Government as a Discriminating Monopolist
in the Financial Market:
The Case of China

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Abstract

We show that the many unusual features of China's financial markets are consistent with a government choosing regulations to maximize a standard type of social welfare function. Under certain conditions, these regulations are equivalent to imposing explicit taxes on business and interest income, yet should be much easier to enforce. The observed implicit tax rates are broadly in line with those observed in other countries. The theory also forecasts, however, that China will face increasing incentives over time to shift to explicit taxes.

1 Introduction

The emerging Chinese financial market has exhibited many puzzling features. China, like a number of other countries, has imposed ownership restrictions on foreigners seeking to acquire shares in domestic firms. Much more unusual, however, is the fact that China also restricts the amount of shares available to domestic investors. Uniquely, foreign investors in China pay much less than domestic investors for intrinsically identical shares.[1]

In addition to restricting share purchases, the Chinese government has also imposed capital controls, in principle preventing domestic investors from investing abroad. Given these controls, the government has been able to set the interest rate much lower than that available abroad. The government also prevents nonstate firms from having their shares listed in the public exchanges.[2] In addition, the government puts pressure on the banking system to lend primarily to state enterprises, with little regard for financial considerations.

In this paper, we argue that all of these observations can be consistent with a government choosing regulations that maximize a standard type of social welfare function. The observed regulations all aid the government in collecting revenue from both foreign and domestic investors. Due to risk aversion, domestic and foreign demand for domestic securities should be downward sloping — investors need more attractive terms to induce them to concentrate their portfolios further in any one country's securities.[3] The government as a result certainly has an incentive to restrict the supply of domestic shares available to foreign investors, in order to extract monopoly rents from these investors.[4] The government can use equivalent regulatory restrictions to collect revenue from domestic investors. Here, its monopoly power is even greater, since it also controls the interest rate available to domestic investors on their

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[1]Examples of countries where ownership restrictions also exist, but where foreigners pay a premium for owning domestic shares, include Finland (Hietala, 1989), Thailand (Bailey and Jagtiani, 1994), Switzerland (Stulz and Wasserfallen, 1995), and Mexico (Domowitz, Glen and Madhavan, 1997). On the effects of foreign ownership restrictions, see also Stulz (1981), Errunza and Losq (1985), Eun and Janakiramanan (1986), and Errunza and Losq (1989) among others. On the Chinese domestic price premium, see Bailey (1994), World Bank (1995), Su (1997) and Fernald and Rogers (1998).

[2]The government recently relaxed this restriction, allowing nonstate firms to sell shares to foreign investors.

[3]See Adler and Dumas (1983) or French and Poterba (1991) for evidence that the correlation in the returns on stock markets in different countries is quite low, implying substantial risk-sharing gains from international diversification. A long-standing puzzle in the international finance literature is why investor portfolios are not more diversified internationally, given the large potential gains. For attempts to explain the observed home bias, see for example Baxter and Jermann (1997), Bottazzi, Pesenti and Wincoop (1996), Gordon and Gaspar (2001), and Pesenti and Wincoop (1996).

[4]This point is not new. See, for example, Gordon and Varian (1989). Stulz and Wasserfallen (1995) argue that value-maximizing firms would do the same if, due to market imperfections, they face downward-sloping demand curves for their ownership shares.

bank deposits, and can restrict their access to foreign securities. However, the government may be less aggressive in exploiting its monopoly power over domestic investors to the extent that it cares about their welfare as well as about government revenue.

Within the paper, the only assumed outlet for domestic savings outside the government's direct control is investments in the nonstate sector. This sector is also effectively untaxed by the national government. As a result, the government can further increase its market power over domestic investors by hindering activity in the nonstate sector, e.g. by preventing nonstate shares from being traded on the exchanges or by restricting the access of nonstate firms to bank loans.

Since foreign investors can much more easily find "greener pastures" elsewhere, their demand for domestic assets will be price elastic relative to that of domestic investors. The optimal policy is therefore to price discriminate by segmenting domestic and foreign markets. Since domestic investors' demand for domestic assets is less elastic, given that their only alternative is nonstate assets, the government will charge them a higher price for domestic shares (and offer them a lower interest rate on bank deposits) as long as the government does not put too much weight on their welfare. These implications are consistent with the stylized facts from China.

Our paper is related to Stulz and Wasserfallen (1995), who argue that Swiss firms have an incentive to price discriminate between domestic and foreign investors since foreign demand is less elastic due to tax evasion, leading to higher prices for foreign investors.[5] In our paper, the government, not each individual firm, has market power in the financial markets. Also, it controls access not just to one firm's shares but to all the shares issued by Chinese firms, and to the interest rate paid by Chinese banks. As a result, the government not only can raise share prices but also can lower the interest rate, in order to reduce the cost of capital for financing both government-owned firms and its own budget deficit. In order to capture the government's influence on share prices and interest rates, this paper develops a general equilibrium model to analyze the government's intervention in the financial economy.[6]

This paper is also related to other works on the Chinese financial market. Bailey (1994) and World Bank (1995) argue that differential liquidity in the two markets helps explain the foreign discount observed in China. Since fewer firms are offered to foreign investors, these markets have a lower capitalization and hence require a higher liquidity premium.

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[5]See Domowitz et al. (1997) for a similar explanation for firms issuing separate shares for foreign vs. domestic investors in Mexico.

[6]To do so, we develop a CAPM model of the financial sector, and then embed it into a general equilibrium model of the real economy. Slemrod (1983) and Fullerton and Gordon (1983) are some older examples of such an approach. Merton (1990) provides an equivalent elegant derivation in a continuous time context.

However, this argument does not explain why the government chooses to list fewer firms on foreign markets than on domestic markets. Fernald and Rogers (1998) is perhaps closest to our paper. Its explanation of the domestic price premium rests on the observation that Chinese investors have far fewer investment alternatives and in particular face a lower deposit interest rate, which they use as their discount rate. However, Fernald and Rogers (1998) do not explain why the government wants to restrict domestic individuals' investment opportunities in order to keep the domestic interest rate lower than that prevailing in the international financial market.

Why are the regulations so much different in China than elsewhere? We show that the Chinese regulations are closely equivalent in their economic effects to taxes on interest income and on income from equity. China may use regulations rather than taxes in part because it has had more difficulty to date than other countries do in collecting tax revenue, while regulations are relatively easy to enforce.

If regulations are easier to enforce, why aren't they used more commonly elsewhere? Regulations are equivalent to taxes only when there are no private share holdings when the policy is chosen.[7] Otherwise, explicit taxes will look more attractive. China is unique in setting policy at the time when private shareholding is first being established.

The rest of the paper is organized as follows. Section 2 gives a brief description of the Chinese financial economy and the puzzles that this paper attempts to explain. Section 3 describes the basic assumptions of our model, derives the characteristics of the market equilibrium, and examines the equilibrium government policy. In Section 4, we provide a discussion of our results.

2   The Institution

Before the reforms that started in 1978, capital markets did not exist in China. Private ownership of capital was prohibited. Monetary savings from individuals were deposited in the People's Bank and they accounted for less than six percent of GDP in 1978 (State Statistical Bureau, 1997).

The reforms since 1978 have greatly transformed China's economy. The lifting of the ban on private businesses has brought about an explosive growth of China's nonstate sector. Most of the private or quasi-private firms were self-financed. Private business investment has become a viable alternative savings vehicle for individuals.

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[7]When there are private shareholdings, the rents generated by financial repression are shared with these existing private shareholders.

Domestic individuals' access to foreign capital markets continues to be limited by currency non-convertibility and by administrative barriers. Since the reforms, however, China has opened up to both foreign direct investment[8] and foreign portfolio investment.[9] While foreigners are not yet allowed to participate in China's fixed income securities market, the Chinese government has successfully floated foreign currency denominated bonds in overseas' markets.

The real interest rate on domestic bank deposits has often been negative, and on average has been considerably below the foreign borrowing cost that the government faces.[10] The difference between the foreign borrowing cost and the domestic interest rate, which averages 3.1% over the period between January 1991 and October 1998, represents an implicit tax on domestic savings.

Despite low domestic interest rates, there has been a rapid increase in individual savings, which may be attributed to the rapid increase in income, the expected rapid aging of the population, and the anticipated increase in future uncertainty as the economy becomes more market-oriented. By 1996, individual bank deposits alone accounted for 56 percent of GDP (State Statistical Bureau, 1997). The large bank deposits coupled with the sizable implicit tax rate on bank deposits implies that the revenue from implicit taxes on bank deposits was worth around 2% of GDP per year between 1991 and 1998.

The implicit tax revenue was badly needed, as the government was finding it increasingly difficult to collect tax revenue during the reform period. Between 1978 and 1995, budgetary revenue fell precipitously from 35 percent of GDP to 11 percent. State owned enterprises contributed 71 percent of government revenue (net of subsidies) during this period, even as their share of industrial output dropped below 50 percent (State Statistical Bureau, 1997). However, tax evasion even by state enterprises has become a major problem.

Given the drop in funding from the government, state enterprises experimented with selling stocks directly to the public in 1984, in order to raise financing. Unofficial secondary trading of stocks began shortly thereafter. Share trade was legalized with the formal recognition of the Shanghai Stock Exchange (SHSE) and the Shenzhen Stock Exchange (SZSE) in 1990 and 1991. By January 1999, the number of listings reached 862 with a market capitalization of US$232 billion (International Finance Corporation, 1999).

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[8]In 1996, foreign owned subsidiaries in China accounted for 25 percent of domestic investment, produced 13 percent of output, 32 percent of exports and 11 percent of tax revenues (World Bank, 1997).

[9]Foreign shares were first listed as B-shares on Shanghai and Shenzhen Stock Exchanges in February 1993, and as H-shares on the Hong Kong Stock Exchange (HKSE) in July 1993.

[10]Following Giovannini and de Melo (1993), the foreign borrowing cost is constructed as the sum of the Hong Kong Interbank Offer Rate (one year) and the ex post 12-month ahead depreciation rate of the RMB on the swap market relative to the Hong Kong dollar.

The Chinese stock market exhibits some unusual features when compared to mature financial markets.

1. The government through its regulatory bodies controls both the listing of new enterprises and the value of new stock issued.

2. There is a high degree of market segmentation. In addition to non-transferable government shares, corporate legal person shares (subscribed by state-owned units), and employee shares, tradeable shares can be issued in two ownership categories:

   - *A Shares* or domestic individual shares can be owned only by domestic investors. A-shares dominate China's equity market in both size and level of activity.

   - *B and H Shares* or foreign shares can be owned only by foreign investors.[11] B-shares are listed on domestic exchanges and H-shares are listed on overseas exchanges (Hong Kong, New York, London and Singapore). Foreign shares bear the same ownership rights as A-shares.

3. A-shares are traded at a substantial *premium* over the corresponding foreign shares; see Figure 1. Among all firms that listed both domestic and foreign shares between January 1993 and November 1998, the average ratio of A-share prices to foreign share prices was 3.16.

4. The initial offering price on the A-shares market has been extremely low, generating huge excess demand.[12] As a result, the government charged a small fee for each submitted bid for shares, and then picked randomly from these bids. Other shares, however, were also sold directly at this low price to priority buyers, typically other state-owned enterprises.[13]

5. Share prices in the A-shares market are much more volatile than in foreign-shares markets.[14] This can be seen from Figure 2 which plots A-share and B-share price indices in SHSE and SZSE. Although not shown here, A-shares are also more volatile than their corresponding H-shares.

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[11] As of February, 2001, this restriction was relaxed, so that Chinese investors holding foreign currencies could buy B-shares on the Shanghai market. As would be forecast from our model, the price of B-shares then rose dramatically.

[12] Su and Fleisher (1999) report in a sample of 308 IPO's that the mean one day return on new issues is 948.6%! However, they also report that only 12.8% of funds raised by the firms in their sample were raised at the time of the IPO. (The rest were issued subsequently, at the market price.)

[13] As of February 2000, investors holding 10,000 yuan worth of A-shares were also made priority buyers.

[14] The sample standard deviation of daily percentage changes in price is 3.7% for Shanghai A-shares index, 2.1% for Shanghai B-shares index, 2.9% for Shenzhen A-shares index and 2.1% for Shenzhen B-shares index.

6. Fewer firms are listed in foreign markets. In February 1999, of all 862 firms listed on China's stock exchanges, 835 issued A-shares, while only 107 issued B-shares. An additional 43 firms issued H-shares. A total of 98 firms were cross-listed on both A-shares and B/H-shares markets.

7. However, given that a firm is dual-listed on both domestic and foreign markets, the government often permits more tradeable shares to be floated on the foreign than on the domestic markets. For the 98 dual-listed firms on November 30, 1998, A-shares accounted for an average of 15.6% of total outstanding shares while foreign shares accounted for 29.4%. The rest of the outstanding shares, which were non-tradeable, were held by the government, state-owned institutions and employees.

8. All listed enterprises have been state-owned.

Each year, the new share issue quota is determined jointly by the State Council Securities Policy Committee, the State Planning Commission and the Central Bank as part of the annual investment and credit plan. In 1993, for example, the A-share quota was set at 5.5 billion yuan and the B-share quota was US$100 million.[15] The quota is then divided among provinces. Each regional securities authority then invites enterprises to request a listing, and makes a selection based on firm performance and regional development objectives.[16] Enterprises requesting a foreign share listing are also required to obtain approval from the Ministry of Foreign Trade and Economic Cooperation (MOFTEC). Once an enterprise is approved for listing by its regional government (and MOFTEC), final approval is virtually automatic.

3   The Model

In an attempt to make sense of the above observations, we develop a simple model of a one-period economy which consists of a home country (domestic) and the rest of the world (foreign). The economy produces a single tradeable good.[17] The home country is open

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[15]In December 1993, the swap market exchange rate was US$1 = 8.70 yuan.

[16]Consistent with observation, our model forecasts excess demand by state firms for new share issues on the exchanges (assuming that each firm can keep some fraction of the resulting revenue). The reason is simple: each firm has less market power than the government, and would ignore the effects of its new share issues on the equilibrium prices of other firms.

[17]To begin with, we assume a fixed exchange rate between the domestic and the foreign currency. We will discuss the implications of exchange rate risk below.

asymmetrically: it welcomes foreign investments, but prevents domestic individuals from owning foreign assets.[18]

The home country has two real sectors: a state-owned sector consisting of S enterprises initially owned by the government, and a nonstate sector. Let K_s denote the investment in state enterprise s and K_N the investment in nonstate enterprises. The random ex post sizes of these firms are then $\tilde{\theta}_s K_s$ and $\tilde{\theta}_N K_N$, where $\tilde{\theta}_s$ and $\tilde{\theta}_N$ are normally distributed.

The government controls a variety of policies. To begin with, the government sets the interest rate r on bank deposits and government bonds. The government also controls the number of shares in each state firm that can be purchased by either domestic investors (A-shares) or foreign investors (B-shares).

We assume that the foreign market offers a riskless asset with a return r^*. It also offers a diversified portfolio of risky assets, including investments in all countries other than China. Let $\tilde{\theta}^*$ denote the random returns on this diversified portfolio. Foreign individuals have free access to the foreign market. Domestic individuals are barred from owning foreign assets. The government itself, however, has access to the riskless asset in the foreign market.

Both the government and the individuals are rational and risk averse. Each individual maximizes his own expected utility of wealth, taking as given the various policies chosen by the government. The government's objective is to maximize a standard type of social welfare function equal to a weighted sum of the expected utilities of domestic residents plus the expected welfare from government revenue. In choosing policies, the government assumes that individuals will respond rationally, allowing the government to forecast how savings and asset prices will be influenced by its policies. Below we use backward induction to characterize the equilibrium. We start with individuals' portfolio choices and derive domestic and foreign demands for the equity of Chinese state enterprises, for any given set of policy choices for the government. We then solve for the optimal policies of the government.

3.1 Domestic Individuals

At the beginning of the period, each individual decides how to divide his initial wealth W_i between the domestic riskless asset, D_i, risky investment in the nonstate sector, K_{Ni}, and risky investment in equity (A-shares) of each state enterprise s, K_{Asi}. The individual's budget constraint is

$$K_{Ni} + D_i + \mathbf{P}'_A \mathbf{K}_{Ai} = W_i \tag{1}$$

[18]See below for a discussion of when this restriction would be chosen.

where $\mathbf{P}_A = (P_{A1}, \ldots, P_{AS})$ is the vector of prices per share of state enterprises in the A-shares market, and $\mathbf{K}_{Ai} = (K_{A1i}, \ldots, K_{ASi})$ is the vector of corresponding shares owned by individual i. His uncertain end-of-period wealth is

$$\tilde{W}_i = (1+r)D_i + \tilde{\theta}_N K_{Ni} + \tilde{\boldsymbol{\theta}}'_S \mathbf{K}_{Ai} \tag{2}$$

where $\tilde{\boldsymbol{\theta}}_S$ is a vector of random returns. The domestic individual chooses K_{Ni} and $\mathbf{K}_{Ai}$, allowing D_i to adjust according to the budget constraint, so as to maximize the following expected utility function:

$$\mathrm{E}U_i(\tilde{W}_i) = -\mathrm{E}e^{-h_i\tilde{W}_i} = -e^{-h_i[\mathrm{E}\tilde{W}_i - .5h_i\mathrm{Var}(\tilde{W}_i)]} \tag{3}$$

Here h_i is individual i's constant–absolute–risk–aversion parameter, and E is an expectation operator. The resulting first order conditions can be expressed as:

$$\mathrm{E}\tilde{\theta}_N - (1+r) = h_i\mathrm{Cov}(\tilde{\theta}_N, \tilde{W}_i) \tag{4}$$

$$\mathrm{E}\tilde{\boldsymbol{\theta}}_S - (1+r)\mathbf{P}_A = h_i\mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{W}_i) \tag{5}$$

The individual invests up to the point where the expected excess return on each risky asset equals the risk premium.

Dividing both sides of (4) by h_i, substituting in (2), and summing over i, we can derive the aggregate investment in the nonstate sector as

$$K_N = h^{-1}\sigma_N^{-2}\left[\mathrm{E}\tilde{\theta}_N - (1+r) - h\mathrm{Cov}(\tilde{\theta}_N, \tilde{\boldsymbol{\theta}}_S)\mathbf{K}_A\right] \tag{6}$$

where $\mathbf{K}_A = \sum_i \mathbf{K}_{Ai}$ is the aggregate demand for A-shares, $h^{-1} = \sum_i h_i^{-1}$, and $\sigma_N^2 = \mathrm{Var}(\tilde{\theta}_N)$. Here h can be interpreted as the individuals' aggregate absolute risk aversion. The optimal investment is proportional to the risk-adjusted excess return from the investment.

Dividing both sides of (5) by h_i, summing over i, and then substituting in (2) and (6), we can solve for the market clearing prices for A-shares:

$$\mathbf{P}_A = \frac{\mathrm{E}\tilde{\boldsymbol{\theta}}_S - \boldsymbol{\beta}_{SN}(\mathrm{E}\tilde{\theta}_N - (1+r))}{1+r} - \frac{h}{1+r}\mathrm{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}_N)\mathbf{K}_A \tag{7}$$

where $\boldsymbol{\beta}_{SN} = \mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{\theta}_N)/\sigma_N^2$ is the vector of A-shares' betas relative to the available nonstate asset, and where $\mathrm{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}_N) = \mathrm{Var}(\tilde{\boldsymbol{\theta}}_S - \boldsymbol{\beta}_{SN}\tilde{\theta}_N)$ is a positive definite square matrix measuring the residual variance in A-shares. This implies that the demand curve

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for each A-share stock is downward sloping:[19] investors must be offered a lower price to induce them to invest further in A-share stocks.

In (7), the risk discount on the price of each A-share can be decomposed into two parts. The first part is represented by $\boldsymbol{\beta}_{SN}(\mathrm{E}\tilde{\theta}_N - (1+r))$. This term equals $\boldsymbol{\beta}_{SN}$, a measure of the risk from owning A-shares arising from their covariance with the return on the available nonstate share, times the risk premium required per unit of such risk. The first term in (7) thus measures the maximum price that a domestic individual is willing to pay for the *first* share of each state enterprise. The second term in (7) measures the additional risk discounts on A-share prices for that component of the random return from A-shares that is uncorrelated with the return on the nonstate shares.

Since nonstate firms have largely been in the service sector, or else in light manufacturing, whereas existing state firms have largely been in heavy industry or in other capital intensive sectors, the correlation in their returns, $\boldsymbol{\beta}_{SN}$, is likely to be small. As a result, investors will be able to offset only a small fraction of the risk they face on A shares through adjusting their portfolio of nonstate shares, so that $\mathrm{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}_N)$ should be large.

3.2 Foreign Individuals

Each foreign individual j starts with wealth W_j^*. He must decide how to allocate his wealth between the foreign riskless asset, D_j^*, a diversified portfolio of foreign equity, K_j^*, and ownership shares of each state enterprise s listed on the domestic B-shares market, K_{Bsj}. His budget constraint equals

$$D_j^* + K_j^* + \mathbf{P}_B' \mathbf{K}_{Bj} = W_j^* \tag{8}$$

where $\mathbf{P}_B = (P_{B1}, \ldots, P_{BS})$ is the vector of share prices of state enterprises in the B-shares market. The individual's end of period random wealth is thus

$$\tilde{W}_j^* = (1 + r^*)D_j^* + \tilde{\theta}^* K_j^* + \tilde{\boldsymbol{\theta}}_S' \mathbf{K}_{Bj} \tag{9}$$

Foreign investors thus face a problem similar to that of domestic investors. Under the analogous assumptions about the utility function as above, it easily follows that the market–clearing price for B shares equals

$$\mathbf{P}_B = \frac{\mathrm{E}\tilde{\boldsymbol{\theta}}_S - \boldsymbol{\beta}_{SF}(\mathrm{E}\tilde{\theta}^* - (1+r^*))}{1+r^*} - \frac{f}{1+r^*}\mathrm{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}^*)\mathbf{K}_B \tag{10}$$

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[19]This is true as long as $\tilde{\boldsymbol{\theta}}_S$ is not perfectly correlated with $\tilde{\theta}_N$.

where $\boldsymbol{\beta}_{SF} = \text{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{\theta}^*)/\text{Var}(\tilde{\theta}^*)$ is the vector of B-shares' betas relative to the international market portfolio, and f is a measure of the aggregate absolute risk aversion of foreign investors. As before, the first term represents the maximum price that a foreign individual is willing to pay for the first B-share, while the last term measures the costs of bearing the added risks from further investments in B-shares.

Foreign investors can hedge against the risks in B-shares by adjusting their portfolios of shares in firms located anywhere else in the world, whereas Chinese investors can hedge only through adjusting their holdings of Chinese nonstate firms. Since Chinese state firms are in the same industries, and using the same types of technologies as many other firms located elsewhere in the world, we expect that $\boldsymbol{\beta}_{SF}$ will be larger than $\boldsymbol{\beta}_{SN}$. However, we do not expect that foreign investors can come close to fully hedging against these risks from owning B-shares, due to idiosyncratic risks faced by the Chinese economy as a whole.

In sum, while the equations determining the two sets of market clearing prices, $\mathbf{P}_A$ and $\mathbf{P}_B$, have the same functional forms, the parameters are very different. Because of these differences in the demand functions between foreign and domestic investors for shares in state enterprises, the government will have an incentive to segment the market in order to price discriminate.

3.3 Government

At the beginning of the period, the government is endowed with liquid assets L and 100% ownership of the state sector with an initial capitalization $\mathbf{K}_0$. To finance the expansion of state enterprises, the government can invest its liquid assets, issue domestic debt D at the riskless rate r, issue foreign debt D^* at the riskless rate r^*, and issue new equity shares of each of the state enterprises, $\mathbf{K}_A$ and $\mathbf{K}_B$. Let $\mathbf{K}$ denote the aggregate new investment in each of the firms in the state sector. Then the amount of foreign borrowing required to balance the government's budget is

$$D^* = \boldsymbol{\iota}'_S \mathbf{K} - L - D - \mathbf{P}'_A \mathbf{K}_A - \mathbf{P}'_B \mathbf{K}_B, \tag{11}$$

where $\boldsymbol{\iota}_S$ is a vector of ones of length S.

Equilibrium in the domestic riskless asset market implies that the supply of domestic debt must equal the demand:

$$D = W - K_N - \mathbf{P}'_A \mathbf{K}_A, \tag{12}$$

where $W \equiv \sum_i W_i$. Equilibrium in the stock market implies that the supply of shares must equal demand, so $\mathbf{K}_A = \sum_i \mathbf{K}_{Ai}$ and $\mathbf{K}_B = \sum_j \mathbf{K}_{Bj}$.

The government's wealth at the end of the period is

$$
\begin{aligned}
\tilde{W}_G \equiv\ & -(1+r^*)D^* - (1+r)D + \tilde{\boldsymbol{\theta}}_S'(\mathbf{K} - \mathbf{K}_A - \mathbf{K}_B + \mathbf{K}_0) \\
=\ & (\tilde{\boldsymbol{\theta}}_S' - (1+r^*)\boldsymbol{\iota}_S')\mathbf{K}_G + (1+r^*)L + \tilde{\boldsymbol{\theta}}_S'\mathbf{K}_0 \\
& + (r^* - r)D + (1+r^*)[(\mathbf{P}_A' - \boldsymbol{\iota}_S')\mathbf{K}_A + (\mathbf{P}_B' - \boldsymbol{\iota}_S')\mathbf{K}_B]
\end{aligned}
\tag{13}
$$

where (13) is obtained by substituting in (11), and where $\mathbf{K}_G \equiv \mathbf{K} - \mathbf{K}_A - \mathbf{K}_B$ measures the new investment whose return accrues to the government. The first term in (13) measures the government's investment income net of its opportunity cost of funds, $(1+r^*)$, in the international financial market. The second and third terms in (13) measure the value of the government's endowments at the end of the period. The last two terms can be interpreted as the implicit taxes that the government collects from domestic and foreign investors. The implicit taxes collected from the domestic bond market are simply, $(r^* - r)D$. The government also collects implicit taxes from the equity market. Since a share is defined as a financial claim to income generated by one yuan of capital investment in Chinese enterprises, the implicit tax on any share equals $P_s - 1$.[20]

We assume that the government maximizes the following social welfare function:

$$
\lambda \sum_i \mathrm{E}U_i(\tilde{W}_i) + \mathrm{E}U_G(\tilde{W}_G)
\tag{14}
$$

where $\mathrm{E}U_G(\tilde{W}_G) = -\mathrm{E}e^{-h_G \tilde{W}_G}$. Here, λ measures the weight the government puts on the utility residents receive from private consumption, relative to that received from government expenditures.

In what follows, we first consider an interior Nash equilibrium in which both A-shares and B-shares have positive net supply, and the government is a net borrower in the domestic bond market, so that $D > 0$. We will then consider "corner solutions," and describe the conditions under which the net supplies of enterprises' shares and government bonds are positive.

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[20]We assume here that the government collects no tax revenue from investments in the nonstate sector. Small firms are difficult to tax in all countries, given that there is no effective outside monitoring of their cash flows. Even in the United States, IRS audits indicate that the evasion rate for small firms is over 30%, implying that they face a much lower effective tax rate than larger firms. While we have made the extreme assumption that these firms are entirely untaxed, the qualitative story would remain the same even if they could be taxed, but at a lower effective rate than applies to state firms.

The government chooses its own new investment, $\mathbf{K}_G$, the riskless interest rate, r, and the supply of shares, $\mathbf{K}_A$ and $\mathbf{K}_B$, in order to maximize its expected utility, while allowing the riskless borrowing in the international bond market, D^*, to be determined by its budget.

The resulting first-order condition for K_G takes a standard form:

$$\mathrm{E}\tilde{\boldsymbol{\theta}}_S - (1 + r^*) = h_G \mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{W}_G) \tag{15}$$

In particular, the expected return on government investments in the state sector simply has to exceed the risk-free rate of return available abroad by enough to compensate for the added risk.

Implications for the interest rate

The first-order condition for r is:

$$-\sum_i (1 - \lambda\alpha_i)\left(D_i - (1 + r)\frac{\partial \mathbf{P}'_A}{\partial r}\mathbf{K}_{Ai}\right) = (r^* - r)\frac{\partial K_N}{\partial r}, \tag{16}$$

where $\alpha_i \equiv (h_i \mathrm{E}U_i(\tilde{W}_i))/(h_G \mathrm{E}U_G(\tilde{W}_G))$ measures the ratio of the marginal utility of income to individual i relative to the marginal utility of income to the government. We find that an increase in r implies an implicit payment from the government to each individual in proportion to their existing bond holdings, D_i. In addition, the resulting drop in market clearing prices for equity lowers the payments from each individual to the government in proportion to their equity holdings $\mathbf{K}_{Ai}$. The welfare cost of the combined transfer is proportional to the difference in welfare weights between the government and individual i, $(1 - \lambda\alpha_i)$. Offsetting these welfare costs, individuals will reduce their investments in nonstate assets when r rises, providing an efficiency gain proportional to the implicit tax rate $(r^* - r)$ on all assets other than nonstate firms.

Equations (16) can be rewritten as follows, using previous results:

$$r = \frac{r^* + (1 - \lambda\alpha_h)(\mathrm{E}\tilde{\theta}_N - 1 - h\sigma_N^2\omega W)}{2 - \lambda\alpha_h}, \tag{17}$$

where $\alpha_h = h\sum_i(\alpha_i/h_i)$ is the weighted average marginal utility of income weighting by the inverse of each individual's risk aversion, $\omega = (1 - \lambda\alpha_h)/(1 - \lambda\alpha_W)$, and $\alpha_W = \sum_i \alpha_i W_i/W$ equals the weighted average marginal utility of income weighting by each individual's wealth. Note that the expression $(1 - \lambda\alpha_W)$ measures the net welfare gain from taking W_i/W from each individual i and transferring it to the government. For simplicity in interpreting

the results, we will assume from now on that $\omega = 1$, which holds as long as individuals invest equal fractions of their portfolios in each asset.[21] The expression $E\tilde{\theta}_N - 1 - h\sigma_N^2 W$ measures the risk adjusted rate of return in the nonstate sector if domestic individuals invest *all* of their endowments in the nonstate sector. It therefore represents domestic individuals' minimum required risk-free rate of return, r_{min}, for buying any securities from the government.

If $\lambda\alpha_h = 1$, so that the government values equally a yuan in its hands and one distributed proportionately among domestic residents, then equation (17) implies that $r = r^*$: the government would not be willing to distort interest rates in the bond market, thereby lowering efficiency, in order to raise tax revenue. In contrast, to the extent that $\lambda\alpha_h < 1$, then the government does introduce distortions in order to raise tax revenue. The optimal value of r is then a weighted average of r^* and r_{min}. The government issues bonds to domestic residents ($D > 0$) at an interest rate $r < r^*$ as long as $r_{min} < r^*$; otherwise it lends to residents ($D < 0$).

Implications for $\mathbf{P}_A$ and $\mathbf{P}_B$

The first-order conditions for $\mathbf{K}_A$ and $\mathbf{K}_B$ are:

$$\mathbf{P}_A + \sum_i (1 - \lambda\alpha_i)\frac{\partial \mathbf{P}'_A}{\partial \mathbf{K}_A}\mathbf{K}_{Ai} - \left(\boldsymbol{\iota}_S + \frac{\partial K_N}{\partial \mathbf{K}_A}\right)\frac{r^* - r}{1 + r} = \boldsymbol{\iota}_S \tag{18}$$

$$\mathbf{P}_B + \frac{\partial \mathbf{P}'_B}{\partial \mathbf{K}_B}\mathbf{K}_B = \boldsymbol{\iota}_S, \tag{19}$$

These equations equate the marginal revenues collected from selling an extra share of the state sector in the A-shares and B-shares markets to the cost of the underlying capital. Equation (19) describes the standard pricing rule for a monopolist. The extra term in equation (18) captures any changes in D that occur as a result of selling more $\mathbf{K}_A$. If K_N and each K_{As} are perfect substitutes, so that $\partial K_N/\partial K_{As} = -1$, then this added term disappears. If K_N falls by less, however, then purchases of D fall when $\mathbf{K}_A$ increases, causing a loss in government revenue. As a result, fewer shares of equity will be issued.

What can be said about the relative sizes of $\mathbf{P}_A$ and $\mathbf{P}_B$? Clearly, the first-order conditions for $\mathbf{P}_A$ and $\mathbf{P}_B$ are different, so that the government in general has an incentive to segment the two markets, as it has done. To shed further light on the optimal relative

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[21]Note that $\omega = 1$ if $\alpha_W = \alpha_h$. This equality holds if $h_i W_i = hW$, consistent with constant relative risk aversion across people. Given this assumption, the government cannot redistribute among individuals through changing relative asset prices.

prices, we rewrite equation (18) slightly, making use of equations (5) and (6):

$$\mathbf{P}_A + (1 - \lambda\alpha_h)\frac{\partial \mathbf{P}'_A}{\partial \mathbf{K}_A}\mathbf{K}_A = \boldsymbol{\iota}_S + (\boldsymbol{\iota}_S - \boldsymbol{\beta}_{SN})\frac{r^* - r}{1 + r} \qquad (20)$$

When $\lambda\alpha_h = 1$, so that the government has no incentive to raise revenue from individuals, then it immediately follows that $\mathbf{P}_A = \boldsymbol{\iota}_S$ and $r = r^*$ are the optimal policies, so that there would be no distortions in the *domestic* financial market. However, equation (19) remains unaffected, so that the government would still take advantage of its market power when selling shares to foreign investors. Therefore, when $\lambda\alpha_h = 1$, we conclude that $\mathbf{P}_B > \mathbf{P}_A$, as long as there is any market abroad for Chinese shares.

What happens in the opposite extreme case, when $\lambda = 0$, so that the government cares only about maximizing tax revenue? Figures 3A and 3B portray graphically the resulting first-order conditions. Given the shapes of the curves in the graph, we have $\mathbf{P}_A > \mathbf{P}_B$, but $\mathbf{K}_A < \mathbf{K}_B$. We now argue that the first of these results should strongly be expected, while the second may or may not be true in general.

The two demand curves have been described algebraically in equations (7) and (10). These curves are fully characterized by their intercepts on the vertical axis and their slopes. To begin with, there should be a strong presumption that the vertical intercept of the demand curve for $\mathbf{P}_A$ will be much higher than that for $\mathbf{P}_B$. Intuitively, Chinese domestic investors have much less attractive outside options than do foreign investors. Even without access to Chinese stocks, foreign investors can still invest in bonds and stocks anywhere else in the world, whereas Chinese investors can only invest in Chinese bank deposits and in nonstate firms. Since $r < r^*$, the option to invest in a Chinese bank is, by design, unattractive. The Chinese nonstate sector is very small relative to the desired financial holdings of Chinese investors. As a result, Chinese investors should be willing to pay much more than foreign investors to have access to at least some equity in Chinese firms.

More formally, these vertical intercepts are measured by the first term on the right-hand side in equations (7) and (10). Since the discount rate faced by Chinese investors is lower, as long as the numerators in these terms were the same the maximum price that Chinese investors would be willing to pay would be higher. The numerators differ, however, due to differences in the risk premia arising from the covariance of income from equity in state firms with assets other than Chinese equity that investors own. If the risk premium is smaller for domestic investors, then the intercept for domestic demand is necessarily higher.

Using equation (6) and the equivalent result for foreign investors, it is easy to show that the risk premium term for domestic investors is smaller than that for foreign investors if

and only if

$$hW\,\mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{\theta}_N)\left[\frac{K_N}{W} + \boldsymbol{\beta}'_{SN}\frac{\mathbf{K}_A}{W}\right] < fW^*\mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{\theta}^*)\left[\frac{K^*}{W^*} + \boldsymbol{\beta}'_{SF}\frac{\mathbf{K}_B}{W^*}\right], \qquad (21)$$

where $W^* = \sum_j W_j^*$. This inequality should hold under several plausible conditions. First, we expect that

Presumption 1: $hW \le fW^*$

Why? This claim is true as long as the measure of relative risk aversion is constant or increasing as a function of income. Foreign investors as a group are certainly far richer than Chinese investors.

Second, we also presume that

Presumption 2: $\mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{\theta}_N) < \mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{\theta}^*)$

Why? Nonstate firms are typically small new entrants in the service or transportation sectors while both state firms and foreign firms are typically large manufacturing enterprises. We presume that industry shocks, whether to demand or technology, outweigh shared country shocks to Chinese state and nonstate firms.[22]

The remaining terms in brackets in equation (21) correct the initial measure of risk for the fact that portfolios are not simply invested in nonstate firms or foreign equity. It is straight-forward to show that these terms will also be smaller for domestic investors as long as:

Presumption 3:

- $(K_N + \sum_s K_{As})/W < (K^* + \sum_s K_{Bs})/W^*$

- $\sum_s K_{As}/(K_N + \sum_s K_{As}) > \sum_s K_{Bs}/(K^* + \sum_s K_{Bs})$

- $\mathrm{Cov}(\tilde{\boldsymbol{\theta}}_S, \tilde{\theta}_N) < \sigma_N^2 \boldsymbol{\iota}_S$, and

- $\sigma_F^2 < \sigma_N^2$

Why should these four conditions hold? The first condition is simply that Chinese investors allocate a larger fraction of their portfolios, on net, to interest bearing assets than do foreign investors, reflecting the difficulties they face in undertaking other investments. The second condition is that Chinese investors hold a larger fraction of their nondebt portfolios in Chinese equity than do foreign investors, which should hold even ignoring government

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[22] In fact, the covariance between the returns in the state and the nonstate sector could be negative, since growth in one sector can be at the expense of the other.

restrictions due to "home bias." The third part of the presumption states that $\boldsymbol{\beta}_{SN} < \boldsymbol{\iota}_S$: we have already argued that these $\boldsymbol{\beta}$'s will be small due to the very different activities undertaken by state vs. nonstate firms. Finally, nonstate firms are mostly recent start-ups, and start-ups face much higher risks than ongoing firms. In addition, holdings of nonstate firms will not be well diversified, if only due to government restrictions preventing their being listed on the exchanges. The diversification available abroad can substantially lower the variability of investments in a *portfolio* of foreign shares.

Together these presumptions are sufficient to imply a higher intercept for the demand curve for $\mathbf{K}_A$ vs. $\mathbf{K}_B$. Since the marginal cost curve in Figure 3A is higher than that in Figure 3B, given that $\boldsymbol{\beta}_{SN} < \boldsymbol{\iota}_S$, we can then conclude that $\mathbf{P}_A > \mathbf{P}_B$ when $\lambda = 0$.

Is it plausible, however, that $\mathbf{P}_A$ will be over *three times* $\mathbf{P}_B$? Answering this quantitative question in the context of a two period model is not really appropriate, since in particular changes in the discount rate have little effect on the price unless the second period is far in the future. If we instead derived these results in an infinite horizon model, with the certainty equivalent expected values growing at some rate g, then the denominators in the first terms in equations (7) and (10) would instead be $r - g$ and $r^* - g$ respectively. Given the extent of financial repression forecast by the model (as seen in equation (19)) and as observed in practice, it is easily the case for a reasonable value of g that $r^* - g > 3(r - g)$, implying by itself that $\mathbf{P}_A > 3\mathbf{P}_B$. Differences in the numerators in the first terms in equations (7) and (10), and differences in the marginal cost terms in equations (17) vs. (18) would further raise $\mathbf{P}_A$ relative to $\mathbf{P}_B$.

Implications for $\mathbf{K}_A$ and $\mathbf{K}_B$

What can be said in general about the respective quantities, $\mathbf{K}_A$ and $\mathbf{K}_B$? Given the higher intercept for the demand curve for $\mathbf{K}_A$, if the slope of this demand curve were no steeper than that for $\mathbf{K}_B$ and if we could ignore the difference in marginal cost curves, then we could conclude that $\mathbf{K}_A > \mathbf{K}_B$. The higher marginal cost curve for $\mathbf{K}_A$ raises some questions about this forecast. More importantly, the demand curve for $\mathbf{K}_A$ is steeper than that for $\mathbf{K}_B$ as long as $\text{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}_N) > \text{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}^*)$. This result immediately follows from Presumptions 2 and 3. With a steeper demand curve for $\mathbf{K}_A$, it is entirely possible that $\mathbf{K}_A < \mathbf{K}_B$ under optimal pricing, as shown in the graph.

Figure 3A is draw under the extreme assumption that $\lambda\alpha_h = 0$. As λ increases, the weighted marginal revenue curve (as described in equation (18)) rotates towards the demand curve, while the marginal cost curve moves downwards towards the $v = 1$ line. As a result, the optimal value of $\mathbf{P}_A$ moves down the demand curve. In the limit, when $\lambda = 0$, the

optimal point is at the intersection of the demand curve and the $v = 1$ line.

<p align="center">Implications for the variances of $\mathbf{P}_A$ and $\mathbf{P}_B$</p>

Can these results be used to explain why the price of A-shares is more volatile than the price of B-shares? The first-order conditions determining these prices can be rewritten as

$$\mathbf{P}_A = \boldsymbol{\iota}_S + \sum_i (1 - \lambda\alpha_i)\frac{h}{1+r}\text{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}_N)\mathbf{K}_A + \left(\boldsymbol{\iota}_S + \frac{\partial K_N}{\partial \mathbf{K}_A}\right)\frac{r^* - r}{1+r} \tag{22}$$

$$\mathbf{P}_B = \boldsymbol{\iota}_S + \frac{f}{1+r^*}\text{Var}(\tilde{\boldsymbol{\theta}}_S|\tilde{\theta}^*)\mathbf{K}_B, \tag{23}$$

If these first-order conditions were reevaluated over time, as conditions change, the implied optimal prices will change. To what degree will the size of these changes be larger, relative to the original prices, for A shares compared with B shares? The first term on the right hand side of each equation, $\boldsymbol{\iota}_S$, is nonstochastic. Given that $\mathbf{P}_B << \mathbf{P}_A$, this nonstochastic term is far more important in the expression for $\mathbf{P}_B$. As a result, even if the changes in the remaining terms over time are roughly proportional, the percent changes in $\mathbf{P}_A$ will be much above that for $\mathbf{P}_B$.

<p align="center">Implications for which firms will be listed</p>

According to the model, when will the government choose to list at least some shares from a firm on the domestic or foreign market? The optimal $\mathbf{K}_A$ ($\mathbf{K}_B$) is positive as long as the intercept of the demand curve, reflecting the maximum price investors are willing to pay for a share, is above the marginal cost curve. These conditions are satisfied for A-shares and B-shares respectively as long as

$$\frac{\text{E}\tilde{\boldsymbol{\theta}}_S - \boldsymbol{\beta}_{SN}(\text{E}\tilde{\theta}_N - (1+r^*))}{1+r^*} > \boldsymbol{\iota}_S \tag{24}$$

and

$$\frac{\text{E}\tilde{\boldsymbol{\theta}}_S - \boldsymbol{\beta}_{SF}(\text{E}\tilde{\theta}^* - (1+r^*))}{1+r^*} > \boldsymbol{\iota}_S \tag{25}$$

Equations (24) and (25) imply, given Presumptions (2) and (3), that shares are more likely to be issued to domestic investors than to foreign investors.

That the Chinese government wants to invest in the firm does not necessarily imply that either foreign or domestic investors are willing to pay enough to cover investment costs, given the differences in the other risks that each faces. In equilibrium, some state-owned enterprises may not be listed on the exchanges.

<p align="center">17</p>

Why are IPO prices so low?

One other puzzling aspect of these new share issues is that the IPO price for shares has been dramatically below the subsequent market clearing price, implying huge capital gains shortly after a firm is first listed. Any such transfer of rents to private investors is inconsistent with the above model. This puzzling underpricing of IPO's has generated its own sizeable literature, which proposes a wide variety of possible explanations.[23] Each of these stories has some appeal, though even together we are skeptical that they can explain the *degree* of underpricing observed in the data. As a result, we offer here two additional explanations, dealing with different parts of the market for IPO shares.

Consider first the sale of shares to small individual investors. A closer look at the structure of the privatization process suggests that the government is not in fact giving away rents. The government charged individuals for the right to submit a bid for shares, so that the number of bids rises (and the probability of winning a share) falls until investors are indifferent. In effect, the government was selling lottery tickets. Consistent with lotteries in Western countries, lottery tickets can become more attractive as the potential prize becomes larger, holding the expected prize constant. Therefore, if Chinese investors have the same taste for lotteries observed in other countries, then the government would gain revenue from increasing the size of the potential prize, and in the process lowering the equilibrium probability of winning this prize. The rate of return on winning bids in the Irish Sweepstakes, for example, is far more dramatic than the return of 948.6% observed in China!

Not all sales of shares go to small individual investors, however. Large holders of shares were given priority in buying IPO issues. The government was thereby able to price discriminate between large and small holders of domestic shares, as well as between domestic and foreign owners. Large owners are likely to have more attractive alternative investments, and may even be able to get around existing capital controls and invest abroad.[24] As a result, the optimal price charged to these large investors will be below that charged to small

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[23]For example, Su and Fleisher (1999) argue that better firms signal their quality by underpricing their shares by more, and then recouping this loss on later seasoned issues. Basu and Li (1994) suggest that this underpricing is a mechanism for bribing insiders, or at least sharing revenue with them. Mok and Hui (1998) find evidence from Chinese IPO prices supporting the forecast in Beatty and Ritter (1986) that uninformed outside investors (facing a winner's curse) will participate in the market only if they receive an additional risk premium. They also find that firms that announce new issues longer before the first day of market trading underprice by more: the mean lag until trading is extremely long by international standards. Datar and Mao (1998) hypothesize that the government is providing these subsidies in order to encourage the development of stock ownership.

[24]For example, by use of transfer pricing, existing firms can leave profits abroad, where they can be invested in foreign securities or in B shares.

investors. One way to implement such price discrimination is to give large investors priority in IPO purchases, in proportion to their holdings of A shares.

<p style="text-align: center">Implications for controls over the nonstate sector</p>

So far, we have assumed that the government has no control over investments in the nonstate sector. The government may have many indirect means of affecting these investments, however. For example, it can raise σ_N^2 by making trade in nonstate shares more difficult, reducing diversification. It can also reduce $\mathrm{E}\tilde{\theta}_N$ by making it difficult for nonstate firms to gain access to bank loans, land, electricity, and other inputs controlled by the government. In some cases, it may be able to restrict explicitly the amount of nonstate investment that occurs, in the limit banning nonstate activity entirely as it did prior to the reforms.

If $\lambda = 0$, the model implies that the government would want to ban all nonstate investments — it can then simply seize the wealth of domestic residents. As λ increases, the extent of restrictions should ease. The most efficient restrictions would limit the amount of investment, without affecting the efficiency of the investment that does occur. Remaining wealth is then entirely "captive." However, if the government can only affect nonstate investments indirectly, by reducing the expected return or raising the risk of nonstate investments, these interventions would still be used unless λ is large enough.

To see this, note from (17) that these policy changes reduce the optimal domestic interest rate, so raise the implicit tax rate on domestic individuals. From (24) we also see that these policies increase the optimal number of state firms sold to domestic investors as long as $\boldsymbol{\beta}_{SN} > 0$ and $\mathrm{E}\tilde{\theta}_N > (1 + r^*)$. In addition, if $\partial \mathrm{Var}(\tilde{\theta}_s|\tilde{\theta}_N)/\partial \sigma_N = 0$, these policies raise the optimal share issuance for all listed firms in the domestic market, further enlarging the tax base. These policies then raise implicit tax rates and enlarge the tax base by making the non-taxed investment alternatives less attractive to domestic investors. Due to market segmentation, these policies have no impact on foreign investors. Individuals obviously lose both directly from the restrictions on nonstate activity and indirectly from the resulting changes in implicit tax rates. To the extent that the government cares about domestic individuals' welfare ($\lambda > 0$), it would set these policies optimally to balance the marginal gains in added tax revenue against the marginal excess burden borne by domestic individuals. If $\lambda \alpha_h = 1$, however, the government simply wants to maximize efficiency, so would impose no restrictions on nonstate activity.

On June 4, 1999, the government relaxed one of these restrictions on nonstate firms, and now allows them to issue shares to foreign investors. As a result, foreign investors can now invest in China without the government receiving the implicit (and explicit) taxes it

would have collected through equivalent investments in state-owned firms. However, the new foreign investment should drive down the rate of return on nonstate shares, making the outside options available to domestic investors even less attractive than before, thereby allowing the government to collect more revenue from domestic investors. Apparently, the government decided that this latter effect now dominates.

<center>*Implications for capital controls*</center>

So far, we have also assumed that Chinese residents are not allowed to invest abroad in either foreign bonds or foreign equity. Consider the impact on the government's objective function if domestic residents were allowed to invest a unit of wealth in foreign bonds. This investment would replace a unit of investment in domestic bonds, and leave unaffected the amount invested in equity in either nonstate or state firms, given constant absolute risk aversion. The resulting gain in social welfare arising from the increase in individual utility would equal $\lambda \alpha_W (r^* - r)$, while the loss in government revenue would equal $(r^* - r)$. As long as $1 > \lambda \alpha_W$, so that the government prefers to transfer revenue from individuals to itself, it will try to prevent domestic residents from purchasing foreign bonds.

The case for banning purchases of foreign equity is less clear. While individuals gain from the expanded investment opportunities, government revenue falls due to the "capital flight." If $\lambda = 0$, so that the government is only concerned about maximizing government revenue, then it would clearly choose to ban such investments abroad. In contrast, if $\lambda \alpha_W = 1$, so that the government cares only about efficiency, then it would want to give domestic residents the opportunity to diversify their portfolios by investing abroad. As λ increases, restrictions on investments in foreign shares should gradually ease.

<center>*Implications of exchange rate risk*</center>

Our model also assumes that the real exchange rate between domestic and foreign currencies is fixed and that the Chinese government pays no risk premium for international borrowing. How do our results change when exchange and sovereign risks are taken into account?

Because of capital controls and market segmentation, domestic individuals' portfolio choice decisions will not be affected by these risks. The demand functions for domestic equity and government bonds derived in Section 3.1 remain valid.

Foreign investors, however, now face exchange rate risk from owning Chinese shares. Consequently, foreign investors in firm s in China earn a random real return per-share of $\tilde{\theta}_s^e$, denominated in foreign currency, where the difference between $\tilde{\theta}_s^e$ and $\tilde{\theta}_s$ is the random

<center>20</center>

appreciation of the yuan relative to the dollar during the period. Exchange rate risk increases the variance of Chinese stocks for foreign investors, given the presumption that poor firm performance is associated with a depreciation of the currency. From (10), we find that exchange rate risk lowers the maximum price that foreigners are willing to pay for Chinese equity to the extent that $\text{Cov}(\tilde{\boldsymbol{\theta}}_S^e - \tilde{\boldsymbol{\theta}}_S, \tilde{\theta}^*) > 0$, and makes foreign demand more inelastic since $\text{Var}(\tilde{\boldsymbol{\theta}}_S^e - \tilde{\boldsymbol{\theta}}_S | \tilde{\theta}^*) > 0$. As a result, both the optimal price and the optimal foreign holdings of Chinese equity fall due to exchange rate risk.

Exchange rate risk also affects the cost to the Chinese government of borrowing abroad. Given that its debt has been denominated in the foreign currency, the size of the repayment in renminbi the government needs to make is now random. If this random repayment is denoted by $\tilde{r}^*$, then the net cost of foreign debt now equals $\text{E}\tilde{r}^* - h_G \text{Cov}(\tilde{r}^*, \tilde{W}_G)$. If the exchange rate tends to depreciate when the Chinese economy is doing badly, then the covariance is negative, raising the cost of foreign funds.

Sovereign risk, however, has an offsetting effect. To the extent that China defaults on its foreign debt when conditions are bad enough, then the covariance of the actual repayment with $\tilde{W}_G$ becomes less negative, and may even change sign. Effects of exchange rate risk and sovereign risk together on the cost of foreign borrowing are therefore ambiguous.

Policy in a multi-period setting

So far, we have used a two-period model to shed light on Chinese regulatory practices. Yet the theory should have something to say as well about how optimal policies change over time.

Assume to begin with that the demand curve for shares is a stable function over time of the number of shares outstanding, an assumption plausibly appropriate in the B-shares but not the A-shares market. For simplicity, assume that the government in any period t maximizes the discounted present value of its revenue from new share issues, minus the costs of the real capital underlying these share issues, from that date forward. In particular, due to an inability to precommit to these policies, it must ignore any effects of current policy choices on the amount shareholders were willing to pay for shares in earlier periods.

Clearly, some new shares will be issued after period t, as long as the market price is above the cost of the underlying real capital. If not, the discounted present value of revenue from date $t + 1$ forward is zero. Yet any small positive deviation from this policy collects positive revenue, so would be preferred by a government that cannot precommit. If the demand curve is stable, then these new issues will lower the market clearing prices steadily over time.

If the demand curve for shares shifts out over time, as must be true in China due to rapidly increasing incomes, then this simple argument is not sufficient. In particular, without new share issues prices of existing shares would rise; with new share issues it is not immediately clear what trend to expect in share prices.

Consider, for example, a setting in which the market clearing price for A shares at any date t, which we denote by $\mathbf{P}_A^t$, depends on the current number of shares outstanding, and expectations for future new issues. Let $\mathbf{K}_A^t$ measure the quantity of A-shares newly issued by the government in any period t, and let the total shares outstanding in period t equal $\mathbf{K}_A^{Tt} \equiv \sum_1^t \mathbf{K}_A^t$. We then have a demand curve in each period equal to $\mathbf{P}_A^t(\mathbf{K}_A^{Tt})$, where we assume that future expectations are unaffected by when currently traded shares were issued in the past.

In each period t, assume that the government maximizes the present value of current and future net revenue from new share issues,[25] which equals $\sum_{s \geq t} d^{s-t}(\mathbf{P}_A'^s - \iota_S)\mathbf{K}_A^s$, where d is the appropriate discount rate. Differentiating this objective with respect to $\mathbf{K}_A^t$, we find

$$\mathbf{P}_A^t = \iota_S - \sum_{s \geq t} d^{s-t} \frac{\partial \mathbf{P}_A'^s}{\partial \mathbf{K}_A^t} \mathbf{K}_A^s \tag{26}$$

If we derive the equivalent first-order condition for $\mathbf{K}_A^{t+1}$, weight this equation by d, subtract it from equation (26), and substitute for $\mathbf{P}_A^{t+1}$ from the first-order condition for $\mathbf{K}_A^{t+1}$, we find

$$\mathbf{P}_A^t - \mathbf{P}_A^{t+1} = (1 - d) \sum_{s \geq t+1} d^{s-t-1} \frac{\partial \mathbf{P}_A'^s}{\partial \mathbf{K}_A^{t+1}} \mathbf{K}_A^s - \frac{\partial \mathbf{P}_A'^t}{\partial \mathbf{K}_A^t} \mathbf{K}_A^t \tag{27}$$

The right-hand side of this equation is the different between a weighted average of the future terms $(\partial \mathbf{P}_A'^s / \partial \mathbf{K}_A^{t+1})\mathbf{K}_A^s$ and the value of the equivalent term in period t. The direction of the trend in share prices depends on which term is larger.

The absolute value of the derivative $\partial \mathbf{P}_A'^s / \partial \mathbf{K}_A^{t+1}$ will inevitably decline over time. To begin with, this term should be proportional to h, the coefficient of absolute risk aversion. If investors have constant relative risk aversion, then h will be inversely proportional to wealth. If this increasing wealth is the only reason for changes in the slope of the demand curve, then the right-hand side of equation (27) will be positive unless the size of new issues grows even more quickly than wealth over time.

In a mature stock market, the number of new shares issues should be roughly propor-

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[25]For simplicity, we ignore here the effects of new share issues on government revenue from financial repression in the banking sector. In general, new issues of A-shares can lower revenue from bank deposits, an effect captured by the third term on the left-hand side of equation (18). Therefore, the optimal amount of new issues will be lower in a model in which this spillover is taken into account.

tional to the size of the economy, so would be proportional to wealth. If the number of new share issues were also proportional to wealth in China during this time period, then the two terms on the right-hand side of equation (27) precisely offset each other, and prices would be stable. Since the stock market is new, however, new share issues need to be larger intially as the market is first being established. If the rate of new issues grows more quickly than wealth during an extended start up period, as investors learn about and respond to the possibility of buying stocks, then equation (27) suggests that prices should be growing during this period. However, this surge of new share issues must be temporary, since any such portfolio shifting (out of nonstate firms and bank deposits into equity) is inherently limited. As the date becomes nearer when the rate of new issues falls back to the fraction of wealth that can be sustained, equation (27) suggests that prices will start to fall to a new lower level.

Figure 1 reports the pattern over time of the ratio of A-share to B-share prices. Given the forecast that B-share prices should fall over time and that A-share prices would plausibly be stable or growing, it is not surprising to find that the price ratio has generally been moving upwards during this period. In fact, we know from news accounts that the drop in the market during the first six months of 1994 occured in response to reports that the government was seriously considering merging the A-share and B-share markets, which if enacted would push this price ratio by construction to 1. The government then announced in July, 1994 that this merger would not occur, and prices quickly rebounded to their previous level and continued to grow.

4 Discussion

If the types of restrictions on the financial market observed in China are consistent with the government maximizing some measure of social welfare, why are many of these restrictions so unusual? One explanation implicitly given above is that the Chinese government may put an unusually small weight on the welfare of domestic residents, so be willing to impose larger efficiency costs at the margin, than other governments, in order to raise an additional unit of government revenue. Probably a more important explanation, however, is that these restrictions take a different form in other countries.

In particular, many of the restrictions within the model would be perfect substitutes for standard types of tax policies. Consider, for example, the impact of imposing a tax on interest income from bonds at rate t, so that $r^*(1 - t) = r$. With this tax in place, the government can issue domestic bonds with an interest rate equal to the international

rate, r^*, and still maintain the same allocation described above. If the tax can be imposed on purchases of foreign bonds as well, then there would be no need to prevent domestic residents from buying foreign bonds.

During the period January 1991 to October 1998, the average nominal interest rate in China on one-year savings deposits was 8.6%. In contrast, the average cost of borrowing on the Euro market,[26] taking into account the ex post depreciation of the currency during this period, was 11.7%. The tax rate consistent with this spread equals 26%, which is very much within the range of tax rates on interest income observed elsewhere.

Similarly, consider the implications of imposing an income tax at rate τ_s on the earnings of state firm s. If $1 - \tau_s = 1/P_{As}$, then the government can maintain the desired allocation while eliminating all restrictions on new share issues, so that the market clearing price of new shares simply equals the opportunity cost of the underlying capital. To see this, note first that equation (5) remains satisfied at the previous allocation, except that each individual will now need to purchase $K_{Asi}/(1-\tau_s)$ shares in order to replicate the amount of risk borne in the optimal allocation found above. The government, however, now bears the added risk from the random tax revenue $\tau_s \tilde{\theta}_s K_{As}$. If K_G falls by $\tau_s K_{As}/(1 - \tau_s)$ to compensate, so that the government bears the same risk as before, then it is straight-forward to check that government revenue, as described in equation (15), is entirely unchanged by this shift from regulations to taxes. The previously optimal allocation remains feasible, and is still optimal.

In the model, when the optimal P_{As} varies by firm, so does the equivalent optimal tax rate τ_s. In particular, as can be seen in equation (20), given equation (7), the government should charge a lower price for shares (or impose a lower tax rate) on firms whose returns have a higher covariance with the return from the nonstate sector. For these firms, given that nonstate firms are a closer substitute, taxes create a larger behavioral response and so a larger excess burden at the margin.[27] For example, in most countries the main untaxed sector analogous to the nonstate sector is owner-occupied housing. Our results imply that the effective tax rate on firms providing rental housing should be lower than that on other types of firms. Just as $P_{As} > 1$ is equivalent to a tax on equity owned by domestic residents, $P_{Bs} > 1$ is equivalent to imposing a tax at some rate τ_{fs} on the profits accruing to investors in B-shares, where $1 - \tau_{fs} = 1/P_{fs}$. Observed data on the relative sizes of $\mathbf{P}_A$ and $\mathbf{P}_B$ then imply that the implicit tax rate on Chinese investors is much above any tax rate on foreign investors.

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[26] Here, we used the one-year Euro dollar middle rate.

[27] See Piggott and Whalley (1996) for a similar argument, dealing with the taxation of substitutes for home production.

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Without knowing the replacement cost of the underlying assets, we cannot solve directly for the two implicit tax rates, simply given past observations on share prices. What can be inferred, though, given the price ratio? According to Figure 1, this price ratio averaged 2.44 prior to the Asian crisis. At the start of the Asian crisis, prices in the B market fell dramatically. Plausibly, the price of B-shares fell below the replacement cost of the underlying assets. Consistent with this interpretation, as of October 15, 1999 the Chinese government allowed state firms to repurchase their shares on the foreign exchanges.[28]

To calculate the tax rates implicit in the observed price ratios we therefore focus on the period prior to July 1997, when the price ratio averaged 2.44. Even during this period, our presumption is that China had little market power in the B-shares market, so that the price for B-shares was not much above the replacement cost of the underlying assets. If we assume that the implicit tax rate in the B shares market is between 5% and 15%, then we infer that the implicit tax rate on A shares is between 61% and 65%. This is in addition to any corporate income tax that was imposed on these firms.[29] These tax rates, while high, are not out of line with tax rates seen elsewhere. For example in Sweden during the 1980's, the top personal tax rate on dividend income was around 80%, in addition to a corporate tax rate averaging around 55%. The Chinese tax rates are not even that different from top tax rates in the United States prior to the 1980's, when the top corporate tax rate was 48%, while the top personal tax rate on dividends was 70%.[30] Foreign owned firms still owed U.S. corporate income taxes, but were then subject simply to a low withholding tax rate on dividends. This rate varied by country, based on bilateral tax treaties, but was typically in the range of 5% to 15%,[31] the range of rates we have assumed prevailed in China.

While consistent with the top tax rates elsewhere, the implicit taxes in China apply to all domestic investors. Such a high *average* tax rate is very unusual. Capital controls may provide at least a partial explanation for this high average tax rate. China bans investments abroad by domestic residents. A number of developed countries have also imposed analogous restrictions on domestic residents, hindering if not banning their investments abroad. Gordon and Jun (1993), provide evidence that taxes on the dividend income received by domestic residents tend to be very high in countries where such controls are in place, and

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[28] While there were a few issues of B-shares during 1998-9, the rate of new issues was down dramatically compared with prior years.

[29] As of 1993, the corporate tax rate was 33%, dropping from its previous value of 55% for domestic firms. The evasion rate on the corporate income tax appears to be very high, however. Indicating the difficulties of tax enforcement, the State Tax Bureau reports that since 1993 hundreds of tax inspectors have been beaten, and twenty have lost their lives.

[30] Capital gains income, however, faced lower effective tax rates in the U.S.

[31] See Hines and Willard (1992) for further information.

that they drop dramatically when these controls are removed. For example, Australia, France, Italy, Japan, and Sweden all had some form of capital controls during the 1980's, all these countries have since eliminated these controls, and in each case tax rates fell shortly thereafter.

Even if the Chinese use of a higher tax rate on domestic than on foreign investors is not uncommon, their use of regulations rather than tax policy to raise revenue is very unusual. Why? The administrative costs in China of raising revenue from shareholders is almost surely much lower when regulations rather than taxes are used — monitoring the amount of new share issues is much easier than monitoring financial profits period by period.

Regulations likely have administrative advantages over taxes in other countries as well. Why is China so unusual in its reliance on regulatory policies? Part of the answer is that it is not so unusual. Capital controls, for example, have been used by a number of countries in recent years. Direct controls over interest rates are also not unique to China. Regulation Q in the U.S. during the 1960's and 1970's, under which the interest rates paid on bank deposits were capped, is one example. Japanese regulations funneling household savings largely to postal accounts, paying very low interest rates, is another. Other countries may also have forms of regulations qua indirect taxes that are not observed in China. For example, government ownership and controls over land usage in Hong Kong have succeeded in creating very high property values, generating substantial government revenue.

What is very unusual are the government controls over listing of new equity in the stock market. Rationing of new share issues is equivalent to corporate income taxes, however, only when the government owns *all* the firm's shares when the policy is decided on. Otherwise, existing owners receive a capital gain when restrictions on new share issues are employed. In contrast, they would suffer a capital loss if new taxes were imposed instead.[32] As a result, the more shares that are owned privately, the more attractive taxes will appear relative to regulations.[33] During the period we focus on, China was in virtually the unique position of deciding how to raise revenue from the *first* issues of corporate equity. In the future, it will be under pressure to shift to taxes rather than regulations to raise revenue.

In summary, the model in this paper suggests that the types of restrictions that China has imposed on its financial market, leading to segmented markets with much higher prices for shares owned by domestic than by foreign investors, are consistent with its maximizing

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[32]The capital gain with regulations comes at the expense of investors who hope to be buying shares in the future, while the capital loss with taxes reflects the added tax revenue received from taxing existing as well as new investments.

[33]This reflects, however, a time inconsistency in optimal policies, since taxes and regulations are equivalent if fully anticipated.

a standard type of social welfare function. These regulations are equivalent to imposing taxes on firm income, and imply a pattern of relative tax rates that is broadly consistent with those observed in many other countries. However, the use of regulations rather than taxes is more unusual. At least the restrictions on listing of shares in the stock market are likely to be a temporary phenomenon.

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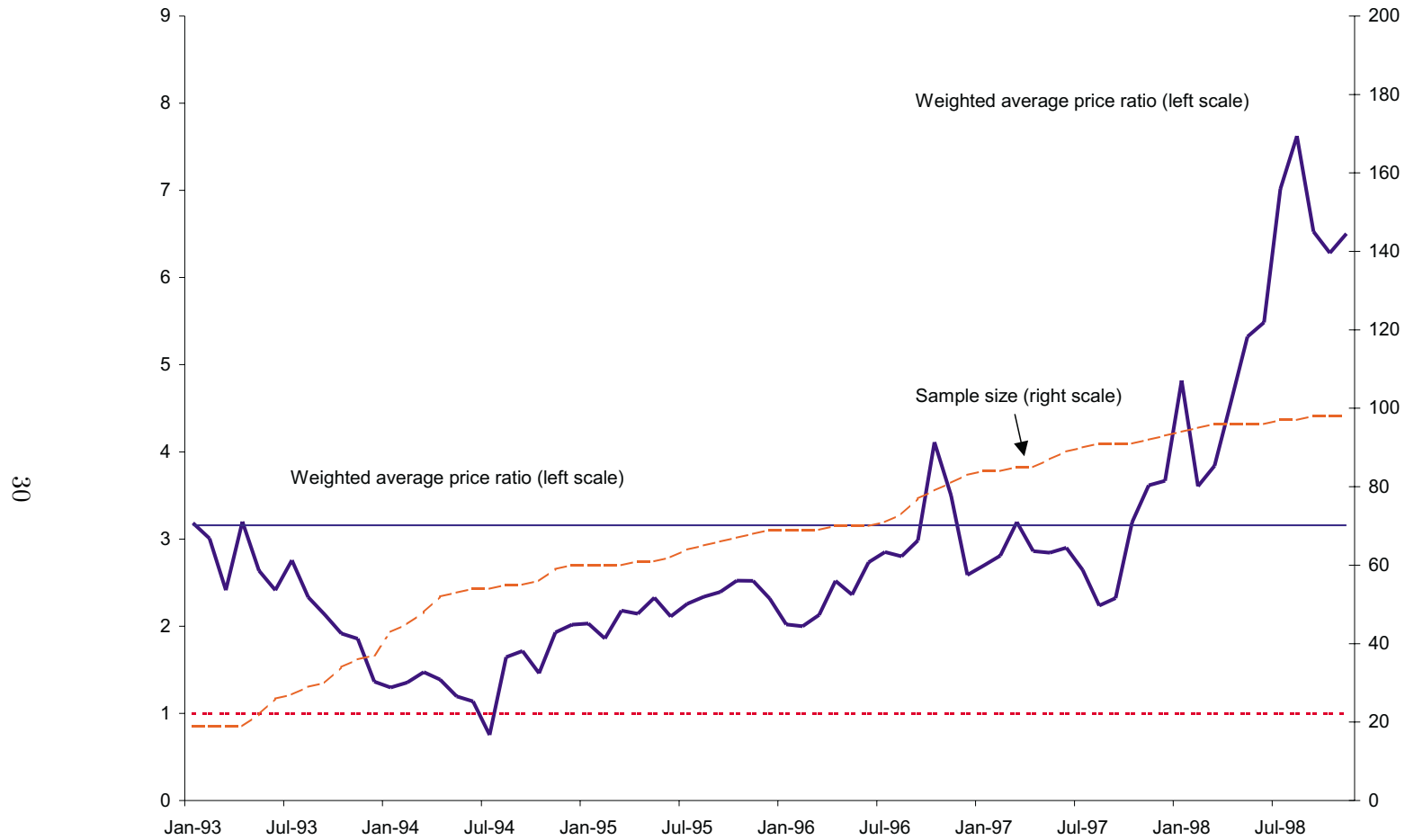
Figure 1: Weighted average premium of A-shares prices over the corresponding B-shares prices. Market value of tradeable shares in each firm was used as the weighting variable. The maximum sample contains 98 dual-listed firms. The number of dual-listed firms grew from 19 in January 1993 to 98 in November 1998. Data source: Datastream and China Securities Regulatory Commission.
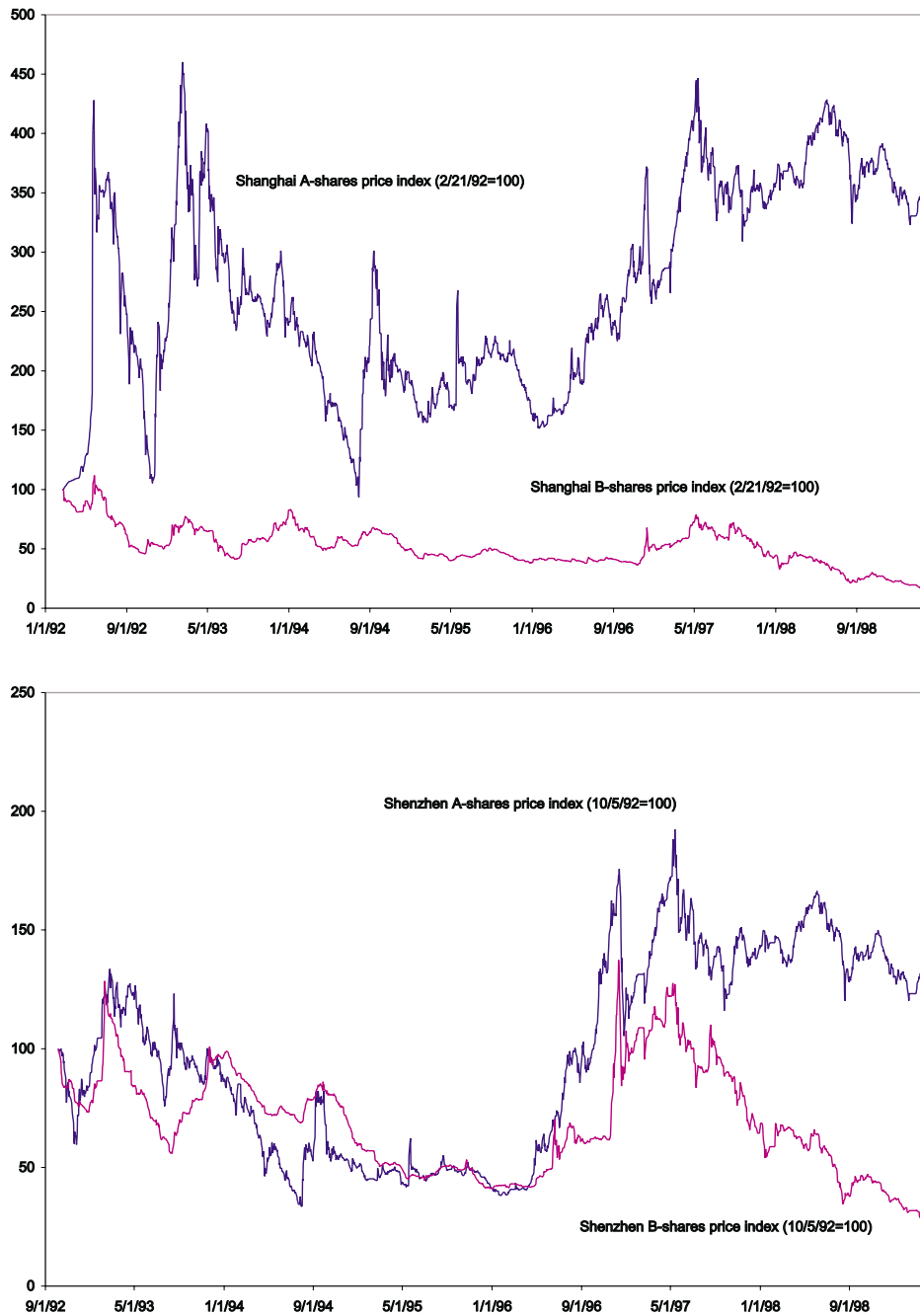
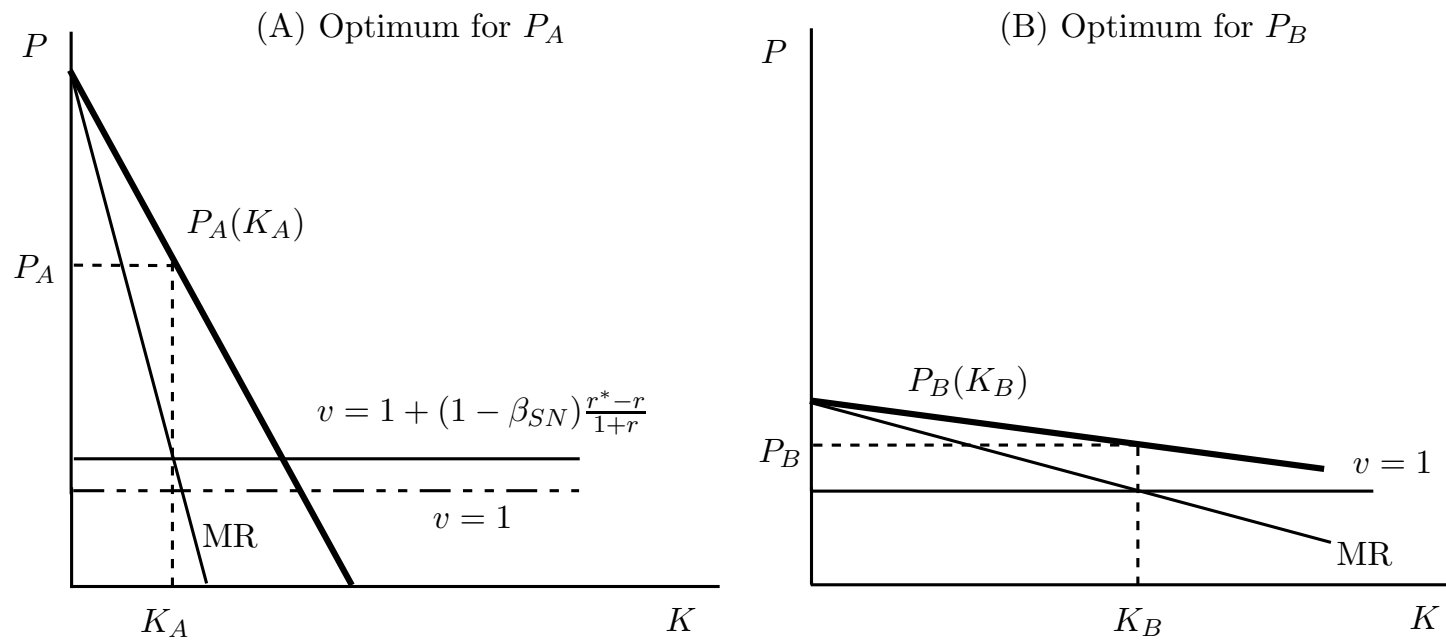Figure 2: A-shares and B-shares price indices (daily) in SHSE and SZSE. Source: Datastream.

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Figure 3: Stock market equilibrium