# FOREIGN INVESTMENT FLUCTUATIONS AND EMERGING MARKET STOCK RETURNS: THE CASE OF MEXICO

by
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**Abstract**

We investigate the economically and statistically significant positive correlation between monthly foreign purchases of Mexican stocks and Mexican stock returns. We find that a 1 percent of market capitalization surprise foreign inflow is associated with a 13 percent increase in Mexican stock prices. We explore whether this correlation might be explained by permanent reductions in conditional expected returns resulting from expansion of the investor base along the lines modeled by Merton (1987), or correlations with other factors causing returns, price pressures, or positive feedback strategies by foreign investors, and conclude that the available evidence is consistent with the base-broadening hypothesis.

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# FOREIGN INVESTMENT FLUCTUATIONS AND EMERGING MARKET STOCK RETURNS: THE CASE OF MEXICO*

The current decade has witnessed a remarkable turnaround in investors' attitudes toward foreign stocks. As discussed by French and Poterba (1991), Lewis (1994), and Tesar and Werner (1995), at the start of this decade investor portfolios demonstrated strikingly, indeed puzzlingly high weightings toward home country equities. Yet, in the 1990s investors have apparently awakened to the benefits of greater international diversification. For example, from 1989 through 1995 U.S. investors purchased foreign shares at 25 times the rate observed during the previous ten years. The change in flows has been particularly dramatic with respect to the so-called "emerging markets" of Asia and Latin America, where foreigners have moved in recent years from holding almost no shares to a sizeable proportion of the market.

The literature on equity market segmentation (see Stulz (1995)) implicitly suggests that such dramatic changes in the investor base for emerging market equities should have profound implications for their pricing: in particular, because of greater risk sharing and increased liquidity, expected returns should fall and prices should rise.

In this paper we test this "base broadening" hypothesis--that foreign inflows cause emerging equity prices to rise--using monthly data from Mexico, the emerging economy that has received the largest amount of such inflows during the last seven years. Our discussion below is

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organized as follows. We begin by briefly discussing the theoretical basis for the base-broadening hypothesis, placing particular emphasis on the model of market segmentation proposed by Merton (1987). We then lay out our econometric strategy for quantifying the size of the base-broadening effect. For the most part, we apply the methodology used by Warther (1995) to analyze the impact of mutual fund flows on U.S. stock and bond prices. We extend Warther's approach, however, by broadening his set of tests for distinguishing the base-broadening hypothesis against several relevant alternatives that might account for the positive correlation, evident in the data, between inflows and returns. The next two sections discuss the sources of data used for the study and briefly overview the pattern of equity inflows to Mexico; further details are provided in the appendix. We then discuss the results of our econometric tests. We present our summary and conclusions in the final section.

## I. The Base-broadening Hypothesis

The theoretical literature on market segmentation suggests two important reasons why an exogenous increase in foreign participation could have propelled Mexican share prices to a permanently higher level, other things being equal. Broadening the investor base increases diversification and risk sharing, lowering the required risk premium for Mexico specific volatility (Merton (1987) and Errunza and Losq (1985 and 1989)). Additionally, the influx of new investors could have lowered the perceived liquidity risk of Mexican stocks (Pagano (1989), Allen and Gale (1991), and Hargis (1995.))[1]

Merton (1987) provides an intuitive and tractable model for illustrating how broadening the investor base for a given stock, and by extension for an emerging equity market, may raise

equity prices through risk pooling. In Merton's model, investors are assumed to invest in only an exogenously determined subset of the universe of equities. Merton characterizes the assumed barriers that prevent investors from holding fully diversified portfolios as informational, i.e. investors invest only in stocks about which they are "informed." However, he notes that his approach is consistent with explaining the impact of other barriers such as institutional restrictions including "...limitations on short sales, taxes, transactions costs, liquidity, and imperfect divisibility of securities."[2]

Merton demonstrates that in his framework if investors were able to invest in (that is, were "informed" about) all equities, the standard Capital Asset Pricing Model pricing relations would prevail, that is, the expected return on a given share (or market) would be a function of its covariance with the global market, but not its variance. However, with segmentation restrictions, the expected return on a share with a restricted investor base will be higher than its unrestricted return by a risk premium that will be an increasing function of the stock's conditional variance, the narrowness of the investor base and investors' risk aversion. Stocks (and, by extension, markets) with narrow investor bases exhibit higher expected returns because for the holders of these shares the variance of the returns on the stocks is more systematic than it appears from the perspective of the market as a whole. Specifically Merton shows that

$$E(R_k) - E(R^*_k) = \lambda_k [\, E(R^*_k)/R] \qquad (1)$$

where $E(R_k)$ is the equilibrium expected return on the kth security in the segmented market case, $E(R^*_k)$ is the expected return in the complete absence of segmentation restrictions, R is the rate of return on the risk free asset and $\lambda_k$ is the shadow cost of the segmentation restriction. $\lambda_k$ in turn is shown to be equal to:

$$\lambda_k = \frac{\delta \sigma_k^2 x_k (1 - q_k)}{q_k} \tag{2}$$

where $\delta$ is the coefficient of aggregate risk aversion, $\sigma_k^2$ is the idiosyncratic component of the variance of the kth stock's return, $x_k$ is the kth stock's share of the aggregate market portfolio, and $q_k$ is the share of the total investor universe that invests in (and is "informed" about) stock k. Merton also derives the comparative static result that as the investor base increases (i.e. $q_k$ rises), equilibrium required returns fall, and prices ($P_k$) rise; that is,:

$$\frac{\partial P_k}{\partial q_k} = \frac{P_k \delta x_k \sigma_k^2}{q_k^2} > 0. \tag{3}$$

In the Mexican context, Merton's $q$ would measure the ratio of the number of investors that are "informed" about Mexican stocks to the total number of investors:

$$q \equiv \frac{n_m + n_f^i}{N} \tag{4}$$

where $n_m$ is the number of Mexican investors (who are all assumed to be "informed" about Mexican stocks), $n_f^i$ is the number of foreign investors "informed" about Mexican stocks, and $N$ is the total number of investors. Though we lack direct observations on $q$, we can infer changes in $q$ from changes in foreigner's holdings of Mexican stocks as a percentage of Mexican market capitalization, defined as $\theta$, assuming the number of domestic investors is held constant. Merton's model implies that if domestic and "informed" foreign investors have the same

information sets, they will allocate their portfolios equivalently. Hence, $\theta$ will equal the ratio of "informed" foreign investors to the total of "informed" foreign investors and Mexican investors:

$$\theta = \frac{n_f^i}{n_m + n_f^i} \tag{5}$$

For example, if foreign investors account for one-half of the investors that are "informed" about Mexico, according to Merton's model they would be expected to account for one-half of the holdings of Mexican stocks. By substitution and rearrangement, $q$ can be rewritten, as follows:

$$q = \frac{n_M}{N} \cdot \left[\frac{1}{1-\theta}\right] . \tag{6}$$

This expression implies that:

$$\frac{\partial q}{q} = \frac{\partial \theta}{1-\theta} \tag{7}$$

Substituting into equation (3) from the main text, and rearranging, we have that:

$$\frac{\partial P_k}{P_k} = \left[\frac{\delta x_k \sigma_k^2 N}{n_M}\right] \partial \theta \tag{8}$$

Finally, noting that the foreign share, $\theta$, will change with net foreign purchases of Mexican equities ($Np_t$) as a percentage of Mexican market capitalization ($MCap_{t-1}$), we can conjecture the following testable hypothesis based on Merton's comparative statics. In a regression of the form:

$$Return_t = \beta_0 + \beta_1 \frac{NP_t}{MCap_{t-1}} \quad (9)$$

where $Return_t$ is the return on Mexican stocks during month t, we would expect to reject the null that the coefficient on net purchases, $\beta_1$, equals zero in favor of the one sided alternative: $\beta_1 > 0$.[3] The specification of equation (9) parallels the basic form of the regressions in Warther's (1995) study of mutual fund flows and U.S. stock and bond returns.[4]

*A. Expected versus unexpected inflows*

Even if the base-broadening hypothesis is true, the $\beta_1$ coefficient from regression (9) would likely understate the impact of foreign inflows on Mexican equity prices. The efficient markets hypothesis implies that relevant information available at the start of the period should already be reflected in the price of assets at the start of the period. Hence, if foreign demand is expected to ultimately push prices to a higher equilibrium level, but foreigners only invest gradually, prices should rise ahead of the actual inflows. Moreover, if investors are unsure of the magnitude of new foreign demand for Mexican stocks, the arrival of new information that causes investors to raise their estimate of total foreign inflows should push prices to a higher level.[5]

These considerations suggest that instead of regressing returns on actual changes in the investor base, we should regress returns on expectational revisions about the evolution of the investor base. Unfortunately such expectational revisions are not directly observable. However, if we assume that investors forecast the future evolution of the investor base by studying realized flows, i.e. if:

$$E_t(\mathcal{S}_{k,t+1}) = \mathcal{F}(a_1, a_2, \ldots a_n, Np_{t-1}, \ldots Np_{t-n}, b_1, b_2, \ldots b_j, \Omega_{t-1}, \ldots \Omega_{t-m}) \quad (10)$$

where $\mathcal{S}_{t+1}$ are foreign holdings of market k in period t+I, $\mathcal{F}(\,)$ is the forecasting function, the $a_j$ and $b_j$ are coefficients from the distributed lag processes A(L) and B(L) from the time series for net purchases:

$$Np_t = A(L)Np_{t-1} + B(L)\Omega_{t-1} + \epsilon_t \quad (11)$$

and $\Omega_{t-1}$ is a vector of other variables useful for forecasting net purchases, then innovations in the time-series of net purchases can serve as a proxy measure for expectational revisions to the time path of investor inflows. Hence, if we define unexpected net purchases, $U_t(NP_t/MCap_{t-1})$, as being equal to observed purchases minus investors' expectation of net purchases, $E_t(NP_t/MCap_{t-1})$, i.e.

$$U_t\left[\frac{NP_t}{MCap_{t-1}}\right] \equiv \frac{NP_t}{MCap_{t-1}} - E_t\left[\frac{NP_t}{MCap_{t-1}}\right] \quad (12)$$

we would expect returns to co-vary with unexpected purchases, but not with expected purchases. That is to say, in a regression of the form

$$Return_t = \beta_0 + \beta_1 \cdot U_t\left[\frac{NP_t}{MCap_{t-1}}\right] + \beta_2 \cdot E_t\left[\frac{NP_t}{MCap_{t-1}}\right] \quad (13)$$

we would expect to find that returns would show significant co-variance with unexpected inflows, but less co-variance with expected inflows: $\beta_1 > \beta_2 \geq 0$.

Strictly speaking, we might expect $\beta_2$ to be equal to zero if we were able to accurately measure investors' expectations. However, given our short sample size, we are limited to within sample estimation of the forecasting model for expected inflows. Hence, we may ascribe to

investors an overly accurate understanding of the time series process for net purchases. In that case, our estimated value of expected net purchases may include some unexpected net purchases, and we would reject the hypothesis that $\beta_2 = 0$.

*B. Distinguishing the base-broadening hypothesis from relevant alternatives*

We consider a number of alternative hypotheses that can be advanced to explain the correlation between net foreign purchases and Mexican stock returns. We focus on these hypotheses because of their plausibility as well as the fact that they have other testable implications that potentially allow us to discriminate between them and the base-broadening hypothesis. Below we discuss our strategy for distinguishing between the base-broadening hypothesis and, respectively, the price pressure hypothesis, the omitted variables hypothesis, and the positive feedback hypothesis. Table I summarizes the testable implications of these alternative hypotheses which we develop in more detail below.

*C. Alternative 1: The price pressure hypothesis*

Considerations based on improved risk sharing and increased liquidity suggest that increased foreign participation should produce, ceteris paribus, a permanent reduction in risk premia and, hence, a permanent price rise. An alternative theory, which Warther (1995) refers to as the price pressure hypothesis, suggests that the rises in prices associated with inflow surges are due to temporary illiquidity; such a theory would predict that inflow induced price increases would be subsequently reversed. For example, Shleifer (1986) and Harris and Gurel (1986) presented evidence that increases in stock prices resulting from the announcement of inclusion of individual stocks in the S&P 500 index are at least partially reversed over the subsequent 30 to 60

trading days.[6] The hypothesis of temporary illiquidity would appear plausible in the context of an emerging market such as Mexico. To test for the existence of such reversals, we adapt the approach of Warther and add lagged values of surprise inflows for the previous three months to our regression equation:[7]

$$Return_t = \beta_0 + \sum_{i=1}^{4} \beta_i \cdot U_{t+1-i}\left(\frac{NP_{t+1-i}}{MCap_{t-i}}\right) \tag{14}$$

If the price-pressure hypothesis is true, we would expect to find that lagged surprise inflows have significant negative coefficients. In particular, we would expect to reject the null hypothesis

$$H_0: \quad \beta_2, \beta_3, \beta_4 = 0 . \tag{15}$$

In the limit, the sum of the coefficients might equal the positive coefficient on contemporaneous inflows.

*D. Alternative 2: The omitted-variables hypothesis*

If inflows are correlated with other factors that also move prices, then the correlation between inflows and prices may reflect primarily the influence of these third factors, and not the independent effect of foreign portfolio shifts. To control for possible omitted variable bias, we added several additional regressors, discussed in Section II.A, that help explain Mexican equity returns:

$$Return_t = \beta_0 + \beta_1 U_t(NP_t/MCap_{t-1}) + \bar{\beta}\, \mathbf{Z}_t \tag{16}$$

where $\mathbf{Z}_t$ is a vector of additional regressors and $\bar{\beta}$ is a vector of coefficients. Under the joint hypotheses that the omitted variable hypothesis is true, and that we have correctly included the

variables for which inflows were acting as a proxy, we would not expect to reject the null that the coefficient on surprise returns in a multi variate regression is equal to zero:

$$H_0: \quad \beta_1 = 0. \tag{17}$$

Alternatively, if the base-broadening hypothesis is true, we would still expect to be able to reject this null hypothesis, although the magnitude of the coefficient on inflows, $\beta_1$, might change.

While this approach of adding regressors potentially might allow us to dismiss the correlation between inflows and returns as being driven by third factors, it must be admitted that it cannot provide definitive proof of the converse. The possibility exists that some other omitted variables could be playing the hypothesized role of driving both inflows and returns. The power of this test is clearly a function of the proportion of the variation in returns that we are able to explain through the addition of these extra explanatory variables.

*E. Alternative 3: The positive feedback hypothesis*

If foreign investors are reacting to recent movements in Mexican prices by buying on increases and selling on declines (i.e. following a positive feedback strategy), then, because of temporal aggregation, we might find a statistically significant correlation between inflows and contemporaneous returns even if inflows are not causing returns. As noted by Warther, an approach that could potentially uncover such feedback trading would be to regress surprise inflows on lagged returns, to see whether lagged returns appear to have significant explanatory power. However, the power of this test might not be limited if investors' feedback horizon is quite short compared to the frequency of the available data, for example a feedback horizon of one or two weeks, when one is constrained to using only monthly data.

Warther confronted the same problem in his analysis of U.S. mutual fund flows and proposed a solution, which we follow here, that takes advantage of the fact that return data are available at a higher frequency. Warther noted that if the positive feedback hypothesis is true, then there should be a higher correlation between flows over the whole month and returns during the weeks at the beginning of the same month and end of the previous month, than between monthly flows and returns during the last week of the same month. Hence, Warther constructed series for returns during the first to fourth week of each month and regressed unexpected inflows on returns during each of the four weeks of the same and the preceding months. Similarly, we tested for feedback effects by regressing surprise inflows on the sum of the returns over each of the four weeks of the same month, as well as on the returns for each of the weeks 1 to 3 of the current month, and weeks 3 and 4 of the previous month:

$$U_t(NP_t/MCap_{t-1}) = \beta_0 + \beta_1 Sum_t + \beta_2 W3_t + \beta_3 W2_t + \beta_4 W1_t + \beta_5 W4_{t-1} + \beta_6 W3_{t-1} \qquad (18)$$

where

$$Sum_t = W4_t + W3_t + W2_t + W1_t \qquad (19)$$

and we follow Warther in defining week 1 returns ($W1_t$) as the returns over the first seven calendar days of the month, week 2 returns ($W2_t$) as the returns over the second seven calendar days, week 4 returns ($W4_t$) as the returns over the last seven calendar days, and week 3 returns ($W3_t$) as the return over the seven calendar days ending with the beginning of week 4.[8] Under the positive feedback hypothesis, we would expect to reject the null of zero coefficients on the individual weekly returns:

$$H_0: \quad \beta_2, \beta_3, \beta_4, \beta_5, \beta_6, = 0 . \qquad (20)$$

In contrast, the base broadening hypothesis--which would predict an equal impact for each of the weeks in the current month and no impact from last month--would not lead us to expect rejection.

## II. Data sources and definitions

Table II provides a summary description of the data series used for this study and includes the respective first and second sample moments. We measure foreign investment in Mexican shares from monthly flow data on net purchases of Mexican equities by foreigners; the data are collected by the Central Bank of Mexico and published by the National Banking and Securities Commission. Our sample, from January, 1989 to the March, 1996, covers the entire period during which Mexico experienced significant equity inflows. Appendix 1 discusses this data in further detail and compares it with alternative measures of foreign investment in Mexican equities.

For certain analyses, we separate the Mexican flow data into publicized and unpublicized flows. Publicized inflows were identified from accounts of specific transactions published in the financial press (primarily International Financing Review, see Table III); such flows account for about two-fifths of the cumulative foreign equity purchases over our sample period, but only one-fourth since mid-1992 (Table IV). Unpublicized inflows are defined as the difference between total inflows and publicized inflows.

The market capitalization statistics and stock price index used for this study are collected and published by the Mexican stock exchange. Mexican stock returns are measured using the percent change in the end-of-month IPC index in nominal pesos.[9] The IPC index is a capitalization weighted index of the prices of the largest and most liquid Mexican stocks.

### *A. Additional variables*

Our additional regressors for the omitted variables test comprised measures of the following: movements in foreign (non-Mexican) stock prices; the level and change in Mexican

short-term interest rates, the percentage change in the peso/dollar exchange rate, the within-the-month volatility of Mexican stock prices, shifting assessments of Mexican country risk, and a measure of revisions to aggregate earnings forecasts for Mexican stocks. We also experimented with measures of changes in foreign interest rates and/or bond yields but found that the explanatory power of these variables was weak and in any event subsumed by the included variables.

We included two measures of changes in foreign stock prices (the percent changes in the Morgan Stanley Capital International (MSCI) World stock price index and in the S&P 500 price index) because we conjectured that although Mexican stock prices should respond to global price swings, they might be more closely linked with the U.S. market. The level of Mexican interest rates on one-month government bonds at the start of the period is included to capture the market's ex-ante expected nominal return in pesos.[10] The inclusion of the contemporaneous change in Mexican interest rates and the peso/dollar exchange rate controls for changes in the outlook for Mexican monetary and/or exchange rate policy during the month. The Merton model predicts that Mexican equity prices should co-vary negatively with their own variance, hence we used daily stock price data to construct a within-the-month measure of annualized Mexican stock price volatility.

Our country risk measure, the adjusted percentage change in the average "stripped yield" on Mexican long-term (Brady) bonds, was included as a broad gauge measure of shifts in investors' assessment of Mexico's access to spontaneous capital flows, and the country's overall growth prospects.[11] The stripped yield measures the yield to maturity on the uncollateralized portion of long-term Mexican bonds, and varies over time with both the level of global interest

rates and changes in spreads.[12] To separate the effects of changes in spreads from changes in global interest rate conditions, we calculate the "adjusted" percent decrease in the stripped yield ($\hat{y}_t$), defined as follows:

$$\hat{y}_t \equiv (y_{t-1}) / [y_t - (r_t - r_{t-1})] - 1 \qquad (21)$$

where $y_t$ is the stripped yield at time t, and $r_t$ is the yield on comparable maturity U.S. long-term treasury bonds.

Measures of the revision to analysts' earnings forecasts were constructed from average price-earnings ($p/e^f$) forecasts for Mexican equities compiled by I/B/E/S for the period mid-1992 to March 1996. The forecasts are available on a fiscal year basis; to approximate a constant 12 month forward looking horizon we constructed a shifting weighted average of p/e forecasts for the current and next fiscal year. The earnings revision ($EarnRev_t$) is obtained by multiplying the ratio of p/e forecasts by the ratio of price indices, i.e.

$$EarnRev_t = [(p/e^f)_{t-1} / (p/e^f)_t] \cdot [p_t / p_{t-1}] - 1$$

$$\approx (e^f_t / e^f_{t-1}) - 1 \qquad (22)$$

We proxy for aggregate earnings forecasts revisions during earlier periods (1989 though mid-1992) by using the conventional p/e ratio, that is, price to trailing earnings, in place of $p/e^f$ in the above expression.

Time series on end-of-month U.S. interest rates, bond yields and stock returns, and Mexican domestic currency government bill (Cetes) and exchange rates were taken from DRI. The Morgan Stanley stock price index was obtained from Bloomberg News Services. The stripped spread data are from J.P. Morgan Securities.

## III. Foreign Net Investment in Mexican Stocks: An Overview

Significant foreign investment in the Mexican stock market basically dates from 1989 and coincides with major changes in the climate for foreign investment (Table IV). Earlier, foreign investment in Mexican equities appears to have been restrained by investors' general reluctance to diversify internationally, and their concerns about restrictions, actual and potential, on foreign equity investments in Mexico. This situation was changed, on the one hand, by developments in the U.S. and other industrial countries--institutional changes and low bond and dividend yields--that encouraged investors to look outward, including to Mexico (Calvo, Leiderman and Reinhart (1993 and 1994), Chuhan, Claessens and Mamingi (1993), and Gooptu (1993)). On the other hand, the Mexican authorities' implementation of structural reforms--such as expanding the range of companies and shares in which foreigners could invest--and pursuit of macroeconomic policies improved both the attractiveness and feasibility of investment in Mexico (Loser and Kalter (1992)). Evidence of the Mexican government's success in restoring investor confidence through macroeconomic and structural policies can be seen in the sharp reduction in the risk premium on long-term Mexican bonds from end-1988 to end-1993 (Chart 1).[13]

Concentrating on the Mexico-specific factors that may be less familiar to the reader, in 1989, the Mexican authorities modified the foreign investment regime to ease restrictions on foreign participation in the Mexican stock market and, in 1990, removed a 40 percent tax on dividend income (Mullin 1993).[14] Also, the government moved aggressively to divest itself of holdings in a number of key industries, chiefly banking and telecommunications, raising some $25 billion through the sale of state owned enterprises between 1989 and 1994. While only a fraction of these privatized shares were sold directly to foreign investors--Telmex, the telephone company,

standing as the major exception--foreigners often bought into the newly privatized firms through the secondary market, or during subsequent public offerings by the privatized firms.

*A. Size and volatility of flows*

The scale and volatility of equity inflows to Mexico has been quite large. Between 1989 and end-1993 foreigners increased their share of Mexican stocks from negligible levels to over one-fourth; the share of foreign ownership has fluctuated around this level subsequently (Chart 1 and Table IV). Inflows into the Mexican stock market generally have been positive, averaging 0.42 percent of market capitalization per month, but have varied considerably in intensity from month-to-month with a standard deviation of 0.63 percent of market capitalization, and maxima and minima of 4.3 percent and -0.3 percent of market capitalization (Chart 2, Table II). Actual outflows have occurred only infrequently, generally during periods of heightened policy uncertainty. For example, foreigners sold in 1994 following the assassination of the presidential front-runner (April) and ahead of the December inauguration of the new president. Notably--and contrary to some popular perceptions--the market backlash that followed Mexico's December 1994 devaluation produced only limited realized outflows from the equity market.

We note that aggregate mutual fund inflows into U.S. stocks, which have garnered much attention of late in the financial press, averaged 0.052 percent of U.S. stock market capitalization during the 1984 through 1992 time period studied by Warther (1995), with a standard deviation of only 0.078 percent of market capitalization. Hence, by the metric of market capitalization, foreign flows into Mexico's stock market were eight times as large and eight times as volatile as mutual fund flows into the U.S. stock market.

## IV. Test Results

*A. A first pass: returns vs. total equity inflows*

As shown in Table V, there is a strong correlation between inflows into the Mexican equity market and contemporaneous price performance. As can be seen, foreign inflows explain about one-seventh of the monthly variation in peso returns over the whole seven year sample period, 1989-1996:03. Column (1) reports the results of regressions of stock market returns measured in local currency on contemporaneous total monthly foreign inflows as a percentage of market capitalization. Virtually identical results are found in Columns (2) and (3) when we used local currency excess returns (local currency returns minus the local government bill rate) or returns measured in dollars. Because we generally found equivalent results throughout whether we used local currency, foreign currency, or excess returns, below we tend to report on tests using local currency returns as the dependent variable so as to maintain symmetry with the specifications used by Warther.

The regression coefficient--foreign purchases of 1 percent of market capitalization are associated with a 6 percent rise in the Bolsa index--is quite large when compared with some studies of the Price Pressure-Upward Sloping Supply Curve literature. These latter papers look at price responses for individual shares to shifts in demand; for example, Harris and Gurel (1986) and Shleifer (1986) found that following announcements that new companies would be added to the S&P 500 index, the price of their shares typically rose by around 3-4 percent, presumably in response to purchases by index fund managers who typically purchase around 3 percent of the shares of the included stocks. Similarly, Bagwell (1991) reported evidence from Dutch auctions that suggested prices rise by 1.7 percent for each 1 percent of outstanding shares purchased. On

the other hand, Warther (1995) found a much larger response coefficient in his regressions of changes in U.S. stock prices on surprise inflows into equity mutual funds; in his data a surprise inflow to stock mutual funds equal to 0.1 percent of aggregate market capitalization was associated with a price rise of 5.2 percent (Table 4, p. 223)--nearly ten times the price rise found in our data. Our coefficient is also considerably smaller than that found by Jun (1993) in his study of foreign inflows into the Korean equity market. Jun found that a $1 billion net foreign purchase of Korean equities, roughly 1 percent of market capitalization was associated with a 24 percent price rise; however, his results must be viewed as tentative given the short sample period (16 months).

*B. Anticipated vs. surprise inflows*

To test whether inflows respond differently to anticipated and surprise inflows, we first constructed a forecasting model for anticipated inflows, adapting the approach used by Warther (1995) to analyze mutual fund flows. Specifically, we first separated inflows into the Mexican equity market into two components, publicized inflows and unpublicized inflows, and then fit a time series model to explain unpublicized inflows. We termed the residuals and fitted values from the final model surprise unpublicized inflows and expected unpublicized inflows, respectively. We treated publicized equity placements separately because such flows clearly do not represent surprise inflows in the months that they are concluded. Typically these flows are reasonably well known to the market at least several months in advance, although the exact timing is not always easy to identify.

In his study of mutual fund flows, Warther used only lagged inflows to forecast current

inflows. In our case, we experimented with including current and lagged publicized inflows as well, to control for possible crowding out of unpublicized flows by publicized flows. To guard against over fitting our model, we then experimented with reduced lag lengths and dropping the publicized flows. As shown in Table VI, using the Schwartz criterion, the best results were obtained with a simple AR(1) specification, while the Akaike criterion favored an AR(2) specification. Using either criterion, current and lagged publicized inflows were not found to be useful in forecasting unpublicized flows and therefore were excluded. In the remainder of this paper, we used the AR(1) specification for separating inflows into the anticipated and surprise components. However, we found similar results for all the tests reported below when we used the AR(2) specification, or when we broadened the set of prediction variables as would be suggested by a more structural model.

We found evidence that generally supported the conjecture of differential responses when we tested whether returns appear to respond to anticipated or anticipated flows. As shown in Table VII, Columns (1) and (2), when total equity inflows are replaced with surprised unpublicized inflows, the coefficient on inflows rises from 6 to 13, and the regression $R^2$ increases, a result consistent with the conjecture that the inclusion of expected flows biases our coefficient on total inflows toward zero. However, when we include all three components of equity inflows as reported in Column (3), i.e. publicized inflows, expected unpublicized flows and surprise unpublicized flows, we find that our hypothesis that the coefficients on the first two variables is equal to zero is rejected at the 5 percent level. Nonetheless, the estimated coefficient on the surprise inflows is higher than the estimated coefficients on the more predictable components, as would be predicted by the base-broadening/efficient markets hypotheses, and we

are able to reject at the 1 percent level the hypothesis of equal coefficients on the various components of the equity inflows. The significant positive correlation found between publicized inflows and prices could reflect market timing by Mexican issuers, i.e. issues are not launched when prices are declining. We also find that the result of non-zero coefficients on expected flows is strongly influenced by the positive association between prices and inflows during the first Telmex deal. When we include a dummy for the May 1991 Telmex placement, we are then unable to reject the hypothesis that the coefficients on publicized inflows and expected unpublicized inflows are equal to zero, and we still are able to reject the hypothesis of equal coefficients on surprise and expected inflows at the 1 percent level.

*C. Are the price rises associated with inflows temporary or permanent?*

Our test to distinguish whether the data supported the Price Pressure Hypothesis as an alternative to the base broadening hypothesis, failed to detect evidence of price reversals. While the hypothesis of price pressures emerging from temporary illiquidity would appear plausible in the context of an emerging market such as Mexico, particularly in view of the large coefficient on surprise inflows, we did not find evidence that lagged surprise inflows were associated with negative returns. On the contrary, the coefficients on lag surprises summed to an economically significant but statistically insignificant positive number (Table VIII, Column (2)). In particular, the previous month's surprise was found to carry an economically significant positive coefficient. Moreover, when we included only the previous month's inflows, we found that we could reject the null of a zero coefficient at the 15 percent level in favor of the one-sided hypothesis of a positive coefficient (Column (3)). We note that Warther also found weak evidence, (Table 5, p. ...

226) that surprise inflows this month are associated with positive returns next month. We conjecture that this delayed reaction weakly evident in both data sets could be the result of learning by market participants about the true magnitude of the initial shift in investor demand.

*D. Do additional variables explain away the correlation between flows and returns?*

To control for possible omitted variable bias, we added several additional regressors, discussed in section II.A, that help explain Mexican equity returns. As can be seen in Table IX, our additional variables explain a significant share of Bolsa returns. As a group, the variables explain about five-ninths of the monthly peso variation in Mexican stock returns (Column (1)) and two-thirds of the variation in dollar returns (Column (2)). All of the variables possess their expected signs and almost all of the variables are found to have statistically significant independent explanatory power. The adjusted change in stripped spreads--which captures shifts in market sentiment toward Mexico-specific risk--has the greatest explanatory power, by itself accounting for about one quarter of the variation in Bolsa returns.

Controlling for these third factors reduces but does not eliminate the estimated impact of foreign flows on prices (Table X). As can be seen, the estimated coefficient on surprise foreign purchases falls by about two-fifths when we expand out regressor set to include the variables in Table IX, but remains significantly different from zero at the 1 percent level. Overall, the model of returns specified in Table X including surprise inflows explains more than three-fifths of the variance of local currency returns and about 70 percent of the variation in dollar returns.

*E. Do foreign investors chase recent returns?*

We found no evidence that foreign investors are positive feedback traders. As shown in column (1) of Table XI, lagged monthly returns do not help forecast unpublicized flows. Likewise, when we used weekly returns, we did not find any evidence that inflows are more positively associated with returns during the weeks at the beginning of the month or the end of the previous month, contrary to the predictions of the positive feedback hypothesis. Instead, as shown in columns (2) and (3), our highest coefficient estimate in a regression of surprise flows on weekly returns is found on the return on the fourth week of the current month and the lowest coefficient for the current month is found on the return from week 1. This pattern exactly reverses of the predictions of the positive feedback hypothesis. However, these difference within the month are not statistically significant. As shown in column (3), we cannot reject the null of equal coefficients on each of the four week's of the current month, and zero coefficients on the returns from the last two weeks of the previous month.

## V. Summary and Conclusions

The results from our study of the inflow-price linkage support the belief, common among market participants, that foreign inflows to emerging equity markets have an important impact on emerging equity returns. Surprise foreign purchases totalling one percent of market capitalization (a three standard deviations innovation) are associated with contemporaneous price rises of about 13 percent.

We considered a variety of hypotheses to account for the correlation between flows and returns in our data set and conclude that the evidence is consistent with the base-broadening

hypothesis, that is, the hypothesis that greater risk sharing and improved liquidity resulting from foreign inflows produce permanent price rises. We did not find evidence of inefficiency in the response of prices to inflows: forecastable inflows do not produce statistically significant price effects, but surprise inflows do; and we did not find any evidence that inflow-associated price changes reverse themselves in subsequent months. We found that we could not explain away the price-inflow link through the inclusion of other variables that also cause returns. Inclusion of additional regressors that explained five-ninths of the monthly variation in local currency returns and two-thirds of the variation in dollar stock returns reduced the coefficient on surprise inflows by about two-fifths, but the inflow coefficient remained highly significant. Finally, tests of whether price-inflow correlation is the result of foreign investors chasing recent price rises produced negative results.

There are considerable similarities between our findings and those from Warther's (1995) study of U.S. mutual fund flows and stock returns. Warther found that from 1984 to 1992 mutual fund flows explained a significant fraction of monthly U.S. equity returns. Similar to our findings for Mexican returns, he found no evidence of return reversals or positive feedback trading. Compared with our study, Warther found a higher response coefficient (52 versus 13) on surprise inflows when scaled by market capitalization. However, mutual fund flows into U.S. stocks were smaller on average (one-eighth as large in relation to market capitalization) and less volatile than foreign inflows into Mexican equities. Also, Warther found that inflows into U.S. stocks explained a greater fraction of return variability, an $R^2$ of ½ vs 1/7 in our data set. This high explanatory power might reflect the role of omitted variables. Warther did not control for other factors causing returns that could have been correlated with mutual fund flows.

It is not clear whether the coefficients found in the present study will necessarily generalize to other cases, or even prove stable over time for Mexico, nor are we able to provide definitive proof against the possibility that our estimated coefficients overstate the impact of demand shifts on prices due to correlation with omitted variables, although we were able to eliminate some obvious candidates. The evidence suggests, however, that analysts seeking to model emerging market returns may wish to take into account fluctuations in foreign equity portfolio investment activity. Ignoring such flows may cause analysts to observe returns in recent years that appear to be too high or too uncorrelated with global equity returns; this behavior, which might reflect a disequilibrium adjustment to increasing market integration, potentially could be viewed as symptomatic of a continued equilibrium of market segmentation.

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**Notes**

1. If a stock market is characterized by low turnover and/or insider trading, investors may find it difficult to adjust their portfolios without moving prices against themselves; moreover the situation may be self-reinforcing, as some investors may react to such illiquidity by shying away from the market, further reducing liquidity. In such an environment, investors discount future earnings by an additional factor that takes into account the fact it may be difficult to fully realize the fundamental value of a share (see Pagano (1989) Allen and Gale (1991) and Hargis (1995)). However, broadening the universe of active investors can increase the elasticity of demand at given prices, and lower concerns about liquidity risk.

In fact, a number of Mexican stocks have become much more actively traded as a result of the internationalization of Mexico's equity market. In particular, Telmex, whose ADRs have traded on the New York stock exchange since 1991, consistently ranked among the most actively traded shares on the New York stock exchange in recent years; the high liquidity of Telmex has also improved the liquidity of other Mexican shares because investors have been able to use Telmex as a proxy for trading Mexican market risk.

2. In some countries, the government establishes a ceiling on the proportion or type of shares that foreigners may hold. In such a situation, modeled by Eun and Janakiramanan (1986), two prices may be observed, a price for foreign investors and a lower price for domestic investors. Such price spreads have been studied by Hietala (1989), Baley and Jagtiani (1994) and Stulz and Wasserfullen (1995) for Finnish, Thai, and Swiss stocks, respectively.

3. Our approach may be viewed as a time-series alternative to the event study methodology of Kadlec and McConnell, 1994. Kadlec and McConnell studied market reactions to announcements

of new listings on the New York Stock Exchange, and found that the price impact was related to the size of the associated increase in the investor base.

**4.** $\beta_1$ in equation (9) essentially measures the mean of the variables in parentheses in front of the $\partial\theta$ term in equation (8). Some of the bracketed terms, in particular $x_t$, the ratio of Mexico's market capitalization to global wealth, may vary over our sample period. We adopted the fixed coefficient specification reported in this paper in part to maintain parallelism with Warther's (1995) functional forms, and also because of measurement error problems with respect to the correct measure of global wealth to put in the denominator. We did experiment with using the Morgan Stanley world stock price index to construct a measure of $x_t$. We found similar results whether we adjusted for changes in $x_t$ or assumed $x_t$ to be constant.

**5.** Merton recognized this point, and noted that the issue would have to be addressed in constructing a dynamic version of his model. Specifically he points out (p.500) that "if a favorable story implies an upward revision in those anticipations (i.e. expectations about the future time path of the size of the investor base), then the price should rise immediately, even if there is a time lag before the newly-informed investors take positions. Similarly, an unfavorable story implying a reduction in the anticipated growth in the investor base should cause an immediate price decline." The noise trader model of DeLong Shleifer, Summers and Waldmann (1990) gives an example where a noise parameter causes the investor base to shift randomly and where investors (and hence prices) take into account the mean and variance of such shifts in the investor base.

**6.** Fama and French (1988), on the other hand, have presented evidence of price reversals over a five-year period. Our sample is too short to detect reversals over such long horizons.

7. In contrast, Warther (1995) tested for the existence of a negative relation between flows and future returns by regressing monthly flows on the returns from the each of the four weeks of the current, previous and future month. Our approach is more general in allowing for reversals over a horizon as long as three months.

8. This approach results in the truncation of up to three days in the middle of the month, but accounting for these missing days does not materially affect the results.

9. Using annual data, the percent change in IPC price index has a 99.5 percent correlation with the International Finance Corporation's total return index for Mexico measured in local currency.

10. Harvey (1995) presents evidence from a broad range of emerging markets that local interest rates help predict returns.

11. The importance of controlling for country risk has been suggested by Bailey and Chung (1995), who provide evidence of time varying risk premia for country risk, as proxied by movements in sovereign debt prices, from panel data of returns on individual Mexican equities. Also, Erb, Harvey and Viskanta (1995) show that much of the excess returns displayed by emerging equity markets is correlated with measures of country risk, i.e. high default risk countries (as measured from surveys of internationally active banks) exhibit higher expected returns. Erb, Harvey and Viskanta's results suggest that improving policy performance should have been associated with an increase equity prices.

12. Brady bonds are highly liquid partially collateralized bonds that were originally issued to commercial banks as part of the country's commercial bank debt reduction agreement concluded under the auspices of the Brady plan in 1990. Trading of Mexico's Brady bonds is centered in New York and takes place among a range of sophisticated investors that includes trading desks at

the largest U.S. and European commercial banks and securities firms, hedge funds and mutual funds, and financial institutions and high net worth investors from Latin America. For the period prior to the 1990 issuance of the Brady bonds we use changes in the secondary market price of Mexican bank debt. For further discussion of the liquidity and participants in the Brady bond market, see Clark 1994b.

**13.** The improvement in Mexico's market access was accelerated by the 1990 debt reduction agreement with the country's commercial bank creditors. For a discussion of the restoration of market access for Mexico and other restructuring countries, see Clark, 1994a.

**14.** After 1989, the most significant remaining restrictions applied to bank shares where foreigners were subject to a 30 percent ceiling on aggregate holdings. Claessens and Rhee (1993) estimate that the share of Mexican stocks that could potentially be held by foreigners jumped from 10 percent of the market in early 1989 to around 60 percent in 1990 and over 80 percent by 1993.

**Table II.**
**Description of Time Series**

| Description | Source | Units | Mean | Median | Standard deviation |
|---|---|---|---|---|---|
| Total net foreign purchases of Mexican equities | Banco de Mexico | Percent of market capitalization<br>Millions of dollars | 0.42%<br>343 | 0.29%<br>216 | 0.63%<br>578 |
| Publicized net foreign purchases | IFR, Bank of New York authors' estimates | Percent of market capitalization<br>Millions of dollars | 0.13%<br>128 | 0.00%<br>0 | 0.49%<br>323 |
| Unpublicized net foreign purchases | Total - Publicized | Percent of market capitalization<br>Millions of dollars | 0.29%<br>215 | 0.23%<br>176 | 0.35%<br>401 |
| Expected unpublicized net foreign purchases | See text | Percent of market capitalization | 0.30% | 0.27% | 0.20% |
| Surprise unpublicized net foreign purchases | See text | Percent of market capitalization | -0.00% | 0.00% | 0.30% |
| Peso return on Bolsa index | Bolsa de Valores | Percent change | 3.61% | 3.97% | 9.49% |
| Dollar return on Bolsa index | Bolsa de Valores | Percent change | 2.39% | 3.44% | 10.97% |
| Excess peso return on Bolsa index | Bolsa de Valores | Percent change | 1.29% | 2.08% | 9.30% |
| Percentage return on MSCI World dollar index | DRI-McGraw/Hill | Percent change | 0.41% | 0.79% | 4.41% |
| Percentage return on S&P 500 | DRI-McGraw/Hill | Percent change | 0.96% | 1.17% | 3.36% |
| Short-term peso interest rate | Banco de Mexico | End-of-month yield, annualized | 27.70% | 20.49% | 15.30% |
| Change in short-term peso interest rate | Banco de Mexico | Change in yield | -0.14% | -0.48% | 5.43% |
| Adjusted percent decrease in stripped yield of Mexican Brady bonds | See text | Percent change | 0.93% | 0.73% | 7.62% |
| Percent growth in aggregate earnings forecasts | See text | Percent change | 2.32% | 0.44% | 11.03% |
| Annualized daily stock price volatility | See text | Percent, period average | 22.27% | 19.71% | 9.35% |
| Percent change in peso-dollar exchange rate | Banco de Mexico | Percent change | 1.53% | 0.41% | 5.91% |

Note: Sample comprises monthly data from January 1989 to March 1996. Variables scaled by market capitalization are scaled by market capitalization at the start of the period. Percent changes are all calculated on an end of period basis.

**Table III**

**Mexico: Publicized International Equity Flows**

Millions of dollars

| Date | Company | Amount |
|---|---|---|
| April 1991 | Fomento Economico Mexicano | 87.4 |
| | Vitro S.A. | 37.0 |
| | Internacional de Ceramica | 22.7 |
| May 1991 | Telmex | 1876.2 |
| July 1991 | Grupo Gigante | 48.8 |
| September 1991 | Grupo Carso | 213.7 |
| | Empaques Ponderosa | 32.7 |
| October 1991 | Tubos de Acero de Mexico | 41.0 |
| November 1991 | Vitro S.A. | 165.0 |
| | Aerovias de Mexico | 95.4 |
| | Grupo Video Visa | 45.0 |
| | Tranportacion Maritima | 35.0 |
| | Empaques Ponderosa | 33.0 |
| December 1991 | Grupo Televisa | 747.0 |
| | Grupo Situr | 51.0 |
| March 1992 | GF Bancomer | 602.0 |
| | Sears de Mexico | 102.0 |
| | Grupo Posadas | 28.0 |
| April 1992 | Cemex S.A. | 461.0 |
| | Empresas ICA | 326.0 |
| May 1992 | Telmex | 1243.3 |
| June 1992 | Tranportacion Maritima | 76.0 |
| | El Puerto de Liverpool | 48.0 |
| July 1992 | Grupo Video Visa | 20.6 |
| December 1992 | Grupo Embotellador de Mexico | 135.3 |
| February 1993 | Grupo Carso | 235.0 |
| March 1993 | Consorcio G Grupo Dina S.A. | 173.2 |
| June 1993 | Grupo Simec S.A. | 65.7 |
| July 1993 | Grupo Radio Centro | 45.6 |
| | Servicios Financieros Quadrum | 40.6 |
| August 1993 | Grupo Situr | 9.1 |
| September 1993 | Panamerican Beverage Co. | 264.0 |
| | Grupo Tribasa | 211.0 |
| | Coca-Cola Femsa | 151.0 |
| October 1993 | Grupo Industrial Maseca | 49.5 |
| November 1993 | Bufete Industrial S.A. | 95.8 |
| December 1993 | Grupo Televisa | 874.8 |
| | GF Serfin | 308.3 |
| | Grupo Mexicana de Desarollo | 248.5 |
| | Grupo Casa Autrey | 63.8 |
| January 1994 | Grupo Tribasa | 39.9 |
| February 1994 | Grupo Tribasa | 300.3 |
| | Empresas La Modema | 277.6 |
| March 1994 | GF GBM Atlantico | 90.4 |
| April 1994 | Grupo Embotellador de Mexico | 119.4 |
| June 1994 | Grupo Iusacell S.A. | 155.7 |
| | Banpais S.A. | 102.7 |
| July 1994 | Grupo Industrial Durango | 111.3 |
| | Grupo Sidek | 96.7 |
| | DESC S.A. | 55.2 |
| August 1994 | Corporacion GEO | 44.3 |
| | Grupo Mexicana de Desarollo | 29.6 |
| September 1994 | Sigma Alimentos | 131.0 |
| October 1994 | Hylsamex S.A. | 123.5 |
| December 1994 | Grupo Simec | 49.3 |
| | Internacional de Ceramica | 22.7 |
| February 1996 | Corporacion Industrial San Luis | 45.0 |
| March 1996 | Elamex | 28.4 |
| | Panamerican Beverage | 44.4 |

Sources: International Financing Review, Bank of New York, Bolsa Mexicana de Valores, authors' estimates

Note: Excludes domestically placed tranches.

**Appendix 1: Measuring Foreign Investment in Mexican Equities**

Foreigners invest in Mexican shares through a variety of modalities, direct and indirect. Following the passage of the new foreign investment law in 1989, most classes of Mexican shares could be purchased and held by foreigners directly and without overall ceilings on foreign holdings. Class A Mexican shares cannot be held directly by foreigners; however these shares may be held indirectly through "ordinary participation certificates" (CPOs) issued by NAFINSA, the state-owned development bank, against A shares held in trust. Shares held to back CPOs are referred to as "Neutral Fund" holdings. CPOs entitle foreign investors to the cash flow associated with the shares but do not confer voting rights. Many individual and institutional foreign investors nonetheless have preferred to hold Mexican shares indirectly, via the purchase of American or Global Depository Receipts (ADRs or GDRs). Foreign investors find ADRs attractive because they trade and settle outside of Mexico--most often in the case of Mexican ADRs on the New York Stock Exchange--and allow foreigners to bypass the Mexican foreign exchange market. Finally, many retail investors rely on an additional layer of intermediation, by holding their Mexican shares indirectly through mutual funds; these mutual funds in turn hold ADRs, free subscription or neutral fund shares.

To measure foreign investment activity in the Mexican equity market we draw primarily on monthly flow data on net purchases of Mexican equities by foreigners collected by the Central Bank of Mexico. This data is published by the National Banking and Securities Commission on a monthly basis and is included in Mexico's official quarterly balance of payments estimates. These monthly Mexican flow data are available from 1989 to the present; the coverage since 1991 includes a disaggregation between net flows into ADRs, direct or "free subscription" holdings of

unrestricted shares, Neutral Fund holdings of restricted shares, and purchases by the Mexico Fund, a closed-end mutual fund.

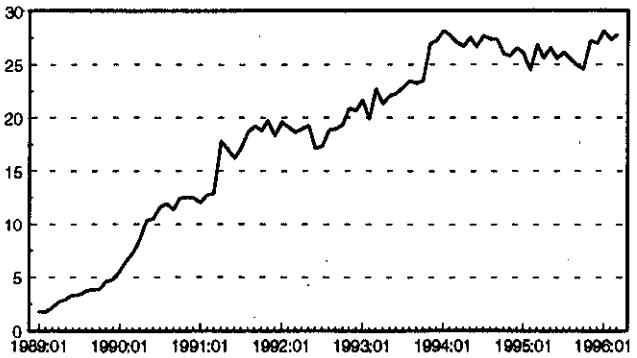
For certain analyses, we separate the Mexican flow data into publicized and unpublicized flows. Publicized inflows were identified from accounts of specific transactions published in the financial press (primarily International Financing Review, see Table III); such flows account for about two-fifths of the cumulative foreign equity purchases over our sample period, but only one-fourth since mid-1992.

Two alternative data sources are available for tracking foreign participation in the Mexican stock market. Data on the stock of foreign holdings of Mexican shares are collected by the Mexican stock exchange (Bolsa de Valores) and are available on a monthly basis from end-1990. Holdings data disaggregated into four broad categories (the same categories as for inflows) are regularly reported in the financial press; the Bolsa also publishes more disaggregated data on foreign holdings on a stock-by-stock, and modality-by-modality basis. Flow data on U.S. net purchases of foreign equities are published by the U.S. Treasury Department. The U.S. data, which is collected on a gross and net basis, is collected monthly, but flows by country are only published quarterly; a monthly breakout of flows to Mexico was provided to us by the Treasury Department. On average, identified purchases of Mexican equities by U.S. investors account for four-ninths of the foreign equity inflows recorded by the Mexican authorities; discussions with market participants suggest an even larger role for U.S. investors, implying some degree of undercounting in the U.S. data. Chuhan, Claessens and Mamingi (1993), Tesar and Werner (1993 and 1994), and Bohn and Tesar (1996) have used the U.S. data to analyze the pattern U.S. portfolio flows to a range of countries including Mexico.

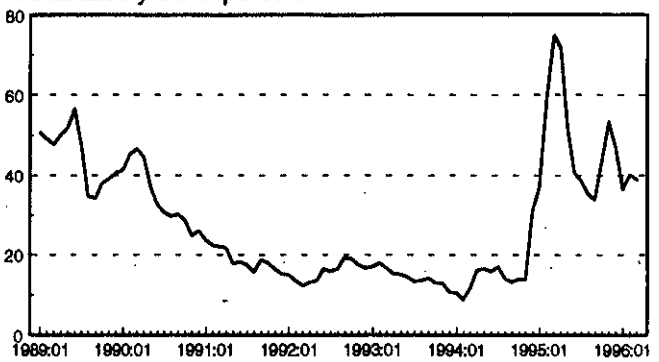
These three alternative sources for data on foreign investment in Mexican equities typically reveal similar trends and movements. However, the implicit flows derivable from fluctuations in the value of foreign holdings are often more volatile than the directly measured flows and have a correlation of only 55 percent with measured flows. The higher volatility of the derived flows likely reflects short-run divergence in the price performance of the foreign portfolio vis-a-vis the index portfolio, rather than a better measure of purchasing activity. Overall, there is a reasonably close correlation between the Mexican and U.S. flow data (76 percent correlation), particularly since mid-1992 (89 percent); the U.S. flow data and the implied flows from the stock data correlate least well (35 percent correlation).

## Chart 1
## Mexico: Selected Financial Time Series

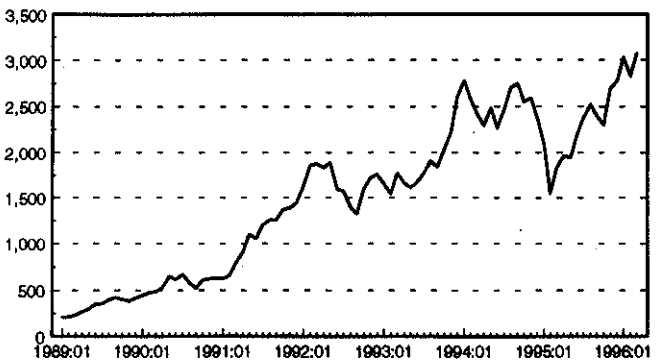
### Foreign holdings of Mexican Equities
Percent of Market Capitalization



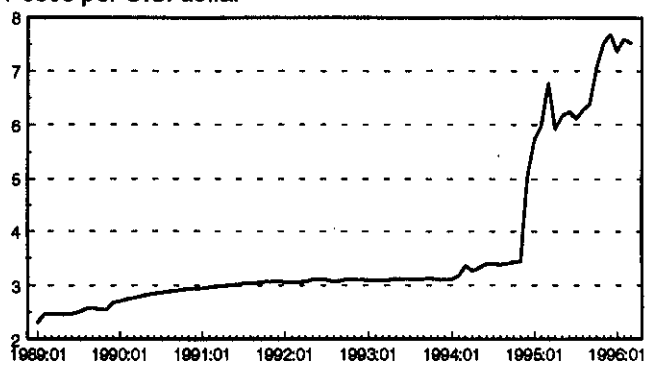

### Mexican Local Currency Interest Rates
Annualized yield in percent



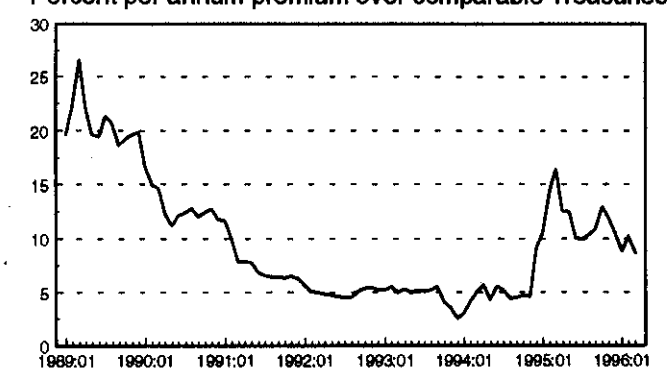

### Price of Mexican Equities
IPC local currency index



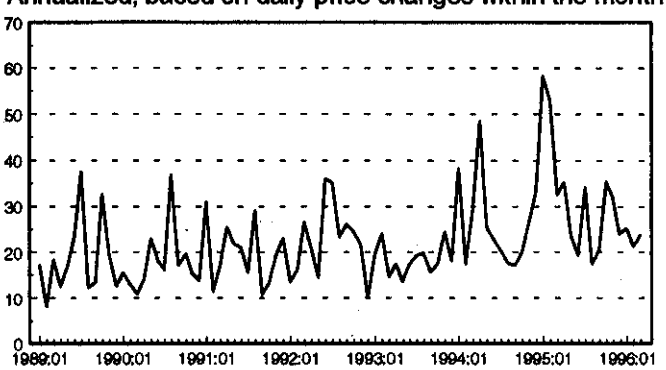

### Mexican Peso-Dollar Exchange Rate
Pesos per U.S. dollar



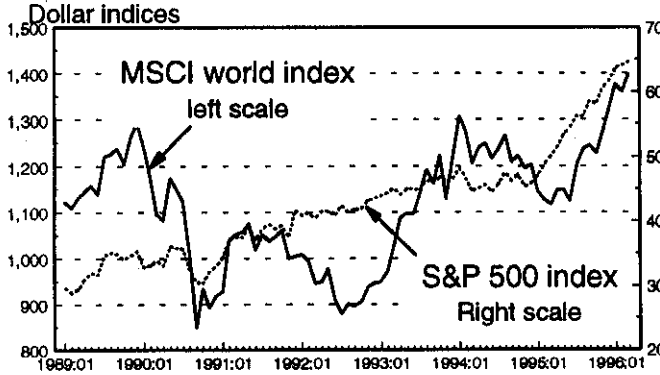

### Stripped Spreads on Mexican Brady Bonds
Percent per annum premium over comparable Treasuries



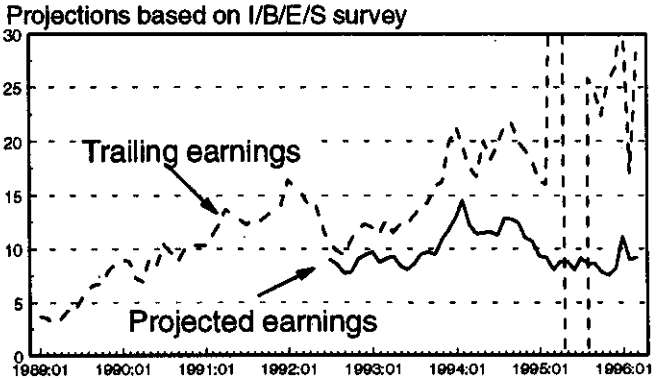

### Monthly Price Volatility of Mexican Stocks
Annualized, based on daily price changes within the month



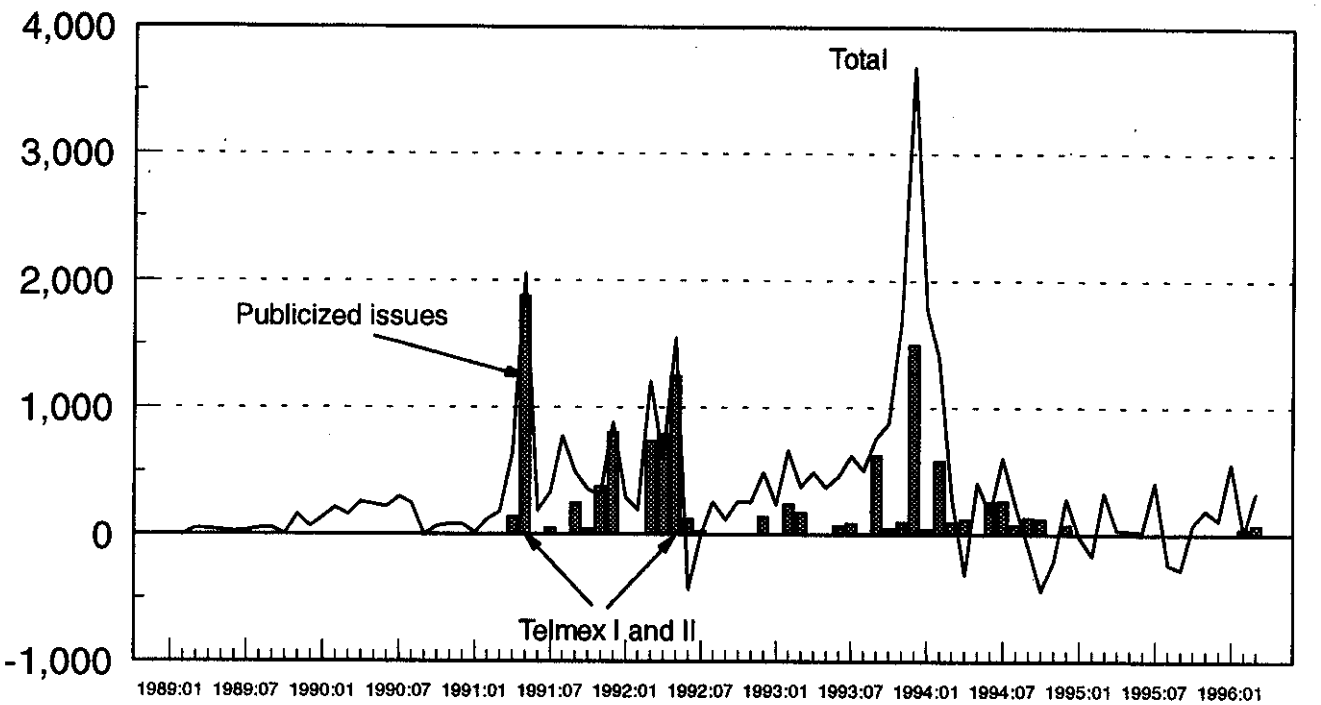

### Prices of Foreign Stocks
Dollar indices




### Mexican Price-to-Earnings Ratio
Projections based on I/B/E/S survey



## Chart 2.
## Monthly Net Foreign Purchases of Mexican Equities
January 1989-March 1996
**Millions of dollars**




Source: Banco de Mexico, International Financing Review, Bank of New York, Bolsa Mexicana de Valores and authors' estimates.

**Table I.**
**Testable Implications of Selected Alternative Hypothesis to Account for Correlation between Equity Inflows and Returns**

| Hypothesis | Price changes correlated with lagged surprise inflows | Price changes correlated with contemporaneous surprise inflows after controlling for other factors causing returns | Correlation between flows and returns higher for weekly returns at the beginning of current month and end of previous month |
|---|---|---|---|
| Base-broadening | No | Yes | No |
| Price pressure | Yes, negative correlation | Yes | No |
| Omitted variables | No | No | No |
| Positive feedback | No | Yes | Yes |

**Table IV.**
**Foreign Net Purchases of Mexican Equities**
billions of U.S. dollars

| | 1989 | 1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996:Q1 |
|---|---|---|---|---|---|---|---|---|
| Total inflow | 0.5 | 2.0 | 6.3 | 4.8 | 10.7 | 4.1 | 0.5 | 0.9 |
| *of which: from the U.S.* | *0.0* | *1.1* | *2.1* | *2.8* | *5.1* | *1.4* | *0.2* | *0.3* |
| Publicized placements 1/ | ... | ... | 3.5 | 3.0 | 2.8 | 1.7 | 0.0 | 0.1 |
| Other inflows | 0.5 | 2.0 | 2.8 | 1.7 | 7.9 | 2.3 | 0.5 | 0.8 |
| Memorandum item: | | | | | | | | |
| Foreign holdings of Mexican stocks at current market value | 0.8 | 4.1 | 18.5 | 28.7 | 54.6 | 34.4 | 24.5 | 28.3 |
| (in percent of market capitalization) | (3.6) | (12.5) | (18.3) | (20.8) | (27.2) | (26.5) | (27.0) | (27.7) |
| Total portfolio equity flows to developing countries 2/ | 3.4 | 3.7 | 7.6 | 14.1 | 45.6 | 34.9 | 22.0 | |

Sources: Banco de Mexico, U.S. Treasury Bulletin, Bolsa Mexicana de Valores, International Financing Review, World Bank.

1/ Comprises international equity placements identified in Table III.

2/ World Bank estimates.

# Table V.
# Regressions of Mexican Stock Returns on Net Foreign Purchases of Mexican Equities

| | Dependent variable | Peso return on Mexican stocks 1/ | | Excess return on Mexican stocks 2/ | | Dollar return on Mexican stocks 3/ | |
|---|---|---|---|---|---|---|---|
| | | (1) | | (2) | | (3) | |
| | Sample period | 89:02-96.03 | | 89:02-96.03 | | 89:02-96.03 | |
| C(0) | Constant | 0.0109 | | -0.0132 | | -0.0037 | |
| | | (0.9248) | | (-1.1314) | | (-0.2585) | |
| C(1) | Total net foreign purchases 4/ | 5.8657 | *** | 6.1135 | *** | 6.4767 | *** |
| | | (4.6578) | | (4.6674) | | (4.3511) | |
| | Adjusted R2 | 0.1421 | | 0.1616 | | 0.1282 | |
| | Durbin-Watson | 1.8499 | | 1.9446 | | 1.6305 | |

The regressions are estimated by ordinary least squares with heteroskedasticity consistent covariance. The figures in parentheses are t-statistics. Significance at the 15, 10, 5 and 1 percent levels are indicated by the symbols #, *, **, ***, respectively.

1/ Percent change in the IPC index in pesos from the end of the previous month.

2/ Percent change in the IPC index in pesos from the end of the previous month minus Cetes interest rate at the end of the month t-1.

3/ Percent change in the IPC index converted to dollars at the official exchange rate, from the end of the previous month.

4/ Total foreign net purchases in month t divided by market capitalization at the end of month t-1.

## Table VI.
## Forecasting Equations for Net Foreign Purchases of Mexican Equities

| | Dependent variable | Unpublicized net foreign purchases (1) | | Unpublicized net foreign purchases (2) | | Unpublicized net foreign purchases (3) | | Unpublicized net foreign purchases (4) | |
|---|---|---|---|---|---|---|---|---|---|
| | Sample period | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | |
| C(0) | Constant | 0.2637 | ** | 0.0013 | *** | 0.0012 | *** | 0.0015 | *** |
| | | (3.3701) | | (3.4280) | | (3.3196) | | (4.2835) | |
| C(1) | Unpublicized net foreign purchases(-1) | 0.4476 | *** | 0.4156 | *** | 0.4309 | *** | 0.5162 | *** |
| | | (3.9902) | | (3.6657) | | (3.8085) | | (5.2342) | |
| C(2) | Unpublicized net foreign purchases(-2) | 0.1981 | # | 0.2072 | * | 0.1624 | # | | |
| | | (1.6574) | | (1.7613) | | (1.5906) | | | |
| C(3) | Publicized net foreign purchases | -0.0635 | # | | | | | | |
| | | (-1.5231) | | | | | | | |
| C(4) | Publicized net foreign purchases (-1) | -0.0786 | * | -0.0836 | * | | | | |
| | | (-1.6815) | | (-1.7162) | | | | | |
| C(5) | Publicized net foreign purchases (-2) | -0.0008 | | | | | | | |
| | | (-0.0207) | | | | | | | |
| | Adjusted R2 | 0.2637 | | 0.2745 | | 0.2708 | | 0.2602 | |
| | Durbin-Watson | 1.9634 | | 1.9679 | | 1.9718 | | 2.1461 | |
| | **Akaike information criterion** | -11.5155 | | -11.5524 | | **-11.5586** | | -11.5555 | |
| | **Schwartz criterion** | -11.3431 | | -11.4375 | | -11.4724 | | **-11.4980** | |

Note: The regressions are estimated by OLS with heteroskedasticity consistent covariance. The figures in parentheses are t-statistics. Lagged values of variables are indicated (-n), where n is the number of months. Significance at the 15, 10 ,5, and 1 percent level are indicated by the symbols #, *, **, and ***, respectively.

The variables in these regressions are all scaled by the capitalization of the Mexican stock market at the end of the previous period.

# Table VII.
# Regressions of Mexican Stock Returns on Expected and Surprise Net Foreign Purchases of Mexican Equities

| | Dependent variable | Peso return on Mexican stocks 1/ (1) | | Peso return on Mexican stocks 1/ (2) | | Peso return on Mexican stocks 1/ (3) | | Peso return on Mexican stocks 1/ (4) | |
|---|---|---|---|---|---|---|---|---|---|
| | Sample period | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | |
| C(0) | Constant | 0.0115 | | 0.0366 | *** | 0.0227 | | 0.0280 | |
| | | (0.9489) | | (3.8639) | | (1.2739) | | (1.5054) | |
| C(1) | Total net foreign purchases | 5.8180 | *** | | | | | | |
| | | (4.5983) | | | | | | | |
| C(2) | Surprise unpublicized net foreign purchases 2/ | | | 12.9081 | *** | 13.7001 | *** | 14.1412 | *** |
| | | | | (4.3589) | | (5.0164) | | (5.0303) | |
| C(3) | Expected unpublicized net foreign purchases 3/ | | | | | 2.7259 | | 2.2984 | |
| | | | | | | (0.5008) | | (0.4200) | |
| C(4) | Publicized net foreign purchases 4/ | | | | | 4.2858 | *** | -1.0257 | |
| | | | | | | (3.4392) | | (-0.4164) | |
| C(5) | Telmex Dummy 5/ | | | | | | | 0.2713 | *** |
| | | | | | | | | (2.6974) | |
| | **Hypotheses tests** | | | | | **Probability Values** | | | |
| | C(3),C(4)=0 | | | | | 4.13% | ** | 88.79% | |
| | C(2)=C(3)=C(4) | | | | | 0.17% | *** | 0.03% | *** |
| | Adjusted R2 | 0.1386 | | 0.1597 | | 0.2012 | | 0.2074 | |
| | Durbin-Watson | 1.8364 | | 1.9553 | | 1.9093 | | 1.8833 | |

The regressions are estimated by ordinary least squares with heteroskedasticity consistent covariance. The figures in parentheses are t-statistics. Significance at the 15, 10, 5 and 1 percent levels are indicated by the symbols #, *, **, ***, respectively.
The indicated probability values for hypothesis c(3)=c(4)=0 are for likelihood ratio tests of the indicated null hypothesis; the test statistics have a chi-squared distribution. The probability values for the hypothesis c(2)=c(3)=c(4) is from Wald test, which also has a chi-squared distribution.

1/ Percent change in the Mexican IPC index in pesos from the end of the previous month.

2/ The residual values of the estimating equation for unpublicized flows -- see column 4 of Table VI.

3/ The fitted values of the estimating equation for unpublicized flows -- see column 4 of Table VI.

4/ Scaled by market capitalization at the end of month t-1.

5/ This variable equals 1 for the May 1991 Telmex offering, and zero otherwise.

# Table VIII.
# Test of the Price Pressure Hypothesis: Regression Tests for Price Reversals

| | Dependent variable | Peso return on Mexican stocks 1/ | | Peso return on Mexican stocks 1/ | | Peso return on Mexican stocks 1/ | |
|---|---|---|---|---|---|---|---|
| | | (1) | | (2) | | (3) | |
| | Sample period | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | |
| C(0) | Constant | 0.0366 | *** | 0.0335 | *** | 0.0362 | *** |
| | | (3.8639) | | (3.4958) | | (3.8264) | |
| C(1) | Surprise unpublicized net foreign purchases 2/ | 12.9081 | *** | 13.5652 | *** | 13.2151 | *** |
| | | (4.3589) | | (4.6072) | | (4.6373) | |
| C(2) | Surprise unpublicized net foreign purchases (-1) 2/ | | | 5.1161 | | 5.6317 | # |
| | | | | (1.4334) | | (1.6416) | |
| C(3) | Surprise unpublicized net foreign purchases (-2) 2/ | | | -1.4004 | | | |
| | | | | (-0.4627) | | | |
| C(4) | Surprise unpublicized net foreign purchases (-3) 2/ | | | 1.8921 | | | |
| | | | | (0.6352) | | | |
| | **Hypotheses tests** | | | **Probability Values** | | | |
| | C(2),C(3),C(4)=0 | | | 29.34% | | | |
| | Adjusted R2 | 0.1597 | | 0.1716 | | 0.1789 | |
| | Durbin-Watson | 1.9553 | | 2.0061 | | 1.9436 | |

The regressions are estimated by ordinary least squares with heteroskedasticity consistent covariance. The figures in parentheses are t-statistics. Significance at the 15, 10, 5 and 1 percent levels are indicated by the symbols #, *, **, ***, respectively. The indicated probability value is for a likelihood ratio test of the indicated null hypothesis; the test statistic has a chi-squared distribution.

1/ Percent change in the IPC index in pesos from the end of the previous month.

2/ The residual values of the estimating equation for unpublicized flows -- see column 4 of Table VI.

## Table IX.
## Regressions of Mexican Stock Returns on Additional Explanatory Variables

| | Dependent variable | Peso return on Mexican stocks 1/ | | Dollar return on Mexican stocks 1/ | | Peso return on Mexican stocks 1/ | | Peso return on Mexican stocks 1/ | | Peso return on Mexican stocks 1/ | | Peso return on Mexican stocks 1/ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | (1) | | (2) | | (3) | | (4) | | (5) | | (6) | |
| | Sample period | 89:01-96.03 | | 89:01-96.03 | | 89:01-96.03 | | 89:01-96.03 | | 89:01-96.03 | | 89:01-96.03 | |
| C(0) | Constant | 0.0457 | ** | 0.0417 | ** | 0.0298 | ** | 0.0091 | | 0.0295 | *** | 0.0950 | *** |
| | | (2.3671) | | (2.1302) | | (3.2600) | | (0.4318) | | (3.2847) | | (4.6811) | |
| C(1) | Percent change in world stock prices 2/ | 0.6893 | *** | 0.7025 | *** | 0.7596 | *** | | | | | | |
| | | (3.5791) | | (3.6657) | | (3.0993) | | | | | | | |
| C(2) | Percent change in U.S. stock prices 3/ | 0.2868 | | 0.2689 | | 0.3721 | | | | | | | |
| | | (1.4007) | | (1.3248) | | (1.1337) | | | | | | | |
| C(3) | Mexican bill rate at the end of the previous month 4/ | 0.0503 | | 0.0443 | | | | 0.0948 | | | | | |
| | | (1.0058) | | (0.8905) | | | | (1.2568) | | | | | |
| C(4) | Change in Mexican bill rate during month | -0.1184 | | -0.1192 | | | | -0.4599 | # | | | | |
| | | (-0.6763) | | (-0.6686) | | | | (-1.5250) | | | | | |
| C(5) | Adjusted percent decrease in Brady bond stripped yields 5/ | 0.3603 | *** | 0.4071 | ** | | | | | 0.6507 | *** | | |
| | | (2.8364) | | (3.1378) | | | | | | (5.8799) | | | |
| C(6) | Percent growth in aggregate earnings forecasts 6/ | 0.3322 | *** | 0.2971 | *** | | | | | | | 0.3547 | *** |
| | | (4.0423) | | (3.6464) | | | | | | | | (4.2231) | |
| C(7) | Stock price volatility 7/ | -0.1888 | ** | -0.1690 | # | | | | | | | -0.3035 | *** |
| | | (-2.8989) | | (-2.4987) | | | | | | | | (-3.5454) | |
| C(8) | Percent change in the dollar/peso exchange rate | 0.1026 | | -0.5873 | *** | | | | | | | | |
| | | (1.0681) | | (-4.4952) | | | | | | | | | |
| | Adjusted R2 | 0.5542 | | 0.6646 | | 0.1742 | | 0.0881 | | 0.267367 | | 0.2863 | |
| | Durbin-Watson | 1.8728 | | 1.8752 | | 1.8114 | | 1.9550 | | 2.0593 | | 1.8442 | |

The regressions are estimated by ordinary least squares with heteroskedasticity consistent covariance. The figures in parentheses are t-statistics. Significance at the 15, 10, 5 and 1 percent levels are indicated by the symbols #, *, **, ***, respectively.

1/ Percent change in the IPC index in pesos from the end of the previous month.

2/ Percent change in the Morgan Stanley world dollar price index from the end of the previous month.

3/ Percent change in the S&P500 price index from the end of the previous month.

4/ The last weekly auction rate on 28-day Cetes during the previous month; expressed as an annual rate.

5/ Stripped yields adjusted to remove the impact of change in U.S. treasury bond yields. For further details please see Section II of the text.

6/ See Section II of the text for an explanation of sources and computation.

7/ Annualized stock price volatility calculated from daily returns during month t.

## Table X.
## Test of the Omitted Variable Hypothesis: Regressions of Mexican Stock Returns on Surprise Net Foreign Purchases and Additional Variables

| | Dependent variable | Peso return on Mexican stocks 1/ | | Peso return on Mexican stocks 1/ | | Dollar return on Mexican stocks 1/ | | Dollar return on Mexican stocks 1/ | |
|---|---|---|---|---|---|---|---|---|---|
| | | (1) | | (2) | | (3) | | (4) | |
| | Sample period | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | |
| C(0) | Constant | 0.0366 | *** | 0.0454 | ** | 0.0251 | ** | 0.0417 | ** |
| | | (3.8639) | | (2.5720) | | (2.2328) | | (2.1827) | |
| C(1) | Surprise unpublicized net foreign purchases 2/ | 12.9081 | *** | 7.9793 | *** | 12.6260 | *** | 7.4312 | *** |
| | | (4.3589) | | (4.0868) | | (4.0481) | | (3.6989) | |
| C(2) | Percent change in world stock prices 3/ | | | 0.5619 | *** | | | 0.5851 | *** |
| | | | | (3.0622) | | | | (3.1940) | |
| C(3) | Percent change in U.S. stock prices 4/ | | | 0.3547 | * | | | 0.3283 | # |
| | | | | (1.6735) | | | | (1.5619) | |
| C(4) | Mexican bill rate at the end of the previous month 5/ | | | 0.0507 | | | | 0.0462 | |
| | | | | (1.0188) | | | | (0.8782) | |
| C(5) | Change in Mexican bill rate during month | | | -0.1567 | | | | -0.1562 | |
| | | | | (-0.9416) | | | | (-0.8989) | |
| C(6) | Adjusted percent decrease in Brady bond stripped yields 6/ | | | 0.2319 | * | | | 0.2834 | ** |
| | | | | (1.7061) | | | | (2.0202) | |
| C(7) | Percent growth in aggregate earnings forecasts 7/ | | | 0.3500 | *** | | | 0.3138 | *** |
| | | | | (4.4580) | | | | (3.9754) | |
| C(8) | Stock price volatility 8/ | | | -0.1780 | *** | | | -0.1611 | ** |
| | | | | (-2.7694) | | | | (-2.3769) | |
| C(9) | Percent change in the dollar/peso exchange rate | | | 0.0224 | | | | -0.6621 | *** |
| | | | | (0.2306) | | | | (-4.7369) | |
| | Adjusted R2 | 0.1597 | | 0.6093 | | 0.1117 | | 0.6977 | |
| | Durbin-Watson | 1.9553 | | 1.8891 | | 1.6859 | | 1.9229 | |

The regressions are estimated by ordinary least squares with heteroskedasticity consistent covariance. The figures in parentheses are t-statistics. Significance at the 15, 10, 5 and 1 percent levels are indicated by the symbols #, *, **, ***, respectively.

1/ Percent change in the IPC index in pesos from the end of the previous month.

2/ The residual values of the estimating equation for unpublicized flows -- see column 4 of Table VI.

3/ Percent change in the Morgan Stanley world dollar price index from the end of the previous month.

4/ Percent change in the S&P500 price index from the end of the previous month.

5/ The last weekly auction rate on 28-day Cetes during the previous month; expressed as an annual rate.

6/ Stripped yields adjusted to remove the impact of change in U.S. treasury bond yields. For further details please see Section II of the text.

7/ See Section II of the text for explanation of sources and computation.

8/ Annualized stock price volatility calculated from daily returns during month t.

## Table XI.
## Test of the Positive Feedback Hypothesis: Regression of Surprise Net Purchases on Current and Lagged Weekly Stock Returns

| | Dependent variable | Surprise unpublicized net foreign purchases 1/ | | Surprise unpublicized net foreign purchases 1/ | | Surprise unpublicized net foreign purchases 1/ | | Surprise unpublicized net foreign purchases 1/ | |
|---|---|---|---|---|---|---|---|---|---|
| | | (1) | | (2) | | (3) | | (4) | |
| | Sample period | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | | 89:03-96.03 | |
| C(0) | Constant | -0.0005 | # | -0.0004 | | -0.0004 | | -0.0005 | # |
| | | (-1.5731) | | (-1.3317) | | (-1.3317) | | (-1.5905) | |
| C(1) | Monthly peso return on Mexican stocks 2/ | 0.0132 | *** | | | | | | |
| | | (4.2689) | | | | | | | |
| C(2) | Monthly peso return on Mexican stocks (-1) 2/ | -0.0001 | | | | | | | |
| | | (-0.0405) | | | | | | | |
| C(3) | Sum of weekly returns on Mexican stocks 3/ | | | | | 0.0218 | *** | 0.0156 | *** |
| | | | | | | (2.6983) | | (4.4988) | |
| C(4) | Week 4 return on Mexican stocks 3/ | | | 0.0218 | *** | | | | |
| | | | | (2.6983) | | | | | |
| C(5) | Week 3 return on Mexican stocks 3/ | | | 0.0128 | ** | -0.0090 | | | |
| | | | | (2.0712) | | (-0.8882) | | | |
| C(6) | Week 2 return on Mexican stocks 3/ | | | 0.0203 | ** | -0.0015 | | | |
| | | | | (2.0673) | | (-0.1131) | | | |
| C(7) | Week 1 return on Mexican stocks 3/ | | | 0.0103 | | -0.0115 | | | |
| | | | | (0.8905) | | (-0.9211) | | | |
| C(8) | Week 4 return on Mexican stocks (-1) 3/ | | | 0.0002 | | 0.0002 | | | |
| | | | | (0.0169) | | (0.0169) | | | |
| C(9) | Week 3 return on Mexican stocks (-1) 3/ | | | -0.0015 | | -0.0015 | | | |
| | | | | (-0.2140) | | (-0.2140) | | | |
| | **Hypotheses tests** | | | | | **Probability Values** | | | |
| | C(5),C(6),C(7),C(8),C(9)=0 | | | | | 90.41% | | | |
| | Adjusted R2 | 0.1698 | | 0.1289 | | 0.1289 | | 0.1660 | |
| | Durbin-Watson | 2.3273 | | 2.3820 | | 2.3820 | | 2.3221 | |

The regressions are estimated by ordinary least squares with heteroskedasticity consistent covariance. The figures in parentheses are t-statistics. Significance at the 15, 10, 5 and 1 percent levels are indicated by the symbols #, *, **, ***, respectively. The indicated probability value is for a likelihood ratio test of the indicated null hypothesis; the test statistic has a chi-squared distribution.

1/ The residual values of the estimating equation for unpublicized flows -- see column 4 of Table VI.

2/ Percent change in the IPC index in pesos from the end of the previous month.

3/ Percent change in the Morgan Stanley local currency price index for Mexican stocks. Week 4 refers to return over the last 7 calendar days of the month, Week 3 to the 7 days before Week 4, Week 1 to the first seven days of the month, and Week 2 to the second 7 days.

**FEDERAL RESERVE BANK OF NEW YORK**
**RESEARCH PAPERS**
**1996**

The following papers were written by economists at the Federal Reserve Bank of New York either alone or in collaboration with outside economists. Single copies of up to six papers are available upon request from the Public Information Department, Federal Reserve Bank of New York, 33 Liberty Street, New York, NY 10045-0001 (212) 720-6134.

9601. Bartolini, Leonardo, and Gordon M. Bodnar. "Are Exchange Rates Excessively Volatile? And What Does 'Excessively Volatile' Mean, Anyway?" January 1996.

9602. Lopez, Jose A. "Exchange Rate Cointegration across Central Bank Regime Shifts." January 1996.

9603. Wenninger, John, and Daniel Orlow. "Consumer Payments over Open Computer Networks." March 1996.

9604. Groshen, Erica L. "American Employer Salary Surveys and Labor Economics Research: Issues and Contributions." March 1996.

9605. Uctum, Merih. "European Integration and Asymmetry in the EMS." April 1996.

9606. de Kock, Gabriel S. P., and Tanya E. Ghaleb. "Has the Cost of Fighting Inflation Fallen?" April 1996.

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