Foreign Equity Investment Restrictions, Capital Flight, and Shareholder Wealth Maximization: Theory and Evidence

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This article provides a theory of foreign equity investment restrictions. We consider a model where the demand function for domestic shares differs between domestic and foreign investors because of deadweight costs in holding domestic and foreign securities that depend on the country of residence of investors. We show that domestic entrepreneurs maximize firm value by discriminating between domestic and foreign investors. The model implies that countries benefiting from capital flight have binding ownership restrictions such that foreign investors pay a higher price for shares than domestic investors. The empirical implications of this theory are supported by evidence from Switzerland.

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In many countries, foreign investors face restrictions on owning domestic shares.[1] In some countries, such as Japan, these restrictions are imposed by law; in others, such as Switzerland, they are chosen by individual companies. In the United States and a number of other countries, foreign ownership restrictions which are binding only in rare cases in which a control contest is initiated by a foreign bidder exist in some industries. In other countries, such as Switzerland, Finland, or Thailand, ownership restrictions are almost always binding for the firms affected. Whereas legislated restrictions are sometimes motivated by a desire to preserve the independence of local industries, possibly because of national defense concerns, such a motivation cannot explain binding restrictions imposed by individual firms. In this paper, we propose a theory of foreign equity investment restrictions which shows conditions under which the imposition of binding ownership restrictions maximizes firm value. Although we are aware of models that study how foreign equity investment restrictions affect share prices and explain why unrestricted shares generally trade at a premium relative to the restricted shares, we do not know of any theory explaining why such restrictions exist.[2]

In this paper, we test our theory using data from Switzerland. The Swiss case is a promising testing ground because it is a country where one major firm, Nestlé, relaxed ownership restrictions during our sample period. Figure 1 shows the main empirical facts that a good theory should explain, using share prices of Nestlé as an example. The facts are (1) firms impose binding ownership restrictions willingly; (2) shares with restrictions trade at a substantially lower price than comparable shares without restrictions; (3) an increase in the supply of unrestricted shares associated with the relaxation of restrictions decreases the price of unrestricted shares; and (4) firms that have ownership restrictions sometimes choose to eliminate them. Our theory is consistent with this empirical evidence. In contrast, alternative theories which focus on the pricing of shares in the presence of ownership restrictions are consistent only with the second empirical fact, namely the premium on unrestricted shares.

[1] Eun and Janakiramanan (1986) provide a partial list of such restrictions.

[2] See Stulz (1981) for a general model of barriers to international investment. Eun and Janakiramanan (1986) analyze the effect of equity ownership restrictions on the pricing of shares when the fraction of shares that can be held by foreign investors is the same for all shares in a country. Hietala (1989) has a model where domestic investors cannot hold foreign shares and foreign investors can hold a limited quantity of domestic shares. Horner (1986) studies restrictions on foreign equity investment when restrictions can be bypassed at a cost. Errunza and Losq (1985, 1989) have a model where investors can invest in an unrestricted market and some investors can invest in a restricted market.

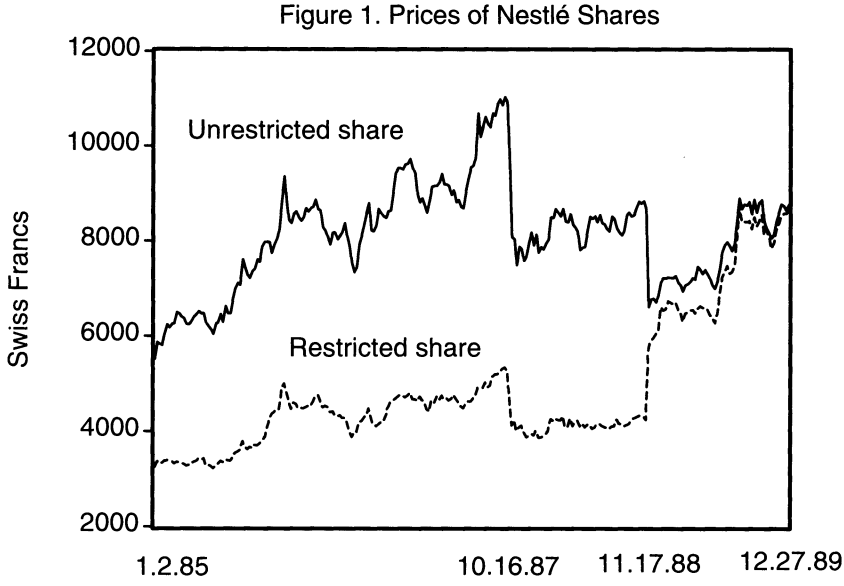

Figure 1
Prices of Nestlé restricted and unrestricted shares
Wednesday closing Swiss francs prices of Nestlé unrestricted and restricted shares from 1/2/85 to 12/27/89 are used. Unrestricted shares are bearer shares that can be held by all investors irrespective of their residence or nationality. Restricted shares are registered shares that can only be held by resident investors until 11/17/88 but have the same voting rights and dividend payments as bearer shares. After 11/17/88, Nestlé allows all investors to hold registered shares. The stock market crashed on 10/16/87.

Our basic argument is that if the demand functions for domestic shares differ for foreign and domestic investors, a firm seeking financing by issuing shares will find it advantageous to price discriminate between the two classes of buyers by selling shares at different prices to domestic and foreign investors. In our model, demand functions for domestic shares differ between domestic and foreign investors because investors bear deadweight costs for holding risky assets which differ across investors and across countries. Examples of such deadweight costs might be withholding taxes, political risks, transaction costs, or information acquisition costs. If, as a result of these costs, the demand for shares from domestic investors is more price elastic than the demand from foreign investors, the shares available to foreign investors trade at a premium relative to the shares available to domestic investors.[3]

[3] Whereas it is traditional in finance to assume that the demand for shares by investors is perfectly elastic, it is now recognized that this assumption is not always appropriate. See Bagwell (1991) for a review of some evidence on the imperfect elasticity of demand curves for shares and for a

The model we develop differs from existing models with deadweight costs in two important respects. First, we allow deadweight costs to vary across investors within a country. Second, some foreign investors face deadweight costs on assets held in their country of residence. With these two extensions, the domestic country can benefit from capital flight, which is defined in the literature as "the acquisition ... of a claim on nonresidents that is motivated by the owner's concern that the value of his asset would be subject to discrete losses if his claim continued to be held" in his country of residence.[4] In other words, some foreign investors may choose to hold more domestic assets in their portfolios than the domestic market's share in the world market portfolio. Such overweighting could be explained by fear of expropriation, a demand for secrecy, advantageous tax treatment, and so on. The literature on international portfolio choice has ignored capital flight, which is surprising given its economic importance and given the attention paid to it in the international economics literature.[5] Our paper is the first paper in the international portfolio choice and asset pricing literature that takes capital flight into account and is consistent with the simultaneous existence of a home bias in asset holdings for most investors and of capital flight from some investors.

We show that our model can explain the empirical evidence when (1) there is a home bias in the asset holdings of foreign investors and only a subset of foreign investors hold domestic shares and (2) the foreign investors who invest in the domestic country face greater deadweight costs in their home country than in the domestic country. There is substantial evidence that the first condition is generally met because relatively few investors take advantage of international diversification.[6] The second condition implies that countries benefiting from capital flight are countries where binding foreign ownership restrictions maximize firm value. With this second condition, capital flight leads some foreign investors to value the payoffs of domestic shares more than domestic investors so that foreign investors are willing to buy domestic shares at a premium. The home bias condition ensures that foreign investors have a demand for domestic shares that is less price elastic than the demand from domestic investors.

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discussion of the implications of that evidence. Loderer and Zimmermann (1988) provide evidence that the demand for Swiss shares is downward sloping by studying the price reaction to stock issues.

[4] See Deppler and Williamson (1987, p. 41). Williamson and Lessard (1987) review some of the definitions used in the literature.

[5] See Williamson and Lessard (1987) for additional references.

[6] See, for instance, French and Poterba (1991) and Cooper and Kaplanis (1994).

Though not all countries benefit from capital flight, Switzerland is surely one that has benefited from it. Historically, investors have been attracted to Switzerland by the lack of political risk, the bank secrecy, the low purchasing power risk, and the fact that tax fraud is not a penal violation so that foreign tax authorities receive limited help in pursuing tax fraud cases involving Swiss bank accounts. Walter (1990, p. 205) argues that "the amount of flight capital in Swiss banks was around 100 billion SFr in 1984," but there is wide variation in estimates. For instance, Walter (1990) shows that estimates of French funds invested in Switzerland following the accession of Mitterrand to power range from $3.75 billion to $60 billion and estimates of Ferdinand Marcos' holdings in Switzerland when he left the Philippines have ranged from less than $100 million to $15 billion. Interestingly, one would expect that China does not benefit from capital flight and does not, therefore, meet our conditions for a premium on unrestricted shares. Evidence that shares of Chinese companies that can be held by foreign investors sell at substantial discounts relative to the shares of the same companies that can only be bought by resident investors could therefore also be viewed as evidence supporting our model.[7]

Our theory helps to understand the evolution of share ownership restrictions. As the foreign demand for domestic shares changes, firms find it advantageous to modify the extent to which foreign investors can acquire domestic shares. In particular, if the price elasticity of the demand from foreign investors increases sufficiently, for example, because of greater integration of international financial markets, it may become optimal to remove all restrictions on share ownership. With our model, unexpectedly removing share ownership restrictions can decrease the value of the unrestricted shares substantially. This prediction differs drastically from the prediction obtained from international asset pricing models without deadweight costs, which suggest that the removal of restrictions has only a marginal effect on the price of unrestricted shares. It is consistent, however, with the evidence on Nestlé presented in Figure 1 and discussed further later.[8]

The paper proceeds as follows. In Section 1, we present our model and derive its empirical implications. In Section 2, we present our data for Switzerland. In Section 3, we show how the time-series and cross-sectional properties of the data are consistent with our theory. In Section 4, we demonstrate that the change in the price of Nestlé shares around the announcement concerning the relaxation of its foreign

[7] See Bailey (1994) for empirical evidence on this issue.

[8] Loderer and Jacobs (1994), in a contemporaneous paper, show that the evidence associated with the Nestlé announcement is consistent with the existence of finite demand elasticities.

equity restrictions is supportive of our theory. In Section 5, we provide some concluding remarks.

1. A Theory of Foreign Equity Investment Restrictions

In Section 1.1, we show how the general results of the literature on price discrimination apply in the context of this paper. In Section 1.2, we provide a detailed analysis of the conditions under which discrimination results in a higher price for shares available to foreign investors for the simple case where there is only one domestic firm. In Section 1.3, the pricing results of Section 1.2 are extended to the case of many domestic firms. Finally, in Section 1.4, we compare the implications of our theory with the implications of the argument that ownership restrictions exist for corporate control reasons.

1.1 Price discrimination and ownership restrictions

It is well known from microeconomics that a firm selling a good to consumers with different demand functions can increase its income through price discrimination.[9] The literature, following Pigou (1920), distinguishes between various types of price discrimination. One type is called *perfect price discrimination* and occurs when the seller can extract the surplus of each consumer. The more relevant type of price discrimination is the one in which consumers differ according to observable characteristics and the seller charges different prices to buyers with different observable characteristics. This type of price discrimination is called *third-degree price discrimination.* If consumer characteristics differ predictably according to their country of origin, discrimination according to country of origin benefits the seller. This is true irrespective of the nature of the good sold, as long as the seller can charge different prices to buyers from different countries. For prices to differ across countries, though, the seller must be able to prevent buyers in countries where the price is high from buying where the price is low and buyers in countries where the price is low from reselling where the price is high. Hence, for discrimination to be implemented for securities, the issuing firm must be able to prevent sales of securities from investors of one country to investors of another country.

There are many reasons to believe that demands for assets differ across countries. For instance, investors from different countries have different tax rates for identical securities and face different degrees of political risk. One would therefore expect to observe cases where

[9] See Tirole (1988) for an exposition of the theory of price discrimination.

price discrimination occurs. What remains to be seen is whether price discrimination can explain the widely observed fact that securities available to foreign investors typically sell at a higher price than those available to domestic investors only.

To derive the conditions under which it is optimal for a domestic firm to discriminate by charging a higher price to foreign investors than to domestic investors, we consider a domestic entrepreneur who wants to maximize the proceeds from selling his firm's shares. There is no other firm in the domestic country and there is only one foreign asset in the simple two-date model. Both the domestic country and the foreign country have the same numeraire, so that there is no exchange rate risk. The firm pays a liquidating dividend Sp at date 1, where S is the number of shares and p is the random payoff per share. The entrepreneur must decide how to divide the S shares between S_R restricted R shares available to domestic residents only, and S_U unrestricted U shares available to foreign investors only.[10] The U and R shares differ only in their ownership restrictions and thus receive the same liquidating payoff p. The distribution of p does not depend on how the shares are divided between U and R shares. The foreign asset, asset F, pays a random liquidating dividend at date 1 of p_F per share. There is a risk-free asset which pays interest of r at date 1 per unit invested. P_a denotes the price of asset a, $a = R, U, F$, at date 0. The model is a partial equilibrium model in the sense that P_F, the distribution of p_F, and r are fixed and do not depend on the solution of the entrepreneur's maximization problem. Hence, the entrepreneur's decision to discriminate against foreign investors does not result in price discrimination abroad against domestic investors. We discuss later the implications of relaxing this assumption. The partial equilibrium perspective is the analog of the small country assumption used in international economics where, for small countries, prices abroad are taken as given.

Let $D_a = D_a(P_a)$ be the demand for asset a, and assume that the demand function is differentiable with respect to P_a for $D_a(P_a) > 0$. With this notation, the entrepreneur's proceeds from selling his shares are

$$V = D_R P_R + D_U P_U. \tag{1}$$

[10] We could allow domestic investors to hold unrestricted shares, but we would have to assume that they cannot sell unrestricted shares short to prevent them from selling short U shares and hedging their short-sales with long positions in R shares. In this case, domestic investors would not hold unrestricted shares in equilibria with price discrimination, since in such equilibria, U shares are dominated by R shares for domestic investors. Consequently, allowing domestic investors to hold unrestricted shares would not change our results. The model could be extended so that some domestic investors hold unrestricted shares in equilibrium by creating a class of domestic investors with deadweight costs similar to those of foreign investors. Such an extension would not affect the results of this article as long as this class of domestic investors is not too large.

To maximize V, the entrepreneur chooses S_R and S_U so that the market for R and U shares is in equilibrium, $D_R(P_R) = S_R$ and $D_U(P_U) = S_U$, the supply of R and U shares equals the supply of shares available, $S_R + S_U = S$, and the asset supplies are nonnegative, $S_R \geq 0$ and $S_U \geq 0$. With our assumptions, the maximization problem of the entrepreneur differs from the problem usually examined in the finance literature. The entrepreneur here is a monopolist in the capital market and faces a downward-sloping demand curve for the firm's shares on a risk-adjusted basis. There are no perfect substitutes for the securities he offers for either domestic or foreign investors. If the entrepreneur supplies strictly positive quantities of R and U shares, share prices that maximize V satisfy

$$\frac{P_U}{P_R} = \left[\frac{\varepsilon_U \varepsilon_R - \varepsilon_U}{\varepsilon_U \varepsilon_R - \varepsilon_R}\right], \tag{2}$$

where ε_a is the price elasticity of demand for shares of type a.[11] For domestic investors, therefore, $\varepsilon_R = -[\partial D_R(P_R)/\partial P_R][P_R/D_R(P_R)]$. It follows from Equation (2) that

Result 1. *It is optimal for the entrepreneur to sell shares at a higher price to foreign investors if the price elasticity of the demand from foreign investors is lower than the price elasticity of the demand from domestic investors.*

In models that assume perfect markets, the price elasticity of the demand for individual securities is generally considered to be high because of the presumption that there are many close substitutes for each individual security. Thus, the firm is typically assumed to be a price-taker with respect to the market price of risk, and, given the firm's assets, its cost of capital. In an international setting, though, the securities of the domestic country might have few close substitutes for foreign investors. This might be because the foreign investors face unattractive investment opportunities elsewhere, because there are barriers to international investment that lead them to prefer securities from their own country, or finally because domestic shares offer great diversification benefits. In the literature on international investment, deadweight costs are often used to model barriers to international investment. In the next section, we use deadweight costs to derive a model where some foreign investors face barriers to international

[11] To derive Equation (2), maximize firm value given by Equation (1) with respect to prices subject to the constraints that $S = S_R + S_U$, $S_R = D_R(P_R)$, $S_U = D_U(P_U)$, $S_R \geq 0$, $S_U \geq 0$, and rearrange the first-order conditions.

investment and others face unattractive investment opportunities in their home country.

1.2 Pricing *R* and *U* shares in the presence of deadweight holding costs

To obtain asset demands which differ across countries, we follow Stulz (1981) and assume that investors bear deadweight costs for holding risky assets which depend on the country of origin of investors and on the country in which an asset is traded. To allow for the simultaneous existence of a home bias in asset holdings and of capital flight, deadweight costs are allowed to differ across investors and investors bear deadweight costs for holding assets in their home country, as well as for holding assets outside their home country. To simplify the analysis, we assume that in each country, there are two classes of investors: one class faces low deadweight costs of investing abroad and the other class faces high deadweight costs of investing abroad. All investors in the same class are identical. We only consider the equilibria where (1) all investors choose to be long in securities from their own country and (2) in each country only one class of investors invests in the foreign country so that there is a home bias similar to the one observed empirically. Deadweight costs are defined as in Stulz (1981) as a fraction of the beginning-of-period investment in a security. Investor k's deadweight cost in the domestic country is c_k, and h_k is her deadweight cost in the foreign country. We assume for simplicity that deadweight costs are prohibitive on short-sales.[12] The liquidating payoffs at the end of the period do not depend on deadweight costs and are jointly normally distributed. There are no other imperfections in capital markets besides those already mentioned. Risk-free borrowing or lending is allowed for all investors at the rate r with no deadweight costs.[13]

All investors maximize

$$E[U_k(w_k)] = E[-\exp[-Aw_k]], \tag{3}$$

[12] This assumption is made to reduce the investment in notation. As shown in Stulz (1981), without this assumption we would need to model separately long and short positions to take into account the fact that deadweight costs are positive both on long and on short positions. This assumption is not restrictive in the context of our model, since in equilibrium the foreign investors must hold the U shares long and the domestic investors must hold the R shares long if both types of shares are in positive net supply.

[13] The assumption that deadweight costs do not apply to risk-free lending and borrowing is generally made in the literature on international portfoilo choice with investment barriers. A justification for this assumption might be the existence of a large offshore market for risk-free lending and borrowing, whereas there is no offshore market for equities.

where w_k is the end-of-period wealth of investor k and A is her coefficient of absolute risk aversion, which is assumed to be the same for all investors. End-of-period random variables are written in lowercase letters and beginning-of-period variables are written in uppercase letters. The kth investor must satisfy the following budget constraint:

$$W_k = D_{kF}P_F + D_{ka}P_a + L_k, \tag{4}$$

where W_k is investor k's initial wealth, D_{kF} her holdings of F shares, D_{ka} her holdings of a shares, $a = U$ for a foreign investor and $a = R$ for a domestic investor, and L_k her holdings of the riskless asset. The end-of-period wealth of investor k is given by

$$w_k = D_{kF}[p_F - h_kP_F] + D_{ka}[p - c_kP_a] + (1 + r)L_k. \tag{5}$$

The asset demands are obtained by maximizing Equation (3) subject to the budget constraint of Equation (4) and to the constraints that holdings of each type of shares must be nonnegative. Note that, with our assumptions, there are investors who hold no shares of a particular type because their deadweight costs for that type of share are too high. The appendix provides a derivation of the demand functions for the most general case considered in this paper. For the special case analyzed in this section, the demand for domestic shares from investor k, assuming that she holds positive amounts of domestic and foreign shares, is

$$D_{ka} = \frac{1}{(1-\rho^2)A\sigma^2}[E(p) - P_a(1+r+c_k) - \beta[E(p_F) - P_F(1+r+h_k)]], \tag{6}$$

where $a = U$ for a foreign investor and $a = R$ for a domestic investor, ρ is the coefficient of correlation between the payoffs of foreign shares and of domestic shares, $E(p)$ denotes the expected payoff of domestic shares, σ is the standard deviation of the payoff of domestic shares, and β is the beta coefficient of the payoff of domestic shares with respect to the payoff of F shares, $\text{cov}(p, p_F)/\text{var}(p_F)$. In this case, the demand for domestic shares of type a by investor k increases with her deadweight costs for F shares and falls with her deadweight costs for a shares. Equation (6) holds for a subset of foreign investors and a subset of domestic investors. Foreign investors with high deadweight costs for investing in the domestic country are assumed to never invest in the domestic country and consequently have no demand for domestic shares. Domestic investor j who invests only at home has the following demand for restricted shares:

$$D_{jR} = \frac{1}{A\sigma^2}[E(p) - P_R(1 + r + c_j)] \tag{7}$$

We can rewrite Equation (6) to emphasize its linearity in the domestic asset price:

$$D_{ka} = \alpha_k - \gamma_k P_a, \tag{8}$$

where

$$\alpha_k = \frac{1}{(1-\rho^2)A\sigma^2}[E(p) - \beta[E(p_F) - P_F(1+r+h_k)]]$$

$$\gamma_k = \frac{(1+r+c_k)}{(1-\rho^2)A\sigma^2}.$$

Equation (7) can be rewritten in the same way. Since all demand functions are linear, we can construct a domestic representative investor d whose demand function is a weighted average of Equations (6) and (7). Let f denote a foreign investor who invests in the domestic market. We assume that there are N_d investors of type d and N_f investors of type f.

With these assumptions, the entrepreneur chooses S_U and S_R to maximize firm value V as in Section 1.1. From Equation (1), we have

$$\begin{aligned} V &= D_U P_U + D_R P_R \\ &= N_f D_{fU} P_U + N_d D_{dR} P_R \\ &= \left(\frac{N_f\alpha_f - S_U}{N_f\gamma_f}\right) S_U + \left(\frac{N_d\alpha_d - S_R}{N_f\gamma_d}\right) S_R \\ &= \left(\frac{N_f\alpha_f - S_U}{N_f\gamma_f}\right) S_U + \left(\frac{N_d - (S - S_U)}{N_d\gamma_d}\right)(S - S_U). \end{aligned} \tag{9}$$

To get the second line, we replace the aggregate demands with the demands of the representative investors multiplied by the corresponding number of representative investors. We then use Equation (8) to substitute out the prices from the second line and the constraint that $S_R = S - S_U$ to obtain the last line. Note that with the definition of firm value in the last line, the only constraint on the entrepreneur's maximization problem is that $S \geq S_U \geq 0$. Solving for the optimal S_U, we get

$$S_U^* = \text{Min}\left[\frac{1}{2}\left[\frac{N_d\gamma_d N_f\alpha_f - N_d\alpha_d N_f\gamma_f + 2N_f\gamma_f S}{N_d\gamma_d + N_f\gamma_f}\right], S\right]. \tag{10}$$

If deadweight costs are the same for all investors who participate in the domestic market, the intercept and slope of the per capita asset demand functions are the same for all investors, so that there is no reason to price discriminate. In this case, $S_U^* = SN_f/(N_d + N_f) < S$,

which is the first-best risk-sharing rule for the investors who participate in the domestic market. Hence, deadweight costs that depend on the country of residence of investors are a necessary condition for the optimal supply of U shares to differ from the first-best risk-sharing rule. In Equation (10), S_U^* increases with N_f and with h_f. When N_f and h_f are not too large, foreign investors as a group hold fewer domestic shares than they would in the absence of deadweight costs and the data on shareholdings exhibit a home bias. If the foreign investors who invest in the domestic country face sufficiently high deadweight costs on their home market, the degenerate case where foreign investors hold all of the firm's shares can be obtained. Henceforth, we do not consider this degenerate case.

To obtain a necessary and sufficient condition for price discrimination to maximize firm value, we now derive the difference between the price of unrestricted shares and the price of restricted shares. By substituting the optimal number of shares allocated to foreign investors from Equation (10) into Equation (8), we can solve for share prices assuming that the firm supplies positive quantities of each type of share. We obtain

$$P_U - P_R = \frac{1}{2}\left[\frac{\alpha_f}{\gamma_f} - \frac{\alpha_d}{\gamma_d}\right]. \tag{11}$$

To understand the implications of Equation (11), we define $P_a(D_a)$ as the inverse demand function for shares of type a. With this notation, $P_a(0)$ is the price corresponding to $D_a = 0$ in Equation (8), which is the price at which the linear demand function intersects the price axis in a graph of the demand function. Equation (11) implies that:

Result 2. *A necessary and sufficient condition for price discrimination to maximize firm value is that* $P_R(0) \neq P_U(0)$.

Proof. From Equation (8), $(\alpha_f/\gamma_f) = P_U(0)$ and $(\alpha_d/\gamma_d) = P_R(0)$. ■

Result 2 follows in a straightforward way from Result 1 and from the linear demand functions obtained in Equation (8). Linear demand functions for which $P_R(0) = P_U(0)$ have the same elasticities because $\varepsilon_{fU} = P/[(\alpha_f/\gamma_f) - P]$ and $\varepsilon_{dR} = P/[(\alpha_d/\gamma_d) - P]$, so that $\varepsilon_{fU} = \varepsilon_{dR}$ when $(\alpha_f/\gamma_f) = (\alpha_d/\gamma_d)$ and $P_U = P_R = P$. It follows from Result 1 that if the demand functions have the same elasticities, there is no gain from price discrimination.

The empirical evidence shows that typically unrestricted shares sell at a premium. The next result provides a necessary and sufficient condition for this to be the case:

Result 3. *Firm value is maximized with $P_U > P_R$ if and only if*

$$P_U - P_R = \frac{1}{2}[P_U(0) - P_R(0)]$$

$$= \frac{1}{2}\left[\frac{E(p) - \beta[E(p_F) - (1 + r + h_f)P_F]}{1 + r + c_f} - \frac{E(p) - \beta[E(p_F) - (1 + r + h_d)P_F]}{1 + r + c_d}\right] > 0. \quad (12)$$

Proof. Use Equation (8) to obtain the inverse demand functions and then substitute these functions in Equation (11). ■

To understand better the implications of Result 3, it is useful to note first that taking the derivatives of $P_U - P_R$ with respect to the various deadweight costs shows that $P_U - P_R$ is an increasing function of c_d and h_f, and a decreasing function of c_f and h_d. Changes in deadweight costs which increase the demand of the domestic asset for one class of investors are equivalent to a decrease in the price elasticity of the demand for the domestic asset for that class of investors in the model we consider. Hence, any change in deadweight costs which increases the demand for the domestic asset from foreign investors increases $P_U - P_R$, and any change in deadweight costs which increases the demand for the domestic asset from domestic investors decreases $P_U - P_R$. With these comparative statics, one expects $P_U - P_R > 0$ when c_d and h_f are large relative to c_f and h_d. This will be the case if domestic investors face higher deadweight costs in the domestic country than abroad and/or the foreign investors who participate in the domestic market face higher deadweight costs in their home country than in the domestic country. Hence, $P_U - P_R > 0$ requires capital flight from domestic investors toward foreign securities or capital flight from foreign investors toward domestic securities. With either type of capital flight, foreign investors have a less price-elastic demand for domestic shares than domestic investors, and Result 3 implies that it is optimal for domestic firms to discriminate between domestic and foreign investors by restricting the supply of shares available to foreign investors.

Because of the well-known existence of a home bias in portfolio holdings, it cannot be the case that all foreign investors face greater deadweight costs at home than in the domestic country. If they did, one would have a situation where foreign investors hold mostly domestic shares if the foreign country is large, which would be inconsistent with the empirical evidence. If the foreign country of our model is the rest of the world, one would expect capital flight to affect only

a small subset of foreign investors (those from Sweden or Colombia, but not those from Germany or the United States). For most other investors, price discrimination and deadweight costs in the domestic country make investments in unrestricted shares unadvantageous. This creates a situation which is quite different from the one typically assumed in models of international asset pricing.[14] Models without barriers to international investment predict that the demand for domestic shares from foreign investors is highly price-elastic relative to the demand for domestic shares from domestic investors because all foreign investors invest in the domestic country. Using Equation (8), we have

$$\varepsilon_U = \frac{N_f \alpha_f - S_U}{S_U}. \tag{13}$$

Hence, for a given supply of shares available to foreign investors, the price-elasticity of demand increases with the number of foreign investors participating in the domestic country, assuming that α_f is constant. In existing models, a large foreign country implies that N_f is large since all foreign investors participate in the domestic country. In this case, ε_U is large compared to ε_R and price discrimination such that $P_U/P_R > 1$ is not optimal given Result 1. In contrast, in our model, only a subset of foreign investors invests in the domestic country, so that N_f can be small even relative to N_d, and hence, price discrimination such that $P_U/P_F > 1$ can be optimal.

In our model, price discrimination with a higher price for unrestricted shares takes place only if the demand from foreign investors is less price-elastic than the demand from domestic investors. This means that for price discrimination to become unprofitable, the price elasticity of the demand for domestic shares from foreign investors has to increase so that it equals the price elasticity of the demand from domestic investors. In our model, price discrimination becomes unprofitable if the deadweight costs of foreign investors who participate in the domestic market become the same as the deadweight costs of domestic investors. As long as only a subset of foreign investors participates in the domestic market, though, removal of ownership restrictions has an adverse effect on the price of unrestricted shares because the price elasticity of the demand for these shares is limited.

As an example of a situation which would lead to the elimination of ownership restrictions, consider the following scenario. Suppose that initially $b_d = c_d = c_f = 0$, $b_f > 0$. In this case, price discrimination so that $P_U > P_R$ is optimal. Consider now the effect of a decrease in deadweight costs so that the deadweight costs of foreign investors

[14] For a review of models of international asset pricing, see Stulz (1994).

participating in the domestic country fall to zero and the deadweight costs of some foreign investors who do not participate in the domestic country fall to zero also. The effect of this fall in deadweight costs on $P_U - P_R$ is ambiguous because it decreases the demand for domestic shares from foreign investors who participate already in the domestic country but increases the demand for domestic shares from some foreign investors who currently do not hold domestic shares. Since the deadweight costs of the foreign investors who participate in the domestic country have fallen to zero, price discrimination is no longer optimal. Nevertheless, the fall in deadweight costs may have been accompanied by an increase in $P_U - P_R$. Finally, since, by construction, not all foreign investors invest in the domestic country, the demand for U shares is not perfectly price elastic and the price of these shares falls when ownership restrictions are removed.

The model developed in this section suggests that if there is a nontrivial fixed cost from imposing ownership restrictions, firms in sufficiently large countries do not impose such restrictions. To see this, note that the limit of S_U as N_d/N_f increases is zero. Hence, for sufficiently large countries, there is no benefit from charging a different price to foreign investors because foreign ownership is trivial. Similarly, if a country becomes sufficiently small, it becomes optimal for foreign investors to hold most shares. However, the country size which matters is not the total number of investors weighted by their wealth, but rather the number of investors weighted by their wealth willing to invest in the domestic country. Hence, N_d/N_f may be greater than one even though the foreign country is the rest of the world because only a few foreign investors invest in the domestic country.

Throughout our analysis, we have assumed that the foreign country does not discriminate against the investors from the domestic country. In some ways, our argument in this paper is similar to the optimal tariff argument of international trade.[15] Hence, one might expect the foreign country to discriminate against domestic investors if the domestic country discriminates against foreign investors. However, we have seen that price discrimination of the type discussed here requires that nonresident investors face unattractive deadweight costs in their country of residence. Typically, countries that benefit from capital flight are not countries that generate capital flight. Hence, if the conditions are met for the domestic country to discriminate against

[15] See, for instance, Dixit and Norman (1980). Gordon and Varian (1988) extend optimal tariff considerations to asset markets by showing that if governments are not price-takers, they may affect terms of trade in asset markets through taxation to improve their country's welfare. Optimal tariff or tax arguments require the domestic country to be, in some sense made precise in the context of the model, large. Hence, they offer no basis for the existence of ownership restrictions in small countries.

foreign investors by charging them a higher price, it is unlikely that at the same time the foreign country will find it worthwhile to discriminate against domestic investors by charging them a higher price.[16]

Our analysis so far has focused on a static model. Developing a dynamic model is beyond the scope of this article. Nevertheless, it is possible to reinterpret our model in a dynamic setting by assuming that the share supplies are fixed, that deadweight costs are paid period by period, and that the demand functions derived here hold period by period. In this case, nothing changes if deadweight costs are constant through time except that the end-of-period payoffs become next period's share prices, since markets are open and shares trade at the beginning of each period. If deadweight costs change randomly through time, next period's share prices depend on next period's deadweight costs and on the joint distribution of the share prices one period hence, which will depend on new information about the deadweight costs. In this multiperiod setting, next period's share prices will differ between U and R shares because these share prices are affected differently by changes in deadweight costs.

When the model is viewed from such a perspective, deadweight costs of a size consistent with tax rates can generate large differences between U and R shares. Consider the extreme case where F, U, and R shares all pay the same dividend each period and deadweight costs are constant over time. Suppose then that investors holding U shares are foreign investors who face deadweight costs at home and no deadweight costs in the domestic country. If deadweight costs are equal to 1/2 the dividends at home for the foreign investors who invest in the domestic country, these investors are willing to hold U shares at a price equal to twice the price of F shares. Since domestic investors can hold F shares, R shares cannot sell for more than the price of F shares in equilibrium since otherwise they would not be held. With no short-sales, however, R shares can sell for less than the price of F shares.

Time-consistency problems might lead the static equilibrium derived here to unravel because foreign investors expect the firm to increase the supply of unrestricted shares immediately after they have bought some U shares. As in the durable monopolist problem, firms

[16] Note that both foreign country firms and foreign country investors are worse off if the foreign country discriminates against domestic investors in the absence of capital flight from the domestic country. This is because, in the absence of capital flight from the domestic country, the foreign country firms cannot benefit from price discrimination against domestic investors. Further, the imposition of ownership restrictions by the foreign country in this case makes it optimal for the domestic country to tighten its restrictions. This is because an increase in P_F for domestic investors increases α_d in Equation (8), and hence decreases S_U^* in Equation (10). This means that the foreign country investors are hurt by the imposition of ownership restrictions on domestic investors by foreign firms.

may be unable to commit not to act opportunistically. Since price discrimination is profitable, firms have incentives to make the elimination of price discrimination difficult. For instance, their charter can require the consent of holders of U shares for new issues of U shares. In addition, managerial incentives may be such that management maximizes total firm value rather than only the value of R shares, in which case management would change the relative supplies of shares if doing so increases firm value, but not if it only redistributes wealth across shareholders. If firms create obstacles to the elimination of price discrimination, price discrimination can persist even when it no longer maximizes firm value in the absence of obstacles to eliminate it.

1.3 An extension to multiple domestic firms

In general, ownership restrictions affect the shares of many different firms in a country. Consequently, to investigate empirically the pricing implications of our model, an extension of the analysis to the case where there is a single foreign risky asset, but many domestic firms that issue U and R shares, is required. For this extension, we assume that the model of Section 1.2 holds period per period. In this case, the end-of-period payoffs of shares are their end-of-period prices. In a multiperiod model, the end-of-period prices of U and R shares may differ even though they always pay the same dividends, since deadweight costs could change. We provide in the appendix an extension of the analysis that leads to the following equations for the prices of U and R shares:

$$\underline{P}_U = \left(\frac{1}{1+r+c_f}\right)\left[E(\underline{p}_U) - \left(\frac{A}{N_f}\right)\left[V_{UU} - V_{UF}\frac{1}{\sigma_F^2}V_{FU}\right]\underline{S}_U - \underline{\beta}_{U,F}[E(p_F) - (1+r+b_f)P_F]\right], \tag{14}$$

$$\underline{P}_R = \left(\frac{1}{1+r+c_d}\right)\left[E(\underline{p}_R) - \left(\frac{A}{N_d}\right)\left[V_{RR} - V_{RF}\frac{1}{\sigma_F^2}V_{FR}\right]\underline{S}_R - \underline{\beta}_{R,F}[E(p_F) - (1+r+b_d)P_F]\right], \tag{15}$$

where $\underline{P}_a$ is the $n \times 1$ vector of share prices of type a when there are n domestic firms, $E(\underline{p}_a)$ is the $n \times 1$ vector of next period's prices of shares of type a, V_{aa} is the $n \times n$ variance-covariance matrix of next period's share prices of type a, V_{aF} is the $n \times 1$ vector of covariances between next period's share prices of type a and the price of F shares, V_{Fa} is the transpose of V_{aF}, $\underline{\beta}_{a,F}$ is the vector of beta

coefficients of share prices of type a with respect to foreign shares, and $\underline{S}_a$ is the $n \times 1$ vector of supplies of a shares, where $a = R, U, F$. In each equation, the asset supplies are multiplied by a term in square brackets that corresponds to the variance-covariance matrix of next period's share prices hedged with positions in F shares. Since hedging cannot eliminate all the risk of domestic shares, it follows that the price of domestic shares falls as the supply of these shares increases. In addition, the price of domestic shares increases with deadweight costs on foreign shares and falls with deadweight costs on domestic shares.

With n domestic firms, it is still the case that price discrimination is optimal if demand elasticities differ due to heterogeneity in deadweight costs. Although we do not do this here, it would be possible, using Equations (14) and (15), to derive optimal supplies of R and U shares for each firm in one of two ways. One approach would be to assume that all firms in a country collude in choosing the supplies of R and U shares to maximize country wealth; to save on coordination costs, firms might prefer to have legislated restrictions on foreign ownership, though. The other approach would be to let each firm choose its supplies of R and U shares to maximize its value given that all firms choose their supplies to maximize their value.[17] Such an extension is beyond the scope of this article.

1.4 Alternative explanations for the existence of ownership restrictions

Our approach shows that ownership restrictions can be value-maximizing. In addition, since the ownership restrictions of individual domestic firms affect the cost of capital of other domestic firms, a case can be made that government-imposed ownership restrictions minimize the country's overall cost of capital because individual firms do not take into account the effects of their decisions on other firms' cost of capital.

Alternative explanations for ownership restrictions advanced in the literature mostly focus on control issues.[18] Governmental ownership restrictions could be motivated by a desire to keep control of home-country firms with home-country investors. This motivation, however, cannot explain why individual firms would choose to have ownership restrictions, and why restrictions do not simply preclude transfer of control to foreign investors rather than ownership of shares by foreign

[17] For individual firms, strategic considerations become important in a context with multiple firms. This is because a firm's optimal supply of shares depends on the supplies of the other firms.

[18] For the case of Switzerland, this argument is advanced by Horner (1988) and Vock (1987).

investors. To the extent that *R* shares as a control block have a majority of a corporation's voting rights, the fact that transfers of *R* shares have to be approved by the corporation essentially precludes a takeover of the corporation. Nevertheless, takeover deterrence does not explain restrictions on foreign ownership. Since the corporation can always control ownership of *R* shares, it is better off prohibiting ownership by potential raiders only, rather than investors at large, since doing so will result in higher share prices.

Suppose, however, that it is indeed true that ownership restrictions exist to enable management to keep control of the firm and that this is the only reason for these restrictions. In this case, one would still expect the demand for *U* shares to be almost perfectly price-elastic if the domestic country is small. Hence, removal of ownership restrictions would have almost no effect on *U* shares, except through the positive effect on cash flows resulting from the decrease in managerial entrenchment. One would expect ownership of *R* shares to be valuable if it enables investors to receive rents from control. In particular, if a control contest is ever going to take place, *R* shares would presumably receive greater compensation than *U* shares.[19] Further, restricted share owners can form a coalition to share with management the rents from control, which also would make *R* shares valuable. Yet, empirically, *R* shares generally trade at a discount relative to *U* shares so that the market price of *R* shares does not reflect the control advantages of these shares in a way that would justify their existence. It might be, however, that blocks of *R* shares transferred with the approval of the corporation trade at a price that is greater than the price of *U* shares. We do not have any data on transfers of blocks, but such data could provide evidence supporting the control hypothesis, given that this hypothesis fails to explain the pricing of *U* shares in general. In any case, with this control hypothesis, we would expect both the price of *R* and *U* shares to increase if ownership restrictions are removed because of the associated efficiency gain from less managerial entrenchment.

An alternative control hypothesis is that *R* shares provide the firm with a stable clientele of shareholders that are better monitors because they are closer to the firm. In that case, removing the ownership restrictions would decrease firm value unless, somehow, the value of monitoring has become less important. This argument also implies, however, that the removal of restrictions should have a trivial effect on *U* shares unless it reduces total firm value, since again one would expect the demand for *U* shares to be highly price-elastic.

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[19] See DeAngelo and DeAngelo (1985).

Alternative explanations for the discount of *R* shares could be based on the argument that these shares are less liquid and/or that these shares have tax disadvantages. Since transfers of ownership of these shares are limited, it makes sense that a seller of *R* shares might find it more difficult to find a qualified buyer. Allowing foreign investors to hold *R* shares increases the liquidity of these shares, but it does not affect their possible tax disadvantages. In a standard asset pricing model, though, one would not expect that allowing foreign investors to hold *R* shares would have a significant impact on the price of *U* shares.

2. The Swiss Data

The Swiss evidence provides a sample for which it is possible to assess directly the valuation implications of ownership restrictions by constructing *R* and *U* securities that differ only in their ownership restrictions.[20] The sample includes 19 firms that have both *R* and *U* shares outstanding. All these firms had two types of *U* shares outstanding at the beginning of 1985: *U* shares with voting rights (bearer shares) and *U* shares with no voting rights (participation certificates). The *R* shares (registered shares) are available to Swiss citizens or to Swiss residents only depending on the firm. The ownership restrictions for these shares are enforced by the company through refusal to register owners of shares who do not meet its registration requirements. Owners of registered shares who are not registered do not exist as far as the company is concerned.[21] Our sample includes 8 of the 10 Swiss firms with the largest stock market capitalization in 1985 and all firms listed in the *Swiss Stock Guide* edited by Union Bank of Switzerland that had all three types of shares outstanding at the beginning of 1985, except for one, Bank Leu, for which stock data was lacking. The *Stock Guide* lists 98 firms which, on September 15, 1985, had a total capitalization of 126 billion SFr. The firms in our sample had a capitalization of 78 billion SFr on the same day, which amounts to about 62% of the total capitalization. Of the firms not in our sample, 17 seem to have only *U* shares; most of these companies are fairly small and are controlled by one shareholder.[22]

[20] *R* and *U* shares in our sample differ also because *U* shares are bearer shares, whereas *R* shares are registered shares. Hence, shareholders who value anonymity will find *U* shares more valuable. However, in Switzerland, the tax advantage of anonymity is limited because dividends are subject to withholding taxes on all types of shares. Consequently, whereas this difference between share types implies a higher valuation of unrestricted shares, its value appears limited. An indication of this is that when the residency requirement for *R* shares is removed the ratio of the prices of *R* and *U* shares is very close to one as shown in Figures 1 and 2.

[21] Kaufmann and Kunz (1991) review the history of the legal status of registered and bearer shares.

[22] An exception is F. Hoffmann-La Roche & Co. which, as of September 15, 1985, is the sixth largest firm in terms of capitalization. As of that date, Roche has shares with and without voting rights, but all shares are unrestricted.

In Switzerland, dividends are the same fraction of face value for all share types and each voting share has one vote. Hence, a share type can gain a voting rights advantage by having a lower face value. If registered and bearer shares have different face values, it is always the case that registered shares have a lower face value so that investors who hold registered shares have more voting rights for a given stake in the firm's cash flows than investors who hold bearer shares. To isolate the effects of ownership restrictions, we construct for each firm a portfolio of bearer shares and participation certificates which pays the same dividend and has the same voting rights as registered or restricted shares. We call these portfolios U shares in the following analysis. More formally, these U shares consist of one bearer share and $[F_R - F_B]/F_P$ participation certificates, where F_R, F_B, and F_P are, respectively, the face values of the registered shares, bearer shares, and participation certificates. Consequently, the face value of a U share is F_R so that it has the same face value as a registered share and therefore pays the same dividend. If a firm's bearer and registered shares have identical face values, its U shares have no short position in participation certificates.

Our empirical tests use portfolios which have short positions in participation certificates for some of the U shares. With this approach, we can match registered shares with portfolios which have identical dividends and voting rights. Since it may not be possible to implement the portfolio strategy that we assume, we distinguish in our empirical work between U shares that require short-sales of participation certificates and those that do not. This assures that we understand the sensitivity of our results to the use of short-selling in the construction of the U shares. In addition, we also show results which directly compare bearer shares versus registered shares; however, in this case we would be comparing shares that have different voting rights, except for nine firms for which there is no difference in face values between the bearer and registered shares. It is interesting to note, however, that the comparison of the price of bearer shares per Swiss franc of face value and the price of registered shares per Swiss franc of face value shows that the bearer shares are always more expensive. In cases where registered shares have a lower face value than bearer shares, an investment in restricted shares that pays the same dividends as an investment in bearer shares but has more voting rights always sells for less than the investment in bearer shares. Thus, voting rights considerations are always a second-order phenomenon.

Table 1 lists the firms in our sample and provides relevant information. The criteria used to register shareholders are those in effect at the end of the sample period as reported by the stock guide prepared by *Finanz und Wirtschaft* for 1989 and by Kaufmann and Kunz (1991).

Table 1
Characteristics of firms

Firm	Symbol	Market value, Mio. SFr	Large shareholder	Bearer share, face value (number)	Registered share		Participation certificate, face value (number)
					Ownership restrictions (1989)	Face value (number)	
Alusuisse	ALU	2421	No	250 (1351)	Up to 3% per holder	125 (1492)	25 (1624)
Brown-Boveri	BBC	5956	No	500 (1007)	Up to 7% per holder	100 (1007)	100 (1875)
Banca della Svizzera Italiana	BSI	987	2 holders jointly control	500 (267)	Residents only	100 (320)	100 (663)
Ciba-Geigy	CIG	15,790	No	100 (749)	Swiss only, up to 2% per holder	100 (3512)	100 (1138)
Feld-schlösschen	FEL	556	Several large holders	250 (38)	Swiss only	100 (192)	100 (100)
Georg Fischer	FIS	714	Employee fund holds 10%	500 (280)	Swiss up to 4000 shares, foreigners up to 400 shares per holder	100 (420)	100 (526)
Globus	GLO	699	Trust controls	500 (44)	Residents only	500 (22)	100 (267)
Haldengut	HAG	195	Large minority holder	100 (20)	Discretion	100 (40)	100 (20)
Jacobs	JAC	4887	Trust controls	500 (435)	Swiss only	100 (1066)	50 (632)

Table 1
continued

Firm	Symbol	Market value, Mio. SFr	Large shareholder	Bearer share, face value (number)	Registered share		Participation certificate, face value (number)
					Ownership restrictions (1989)	Face value (number)	
Konsumverein Zürich	KVZ	383	No	250 (41)	Residents only, up to 2% per holder	100 (160)	50 (65)
Nestlé	NES	26,218	No	100 (1073)	Up to 3% per holder	100 (2227)	20 (1150)
Oerlikon-Bührle	OEB	1716	Trust holds 45% of votes	250 (1000)	Up to 50,000 shares per holder	100 (1299)	100 (240)
Rückver-sicherung	RUK	1611	No	100 (44)	Swiss only, up to 3% per holder	100 (400)	20 (860)
Sandoz	SAN	14,407	No	250 (155)	Up to 2% per holder	250 (1043)	50 (1305)
Schweiz. Bank-gesellschaft	SBG	16,370	No	500 (3590)	Residents only, up to 5% per holder	100 (3800)	20 (9026)
Schweiz. Bank-verein	SBV	11,233	No	100 (13,838)	Swiss only, up to 2% per holder	100 (14,204)	100 (8936)
Schindler	SCH	1162	Trust controls	500 (31)	Residents only	100 (751)	100 (282)
Winterthur-Versicherung	WIN	4854	No	100 (270)	Swiss only, up to 10,000 shares per holder	100 (730)	20 (1760)
Zürich-Versicherung	ZUR	8462	No	100 (400)	Swiss only, up to 15,000 shares per holder	100 (1100)	50 (1100)

Market value is the sum of the market values of bearer shares, registered shares, and participation certificates at average prices over 1989. Face values are in SFr at the end of 1989. Number of shares are in thousands. Sources: Swiss Stock Guide (various issues) and Kaufmann and Kunz (1991).

Hence, the requirements reported in the table are those in force after Nestlé decided to allow foreign investors to acquire *R* shares. In general, the cases where registration is at the discretion of the board should be interpreted as cases where foreign shareholders will not be registered. As far as we can ascertain, at the beginning of the sample period, Swiss residency was a requirement for registration for all firms, and for a number of firms the stronger requirement of citizenship was in place.[23] Note further that satisfying the residency or citizenship requirement might not be sufficient to ensure registration of registered shares, since a firm's board of directors generally has the right to reject registration for Swiss citizens. Finally, the information in Table 1 shows that holders of registered shares typically control the firm as a group.

In the empirical work, we use weekly share prices, more precisely Wednesday closing prices, over the period from January 2, 1985, to December 27, 1989. Besides the whole period, we distinguish three subperiods. The first one is from the start of our sample to the end of September 1987, that is, just before the stock market crash on October 16, 1987. The second subperiod extends from the beginning of November 1987 to the second week of November 1988, which is just before Nestlé announced on November 17, 1988, that it would no longer exclude foreign investors from ownership of *R* shares. The third subperiod starts in the third week of November 1988 and goes to the end of our sample. We consider the postcrash period separately to allow us to discern changes in the behavior of share prices following the crash.

Table 2 shows the values of the average ratio of the price of *U* and *R* shares. For many firms, the average price ratio before the removal of the registration restrictions by Nestlé exceeds two. In addition, for all firms but five, the minimum price ratio exceeds one, so that statistical tests for the existence of a price differential are superfluous. The price ratio exhibits substantial variation over time. Not surprisingly, the average values of the ratio fall for a number of firms in the last subperiod following the removal of the registration restrictions by Nestlé. In the absence of deadweight costs for foreign investors, ownership restrictions would appear to impose an extremely large cost on the corporations that have them. For instance, if the ratio is two and if the market for *U* shares has perfectly elastic demand curves, a firm whose value is divided equally between *R* and *U* shares could increase its value by one-quarter by removing the restrictions, assuming

[23] No stock guide with information on the ownership restrictions is available for the beginning of our sample period.

Table 2
Price ratios of unrestricted/restricted shares

	Average price ratio					
	Total period	Before crash	Crash–Nestlé	After Nestlé	Maximum	Minimum
Firm						
ALU	1.62	1.66	1.72	1.43	2.01	1.23
BBC	1.83	1.77	2.27	1.56	2.65	1.07
BSI	1.66	1.59	1.63	1.84	2.55	1.06
CIG	1.91	2.12	2.02	1.27	2.42	1.17
FEL	1.24	1.21	1.25	1.31	1.50	0.93
FIS	2.08	2.12	1.78	2.26	2.86	1.00
GLO	1.17	1.26	1.14	1.00	1.70	0.90
HAG	1.05	1.06	1.05	0.99	1.36	0.87
JAC	1.34	1.02	1.86	1.57	2.46	0.24
KVZ	1.50	1.50	1.39	1.48	1.95	0.60
NES	1.76	1.94	2.00	1.07	2.17	1.00
OEB	2.40	2.57	2.69	1.67	3.21	1.37
RUK	2.20	2.61	2.03	1.37	3.21	1.20
SAN	2.23	2.60	2.38	1.17	2.89	1.03
SBG	1.34	1.29	1.44	1.35	1.66	1.02
SBV	1.24	1.29	1.25	1.12	1.50	1.06
SCH	2.12	1.70	3.29	1.97	3.87	0.94
WIN	1.87	2.05	1.98	1.30	2.37	1.16
ZUR	1.88	2.04	2.10	1.28	2.37	1.16
Portfolios						
All shares	1.71	1.76	1.86	1.42	1.99	1.35
Short sales	1.71	1.65	1.93	1.64	2.16	1.48
No short sales	1.70	1.88	1.77	1.18	2.10	1.12

Price of unrestricted share/price of restricted share. Observations are weekly. Total period extends from January 2, 1985, to December 27, 1989. Subperiods: Before crash (January 2, 1985, through September 30, 1987), crash–Nestlé (November 4, 1987, through November 16, 1988), after Nestlé (November 23, 1988, through December 27, 1989). Price ratios for portfolios are averages for individual shares. Short-sales (no short-sales) portfolios include all shares involving short-sales (no short-sales) of participation certificates to construct unrestricted share.

that the firm's cash flows are unchanged. Figure 2 plots the average price ratio for all firms, for firms where *U* shares require no short-sales of participation certificates, and for firms where *U* shares require such short-sales. In Figure 2, the fall in the price ratios following the announcement by Nestlé is quite dramatic.

Table 2 and Figure 2 show clearly the magnitude of the puzzle that has to be explained by any theory on the existence and pricing of ownership restrictions. In traditional asset pricing models, these restrictions imply a considerable cost without having an offsetting gain. Further, the advocates of the control hypothesis for the existence of *R* shares cannot point to control benefits impounded in the price of *R* shares that offset the loss in firm value resulting from ownership restrictions if the demand for *U* shares is highly price-elastic. Nor can they explain why the price of *U* shares fell following the Nestlé event shown in Figure 2. If removal of ownership restrictions decreases the

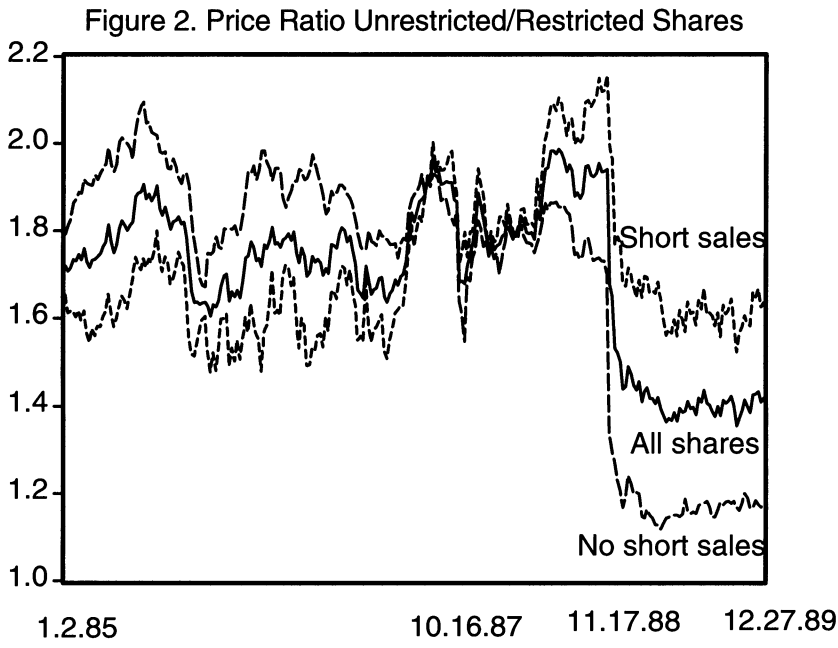

Figure 2
Price ratio of unrestricted/restricted share prices
Wednesday closing Swiss francs prices from 1/2/85 to 12/27/89 are used to construct price ratios of unrestricted/restricted shares for each firm in the sample. Until 11/17/88, restricted shares are registered shares that cannot be held by foreign investors. After 11/17/88, restricted shares of Nestlé can be held by all foreign investors. The firms in the sample have two kinds of shares that can be held by all investors: bearer shares, which are shares with voting rights, and participation certificates, which are shares without voting rights. A firm's unrestricted share is a portfolio of bearer shares and participation certificates that pays the same dividend as that firm's registered shares and has the same voting rights. This portfolio has a short position in participation certificates when registered shares have a voting rights advantage relative to bearer shares or has no position in participation certificates if registered shares have no voting rights advantage relative to bearer shares. "All shares" denotes an arithmetic average of all price ratios whether short positions are taken or not. "Short sales" denotes the arithmetic average of the price ratios where unrestricted shares include short positions. The stock market crashed on 10/16/87.

private benefits of control, one would expect U shares to benefit since their holders get none of the private benefits from control. In addition, in the context of Gordon's growth model, a ratio of two essentially implies that the discount rate for R shares has to be twice what it is for U shares.

3. Cross-sectional Properties of the Relation Between the Prices of Unrestricted and Restricted Shares

To investigate the usefulness of our model, we would like to know whether it helps to understand the cross-sectional variation in the

relation between U and R share prices compared to a model without deadweight costs. Without deadweight costs, the price of Nestlé U shares is determined in the same way as the price of IBM shares. Hence, in our mean-variance model, assuming that R and U shares are a trivial fraction of the world market portfolio, the price of U shares is determined by their beta with the world market portfolio. Thus the supply of U shares relative to the supply of R shares should not matter in the relative price of U shares relative to R shares.

Equations (14) and (15) of Section 1 provide formulas for the price level of U shares and R shares for the case where there are n domestic firms. When investigating the cross-sectional variation in the relation between U and R shares, however, we want to focus on the logarithm of the ratio of the price of U and R shares because the wide variation in the price of these shares makes comparison of the difference between the price of U and R shares meaningless across firms. To obtain a cross-sectional regression model, we derive an explicit formula for the log of the price ratio of U and R shares which is consistent with the model of Section 1. With this formula, the absolute level of share prices is irrelevant and cross-sectional regressions are meaningful. To derive that model, we assume that the model derived in Section 1 holds period by period and then use the log-linear approximation for the log of share prices derived in Campbell and Shiller (1987) and Campbell and Ammer (1993). With this approximation, the price of a share can be written as

$$\ln P_{ia}^{t} = E \sum_{j=0}^{\infty} \eta^{j} \left[(1-\eta) d_{ia}^{t+j+1} - r_{ia}^{t+j+1} \right] + \theta, \tag{16}$$

where $\ln P_{ia}^{t}$ is the log of the price of the stock of type a of the ith firm at date t, d_{ia}^{t+j+1} is the log of the dividend at date $t+j+1$, and r_{ia}^{t+j+1} is the rate of return of the share from date $t+j$ to $t+j+1$. η is a parameter that comes from the approximation procedure and is slightly smaller than one, and θ denotes a constant that depends on η. Small changes in η have a trivial effect on the log of the price; hence, in the following, we assume that η is the same for R and U shares. With this notation and this additional approximation, the log price ratio is the discounted sum of the difference between the expected rates of return of the two types of shares:

$$\ln P_{iU}^{t} - \ln P_{iR}^{t} = E \sum_{j=0}^{\infty} \eta^{j} [r_{iR}^{t+j+1} - r_{iU}^{t+j+1}] \tag{17}$$

The log price ratio is positive, so U shares sell at a premium if the expected value of the sum of the discounted rates of return of R

shares exceeds the expected value of the sum of the discounted rates of return of the U shares.

Table 3 presents evidence on the cross-sectional variation of log price ratios using the model of Section 1 extended to many firms to predict expected rates of return. The data available include the returns on the Swiss shares used so far, the returns on a broad Swiss index — the SBC index — and the returns in Swiss francs on the Morgan Stanley world index. We take the Morgan Stanley world index as the foreign asset in Section 1. In our empirical work, we estimate the relevant parameters using the precrash period and test the model using the period between the crash and the Nestlé event.

Equations (14) and (15) can be restated in returns form for individual securities as follows:

$$\begin{aligned} E(r_{iR}) - r &= c_d + \beta_{iR,RM}(AM_{RM}/N_d)\sigma_{RM}^2 \\ &\quad - \beta_{iR,F}\beta_{RM,F}(AM_{RM}/N_d)\sigma_F^2 \\ &\quad + \beta_{iR,F}[E(r_F) - r - h_d], \end{aligned} \tag{18}$$

$$\begin{aligned} E(r_{iU}) - r &= c_f + \beta_{iU,UM}(AM_{UM}/N_f)\sigma_{UM}^2 \\ &\quad - \beta_{iU,F}\beta_{UM,F}(AM_{UM}/N_f)\sigma_F^2 \\ &\quad + \beta_{iU,F}[E(r_F) - r - h_f], \end{aligned} \tag{19}$$

where r_{ia} is the return of the ith share of type a, aM denotes the market portfolio of shares of type a, M_{aM} denotes the market value of portfolio aM, and σ_{aM} is the standard deviation of the return of the market portfolio of shares of type a. The beta coefficient of the ith share of type a with respect to Z is $\beta_{ia,Z}$. For instance, $\beta_{iU,F}$ is the beta coefficient from a regression of the return of the ith unrestricted share on the return of the foreign shares. Using the log approximation and Equations (14) and (15), we get the following testable equation:

$$\ln P_{iU}^t - \ln P_{iR}^t \propto a_1 + a_2\beta_{iU,F} + a_3\beta_{iR,F} + a_4\beta_{iU,UM} + a_5\beta_{iR,RM} + \epsilon_i \tag{20}$$

Assuming that the model of Section 1 holds period by period, the regression coefficients correspond to

$$\begin{aligned} a_1 &= c_d - c_f, \\ a_2 &= -[E(r_F) - r - h_f - \beta_{UM,F}(AM_{UM}/N_f)\sigma_F^2], \\ a_3 &= E(r_F) - r - h_d - \beta_{RM,F}(AM_{RM}/N_d)\sigma_F^2, \\ a_4 &= -(AM_{UM}/N_f)\sigma_{UM}^2, \\ a_5 &= (AM_{RM}/N_d)\sigma_{RM}^2. \end{aligned} \tag{21}$$

We first consider the implications of a model without deadweight costs

Table 3
Cross-sectional regressions of the natural logarithm of the average estimation period price ratio between unrestricted and restricted shares

Panel A. The market portfolios of restricted and unrestricted shares are value-weighted portfolios from the shares in the sample

Regression	Constant a_1	Beta (U, F) a_2	Beta (R, F) a_3	Beta (U, UM) a_4	Beta (R, RM) a_5	Market value of R shares	Market value of U shares	Dummy for short-sales	Relative total face value	R^2 adjusted F value
A	−0.09	0.40	0.20	−0.11	0.58*			0.30		0.25
	(−0.56)	(1.06)	(0.52)	(−0.33)	(2.24)			(1.92)		2.22
B	0.18	0.43	0.10	0.02	0.55	0.06	−0.08	0.36	0.00	0.10
	(0.15)	(0.93)	(0.15)	(0.03)	(1.05)	(0.27)	(−0.44)	(1.38)	(−0.14)	1.25
C	−0.93					0.17	−0.06	0.27		0.10
	(−1.43)					(1.60)	(−0.55)	(1.59)		1.64
D	0.60*							0.09	−0.02*	0.05
	(5.83)							(0.63)	(−3.39)	1.43
E	0.02				0.60*			0.28*	−0.01	0.29
	(0.11)				(3.70)			(2.24)	(−1.66)	3.50*

Panel B: The market portfolios of restricted and unrestricted shares are the SBC index, which is a broad-based index of Swiss shares

Regression	Constant a_1	Beta (U, F) a_2	Beta (R, F) a_3	Beta (U, D) a_4	Beta (R, D) a_5	Market value of R shares	Market value of U shares	Dummy for short-sales	Relative total face value	R^2 adjusted F value
F	−0.05	0.33	−0.05	−0.28	0.90*			0.15		0.34
	(−0.29)	(1.08)	(−0.14)	(−1.13)	(2.75)			(0.96)		2.84
G	0.08	0.35	−0.19	−0.43*	1.02*					0.34
	(0.59)	(1.02)	(−0.43)	(−2.28)	(2.91)					3.31*
H	0.19	0.39	−0.32	−0.44*	0.99*				−0.01	0.35
	(1.08)	(1.05)	(−0.63)	(−2.39)	(2.59)				(−1.88)	2.98

Table 3
(continued)

Panel C. The price ratios are calculated using bearer shares instead of unrestricted shares. The indices are the same as in panel B.

Regression	Constant a_1	Beta (B, F) a_2	Beta (R, F) a_3	Beta (B, D) a_4	Beta (R, D) a_5	Market value of R shares	Market value of B shares	Dummy for short-sales	Relative total face value	R^2 adjusted F value
I	0.07	0.03	0.08	0.04	0.51			−0.26*		0.44
	(0.42)	(0.18)	(0.23)	(0.09)	(0.94)			(−2.23)		3.86*
J	0.21	0.05	−0.13	0.04	0.64	0.09	−0.11*	−0.16		0.47
	(0.25)	(0.31)	(−0.33)	(0.07)	(1.07)	(1.12)	(−2.04)	(−1.47)		3.31*
K	0.19	0.03			0.50*			−0.25*	−0.03*	0.57
	(0.95)	(0.19)			(2.24)			(−2.16)	(−2.41)	6.86*
L	0.08	0.04			0.57*			−0.27*		0.52
	(0.50)	(0.29)			(3.17)			(−2.29)		7.39*

The sample consists of weekly data for 19 Swiss firms. Regressions are estimated by ordinary least squares using the correction for heteroskedasticity developed by White (1980). The estimation period extends from 11/4/87 to 11/16/88. Beta (U, W) denotes the beta of U shares relative to the W portfolio. The other betas are defined analogously. The betas are estimated over the period from 1/2/85 to 9/30/87. The market portfolio of restricted (R) shares, RM, is the value-weighted portfolio of the registered shares in the sample. The market portfolio of unrestricted (U) shares, UM, is the value-weighted portfolio of the bearer shares in the sample. The world portfolio, F, is approximated by the Morgan Stanley Capital International World Stock Market Index, expressed in Swiss Francs. The domestic portfolio (D) is the SBC index. The parameters a_1 to a_5 correspond to Equations (20) and (21) in the text. Total market values of restricted (R) shares, unrestricted (U) shares, and bearer (B) shares are averages over the estimation period and expressed in natural logarithms. The dummy variable takes a value of one if there is a voting rights difference between restricted and bearer shares (i.e., if unrestricted shares can only be constructed by shorting participation certificates). A firm's relative total face value is the total face value of bearer shares plus participation certificates divided by the total face value of registered shares (participation certificates are not included in panel C). t-values are in parentheses below the estimated parameters. The F value tests for the joint significance of the estimated parameters. An * indicates significance at the 5 percent level (two-sided test).

for the regression coefficients of estimates of Equation (21), assuming that the foreign country is large relative to the domestic country. First, we expect $a_1 = 0$. Second, since N_f is extremely large, a_2 becomes equal to minus the risk premium of foreign shares and hence should be negative. In addition, $a_2 + a_3 < 0$, $a_4 = 0$ as N_f becomes large enough, and $a_5 > 0$. The case which leads to price discrimination with a higher price charged to foreign investors requires $b_f > b_d \geq 0$ and c_f cannot be too large. In this case, one expects N_f to be much smaller than in the model without deadweight costs. Consequently, estimates consistent with that case are $a_1 \leq 0$, $a_2 + a_3 > 0$, $a_3 > 0$, $a_4 < 0$ and $a_5 > 0$.

Regression A of Panel A in Table 3 provides estimates of Equation (20) using as market portfolios of R and U shares the value-weighted portfolios of these shares in our sample. Because of our construction of U shares, we add a dummy variable to our regressions that takes a value of one if a share involves short-sales of participation certificates. We find that $a_5 > 0$ as predicted and that it is the only coefficient significant at the 0.05 level or better. The dummy variable is significant at the 0.10 level. Coefficients a_1 and a_4 have negative coefficients as expected, but they are not significant. The coefficient a_2 is not significantly different from zero, which is inconsistent with a model without deadweight costs. Coefficient $a_2 + a_3$ is nonnegative as expected in the model with deadweight costs. Note that over the estimation period for betas, $\beta_{UM,F} = 0.36$ with a t-statistic of 4.45 when we use the value-weighted portfolio of bearer shares as the market portfolio of U shares and $\beta_{RM,F} = 0.34$ with a t-statistic of 5.77. Hence, it is not the case that our failure to find $a_2 + a_3$ to be negative is due to betas equal to zero. It follows from this that Regression A is consistent with our model and does not provide support for a model without deadweight costs.

One reason for the lack of strength in our results might be that betas changed. The world beta coefficients seem substantially greater after the crash than before. After the crash, we have $\beta_{UM,F} = 0.95$ with a t-statistic of 10.48 and we have $\beta_{RM,F} = 0.72$ with a t-statistic of 9.67. Another reason why we estimate coefficients imprecisely is that we estimate six coefficients with 19 observations when, in addition, four of our explanatory variables are highly correlated. On average, the correlation coefficients between the various betas we estimate are greater than 0.50.

In Regression B, we include as additional explanatory variables the log of the market value of U shares, the log of the market value of R shares, and the total face value of U shares divided by the total face value of R shares. We find that none of these supply variables is significant, indicating that the size or relative size of a firm's outstand-

ing supply of shares has little incremental explanatory power once betas are accounted for, and that adding these variables leads to a substantial fall in adjusted R^2.

In Regression C, we include only the log market value variables and find that these variables do not have significant coefficients. Interestingly, however, the signs of these coefficients are not supportive of liquidity arguments. One would expect shares to become more liquid, ceteris paribus, when their supply increases, so that an increase in the supply of U shares would increase the price ratio and an increase in the supply of R shares would decrease the price ratio if liquidity is an important determinant of the price ratio. Yet, in Regression C the coefficients have signs which are opposite to those predicted by the liquidity argument. The signs of the coefficients are consistent with the supply effects discussed in Section 2 and so is the relative magnitude of the absolute value of the coefficients.

The market values used in Regression C depend on the price ratio. An alternative relative supply measure that does not depend on the price ratio is the ratio of the aggregate face values of U to R shares. This relative supply measure is attractive because it tells us the relative supply of dividends offered in the form of U and R securities. In Regression D, we regress the log price ratio on this variable and find that it has the expected negative sign and is highly significant. Hence, using this variable, it is clear that relative supplies matter as implied by the model of Section 1. In that model, however, relative supplies do not matter when Regression B is estimated, so that the insignificance of the supply measures in Regression B and the significance of the relative face values in Regression D are fully consistent with the model. It could be, though, that multicollinearity makes it difficult to estimate any of the coefficients precisely in Regression B.

In models without deadweight costs, relative supplies should not matter at all. The only supply variable one would expect to matter in that case is the supply of R shares. Another way to look at this is that in the model developed by Hietala (1989), the relative supply should be insignificant if one regresses the price ratio on the beta of R shares relative to the market portfolio of R shares and the relative supply variable. This is Regression E in Table 3, and we find that the relative supply variable has a negative coefficient with a t-statistic of -1.66, which is marginally significant. There, the coefficient on the beta coefficient of R shares is significant and positive as expected.

In Panel B of Table 3, we replace the market portfolios of R and U shares with a single proxy for the Swiss market portfolio — the SBC index. We find that doing so leads to stronger results. The dummy variable for short-sales is no longer significant. When we reestimate the equation without that dummy variable, we find that the beta of U

shares with respect to the domestic portfolio has a significant negative coefficient, whereas the beta of R shares has a significant positive coefficient. In contrast, the world betas of R and U shares are insignificant. The adjusted R^2 of that regression is 0.34. This regression is inconsistent with a model of asset pricing in which Swiss shares are priced in an integrated world market except for the ownership restrictions. In the absence of deadweight costs, one would not expect the risk of U shares relative to the Swiss market portfolio to be important in the determination of the price ratio. In addition, the relative supplies have a significant negative effect on the price ratio. We estimated regressions with the logs of the levels of the supplies (i.e., similar to Regression A) and found the coefficients insignificant.

In Panel C, we use the ratio of the price of bearer shares to registered shares so that no short-sales are needed. In this case, there are voting rights differences for 10 firms as explained earlier. It is clearly the case that these voting rights matter when we estimate Equation (20) with a dummy variable that takes a value of one when the R shares have a voting rights advantage. In Regression I, the dummy variable takes a significant negative value, indicating that the voting rights advantage of R shares makes these shares trade at a smaller discount relative to the U shares. After including the log of the supplies in Regression J, the dummy variable is no longer significant, but the log of the supply of bearer shares is. In Regression K, both the relative supply variable and the dummy variable are significant. Further, the beta of R shares is highly significant. All in all, this is the most significant regression we report, with an adjusted R^2 of 0.57. The last regression is Regression L, without the relative supply variable for comparison.

In summary, there is evidence from our regressions that world betas do not matter for the pricing of unrestricted shares, which we take as evidence of market segmentation induced by the existence of deadweight costs. Further, even controlling for betas, there is some evidence that asset supplies matter and that the price ratio is related to asset supplies as predicted by our model. The voting rights disadvantage of U shares reduces the price ratio as one would expect, but voting rights considerations do not help understand why U shares are priced at a premium and do not affect any of our conclusions.

4. The Nestlé Announcement of the Relaxation of Ownership Restrictions

On November 17, 1988, Nestlé announced that it would allow foreign investors to buy registered shares with a limit of 3 percent for any investor. This announcement more than doubled the number of shares

of Nestlé with voting rights available to foreign investors. Viewed in another way, before the announcement, foreign investors could hold claims to, at most, slightly more than one-third of the total dividend payout of Nestlé. After the announcement they had the right to hold all of it.

Suppose that the announcement conveyed no other information than the information about share ownership. The model of Section 1.2 with deadweight costs set equal to zero implies that the change in the price of U shares following the announcement should be trivial since the distribution of future dividends is unchanged and since the demand for U shares in that case is highly price-elastic. In contrast, the value of R shares should increase because these shares are now priced on world markets, rather than on the market formed by Swiss investors. Figure 1 shows that the price of the R shares increased dramatically during the week of the announcement from 4245 SFr to 5782 SFr. It also shows, however, that the U shares fell by 2079 SFr from 8688 SFr to 6609 SFr. This fall of about 25 percent in the value of U shares cannot be understood in the context of a model without deadweight costs that limit access to the domestic market, but it makes sense viewed from the perspective of our theory. In Section 1.2, we argued that an increase in the supply of U shares leads to a fall in their price because foreign investors have a downward-sloping demand curve for U shares.

The drop in the price ratio of U to R shares associated with the announcement is dramatic also. Table 2 shows that the price ratio for Nestlé is about two before the announcement. After the announcement, it drops to an average of 1.07. To explain a decrease in the price ratio of this magnitude through changes in the risk premium of U shares would require, in the simplest dividend discount model, almost a doubling of the risk premium. Since there is no dramatic decrease in stock prices throughout the world at that time, one would have to explain the fall by a change in beta. There is no evidence of a dramatic fall in beta either.

The price ratio falls for other firms at the time of the Nestlé announcement, but not for all firms. The typical firm for which the average price ratio for the subperiod after the announcement is more than two standard deviations lower than the average price ratio for the subperiod before the announcement is a firm with an average price ratio for the subperiod before the announcement in excess of two. Hence, firms whose U shares were highly valued by foreign investors experienced a fall. This fall can be attributed to the increase in the supply of U shares and to the belief that other firms would follow Nestlé in relaxing the ownership restrictions.

We have not been able to locate other news that could explain

such a drop in the price ratio for so many firms during the week of the Nestlé announcement.[24] For most of these firms, the price ratio had little volatility before the announcement. The average price ratio for Nestlé for the subperiod before the announcement was 2.0 with a volatility of 0.04. Hence, the drop in the price ratio is equivalent to a drop of more than 20 standard deviations!

The dramatic loss in value of the *U* shares takes place against an increase in the market value of Nestlé of 10 percent as measured by the total value of all three categories of shares. This increase is even more dramatic because during that week only two other firms experienced an increase in market value in our sample. Hence, the Nestlé announcement increases firm value as we would expect. The obvious question for which we have no answer is why Nestlé waited to make its announcement until it had such an impact on firm value and why other firms did not follow.

At least three explanations can be given for the increase in the market value of Nestlé that are not related to our theory. One view is that the ownership restrictions enable management to entrench itself. With this view, one could argue that the market reacted favorably because the announcement reflected confidence by management in how it would be evaluated by shareholders, and hence confidence in the future of the company.[25] The second explanation is that Nestlé made the move so it could be a more active player in the European Economic Community. The third possible explanation is that the Nestlé shares became more liquid. None of these arguments, however, can explain why the unrestricted shares fell so dramatically. The first two arguments suggest that the *U* shares should have increased in value because the information represents good news for the company; the third argument predicts little or no effect on the *U* shares because their liquidity would change little.

5. Concluding Remarks

In this article, we argue that in the presence of differential demands for domestic shares by domestic and foreign investors, firms will want to discriminate between these investors, and that this discrimination provides an explanation for why firms sometimes restrict foreign ownership of their shares. Price discrimination explains why shares available to foreign investors sell at a premium when (1) there is a home

[24] Neither can Loderer and Jacobs (1994).

[25] This view has been put forward by Hermann and Santoni (1989).

bias in asset holdings and (2) there is some capital flight from the foreign country. In the absence of a home bias, the price-elasticity of the aggregate demand from foreign investors exceeds the price-elasticity of the aggregate demand from domestic investors when the foreign country is large compared to the domestic country. Without capital flight, foreign investors do not have a sufficient preference for domestic shares to make it worthwhile to discriminate against them.

We explore a two-period model. Further work should study a multiperiod model to see under which conditions price discrimination holds when firms can change the supply of unrestricted shares over time. Most of the analysis in this article focuses on three assets. Hence, we ignore the strategic considerations that apply in a context where several firms have to decide on their supplies of unrestricted shares. These considerations could be usefully explored. Finally, our analysis does not derive explicitly why asset demands differ between investors from different countries. Modeling taxes and political risk explicitly could lead to a richer analysis.

Our cross-sectional evidence obtained using Swiss data is supportive of our model. The empirical analysis is limited by the nature of the database available and the small number of firms for which our experiment could be conducted. With more data, a time-series cross-sectional analysis that looks more directly at the optimal supplies of restricted and unrestricted shares for individual firms could provide useful evidence on our model. Although our model appears to be useful for the case of Switzerland, further work should explore whether it can explain the existence of ownership restrictions for other countries. Whereas historically, it seems clear that there has been a demand for Swiss assets motivated by political risk considerations which gave Swiss firms some monopoly power in supplying shares to foreign investors, it remains an empirical question as to whether political risk or tax effects on asset demands from foreign investors are important enough in other countries with ownership restrictions to make our theory appropriate for these countries.

Appendix

In this appendix, we derive Equation (14), which determines the prices of U shares. The derivation of Equation (15), which determines the prices of R shares, is similar. As in the text, we consider only the case where all shareholdings are strictly positive for simplicity. Since we only present results for the typical foreign investor who invests in the domestic country, we omit the subscript f. Using the notation in the text, Equation (5) can be written as an unconstrained equation through elimination of the holdings of the risk-free asset by substi-

tution of Equation (4). For the case with many different unrestricted shares, the resulting unconstrained equation is

$$w = D_F[p_F-(1+r+h_f)P_F]+\underline{D}'_U[\underline{p}_U-(1+r+c_f)\underline{P}_U]+(1+r)W. \quad \text{(A.1)}$$

We maximize the expected utility of terminal wealth using the definition of terminal wealth given in Equation (A.1):

$$\begin{aligned} E(w) - \frac{1}{2}A\,Var(w) \;=\; & \underline{D}'_U[E(\underline{p}_U) - (1 + r + c_f)\underline{P}_U] \\ & + D_F[E(p_F) - (1 + r + h_f)P_F] \\ & + (1 + r)W - \frac{1}{2}A[\underline{D}'_U V_{UU}\underline{D}_U \\ & + 2\underline{D}'_U V_{UF}D_F + D_F^2\sigma_F^2] \end{aligned} \quad \text{(A.2)}$$

The first-order conditions are

$$\begin{aligned} \partial L/\partial \underline{D}_U \;&=\; E(\underline{p}_U) - (1 + r + c_f)\underline{P}_U - A[V_{UU}\underline{D}_U + V_{UF}D_F] = 0, \\ \partial L/\partial D_F \;&=\; E(p_F - (1 + r + h_f)P_F - A[D_F\sigma_F^2 + V_{FU}\underline{D}_U] = 0. \end{aligned} \quad \text{(A.3)}$$

Solving for the demand functions yields

$$\begin{aligned} \frac{1}{A}V_{UU}^{-1}[E(\underline{p}_U) - (1 + r + c_f)\underline{P}_U] - V_{UU}^{-1}V_{UF}D_F \;&=\; \underline{D}_U, \\ \frac{1}{A}\sigma_F^{-2}[E(p_F) - (1 + r + h_f)P_F] - \sigma_F^{-2}V_{FU}\underline{D}_U \;&=\; D_F. \end{aligned} \quad \text{(A.4)}$$

Substituting D_F in the equation for $\underline{D}_U$, we get

$$\begin{aligned} & \frac{1}{A}V_{UU}^{-1}[E(\underline{p}_U) - (1 + r + c_f)\underline{P}_U] \\ & \quad - V_{UU}^{-1}V_{UF}\left[\frac{1}{A}\sigma_F^{-2}[E(p_F) - (1 + r + h_f)P_F] - \sigma_F^{-2}V_{FU}\underline{D}_u\right] \\ & = \underline{D}_U. \end{aligned} \quad \text{(A.5)}$$

In equilibrium, the aggregate demand for unrestricted shares, N_f, times Equation (A.5), must equal their supply. After imposing this condition, we solve for $\underline{P}_U$ to obtain Equation (14).

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