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Author(s): Ian Domowitz, Jack Glen, Ananth Madhavan

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Market Segmentation and Stock Prices: Evidence from an Emerging Market

IAN DOMOWITZ, JACK GLEN, and ANANTH MADHAVAN*

ABSTRACT

We examine the relationship between stock prices and market segmentation induced by ownership restrictions in Mexico. The focus is on multiple classes of equity that differentiate between foreign and domestic traders, and between domestic individuals and institutions. Significant stock price premia are documented for shares not restricted to a particular investor group. We analyze the theoretical and empirical determinants of premia across firms and over time. In addition to economy-wide factors, segmentation reflects the relative scarcity of unrestricted shares. The results provide additional support for Stulz and Wasserfallen's (1995) hypothesis that firms discriminate between investor groups with different demand elasticities.

INTEREST IN FOREIGN EQUITY markets, especially in emerging economies, has grown rapidly in recent years as investors seek higher returns and international diversification. In many markets, foreign investors must contend with investment barriers in the form of restrictions on foreign equity ownership.¹ Such investment barriers are of particular interest, because they place limits on the percentage of a firm's equity that foreign investors can hold, possibly inducing capital market segmentation. In turn, segmentation reduces foreign investors' gains from diversification, possibly discouraging international equity investment.² This article examines the impact of ownership restrictions on equity prices in an emerging market.

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¹ Examples include China, Finland, Indonesia, Korea, Malaysia, Mexico, Philippines, Singapore, and Thailand, among others. See, e.g., Eun and Janakiramanan (1986) for a description of ownership restrictions in 16 nations.

² Stulz (1981) provides a general model of investment barriers; Gultekin, Gultekin, and Penati (1989) study the effect of capital controls; Bailey (1994), Bailey and Jagtiani (1994), Errunza and Losq (1989), Eun and Janakiramanan (1986), Hietala (1989), Jorion and Schwartz (1986), and Lau and McInish (1996) analyze the impact of foreign ownership restrictions on share prices; and Stulz

Foreign ownership restrictions may be imposed by governments to ensure that control remains in the hands of domestic nationals or may be instituted by individual companies. Other ownership restrictions distinguish among various classes of domestic investors, such as between individuals and institutions. Previous research (e.g., Bailey, 1994, Bailey and Jagtiani, 1994) shows that such investment barriers can induce segmentation in the sense that share prices for identical claims to cash flows and voting rights vary across investor groups.

The nature of this segmentation is unclear, however. In particular, why are ownership restrictions binding at some times but not others, and for some companies but not others? Specifically, is there any evidence of price discrimination by domestic entrepreneurs given the relative scarcity of such shares (as suggested by Stulz and Wasserfallen, 1995) or can other factors such as variation in market liquidity in different share series explain the observed premia? We examine these issues using data obtained from the Mexican Stock Exchange (MSE).

Mexican stocks are of particular interest, because an individual firm typically issues multiple classes of equity that differentiate between foreigners and domestic traders, and, in the case of financial firms, between domestic individuals and institutions. As a result, the cash flows accruing to different classes of stock are the same and any differences in share prices for different classes of stock reflect the effect of ownership restrictions. This allows us to study the effectiveness of various ownership restrictions and their impact on equity prices directly.³ Specifically, the relative prices of restricted and unrestricted shares provide a natural measure of the market segmentation induced by various ownership restrictions.

As an emerging market, Mexico also is of interest, since our knowledge of equity markets outside the United States is primarily drawn from studies of developed markets.⁴ Foreign investment may have a significant impact on an emerging market because these markets are generally small and illiquid compared to their more mature international counterparts. Indeed, foreigners (mostly U.S. nationals) account for over 27 percent of holdings and up to 75 percent of trading in Mexican stocks in the sample period. Finally, Mexico offers important lessons for other countries with similar institutional restrictions.

and Wasserfallen (1995) develop and test a model where corporations endogenously issue classes of stock that differentiate between foreign and domestic owners.

³ In contrast, most previous studies (e.g., Wheatley, 1988) use models of expected returns to determine the extent of international integration. Alternative approaches are adopted by Bekaert (1995), who develops a return-based measure of market integration, and Cooper and Kaplanis (1994), who test predictions about portfolio holdings.

⁴ Exceptions include DeSantis and Imrohroglu (1994), who analyze returns and volatility in emerging markets; Bekaert (1995), and Bekaert and Harvey (1995), who discuss the impact of investment barriers in emerging markets; Bailey and Chung (1995), who examine the determinants of equity returns in Mexico; and Bailey and Jagtiani (1994), who analyze the effect of ownership restrictions in Thailand.

We find that ownership restrictions create market segmentation in the domestic equity market in the sense of economically significant stock price premia for unrestricted shares (differentiated by foreign and domestic ownership, and by individual and institutional ownership) relative to restricted shares. These results provide additional support for previous findings that investment restrictions can have significant economic impacts on security prices. They are also consistent with recent analyses by Harvey (1995) and Bekaert and Harvey (1995, 1996), who show that integration has effects on equity prices in emerging markets.

The importance of ownership restrictions, measured by the premium for unrestricted shares, varies widely over time and across individual companies. We show theoretically that this variation may arise from two sources: (1) differences in the relative valuation of cash flows by domestic and foreign investors, combined with price discrimination by domestic entrepreneurs as described by Stulz and Wasserfallen (1995), or (2) differences in the liquidity of the market for restricted and unrestricted shares, which affect the cost of trading in the two-share series.

We develop a panel-data model to analyze the cross-sectional and time-series determinants of price premia and to distinguish between these two hypotheses. Our empirical results provide support for the Stulz–Wasserfallen hypothesis, emphasizing the relative scarcity of unrestricted shares. We find that the price premium for unrestricted shares is positively related to proxies for foreign demand and is negatively related to the relative supply of unrestricted shares measured by the ratio of unrestricted to total shares outstanding. By contrast, a proxy for relative liquidity in the two series—the ratio of unrestricted to total trading volumes—cannot explain the time-series and cross-sectional patterns in observed premia. This suggests that the premia documented here are not the result of differential market liquidity. Additional tests using a vector autoregression (VAR) model confirm this finding. Although increases in the relative liquidity of restricted shares reduce premia over very short horizons of a few days, there is no evidence that these changes have a long-run affect on share price premia.

The article proceeds as follows. Section I describes the institutional framework and data, and the theoretical determinants of segmentation are developed in Section II. Section III contains an analysis of the empirical variation in premia. A panel-data model, used to investigate the determinants of segmentation jointly across stocks and over time, is described in Section IV. Section V concludes with suggestions for future research.

I. Institutions and Data

A. Multiple Equity Series

The Mexican equity market is characterized by the existence of multiple classes (or series) of shares that differentiate between national and foreign investors, individual and institutional investors, and general and financial

issuers. These distinctions are institutional in nature; they are dictated by government policy with the objective of placing corporate control in the hands of individual Mexican investors.

For a nonfinancial company, the series available for issue that are relevant for our analysis are the following:

A Series: Open only to Mexican individuals or Mexican-controlled institutions. Shares have full voting rights and must collectively represent the majority of voting shares.

B Series: Open to all investors, regardless of nationality. Shares have full voting rights, but cannot collectively represent the majority of voting shares.

All series represent identical claims to earnings and have the same voting rights.⁵

The system of share ownership is complicated by the existence of “financieros,” or financial services companies. Control of these companies is viewed as particularly important by the government and consequently a separate system of series restrictions has been compiled for them. As before, all series provide equal claim to the economic earnings of the issuer. For any financiero, the following set of series exists:

A Series: Open only to Mexican individual investors. Must represent the majority of voting shares; shares have full voting rights.

B Series: Open to Mexican individuals and Mexican-controlled institutions. Shares have full voting rights, but cannot represent the majority of votes.

C Series: Open to all investors. Limited to 30 percent of capital; full voting rights.

Multiple equity series permit one to compare the valuation of a single asset by different investor groups. Specifically, we can use the prices of restricted A and unrestricted B series shares for nonfinancial firms (B and C shares for financieros) to analyze the economic importance of foreign ownership restrictions. Similarly, the prices of A and B series shares for financieros allow us to examine the effect of purely domestic ownership restrictions.

⁵ In addition, nonfinancial companies may issue L Series shares that are open to all investors, but voting rights may be limited to matters related to, for example, mergers, acquisitions, and delisting of the stock. The total of B and L shares cannot exceed the number of A shares. Others series issued by nonfinancial companies include the CPO series, essentially an A share stripped of its voting rights, and the recently authorized D Series. The D Series offers the holder preferred dividend rights, but companies employing this series designation are rare, and that series is not a part of this study.

B. Institutional Features of the Mexican Equity Market

Before turning to an analysis of the prices of the equity series issued by Mexican corporations, we note two additional institutional features of the equity market that may affect share prices.⁶

Mexico was one of the first emerging markets to create mechanisms for foreigners to buy shares restricted to domestic nationals through a national development bank, which strips them of their voting rights and holds them in a trust for the investor.⁷ In Mexico, A shares purchased in this way are stripped of their voting rights, which are held by the national development bank, Nafin. In the case of a stripped-share, the series designation changes from A to an ordinary participation certificate (CPO), so that such shares are identified in our sample.

In theory, a trust program offers the foreign investor a way to circumvent ownership restrictions. In practice, however, there are several issues that limit their use. On the supply side, there may be constraints on the numbers of trust shares issued. A firm may open a Nafin trust for its shares for any reason, but individual investors are not capable of creating CPOs.⁸ Since the issuer bears all costs for opening and maintaining trust accounts, the incentives to create such trusts are limited.

On the demand side, foreign investors may be unwilling to invest in trusts. For example, U.S. institutional investors such as pension funds are often prohibited from investing in undiversified unit trusts (mutual funds), so that special exemptions may need to be secured to invest in the typical trust fund that consists of the shares of a single company. Additionally, custodian banks may not accept CPOs as proof of share ownership. Complicating matters, CPOs are often complex "share cocktails" that are not tied to a single share and are thus difficult to understand and value. For example, a Televisa CPO consists of one A share, one L share, and one D share. Finally, foreign institutional investors may be unwilling to give up their voting rights, especially in companies where ownership is concentrated among a family group.

Possibly for these reasons, the use of trusts in our sample period was limited. Other countries attempting to emulate such programs have had limited success in attracting foreign investors. In Thailand, for example, it is estimated that 80 percent of current foreign investors would be unable to invest using the trust mechanism (Berdacke, 1995).

It is also possible that individuals can circumvent ownership restrictions by using domestic investors or firms as fronts, stock parking, or by other such means. While this is undoubtedly possible for individual investors who have close ties to Mexican nationals, it appears infeasible for larger or institutional traders, who also bear higher potential costs if their illegal activity is detected.

⁶ We thank Warren Bailey for bringing this point to our attention.

⁷ The Mexican trust system has attracted attention since its inception in November 1989. Moffett (1990) describes the inception of the Nafin trust. Berdacke (1995) provides a summary of the experience of Thailand with a similar trust system.

⁸ When an investor sells, the shares are taken from the trust for sale and the CPO is cancelled.

Consequently, illegal trades are unlikely to be a significant factor in the determination of share price differentials.

Another issue that is relevant when making comparisons across A and B shares for nonfinancial companies is the possibility that price differentials are driven by taxes. Capital gains on the sale of listed stocks are not subject to taxation by the Mexican authorities for either resident or nonresident investors. Dividends, to the extent that they are paid out of income that has already been taxed by Mexico, will also not be subjected to any additional taxation for either resident or nonresident investors. The net effect of the Mexican system of taxation, because it excludes both capital gains and dividend income from individual investor income that is subject to income tax, makes investment in stocks relatively more attractive for Mexican individual investors than for U.S. individual investors. Thus, other things equal, tax considerations would also tend to reduce any premium to unrestricted B shares. Of course, tax factors generally cannot explain cross-sectional or time-series variation in observed premia.

C. The Data

The data used in this study were obtained from the MSE and are generally not available publicly.⁹ The sample used here consists of observations on prices, returns, and share volumes of 24 equity series on a daily basis and 46 equity series on a weekly basis issued by 21 firms over the period 1990–1993. The stocks included are the only ones for which reliable stock price data on series differentiated by ownership rights were available. We obtained data on market capitalization, dividends, and earnings for those firms in our sample also covered by the databases maintained by the International Finance Corporation.

The data were screened and checked to detect potential errors. The major problem encountered was the fact that companies routinely change series designations after corporate actions, although the underlying changes often have no effect on ownership or voting rights. For example, the A series of company CIFRA underwent seven changes in series designation between January 1988 and July 1993. Companies typically took at least one action per year that had some effect on series designation, few of which were meaningful. Each such change was investigated using information from the *Anuario Bursatil* (the MSE's yearbook) and data supplied from Mexican brokerage houses.

Stock prices and returns were calculated and adjusted based on information from the MSE and from the *Anuario Bursatil*, as were trading volumes. This process is more complicated than the usual simple adjustments for dividends and stock splits. For example, the MSE would occasionally announce the simple cancellation of outstanding tradeable shares in the A series. Share

⁹ Domowitz, Glen, and Madhavan (1996) use a different data set consisting of cross-listed firms to study the impacts of order flow migration on the domestic market.

Table I
Stock Series by Company and Industry

This table contains stock series abbreviations, names of companies, industry classifications, and series by company for a sample of stocks traded on the Mexican Stock Exchange.

Abbreviation	Company	Industry	Series
Panel A: Nonfinancial Firms			
CEM	Cemex	Cement	A, B
CIF	Cifra	Retail stores	A, B
CER	Internacional de Ceramica	Construction materials	A, B
COM	Controladora Comercial Mexicana	Retail stores	A, B
EPN	EPN	Holding company	A, B
FEM	Fomento Economico Mexicano	Food, beverage, tobacco	A, B
KIM	Kimberly Clark de Mexico	Cellulose, paper	A, B
LAT	Conductores Latincasa	Electrical equipment	A, B
MAS	Grupo Industrial Maseca	Food, beverage, tobacco	A, B
PON	Ponderosa Industrial	Cellulose, paper	A, B
SID	Grupo Sidek	Holding company	A, B
SYN	Grupo Synkro	Holding company	A, B
Panel B: Financial Firms			
BAN	Bancomer	Banking	A, B, C
CBF	Afin Casa de Bolsa	Brokerage	A, B
CBO	Operadora de Bolsa	Brokerage	A, B
GFB	Grupo Financiero Bacomer	Financial group	A, B, C
GFI	Grupo Financiero Invermexico	Financial group	A, B, C
GFM	Multiva Grupo Financiero	Financial group	A, B, C
GFO	Grupo Financiero Probursa	Financial group	A, B
GSE	Grupo Financiero Serfin	Financial group	A, B

holdings also were adjusted based on reciprocal buy/sell offers between companies under what seemed to be the same parent umbrella.

Table I provides the names of the 21 companies in the sample, their stock abbreviations, industry classification, and the series issued. A wide variety of industries is represented in the sample, including cement, food, beverage, retail store chains, paper, construction, and banking. Altogether, there are 46 series, mostly A and B series. Four companies in our sample have the full set of A, B, and C shares in existence and traded over the sample period. We turn now to an analysis of the effect of ownership restrictions.

II. The Conceptual Framework

A. Equity Investment Restrictions and Share Prices

Previous research on foreign equity investment restrictions (see, e.g., Stulz, 1981, Eun and Janakiraman, 1986, Hietala, 1989, and Bailey and Jagtiani, 1994, among others) shows that these barriers can have substantial effects on share prices. With the exception of China, the available evidence for foreign

ownership restrictions suggests that series open to foreigners command higher prices than those open to domestic investors. Explanations for these findings can be grouped into two categories of models.

The first category, which we refer to as *differential valuation models*, posits that differences in prices reflect differences in the underlying reservation prices of domestic and foreign investors. This includes cases where foreigners have a lower cost of capital than domestic investors or have higher valuations of the expected future cash flows of the firm because of investor sentiment, taxes, or other factors. It also includes the important case discussed by Stulz and Wasserfallen (1995) where the demand functions for foreign and domestic investors differ because of deadweight costs that vary across countries. While intuitively appealing, these assumptions are less compelling in the case of purely domestic ownership restrictions.

The second category, which we term *liquidity models*, explains price premiums for unrestricted stock in terms of differences in trading costs. In this model, restricted A shares are closely-held and trade infrequently, while the market for unrestricted B shares is active. Since dealers' inventory carrying costs are higher in stocks where the time between trades is large, trading costs in A shares will exceed those of B shares. Potential problems of asymmetric information may compound this problem. Even if ownership restrictions are not binding and investors share common expectations, the lower cost B shares may command a premium over the A shares, just as registered, exchange-traded securities carry a premium over otherwise equivalent unregistered or letter stock.

While both models may explain the existence of stock price premia, they are not necessarily complements. As we discuss below, the two models yield somewhat different empirical predictions. Before turning to the empirical evidence, however, a more formal statement of the two hypotheses is appropriate.

B. A Liquidity Model of Stock Price Premia

The simplest explanation for the existence of stock price premia is the *liquidity hypothesis*. In this model, the price premia for unrestricted B shares reflects the lower transaction costs and greater liquidity in these shares relative to the often inactively traded restricted A series. In particular, it is not necessary that foreign and domestic investors share differential valuations of the asset, or even that they exhibit risk aversion.

To see this, consider the marginal domestic investor who can buy either an A series share or a B series share. The price levels are determined by considerations of fundamental value. Let $2\varphi_A$ denote the percentage bid-ask spread in the A series and similarly denote the spread in the B series by $2\varphi_B$. Thus, a buyer with value estimate v pays the ask price of $p(1 + \varphi)$ and receives $v(1 - \varphi)$ upon selling in the final period. For an investor to be indifferent between the

two markets, the returns net of costs to buying B or A shares should be identical. This implies that

$$\left(\frac{\nu(1 - \varphi_B)}{p_B(1 + \varphi_B)} \right) = \left(\frac{\nu(1 - \varphi_A)}{p_A(1 + \varphi_A)} \right) \quad (1)$$

where p_A and p_B denote the prices of A and B shares, respectively. Rearranging, we obtain

$$\frac{p_B}{p_A} = \left(\frac{1 + \varphi_A}{1 + \varphi_B} \right) \left(\frac{1 - \varphi_B}{1 - \varphi_A} \right). \quad (2)$$

Equation (2) shows that the price premium is an increasing function of the relative costs of trading in the A and B markets. Bid-ask spreads reflect both the risks of carrying inventory and adverse selection costs. Both factors are likely to be higher in A series stocks where trading is thin because the stock is closely held by insiders or family members. This implies a positive price premium for unrestricted B shares, especially in those stocks where the A shares are very thinly traded.

C. The Differential Demand Model

The differential demand hypothesis explains price premia in terms of differences in reservation prices. Our approach follows that of Stulz and Wasserfallen (1995). In their model, ownership restrictions can arise endogenously, because domestic entrepreneurs may choose to price discriminate between the two investor groups. In this section, we apply their analysis to the case of ownership restrictions in Mexico. Some modifications to their model are needed because of the nature of the investment restrictions under consideration.

First, since ownership restrictions in Mexico do not arise endogenously, we need to recognize the possibility that they may be binding even if the firm finds this suboptimal. An important aspect of this problem arises when some shares are kept by the owner-entrepreneur for control purposes, as we discuss below. Second, foreign ownership restrictions in Mexico do not preclude domestic investors from owning shares open to foreign investors. Finally, we model the differences between investor groups as arising from their need for diversification, as opposed to differences in deadweight costs. This approach has the advantage that the results readily extend to restrictions that differentiate between different groups of domestic investors where differences in deadweight costs are unlikely to be important. It also provides an explanation for why there may be differences in the demand elasticities of foreign and domestic investors.

Let p_A denote the price of a series A share and let S_A denote the number of A shares outstanding, with a similar convention for series B shares. We assume A shares (restricted) are open only to domestic nationals while B shares (unrestricted) are open to both foreign and domestic investors. Both

classes of shares carry identical voting rights and represent identical claims to cash flows.

A simple arbitrage argument rules out the case where the restricted A shares are higher priced than the unrestricted B shares. If this were the case, domestic investors will not trade A shares if they can purchase B shares at a lower price.¹⁰ Accordingly, we focus on the case where, following the issue of new shares, the B series shares (which are open to foreign and domestic investors) trade at a premium over the A series shares (which are restricted to domestic investors). Since domestic investors can purchase either A or B series shares (and short sales are not possible), domestic investors will hold the A shares while foreign investors hold the unrestricted B shares, even though these trade at a premium over the A shares.

To explain the price premium, some additional assumptions are necessary. We consider a two-period model. The firm pays a (stochastic) liquidating dividend, denoted by $\tilde{\theta}$, on both restricted and unrestricted shares. Both foreign and domestic investors maximize mean-variance expected utility functions. For a domestic investor, end-of-period wealth is a random variable given by $\tilde{W}_d = E[\tilde{\theta}]q_A - q_A p_A + \tilde{y}_d$, where q_A is the amount of shares purchased and $\tilde{y}_d$ is the stochastic income (normalized to have zero mean) from other assets, including human capital. In this case, it is well-known that the demand functions are linear and take the form $d_A = \alpha(\nu_d - p_A)$ and $d_B = \beta(\nu_f - p_B)$ for domestic and foreign investors, respectively. In the demand functions, α and β are positive constants, and ν_d and ν_f are interpreted as the "valuations" placed on the company's expected dividends, adjusted for their value in portfolio diversification.

Formally, $\nu_d = E_d[\tilde{\theta}] - 2A_d\sigma_d$ where A_d is the coefficient of absolute risk aversion for domestic investors and σ_d denotes the covariance of the stochastic dividend $\tilde{\theta}$ with the asset income of domestic investors, $\tilde{y}_d$. Similarly, we can write $\nu_f = E_f[\tilde{\theta}] - 2A_f\sigma_f$. Using the properties of the expected utility function, we can write $\alpha = N_d/2A_d\sigma_{d,\theta}^2$ and $\beta = N_f/2A_f\sigma_{f,\theta}^2$, where N_d (N_f) is the number of domestic (foreign) investors, and $\sigma_{d,\theta}^2$ ($\sigma_{f,\theta}^2$) is the (conditional) variance of the asset's payoff from the viewpoint of domestic (foreign) investors. Thus, the demand coefficients α and β decrease with risk aversion and perceptions of the variance of the asset's variance, and increase with the number of investors.

In the short-run, a firm's shares outstanding can be viewed as fixed, and the ratio of B to A prices is given by

$$\frac{p_B}{p_A} = \left(\frac{\nu_f - \beta^{-1}S_B}{\nu_d - \alpha^{-1}S_A} \right). \quad (3)$$

¹⁰ This argument applies to marginal investors; controlling blocks of A shares may trade at a premium over B shares. However, conversations with experienced investors in Mexican shares suggest that this factor is negligible for the great majority of stocks because most companies are controlled by traditional family groups whose controlling blocks are not traded. Control contests are very rare in Mexico, supporting this view.

Thus, given a particular ratio of shares outstanding, an increase in the number of foreign investors (i.e., an increase in β) will immediately result in an increase in the premium. Similarly, an increase in foreign risk aversion or an increase in the perceived volatility of the asset will reduce β and lower the premium. Similar remarks apply to domestic investors. Some of the variation in premia across firms at a point in time and over time in individual firms may be explained by equation (3), i.e., by this differential demand model.

Now consider the Stulz–Wasserfallen hypothesis, where the domestic entrepreneur optimally selects the degree of market segmentation. Specifically, we consider a domestically owned private corporation that issues A and B shares to the public, subject to the constraint on foreign ownership imposed by the government. Let S'_A denote the existing number of A shares held by the owner, where $S'_A \geq 0$. These shares are assumed to be held by the owner-entrepreneur for control purposes and are not traded. For simplicity, we assume there are no preexisting B shares. The firm must decide whether to issue *new* A and B series shares (denoted by ΔS_A and ΔS_B , respectively), bringing the shares outstanding to $S_A = S'_A + \Delta S_A$ and $S_B = \Delta S_B$ for the A and B series, respectively. The implicit assumption made here is that if the firm's original owners choose to hold shares, they will hold A series shares. This is rational since the government imposed ownership constraint places an upper limit on the number of B shares. Let c denote the minimum fraction of shares needed for control, where $c \geq 0$. Thus, if the ratio of S'_A to the total number of shares outstanding exceeds c (which need not necessarily be 50 percent), the owner-entrepreneur retains control. Control is associated with a benefit $b > 0$. To focus attention on the pricing of the A and B series shares, we assume that the owner is undiversified, and hence holds the minimum number of shares necessary to retain control provided that b is sufficiently large.

The firm's objective then is to issue new shares so as to raise the maximum amount of equity capital, net of the expected capital costs in the form of the investments needed to make the promised dividend, and subject to constraints imposed by the government and by control considerations. The firm is assumed to have access to a constant returns-to-scale investment technology where an investment of μ yields an expected one-period payoff of $E[\tilde{\theta}] > \mu$.¹¹ The equilibrium prices of A and B series shares are given by the solutions to $d_A(p_A) = \Delta S_A$ and $d_B(p_B) = \Delta S_B$, respectively. Let $p_A(\Delta S_A)$ and $p_B(\Delta S_B)$ denote the inverse demand functions for A and B shares, respectively, as functions of the new issues. The optimization problem is to choose ΔS_A and ΔS_B to maximize $p_A(\Delta S_A)\Delta S_A + p_B(\Delta S_B)\Delta S_B - \mu(\Delta S_A + \Delta S_B)$, subject to: (1) the *ownership constraint* imposed by the government $S'_A + \Delta S_A \geq \Delta S_B$, and (2) the *control constraint* $S'_A \geq c(S'_A + \Delta S_A + \Delta S_B)$. Under our assumption that retaining control is costly at the margin, the control constraint will be exactly binding, so that $S'_A = \psi(\Delta S_A + \Delta S_B)$, where $\psi = c/(1 - c)$. Substituting this into the

¹¹ By contrast, Stulz and Wasserfallen (1995) assume a fixed investment. Incorporating the production technology into the model allows us to examine changes in the total amount of equity offered as a result of changes in the number of foreign and domestic investors.

ownership constraint, we obtain $\Delta S_A \geq \kappa \Delta S_B$, where $\kappa = (1 - \psi)/(1 + \psi)$ if $c < 0.5$ and 0 otherwise. Observe that if there is no control premium, $c = 0$, and the only constraint is the ownership constraint. Alternatively, if $c = 0.5$, the owner seeks to retain complete control and will sell shares only to foreign investors.

The Kuhn–Tucker conditions corresponding to this constrained optimization problem yield $p'_A(\Delta S_A)\Delta S_A + p_A(\Delta S_A) + \lambda = \mu$ and $p'_B(\Delta S_B)\Delta S_B + p_B(\Delta S_B) - \kappa\lambda = \mu$, where λ is the Lagrange multiplier on the inequality constraint. If the inequality constraint imposed by the government that the A shares control the firm is binding, the Lagrange multiplier λ is strictly positive.¹² In this case, the firm would like to issue more B shares, but doing so would violate the control requirement.

We now turn to the stock price premia. Consider the case where the firm issues new shares to the public for the first time. When the inequality constraint is not binding (so that at the optimal levels, $S'_A + \Delta S_A \geq \Delta S_B$), the first-order conditions imply that $\Delta S_A = \alpha(\nu_d - \mu)/2$ and $\Delta S_B = \beta(\nu_f - \mu)/2$. Substituting these expressions into the inverse demand function yields the price premium on unrestricted shares:

$$\frac{p_B}{p_A} = \left(\frac{1 + r_f}{1 + r_d} \right) \quad (4)$$

where $r_f \equiv \nu_f/\mu$ and $r_d \equiv \nu_d/\mu$.

Equation (4) shows that the equilibrium price ratio is a function of the foreign to domestic valuations of the returns (relative to the firm's cost of capital) per share. A positive premium for the unrestricted shares implies that international investors have higher valuations of returns than domestic investors. In terms of our model, this would occur even if both classes had identical expectations but if σ_d , the covariance of the firm's dividend with domestic asset income $\tilde{y}_d$, is greater than the corresponding covariance, σ_f , for foreign investors. This may be expected because the correlation between the earnings from other assets and a domestic firm's earnings is likely to be higher for domestic investors than foreign investors because of the home-country bias in portfolios. For an interior solution, we also require that the ratio of valuations in excess of marginal costs be bounded above, i.e., that $\alpha/\beta\kappa > (\nu_f - \mu)/(\nu_d - \mu)$. Observe that the control constraint is not a determinant of long-run equilibrium prices.

If the requirements for an interior solution are not satisfied, the constraint on share ownership is binding and in the case where both A and B shares are issued, the optimal number of B shares issued is:

$$S_B = \left(\frac{\alpha\beta}{\alpha + \beta\kappa^2} \right) \left(\frac{\kappa\nu_d + \nu_f - (1 + \kappa)\mu}{2} \right). \quad (4')$$

The premium is given by substituting this expression into equation (3), using the fact that $\Delta S_A = \kappa \Delta S_B$. As in the unconstrained case, the ratio of unre-

¹² Technically, the number of A shares should just outnumber the number of B shares.

stricted to restricted share prices is an increasing function of the value of diversification to foreigners, but the control constraint, c , determines the optimal issuance of shares and hence the premium. Intuitively, the larger the initial shareholdings, the firm can issue B shares up to S'_A without violating the constraint. From an econometric viewpoint, the lack of observability of S'_A creates potential problems if it is correlated with other firm specific variables that enter the relative valuations of foreign and domestic investors. We will address this problem in our estimation procedure.

D. Implications of the Analysis

The analysis yields several empirical implications. In particular, the price discrimination model shows that in the long-run, when firms can adjust their outstanding shares, the equilibrium premium for unrestricted shares reflects differences in the valuation of equity earnings by different investor groups and firm-specific control factors.¹³ In our model, foreign and domestic valuations can differ for several reasons. First, and perhaps most likely, domestic earnings provide different portfolio diversification benefits to foreigners and domestic investors. Alternatively, there may be differences in the beliefs or risk tolerances of the two investor groups. The model predicts that a decrease in the correlation between Mexican equity income and foreign income or an increase in the risk aversion of foreign investors will decrease the equilibrium price premium.

Unlike Stulz and Wasserfallen (1995), the effect of a change in the number of foreign investors on the long-run premium depends on past share issuance. This occurs because the ownership restrictions we consider are government-mandated and do not arise endogenously. For example, faced with an increase in the number of foreign investors (i.e., an increase in β), the optimal response of the firm is to issue new B shares (i.e., increase S_B), provided it is not already at the constraint. The increase in S_B will reduce the premium to the equilibrium level indicated by equation (3), i.e., the ratio of relative share valuations that is independent of the number of investors.

This is not the case for the liquidity model. There in both the short and long-run, the relative premium for unrestricted stock is a function of the relative costs of trading. Since the bid-ask spread is known to be inversely related to volume, the liquidity model implies that the price premium is an increasing function of the ratio of volume in B to A series shares. The actual shares outstanding should have little additional effect on price premia if this

¹³ In practice, the existence of a positive premium is unlikely to involve a total separation between foreign and domestic investors. Some foreigners may be able to circumvent rules against the ownership of A shares using intermediaries. Similarly, some Mexican investors may find themselves unable to take large positions in A shares since controlling blocks rarely trade. For such investors, possibly institutions, B shares represent the only available option. However, it seems unlikely that these effects will be so strong as to outweigh the impact of the basic demand and supply factors we have identified as determinants of the price premium.

Table II
Stock Premia and Trading Volumes Across the Market

This table contains summary statistics on stock price premia due to restrictions on foreign ownership and individual ownership rights, respectively, for 21 companies listed on the Mexican Stock Exchange by year. All statistics are computed based on weekly observations. Premium statistics are given in percentage terms. Volume is average weekly trading volume in dollar terms, in millions per firm. "Restricted" denotes volume in A shares, or B shares in the case of *financieros*; in the panel devoted to foreign/domestic restrictions; the same term refers to volume in A shares only, in the panel devoted to institutional/individual restrictions. "Unrestricted" denotes B or C shares in the first panel, and B shares only in the second panel. The second panel contains information on the *financiero* companies only. Reported returns are in percentage terms, and the same conventions governing "restricted" and "unrestricted" categories apply. Returns are average weekly returns.

	1990	1991	1992	1993
Panel A: Foreign/Domestic				
Average premium	4.13	5.39	12.44	9.90
Median premium	1.43	0.78	3.56	3.39
Standard deviation of the premium	8.78	19.37	27.35	19.72
Restricted volume	1.96	6.13	8.99	9.54
Unrestricted volume	1.16	6.40	9.45	11.11
Restricted returns	0.75	0.99	0.43	-0.19
Unrestricted returns	0.82	1.01	0.56	-0.18
Observations	496	606	729	364
Panel B. Institutional/Individual				
Average premium	-0.24	-0.12	2.56	10.92
Median premium	0.00	0.00	0.04	6.91
Standard deviation	2.17	2.11	6.23	9.88
Restricted volume	0.27	2.12	3.42	2.63
Unrestricted volume	0.37	3.04	9.50	6.42
Restricted returns	0.72	0.76	0.39	-0.23
Unrestricted returns	0.78	0.75	0.48	-0.21
Observations	102	184	326	130

volume ratio is considered. We turn now to the empirical evidence on the premium.

III. Empirical Evidence

A. The Magnitude of Stock Price Premia

As a first step toward assessing the effectiveness of ownership restrictions, we computed the average stock price premium. In all cases, the stock price premium refers to the percentage price premium between "restricted" and "unrestricted" shares, based on weekly observations. "Restricted" refers to the A series shares, or B series in the case of *financieros*; "Unrestricted" refers to B series shares, or C series in the case of the *financieros*. Table II contains summary statistics on the annual average percentage stock price premium for

1990–1993, differentiated by type of ownership restriction. The table also provides data on the dollar volume in restricted and unrestricted shares and on the returns in the two series.

For firms with stock differentiated by foreign ownership restrictions, the average premium is statistically and economically significant, suggesting that investment barriers to foreign ownership were a source of market segmentation. Interestingly, the average stock price premium varies significantly over the sample period. The average premium is 4.13 percent in 1990 and increases to 12.44 percent in 1992 before falling to 9.90 percent in 1993.¹⁴ This apparent trend coincides with the enormous expansion of interest in emerging markets by foreign investors and the opening of the domestic market. These premia are considerably lower than the premia for East Asian countries reported by Bailey and Jagtiani (1994) among others.¹⁵ Whether this difference reflects differences in international capital market segmentation or institutional features such as the Nafin trust are at present unclear.

In the case of restrictions on individual and institutional share ownership in financial firms, the increase in the premia from the first half of the sample period to the second half is even more dramatic. In the period 1990–1991, the average premium is statistically and economically negligible. By 1993, however, it had risen to 10.92 percent. This pattern coincides with that of the privatization of banks and other financial institutions. Privatization in the financial sector was just beginning in 1990, and the sample of *financieros* exhibiting purely domestic share restrictions in 1990, in particular, is very limited. As privatization spread, there was an increase in holdings of unrestricted shares, accompanied by an increase in their availability. This intuition is born out by examining the data on traded volumes in Table II. The volume of trading in unrestricted shares relative to restricted shares is significantly greater in the latter part of the period than at the beginning.

For firms with restrictions on foreign ownership, the data on volumes also suggest that the increase in the premia over the sample period was accompanied by a small decline in the ratio of restricted to unrestricted share volumes. This pattern is less noticeable than for the domestic ownership restrictions of the *financieros*, but the market had been open to foreign investment before privatization of the financial sector took place, and prior to the beginning of our sample period.

While we focus on the differences in price levels induced by ownership restrictions, it is also possible that segmentation may be manifested in terms of differences in the returns distribution for the two share series. Accordingly,

¹⁴ The estimated premium on unrestricted shares for Mexican stock is considerably less than that documented by Stulz and Wasserfallen (1995) for Switzerland, possibly because of differences in risk tolerances between foreign and domestic investors.

¹⁵ An important exception is China where, as shown by Bailey (1994), the prices of shares restricted to domestic nationals trade at a substantial premium over the prices of identical shares restricted to foreign investors. As noted by Bailey (1994), this may reflect restrictions on foreign investment by Chinese nationals or investor sentiment on the part of naive and overly optimistic domestic investors.

we perform a formal hypothesis test of the equality of the average weekly returns to restricted and unrestricted stock. The p -values are uniformly high, in the range of 0.90–1.00, indicating no evidence of economically significant differences in the returns of restricted and unrestricted stock.

B. Variation in Premia Across Companies

The evidence in Table II shows that both types of ownership restrictions result in segmentation which, on average, is economically significant and varies over time. Space constraints preclude a full tabular description of analogous statistics across companies, available from the authors on request. Nevertheless, some useful insights may be gained from the following general description of company data.

There is wide cross-sectional variation in the stock price premia. Indeed, the median premia on foreign versus domestic ownership by company range from 44.9 percent for EPN to –1.6 percent for GFM.¹⁶ There does not appear to be any systematic pattern by industry group that would explain the large variation across different stocks. For example, the six companies whose premia exceeds 10 percent are in the financial, retail, paper, and food sectors. A few firms have no economically significant premia.

Some similar clustering of premia around zero in series for which unrestricted volume is small appears in statistics on stock price premia for eight financial firms, arising from restrictions on individual versus institutional ownership. Once again, there is a wide range in the median premium, from 15.2 percent for GFB to –1.0 percent for CBO. Four of these companies (BAN, GFB, GFI, and GFM) also have stock series that permit us to discriminate between both domestic/foreign ownership restrictions and institutional/individual restrictions. For all but GFM, the stock price premium estimated for foreign versus domestic ownership is higher than that for individual versus institutional ownership. This result suggests that the differences in the valuations of equity earnings are greater between foreign and domestic investors than between individual and institutional groups of domestic investors.

IV. An Analysis of Segmentation

A. Empirical Determinants of Equity Premia

In the liquidity hypothesis, the premium across different firms is an increasing function of the liquidity of the unrestricted shares relative to those of the restricted shares. An empirical proxy for this relative liquidity measure across firms is the ratio of volume in the unrestricted shares to total volume. The transaction cost *differentials* between the restricted and unrestricted shares may also be inversely related to market capitalization. Smaller companies tend

¹⁶ A negative premium may reflect nonsynchronous prices in the A and B markets, transactions in controlling blocks of A shares, or data errors. However, there are relatively few negative premia, and the standard deviation of the premium is large in all such cases.

to be closely held, and consequently we expect spreads in the restricted A shares to be high relative to spreads in the B shares. This in turn implies a larger premium. In a large firm, volume in both A and B shares may be sufficiently active that the transaction cost differentials, and hence premia, are small. Again, over time in a given stock, changes in the ratio of volume in the B series to total volume will cause changes in the premium in the same direction.

In the price discrimination model, firms adjust the availability of restricted and unrestricted shares through equity offerings or repurchases (subject to the constraints mandated by the government) to achieve an equilibrium price ratio based on the relative valuations of earnings of foreign and domestic investors. At any point in time, variation in the level of the price premia for unrestricted shares across firms reflects differences in the demands of foreign and domestic investors relative to the shares outstanding. Similarly, for a given firm, changes in the price premium over time reflect either adjustments toward the equilibrium price ratio or changes in this equilibrium level itself. This suggests that unrestricted shares will trade at a premium for those firms where foreign demand is significant.

Bailey and Jagtiani (1994) argue that foreign investors, especially institutions, prefer to invest in larger companies where there is greater financial disclosure and better information. These considerations suggest that we would observe larger premia in high market capitalization firms, exactly the opposite of the prediction for the liquidity hypothesis. Similarly, the information hypothesis predicts higher premia in companies with high dividend payout ratios (a proxy for maturity and stability) whereas the opposite is true under the liquidity hypothesis. There may also be company-specific (unobservable) effects that reflect institutional factors, herding, or a neglected firm effect associated with size and with dividend yields. Similarly, an increase in market capitalization over time at the level of an individual firm may induce greater foreign participation and, other things equal, a larger premium.

As shown in Section II, the premia will be lower for those firms where the ratio of unrestricted B to restricted A shares is large. Over time, the model predicts that a firm faced with an exogenous increase in foreign demand will increase the number of unrestricted shares outstanding. Indeed, there is some evidence that the opening of the market to international investors led to new share issues of unrestricted stock. Specifically, the ratio of B to A shares outstanding averaged over all firms rose from 0.72 in 1990 to 0.85 in 1992. There is also considerable variation across companies in the ratio of B to A shares outstanding averaged over time, with estimates ranging from 0.46 to 0.99, possibly reflecting the uneven distribution of foreign equity investment across firms. In the liquidity model, by contrast, the shares outstanding are not relevant in determining the premium if the relative volume ratio is also included as an explanatory variable.

Finally, in both models, a company's stock price premium may depend on the past premia. Autocorrelation may arise in the Stulz–Wasserfallen model because an individual firm cannot dynamically adjust its shares outstanding to

maintain the equilibrium level of the premium. Similarly, in the liquidity model, changes in trading costs may be serially correlated, inducing serial correlation in the premia.

B. Econometric Methodology

We turn now to the development of an econometric model to investigate the hypotheses discussed above. It is natural to use panel-data techniques, since our hypotheses concern factors that vary both over time and across firms. In addition to increasing degrees of freedom and generally reducing the collinearity among explanatory factors, panel-data methods can improve the precision of estimates of model dynamics in short time-series (e.g., Hsiao, 1986). The most important benefit, however, is the ability to control for unobservable firm-specific effects, whether or not they are correlated with other included observables in the model.

We consider an error components model of the form

$$y_{it} = \beta' x_{it} + \alpha_i + \varepsilon_{it} \quad (i = 1, \dots, N; t = t_i, \dots, T_i) \quad (5)$$

where y_{it} represents the equity premium, our measure of market segmentation, for firm i in period t , and β is a k -dimensional vector of coefficients associated with observable explanatory variables, x_{it} , which may include lags of both dependent and independent variables. The disturbance ε_{it} has zero mean and is assumed to be uncorrelated with the explanatory variables and with the firm-specific fixed effect α_i ; it may be heteroskedastic, however. The latent individual effect α_i is taken to be a time-invariant random variable, distributed independently across firms. In terms of the model, this coefficient can be interpreted as a proxy for the effects of the unobservable control considerations on the premium.

If both ε_{it} and α_i are homoskedastic, and if α_i is uncorrelated with x_{it} , generalized least squares (GLS) would be consistent and asymptotically efficient. Leaving issues of constant variance aside for the moment, we view the unobserved firm effects as potentially quite important, but highly likely to be correlated with the observables in the model. Were the unobservable to be interpreted as a management or control effect, for example, it clearly would be correlated with variables such as the ratio of outstanding B to A shares, market capitalization, dividends, and potentially any dynamics in the premium itself. In the presence of such correlation, ordinary least squares (OLS) and GLS yield biased and inconsistent estimators of all parameters in the model.

These observations necessarily lead us to an estimation method that explicitly conditions on the (unobserved) values of the firm effects in the sample.¹⁷

¹⁷ An alternative that preserves the advantages of GLS in this context is offered by Hausman and Taylor (1981), if one is willing to assume a priori that some of the explanatory variables are indeed uncorrelated with the firm effect. We cannot make such an argument for enough such instruments to identify and estimate our model.

We face an additional complication, however. As indicated in the formulation of equation (5), there are N firms, but the vagaries of the data collection effort have data on firm i starting at time t_i and ending at T_i , with $T(i) = T_i - t_i + 1$ time-series observations on each firm. This type of situation is a particular case of unbalanced data (Searle, 1971). Each such time-series consists of a contiguous block of time-series observations, however, which eases the analysis. We derive the appropriate estimator for this case.

Define $D(N) = \sum_{i=1}^N (T_i - t_i) + 1 = \sum_{i=1}^N T(i)$. The $ND \times 1$ vector of observations on the dependent variable, Y , is ordered first by firm and then by time. It is convenient to stack the observations in such a way as to order firms such that for firms $m < n$, $t_m \leq t_n$. The $ND \times 1$ matrix of observable explanatory variables is ordered conformably, as is the vector of time-varying disturbances ε . The vector α is $N \times 1$, ordered as in Y . Let $\mathbf{e}_i$ be the elementary column vector, with a 1 in the i th position and zeros elsewhere. The vector $\mathbf{1}_i$ is a column vector of ones, of dimension $T(i)$. The matrix representation of the model now can be written as

$$Y = X\beta + L\alpha + \varepsilon \quad (6)$$

where L is a $D(N) \times D(N)$ matrix that consists of an ordered stack of $\mathbf{e}_i' \otimes \mathbf{1}_i$, for $i = 1, \dots, N$.

Let $M = I_{D(N)} - L(L'L)^{-1}L'$. The unobserved firm-specific components are eliminated by the transformation

$$MY = MX\beta + M\varepsilon \quad (7)$$

since $ML = 0$. The GMM estimator for this transformed model is simply

$$\hat{\beta} = (X'MX)^{-1}X'MY \quad (8)$$

In order to simplify and further clarify the estimation technique, note that $L(L'L)^{-1}L' = \text{diag}[\mathbf{1}_i/T(i)]$ where $\text{diag}[\cdot]$ denotes a (block) diagonal matrix. For any conformable matrix Z , composed of vectors Z_i with $T(i)$ time-series observations in each one, $MZ = [Z_i - \bar{Z}_i\mathbf{1}_i]_{i=1, \dots, N}$, in which $\bar{Z}_i$ is the time-series average of the observations. It follows that the estimator here is a version of the usual fixed effects estimator for balanced data, sometimes called Model I of analysis of variance (Eisenhart, 1947). The estimator is obtained from a regression applied to deviations from (time-series) means.

C. Estimation

We estimate a model of the foreign/domestic ownership premium using data that represent the intersection of our database on premia with the corporate database maintained by the International Finance Corporation.¹⁸ The corporate data are monthly, and our maximum time-series coverage is for the 36

¹⁸ Unfortunately, we were not able to obtain cross-sectional data for financial services firms, so the model is estimated only for a subset of the nonfinancial firms.

months from January 1990 through December 1992. The cross section of firms for which data are available includes those from the cement, retail stores, cellulose and paper, food, beverage, and tobacco sectors, and two general holding companies.¹⁹

Given the disparate nature of the industries involved, we employ a generalized method of moments (GMM) estimator, using our explanatory variables in the form of deviations from the mean as instruments, as opposed to the standard regression estimator. The technique allows us to correct the standard errors for heteroskedasticity of unknown form in the time-varying error components and permits efficient estimation under such circumstances.

Based on our discussion of the determinants of market segmentation above, we model the premium for stock i in period t as

$$\begin{aligned} \text{PREM}_{i,t} = & \beta_1 \text{PREM}_{i,t-1} + \beta_2 \text{SRATIO}_{i,t} + \beta_3 \text{VRATIO}_{i,t} + \beta_4 \text{MCAP}_{i,t} \\ & + \beta_5 \text{DIV}_{i,t} + \beta_6 \text{CRISK}_t + \alpha_i + \varepsilon_{i,t} \end{aligned} \quad (9)$$

where, for firm i in month t , $\text{PREM}_{i,t}$ is the ratio of the price of B shares (without foreign ownership restrictions) to the price of A shares (restricted to Mexican nationals); $\text{SRATIO}_{i,t}$ is the ratio of outstanding unrestricted B shares to total outstanding shares; $\text{VRATIO}_{i,t}$ is the ratio of trading volume in B shares to total shares; $\text{MCAP}_{i,t}$ is the company market capitalization; $\text{DIV}_{i,t}$ is the dividend payout ratio (yield defined as the monthly dividend payments relative to earnings); and CRISK_t is a measure of the Peso or currency risk premium. The company-specific fixed effect is represented by the coefficient α_i while $\varepsilon_{i,t}$ represents the error term.

Our measure of currency risk is based on the short-term government debt instruments available in Mexico. The Mexican government issues short-term dollar-indexed (Tesobono) and peso-denominated (Cetes) notes. Since both bonds are issued by the Mexican government and therefore have the same default risk, the yield spread between the two (i.e., the difference between the Cetes yield and the Tesobono yield) provides a measure of peso risk. Bailey and Chung (1995) construct a similar measure to price risk in the Mexican stock market. Using monthly yield data on 28 day notes, we computed this spread measure, CRISK_t , which is common to all firms but varies over time.

The presence of autonomous dynamics, represented by the single lagged dependent variable, creates some additional complication. It is known that fixed effects estimation can yield (asymptotically) biased coefficient estimates in panels with a short number of time-series observations (Nerlove, 1971). The bias goes to zero as the number of time-series observations becomes infinite. Although the number of time-series observations in our sample is not especially small ($T = 27$, on average), it seems prudent to compute bias-corrected estimates as an additional robustness check.

¹⁹ The firms are CEM, CIF, KIM, MAS, PON, SID, SYN, APA, and FEM.

Formally, let $\tilde{Y}_{-1}$ be Y lagged one period, in deviation form, and let $\tilde{X}$ be X in deviation form. The regression of $\tilde{Y}_{-1}$ on $\tilde{X}$, yields coefficients $\tilde{\beta} = (\tilde{\beta}_2, \dots, \tilde{\beta}_K)$ and a residual vector, $\tilde{\varepsilon}$. As in our model, we take β_1 to be the coefficient on the lagged dependent variable. For notational convenience, let $b = (\beta_2, \dots, \beta_K)$ and $\hat{b}$ be the vector of fixed effects estimates of b ; $\hat{\beta}_1$ is the fixed effects estimate of β_1 . It follows immediately from the results of Nickell (1981) that

$$\text{Asymptotic bias}(\hat{b}) = -\text{plim}(\tilde{\beta}). \text{plim}(\hat{\beta}_1 - \beta_1) \quad (10)$$

and

$$\text{Asymptotic bias}(\hat{\beta}_1) = -\left[\text{plim}\left(\frac{1}{NT}\right)\tilde{Y}'_{-1}\tilde{\varepsilon}\right]^{-1}\left[\frac{\sigma^2}{T(1-\beta_1)}\right]\left[1 - \frac{1}{T}\frac{(1-\beta_1^T)}{(1-\beta_1)}\right], \quad (11)$$

where the bias is calculated as a probability limit (plim) and all limits are calculated as $N \rightarrow \infty$.

We calculate these biases by using $\tilde{\beta}$ and sample averages to approximate the probability limits. The variance of ε_{it} is approximated by averaging the sample variances of the ε_{it} . Although we do not have a fixed T for all firms, we have shown that the usual fixed effects estimator applies here, and the use of $\bar{T} = \sum_{i=1}^N T(i)/N$ is appropriate. Finally, these expressions rely on β_1 , which, of course, is unknown. Given that $\bar{T} = 27$, the results change little as β_1 varies between zero and one. We compute bias-corrected estimates based on $\beta_1 = 0.50$.

D. Panel-Data Model Estimates

Table III (Model 1) contains the GMM estimates of the panel-data model given by equation (9) with corrections for unbalanced data and a fixed-effects adjustment for unobservable firm effects. The results without bias-correction are very similar and are not reported here. Several results are apparent: First, the lagged premium is positive and statistically significant, indicating that there is strong first-order autocorrelation in premia. An analysis of the model residuals suggests no serial correlation, indicating that there is little higher-order autocorrelation. The coefficient on the lagged premium is 0.396, indicating that the premium exhibits strong mean reversion. This appears consistent with the evidence presented below, that short-run order imbalances in the A and B series stock cause temporary changes in stock price premia that are ultimately reversed, and is consistent with both hypotheses.

The relative supply of B shares, as measured by SRATIO, is negative, and the coefficient is highly statistically significant. Since the relative scarcity of shares is a choice variable for firms, subject to the constraints on the issuance of B shares, this result suggests that some segmentation is optimal. Interestingly, the coefficient of the ratio of traded volumes, VRATIO, is insignificant. This is consistent with the model of Stulz and Wasserfallen (1995), where firms segment the market to exploit differences in the demand elasticities of differ-

Table III
Panel Data Models

This table contains Generalized Method of Moments (GMM) coefficient estimates and associated heteroskedasticity-consistent standard errors (in parentheses) of two panel data models for foreign and domestic equity ownership restrictions. Model 1 is

$$\text{PREM}_{i,t} = \beta_1 \text{PREM}_{i,t-1} + \beta_2 \text{SRATIO}_{i,t} + \beta_3 \text{VRATIO}_{i,t} + \beta_4 \text{MCAP}_{i,t} \\ + \beta_5 \text{DIV}_{i,t} + \beta_6 \text{CRISK}_t + \alpha_i + \varepsilon_{i,t}$$

where i indexes firms (CEM, CIF, KIM, MAS, PON, SID, SYN, APA, FEM) and t indexes observations by month, for the period January 1990–December 1992. The variables are PREM, ratio of the price of B shares to A shares; SRATIO, the ratio of outstanding B shares to total shares; VRATIO, the ratio of trading volume in B shares to total shares; MCAP, market capitalization; DIV, dividend yield defined as the monthly dividend payments relative to earnings; CRISK, currency risk, measured by the ratio of peso-denominated 30-day notes to \$-denominated note prices; α is the unobservable firm effect. In Model 2, the coefficient of VRATIO is set to zero. Estimation in both cases is by GMM, with a fixed-effects adjustment for unobservable firm effects, corrections for unbalanced data, and a bias correction due to inclusion of the lagged dependent variable.

Variables	Model 1	Model 2
Lagged premium	0.396 (0.090)	0.394 (0.089)
Ratio of B/total shares outstanding	-0.268 (0.050)	-0.269 (0.050)
Ratio of B/total traded volume	0.010 (0.019)	
Market capitalization	0.030 (0.013)	0.031 (0.013)
Dividend yield	-0.294 (0.204)	-0.297 (0.204)
Currency risk	-0.009 (0.004)	-0.008 (0.004)

ent clienteles, but is not consistent with the liquidity hypothesis, where the premia reflect differential trading costs.

The effect of market capitalization, MCAP, is positive and both economically and statistically significant. This echoes the findings of Bailey and Jagtiani (1994) for Thailand. Larger companies are more likely to attract foreign investors than smaller companies, other things being equal, since they are widely followed and provide better information. As a result, the observed premia, which arise from the differential demands of foreign and domestic investors, are likely to be higher for higher market capitalization companies. It is also possible that “hot money” from abroad flows to stocks that have had significant stock price increases (and hence increases in market capitalization), also producing a positive coefficient. By contrast, the liquidity hypothesis predicts a negative coefficient since cost differentials and hence premia should decrease with firm size.

The dividend payout ratio, DIV, however, is not statistically significantly different from zero, possibly because firm size already captures much of the cross-sectional variation in foreign participation. The results are robust to dropping this variable. Finally, our measure of currency risk, CRISK, is negative and statistically significant. As expected, higher perceptions of exchange rate risk (as measured by a wider spread between monthly 28 day peso- and dollar-denominated Mexican Government notes) imply less foreign investment and hence lower premia. This effect, it should be emphasized, is not firm-specific but is common to all the firms in the sample.

Model 2 in Table III contains the results of the panel-data model dropping the variable VRATIO. Comparing Models 1 and 2, it is immediately clear that the coefficients and significance levels of the other variables are largely unaffected by whether our proxy for liquidity, VRATIO, is included or not. This provides some confidence that our conclusions regarding the determinants of price premia are robust. In addition to the models described above, we also estimated two alternative specifications whose results are not reported here. In the first variant, we included dummy variables for each year to capture common effects arising from unobserved macroeconomic or political risks. These variables were not, in general, statistically significant, and the results on the other variables were largely unchanged. In the second variant, we added a book-to-market price ratio as another control variable. This variable proxies for size in that its effects are similar to market capitalization, but was dropped because some observations appeared possibly anomalous, and because market capitalization is less likely to be affected by differences in accounting conventions across firms.

E. VAR Tests of the Liquidity Hypothesis

The panel-data estimates indicate that the liquidity hypothesis has little explanatory power compared with an alternative hypothesis emphasizing the relative scarcity of unrestricted shares together with price discrimination by domestic companies. However, some liquidity effects may be difficult to discern without high frequency data. In this section, we provide additional tests of the liquidity hypothesis using *daily* trading data for both foreign-domestic and individual-institutional restrictions.

To describe the short-run dynamics between stock price premia and the relative liquidity of unrestricted B series shares, we estimate a vector autoregressive (VAR) model for the 14 firms for which *daily* time-series data are available. The 14 firms in our sample are split evenly between those with foreign/domestic and institutional/individual restrictions. The model is

$$\sum_{s=0}^{\infty} A(s)Y_{t-s} = e_t, \quad (12)$$

where $A(s)$ is a 2×2 matrix of coefficients, Y is a 2×1 vector of variables, and e is a 2×1 vector of white noise innovations. The two variables contained in

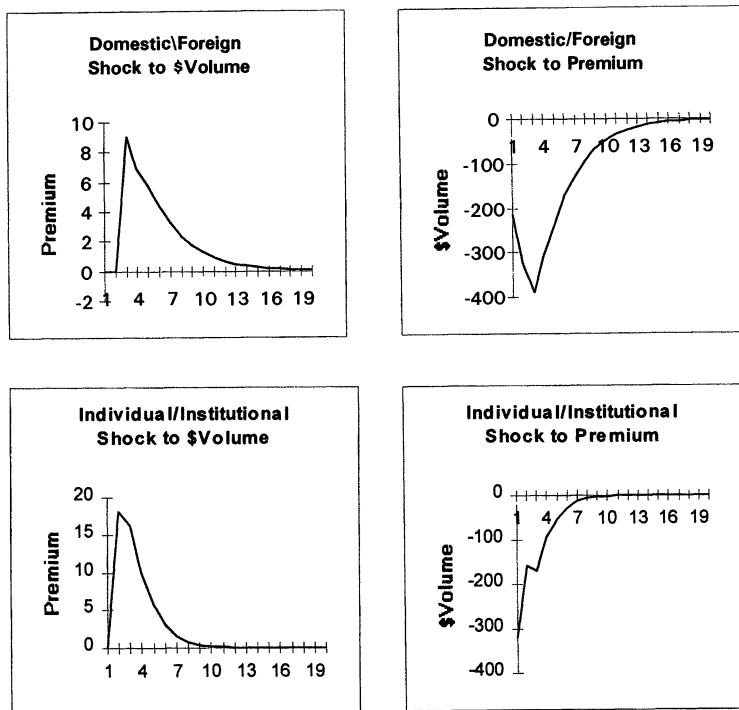


Figure 1. The figures plot the impulse response functions for MAS (top graphs) and CBO (bottom graphs) based on the coefficient estimates of equation (12). The figures show the effect of one standard deviation change in relative dollar volume (left graphs) and the equity premium (right graphs) on thee daily premium and relative volume, respectively, over a 20-day horizon.

the vector Y in the VAR model are the stock price premium for unrestricted shares and the ratio of unrestricted trading volume (in shares) to total trading volume, a measure of the liquidity of the unrestricted B series shares.

Since all firms exhibited virtually the same significant responses, we summarize our results by presenting the impulse response functions for two typical firms. Figure 1 graphs the impulse response functions for MAS (foreign/domestic segmentation) and CBO (institutional/individual segmentation) based on the estimates of equation (12). For each stock, the two graphs illustrate the *long-run* or *permanent* effect on the premium of independently increasing the relative liquidity by one standard deviation and the response of relative liquidity to increasing the premium by one standard deviation.

A relationship between the premium and liquidity is clearly present in both directions. In particular, when the relative share of unrestricted volume is independently increased, the premium also rises in days immediately afterwards. However, although there are short-run liquidity effects, they are transitory and the premium returns to its long-run equilibrium level within 5 to 10 days. This is inconsistent with the liquidity hypothesis, which predicts that an increase in the relative liquidity of restricted shares should induce a perma-

nent reduction in the price premium. To check that there are no liquidity effects over longer horizons, we also estimated a *structural* VAR, incorporating restrictions from a dynamic simultaneous equations equilibrium model, for every firm in the sample using weekly time-series data. The estimates are statistically and economically insignificant, indicating that while changes in the premia can be brought about by transient shifts in traded volumes, these effects are short-lived and do not carry over into equilibrium.

V. Concluding Remarks

Restrictions on equity ownership are common in many countries, especially emerging markets. We show that ownership restrictions effectively segment the equity market in Mexico in the sense that there are economically significant stock price premia for unrestricted shares. These premia vary over time and across individual companies. From a theoretical viewpoint, the variation in premia may be explained by differences in the demands of various investor clienteles (Stulz and Wasserfallen, 1995) or by differences in relative market liquidity. We develop a panel-data model to jointly examine the cross-sectional and time-series behavior of the equity premium. This allows us to distinguish between the two theoretical models of price premia. Our results provide support for the Stulz–Wasserfallen model, in that the observed equity premia reflect the relative scarcity of unrestricted shares. We find little evidence of liquidity effects lasting longer than a few days.

We show that segmentation increases with firm capitalization, presumably because larger companies tend to be favored by foreign investors, and during periods in which foreign perceptions of currency risk are small. Finally, premia exhibit strong mean reversion, consistent with transitory price movements in restricted and unrestricted series stock induced by liquidity shocks.

The research presented here is complementary to our previous work on the international cross-listing of Mexican securities (Domowitz, Glen, and Madhavan, 1996). The focus of the latter article is on volatility, liquidity, and volume effects due to cross-listing. Using a more restricted sample, limited to firms experiencing foreign ADR listings, we find that the effects of cross-listing are more complex than models of market integration or market fragmentation suggest. Among other things, it is demonstrated therein that systematic changes in volatility, liquidity, returns, and bid-ask spreads due to cross-listing are largely concentrated in share series open to foreign ownership prior to the listing event. Such evidence is consistent with the migration of foreign investors, but makes sense only if ownership restrictions actually do segment the domestic equity market. The current study is strongly supportive of the latter proposition, as well as indicating that segmentation is not limited to considerations of foreign ownership.

Our results raise several new questions. Our finding that the relative supply of unrestricted shares affects the extent of market segmentation suggests that firms may consciously limit the extent of foreign participation. But while ownership restrictions may benefit domestic entrepreneurs, these barriers

may discourage future equity investment by other international investors. As a result, it is unclear whether exogenously imposed ownership restrictions reduce the overall cost of capital for domestic firms. Finally, the determinants of foreign participation in new markets require further analysis. In particular, it is important from a practical and policy viewpoint to quantify the sensitivity of foreign investment to measures of political and currency risk. These, however, are topics for future research.

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