WHAT HURTS MOST?: G-3 EXCHANGE RATE OR INTEREST RATE VOLATILITY

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I. Introduction

While fashions concerning appropriate exchange rate arrangements have shifted over the years, advocacy of establishing a target zone surrounding the world's three major currencies has remained a hardy perennial. Work on target zones (pioneered by McKinnon, 1997, and Williamson, 1986, and recently summarized by Clarida, 1999) has mostly emphasized the benefits of exchange rate stability for industrial countries. More recently, though, analysts have apportioned some of the blame for financial crises in emerging markets back on the shoulders of the volatile bilateral exchange rates of industrial countries (as in the dissenting opinions registered in Goldstein, 1999, for instance). With many emerging market currencies tied to the U.S. dollar either implicitly or explicitly, movements in the exchange values of the currencies of major countries–in particular the prolonged appreciation of the U.S. dollar vis-a-vis the yen and the deutsche mark in advance of Asia's troubles–is argued to have worsened the competitive position of many emerging market economies. One solution to reducing destabilizing shocks emanating from abroad, the argument runs, would be to reduce the variability of the G-3 currencies by establishing target bands.[1] This paper examines the argument for such a target zone strictly from an emerging market perspective but will be silent on the costs and benefits for industrial countries.

Given the reality that sterilized intervention by industrial economies tends to be ineffective and that policy makers show no appetite to return to the kinds of controls on

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[1] Of course, since European monetary union, the G-3 currencies cover at least fourteen countries–the United States, Japan, and the twelve nations that have adopted the euro. In what follows, we splice together the pre-single-currency data on the deutsche mark with the post-1999 data on the exchange value of the euro.

international capital flows that helped keep exchange rates stable over the Bretton Woods era, a commitment to damping G-3 exchange rate fluctuations requires a willingness on the part of G-3 authorities to use domestic monetary policy to that end--this, in turn, may require tolerating more variable interest rates. However, while trading patterns may become more stable in an environment of predictable G-3 exchange rates, debt-servicing costs do not as a result of the greater variability of international interest rates. The welfare consequences to an emerging market economy, therefore, are ambiguous, depending on initial conditions, the specification of behavior, and the dynamic nature of the tradeoff between lower G-3 exchange rate volatility and higher G-3 interest rate variability.

The consequences for the developing "South" of interest rate and exchange rate volatility in the "North" is only one particular aspect of the myriad North-South links. As such, issues related to G-3 exchange rate variability should be viewed within the much larger panorama (and related literature) of how economic outcomes in developed countries influence those in less developed economies. In this paper, we review and revisit the "traditional" North-South links via trade, commodity markets, and capital flows, and add tranmission channels in the form of interest-rate and exchange-rate volatilities.

In Section II, we discuss the various channels of North-South transmission and use the example of a simple trade model to establish that, for a small open economy with outstanding debt, the welfare effect of damping variations in the exchange rate by making international interest rates more volatile is ambiguous. Section III presents stylized evidence on how the monetary policy and economic cycle in the United States influence capital flows

to emerging markets as well as growth. In Section IV, we first examine the contribution of G-3 exchange rate volatility to fluctuations in the exchange rates of emerging markets and proceed to analyze the link between G-3 interest rate and exchange rate volatility and capital flows and economic growth in developing countries. The final section summarizes our main findings and discusses some of the policy implications of our analysis.

Section II. North-South Links

In this section, we discuss the various channels through which economic developments in the major developed economies can potentially affect developing countries. On the developed side, we examine how the exchange-rate arrangements among industrial countries influence the mix of interest-rate and exchange-rate volatility on world financial markets. On the emerging markets side, our focus is on capital flows--their level and composition--and on economic performance, as measured by GDP growth.

1. The Winds from the North: The Role of G-3 Exchange Rate Arrangements in Determining the Mix of Interest-Rate and Exchange-Rate Volatilities

In principle, G-3 exchange rates could be induced to stay within a target bands through some combination of three tools. First, national authorities could rely on sterilized intervention to enforce some corridor on bilateral exchange rates. However, except to the extent that such intervention tends to signal future changes in domestic monetary policy, researchers have found little empirical support that sterilized intervention in industrial

3

countries is effective.[2] Second, national authorities could impose some form of exchange or capital control, presumably in the form of a transactions tax or framed as prudential reserve requirements. Opponents of such efforts generally argue that capital controls generate financial innovation that undercuts them over time, implying that the controls either become increasingly complicated or irrelevant. Third, monetary policy makers in the major countries could alter domestic market conditions to keep the foreign exchange value of their currencies in a desired range. This could take the form of allowing intervention in the currency market to affect domestic reserves–that is, not sterilizing intervention–or more directly keying the domestic policy rate to the exchange value of the currency (as discussed in McKinnon, 1997, and Williamson, 1986).

Given the lack of evidence finding any independent effect of sterilized intervention (over and beyond what subsequently happens to domestic monetary policy) and the consensus supporting the free mobility of capital internationally, it would seem that the only instrument available to enforce a target zone would be domestic monetary policy of the G-3 central banks. But this implies some tradeoff, in that G-3 domestic short-term interest rates would have to become more variable to make G-3 exchange rates smoother.

To understand the trade-off between G-3 interest-rate and exchange-rate volatility from an emerging markets perspective, it is important to remember that most developing countries are net debtors to the industrial world and typically that debt is short-term and denominated in one of the G-3 currencies. As a result, the welfare consequences for an

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[2] The signaling channel is addressed by Kaminsky and Lewis (1996); Dominguez and Frankel (1993) examine whether there are any portfolio effects of sterilized intervention.

emerging-market economy of G-3 target zones depends on exactly how those zones are enforced and the particulars of the small country's mix of output, trading partners, and debt structure.

2. A Stylized Model of an Emerging-Market Economy

The effects of trading interest-rate for exchange rate volatility can be seen in a basic single-period, two-good model of trade for a small open economy, as in Figure 1. This figure is drawn for a country taking as given the relative price of the two traded goods that receives an endowment in terms of good A. For simplicity, we assume that its external debt is denominated in terms of good A and its currency is pegged to that of country A.[3] Volatility of the relative price of the traded goods–which might stem solely from nominal changes in exchange rates between the industrial countries if the small country fixes its exchange rate or if it prices to the industrial country market–pivots the budget line and thus alters the desired consumption combination in the small country. Suppose, for instance, that the currency of country A depreciates relative to that of country B, rotating the budget line from EF to GF. All else equal, welfare would decline, representing a cost associated with developments on the foreign exchange market for this small country.

Target zones for the large countries, if effective, would be able to prevent the budget line from rotating as the result of influences emanating from the developed world. However,

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[3] Behind the scenes of this model in the larger industrial world, it is simplest to think of two large countries, A and B, specialized in the production of their namesake good. The net effect of our assumption about the small economy's endowment and debt structure is that the intercept of the budget line depends on the interest rate in country A.

this reduced major-country exchange rate volatility will only be accomplished if the major central banks change short-term interest rates in response to incipient changes in cross rates. For most emerging-market economies, which are debtors, such coordination of G-3 monetary policy could deliver more stable terms of trade at the expense of a more variable interest service. In this particular case, the central bank of country A would presumably have to raise its domestic short-term interest rate in defense of the currency. So, while the slope of the budget line would be unchanged, its location would shift in, as labeled HI. Regardless of whether the effects of the initial shock were felt through the exchange rate of the interest rate, welfare in this small country would decline. Whether they decline more or less if the large countries allow the cross exchange rate or their interest rates to adjust will depend on many factors.

3. *Going Beyond the Stylized Model*

In reality, many developing countries send primary commodities onto the world market, there is some substitutability in world demand for those countries that produce manufactured products, and capital markets are far from perfect. In this section, we use the traditional North-South linkages to broaden our understanding of the issues related to G-3 exchange rate arrangements.

As opposed to the simple example, most emerging-market economies face some slope to the demand curve for their exports. As a result, a slowdown in a large developed economy will have adverse consequences for its trading partners to the extent that imports in the developed economy have a positive income elasticity. This channel, as it relies on the

6

behavior of the large partner, is present irrespective of the level of development of the

smaller trading partners. The higher the share of exports of the country that are destined for

the country experiencing the economic downturn, the more negative the consequences. On

the basis of this channel, for example, Mexico and Canada would be far more affected by an

economic downturn in the United States than Argentina. This follows because in 1999 about

88 percent of all Canadian and Mexican exports were shipped to the U.S. market, while only

about 11 of Argentina's exports were destined for the United States.[4] Other things equal, the

higher the income elasticity of imports in the developed country, the more pronounced will

be the contraction in the country's exports. In this regard, developing countries which

export predominantly manufactured goods (which typically are more sensitive to income)

may fare worse that their counterparts exporting primary commodities, which tend to be

relatively income-inelastic.[5] The heterogeneity in export structure across developing

countries are sufficiently significant to expect, a priori, highly differentiated outcomes. For

instance, the contrast between the export structure of East Asian countries (which are heavily

weighed to manufactured goods) to that of most African countries (which are predominantly

skewed to primary commodities) is particularly striking.[6]

As opposed to the simple example, emerging market economies generally produce a

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[4] The stylized evidence on patterns of trade is discussed in the next session.

[5] See, for example, Reinhart (1996), who estimates industrial countries' import demand function for various regions and countries with varying degrees of export diversification and primary commodity content.

[6] For example, manufactures account for only 10 percent in Côte D'Ivoire but account for more than 65 percent of Thai exports.

different mix of goods than those of industrial countries. In that case, the business cycle in

the world's largest economies may itself exert a significant influence on the terms of trade of

their smaller developing trading partners, as argued in Dornbusch (1985). Perhaps, the

clearest example of such a North-South link comes from international commodity markets.

The literature on commodity price determination has consistently accorded a significant role

to the growth performance of the major industrial countries. [7] Recessions in industrial

economies, particularly the United States, have historically been associated with weakness in

real commodity prices. In our simple example, if the small country's endowment was made

up of a commodity, the effects of G-3 monetary policy actions on overall demand for those

primary goods could induce more sizable shifts in the position of the budget line.

Yet, the impacts of fluctuations in the business cycle on developing economies is

likely not limited just to income and relative price effects. There is a well-established,

endogenous and countercyclical "monetary policy cycle" in the major developed economies.

To damp the amplitude of the business cycle, central banks ease monetary conditions and

reduce interest rates during economic downturns and hike interest rates when signs of

overheating develop. Calvo, Leiderman, and Reinhart (1993) stressed the importance of U.S.

interest rates in driving the international capital flow cycle. They present evidence that, in

periods of low interest rates in the United States, central banks in developing countries in

Latin America systematically accumulate foreign exchange reserves and the real exchange rate

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[7] See, for example, Dornbusch (1986); he stresses the role of the demand side in commodity price determination. Borensztein and Reinhart (1995), who incorporate supply-side developments in their analysis, also find a significant and positive relationship between growth in the major economies and world commodity prices.

appreciates. Subsequent studies that examined net capital flows and extended the analysis to a variety of their components over various sample periods and that extended the analysis to developing countries in other regions found similar evidence. This link between the interest rate and capital flow cycle may arise for a variety of reasons. Investors in the developed economies faced with lower interest rates may be inclined to seek higher returns elsewhere (i.e., the demand for developing country assets increases). It also might be the case that the decline in international interest rates makes borrowing less costly for emerging markets and increases the supply of emerging market debt. As illustrated in the interest rate parity condition below, where ϵ^e denotes the expected change in the exchange rate, the decline in the cost of borrowing for emerging-market countries (i) may be even greater than the decline in international interest rates (i^*) if the country risk premia (ρ) is itself a positive function of international interest rates,

$$ i = i* + \rho(i*) + \epsilon^e, \qquad \rho' > 0. \tag{1} $$

The evidence presented in Fernandez-Arias (1996), Frankel et. al. (2000), and Kaminsky and Schmukler (2001) support the notion that country-risk premia in many emerging markets indeed move with international interest rates in a manner that amplifies the interest rate cycle of industrial countries. If that is the case, a change in G-3 interest rates shifts the budget line by more than given in our simple example, as procyclical capital flows imply that the change in the industrial country interest rate changes the developing country's interest-rate risk premium in the same direction. Moreover, one could posit nonlinearities in

9

the response if large increases in borrowing costs--by inducing balance-sheet strains and credit rationing--have more substantial effects on income prospects than do similar size reductions in borrowing costs.

Taken together, these findings would suggest that the trade and finance effects that arise from the growth and interest rate cycles, respectively, in developed economies tend to, at least partially offset. The countries that would benefit the most from the interest rate cycle may well be those that start from a shakier financial position--that is the ones with the higher international debt-to-reserves ratio. This is so because these countries would benefit the most from a decline in debt-servicing costs (possibly also owing to a proportionally larger decline in their risk premia) and lose the least in the interest earnings from holding international reserves. For example, a country like China, which has a low level of external debt and a high level of external reserves might even benefit from interest rate increases in the United States. For low-income countries that have no access to international capital markets under any interest rate scenario, this capital flow-debt servicing channel would not be present at all.

However, G-3 exchange rate and interest rate volatility would seem *a priori* to have a negative effect on economic growth in the developing world. Higher interest rate volatility may hamper investment, while higher G-3 exchange rate volatility may retard emerging market trade.[8] While the literature on the impacts on trade of exchange rate volatility for developed economies is inconclusive, the comparable analysis of this issue for emerging

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[8] Of course, G-3 interest rate volatility may also complicate significantly emerging market debt management strategies or make systemic strains more likely.

markets seems overwhelmingly to reach the conclusion that exchange rate volatility tends to reduce trade.

Table 1 provides a summary of the channels of transmission of how developments in the major industrial countries may influence growth in emerging markets.

Table 1. Developed and Developing Country Links

Type of shock	Transmission channel	Amplifiers	Expected growth consequences
The growth cycle: Recessions in the G-3			
Income effects	Trade: Lower exports to G-3	High trade exposure High G-3 income elasticities	Negative
Relative price effects	Trade: Decline in the terms of trade for developing countries	High primary commodity content in exports High exposure to cyclical industries in exports	Negative
International capital flows	Finance: Higher capital flows (primarily bank lending) to emerging markets	Large declines in the domestic demand for bank loans	Positive,
The interest rate cycle: Monetary easings			
International capital flows	Finance: Higher portfolio capital flows to emerging markets	Developed bond and equity markets. High interest sensitivity of flows.	Positive
Debt servicing	Finance: Lower cost	High levels of debt Sensitive risk premia to international interest rates	Positive
Interest earnings	Finance: Declining interest income	High level of reserves relative to debt	Not obvious
High volatility in G-3:			
Interest rates	Finance: Complicates debt management	High levels of short term debt Large new financing needs	Not obvious
	Investment: Uncertainty tends to reduce investment consequences	An initially high level of FDI	Negative
Bilateral exchange rate	Trade: Reduces trade	Pegging to a G-3 currency	Negative?

III. The Role of the North's Business and Monetary Policy Cycles: The Stylized Facts

In this section, we present stylized evidence on the "North-South" links that were

discussed in the preceding section. For emerging markets, we examine international capital flows and growth around various measures of the United States growth and interest rate cycle and contrast periods of high interest rate and exchange rate volatility to those where volatility was relatively subdued. We present evidence of the direction of " North-South" trade and on the impact of G-3 developments on international commodity markets.

Our data is annual and spans 1970 to 1999, and the country groupings are those reported in the International Monetary Fund's *World Economic Outlook* (WEO). For capital flows, these groupings include: All emerging markets, Africa, Asia crisis countries, other Asian emerging markets, Middle East and Europe, Western Hemisphere, and Countries in Transition. In reporting aggregate real GDP, the WEO groups the Asian countries somewhat differently; the two reported subgroupings are newly industrialized Asia and Asia; all other categories remain the same.[9] We examine the cyclical behavior of net private capital flows and its components: net private direct investment (FDI), private portfolio investment (PI), other net private capital flows (OTF)--which is heavily weighed toward bank lending, and net official flows (OFF).

1. The growth cycle, capital flows, and emerging market growth

Given its prominent position in the world economy, the United States business cycle (not surprisingly) has important repercussions for the rest of the world. Economic developments in the United States echo loudly in many developed economies--most notably Canada; the same holds true for developing economies, especially so those in the Western

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[9] Details on the individual series and country coverage are provided in the Data Appendix.

Hemisphere and newly-industrialized Asia. To examine the behavior of growth and various types of capital flows to emerging markets, we first split the sample into two states of nature according to two criteria. The first parsing separates the sample into recessions and expansions according to the National Bureau of Economic Research's dating of U.S. business cycle turning points. The second cut of the data divides the sample into those periods in which U.S. real GDP growth is above the median growth rate for the sample and those in which growth is below the median. Figures 2 and 3 depict capital flows to emerging markets (billions of U.S. dollars in 1970 terms) in recession years versus recovery years for the 1970-1999 period. The picture shown in the top panel of Figure 2 reveals that net flows to emerging markets are almost twice as large when the United States is in expansion (almost US $60 billion) as when the United States is in recession. Furthermore, this vast gap between recession and expansion owes primarily to a surge in FDI flows (which nearly go up fivefold from recession to expansion) and to portfolio flows (Figure 3, top panel). Indeed, other **net inflows** to emerging markets fall from about US $17 billion, when the U.S. is in recession to about US $8 billion of **net outflows** in expansions (Figure 3, bottom panel). This disparate behavior between FDI and portfolio flows importantly owes to bank lending, which accounts for a significant part of other flows. Apparently, banks tend to seek lending opportunities abroad when the domestic demand for loans weakens, as it usually does during recessions. The U.S. bank lending boom to Latin America in the late 1970s and early 1980s and the surge in Japanese bank lending to emerging Asia in the mid-1990s are two clear examples of this phenomena.

14

However, the surge in FDI flows from the mid-1990s to the present is a significant departure from FDI's historical behavior that is, no doubt, heavily influenced by the wave of privatization and mergers and acquisitions that took hold in many emerging markets during recent years. It is possible that because this period of privatizations and surging FDI is coincident with the longest economic expansion in U.S. history, the results may be skewed toward finding an exaggerated role for U.S. growth in driving FDI and total net flows. When we end our sample in 1992, which is two years following the only U.S. recession in the 1990s, capital flows to emerging markets still diminish during economic upturns in the United States. While FDI flows and portfolio flows continue to be higher in expansions than in recessions, the drop in other flows during expansions more than offsets this. As a robustness check of the NBER business-cycle data, we also split the sample into years in which U.S. real GDP growth is above the median growth rate for the sample and those in which growth is below the median and a similar pattern of flows.

In sum, from the vantage point of the volume of capital flows to emerging markets-- U.S. recessions are not a bad thing. From a compositional standpoint, however, the more stable component of capital flows, FDI, does seem to contract during downturns--suggesting that emerging markets may wind up during these periods relying more heavily on less stable sources of financing--short-term flows.[10]

The analogous exercise was performed for emerging market average annual GDP growth. As shown in Table 1, for all developing countries, growth is somewhat slower during

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[10] Other flows are mostly short-term.

U.S. recessions, averaging 4.8 percent per annum versus 5.2 percent average growth during expansion years. However, the pattern is uneven across regions. For the countries in transition, Asia (including the newly-industrialized economies), and the Middle East and Europe growth tend to slow during U.S. recessions while for Africa and Western Hemisphere,

the opposite is true. However, in most instances the differences across regimes are not markedly different--an issue we will explore further later.

Table 2. Economic Growth and the U.S. Business Cycle, 1970-1999
Average Annual real GDP Growth (in percent)

Major Regional Groupings	Entire Period	During U.S. Recessions	During U.S. Expansions
Newly Industrialized Asian Economies	7.68	7.11	7.79
Developing Countries	5.08	4.82	5.21
Africa	2.91	3.29	2.77
Asia	6.57	6.25	6.69
Middle East and Europe	4.43	4.31	4.52
Western Hemisphere	3.69	3.81	3.58
Countries in Transition	1.51	2.71	0.88

Source: The authors and *World Economic Outlook*, International Monetary Fund.

2. The growth cycle and trade

If economic downturns in the United States are not necessarily a bad thing from the vantage point of the availability of international lending to emerging markets, slowdowns are likely to have adverse consequences for countries that rely heavily on exports to the United States. Table 3 reports the percentage of total exports (as of 1999) of various emerging

markets in Africa, Asia, and Western Hemisphere that are destined for the United States market. It is evident that bilateral trade links between the United States and the developing world are strongest for Latin America, although there is considerable variation within the region with Mexico and Argentina sitting at the opposite ends of the spectrum. However, trade between the United States and the Asian countries shown in this table is, by no means, trivial, especially if one considers that (as shown in Table 4) the income elasticity in developed economies for Asian exports typically is estimated to be more than twice as large as the income elasticity for African exports; more generally, the income elasticity of the exports of developing countries that are major exporters of manufactured goods is well above that of those whose exports have a higher primary commodity content.

Table 3. North-South Trade Patterns: 1999

Region/Country	Exports to the United States as a share of total exports (in percent)	Imports from the United States as a share of total imports (in percent)
Latin America		
Argentina	11.3	19.6
Brazil	22.5	23.8
Chile	19.4	22.9
Colombia	50.3	32.1
Peru	29.3	31.6
Mexico	88.3	74.1
Venezuela	55.4	42.0
Asia		
China Mainland	21.5	11.8
Indonesia	16.1	7.3
Korea	20.6	20.8
Malaysia	21.9	17.4
Philippines	29.6	20.3
Singapore	19.2	17.1
Thailand	21.5	11.5
Africa		

Chad	7.2	2.1
Congo, Rep of	19.0	3.5
Ethiopia	8.4	4.9
Kenya	4.6	6.7
Mozambique	4.8	3.7
South Africa	8.2	13.3
Uganda	5.4	3.3
Zimbabwe	5.8	4.8

Source: *Direction of Trade Statistics,* International Monetary Fund (2000).

Table 4. Industrial Countries Demand for Developing Country Exports

Study and Sample Period	Importing country	Exporting country	Income Elasticity
Dornbusch (1985), 1960-1983		All non-oil developing	1.74
		Major exporters of manufactures	2.67
Marquez (1990)	Canada	Non OPEC developing	2.83
	Germany	Non OPEC developing	2.29
	Japan	Non OPEC developing	1.22
	United Kingdom	Non OPEC developing	1.45
	United States	Non OPEC developing	3.04
	Rest of OECD	Non OPEC developing	2.61
Reinhart (1995), 1970-1991	All developed	All developing	2.05
		Africa	1.25
		Asia	2.49
		Latin America	2.07

As noted earlier, swings in the economic cycle in the United States and other major industrialized economies have had a systematic impact on the terms of trade of primary-commodity exporters. According to the various studies reviewed in Table 5, a one percentage point drop in industrial production growth in the developed economies results in a drop in real commodity prices of roughly 0.77 to about 2 percent, depending on the study.

Table 5. Commodity Prices and Economic Cycles: A Review

Study	Dependent variable/sample period	Measure of developed-country growth rate used	Coefficient
Borensztein and Reinhart (1994)	All commodity index/ 1971:1-1992:3, quarterly	Industrial production for developed economies	1.40
	All commodity index/ 1971:1-1992:3, quarterly	Industrial production for developed economies plus GDP for the Former Soviet Union	1.54
Chu and Morrison (1984)	All commodity index/ 1958-1982, quarterly	GDP weighted industrial production-G-7 countries	1.66
Dornbusch (1985)	All commodity index/ 1970:2-1985:1, quarterly	OECD industrial production	2.07
Holtham (1988)	All commodity index/ 1967:2-1982:2, semiannual	GDP growth for the G-7 economies	0.51
		Industrial production for the G-7 economies	0.77

3. The interest rate-monetary policy cycle

As noted earlier, in a world of countercyclical monetary policy in industrial countries, an economic cycle goes hand in hand with an interest-rate cycle. As with the growth cycle, we proceed to describe the stylized evidence by breaking up the sample in two ways. First, we subdivide the 1970-1999 sample into two subsamples, one where monetary policy was "easing"--that is to say that the federal funds rate was declining--and periods of tightening, where the federal funds rate was rising.[11] However, this cut of the data does not discriminate

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[11]More specifically, a year was denoted as one of tightening (easing) if the average level of the federal funds rate in December was higher (lower) than that of twelve months earlier.

between a modest and marked policy changes, as a 50 basis point drop in the federal funds rate during a given year would be lumped together with a 400 basis point drop. To get at this issue, we also break the sample into periods where real interest rates are above the sample median and those years in which rates are below the median. [12]

Figures 4 and 5 report the results of this exercise. The outcomes are consistent, irrespective of whether the observations are split along the lines of rising versus falling interest rates or real interest rate levels above or below their median, or whether the sample ends in 1999 or 1992. In years when U.S. monetary policy was easing, emerging markets in all regions (with the exception of Africa, which is almost entirely shut out of international capital markets) receive a markedly higher volume of capital inflows. While FDI and portfolio flows do not change much, other (short-term) flows respond markedly to the interest rate cycle.

As Figures 8 and 9 illustrate, the surge in net private inflows is even more dramatic when the sample is split according to whether interest rates are above or below their sample median. As before, Africa is the only region unaffected by the interest rate cycle in the United States. Performing the same exercises on emerging market GDP growth, however, does not yield any obviously intuitive results. By and large, average annual GDP growth rates are lower during easings of U.S. monetary policy than during tightening episodes-- which may simply attest to the fact that Federal Reserve easings most often coincide with a U.S. economic slowdown. It may also suggest that, to the extent that capital inflows have

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[12] Real ex post interest rates are calculated as the nominal yield on a three-month Treasury bill less the annual consumer price inflation rate.

positive consequences for economic activity (an important issue that has not received much attention in the literature), these effects may not be contemporaneous.

Table 6. Economic Growth and U.S. Monetary Policy, 1970-1999
Average Annual real GDP Growth (in percent)

Major Regional Groupings	Entire Period	During U.S. Tightenings	During U.S. Easings
Newly Industrialized Asian Economies	7.68	8.79	6.93
Developing Countries	5.08	5.17	5.02
Africa	2.91	2.63	3.10
Asia	6.57	6.72	6.46
Middle East and Europe	4.43	3.87	4.80
Western Hemisphere	3.69	4.21	3.34
Countries in Transition	1.51	2.96	0.65

Source: *World Economic Outlook*, International Monetary Fund.

In the preceding sub-section, we discussed the stylized evidence on capital flows, growth and G-3 developments. In what follows, we take that analysis further by examining the interaction between the "twin" monetary policy-growth cycles and capital flows and its components.

4. Stylized evidence on the twin cycles

Table 7 cuts the sample into four states of nature for the United States: recession accompanied by monetary policy tightening, recession accompanied by easing, expansion and tightening, and expansion and monetary policy easing. Our priors as regards emerging markets growth are straightforward: high U.S. growth and easier monetary policy would

provide the best conditions for more rapid growth in emerging markets. As to capital flows, the priors are less well defined. On the one hand, the Calvo, Leiderman, and Reinhart (1993) hypothesis would suggest that tighter monetary policy (i.e., rising interest rates) would lead to (other things equal) lower capital flows to emerging markets. On the other hand, while recessions in the North may dampen FDI flows (as these are often linked to trade), economic slowdowns tend to be accompanied by a weakening in the domestic demand for loans--which, in the past, has often led bank to seek lending opportunities abroad.[13] In other words, the consequences of the U.S. cycle for capital flows is, in principle, ambiguous.

Table 7 presents net capital flows and its components to all emerging markets during these four states of nature. As the top panel indicates, net flows more than double along the diagonal, suggesting that both lower interest rates and faster growth in the United States are a potential catalyst for capital flows into emerging markets. However, as the previous discussion suggested, this feature is not even across categories. FDI and portfolio flows thrive when expansions are coupled with falling interest rates. Other flows, which are largely comprised of bank lending do not. Like other flows, these tend to increase in period of falling interest rates but contract during expansions; other flows are highest when the U.S. is in recession and interest rates are falling.

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[13] See Kaminsky and Reinhart (2001).

Table 7. Real Capital Flows and the Twin Cycles: Total Emerging Market Economies
(Billions of 1970 U.S. dollars)

Net Private Capital Flows		Recession	Expansion
	Tightening	8.6	13.2
	Easing	13.9	19.3
Net Private Direct Investment			
	Tightening	3.4	11.0
	Easing	4.2	11.5
Net Private Portfolio Investment			
	Tightening	0.2	4.0
	Easing	1.5	6.6
Other Net Private Capital Flows			
	Tightening	5.0	1.8
	Easing	8.4	1.2

Source: *World Economic Outlook*, International Monetary Fund.

5. The repercussions twin cycles: Basic tests

The preceding discussion does not shed light on the relative statistical significance of the twin cycles. To address that issue, we next run a variety of simple regressions that attempt to explain capital flows and growth in emerging markets through developments in the developed economies, particularly the United States. Our sample spans 1970-1999 for all regions except Western Hemisphere, where the debt crisis (1981-1986) period is excluded.

The dependent variable is a real private capital flow measure that is split into four categories: Net capital flows, net direct investment, net portfolio flows, and other capital flows. The regressors in the first set of regressions are real U.S. GDP growth and the U.S.

short-term nominal interest rate (the yield on the three-month Treasury bill). As neither of these variables pose a potential endogeneity problem, our estimation method is simple ordinary least squares. Table 9 reports the results of this regression for all emerging market economies; (Appendix Table 1 reports results for particular regions).

Table 9. U.S. Determinants of Real Capital Flows: 1970-1999

	Dependent variable:	Independent Variables:	
Total Emerging Market Economies		U.S. Real GDP Growth	U.S. Real Interest Rates
	Net Capital Flows	-1.09 (1.11)	-2.32 (0.96)
	Net Direct Investment	0.26 (0.88)	-1.57 (0.76)
	Net Portfolio Investment	-0.33 (0.57)	-1.26 (0.50)
	Other Net Capital Flows	-1.06 (0.88)	0.50 (0.71)

Note: Standard errors are in parentheses.

As shown in Table 9, when examining the results for the emerging market aggregate, as well as for most of the regional subgroups, U.S. nominal interest rates seem to play a more dominant and systematic role in explaining capital flows to emerging markets than U.S. economic growth. As a general rule, rising U.S. interest rates are associated with falling capital flows to emerging markets. In effect, in many of the regressions, the coefficient on growth is negative--suggesting that when the U.S. is enjoying rapid growth--capital stays at home. This effect is most pronounced in Other Net Flows, which largely consists of bank

25

lending. Both FDI flows and portfolio flows are consistently interest rate sensitive.[14]

There are, however, various regional differences worth highlighting.[15]   First, U.S. nominal interest rates are significant in explaining portfolio and FDI flows in all regions--but the impacts are greatest in Western Hemisphere and lowest in Africa. This result may simply highlight that, among the emerging markets with some extent of access to international capital markets (Asia and Latin America), the latter are more heavily indebted and interconnected with the United States. Second, growth in the United States has a significant and positive influence in explaining FDI to Western Hemisphere--which is not the case for other regions. Third, as the descriptive analysis anticipated, the other capital flow category behaves very differently from FDI and portfolio flows.

We next perform a comparable exercise for growth similar to Dornbusch (1985), who focused on the links between developing debtor countries and their developed counterparts. The dependent variable was developing country GDP growth (as is the case here) while the independent variable was measure of OECD growth. [16] He found the coefficient on the OECD growth measure to be statistically significant and in the 0.28-0.76 range. More recently, Frankel and Roubini (2000) regress developing country growth for various regional groupings against the G-7 real interest rate; they found that the coefficients on real interest

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[14] Similar results obtain but are not reported to save space, when developed-country real GDP growth rates are used in lieu of the U.S. growth rate.

[15] This discussion is based on Appendix Tables 1-2.

[16] Dornbusch used industrial production, real GDP growth, and import volume alternatively; the sample was 1961-84.

rates were negative and in most cases statistically significant--with the greatest interest sensitivity in the Western Hemisphere.[17]

Our exercise here combines these two approaches. As shown in Table 10, when GDP growth for the various country groupings is regressed against U.S. growth and real interest rates, the results tend to be quite intuitive. The sensitivity of growth to U.S. growth is highest (and statistically significant) for the newly industrialized Asian Economies, which depend importantly on trade with the United States and lowest for the remainder of Asia. For all developing countries, both of the regressors have the anticipated signs and are statistically significant. A one percentage point decline in U.S. growth rates reduces GDP growth for the developing countries by 0.23 percent while a one percent increase in U.S. real interest rates reduces it by 0.27 percent. Despite strong trade links with the United States for most countries in the region, U.S. growth is not statistically significant for Western Hemisphere, although the coefficient is positively signed. U.S. growth is also significant for the Middle East and European developing countries. Given its history of relatively high levels of indebtedness and periodic debt-servicing difficulties, it is not surprising that the U.S. real interest rate is significant and growth is the most sensitive to interest rate fluctuations in Western Hemisphere; the coefficient (-0.88) is almost four times as large--in absolute terms-- as for all developing countries. Indeed, one cannot reject the hypothesis that a one percent increase in U.S. real interest rates leads to a one percent decline in growth in the region. Real U.S. interest rates are also statistically significant for the Middle East and Europe. At the

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[17] The coefficient for Western Hemisphere was -0.77 compared to -0.39 for all market borrowers.

27

other end, the newly industrialized Asian economies, with low levels of external debt and considerable access to private capital markets, U.S. interest rates are not significant, although the coefficient has the (expected) negative sign. As far as these regressions are concerned, U.S. developments have no systematic relationship with the rest of developing Asia or the transition economies.

Table 10. Developing Country Growth and U.S. Developments

Country Group	Independent variables		
	U.S. GDP growth	U.S. Real Interest Rates	R^2
Newly Industrialized Asian Economies	0.58 (0.26)	-0.21 (0.24)	0.16
Developing Countries	0.23 (0.11)	-0.27 (0.10)	0.25
Africa			
Asia	-0.02 (0.18)	0.20 (0.17)	0.05
Middle East and Europe	0.50 (0.28)	-0.56 (0.27)	0.18
Western Hemisphere	0.20 (0.38)	-0.88 (0.46)	0.22
Countries in Transition	0.37 (0.46)	-0.33 (0.44)	0.03

Note: Standard errors are in parentheses.

Section IV. The Consequences of Exchange Rate and Interest Rate Volatility in the North

To examine the issue of whether the volatility of interest rates and G-3 exchange rates have adverse consequences for cross-border capital flows to emerging markets and growth, we split our sample into periods in which volatility is high and periods in which it is low and conduct a comparable set of exercises as those discussed in the preceeding section.

1. Background on exchange rate variability in emerging markets

The argument that excessive volatility of G-3 exchange rates imposes significant costs on emerging markets seems to rely mostly on a spending channel. A large swing in the

dollar's value on the foreign exchange market in terms of the yen and the euro translates directly into changes in the competitiveness of countries that link their currencies to the dollar–either through a hard peg or a highly managed float. The evidence in Calvo and Reinhart (2000) suggests many developing countries fall into that group. They report a widespread "fear of floating," in that many emerging market currencies tend to track the dollar or the euro closely, even in cases that are officially classified as floating.

From the perspective of aggregate spending, the relevant "exchange rate" for a small open economy would be some index that averages across many bilateral real exchange rates. Consider one such index, w^i, for country i, that is the geometric mean of bilateral real exchange rates, s^{ij} (measured as foreign currency per unit of home currency):

$$w^i_t = \prod_{j=1}^{k} (s^{ij}_t)^{\sigma^j}. \tag{2}$$

Reasonable weights, which presumably reflect bilateral or multilateral trade shares, would sum to one.[18] Because such an index is linearly homogeneous, we can write it in terms of the dollar exchange rate for country i and corresponding bilateral dollar cross rates for all the other currencies. That is, if s^{i1} and F^1 are the foreign exchange value of the dollar in terms of units of the currency of country i and the trade share with the United States, respectively, we can write:

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[18] See, for instance, *International Financial Statistics,* where the International Monetary Fund calculates real effective exchange rate indexes using multilateral trade weights.

$$w_t^i = s_t^{i1} \prod_{j=2}^{k} \left\{ s_t^{ij} \bigg/ s_t^{i1} \right\}^{\sigma^j}. \tag{3}$$

Thus, movements in the effective exchange rate for country i can be thought of as owing to movements in the dollar exchange rate of country i and all other relevant dollar cross exchange rates.

For the purpose at hand, we can use the log difference in this relationship to parse the relative contribution of variability in the G-3 cross rates to the overall variability in emerging market exchange rates. In principle, the movement in the weighted effective exchange rate owes to changes in the country's exchange rate vis-a-vis the dollar, the changes in the two bilateral G-3 exchange rates, and all other changes in bilateral dollar exchange rates, as in:

$$\Delta w_t^i = a_1 + a_2 \Delta s_t^{1i} + a_3 \Delta (DM / \$)_t + a_4 \Delta (Yen / \$)_t + \cdots \tag{4}$$

The issue that concerns us is the effects of changes in the bilateral G-3 exchange rates on the overall volatility of the emerging market weighted exchange rate, which presumably then influences economic growth and capital flows.

2. *Stylized Evidence*

Some sense of the stakes for emerging-market economies can be gotten from Figures 8 through 11 and Tables 11 and 12. We calculated simple annual averages of the absolute value of the monthly changes in the logarithms of the real deutsche mark/dollar and real

31

yen/dollar exchange rates from 1974 to 1999 and the percentage point change in the real U.S Treasury bill rate (on the rationale that most developing country borrowing is denominated in U.S. dollars).

Figures 8 and 9 split the sample into two states of nature, those in which U.S. interest rate volatility is above the median and those periods in which it is below the median. As before, we report the volume of real capital flows by country grouping and type across the sample split. When considering aggregate net private flows (Figure, 6 top panel), the results appear to run counter to our priors that increased uncertainty may lead to lower levels of cross border flows.[19] Much the same can be deduced from Figure 7 for portfolio flows and other capital flows. We then divided the sample into four cells corresponding to the combinations possible when those two volatility measures were above or below their respective median values.

The top panel of Table 12 reports the average annual growth rates of real GDP in developing countries. As is evident from the first column, economic growth in developing countries tends to be faster against a backdrop of more stable U.S. short-term interest rates. Moreover, over the past twenty years it would have been a bad bet for developing countries to trade times when G-3 foreign exchange rates were volatile but U.S. interest rates stable (the lower left cell) for times when G-3 foreign exchange rates were stable but U.S. interest rates were volatile (the upper right cell). The 1-1/4 percentage point difference in real GDP growth between the two cells does suggest some caution in assuming that emerging-market

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[19] Of course, this may well be the case for gross flows but it is not the case for net flows.

economies necessarily benefit from reduced exchange rate variability of the G-3 currencies.

The lower two panels address the possibility of nonlinearities in the responses of developing countries by using an indicator approach. In the middle panel, data on the number of currency crises in developing countries by year are sorted according to G-3 exchange rate and interest rate volatility (with the crisis indicator defined according to the methodology in Frankel and Rose, 1996, as recently updated and extended to a larger country set by Reinhart, 2000).[20]   The bottom panel reports similar calculations using the number of banking crises from the same source. As can be seen in the first column of both panels, years in which interest-rate volatility in the United States was below its median over the past twenty years were associated with relatively fewer crises in developing countries. But it is also the case that low G-3 exchange rate volatility (the two top rows) was also associated with fewer crises. Thus, while low volatilities in financial asset prices appear conducive to avoiding crisis in developing countries, the net benefit of trading between G-3 exchange rate and interest-rate volatility would seem to be ambiguous.

Table 11. Real Capital Flows and Volatility: Total Emerging Market Economies
(Billions of 1970 U.S. dollars)

Net Private Capital Flows	G-3 exchange rate variability	Real interest rate volatility is:	
		higher	lower
	higher	14.9	15.0
	lower	19.9	13.4
Net Private Direct Investment			
	higher	4.3	14.8

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[20] The results are similar using the methodology of Kaminsky and Reinhart (1999).

	lower	7.7	10.0
Net Private Portfolio Investment			
	higher	1.4	3.0
	lower	9.0	5.1
Other Net Private Capital Flows			
	higher	5.2	-1.1
	lower	2.0	-2.9

Source: *World Economic Outlook*, International Monetary Fund.

Table 12. Real GDP Growth, Financial Crises and Volatility: Total Emerging Market Economies
(Billions of 1970 U.S. dollars)

Real GDP growth (percent, annual rate)	G-3 exchange rate variability	Real interest rate volatility is:	
		higher	lower
	higher	5.1	4.3
	lower	5.5	4.5
Incidence of currency crises			
	higher	12.7	27.3
	lower	30.9	29.1
Incidence of banking crises			
	higher	16.7	28.8
	lower	28.8	26.7

Source: Real GDP, IMF *World Economic Outlook* (2000); incidence of currency and banking crises, Reinhart (2000). The sample is divided based on the medians of the annual averages of the monthly absolute change in the logarithms of the yen/dollar and deutsche-mark/dollar exchange rates and in the percentage point change in the nominal U.S. three-month Treasury bill rate.

3. Basic Tests

Table 13 reports our efforts to put some confidence bands about the estimates of the effects of interest-rate and exchange-rate volatility on capital flows. The table provides the coefficients of regressions of real capital flows on a constant (not shown) and dummies representing above-the-median values for the volatilities of U.S. real interest rates and G-3 exchange rates. There appears to be no significant effect on average of episodes of higher volatilities by either measure for topline net capital flows. Taken literally--no doubt too literally--this would indicate there is no particular cost to making real interest rates more volatile, but there are no particular benefits either in damping G-3 exchange rate volatility.

Higher G-3 exchange rate volatility does appear to pull down net private direct investment in a statistically significant manner. However, there is a more-than-compete offset, also statistically different from zero, in other net capital flows. Real interest rate volatility tends only to reduce net portfolio investment in a reliable manner.

This statistical evidence comes out not much different than the theoretical analysis: From the perspective of emerging market economies, the case for limiting G-3 exchange rate volatility is not proven. A similar analysis across regional aggregates, not shown to conserve on space, provides no reason to question that judgment.

Table 13. Real Capital Flows and Volatility in the North: 1970-1999

	Dependent variable:	Independent Variables:	
Total Emerging Market Economies		High Volatility in U.S. interest rates	High volatility in G-3 exachange rates
	Net Capital Flows	2.52 (5.82)	-1.95 (5.91)
	Net Direct Investment	0.45 (4.29)	-7.24 (4.22)
	Net Portfolio Investment	-5.03 (2.89)	0.63 (2.84)
	Other Net Capital Flows	2.64 (3.69)	9.13 (3.63)

Notes: Standard errors are in parentheses.

V. Concluding Remarks

In this paper, we have attempted to analyze and quantify how developments the exchange rate arrangements of the G-3 countries influence emerging markets economies.

TO do required us to assess the effects of developments in the industrial world on capital flows and economic growth in the emerging world. Recessions in the United States

36

are associated with a lower volume of capital flows to emerging markets, FDI flows are particularly sensitive to the growth cycle. Other capital flows (which include bank lending and capital flight), however, behave countercyclically--as banks seek to lend abroad as U.S. loan demand weakens during recessions. This offset has, at least historically cushioned the blow. Other things equal, lower U.S. real GDP growth is also associated with lower growth in developing countries. The difference in U.S. GDP growth rates between expansions and recessions is 3.3 percent. Hence, in an "average" U.S. recession, the slowdown alone would shave about 3/5 percent off growth in developing countries GDP growth (Table 11). However, some regions like Western Hemisphere and the newly industrialized economies of Asia would be hit harder.

But other things are not equal, nominal and real interest rates usually fall during recessions as the Federal Reserve attempts to revive the economy. Real interest rates typically fall by about one-and-half percent during recessions, which translates (other things equal) to about half a point boost to real GDP growth for the all developing country category (Table 11) and considerably more for the relatively indebted nations of Western Hemisphere (which maintain access to international capital markets).

The debate on G-3 target zones should be put into the broader perspective of the ongoing debate on exchange–rate arrangements in emerging market economies, which usually hinge on credibility. The advocates for dollarization, for instance, argue that a nation with an uneven history of showing a commitment to low inflation can import the reputation of the central bank of the anchor currency. For the issue at hand, however, there are no

obvious credibility bonuses to smaller countries should G-3 central banks damp the fluctuations of their currencies. This also implies that the direct benefits to emerging market economies should stem only from the lessened volatility of their trade-weighted currencies. But as Rose (1999) points out, the benefits of reduced exchange rate variability on trade flows, at least, are small compared to adopting a common currency.

This is also the place to discuss the limitations to our analysis. In particular, our use of linear–or nearly linear models–may understate the consequences of variability in interest rates and exchange rates. To the extent that high world interest rates trigger balance sheet problems in emerging markets, the consequences of the tradeoff implied by a target zone may be considerable. Indeed, one repeated message of this paper is that emerging market economies, which have already surrendered a high degree of autonomy in their monetary policies, often price their goods in foreign–not local–currencies, and can be shut out of world financial markets suddenly, are different from their industrial brethren.

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Appendix Table 1. U.S. Determinants of Real Capital Flows: 1970-1999

Africa			
	Net Capital flows	0.04 (0.19)	0.21 (0.17)
	Net Direct Investment	0.00 (0.04)	-0.07 (0.03)
	Net Portfolio Investment	0.04 (0.05)	-0.09 (0.04)
	Other Net Capital Flows	0.00 (0.20)	0.37 (0.18)
Other Asian Emerging Markets			
	Net Capital flows	-0.06 (0.31)	-0.26 (0.27)
	Net Direct Investment	0.07 (0.31)	-0.64 (0.27)
	Net Portfolio Investment	-0.04 (0.06)	-0.04 (0.05)
	Other Net Capital Flows	-0.09 (0.28)	0.42 (0.25)

Appendix Table 2. U.S. Determinants of Real Capital Flows: 1970-1999

Asia, Crisis Countries			
	Net Capital flows	-0.42 (0.39)	0.05 (0.34)
	Net Direct Investment	0.02 (0.06)	-0.12 (0.06)
	Net Portfolio Investment	-0.05 (0.15)	-0.25 (0.13)
	Other Net Capital Flows	-0.35 (0.29)	0.43 (0.29)
Western Hemisphere			
	Net Capital flows	0.70 (0.91)	-2.71 (0.85)
	Net Direct Investment	1.69 (0.84)	-0.93 (0.79)
	Net Portfolio Investment	0.03 (0.81)	-2.60 (0.75)
	Other Net Capital Flows	-0.97 (0.89)	0.83 (0.83)

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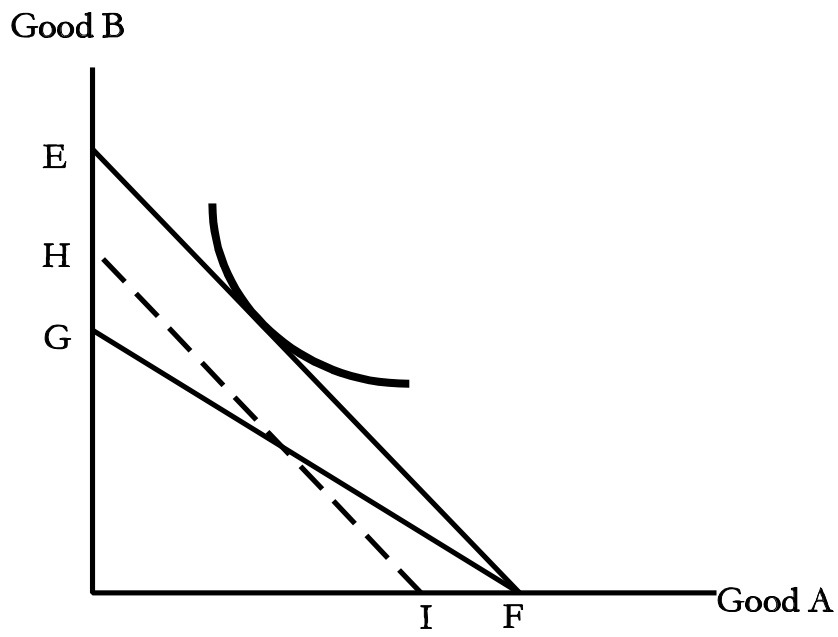
Figure 1: Welfare in a Small Open Economy

Figure 2. Real Capital Flows to Emerging Markets and the U.S. Business Cycle
1970-1999
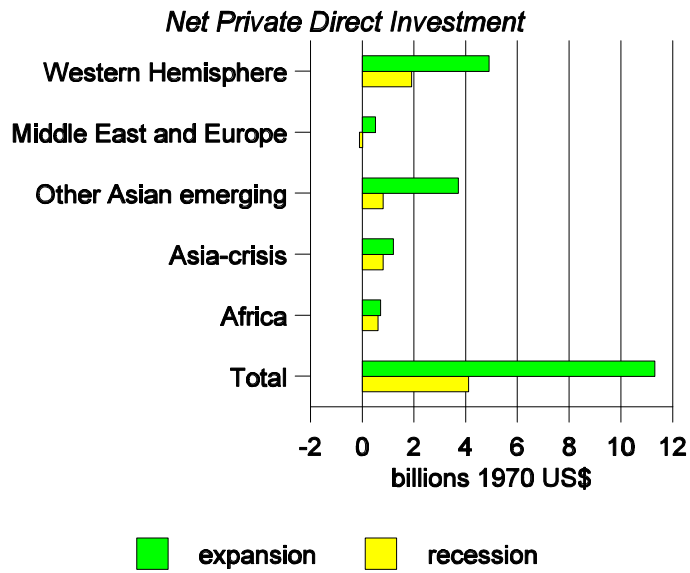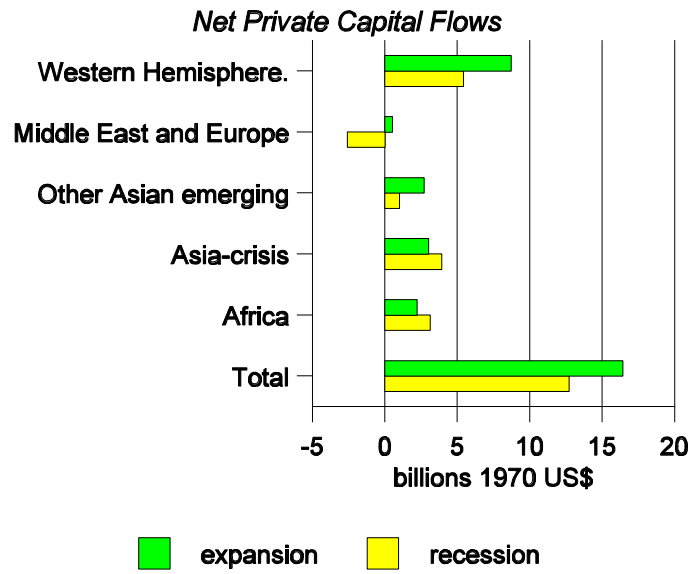
Figure 3. Real Capital Flows to Emerging Markets and the U.S. Business Cycle
1970 to 1999 (continued)

Net Private Portfolio Investment

Other Net Private Capital Flows
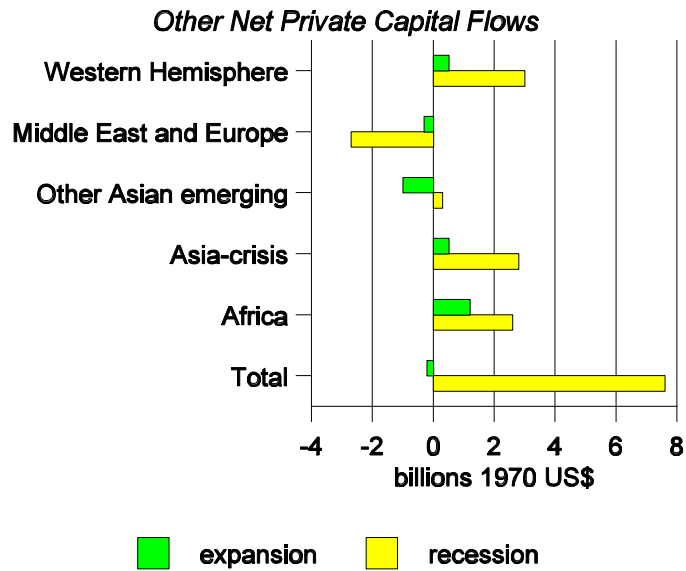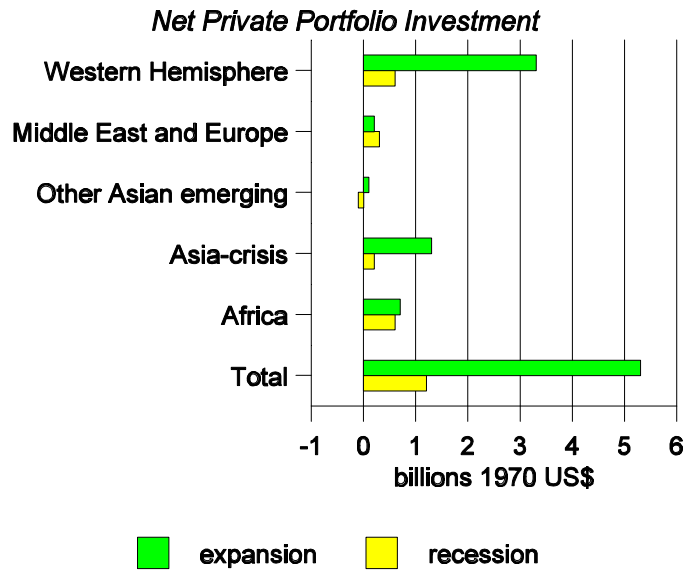
Figure 4. Real Capital Flows to Emerging Markets and the Monetary Policy Cycle
(direction of nominal interest rates)
1970-1999

Net Private Capital Flows

easing   tightening

Net Private Direct Investment

easing   tightening
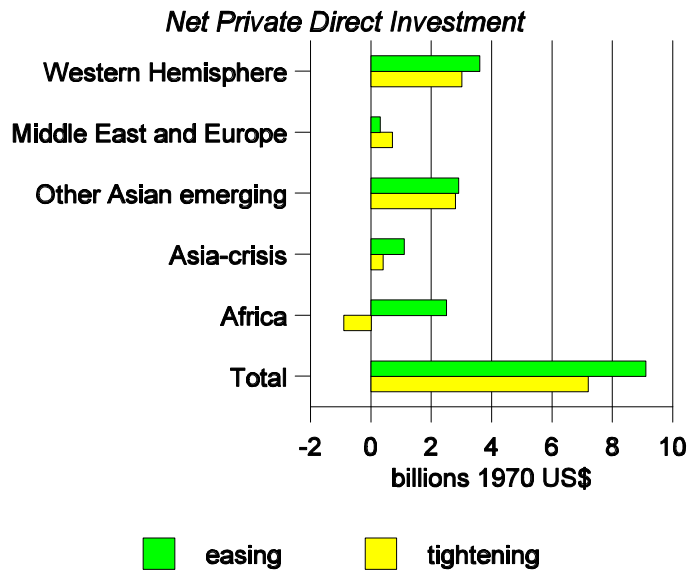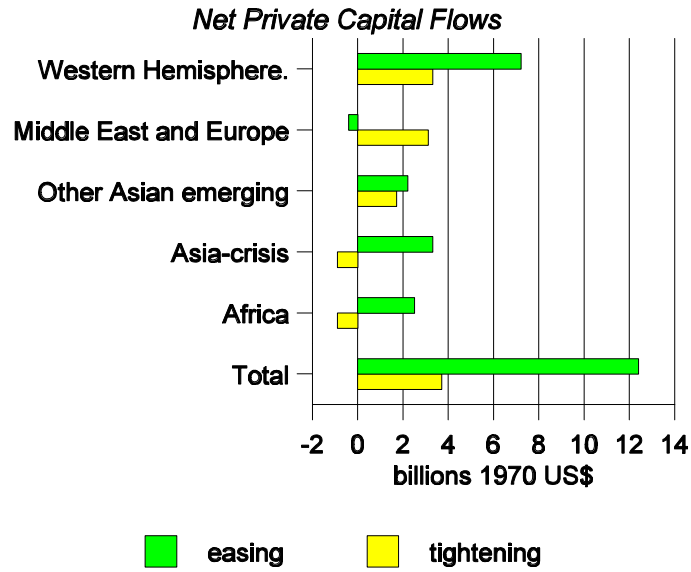
Figure 5. Real Capital Flows to Emerging Markets and the U.S. Monetary Policy Cycle
(direction of nominal rates, continued)
1970 to 1999

Net Private Portfolio Investment

Net Private Portfolio Investment
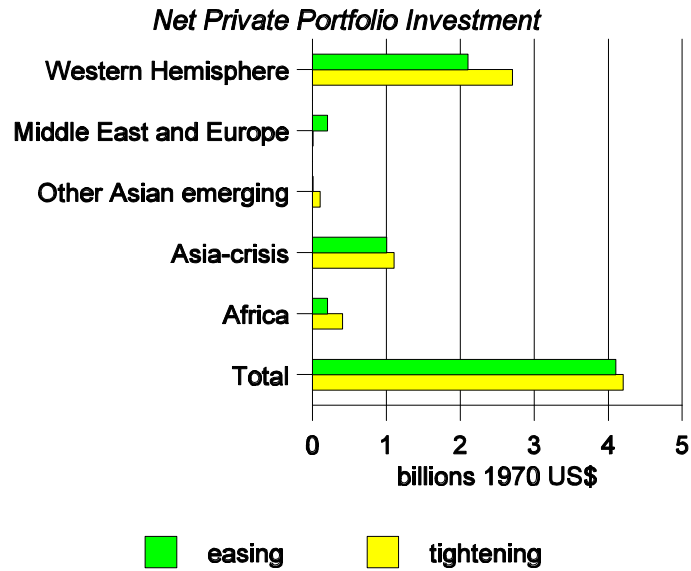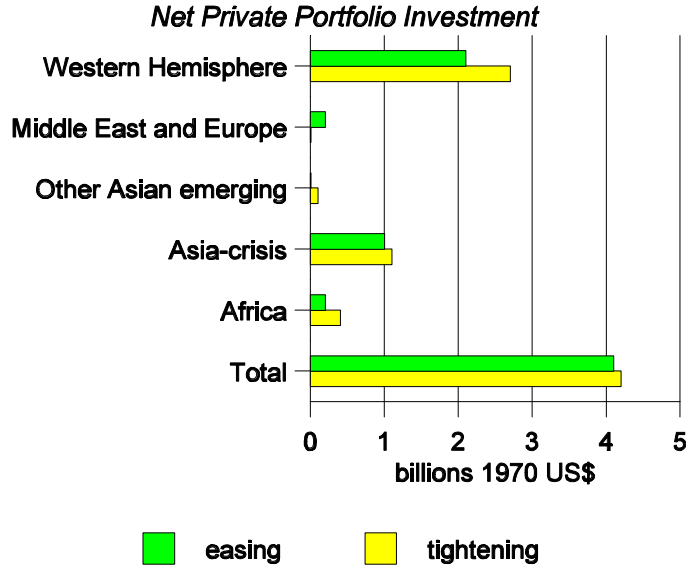
Figure 6. Real Capital Flows to Emerging Markets and the Monetary Policy Cycle (level of real rates) 1970-1999

Net Private Capital Flows

Categories (top to bottom): Western Hemisphere., Middle East and Europe, Other Asian emerging, Asia-crisis, Africa, Total

X-axis: -2 0 2 4 6 8 10 12 14
billions 1970 US$

Legend: ■ lower real rates   ■ higher real rates

Net Private Direct Investment

Categories (top to bottom): Western Hemisphere, Middle East and Europe, Other Asian emerging, Asia-crisis, Africa, Total

X-axis: -2 0 2 4 6 8 10
billions 1970 US$

Legend: ■ easing   ■ tightening

Figure 7. Real Capital Flows to Emerging Markets
and the Monetary Policy Cycle (level of real rates, continued)
1970-1999
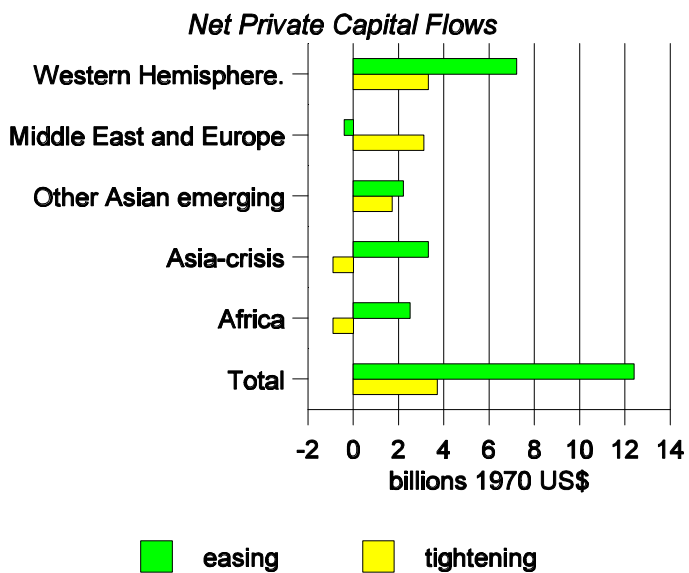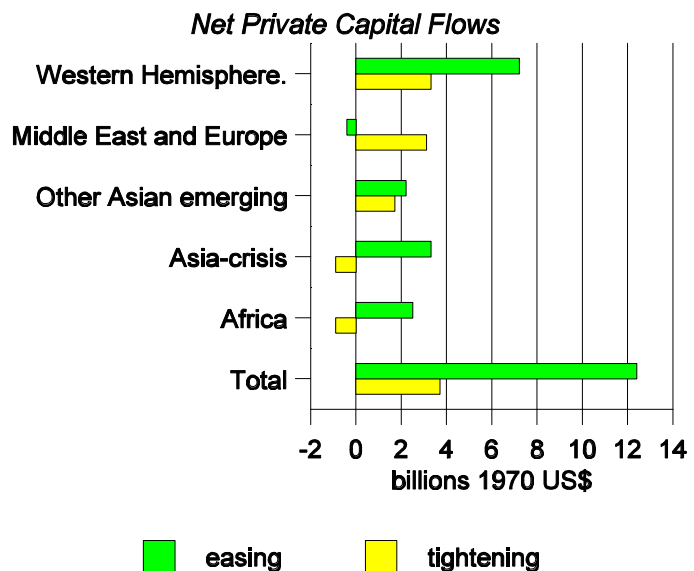
Figure 8. Real Capital Flows to Emerging Markets and Real Interest Rate Volatility
1970-1999

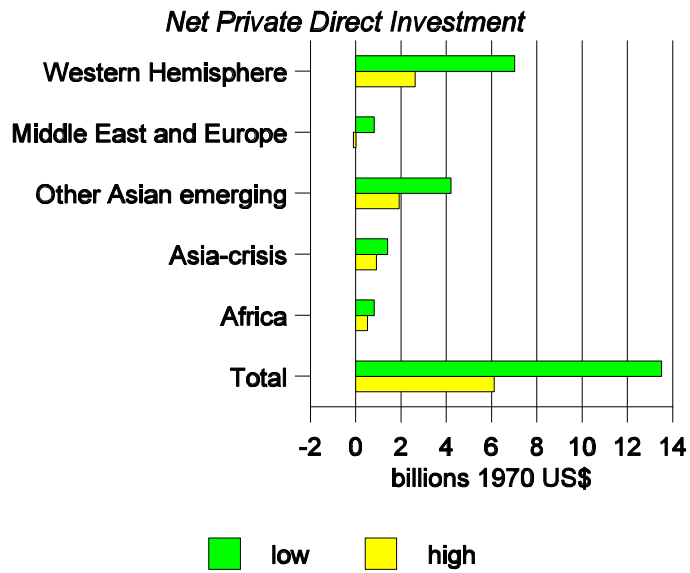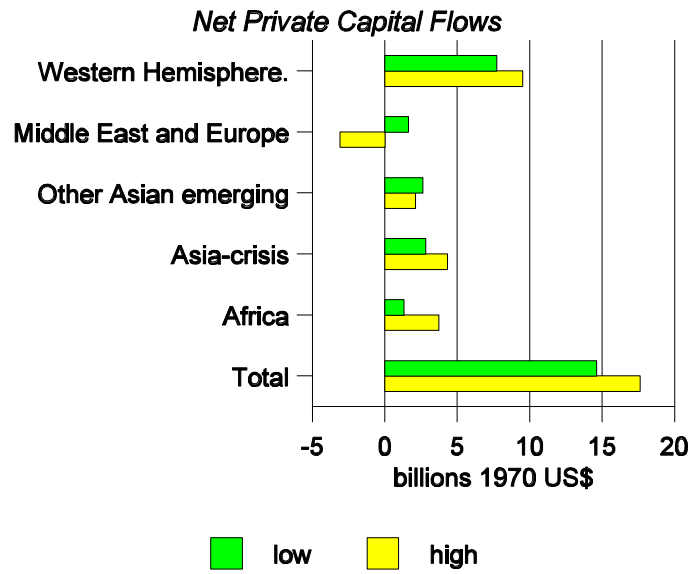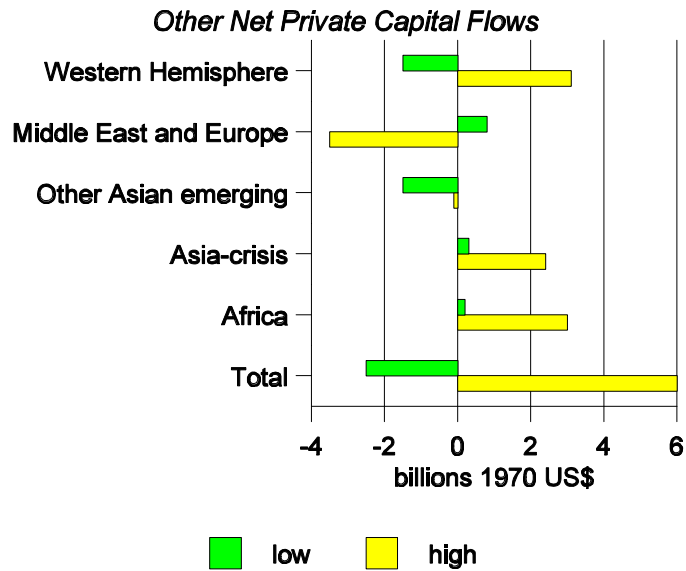**Net Private Capital Flows**

Net Private Direct Investment

Figure 9. Real Capital Flows to Emerging Markets and Real Interest Rate Volatility
1973 to 1999 (continued)

Net Private Portfolio Investment

Other Net Private Capital Flows
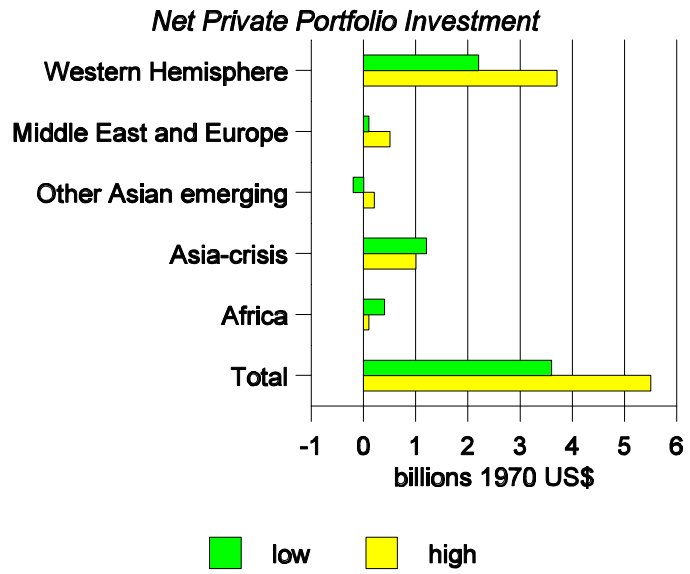
Figure 10. Real Capital Flows to Emerging Markets and G-3 Exchange Rate Volatility
1970-1999

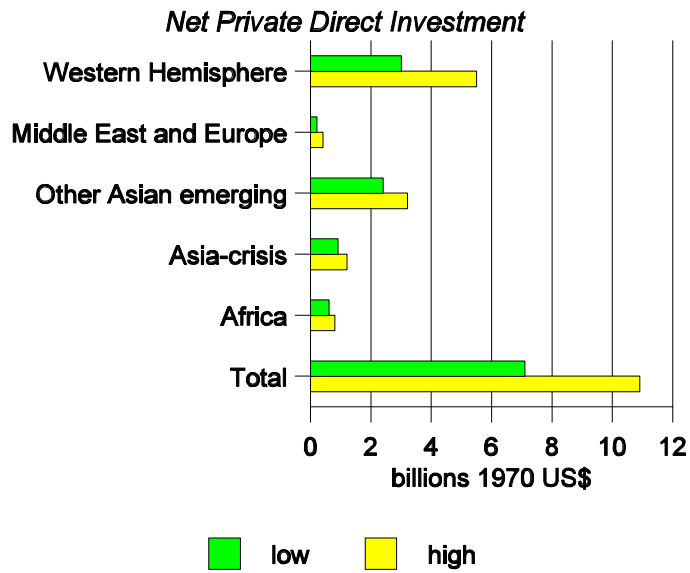**Net Private Capital Flows**
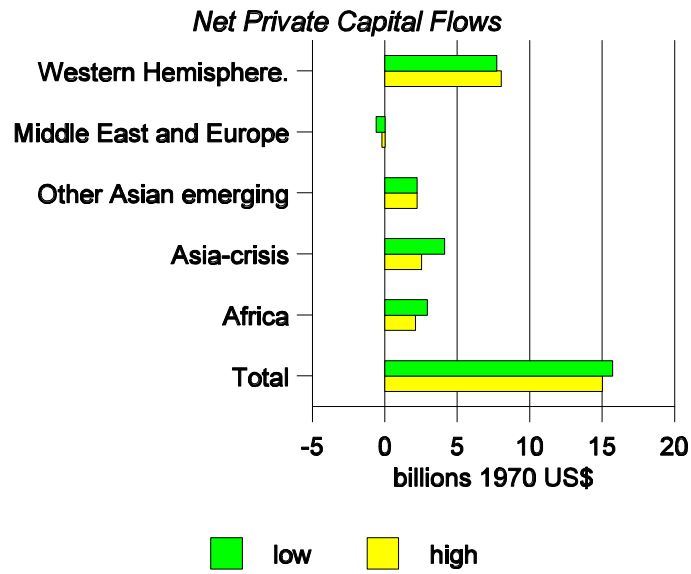
Net Private Direct Investment

Figure 11. Real Capital Flows to Emerging Markets and G-3 Exchange Rate Volatility 1970 to 1999 (continued)

Net Private Portfolio Investment

Other Net Private Capital Flows