fund, and Fund staff calculations. See Cardoso (1997).

Figure 1 shows the composition of capital flows. It illustrates the declining share of medium- and long-term capital flows (lines d and e in Table 1) and the growing importance of short-term capital (lines c and f) in total private capital flows. Figure 1 also shows that the share of net direct investment (including reinvested profits, lines a and b in Table 1) in total private capital flows oscillated between 1991 and 1995. Net direct investment, as a share of private capital flows, declined from 22 percent in 1992 to a negative 5 percent in 1993, increasing to 11 percent in 1994, and falling to 9 percent in 1995.

Figure 1: Composition of Capital Flows: Brazil



Source: Banco Central do Brasil

At the end of 1994, Mexico's financial crisis led to an immediate cutback in capital flows to emerging markets. During the fourth quarter of 1994 and the first quarter of 1995, the net flow of capital to Brazil was insufficient to finance the current account deficit, and the central bank lost reserves of about \$9.8 billion. When the crisis erupted, the initial reaction of investors suggested that the Mexican financial crisis would compromise all emerging markets, as stock prices plunged, particularly in Argentina and Brazil; currencies weakened in developing countries from Thailand to Bulgaria, and foreign portfolio investment disappeared. The IMF joined the United States in a rescue operation under which the United States committed \$20 billion from its Exchange Stabilization Fund and the IMF pledged \$17.8 billion to support Mexican reforms. This infusion of capital successfully insulated financial markets from the crisis and soon capital also returned to Brazil. At the end of 1995 net capital flows were close to \$30 billion and in 1996 net flows again exceeded \$29 billion. In 1996, a boom in mergers and acquisitions led to an increase in foreign direct investment, which amounted to \$8 billion while the sum of equity investment and short-term capital fell from \$20 billion to approximately \$17 billion.

B. Determinants of Capital Flows

Calvo, Leiderman, and Reinhart (1996) divide the factors that encourage or inhibit capital flows into external and internal factors. The most important external factor is world interest rates. Short-term interest rates in the United States declined steadily in the early 1990s and the recessions in the United States and Japan made profit opportunities in developing countries more attractive. Agénor and others (1997) find that variance decompositions indicated that world interest rate shocks explain a large component of medium-term fluctuations in capital inflows in Brazil.

On the internal side, factors that attract capital flows include sound monetary and fiscal policies and market-oriented reforms, such as trade and capital market liberalization. Inflation stabilization reduces risks and stimulates capital inflows. Yet, Fernández-Arias and Montiel (1995) conclude that formal evidence indicates that falling interest rates in advanced economies have played a dominant role in driving capital to developing countries and that flows were not restricted to countries with good reform records.

Finally, there are contagion effects. Capital flows to a couple of countries in a region generate externalities to neighboring countries and an external crisis in one country may spread to others.

This section investigates if the conclusions above apply to Brazil. The OLS regression controlling for heteroscedasticity and serial correlation is:

$$nf = \frac{NF}{GDP} = \beta_0 + \beta_1(i - Ee) + \beta_2i^* + B X + \epsilon, \quad (1)$$

where nf , i , i^* , Ee are the net capital flows as percentage of GDP, domestic interest rate, foreign interest rate, and expected devaluation, respectively, and X is a group of variables

including domestic variables such as inflation, government spending, the real exchange rate, a dummy for the Real Plan, and a variable for contagion effects, that is, a dummy for the Tequila effect. The data is described in Appendix IV and results are summarized in Table 2.

Table 2. Dependent Variable: Ratio of Monthly Total Net Private Capital Flows to GDP (nf)
Period: January 1988-December 1995

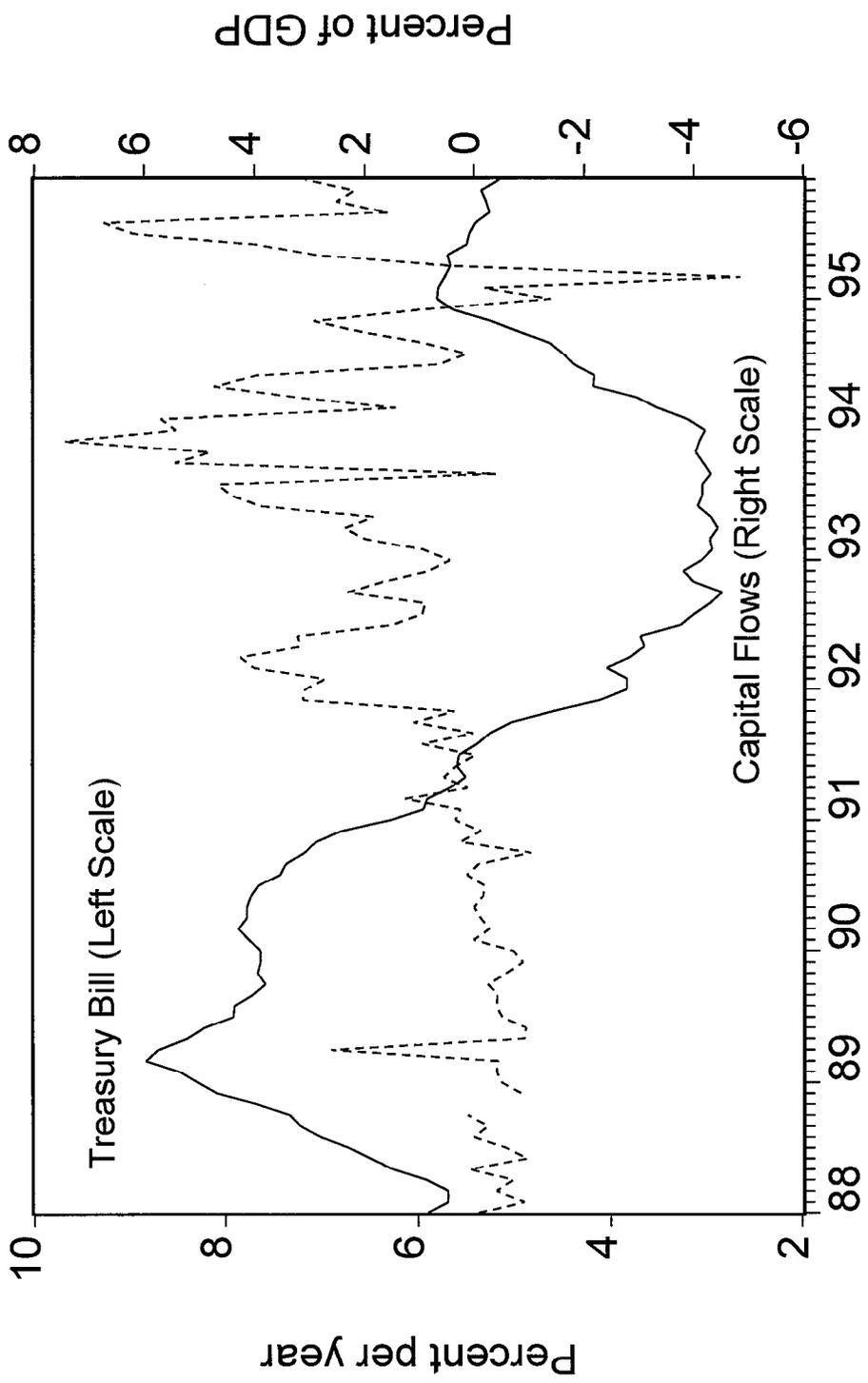
Constant	4.97 (8.35)	4.78 (7.75)	3.87 (3.52)
i*	-0.66 (-7.14)	-0.66 (-7.08)	-0.65 (-6.60)
i-Ee	0.07 (2.30)	0.06 (2.08)	0.08 (2.30)
Tequila dummy	-3.41 (-2.79)	-4.26 (-3.21)	-4.34 (-3.28)
Real Plan dummy		1.04 (1.84)	1.41 (1.49)
Inflation rate			0.02 (1.18)
Ratio of government spending to GDP			1.56 (0.56)
Real exchange rate deviation from equilibrium rate			-0.93 (-0.85)
Adj. R-squared	0.44	0.46	0.46

Notes: i* is the interest rate on U.S. Treasury bills and i-Ee is the interest rate on Brazilian government bonds deflated by expected devaluation. Standard errors are corrected by Newey-West heteroscedasticity and autocorrelation consistent covariance matrix.

As predicted by theory, the coefficient of the international interest rate is negative and significant. This result is consistent with evidence for Latin America in Calvo and others (1993), and with evidence for developing countries in Fernández-Arias and Montiel (1995). This negative relationship is illustrated in Figure 2. The result is robust across specifications and to using either returns on U.S. Treasury bills or yields on 10-year Treasury bonds.

The dummy for the Tequila months is significant, as expected from the contagion effects reported during the Mexican crisis. The coefficient of the domestic interest rate adjusted for expected depreciation is positive as predicted. The coefficients of other domestic factors do not help in explaining capital flows to Brazil. The coefficients of the dummy for the

Figure 2: Treasury Bill Rates and Capital Flows



Source: Banco Central do Brasil and IFS.

Real Plan and the coefficient of the real exchange rate are insignificant. The coefficients of the inflation rate and of expenditures have a different sign than expected. We interpret the results as evidence in favor of *push* effects as opposed to *pull* effects in explaining the recent surge in capital flows.

Appendix I presents additional results using different sample periods and different data (primary flows data from Loanware and Bondware) and checks the effects of the factors above in the composition of flows. The main conclusion above holds for these samples as well. It should be noted, however, that the above results, as well as most of the analysis in the literature on capital flows, do not consider the effect of capital controls. The next section introduces capital controls into the analysis.

C. Capital Controls

The currency of Brazil is the real (R\$) and the central bank sets an adjustable band for the dollar value of the real and maintains a continuing crawling peg within it, while the National Monetary Council is responsible for formulating the overall foreign exchange policy. Regulations on capital outflows and capital inflows differ. Brazilian banks are permitted to sell foreign exchange to Brazilian investors in the Common Market of the South, or Mercosur countries but, outward capital transfers not included in public regulations need prior authorization from the central bank.

Portfolio investment by foreign investors is restricted to two classes of fixed-income funds, and foreign investment in the Brazilian capital market may be made through one of the five alternatives established under National Monetary Council Resolution 1289. Special regulations govern borrowing abroad. Payments for current invisibles not covered by current regulations require approval from the central bank's exchange department. Remittances abroad of income from foreign direct investment and remittances in respect of royalties and technical assistance require prior registration of the foreign capital concerned, including reinvestment, and the contracts for patents and trademarks with the department of foreign capital of the central bank.

Capital inflows in the form of financial loans require prior approval from the central bank. Proceeds of foreign borrowing are subject to a financial transaction tax with rates that range from 5 percent for loans with maturities under 3 years to zero percent for loans with maturities over 6 years. Otherwise, inward transfers are unrestricted, although use of the proceeds for the acquisition of certain domestic assets are restricted. Remittances of interest on loans and credits and of related amortization payments are permitted freely in accordance with the terms stipulated in the respective contract and recorded in the certificate of registration. Purchasers of foreign exchange for some current invisibles are subject to the financial transaction tax of 25 percent.

Appendix II lists the monthly changes in taxes and restrictions on capital flows and on payments of invisibles from 1983 to 1995. The list also includes other changes in legislation that affect payments abroad used to circumvent legislation on capital flows. In the 1980s, following the debt crisis, controls on capital outflows were the norm. With the capital surge of

the early 1990s, controls on outflows were lifted and controls on inflows were increased before the Mexican financial crisis and then reduced after the crisis induced an increase in capital outflows. Controls are divided into two types: restrictions on inflows and restrictions on outflows.

The changes in legislation listed in Appendix II are used to build indicators of restrictions on inflows and outflows and composite indicators as well. The first indicator is a measure of restrictions on inflows and defined as ΔRI . A change in legislation that is directed at reducing capital inflows, such as an increase in the financial tax on capital inflows, receives a value equal to 1 and a change in legislation that is directed at increasing capital inflows, such as a reduction of the financial tax on capital inflows, receives a value of -1. Each month the changes in legislation affecting capital inflows are added to obtain the total value of changes in legislation affecting capital inflows in that month, ΔRI .⁴

Between January 1983 and December 1995, monthly ΔRI varied between -3 and 3. The average number of changes in restrictions on capital inflows per month during the whole 1983-1995 period was -0.051, characterizing a trend of liberalization of restrictions on capital inflows.

The second indicator measures changes in restrictions on capital outflows, ΔRO . Any change in legislation that is aimed at reducing capital outflows, such as introducing new restrictions on payments of debt amortization by public enterprises, receives a value of 1. Any change in legislation that liberalizes capital outflows, such as an agreement for the elimination of arrears, receives a value of -1. By adding up the changes in restrictions on capital outflows in a month we obtain ΔRO . Between January 1983 and December 1995, monthly ΔRO varied between 1 and -3. The average number of changes in restrictions on capital outflows per month during the whole 1983-1995 period was -0.045, characterizing a trend of liberalization of restrictions on capital outflows.

This paper also uses overall measures of capital controls composed by both type of restrictions. Restrictions on inflows potentially reduce capital inflows and thus potentially reduce net capital inflows. In the calculation of an overall measure of restrictions on net flows, changes in restrictions on capital inflows, ΔRI , are thus recorded as a positive restriction on net flows. Restrictions on capital outflows, however, have two potential effects on net flows. First, they reduce officially registered outflows and thus potentially increase total net flows. But foreign investors will perceive restrictions on outflows as a threat to remitting abroad the returns of their investments. This policy, thus, can reduce inflows. The effect on net flows of restrictions on outflows will thus depend on the relative strength of the responses of outflows and inflows.

This section builds two composite measures of capital controls, $\Delta CC1$ and $\Delta CC2$, defined as linear combinations of changes in restrictions on inflows and outflows. Both

⁴The index series of restrictions on inflows (RO) and restrictions on outflows (RI), as well as their composite, CC1 and CC2, can be obtained directly from the authors on request.

composite measures allow for opposite responses of capital outflows and capital inflows to changes in ΔRO by setting the weight given to ΔRO to one half.⁵ The first overall measure, $\Delta CC1$, assumes that restrictions on outflows have a bigger impact on outflows than on inflows:

$$\Delta CC1 = \Delta RI - 0.5\Delta RO \quad (2)$$

Figure 3 shows changes in the composite indicator of capital controls, $\Delta CC1$, between January 1983 and December 1995. $\Delta CC1$ varies between -3.5 and 6.5, averaging -0.029 per month during the whole period.

The second overall measure assumes that the impact on capital inflows of restrictions on capital outflows dominates the effect of these restrictions on outflows:

$$\Delta CC2 = \Delta RI + 0.5\Delta RO \quad (3)$$

Between 1983 and 1995, $\Delta CC2$ varied between -3 and 6.5, averaging -0.073 per month during the whole period.

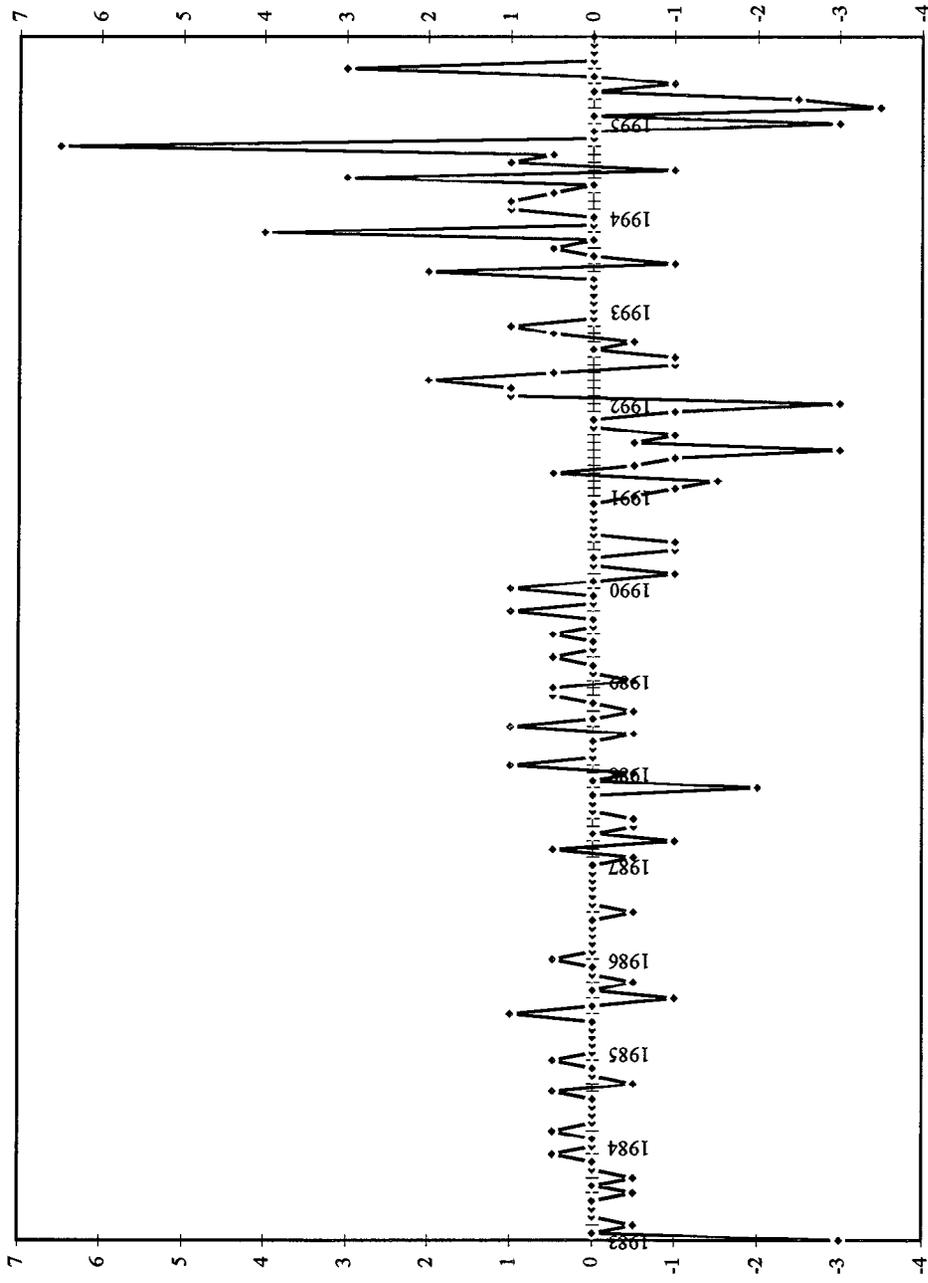
Does a reduction in controls over capital outflows and an increase in controls over capital inflows actually reduce net capital flows in a significant way? Are controls just an ineffective reaction of authorities to capital flows, that is, are restrictions on capital outflows relaxed and capital controls on inflows increased when there is a surge in inflows? Which effects are more important?

Between January 1988 and December 1995 there is a positive correlation (equal to 0.34) between total net monthly private capital flows and changes in capital controls on net flows in Brazil, $\Delta CC1$. This is explained by a positive correlation (0.33) between ΔRI and capital flows and a negative correlation (-0.09) between ΔRO and flows. Such correlations could be interpreted as a first intuitive result indicating that controls are ineffective in reducing capital flows.

Changes in controls are introduced in the OLS regressions from the previous section. Most of the previous results are confirmed, relative returns and contagion effects are important. The coefficients on capital controls are positive and significant (Table 3). This result would reject the hypothesis that capital controls reduce capital inflows and would

⁵ It is not trivial, in the present context, to estimate the weight that should be assigned to ΔRO . The OLS regressions in the next section show that the effect of ΔRO on net capital flows is positive (implying that ΔRO should have a negative weight in the composite measure of controls). But the next section will argue that the positive coefficients in the OLS equations are the result of reversed causality. The VAR results in the last section suggest that the weight of ΔRO in the composite measure should be negative as it is the measure defined as $\Delta CC1$.

**FIGURE 3: Changes in Restrictions on Capital Flows,
Brazil, January 1983 - December 1995**



Source: International Monetary Fund

suggest that the reaction of capital controls to flows is important. The next section explores the endogeneity of controls.

Table 3. Dependent Variable: Ratio of Total Net Capital Flows to GDP
Period: January 1988-December 1995

Constant	4.85 (8.28)	5.08 (8.09)	4.92 (8.48)	4.81 (8.06)
ΔRI	0.37 (2.54)			
ΔRO		0.31 (1.21)		
$\Delta CC1$				0.33 (2.26)
$\Delta CC2$			0.39 (2.86)	
i^*	-0.64 (-6.97)	-0.67 (-6.91)	-0.65 (-7.08)	-0.36 (-2.91)
$i-Ee$	0.07 (2.31)	0.08 (2.41)	0.08 (2.40)	0.07 (2.21)
Tequila dummy	-2.64 (-2.52)	-3.56 (-2.73)	-2.71 (-2.48)	-2.66 (-2.60)
Adj. R-squared	0.47	0.43	0.48	0.46

Notes: ΔRI is the increase in restrictions on capital inflows, ΔRO is the increase in restrictions on capital outflows, $\Delta CC1 = \Delta RI - 0.5 \Delta RO$; $\Delta CC2 = \Delta RI + 0.5 \Delta RO$; i^* is the interest rate on U.S. Treasury bills, and $i-Ee$ is the interest rate on Brazilian government bonds deflated by expected devaluation. t-statistics are in parentheses. Standard errors are corrected by Newey-West heteroscedasticity and autocorrelation consistent covariance matrix.

D. Endogeneity of Capital Controls

This section assumes that domestic and foreign economic agents compare expected relative returns on domestic and foreign assets and restrictions imposed by different types of controls. Thus, we can write that total net private capital flows, NF , respond to expected returns, ER , and to changes in net capital controls, ΔCC :

$$NF = aER - b\Delta CC + \varepsilon, \quad (4)$$

where ε is a random error.

Capital controls are endogenous. The policy reaction function reflects the effect of capital flows on the creation or withdrawal of new controls. With large capital inflows governments tend to impose controls to avoid real exchange rate appreciation, money expansion from accumulating reserves, or increasing debt from sterilization policies, and to react to excessive inflows by taxing some forms of capital inflows and imposing other forms of restrictions. On the other hand, controls on capital outflows are imposed in moments of distress, when there is a shortage of external financing, and authorities respond to a decline in net flows by restricting outflows and creating incentives to inflows. Thus, restrictions on net inflows respond positively to net capital inflows:

$$\Delta CC = hNF + v, \quad (5)$$

where v is a random error.

Substitution yields:

$$NF = \alpha ER + v, \quad (6)$$

and:

$$\Delta CC = \beta ER + \mu, \quad (7)$$

where:

$$\alpha = a/q, \quad \beta = ha/q, \quad v = (\varepsilon - bv)/q, \quad \mu = (v + h\varepsilon)/q, \quad \text{and } q = (1 + bh).$$

Observe that in the reduced form (6) the effect of expected returns on net capital flows, α , would be unaffected by the introduction of controls (i.e., $q=1$ and $\alpha = a$) if either capital controls can be avoided (b is zero), or if capital controls are not endogenous (h is zero). But the response of capital flows to expected returns would appear to be smaller than it is--the smaller q --the bigger the combined effect of capital controls on capital flows and the response of controls imposed by the authorities if inflows increase. Assume there is a decline in foreign interest rates. The increased relative expected return on domestic assets increases capital inflows. If the authorities respond immediately by increasing controls and controls bite, the increase in capital inflows is reduced and the effect of the decline on foreign interest rates would appear smaller than it is in fact.

Also observe that the covariance between net capital flows and capital controls depends on the relative size of b , the coefficient of capital controls in the equation that determines net flows, and h , the coefficient of net flows on the equation that determines changes in capital controls:

$$\text{cov}(NF, \Delta CC) = \alpha\beta\text{var}(ER) + (h/q)\text{var}(\epsilon) - (b/q)\text{var}(v) \quad (8)$$

Equation (8) implies that the relationship between capital flows and capital controls can appear as positive or negative depending on the strength of different effects. For the given variance of the shocks v and ϵ , if capital controls are not endogenous and effective (b is big relative to h), the correlation between net flows and changes in capital controls will tend to be negative. But the correlation would tend to be positive if controls increase in response to an increase in capital inflows, but are not effective (h is big in relation to b).⁶

The positive correlations between capital flows and capital controls reported in the previous section were interpreted as a first intuitive signal that evidence may support the hypothesis that one direction of causality runs from capital flows to capital controls. It also warns against using capital controls as exogenous variables in OLS regressions. The positive coefficients found in the regressions reported in Table 3 are also consistent with the hypothesis that the positive response of controls to flows dominates the negative effect controls may have on flows. Furthermore it also implies that the coefficients in the OLS regressions are biased downwards.

The government reaction function to capital flows can be estimated through a reverse regression using expected returns as instruments to capital flows. Table 4 shows the results of two-stage least squares regressions that use foreign interest rates and domestic returns in dollars as instruments for net foreign flows in regressions relating net flows to capital controls. The regressions include the dummy variables, ANNEX and Real Plan, to control for the change in regime with the introduction of Annex IV legislation in 1991 and the Real Plan in 1994, respectively. The regressions show that an increase in net flows increases controls. The coefficient of net foreign capital flows is always positive and significant (consistently, the coefficient in the ΔRO regression is negative).

The regressions in Table 4 show that the authorities react immediately to an increase in net flows. But it is possible that when they react they look not only at the last observed monthly inflow but also at the behavior of capital flows during the previous 3 to 6 months. Table 5 shows the results of regressions in which accumulated lagged capital flows appear as the independent variable determining capital controls. The coefficient of these accumulated lagged flows is positive and significant in all regressions. The independent variables are the lagged average net flows during the previous 3, 4, 5, and 6 months. Observe that the response of controls increases as the period of observation increases, indicating that sustained increases in net flows will meet with a stronger policy response than would a single event. This section

⁶ Also, for given structural coefficients, if the independent shocks to capital flows (ϵ) are relatively more important than the independent shocks to capital controls (v), then we would tend to observe a positive correlation.

thus finds strong evidence that net capital flows strongly influence policy decisions on implementing or reducing restrictions on capital flows.

Table 4. Dependent Variable: Change in Capital Controls
 Period: January 1988-December 1995
 Instruments for Net Capital Flows are i^* , $i-E(e)$, and the Tequila Effect

Dependent Variable	$\Delta CC1$	$\Delta CC2$	ΔRI	ΔRO
Constant	0.20 (1.78)	0.16 (1.21)	0.18 (1.52)	-0.04 (-0.78)
nf	0.56 (5.85)	0.42 (5.35)	0.49 (6.04)	-0.14 (-2.23)
Annex	-1.48 (-5.49)	-1.33 (-5.31)	-1.4 (-5.85)	0.15 (0.78)
Real Plan	0.32 (0.52)	0.35 (0.88)	0.33 (0.68)	0.03 (0.10)

Notes: ΔRI is the increase in restrictions on capital inflows, ΔRO is the increase in restrictions on capital outflows, $\Delta CC1 = \Delta RI - 0.5\Delta RO$; $\Delta CC2 = \Delta RI + 0.5\Delta RO$; i^* is the interest rate on U.S. Treasury Bills; $i-Ee$ is the interest rate on Brazilian government bonds deflated by expected devaluation, and nf are the net private capital flows; t-statistics in parentheses.

Table 5. Dependent Variable: Controls
 Period: 1988-1995
 (Constant not reported)

Dependent Variable	$\Delta CC1$	$\Delta CC2$
Average of nf(-1) to nf(-3)	0.17 (2.32)	0.13 (1.84)
Average of nf(-1) to nf(-4)	0.19 (2.51)	0.15 (1.92)
Average of nf(-1) to nf(-5)	0.20 (2.45)	0.14 (1.74)
Average of nf(-1) to nf(-6)	0.22 (2.46)	0.16 (1.80)

IV. FURTHER EVIDENCE FROM VECTOR AUTOREGRESSIONS

The evidence in the previous sections is indicative of the importance of capital controls in the analysis of capital flows. García and Barcinski (1996) argue that Brazil's restrictions on capital flows have not been effective in preventing the inflows of foreign capital to invest in the high-yield public debt. But, as much as in our previous sections, their results leave room for further investigation. The next section explores further the relationships between capital controls and capital flows in a Vector Autoregressive framework (VAR).

A. Controls and Total Net Flows

This section analyzes the effects of capital controls on capital flows in a Vector Autoregressive (VAR) framework. This framework permits inference of the dynamic response of flows to controls over time now that the previous sections have shown that there is an inverse causality running from flows to controls through a policy reaction function.

The estimated VAR takes into account the dynamic interactions between capital flows, capital controls, and interest differentials. Formally, we can express the system in a reduced form format:

$$X_t = B(L)X_{t-1} + \epsilon_t, \quad (9)$$

where X is the set of endogenous variables that includes capital flows (nf), changes in capital controls ($\Delta CC1$), and interest differentials ($i - E(e) - i^*$), and $B(L)$ a lag operator of order L .⁷

We are particularly interested in the effect of innovations of changes in capital controls on capital flows over time once the reverse effect is taken into account. The system above can be inverted and represented as a moving average of past shocks:

$$X_t = [I - B(L)L]^{-1} \epsilon_t, \quad (10)$$

where ϵ is a vector of reduced form residuals.

The objective is to graph the impulse response of structural shocks to our endogenous variables. In general, the reduced form residuals are a linear combination of the structural

⁷The optimal lag order was estimated using the Akaike criterium. In most of the VAR's estimated in this section the optimal lag was calculated as 4. In addition the empirical estimations have added a set of dummies to control for the Tequila and Real Plan effects.

innovations that can only be obtained once sufficient identifying assumptions are made. In our case, it is crucial to disentangle the simultaneous correlation of capital controls and flows.

The instrumental variables regressions in Table 4 indicate that capital controls react contemporaneously to capital flows. This section thus assumes that shocks to capital flows can potentially affect capital controls contemporaneously. In addition, this section assumes that capital flows do not react contemporaneously to capital controls, at least on a monthly basis. This is justified by the results obtained in the OLS regressions in Table 3 that show a positive relationship between controls and net flows indicating that the reverse causality of flows to controls dominates any immediate effect that controls can have on flows. The reasons for no contemporaneous response of capital flows to capital controls are the following. Investment projects may take more than one month to react to new legislation and part of the reaction of the capital market will be reflected in price movements. These assumptions make the system recursive in the following order: interest differentials, capital flows and capital controls. We can thus use the standard Cholesky decomposition to orthogonalize the reduced form residuals.

One could argue that the ordering should be the inverse, with capital flows reacting to controls contemporaneously but not vice-versa. This will be the case if one believes markets react very fast to controls (including FDI flows) but the authorities take time to implement a response to a change in capital flows. All the results described below are robust to reordering the variable shocks in this manner when using the Cholesky decomposition

The impulse responses using the components of capital controls are shown in Figures 4 and 5. The effects of ΔRO and ΔRI on capital flows have opposite signs. While shocks to ΔRI reduce capital flows, shocks to ΔRO increase them. These results indicate that $\Delta CC1$ is the appropriate controls measure where restrictions on outflows enter with an opposite sign to restrictions on inflows.

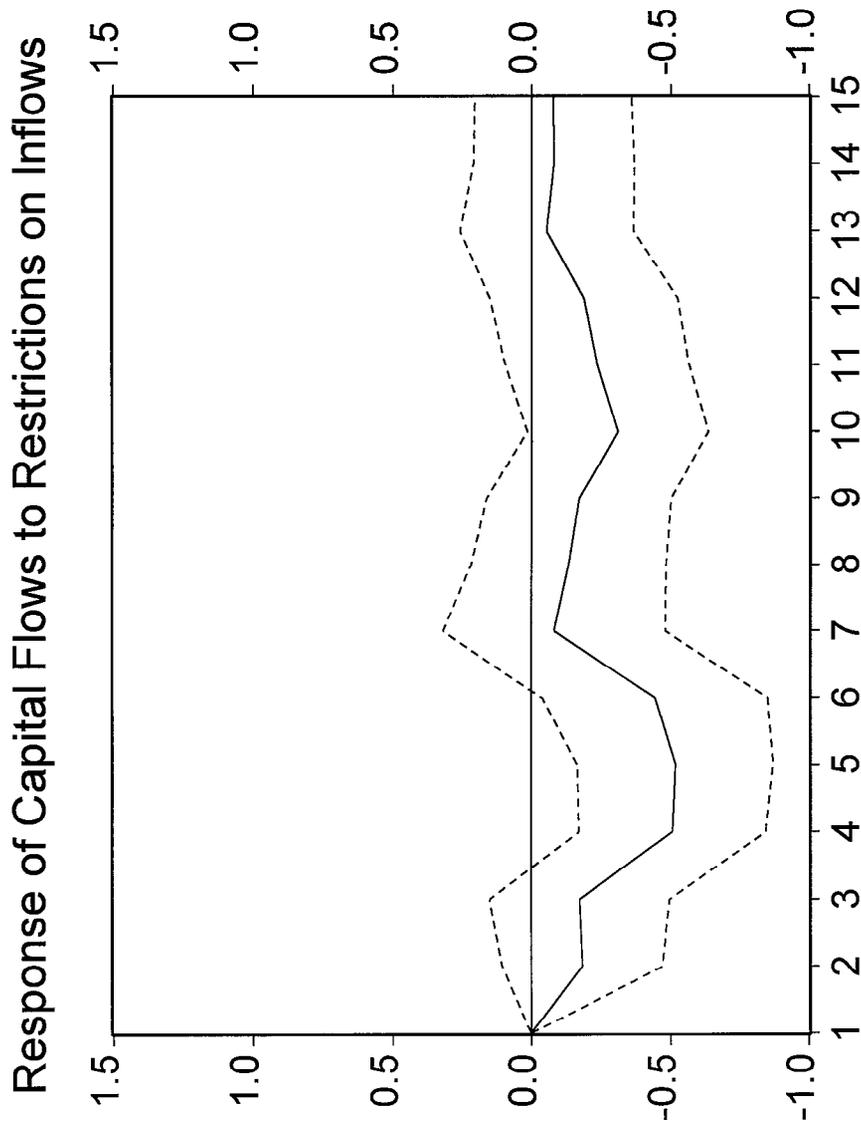
The impulse responses using $\Delta CC1$ are shown in Figure 6. The evidence shows that a permanent increase in controls (a shock to $\Delta CC1$) has a temporary negative effect on capital flows, with a peak five months after the increase and the effect fading out fast after the sixth month. This result implies that policy makers were able to change temporarily, but not permanently, the amount of capital flows to Brazil.

The impulse responses also show that capital flows have a positive effect on changes in capital controls. A boom in capital flows induces a permanent effect on controls (a temporary effect on the changes of controls in the first two months). This confirms the instrumental variable results from the previous section. In addition, as expected, an increase in interest differentials boost capital flows to Brazil.

The effectiveness of controls can also be gauged by analyzing the variance decomposition of the forecasted errors of capital flows. Capital controls explain almost 28 percent of total variance of capital flows after 15 periods, while interest differentials explain only 6.5 percent (Table 6).

Figure 4: VAR using Restrictions on Inflows

Response to One S.D. Innovations ± 2 S.E.



Response of Restrictions on Inflows to Flows

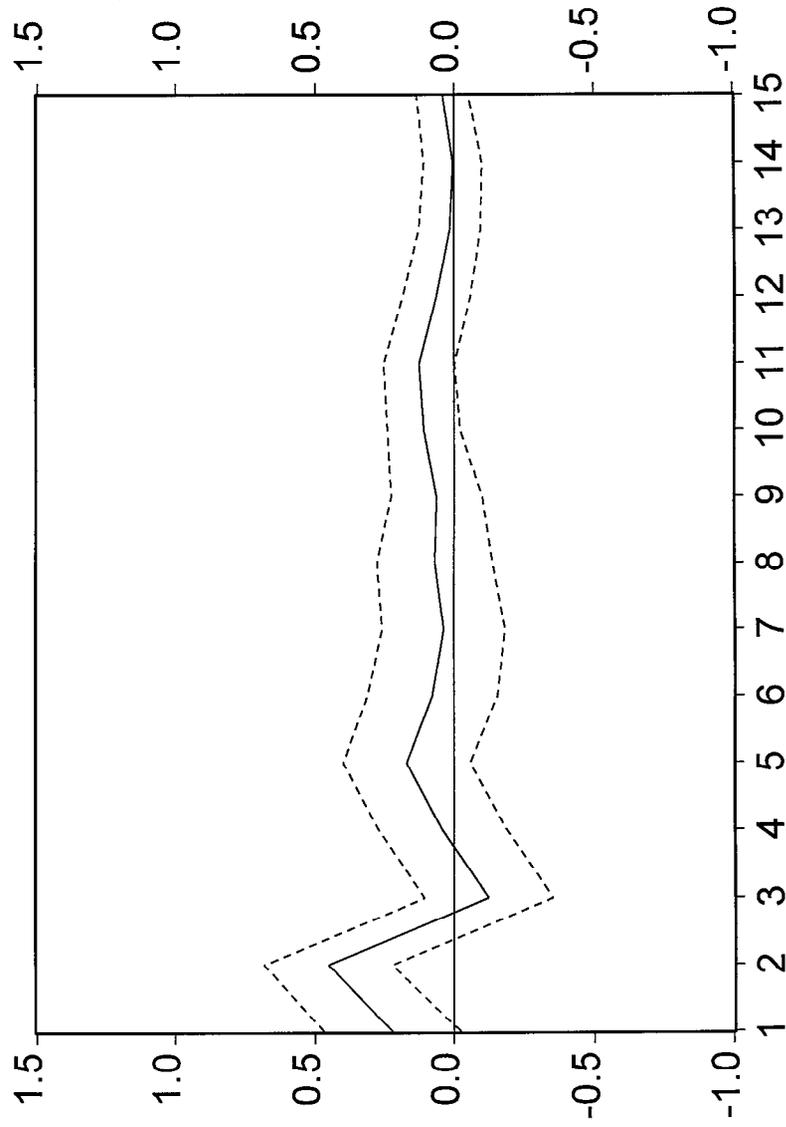


Figure 5: VAR using Restrictions on Outflows

Response to One S.D. Innovations ± 2 S.E.

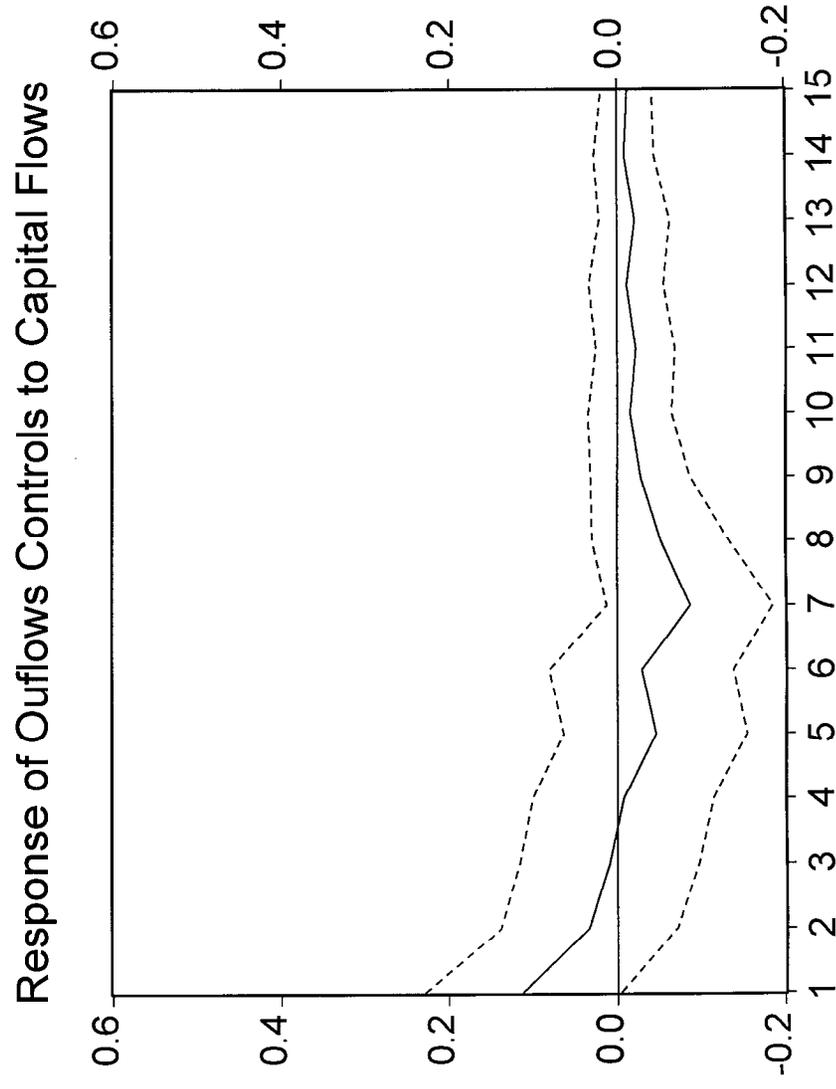
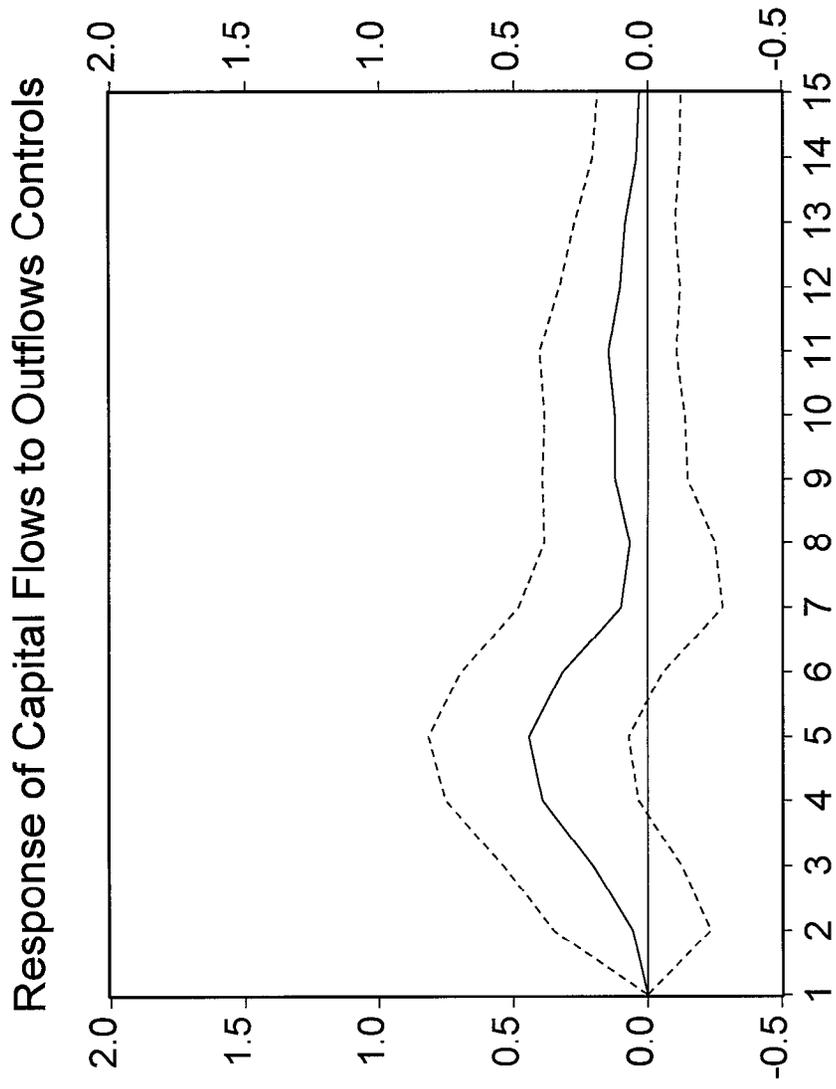


Figure 6: VAR using Controls
Response to One S.D. Innovations ± 2 S.E.

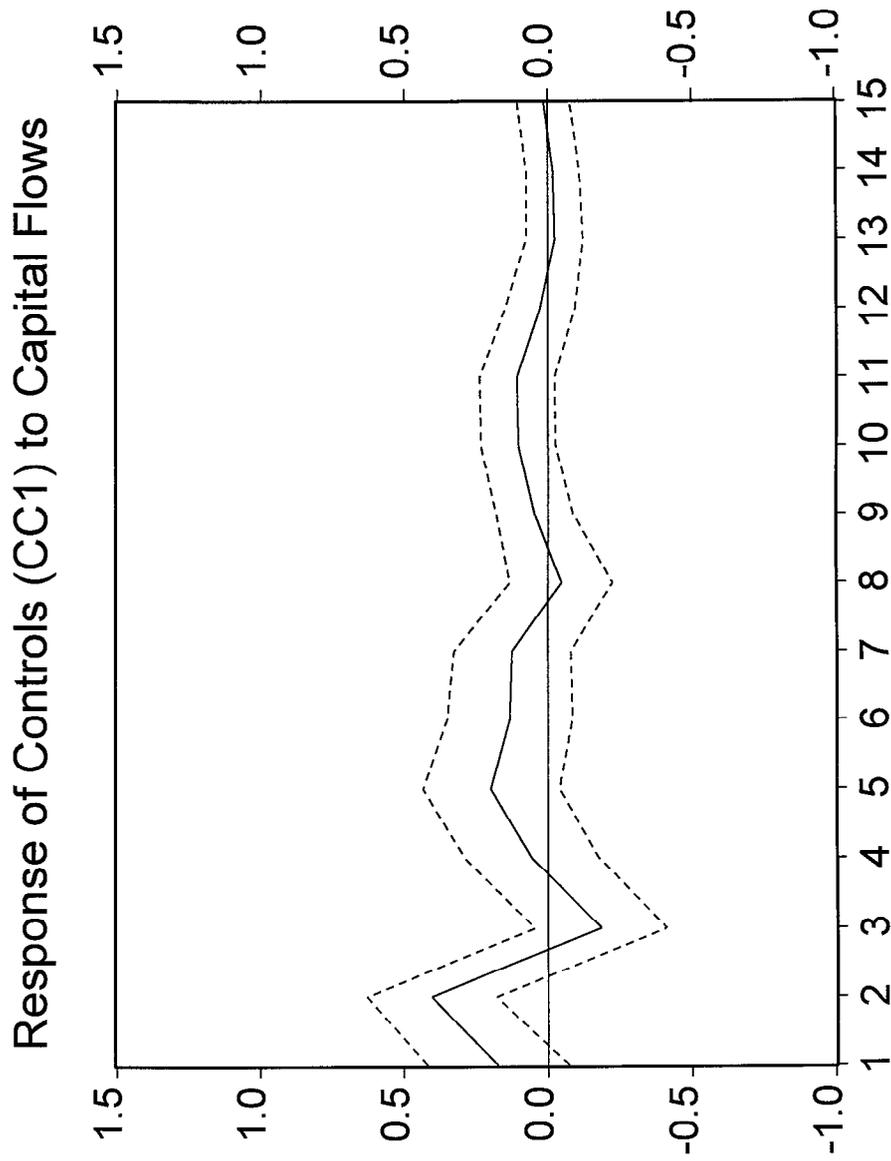
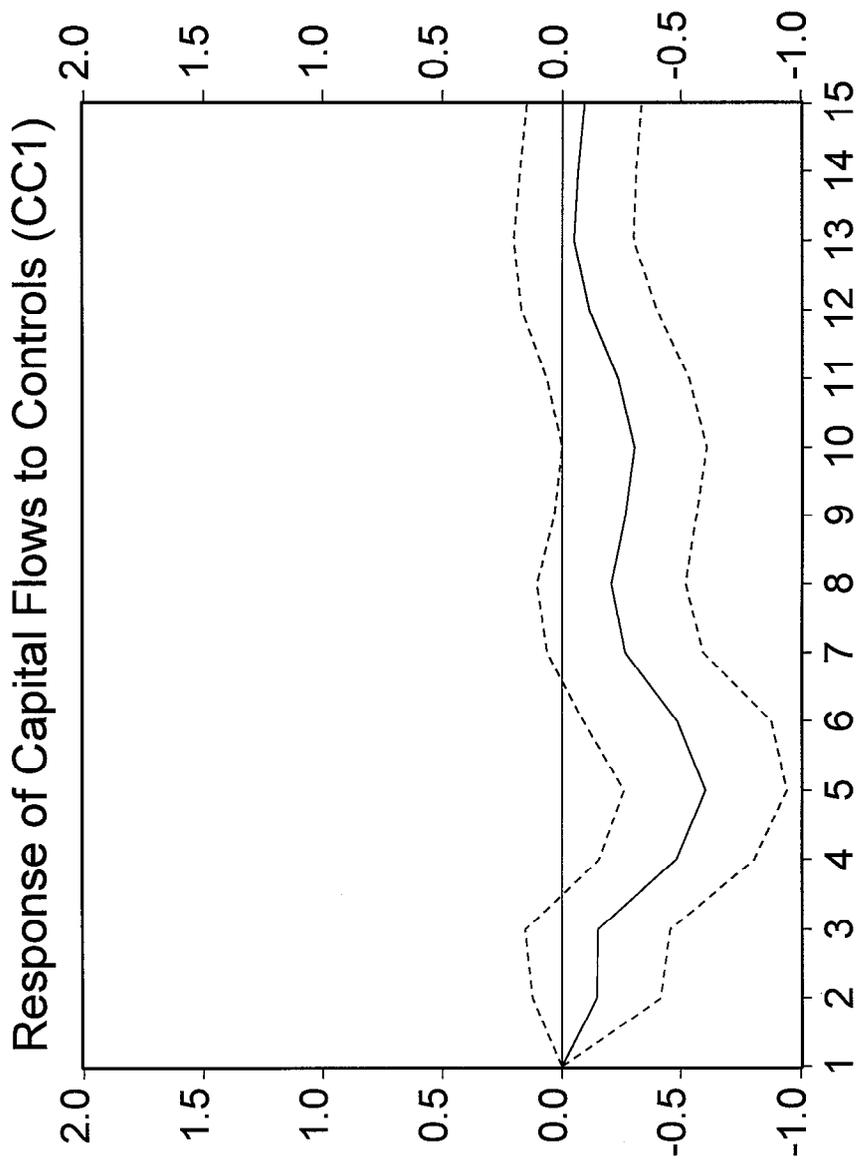


Table 6. Variance Decomposition of Capital Flows

Period	Forecasting Error of nf	Percentage attributed to $\Delta CC1$	Percentage attributed to nf	Percentage attributed to $i-E(e)-i^*$
1	1.203730	1.563098	98.05191	0.384990
2	1.423215	1.301870	94.99661	3.701523
3	1.530930	1.650398	93.72625	4.623349
4	1.639868	11.82882	84.12475	4.046434
5	1.766686	21.02420	74.62018	4.355625
6	1.835479	26.38333	69.53941	4.077260
7	1.875571	25.32275	70.22430	4.452946
8	1.907860	24.57291	70.06804	5.359048
9	1.933946	24.26400	69.39995	6.336045
10	1.961063	26.00287	67.75109	6.246041
11	1.986576	27.13729	66.54943	6.313274
12	1.998234	27.84834	65.87634	6.275316
13	2.000508	27.81296	65.78667	6.400378
14	2.001842	27.82971	65.69959	6.470701
15	2.004149	27.88063	65.55388	6.565488

The variance decomposition of capital controls shows that almost 20 percent of the variance of capital controls can be explained by reactions to shocks to capital flows. As expected, little is explained directly by interest differentials (Table 7).

B. Controls and the Composition of Flows

Most of the control measures implemented during the 1990s were not intended to reduce the overall flow of capital to Brazil but rather to change its composition. Controls were directed against equity and debt flows, suspected of higher volatility, while trying to reinforce incentives to net direct investments.⁸

This section investigates the effect of controls on the composition of flows and discusses the evidence of separate VAR's for each component of the capital flows. The results are shown in Figures 7, 8, and 9. A shock to controls reduces debt securities flows between the fourth and the seventh months after introduction but the effect slowly fades away. The same is true with portfolio investment. In contrast, net direct investment flows remain stable and are not affected by a shock to ΔCC . In other words, a permanent increase in controls reduces temporarily the proportion of debt and equity relative to net direct investment.

⁸Table 10 in Appendix I shows that this suspicion is unfounded, at least based on estimated coefficients of variation of the three aggregates. Net direct investment was more stable during the last five years and only slightly more stable during the whole period.

Table 7. Variance Decomposition of Capital Controls

Period	Forecasting Error of $\Delta CC1$	Percentage Attributed to $i-E(e)-i^*$	Percentage Attributed to nf	Percentage Attributed to $\Delta CC1$
1	1.079158	0.026848	2.563462	97.40969
2	1.165686	1.716712	14.10603	84.17726
3	1.181754	1.871907	16.14342	81.98467
4	1.212708	1.777683	15.53215	82.69017
5	1.246686	4.560536	17.17321	78.26626
6	1.255428	4.741208	18.03469	77.22410
7	1.263243	4.853373	18.76243	76.38420
8	1.275088	5.467750	18.54992	75.98233
9	1.283901	5.520693	18.42165	76.05766
10	1.293778	5.627142	18.75923	75.61363
11	1.298784	5.680307	19.27598	75.04371
12	1.300532	5.861304	19.26517	74.87353
13	1.302401	5.844983	19.24474	74.91028
14	1.307080	5.898993	19.12518	74.97583
15	1.308675	5.922094	19.08979	74.98811

In contrast, the government reaction function seems to be driven solely by equity securities flows. Higher debt or net direct investment flows have no effect on controls. The combination of the results above shows an asymmetry. While debt flows are largely affected by capital controls, the government control function does not react to debt flows. One hypothesis is that government targets mainly equity flows but the effect of controls spill over to debt flows.

C. Robustness of the Results

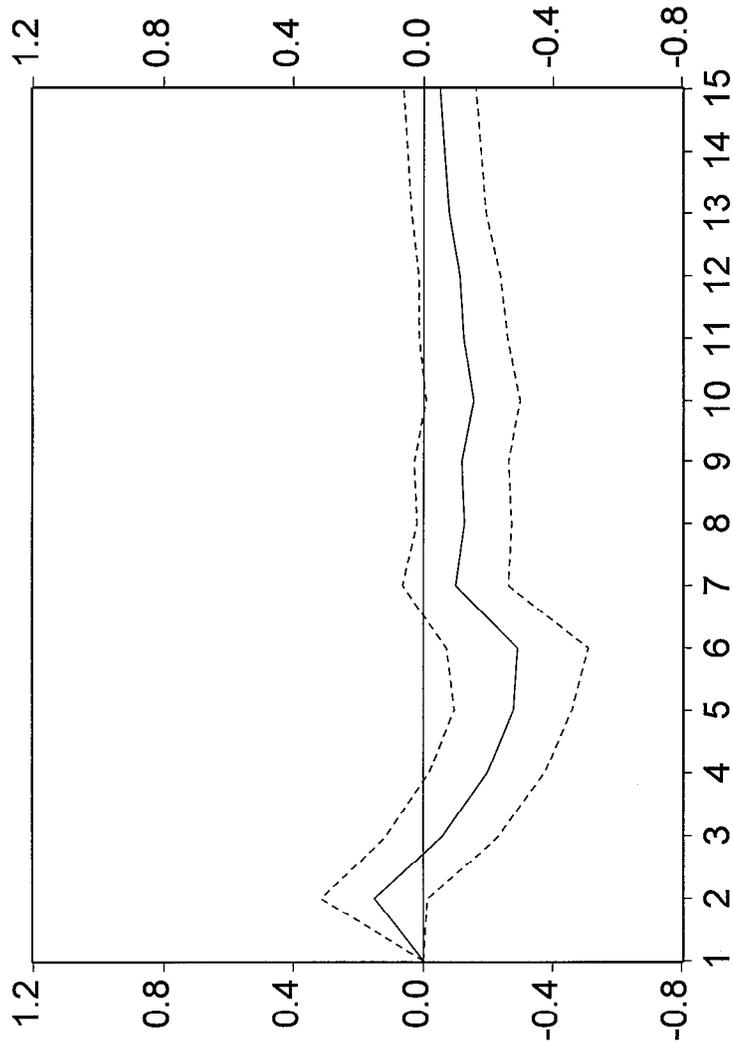
One of the main shortcomings of the previous section is that monthly data flows to Brazil do not report very short-term flows. This may bias our results to downplay the effectiveness of controls (although the previous section has already found a temporary effect).

As a first approach to this limitation, this section checks how robust the results of the previous section are by substituting the information on net capital flows with information on gross primary flows. These data include bonds, equities, and syndicated loans issued by Brazilian entities in international markets (mainly New York and London but increasingly global). The data is compiled by Dataware and published by Loanware and Bondware. Primary flows are useful because they are primary (not including transactions in the secondary market), gross (they do not account for nonresident purchases of Brazilian securities in Brazil and amortization and purchases of securities by Brazilian residents from nonresidents) and do include short-term flows.

Figure 7: VAR using Debt Flows

Response to One S.D. Innovations ± 2 S.E.

Response of Debt Flows to Controls



Response of Controls to Debt Flows

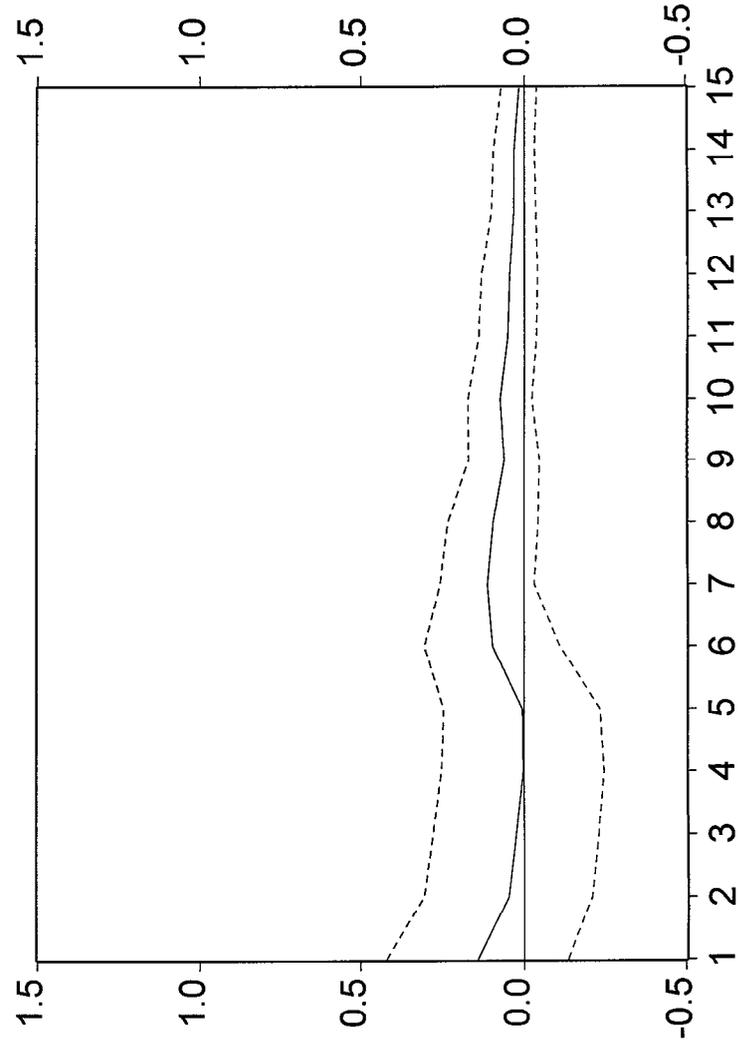


Figure 8: VAR using Portfolio Flows
Response to One S.D. Innovations ± 2 S.E.

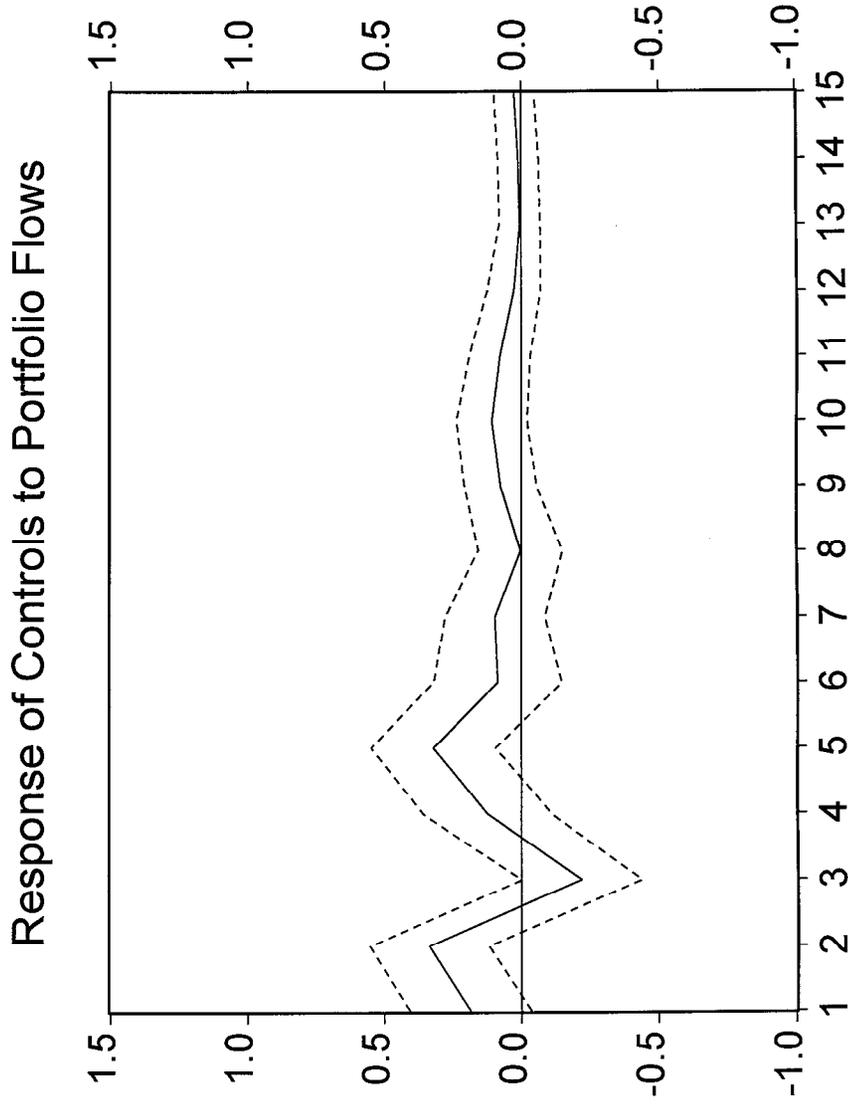
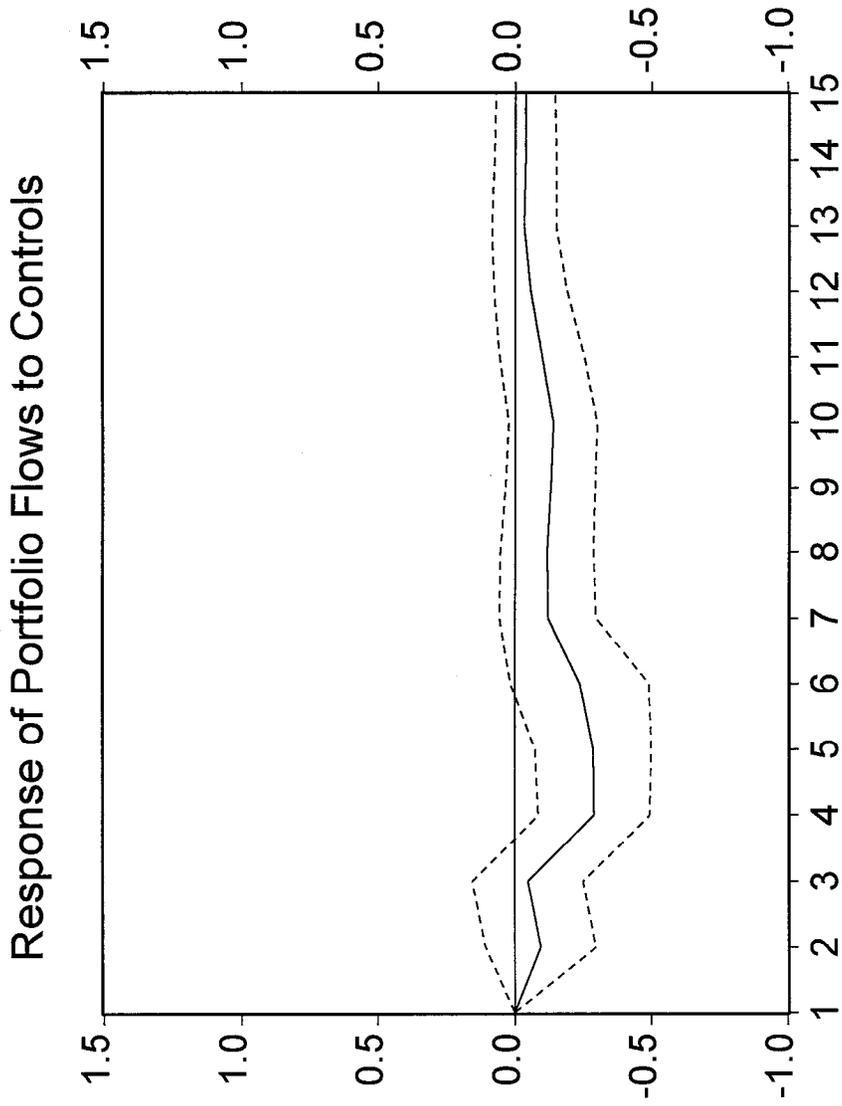
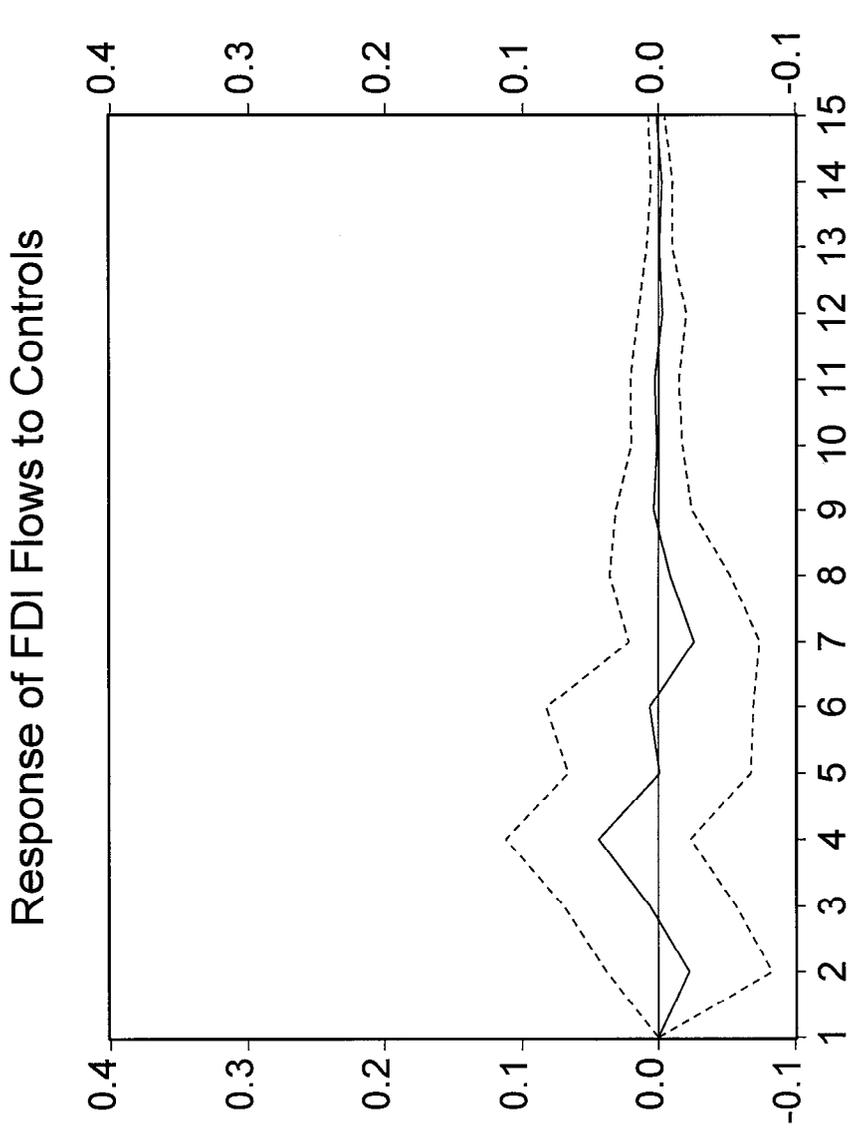
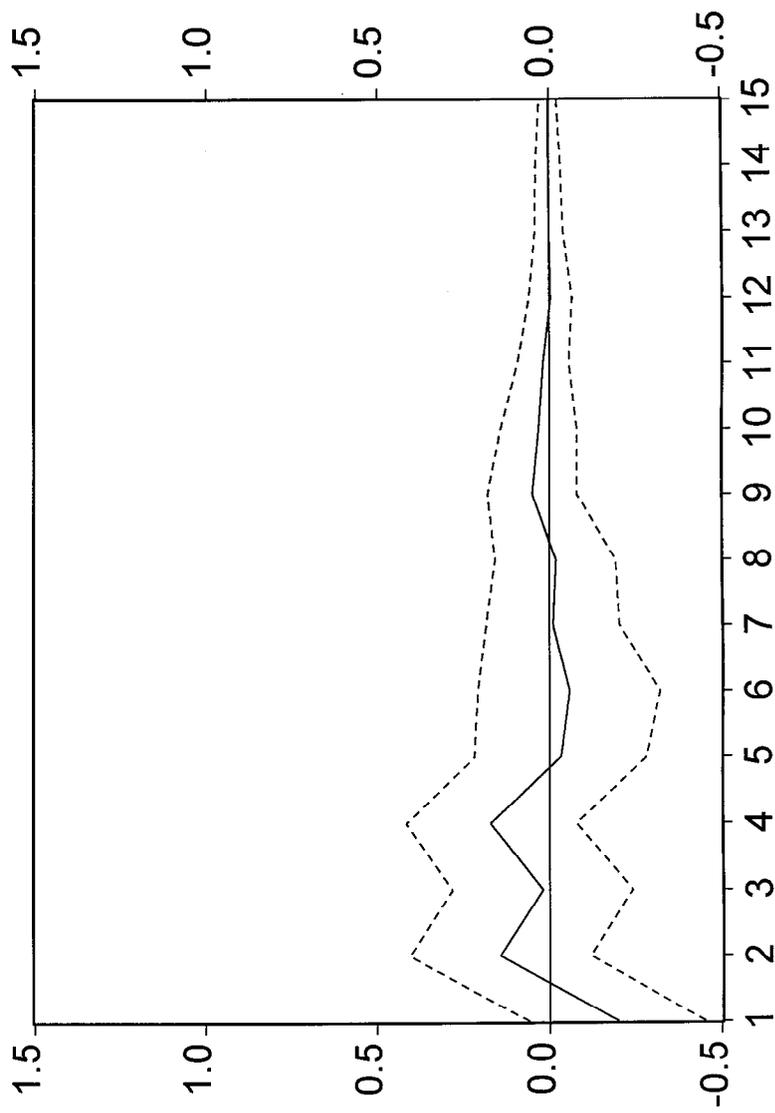


Figure 9: VAR using FDI Flows

Response to One S.D. Innovations ± 2 S.E.



Response of Controls to FDI Flows



The impulse response for primary flows confirms the results from the previous section. Capital flows are negatively affected by controls within the first six months but the effect slowly disappears thereafter. Similarly, capital controls react immediately (2-4 months) to a shock in capital flows.

The results above are surprising since one would expect capital controls to have less effect on primary flows involving assets that are negotiated and liquidated out of Brazil (although the Central bank may still impose control on remittances).

Another approach is to replicate the exercise using quarterly data that include short term flows.⁹ The capital flows data are obtained from the financial account of the balance of payments published by the IMF and the interest differential is borrowed from estimates in García and Barcinsky (1996). The measure of capital controls is the quarterly average of the monthly indicator. The results confirm that the effect of controls on capital flows is strongest at two quarters and slowly fades after that. In contrast to monthly results, capital controls react within the first three quarters, instead of the first two months.

V. Conclusions

Most of the empirical results in the literature on the determinants of capital flows to developing countries are derived without introducing an empirical measure of capital controls. This is at odds with the reality of many countries where capital controls are widespread and potentially may affect the level and composition of flows. Furthermore, capital controls cannot be treated as exogenous in determining capital flows. Using the case of Brazil, this paper introduces an empirical measure of capital controls and argues that the government sets capital controls taking into account capital flows.

The paper finds that capital flows and controls are positively correlated in simple OLS regressions where foreign interest rates and contagion effects appear as the main determinants of capital flows to Brazil. Using these as instruments, the paper estimates the government reaction function and finds that government reacts strongly and positively to capital flows by changing control measures.

Having established the endogeneity of controls, the paper estimates a structural VAR and derives impulse responses to check the effectiveness of controls. The paper finds that capital controls are effective in the short run but have no lasting effects. VAR impulse responses provide evidence that controls indeed reduce flows and change its composition away from equity and debt, for about six months. The causality runs in both directions, capital controls react to capital flows within two months. The results are robust to using different data sets and different frequencies.

⁹There are fewer data points in the quarterly exercise.

ADDITIONAL EVIDENCE FROM OLS REGRESSIONS

A. Total Net Flows After 1991

García and Barcinsky (1996) argue that "...1991 represents a major mark in terms of Brazilian integration in the world financial markets with the liberalization of portfolio flows through the creation of the Annex IV legislation and several other measures." Table 8 shows results using only the data in the subsample 1991-1995. To explain the increase in relative importance of domestic returns and the decline of the importance of foreign interest rates in determining capital flows to Brazil it would be possible to argue that before 1991 investors transferred capital to developing countries including Brazil mainly in response to lower international interest rates but after 1991 additional capital inflows to Brazil have responded to Brazil's relatively higher yields in relation to other developing countries.

Not only did yields on Brazilian financial assets increase in relation to yields of other developing countries but Brazil's risk may have declined with the liberalization of capital outflows and services of invisibles after 1991. By 1993, the debt burden inherited from the 1980s had been eased by lower international interest rates, and the debt moratorium that had been in place during the second half of the 1980s was suspended, and capital controls on transfers abroad were liberalized. Thus, once the situation before 1991--which made investments in Brazil too risky and thus unprofitable for a wide range of domestic interest rates--was reversed, capital flows became more responsive to movements in domestic interest rates corrected for expected depreciation.

B. Primary Flows

The regressions in Section III suffer from two shortcomings. First, the monthly data on capital flows published by the central bank exclude short-term flows. Second, capital controls may be important in explaining the difference in the response to interest rates before and after 1991.

As a first approach to these limitations, this section checks how robust the results of the previous section are by substituting the information on net capital flows with information on primary flows. Data on primary flows include bonds, equities, and syndicated loans issued by Brazilian entities in international markets (mainly New York and London, but increasingly global). The data is compiled by Dataware and published by Loanware and Bondware. Primary flows are useful because they do include short-term flows. But primary flows also differ from the net capital flows used in the previous regressions because they do not account for nonresident purchases in Brazil of Brazilian securities, transactions in secondary markets, and amortization and purchases of securities by Brazilian residents from nonresidents.

As shown in Table 9, the results of regressions using the ratio of primary flows to GDP as the dependent variable are consistent with the results in the previous section. International interest rates are the driving force in explaining the acquisition of Brazilian

Table 8. Dependent Variable: Ratio of Monthly Total Net Capital Flows to GDP
 Period: January 1991- December 1995

Constant	3.31 (2.85)	3.91 (3.47)
i*	-0.32 (-1.35)	-0.49 (-2.13)
i-Ee	0.37 (3.34)	0.33 (3.10)
Tequila dummy	-4.12 (-2.92)	-4.36 (-3.01)
Real Plan dummy		0.69 (1.14)

Note: t statistics in parentheses. Standard errors corrected by Newey-West heteroscedasticity and autocorrelation consistent covariance matrix.

Adjusted R-squared are 0.30 and 0.30, respectively.

Table 9. Dependent Variable: Ratio of Primary Flows to GDP
 Period: January 1988-December 1995

Constant	1.50 (5.49)	1.31 (4.88)	1.32 (2.94)
i*	-0.16 (-3.83)	-0.16 (-3.94)	-0.14 (-2.98)
i-Ee	0.01 (0.46)	-0.00 (-0.19)	-0.01 (-0.35)
Tequila dummy	-0.48 (-4.07)	-1.32 (-4.25)	-1.29 (-4.2)
Real Plan		1.02 (3.23)	1.1 (2.35)
Ratio of government spending to GDP			-0.44 (-0.55)
Inflation rate			0.00 (0.69)
Real exchange rate Deviation from equilibrium			0.33 (0.49)

Note: t-statistics in parentheses. Standard errors corrected by Newey-West heteroscedasticity and autocorrelation consistent covariance matrix. Adjusted R-squares are 0.12, 0.32, and 0.3, respectively.

financial assets and the Tequila effect continues to be important. In contrast with previous results, the Real Plan seems to have had an influence in explaining the increase of primary flows, but other domestic factors remain insignificant.

C. Composition of Capital Flows

Much of the debate on capital flows deals with the composition of flows. Certain flows are believed to be more volatile and driven by different fundamentals. In particular, net direct investment is thought to be a more stable component of flows.

Claessens, Dooley, and Warner (1995) have shown that the balance of payment labels do not provide information about the volatility of capital flows. Table 10 shows the coefficients of variation for the three components of net flows in the monthly data base used in this paper: net direct investment, portfolio, and debt securities. It confirms the results in Claessens and others for Brazil. There is no component with a systematic higher variability.

It is interesting to investigate whether the components exhibit different characteristics from the ones found for the total net flows, using a Seemingly Unrelated Regressions (SUR) system with the three types of flows as dependent variables. This will take into account the information provided by the covariance of the error terms in the regressions:

$$di = \text{Direct Investment/GDP} = \gamma_0 + \gamma_1 (i - Ee) + \gamma_2 i^* + \gamma_3 di(-1) + G_{di} X + \epsilon_{di} \quad (11)$$

$$ds = \text{Debt Securities/GDP} = \gamma_8 + \gamma_9 (i - Ee) + \gamma_{10} i^* + \gamma_{11} ds(-1) + G_{ds} X + \epsilon_{ds} \quad (12)$$

The results are shown in Table 11. Flows of equity securities and debt securities depend inversely on the foreign interest rate, and respond strongly to the Tequila dummy, as total flows in previous regressions. The coefficient of the Real Plan dummy is significant only in the regression for debt securities flows. Domestic interest rates have no effect on both equity and debt flows. The most striking result is the inverse behaviour of foreign direct investment. While domestic interest rate have a strong positive effect on FDI, the coefficient on international interest rates is not significant.

Table 10. Coefficient of Variation of Net Capital Flows

(In percent)

Period	Equity Securities	Net Direct Investment	Debt Securities
1988-91	2.58	2.13	-1.89
1991-95	2.11	2.53	1.13
1988-95	2.73	2.38	2.60

Table 11. SUR Regressions

Dependent Variables: Ratio of Equity Securities Flows to GDP,
Ratio of Debt Securities Flows to GDP, Ratio of Direct Investment to GDP
Period: January 1988- December 1995

Dependent Variable	Ratio of Equity Securities Flows to GDP	Ratio of Debt Securities Flows to GDP	Ratio of Direct Investment to GDP
Constant	2.81 (5.3)	1.68 (3.81)	0.19 (1.12)
i*	-0.34 (-5.27)	-0.37 (-6.82)	0.03 (1.37)
i-Ee	0.04 (1.23)	0.01 (0.24)	0.02 (2.07)
Tequila dummy	-2.86 (-4.33)	-1.46 (-2.66)	-0.06 (-0.27)
Real Plan	-0.70 (-1.53)	1.25 (3.31)	0.19 (1.34)
Ratio of government spending to GDP	-2.04 (-1.41)	3.3 (2.71)	-0.73 (-1.63)
Real exchange rate Deviation from equilibrium	-2.30 (-2.38)	0.04 (0.05)	0.70 (2.35)

Note: t-statistics in parentheses. Adjusted r-squares are 0.33, 0.44, and 0.15, respectively.

**CHANGES IN TAXES AND RESTRICTIONS ON CAPITAL FLOWS AND ON
PAYMENTS OF INVISIBLES**

(Including Changes in Legislation Affecting Other Payments Abroad Used to Circumvent Legislation on Capital Flows); Brazil, 1983-1995¹⁰

1983

- ▶ 11-Jan: Government granted a 20 percent income tax reduction on transactions in the form of leasing with maturity over eight years and exempted leasing fees from the financial transaction tax (IOF).
- ▶ 11-Jan: Government lowered to three months the minimum period for which nonresident capital should be invested in Brazil to receive fiscal benefits.
- ▶ 13-Jan: Government raised from \$1,000 to \$20,000 the maximum amount of securities exchanges without intervention of authorized brokerage houses.
- ▶ 11-Mar: Government reduced foreign exchange allowance for tourist travel abroad from \$ 2,000 to \$ 1,000. The monthly limit of \$300 for personal remittances remained restricted for Brazilians temporarily resident abroad to pursue approved educational programs or medical treatment.
- ▶ 29-Jul: Foreign exchange surrender requirements and a related foreign exchange allocation system were established. Transfers abroad for payments of Brazilian commercial bank obligations would follow priorities established by the central bank.
- ▶ 14-Sep: Government reduced foreign exchange allowance for tourist travel from \$1,000 to \$500, and from \$300 to \$100 for travel to Latin America.
- ▶ 20-Dec: Government made supplementary tax on remittances of profits and dividends applicable to all distributed profits and remittances but exempted reinvested profits.
- ▶ 28-Dec: Government required that the cruzeiro value of 95 percent of principal and interest payments due on medium- and long-term debt eligible for the Paris Club rescheduling to be deposited in special foreign denominated deposits.

1984

- ▶ 19-Mar: The system of comprehensive foreign exchange controls was abolished.
- ▶ 21-Aug: Government allowed investment banks to deal in foreign exchange, provided they met specified standards.
- ▶ 12-Sep: Government restricted the timing of release of voluntary deposits at the central bank in respect of foreign loan obligations to the dates of the maturity of payment of principal, interest, and commissions.
- ▶ 13-Dec: Government raised the sales of foreign exchange for travel abroad to \$1,000 and for trips to Latin America or initial stopover to \$500.

1985

- ▶ 28-Jun: Government reduced from 40 percent to zero the rebate on the tax payment by remitter of interest on loans, commissions, and expenses related to foreign transactions.
- ▶ 15-Aug: Government defined conditions under which foreign exchange sales to small businesses are exempt from financial transaction tax.

¹⁰ Transactions amounts are in U.S. dollars unless specified otherwise.

- ▶ 7-Oct: Ministries and government agencies prohibited from leasing real estate abroad.
- ▶ 31-Dec: Central bank raised the limit to supply foreign exchange to authorized banks to cover their oversold position from 90 percent to 100 percent of the sold position on the same day.

1986

- ▶ 23-Jul: Government introduced a temporary financial tax of 25 percent on the sale of foreign exchange for travel purposes to remain in effect until Dec.31, 1987.

1987

- ▶ 20-Feb: Government required interest payments to nonresident commercial banks to be deposited at the central bank.
- ▶ 11-Mar: Central bank offered special short-term line of credit in foreign currency for domestic commercial banks.
- ▶ 20-Mar: Government introduced new regulations on foreign capital companies and funds.
- ▶ 20-May: Government required interest payments on official loans to be deposited in the central bank.
- ▶ 28-May: Government required amortization payments on official loans to be deposited at the central bank.
- ▶ 17-Nov: Government created framework for debt-equity swaps.

1988

- ▶ 18-Jan: Central bank required payments in gold instead of cruzados for Brazilian investments abroad.
- ▶ 1-Feb: Government introduced new regulations on debt equity conversion.
- ▶ 30-Jun: Government required prepayment of principal or interest on external obligations be done through the banking system and communicated to central bank within two days.
- ▶ 28-Jul: Government introduced new regulation governing the participation of foreign capital in mutual funds.
- ▶ 1-Sep: Government introduced special tax treatment for profits earned from mutual funds owned by foreign residents.
- ▶ 9-Sep: Government reduced foreign exchange available for travel to Latin America to \$250.
- ▶ 21-Sep: Government lifted moratorium on interest payment on debt owed to foreign commercial banks.
- ▶ 28-Sep: Government increased foreign exchange available for travel to Latin America to \$500.
- ▶ 30-Nov: Government allowed investment abroad by Brazilian enterprises in an amount equal to direct investment received excluding investment from debt equity conversion.
- ▶ 1-Dec: Government increased limit on foreign exchange allowances for travel to \$4,000.

1989

- ▶ 9-Jan: Government limited repurchase of foreign exchange by a foreign traveler to \$100.
- ▶ 20-Apr: Government permitted transfers abroad of proceeds from sales of property and inheritance up to \$300,000 with documentation.

- ▶ 1-Jul: Central bank imposed retention of interest payments accrued on debt owed to nonresident commercial banks.
- ▶ 3-Jul: Same for remittances of profits and dividends.
- ▶ 5-Oct: Dividends of foreign companies also to be retained by the central bank for 60 days before being remitted abroad.

1990

- ▶ 10-Jan: Government increased the period of retention by the central bank of dividends permitted to be remitted abroad from 60 to 120 days.
- ▶ 16-Mar: Government introduced foreign exchange interbank market for transactions related to profit and dividend remittances, capital repatriation, debt service payments, and approved foreign investments.
- ▶ 26-Jun: Government announced that remittances of profits, dividends, royalties, and repatriation of capital would be freed gradually.
- ▶ 31-Jul: Government allowed some financial institutions to obtain resources from abroad by issuing commercial papers.

1991

- ▶ 1-Jan: Government allowed private sector and nonfinancial public sector to obtain foreign exchange to service their debts.
- ▶ 24-Jan: Government defined criteria for rebate of accumulated losses of foreign capital enterprises.
- ▶ 8-Feb: Government announced criteria for conversion of debt into equity for private sector debt with maturities beginning in 1991.
- ▶ 2-Mar: Government authorized conversion of external debt instruments of the federal public sector for use in the privatization program.
- ▶ 27-Mar: Government reduced minimum term for exemptions of income tax on external loans from 10 to 5 years.
- ▶ 1-Apr: Government reached preliminary agreement with nonresident creditor banks for the elimination of arrears.
- ▶ 5-Apr: Government allowed debt service payments of public enterprises.
- ▶ 18-Apr: Government allowed remittance of profits and dividends on investments still in the process of registration at the central bank.
- ▶ 31-May: Government liberalized the stock market to foreign institutional investors, by exempting profits from income tax, imposing no capital gains tax, and a 15 percent tax on income remitted abroad.
- ▶ 1-Jun: Government allowed exporters to issue medium-term debt instruments secured with future export receipts.
- ▶ 6-Jun: Government authorized the issuance of debentures convertible into stocks in domestic enterprises.
- ▶ 16-Jul: Government introduced facility for externally-funded nonprofit organizations to undertake debt-for-nature swaps.
- ▶ 23-Jul: Government exempted remittance abroad of late interest payments from specific authorization.
- ▶ 31-Jul: Government issued rules for borrowing external resources through ADR/IDR mechanism.
- ▶ 25-Sep: Government permitted borrowing abroad for financing of agricultural development.

- ▶ 30-Dec: Government abolished the supplementary income tax related to remittances of profits abroad.

1992

- ▶ 1-Jan: Government modified foreign capital law, setting maximum withholding tax rate for remittances of profits and dividends abroad at 25 percent, lower if lower in home countries, and announced the ceiling would be reduced to 15 percent in 1-Jan.1993.
- ▶ 9-Jan: Government liberalized the participation by foreigners in privatization, reducing the period from 12 to 6 years that investments through foreign debt instruments are required to remain in Brazil.
- ▶ 9-Jan: Government abolished minimum holding period of 2 years before assets acquired in privatization could be sold to invest in other assets.
- ▶ 12-Mar: Government increased minimum average maturity of foreign funding obtained through issuance of securities eligible for tax exemption from 23 months to 30 months.
- ▶ 1-Feb: Government reduced maximum period for pre-export financing that may be obtained against exchange contracts unofficially from one year to 180 days. A tax of 3 percent was levied on ACCs not supported by shipments.
- ▶ 1-Apr: Government reduced limit on authorized banks' sold position in the foreign exchange market by relating it to the net position of each bank.
- ▶ 23-Apr: Government imposed minimum maturity of 30 months for companies to arrange foreign funding through the issuance of foreign debt instruments.
- ▶ 23-Apr: Government made the average minimum period of amortization equal to 60 months for borrowers to benefit from tax exemptions.
- ▶ 30-Apr: Government authorized resident companies to hedge against changes in international interest rates.
- ▶ 18-May: Government authorized depository institutions to issue receipts abroad with backing in securities held in specific custody in Brazil.
- ▶ 30-Jun: Government authorized foreign investors represented by funds and institutional investors to operate in options and futures markets.
- ▶ 16-Jul: Government authorized corporations established in Brazil to issue and place abroad securities that can be converted into equities.
- ▶ 30-Sep: Government allowed Brazilian nationals to buy foreign exchange to pay for medical treatment abroad in the floating market.
- ▶ 30-Sep: Government authorized leasing contracts for a minimum term of 2 years, with total tax exemption if term is at least 5 years.
- ▶ 1-Oct: Government allowed issue and placement of securities that can be converted into stocks by companies and institutions headquartered in Brazil.
- ▶ 14-Oct: Government allowed Brazilian nationals to buy foreign exchange to pay for sport events abroad in the floating market.
- ▶ 14-Oct: Government allowed nonfinancial Brazilian residents to invest abroad up to \$1 million, but only with authorization of the central bank if investment is in excess of \$1 million.
- ▶ 21-Oct: Government allowed Brazilian nationals to buy foreign exchange to pay for exhibits abroad in the floating market.
- ▶ 29-Oct: Government extended minimum maturity of external debt other than bonds, notes, and commercial paper under Resolution 63 from 1 year to 30 months.

1993

- ▶ 16-Jun: Government extended minimum term for external borrowing from 30 to 36 months.
- ▶ 28-Jun: Government raised minimum term of external borrowing eligible for exemption on the income tax on interest to 96 months from 60 months.
- ▶ 21-Jul: Government reduced limit on authorized banks' short position in the foreign exchange market by 50 percent.
- ▶ 21-Jul: Government raised limit on authorized long position to \$10 million from \$2 million.
- ▶ 30-Jul: Government authorized firms to make hedging operations related to variations in exchange rates, interest rates, and commodity prices.
- ▶ 4-Aug: Government authorized financial institutions to trade gold among themselves.
- ▶ 19-Aug: Government forbade foreign capital registered under Articles I and IV to be applied to fixed income instruments.
- ▶ 7-Oct: Government allowed Brazilians to obtain foreign exchange for purchases abroad of real estate, advertisement, etc.
- ▶ 20-Nov: Government imposed 3 percent IOF tax on proceeds from foreign borrowing.
- ▶ 20-Nov: Government restricted portfolio investment by foreign investors in fixed income instruments to a single class of fixed income funds, and to a 5 percent IOF tax.
- ▶ 25-Nov: Government forbade foreign capital registered under Articles I and IV to be applied to investment in debentures.
- ▶ 17-Dec: Government restricted the portfolio of the *Fundo de Renda Fixa-Capital Estrangeiro* by excluding transactions in derivative markets yielding fixed or predetermined returns.

1994

- ▶ 13-Jan: Government authorized some institutions to conduct swap operations involving gold, exchange rates, and price indices over-the-counter.
- ▶ 19-Jan: Government introduced new restrictions on the constitution and operation of foreign institutional investors.
- ▶ 28-Feb: Government introduced legislation that permits taxing issues of bonds abroad and foreign investment in fixed income funds up to 25 percent from the current 3 and 5 percent, if considered necessary.
- ▶ 2-Mar: Government stopped automatic authorization for issuing bonds, commercial paper and other fixed-income assets abroad.
- ▶ 2-Mar: Government allowed payments in cash of foreign currency deposits from excess buyer positions.
- ▶ 2-Mar: Government introduced requirement of documents to transfer national currency abroad.
- ▶ 15-Apr: Brazil completed arrangements to reschedule its external debts to commercial bank creditors.
- ▶ 15-Jun: Government issued regulation of foreign investment companies; suspended for 90 days external loans to the public sector, suspended for 90 days flows for future investment, increased banks' short position from \$10 million to \$50 million.
- ▶ 21-Jun: Government reduced the financial transactions tax for purchases of foreign exchange for payment of contracts involving transfers of technology to zero from 25 percent.

- ▶ 1-Jul: Government extended minimum period for external prefinancing of exports to 2 years.
- ▶ 31-Aug: Government permitted prepayment of foreign borrowing and import financing.
- ▶ 31-Aug: Government eliminated 20 percent limit for import financing down payments.
- ▶ 22-Sep: Government allowed creation of investment funds abroad, requiring 60 percent of securities negotiable abroad to consist of Brazilian securities.
- ▶ 5-Oct: Government prohibited inflows in the form of advances for future capital increases and bridge investment in anticipation of future conversions of debts into investment.
- ▶ 19-Oct: Government eliminated limit on foreign exchange allowance for travel abroad.
- ▶ 19-Oct: Government reduced period allowed for anticipatory exports settlements and suspended inflows through anticipated payment of exports.
- ▶ 19-Oct: Government imposed a 15 percent reserve requirement without interest remuneration on anticipatory settlements of credit operations.
- ▶ 19-Oct: Government increased financial transaction tax on foreign investment in fixed-income instruments to 9 from 5 percent.
- ▶ 19-Oct: Government introduces new financial transaction tax on foreign investment in stocks at the rate of 1 percent.
- ▶ 19-Oct: Government increases financial transaction tax on foreign borrowing to 7 percent from 3 percent.

1995

- ▶ 11-Jan: Government eliminated reserve requirement of 15 percent on advances for export contracts.
- ▶ 11-Jan: Government reinstated anticipated payment for export operation with a minimum term of 360 days.
- ▶ 11-Jan: Government lengthened maximum period for advances for export contracts.
- ▶ 9-Mar: Government lowered minimum period for the renewal and extension of foreign credit operations to 6 months from 36 and lowered limits of the long position of banks and dealers in foreign exchange to \$1 million from \$10 million.
- ▶ 9-Mar: Government reduced IOF to zero from 7 percent on foreign loans, from 9 percent to 5 percent on investments in fixed-income funds, and from 1 percent to zero percent on investment in stocks.
- ▶ 9-Mar: Government lowered minimum average term for contracting financial loans from 36 to 24 months and lowered minimum term for relending operations related to resolution 63 to 90 days from 540 days.
- ▶ 9-Mar: Government revoked permission granted for anticipated payment of financial loans and import financing.
- ▶ 16-Mar: Government allowed financial institutions of the national system of rural credit to contract foreign resources exempted from the financial tax of 5 percent, and reduced the minimum contract period to 180 days from 3 years.
- ▶ 20-Apr: Government limited anticipated payment for imports to 20 percent of the value of the merchandise.
- ▶ 27-Apr: Government authorized anticipated payment for exports by foreign individuals, corporations, and financial institutions.

- ▶ 27-Apr: Government increased limits on the short position of banks in foreign exchange by 50 percent.
- ▶ 30-Jun: Government allowed financial institutions to contract resources with a minimum maturity of 720 days for the financing of construction and acquisition of real estate ventures.
- ▶ 11-Aug: Government extended a 7 percent financial tax (IOF) for interbank operations in foreign exchange.
- ▶ 11-Aug: Government raised IOF for financial loans to 5 percent from zero.
- ▶ 11-Aug: Government raised IOF to 7 percent from 5 percent for investments on fixed income funds.
- ▶ 11-Aug: Government prohibited foreign investors from channeling resources into operations in the futures and option-markets.
- ▶ 15-Aug: Government cuts the IOF rate for foreign resources for the agricultural sector to zero.
- ▶ 15-Sep: Government established differentiated IOF rates for financial loans with different maturities.
- ▶ 28-Sep: Government reduced the discount rate on conversion of federal public sector entities foreign debt into investments in the privatization program to zero from 25 percent.

1996

- ▶ 1-Jan: profits and dividends remitted abroad exempted from income tax and profits on direct investment reduced to 15 percent from 25 percent.
- ▶ 1-Jan: maximum tax rate applicable to interests remitted abroad reduced to 15 percent from 25 percent.
- ▶ 8-Feb: numerous modifications introduced but beyond the scope of this list.

DATA SOURCES

Monthly Databases

1. International Interest Rates: U.S. 3-month treasury bill rates or yields on 10-year bonds from *IFS* lines 60c and 61a.
2. Domestic Interest Rates in Dollars: Short term rates on public debt treasury bills from the Central Bank of Brazil discounted by the expected devaluation implicit in dollar futures contracts (first day of the month). The latter from obtained directly from García and Barcinsky (1996).
3. Government Spending: Federal government total expenditure, Central Bank of Brazil.
4. Real Exchange Rate: Deviations from equilibrium real exchange rates calculated in Goldfajn-Valdés (1996).
5. Inflation: Changes in consumer price index, IGP domestic supply, Central Bank of Brazil.
6. Total Net Private Flows is from Brazil's Central Bank's monthly statistics on "capital movement". Monthly "capital movement" statistics do not include short-term capital flows and re-invested profits. See Table 1 for the composition of total flows: net direct investment corresponds to line a in Table 1, equity securities correspond to line c, debt securities to line d, and total net private flows corresponds to the sum of these three flows.
7. Capital Control Index is subjectively constructed using the listed measures in Appendix III. A restriction on outflows increases the RO index. Equivalently, a restriction in inflows increases the RI index. CC is defined as $RI - 0.5 RO$.
8. Set of Dummies as follows: Real Plan (after July 1994), Tequila (Jan-March 1995) and Annex (after 1991).
9. Nominal Monthly GDP from Central Bank of Brazil.

Primary Flows

1. Data on primary capital flows include bonds, equities, and syndicated loans issued by Brazilian entities in international markets (mainly New York and London but increasingly global). The data is compiled by Dataware and published by Loanware and Bondware.

Quarterly Data

1. Capital flows from International Financial Statistics. Line 78 bjd.
2. Covered Interest Differential obtained directly from García and Barcinsky (1996).
3. Nominal GDP obtained directly from IPEA, Brazil.

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