

The Effects of Capital Controls on International Capital Flows in the Presence of Asymmetric Information

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ABSTRACT

This paper examines the effects of capital controls on the volume and composition of international capital flows in the presence of asymmetric information. In the two-period, small open economy model, stochastic second-period output depends on the level of first-period investment, which cannot be verified by international investors. Domestic agents obtain external funding by borrowing on international capital markets and by selling equity to international investors. The paper investigates the effects of various capital controls on the debt-equity choice, domestic investment, and welfare. Controls on capital inflows are shown to shift the composition of flows from fixed-income instruments towards equity and to reduce the overall volume of inflows.

JEL classification: F21; F41; G15

Keywords: International capital flows; debt and equity; capital controls

1. Introduction

In the aftermath of recent financial crises, significant attention has focused on the merits of imposing capital controls to limit the size and volatility of financial flows in developing economies. Of particular concern is the possibility that large capital inflows may be subject to sudden reversals, leading to large capital outflows and increasing the risk of financial crisis. Certain types of flows may be more prone to capital flight than others. In particular, short-term debt is typically considered to be less stable than longer-term debt and equity flows. Moreover, the risk of sudden reversals in investor sentiment is likely to be particularly acute for developing economies where information asymmetries are often severe.¹

This paper analyzes the effects of capital controls on the volume and composition of international capital flows in the presence of asymmetric information. Focusing on the simultaneous use of debt and equity financing, the paper examines the impact of barriers to capital flows on the form of international financing and on the level of investment undertaken by domestic firms. The paper is motivated in part by capital controls imposed by a number of countries in the 1990s to manage increasingly large and volatile capital inflows. Brazil (1993-97), Chile (1991-98), Colombia (1993-98), Malaysia (1994), and Thailand (1995-97) imposed capital controls with the expressed goal of limiting short-term inflows and changing the composition of flows towards longer-term equity holdings. Controls on capital inflows may be useful in limiting capital flight or preventing currency crises by restricting the inflow of short-term, speculative capital, altering the maturity composition towards longer term, less volatile

¹ Obstfeld and Rogoff (1996, p. 353) note that developing economies may face more stringent asymmetric information problems internationally due to limited access to a strong legal system. Also see Gertler and Rogoff (1990) on this point.

flows, and reducing the overall volume of capital inflows.² Conversely, by limiting capital inflows, controls may hinder the ability of developing economies to attract financing for productive domestic investments.

Recent empirical studies indicate that capital controls alter the composition of capital flows to developing countries, but do not necessarily impact the volume of flows. Rodrik and Velasco (1999) and Edwards (1999) find that capital controls can influence the maturity structure of debt flows but have little impact on their volume. Including foreign direct investment (FDI) and portfolio equity in their measure of total capital flows, DeGregorio, et al. (2000) find a compositional shift from short-term flows to long-term flows without a decline in total capital inflows following imposition of an unremunerated reserve requirement (URR) in Chile. Using an index of capital-control intensity for fifteen emerging markets, Montiel and Reinhart (1999) find that capital account restrictions have little impact on the volume of capital inflows but tend to shift the composition of flows from a combination of short-term and portfolio flows towards FDI. Ariyoshi, et al. (2000) describe mixed results in that capital controls reduced net inflows to Malaysia and Thailand but not to Brazil, Chile, and Colombia. In all but Brazil, controls were partially successful in changing the composition towards longer-term inflows. Campion and Neumann (2004) utilize quarterly indices of both capital controls and capital account liberalization to examine the effect of each on the volume and composition of capital inflows. They generally find that controls lead to small declines in the volume of capital inflows along with compositional shifts away from debt inflows.

² See for example, Ariyoshi, et al. (2000), Edwards (1999), Montiel and Reinhart (1999), Rodrik and Velasco (1999), Eichengreen and Mussa (1998), Johnston and Tamirisa (1998), Rodrik (1998), and Stiglitz (1998).

Further theoretical modeling may clarify the conditions under which controls cause changes to both the volume and the composition of capital flows to a developing economy. While some theoretical work has examined the maturity structure of debt, none has focused specifically on the effects of capital controls on debt versus equity financing. The closest theoretical work is by Reinhart and Smith (2002), who show modest welfare benefits for a small economy that taxes debt inflows generated by a temporary decrease in the world real interest rate. Reinhart and Smith, however, ignore any impact of the tax on equity flows and thus do not address the compositional effects of controls.

This paper models the effects of controls on the tradeoffs between international equity and debt financing for domestic investment. The effects of capital controls on the composition and volume of international capital flows are captured by exploring various revenue-neutral tax treatments of international capital flows. The paper highlights the impact of capital controls in the presence of asymmetric information. While this approach ignores the macroeconomic effects of capital controls (including any benefits from limiting the volatility of capital inflows), it emphasizes the cost of such controls in changing the structure of financing across countries. To limit the scope of analysis, the paper focuses on controls governments have imposed to change the composition and volume of capital inflows.³

The model explores the impact of capital controls on the financing decisions of domestic firms and through this channel, on the composition of international capital flows. Agents living in a small open economy that cannot fund production domestically must obtain funds from

³ Other rationales include controls on capital outflows to channel domestic saving to domestic investment, controls to maintain pegged exchange rates, and controls to limit the avoidance of inflation taxes. See Eichengreen (2001) for a summary.

international capital markets. They can select a mixture of debt and equity for project financing. Agents invest in the first period to increase expected output in the second. A two-period model is sufficient to demonstrate the impact of capital controls in an environment with asymmetric information. The information asymmetry, in the form of moral hazard, arises from the dependence of stochastic second-period output on the choice of first-period investment, which cannot be verified by international financiers. The inclusion of asymmetric information ensures that the form of international financing is important for firm value, leading to an equilibrium with both debt and equity financing. The addition of costly bankruptcy then generates a unique debt-equity mix. Thus, the composition of international capital flows influences the level of domestic investment and domestic welfare. The paper then incorporates restrictions on capital inflows to examine the impact on the debt-equity composition of international flows. Capital controls are implemented as either differential taxes on debt-financed versus equity-financed transfers or as taxes on interest and equity payments made to international financiers.

An initial conclusion from this study is that closing off one avenue of international financing is detrimental to domestic welfare. Moreover, the model shows that capital controls can shift the composition of flows from fixed-income instruments towards equity. As the tax rate on debt increases, agents circumvent the controls by using more equity. These compositional effects are accompanied by declines in the volume of international capital flows and the level of domestic investment. Taxing equity at a higher rate than debt implies a smaller volume effect than do uniform taxes or tax rates weighted towards debt. More differentiated tax rates lead to larger compositional effects than do uniform taxes on debt and equity.

The paper proceeds as follows. Section 2 presents the model of asymmetric information with a debt-equity choice for project financing. Section 3 determines the optimal contract and

shows that this contract establishes a unique debt-equity ratio. Section 4 focuses on the effects of capital controls in the form of taxes on international capital flows. This section also analyzes subsidies to international capital flows as an alternative to capital controls. Section 5 summarizes the findings and discusses some extensions of the current model.

2. Model

Consider a small economy inhabited by many identical agents. Each agent has access to an investment project but lacks the necessary funds to finance the project. As a result, domestic agents must obtain funds from international capital markets, choosing a mixture of debt and equity for project financing. Each project produces a second-period output that is observable at zero cost. Moral hazard is generated by the dependence of the project's expected return on the agent's first-period investment, which cannot be verified by international financiers.

Since agents are *ex-ante* identical, the decisions of a representative agent are examined. The agent is assumed to have no personal capital in the first period and is endowed with w_2 units of the single domestic good in the second period. Denoting second-period consumption as c , the risk-neutral agent consumes only in the second period with utility

$$U(c)=c. \quad (1)$$

The domestic agent has access to a productive project, which provides risky output for consumption in the second period. Stochastic second-period output is

$$y = \begin{cases} \mathbf{q} & \text{with probability } \Pi(k) \\ 0 & \text{with probability } 1 - \Pi(k) \end{cases} \quad (2)$$

where k is the level of first-period investment, $\Pi(k)$ is the probability of a good outcome, \mathbf{q} , and $1 - \Pi(k)$ is the probability of a bad outcome in which output is zero. $\Pi(k)$ is a strictly concave

function with $\Pi'(k) > 0$ and $\Pi''(k) < 0$. Accordingly, the probability of a good outcome is increasing with the level of first-period investment. Also, $\Pi(0) = 0$ and $\Pi(\infty) = 1$. Output realizations are assumed to be independent across projects. The span of possible realizations (i.e., q or 0) does not depend on investment, so the level of investment undertaken is not revealed by the realization of output.

If the agent chooses not to invest in his particular project, his alternative is to save on international markets at the world riskless interest rate, r . The agent does not invest in the projects of other domestic agents as all projects are ex-ante identical, and the assumption of risk-neutrality eliminates any risk-sharing motive. The second-period output of the project is perfectly observed and can be verified at zero cost. Therefore, contracts can be written conditional on output. However, they cannot be written conditional on the level of investment, k , since the agent cannot credibly commit to a particular investment level in the first period.⁴

To invest k in the first period, the agent must raise funds on world capital markets. Imagine there are two types of international investors – one who supplies debt financing and one who supplies equity financing. The financiers are large financial intermediaries that achieve full diversification on international markets. Thus, they are modeled as risk neutral with an opportunity cost of capital equal to the world market interest rate, r . Modeling two separate types of international investors provides a method for calculating the division of capital inflows into equity flows and debt flows. The international investors are otherwise identical and must earn an expected return of r on any capital supplied, regardless of the form taken by these capital

⁴ Second-period output and the information asymmetry are identical to those in Gertler and Rogoff (1990) and Neumann (2003). Gertler and Rogoff model international debt flows to focus on the

flows. Denoting first-period equity-financed inflows as T_e and debt-financed inflows as T_b , the agent's budget constraint is:

$$T_e + T_b \geq k . \quad (3)$$

In exchange for a debt-financed transfer, T_b , the agent promises the international debt investor a state-contingent claim that pays Z^g in the event of positive output from the project, and Z^b in the event that project output is zero. The debt participation constraint is given by:

$$T_b(1+r) = \Pi(k)Z^g + [1 - \Pi(k)]Z^b . \quad (4)$$

In exchange for an equity-financed transfer, T_e , the agent sells a claim, $1-g$, to the value of the firm in the second period (the agent retains g of the firm, where $0 \leq g \leq 1$). For consistency with the debt contract, in which the maximum payment promised in the event of the bad outcome depends on the second-period endowment, the equity claim is assumed to be a claim to the value of the firm including the second-period endowment. Assuming that debt repayments take precedence over dividend disbursements to shareholders, the equity participation constraint is:

$$T_e(1+r) = \Pi(k)(1-g)(q - Z^g + w_2) + [1 - \Pi(k)](1-g)(w_2 - Z^b) . \quad (5)$$

The information asymmetry between the domestic agent and the international financiers is used to ensure that the composition of international capital flows influences firm value. While recent empirical literature on capital controls presumes that a fundamental difference arises between types of financial flows, others have shown the capital structure of firms to be irrelevant for firm value (Modigliani and Miller, 1958). Since the original statement of the Modigliani and Miller (MM) proposition, a large literature has developed to describe the circumstances under

inefficiency in investment induced by information asymmetries. Neumann models debt and equity individually and finds that costly monitoring contributes to alleviate the information asymmetry.

which the financing decision of firms is important and when either debt or equity financing may be preferred. One significant subset of this literature shows that information asymmetries can 'break' the MM proposition.⁵ Here, the international investors observe the agent's endowment and project output in the second period, the total amount of each type of transfer, and the contract terms, γ , Z^s , and Z^b . The agent's actions once he receives the transfers, however, are not verifiable by the international investors.⁶ One interpretation of the information asymmetry is that the agent is unable to commit credibly to a given level of investment in the first period. Rather than investing in his own project, he may (secretly) save funds on world capital markets.

To focus on the composition of international capital flows as well as the volume of flows, the model must ensure a unique equilibrium that includes both debt and equity financing. This is provided by a bankruptcy cost that generates an additional tradeoff between debt and equity. The agent suffers a loss, $V(Z^b)$, in the event of bankruptcy, which is defined as realization of the bad outcome and entails a zero project output. The debt contracts are designed such that the agent is always able to make his contracted payment in the event of the bad outcome (i.e., Z^b must be less than or equal to w_2). The bankruptcy loss may be interpreted as a cost of

⁵ Other approaches include differential taxes, product/input market interactions, and corporate control considerations. See Miller (1977), Lee and Zechner (1984), and Hodder and Senbet (1990) for tax considerations in the determination of capital structure. Harris and Raviv (1991) survey nontax-driven theories of capital structure based on agency costs and asymmetric information. Also see Hart and Holmstrom (1987), Hart (1995), Jensen and Meckling (1976), Leland and Pyle (1977), and Myers and Majluf (1984).

⁶ Contracts cannot be written contingent on observable variables because only contracts contingent on verifiable variables can be enforced by a court of law. See Grossman and Hart (1986).

restructuring the firm in the event of project failure or as a general cost to financial distress.⁷ Similar to the restructuring cost used by Chang (1992) or the costly transfer of control used by Zender (1991), the bankruptcy cost is assumed to be an increasing, strictly convex function of the face value of debt in the bad state, Z^b . This assumption implies that the bankruptcy cost is only incurred in the event of a poor project outcome.

Furthermore, assuming that equity financiers have limited liability, any costs of financial distress must be borne by the agent. The bankruptcy cost induces a tradeoff between the benefits of retaining more of the project and an increased cost of debt in the event of a bad outcome. Intuitively, the bankruptcy cost prompts higher investment, thus raising the probability of a good state. As a result, the agent wishes to retain a greater share of equity. In order to invest more, however, he requires a greater capital inflow, thus inducing a greater reliance on debt, which is more costly in the presence of the bankruptcy cost. The combination of the information asymmetry and costly debt generates a unique equilibrium that consists of both debt and equity.

The principal-agent problem can be solved by a two-step procedure. First, consider the agent who is offered a set of financing terms, γ , Z^s , Z^b , T_e , and T_b . Given these terms, the agent chooses the level of investment, k , to maximize his expected utility:

$$U = \Pi(k)\mathbf{g}(q - Z^s + w_2) + [1 - \Pi(k)](\mathbf{g}(w_2 - Z^b) - V(Z^b)) + (1 + r)(T_e + T_b - k), \quad (6)$$

where the first two terms are the expected net return on the firm and the third term is the return from (secretly) saving abroad. Given that $\Pi(k)$ is strictly concave, the objective function is strictly concave. Therefore a unique solution to this problem exists. Contracts are not conditioned on secret saving abroad because this variable is not verifiable. Since the

⁷ See, for example, Zender (1991), Chang (1992), and Santos (1997) for arguments that the inclusion of a restructuring cost generates a unique optimal contract with both debt and equity.

international investors know that the agent may (secretly) save abroad, however, they design contracts to induce him to invest appropriately in his own project.⁸ Thus, the first-order condition from (6) provides an incentive compatibility constraint for the agent:

$$\Pi'(k)(\mathbf{g}(\mathbf{q} - Z^s + Z^b) + V(Z^b)) \geq (1 + r). \quad (7)$$

The incentive compatibility constraint states that the agent's marginal gain from investing in his project must be at least as great as the marginal gain from secretly saving abroad. The agent's marginal benefit from investing depends not only on the marginal gain in expected output but also on the change in his expected obligation to lenders and shareholders (i.e., on the contracted debt and equity payments).

The second step in solving the principal-agent problem is to maximize the agent's utility over the set of implementable choices of investment. This is written as a maximization problem over the joint solution for the contract terms and the level of investment. The international investors infer the investment level chosen by the agent, given the contract terms. They then choose the contract terms to provide the incentives for a particular level of investment. The full maximization problem is:

$$\begin{aligned} \underset{\left\{ \begin{array}{l} k, Z^s, Z^b, \\ \mathbf{g}, T_e, T_b \end{array} \right\}}{\text{Max}} & \quad \Pi(k)\mathbf{g}(\mathbf{q} - Z^s + w_2) + [1 - \Pi(k)](\mathbf{g}(w_2 - Z^b) - V(Z^b)) \\ & \quad + (1 + r)(T_e + T_b - k) \end{aligned} \quad (8)$$

subject to (3), (4), (5), and (7), and the following two constraints:

⁸ The recursive solution method is similar to that in Gertler and Rogoff (1990), Atkeson (1991), and Obstfeld and Rogoff (1996). Understanding the agent's incentives, the international financiers do not offer full-information first-best debt and equity contracts because this would reduce their expected return below r . They instead offer optimal incentive-compatible contracts that earn the financiers an expected return of r given the agent's actions.

$$Z^g \geq Z^b \quad (9)$$

$$g(w_2 - Z^b) - V(Z^b) \geq 0. \quad (10)$$

Constraint (9) ensures that the payment to the debt investor in the good state is at least as high as the payment in the bad state. Constraint (10) ensures that the domestic agent has nonnegative utility in the bad state and subsumes the constraint that Z^b must be less than or equal to w_2 .

3. Optimal Contract

The preceding problem yields a set of necessary and sufficient conditions. The objective function is strictly concave and the constraints are convex, so that a unique solution to this problem exists (a proof is available from the author). The solution provides a level of investment that is optimal in that it solves the maximization problem subject to the incentive constraint and the participation constraints. The presence of the bankruptcy cost, in addition to asymmetric information, determines the levels of debt and equity. In the absence of the bankruptcy cost, the objective function is concave, but not strictly so. Therefore, without the bankruptcy cost, debt-equity contracts are still optimal, but are not unique, and the MM irrelevance proposition holds. When there is a positive bankruptcy cost, the optimal solution is a unique debt-equity combination. Thus, costly bankruptcy and asymmetric information ‘break’ the MM proposition.

The optimal debt-equity contract can be ascertained from the first-order conditions, along with the constraints and the complementary slackness conditions. The first-order conditions and the relevant constraints can be combined into a system of five equations and five unknowns. Given the complexity of the relationships between the joint use of debt and equity financing and the endogenous determination of the level of domestic investment, there is not a closed-form solution to this system of equations. Therefore, the model is solved numerically using specific

functional forms and standard parameter values. The numerical analysis employs a nonlinear problem solver in GAMS (General Algebraic Modeling System) and the solution is checked against the system of five equations and unknowns.⁹

Benchmark. Let the probability function be given by $\Pi(k) = 1 - \exp(-k)$, which satisfies the necessary conditions that it be strictly concave and increasing in k . Note that $\Pi(0) = 0$ and $\lim_{k \rightarrow \infty} \Pi(k) = 1$. Consider a strictly convex bankruptcy cost, $V(Z^b) = \frac{1}{2} B(Z^b)^2$, where $B \geq 0$ determines the severity of the bankruptcy cost. The following parameter values provide a benchmark: $q = 3$, $w_2 = 1$, $r = 0.05$, $B = 1$. The world real interest rate, r , is chosen to be consistent with an historic U.S. three-month money-market deposit rate. The value of the second-period endowment, w_2 , is normalized to one. Output in the event of the good state, q , is arbitrarily chosen to equal three. The bankruptcy term, B , is chosen as a benchmark value – the effects of changing B are considered below. For pure debt financing, γ is set to one. For pure equity financing, Z^s and Z^b are set to zero. For these chosen parameter values, Table 1 reports the benchmark optimal solution and the all-equity and all-debt solutions.

The benchmark optimal solution, which combines debt and equity financing, provides higher expected utility, U , than that restricted to pure equity or pure debt financing. This illustrates that the type of financing matters, and the availability of both forms of finance leads to higher utility for the domestic agent. The optimal contract consists of a risk-free debt contract and an equity contract. These terms alleviate the asymmetric information between the agent and

⁹ An additional appendix showing the system of equations is available from the author. Sensitivity analysis over a variety of parameterizations provides similar qualitative conclusions.

the international financiers. Therefore, the budget constraint binds in equilibrium and the domestic agent refrains from saving any funds (secretly) abroad.

The first-best solution cannot be characterized with this model because the inclusion of information asymmetries provides a tradeoff between equity and debt. Gertler and Rogoff (1990) and Neumann (2003) utilize similar models to compare the efficient level of investment to that with information asymmetries. Solving explicitly for the efficient level of investment, both papers show that investment in the presence of an information asymmetry is lower than the first-best level of investment, which is achieved in the absence of any information asymmetry. When the model includes the simultaneous use of debt and equity with costly bankruptcy, as in this paper, an explicit solution for the levels of investment, debt, and equity in the absence of information asymmetries cannot be established. The absence of information asymmetries is essentially a situation in which the agent credibly commits to invest a particular amount in his project in the first period. Contracts could then be written contingent on investment, which would be verifiable. Consequently, the agent would commit to invest all transferred funds domestically rather than saving funds on international markets. The form of the financing contracts would then remain indeterminate. Thus, in the absence of information asymmetries, the MM irrelevance proposition holds in that the value of the firm does not depend on the method of finance. Since the focus of this paper is on the tradeoffs between debt and equity financing, the presence of asymmetric information plays a central role, and ensures that the form of financing is important for firm value. In the sequential solution to the model, the contract terms are chosen to induce the agent to invest domestically. Thus, the debt-equity combination that prevails in equilibrium entails no (secret) saving abroad.

4. Capital Controls

Motivated by the fact that empirical analysis provides inconclusive evidence on the effects of capital controls, this section models controls on capital inflows to determine the impact of barriers on the structure of capital flows. The analysis focuses on the volume and compositional effects while noting the impact on domestic investment. Of considerable importance is the ability of markets to circumvent the controls. Thus, the analysis emphasizes where one type of flow substitutes for another. Consistent with other theoretical studies, capital controls are implemented as taxes. Observed restrictions provide motivation for the three types of controls modeled here and each is discussed with respect to its practical application. The restrictions considered consist of (i) outright prohibition of one form of financing, (ii) taxes applied directly to capital inflows as proportional taxes on equity- versus debt-financed inflows and, (iii) taxes applied indirectly to capital inflows by taxing interest or equity payments made to the international financiers after a project is completed. In the model, capital controls are levied explicitly on domestic agents, rather than on international investors. Levying taxes on international investors, who are risk-neutral agents that diversify on world markets, would imply an increase in the required before-tax expected return to international financiers. This would change the constraints in the following sections but lead to the same qualitative conclusions.

4.1 Prohibition of One Form of Financing

Consider first a quantity control in which the domestic government prohibits one method of financing. Brazil introduced controls in 1993 to reduce short-term capital inflows, with particularly severe restrictions on fixed-income securities, including outright prohibition of foreign-resident investment in domestic fixed-yield bonds. In the model, eliminating the fixed-

income securities market entails fixing the debt repayments, Z^s and Z^b , at zero. In 1998, Malaysia imposed a 12-month waiting period on the repatriation of portfolio capital held by nonresidents, limited the distribution of dividends, and effectively closed the over-the-counter offshore market in Malaysian equities (see Ariyoshi, et al., 2000, for details). In the model, eliminating the use of equity markets entails fixing equity sales, $I-\gamma$, at zero. Table 1 shows that eliminating the use of debt has the desired outcome of reducing capital inflows. Eliminating the use of equity, however, leads to slightly greater capital inflows as agents circumvent the regulations by switching to debt. Shutting down either the debt or equity market is detrimental to welfare. Expected utility is lower whenever one financing channel is eliminated, implying that the availability of both forms of finance is beneficial to the domestic economy.

4.2 Capital Controls on Debt- and Equity-Financed Transfers

Considerable interest has focused on taxes placed directly on transfers of capital from international markets. The modeled controls are similar to those used by Black (1974) and Stulz (1981), who model barriers to international investment as proportional taxes that either hinder net investment or make it costly to hold risky foreign securities. Likewise, Lee and Zechner (1984) establish a tax on foreign investment as a general representation for a broad range of barriers. In 1992, Colombia adopted a ten percent withholding tax on transfers. In 1993, Brazil imposed an entrance tax on certain foreign exchange transactions and foreign loans. Chile and Colombia both implemented a URR on capital inflows, implicitly raising the cost of capital. In each case, the government's goal was to limit short-term capital inflows and lengthen the maturity structure of flows.

In the model, taxes on capital inflows increase the cost of financing to the domestic agent. As a result, the equilibrium amount of funds the agent receives in the first period may change. Assuming a tax rate of τ_e on equity-financed transfers and a tax rate of τ_b on debt-financed transfers, the agent receives effective first-period transfers of $T_e(1-\tau_e)$ and $T_b(1-\tau_b)$. The agent's expected utility becomes:

$$U = \Pi(k)\mathbf{g}(\mathbf{q} - Z^s + w_2) + [1 - \Pi(k)](\mathbf{g}(w_2 - Z^b) - V(Z^b)) \\ + (1+r)(T_e(1-\mathbf{t}_e) + T_b(1-\mathbf{t}_b) - k). \quad (8')$$

The budget constraint, (3), is the only constraint changed by taxes on first-period transfers:

$$T_e(1-\mathbf{t}_e) + T_b(1-\mathbf{t}_b) \geq k. \quad (3')$$

For uniformity in evaluating the effects of various capital controls, suppose that the domestic government wishes to raise a specific amount of tax revenues that are rebated in a lump sum fashion to the domestic agent in the second period.¹⁰ Government revenue collected in the first period is (denoted with a subscript T for transfers):

$$G_T = \mathbf{t}_e T_e + \mathbf{t}_b T_b.$$

Assuming the government can save collected tax receipts at the world market interest rate, the value of the government revenue to be rebated in the second period is $G_T(1+r)$.

Table 2 reports the results of imposing a range of different tax rates on debt- and equity-financed transfers. Employing the specific functional forms and parameter values as in the

¹⁰ Tax collections are not rebated until the second period and thus cannot be used for investment purposes. When governments do use capital controls to manage government revenues, it is likely that controls that limit the cost of financing do so for favored agents such as the government itself or private sector individuals that the government favors (see Eichengreen, 2001, fn 18). An interesting extension would be to consider heterogeneous domestic agents where some receive tax rebates that can be used for investment purposes.

benchmark, the constrained maximization problem is solved using a nonlinear numerical optimization algorithm. The tax rates are chosen by allowing τ_b to range from 0.03 up to the rate that eliminates debt financing and then searching for τ_e to ensure government revenue in the second period is equal to 0.04. The tax rates are similar to the capital control rates imposed by countries in the 1990s.¹¹ Government revenue of 0.04 provides a benchmark value for revenue-neutral comparison across tax regimes and is approximately equal to 2–3% of expected output.¹² The no-tax benchmark is included for comparison. The first-best solution cannot be characterized using this model. Nor can an optimal tax regime since the two tax rates are chosen simultaneously.¹³ Table 2 indicates both volume and compositional impacts of the imposition of capital controls. The volume of capital inflows is given by T_b and T_e while the amount of investment is k . The table provides the debt-equity ratio (calculated as T_b/T_e) as an indicator of the compositional effects of capital controls. Expected utility, net of rebated revenues, is equal to U plus $G_T(1+r)$ (denoted $U+G$ in the table).

The values reported in Table 2 show that taxes have differential effects depending on the financing instrument to which they are applied. Consider the first tax entry, which taxes equity at a higher rate than debt. In this case, the composition of international financing switches towards debt in comparison to the no-tax benchmark. The level of domestic investment falls while total capital inflows, T_e+T_b , increase to finance the higher taxes. The amount of equity

¹¹ See Ariyoshi, et al. (2000) for specific rates.

¹² The amount of revenue collected is comparable to the amount that governments in developing countries collect from taxes on income, profits, and capital gains (relative to GDP).

¹³ Unlike Neumann (2003), the model in this paper does not permit analysis of an efficient solution, which solves the maximization problem in the absence of information asymmetries. Here, in the absence

retained by the domestic agent, γ , falls, leading to an increase in equity inflows. Promised debt payments rise, leading to higher debt inflows compared to the no-tax equilibrium.

The amount of effective capital inflows, calculated as after-tax inflows of $T_b(1-\tau_b)$ and $T_e(1-\tau_e)$, may provide additional insight into the effects of controls. When the equity tax rate is above the debt tax rate, total capital inflows increase to pay the higher taxes. However, effective equity inflows fall and effective debt inflows rise, leaving total effective inflows somewhat lower. The differential effects on total capital inflows versus after-tax inflows may provide one reason for the disparity among empirical studies with respect to volume effects of capital controls.

As the tax rate on debt-financed transfers rises relative to the tax rate on equity-financed transfers, the debt-equity ratio falls compared to the benchmark. The level of domestic investment declines further. The second and third tax entries in Table 2, with tax rates on equity that are close to the tax rates on debt, imply less reliance on debt relative to equity. The agent sells more of the domestic firm in exchange for increased equity-financed transfers in the first period. Debt inflows decline while equity inflows continue to increase, leading to an increase in total capital flows (although effective flows fall somewhat). When the tax rate on debt is sufficiently above that on equity (moving down Table 2), total capital inflows fall below those in the no-tax equilibrium. Notice that the market circumvents the controls to a large degree by switching from debt to equity financing. Therefore, in the model, capital controls designed to limit capital inflows must tax debt at a higher rate than equity, leading to a decline in overall capital flows as equity inflows only partially substitute for debt inflows. Total effective capital

of information asymmetries, the first-order conditions are not sufficient to solve for the level of domestic investment, or the efficient debt-equity combination.

inflows decline somewhat; the percentage change in k ranges from approximately one percent to nine percent when capital controls are placed on capital inflows. As the tax rate on debt rises high enough, debt financing is eventually eliminated entirely.

Because the model in this paper does not capture the potential benefits from the imposition of capital controls, increasing controls on debt flows relative to equity flows results in declining expected utility. These decreases in expected utility may be more than offset by the gains from capital controls (e.g., the potential for lower volatility of capital flows with greater reliance on equity versus debt). Therefore, utility comparisons across the different regimes may be misleading. The relevant comparison is the level of domestic investment and the composition and volume of capital flows across the different tax regimes.

The analysis provides evidence that controls on capital inflows can shift the composition of flows from fixed-income instruments towards equity. As the tax rate on debt increases, the agent circumvents the capital controls by using more equity. The volume of capital inflows also falls. The largest compositional effects are found with the tax rates that give the largest volume effects (i.e., those with the most differentiated tax rates).

The findings here are consistent with the stated goals of Brazilian controls (Ariyoshi, et al., 2000) to limit the volume of inflows and to change the composition of inflows away from fixed-income instruments towards stocks and fixed investments, and longer-term inflows. DeGregorio, et al. (2000) find a switch from debt to equity financing (in the form of FDI) while Campion and Neumann (2004) show that capital controls are associated with declining portfolio debt inflows relative to portfolio equity inflows. The results are consistent with those found by Montiel and Reinhart (1999) and generalized results from detailed studies on Chile (see Eichengreen, 2001) that capital controls have little impact on the overall volume of flows but can

change the composition of flows away from fixed-income securities towards equity instruments. The reduced volume of one type of capital inflow is partially compensated by increased volumes of other types of flows.

4.3 Capital Controls on Interest and Equity Payments

Now consider indirect taxes on capital inflows using a tax base of interest (debt) and capital-gain (equity) payments. Reinhart and Smith (2002) employ a similar tax measure by modeling barriers to debt inflows as taxes on net interest payments made to foreigners. During the Asian financial crisis, Malaysia adopted restrictions on the repatriation of profits from portfolio investments. Restrictions were initially instituted as a 12-month waiting period on the repatriation of profits (excluding FDI flows, interest, and dividends). They were subsequently converted to a system of exit levies imposed on the repatriation of principal or profits (excluding interest, dividend, or rental income) of capital investments, with the levies decreasing in the duration of the investment. This form of control is discussed as an implicit tax on capital inflows since the controls were applied ex-ante and therefore changed the expected return on investment and the ex-ante behavior of agents.

Suppose that the government institutes a tax in period one on repayments of capital in period two. Assume that the government credibly commits to these taxes so that there are no questions of time inconsistency. For each payment on debt (equity) made to the financier, the agent must also pay a tax at rate τ_b (τ_e). The effective amounts that the agent must pay on the debt contract become $Z^g(1+\tau_b)$ in the good state and $Z^b(1+\tau_b)$ in the bad state (The agent pays Z^e (Z^b) to the debt financier and $Z^g\tau_b$ ($Z^b\tau_b$) to the government). Taxes on equity payments imply that the agent pays a tax of $\tau_e(1-\gamma)$ times the net project return in each state. In the good state, the

agent pays $(1-\mathbf{g})(\mathbf{q} - Z^s(1+\mathbf{t}_b) + w_2)$ to the equity financier and $\mathbf{t}_e(1-\mathbf{g})(\mathbf{q} - Z^s(1+\mathbf{t}_b) + w_2)$ to the government. Similar equations apply for payments in the bad state. Expected utility is:

$$\begin{aligned} U = & \Pi(k)[(1+\mathbf{t}_e)\mathbf{g}(\mathbf{q} - Z^s(1+\mathbf{t}_b) + w_2) - \mathbf{t}_e(\mathbf{q} - Z^s(1+\mathbf{t}_b) + w_2)] \\ & + [1 - \Pi(k)][(1+\mathbf{t}_e)\mathbf{g}(w_2 - Z^b(1+\mathbf{t}_b)) - \mathbf{t}_e(w_2 - Z^b(1+\mathbf{t}_b)) - V(Z^b)] \\ & + (1+r)(T_e + T_b - k). \end{aligned} \quad (8'')$$

The equity participation constraint, (5), the incentive compatibility constraint, (7), and the nonnegativity constraint, (10), are changed as follows (the other constraints remain the same):

$$\begin{aligned} T_e(1+r) = & \Pi(k)(1-\mathbf{g})(\mathbf{q} - Z^s(1+\mathbf{t}_b) + w_2) \\ & + [1 - \Pi(k)](1-\mathbf{g})(w_2 - Z^b(1+\mathbf{t}_b)) \end{aligned} \quad (5'')$$

$$\begin{aligned} \Pi'(k)[(1+\mathbf{t}_e)\mathbf{g}(\mathbf{q} - (1+\mathbf{t}_b)(Z^s - Z^b)) \\ - \mathbf{t}_e(\mathbf{q} - (1+\mathbf{t}_b)(Z^s - Z^b)) + V(Z^b)] \geq (1+r) \end{aligned} \quad (7'')$$

$$(1+\mathbf{t}_e)\mathbf{g}(w_2 - Z^b(1+\mathbf{t}_b)) - \mathbf{t}_e(w_2 - Z^b(1+\mathbf{t}_b)) - V(Z^b) \geq 0. \quad (10'')$$

Table 3 reports the effects of imposing controls on capital inflows when the tax base is second-period interest or equity payments and expected government revenue is equal to 0.04 as in Table 2.¹⁴ Expected government revenue (denoted with a subscript P for payments) is calculated as:

$$\begin{aligned} G_p = & \Pi(k)[\mathbf{t}_b Z^s + \mathbf{t}_e(1-\mathbf{g})(\mathbf{q} - Z^s(1+\mathbf{t}_b) + w_2)] \\ & + [1 - \Pi(k)][\mathbf{t}_b Z^b + \mathbf{t}_e(1-\mathbf{g})(w_2 - Z^b(1+\mathbf{t}_b))]. \end{aligned}$$

The results are similar to those in Table 2. The first two tax entries, in which the equity tax rates are above the debt tax rates, indicate a shift towards debt financing, with only a slight decline in capital inflows and domestic investment. Debt inflows rise while equity inflows fall.

¹⁴ As before, a nonlinear numerical optimization algorithm is used to generate the endogenous responses. Qualitative results are not sensitive to the parameterization.

The agent retains a greater share of ownership in the project. As the tax rate on debt rises above that on equity (moving down Table 3), the necessary rate on equity to achieve the government revenue requirement initially falls and then rises. International capital flows decline, along with the level of domestic investment. As expected, equity inflows rise to compensate for declining debt inflows when interest payments are taxed more heavily than capital-gain payments. A larger impact on the composition of international capital flows results from higher tax rates on debt payments. The domestic agent relies more on equity financing, circumventing the capital controls to some degree. Larger tax differentials, with debt taxed more heavily than equity, also imply larger declines in total capital inflows. The third tax entry, with debt and equity taxed at approximately the same rate, suggests a decline in capital inflows of about three percent. By contrast, the final tax entry, with debt payments taxed much more than equity payments, suggests a decline of twelve percent in capital inflows. Consistent with the results in Reinhart and Smith (2002), the magnitude of the tax rate on debt must be large in order to reduce debt inflows.

Generally, capital controls on second-period payments show similar results to those on first-period payments. The expected utility levels are all lower than the level in the absence of taxes. Therefore, the capital controls impose a distortionary cost that is not recovered through the rebate of tax receipts. This distortion is bigger for more divergent tax rates. In both Tables 3 and 4, expected utility is highest when the tax rate on equity is set above that on debt or the tax rates on debt and equity are set close together. The first two tax entries in each table show results for tax rates where $\tau_e > \tau_b$. The first tax entry shows somewhat divergent tax rates, leading to limited decreases in domestic investment as the agent is able to circumvent the controls. While equity inflows due to first-period controls rise relative to the no-tax benchmark, effective inflows decline. Equity inflows due to second-period controls also decline. Debt-financed

inflows rise in both cases to compensate for these reduced equity inflows. The agent sells more equity claims to the international investor when controls are imposed in the first period compared to the second period. These increased equity sales are used to pay the higher equity taxes in the first period. In both cases, the debt-equity ratio rises, indicating a shift towards debt financing.

The responses as the tax rate on debt rises relative to that on equity are similar for both first- and second-period controls. Domestic investment falls further from the benchmark. The ownership share retained by the agent declines. Debt payments also decline. As τ_b increases above τ_e , debt inflows decline while equity inflows rise, with a commensurate decline in the debt-equity ratio.

In both Tables 2 and 3, the third tax entry depicts a tax regime that is approximately uniform, with $\tau_e < \tau_b$. In each case there is a reduction in the volume of capital inflows that is accompanied by a change in the composition towards equity flows. These volume and composition effects are achieved with little or no reduction in expected utility. Therefore if the government wishes to limit capital inflows while maintaining the highest expected utility, the two tax rates must be set close together. In this case, maintaining τ_b only slightly above τ_e may be the recommended course of action. By contrast, to achieve larger impacts on both the volume and composition of flows, Tables 2 and 3 show that it is necessary to impose more divergent tax rates, raising τ_b further above τ_e .

4.4 Subsidies to Capital Inflows

Finally, the model permits analysis of subsidies to capital inflows as an alternative to capital controls. In a theoretical study of the optimal tax treatment of FDI and portfolio debt and equity, Razin, et al. (1998) emphasize the efficiency of a non-uniform treatment of the different

modes of international capital flows. In the case of portfolio equity, they find that the efficient tax policy subsidizes foreign investment while taxing domestic corporate income. Likewise, efficiency arguments call for favorable tax treatment of foreign portfolio debt investment.

Subsidies are financed by an output tax, τ , in the second period. Assuming that this tax is levied on θ , the effective productivity parameter in the good state is $\theta(1-\tau)$. Expected government revenue collected from the output tax is $\tau\Pi(k)\theta$. Consider first an output tax with no other taxes or subsidies. To generate expected government revenue equal to 0.04, the output tax is 0.026. Subsidies on first-period transfers are then financed by this level of output tax. Expected government revenue is equated to the cost of the subsidies, implying that overall expected government revenue is equal to zero. Table 4 reports three subsidy combinations applied to debt- and equity-financed transfers where subsidies are modeled as negative tax rates applied to first-period transfers. For comparison purposes, Table 4 also reports the no-tax benchmark and the case of a pure output tax without subsidies. Subsidies to payments in the second period (not shown) provide similar qualitative conclusions.

Given the distortionary effects of the output tax used to finance subsidies, the level of expected utility from the subsidy outcome is less than the no-tax level. Consider the first two subsidy combinations in Table 4 – a uniform subsidy to both forms of capital inflows and a subsidy combination favoring debt. Both of these lead to higher equilibrium levels of investment than in the no-tax case. Debt financing increases while equity financing falls. As a result, the domestic agent retains more of his own equity. The third subsidy combination subsidizes equity flows more heavily than debt flows, leading to a lower equilibrium level of investment than in the absence of taxes. Both debt- and equity-financed transfers fall, although equity flows fall less than with the other two subsidy cases.

Generally, any of the subsidy combinations lead to a higher equilibrium debt-equity ratio, with more significant increases when debt is subsidized at a higher rate. Subsidizing equity inflows while taxing output in the good state does not shift the composition of international inflows towards equity flows. This result stems from the fact that subsidies are financed by an output tax only in the good state, lowering the benefits to the good state without raising the costs of the bad state. Thus, even though equity may be subsidized at a higher rate, there is still a compositional shift towards debt financing. On the volume side, any of the three subsidy combinations leads to lower equilibrium inflows of international capital, T_e+T_b , compared to the absence of taxes. Subsidizing equity at a higher rate leads to a larger decrease in total inflows.

While expected utility is lower with subsidies to international capital flows compared to the no-tax level, it is higher than that obtained from any of the tax regimes reported in Tables 2 and 3. Even when government revenue is rebated to the agent, the tax outcomes provide lower expected utility than the subsidy outcomes. Thus, to achieve a given change in a particular variable, subsidies may provide an alternative to taxes on capital inflows. For example, suppose that the domestic government wishes to increase the level of domestic investment, perhaps to take advantage of new technology available in the economy. An appropriate policy to achieve this goal would be to subsidize international debt flows at a higher rate than international equity flows. Suppose instead that the government wishes to decrease total capital inflows into the domestic economy. An alternative to the tax combinations considered previously is a subsidy to capital. Subsidizing equity at a higher rate than debt reduces the amount of capital inflows the most, albeit at a cost of a lower equilibrium level of domestic investment.

5. Summary

This paper attempts to resolve the ambiguity surrounding the impact of capital controls on international financial flows. In particular, it focuses on the impact of barriers to international capital flows on the composition and volume of capital flows to a small open economy. This paper improves our understanding of international capital flows by incorporating the consequences of asymmetric information into a small open economy model where external funds are required to support future domestic output. The paper develops a model of international capital flows that ensures a unique debt-equity combination in equilibrium. Using this model, and imposing barriers to capital flows as taxes on first-period transfers or second-period payments of interest or capital gains, the paper shows clear compositional and volume effects from such barriers.

While others have considered empirically the effects of capital controls on the composition and volume of international capital flows, there has been little theoretical work specifically focusing on the choice of financing. This paper provides a theoretical framework to determine the effects of capital controls on the international debt-equity choice, the volume of capital inflows, and the level of domestic investment. Previous theoretical modeling, with its concentration on debt flows and maturity structure, has ignored the compositional effects of capital controls. The composition of capital flows may be particularly important for developing economies subject to information asymmetries that heighten the risk of sudden capital outflows. As a result, capital controls may be useful in changing the composition of capital flows towards longer-term equity flows.

In the model, capital controls are shown to be effective at changing the composition of international capital flows. As a result, however, they also change the volume of international

flows and the level of domestic investment. Taxing equity at a higher rate than debt implies a smaller volume effect than do uniform taxes or tax rates weighted towards debt. Therefore, controls designed to limit capital inflows must tax debt at a higher rate than equity, leading to a decline in overall capital flows as equity inflows only partially substitute for debt inflows. Subsidies to capital are shown to be an alternative to the tax combinations considered. Subsidizing equity at a higher rate than debt reduces the amount of capital inflows the most, albeit at a cost of a lower equilibrium level of domestic investment.

One possible extension of the theoretical analysis would be to include explicit benefits to capital controls, such as the possibility that capital controls may limit volatility in capital inflows. The current paper does not model volatility because it focuses instead on determining an optimal debt-equity combination and characterizing the costs of capital controls. The theoretical work could also be extended to investigate finer divisions of international capital flows. Debt flows could be partitioned into short-term versus long-term flows while equity could be modeled as portfolio equity versus FDI. This may provide further insight into the role of capital controls in lengthening the maturity structure of international capital flows and tilting the composition towards FDI. A final extension would be to consider the tradeoffs between domestic and foreign financing as well as the choice between debt and equity financing, providing theoretical underpinnings for recent empirical work examining both choices (e.g., Schmukler and Vesperoni, 2000, and Domowitz, et al., 2000). This would also provide a model with which to examine the consequences of capital controls for development of financial markets at the international and domestic levels and the possible impact on debt versus equity financing.

Acknowledgements

I would like to thank Caroline Betts, Martin Boileau, JoAnne Feeney, Rebecca Hellerstein, Jill Holman, Keith Maskus, Anna Maria Mayda, Robert McNown, Nathalie Moyon, Pu Shen, Julie K. Smith, and Linghui Tang for their comments on earlier drafts. Any remaining errors are my own.

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Table 1 Benchmark Debt-Equity Contracts^a

	k	γ	Z^s	Z^b	T_b	T_e	U
Optimal	0.795	0.763	0.271	0.271	0.258	0.537	1.794
Pure Debt ($\gamma=1$)	0.813	1.0	1.178	0.447	0.813	0	1.772
Pure Equity ($Z^s=Z^b=0$)	0.703	0.707	0	0	0	0.703	1.776

^a Notes for Tables 1-4. k is the level of private domestic investment, γ is the amount of equity retained by the agent, Z^s and Z^b are payments on debt, T_b and T_e are debt and equity inflows, U indicates expected utility.

Table 2 Capital Controls on First-Period Transfers to Achieve $G_T(1+r)=0.04$

	k	γ	Z^s	Z^b	T_b^*	T_e^*	U	$U+G$	T_b/T_e^*	Δk^{**}
$\tau_e=0$ $\tau_b=0$	0.795	0.763	0.271	0.271	0.258	0.537	1.794	1.794	0.480	
$\tau_e=0.054$ $\tau_b=0.03$	0.787	0.755	0.292	0.292	0.278 (0.270)	0.547 (0.517)	1.749	1.789	0.508 (0.522)	-1.01%
$\tau_e=0.049$ $\tau_b=0.04$	0.775	0.749	0.261	0.261	0.249 (0.239)	0.564 (0.536)	1.749	1.789	0.441 (0.446)	-2.52%
$\tau_e=0.046$ $\tau_b=0.05$	0.765	0.743	0.233	0.233	0.222 (0.211)	0.580 (0.553)	1.748	1.788	0.383 (0.382)	-3.77%
$\tau_e=0.042$ $\tau_b=0.075$	0.741	0.729	0.168	0.168	0.160 (0.148)	0.619 (0.593)	1.745	1.785	0.258 (0.250)	-6.79%
$\tau_e=0.042$ $\tau_b=0.10$	0.720	0.717	0.106	0.106	0.101 (0.091)	0.656 (0.628)	1.741	1.781	0.154 (0.145)	-9.43%

* Effective inflows, calculated as $T_b(1-\tau_b)$ and $T_e(1-\tau_e)$, and the effective debt/equity ratio, calculated as $T_b(1-\tau_b)/T_e(1-\tau_e)$, are reported in parentheses.

** Δk is the percentage change in k from the no-controls benchmark to each tax combination.

Table 3 Capital Controls on Second-Period Payments to Achieve $G_p=0.04$

	k	γ	Z^s	Z^b	T_b	T_e	U	$U+G$	T_b/T_e	Δk^{**}
$\tau_e=0$ $\tau_b=0$	0.795	0.763	0.271	0.271	0.258	0.537	1.794	1.794	0.480	
$\tau_e=0.058$ $\tau_b=0.03$	0.793	0.772	0.300	0.300	0.285	0.508	1.750	1.790	0.561	-0.25%
$\tau_e=0.053$ $\tau_b=0.04$	0.783	0.766	0.272	0.272	0.259	0.524	1.750	1.790	0.494	-1.51%
$\tau_e=0.049$ $\tau_b=0.05$	0.773	0.760	0.246	0.246	0.234	0.539	1.750	1.790	0.434	-2.77%
$\tau_e=0.043$ $\tau_b=0.075$	0.751	0.747	0.185	0.185	0.177	0.575	1.748	1.788	0.308	-5.53%
$\tau_e=0.042$ $\tau_b=0.10$	0.732	0.736	0.132	0.132	0.126	0.606	1.744	1.784	0.208	-7.92%
$\tau_e=0.049$ $\tau_b=0.15$	0.699	0.718	0.039	0.039	0.037	0.662	1.735	1.775	0.056	-12.08%

** Δk is the percentage change in k from the no-controls benchmark to each tax combination.

Table 4 Subsidies to First-Period Transfers Financed by an Output Tax

	k	γ	Z^s	Z^b	T_b	T_e	U	G_T	T_b/T_e
$\tau=0$ $\tau_e=0$ $\tau_b=0$	0.795	0.763	0.271	0.271	0.258	0.537	1.794	0	0.480
$\tau=0.026$ $\tau_e=0$ $\tau_b=0$	0.770	0.764	0.266	0.266	0.254	0.517	1.744	0.04	0.491
$\tau=0.026$ $\tau_e=-0.054$ $\tau_b=-0.054$	0.800	0.784	0.299	0.299	0.285	0.474	1.792	0	0.601
$\tau=0.026$ $\tau_e=-0.04$ $\tau_b=-0.073$	0.826	0.798	0.362	0.362	0.345	0.438	1.792	0	0.788
$\tau=0.026$ $\tau_e=-0.061$ $\tau_b=-0.04$	0.783	0.775	0.257	0.257	0.245	0.499	1.792	0	0.491