Financial Frictions, Sudden Stops, and the External Capital Structure of Emerging Markets

Enrique Mendoza*
University of Maryland and NBER

Katherine A. Smith†
U.S. Naval Academy

May 2009
[Preliminary and Incomplete]

Abstract

This paper argues that credit frictions and asset trading costs significantly increase the probability of a Sudden Stop in the early stages of financial globalization, and that this in turn, significantly alters the long-run external capital structure of emerging market economies. Upon opening the capital account, domestic agents have an incentive to accumulate debt and sell domestic equity in order to share risk with the rest of the world. Due to a lower cost of capital, equity prices rise allowing agents to accumulate a relatively large amount of debt without being constrained in the near term. As domestic agents accumulate debt and sell equity to re-balance their portfolio, however, adjustment costs force equity prices to subsequently fall. With a lower value of equity, agents within the emerging economy face a greater risk of hitting their credit constraint, triggering a debt deflation crisis. In the long run, the probability of a Sudden Stop is smaller as agents accumulate pre-cautionary savings to avoid the Sudden Stop. However, the adjustment of the external capital structure is permanent. Calibrating the model to Mexico, we solve numerically for the transitional dynamics after financial globalization and show that the model can match the dynamics observed in the data.

JEL Codes:

Key Words: Sudden Stops, Emerging Markets Crisis, Financial Liberalization, Capital Controls

*Department of Economics, 589 McNair Road, Annapolis, MD 21402, USA. Email: Mendoza@econ.bsos.umd.edu.
†U.S. Naval Academy, USA. Email: ksmith@usna.edu.

1 Introduction

Financial globalization has impacted the external capital structures of emerging markets in a strikingly different manner than those of the major industrial countries. In 2004, roughly twenty years after many countries liberalized their capital accounts, the average emerging market economy has a large negative net equity position and a much smaller negative net debt position. In contrast, the major industrial countries are increasingly short debt and long equity. The divergence in the net foreign asset positions (NFAP) has been most severe during the last decade as net debt has turned positive and net equity grown progressively negative for many emerging markets. While the accumulation of reserves by many Asian economies is certainly a driving force in understanding the current external balances, examining the the structure of NFAPs suggests that the major reversal in positions was largely due to an adjustment in liabilities. Since the mid 1990s, emerging markets have taken on much greater equity liabilities and reduced substantially their debt liabilities.

While the external balances may look starkly different today, immediately following liberalization the evolution of the external capital structure for emerging markets followed that of the major industrial countries. According to the Chinn and Ito (2007) financial openness measure plotted in Figure 1, capital account liberalization for many emerging markets began in the late 1980s. During the first decade after liberalization, emerging market economies were on average short equity and to a much larger extent short debt (as seen in Figure 2). This follows fairly closely the major industrial countries external balances plotted in Figure 3. Until the 1990's both groups of countries showed a widening gap between net debt and net equity. [1]. The industrial countries have continued on this same course, giving rise to large positive net equity positions and large negative net debt positions. In the emerging markets, however, the trend reversed suddenly in the mid 1990s, as net equity became increasingly negative and net debt decreasingly negative, turning positive, on average, in 2003.

The shift in emerging markets post-liberalization external balances coincides with the onslaught of Sudden Stops. Sudden Stops can be characterized by sharp reversals in capital inflows, large

[1] Being relatively scarce in capital, the NFAP is negative for many emerging market countries.

declines in output, and steep collapses in real asset prices. [2] A common notion in the literature is that countries choose to buildup assets to self-insure against the risk of future Sudden Stops. The New Mercantilists studies by Aizenman and Lee (2007), Alfaro and Kanczuk (2006), Caballero and Panageas (2006), Choi et al. (2007), Jeanne and Ranciere (2006), and Jeanne (2007) examine key theoretical and empirical features of this idea. Durdu et al. (2008) conducts a quantitative assessment of the New Merchantilism. Examining emerging markets assets and liabilities in Figure 5, however, the rise in debt assets is clearly swamped by a much larger rise in equity liabilities and a fall in debt liabilities. While in 1986 equity liabilities contributed roughly 9% to emerging markets net foreign asset position today it is 30%. Likewise in 1980 debt liabilities were roughly 80%, today they have been cut in half to about 45%. The link between Sudden Stops and the changes in the external capital structure, therefore, seems driven instead by a liability re-balancing. Countries have re-balanced their external portfolios, increasing their equity liabilities and decreasing their debt liabilities, in response to an increased likelihood that they will experience a Sudden Stop.

This paper argues that recently liberalized emerging market economies are more susceptible to Sudden Stops and that this in turn causes the rapid re-balancing of their external liabilities. [3] Upon opening the capital account, agents in the emerging market have an incentive to accumulate debt and sell domestic equity in order to share risk with the rest of the world. Within the financial liberalization literature two stylized facts have been well documented. Equity prices tend to rise and debt to equity ratios increase post-liberalization. Using event study analysis both Bekaert and Harvey (2000) and Henry (2000) show that equity prices rise dramatically post-liberalization. Five years after an emerging market has liberalized, the cumulative excess return using liberalization

[2] While a Sudden Stop is defined by these characteristics, there is some heterogeneity across countries in terms of which macro aggregates were affected most. In the 1994 Mexican crisis, real equity prices in units of the CPI fell by 29 percent, the current account rose by 5.2 percentage points of GDP, industrial output fell nearly 10 percent and consumption declined by 6.5 percent. Argentina's 1995 "Tequila" crisis resulted in collapses in real equity prices and industrial output similar to Mexico's, a current account reversal of 4 percentage points of GDP, and a decline in consumption of 4 percent. The Korean and Russian crises stood out for their large current account reversals of 11 and 9.5 percentage points of GDP respectively, and for the widespread contagion across world financial markets. These Sudden Stops can occur even without a currency crisis such as Hong Kong (1997) and Argentina (1995).

[3] For the most part the financial liberalization literature has emphasized the economic impacts of liberalizing on growth and currency crisis but has done little to try and link Sudden Stops to capital account liberalization and the long run external balances. Previous work on the economic impacts of financial liberalization have mainly attempted to measure the impacts on economic growth Kraay (1998) as well as currency crisis. (Kaminsky and Reinhart (1999) Demirguc-Kunt and Detragiarche (1998) and Glick and Hutchinson (2001)).

dates from Bekaert and Harvey (2000) is 491 percent and 546 percent based on Henry (2000). While their estimates vary, both site declines in the cost of capital that lead to large increases in equity prices. Martell and Stulz (2003) confirms the rise in equity prices but finds that, like individual firm IPOs, the price subsequently falls, suggesting an equity price boom bust cycle post-liberalization. Empirically, Martell and Stulz (2003) show that equity markets in countries liberalizing outperform those of other countries by more than 50 percent in the first year, but underperform by more than 20 percent in the fifth year after liberalization.

In the setup proposed in this paper, the financial frictions are crucial for linking financial liberalization, the probability of Sudden Stops and the long run external capital structure. Post liberalization, equity prices increase dramatically as the cost of capital falls. Even in a model without investment, the cost of capital falls for two reasons. First, the world interest rate is now the relevant risk free rate and second the risk premium falls as the covariance between the world interest rate and the return on equity is lower than in a closed economy. To diversify their labor income, agents within the small open economy, prefer to sell domestic equity and purchase foreign bonds. Due to the rise in equity prices and the zero initial bond holdings, post-liberalization agents are far away from being credit constrained and that encourages emerging market agents to accumulate debt without much concern for hitting their credit limits. If portfolio adjustments are costly, as the domestic agents sell domestic equity to re-balance their portfolios, equity prices should fall, replicating Martell and Stulz (2003) boom-bust pattern in equity returns. With a lower value of equity, however, agents within the emerging market face a greater risk of hitting their credit limits, and the value of collateral assets drops. If they hit the limit, a Fisherian debt deflation crisis follows.

The increased likelihood of a debt deflation crisis has permanent impacts on an economy's external capital structure in that domestic agents are forced to sell off additional equity and reduce their debt positions. As a result the debt to equity ratio is significantly lower than an economy where credit frictions are not present and therefore a debt deflation crisis is not a threat. In addition, the magnitude of the trading costs greatly affect the equity price dynamics and in turn is likely to alter the long term capital structure.

While there seems to be consensus in the Sudden Stop literature that financial frictions are

important for explaining Sudden Stops, there is no smoking gun as to what forces the financial frictions to suddenly become relevant. In much of the existing literature, the current account reversal itself is modeled as an exogenous shock rather than as an endogenous outcome of financial frictions (see for example Calvo (1998)) and Christiano et al. (2000)). Mendoza and Smith (2006) studies the quantitative predictions of an equilibrium asset-pricing model with financial frictions in which Sudden Stops are an endogenous response to productivity shocks identical to those that drive a frictionless real-business-cycle model. While qualitatively and quantitatively the results match quite well the dynamics of a Sudden Stop, the probability of one occurring is much lower than has been witnessed in the last twenty years. For a model with borrowing constraints to be able to explain a crisis, there needs to be the incentive to accumulate debt in order for the constraint to play a role. Due to pre-cautionary savings, such accumulation tends to be quite low in the long run.

In the model examined here, financial globalization provides the impetus for domestic agents to accumulate debt in the short run, exposing them to the risk of a Sudden Stop. This paper substantially improves upon Mendoza and Smith (2006) in two important ways. First, a two sector model is introduced which amplifies the debt deflation dynamics and raises the probability of a debt deflation crisis. With both a tradeable and nontradeable sector the goods price of nontradeables (the real exchange rate) impacts dividends and increases the volatility of asset prices, magnifying the debt deflation mechanism. Second, by solving for the transitional dynamics as an economy opens, we can explicitly link the probability of a Sudden Stop to the financial liberalization of the emerging market economy.

If financial liberalization precipitates a Sudden Stop and leads a country to substantially reduce its long run equity position the next question is how does this link depend on the way the liberalization occurs? More specifically, can a country open its capital account in such a way as to maximize the risk sharing benefits and minimize the probability of a Sudden Stop? For instance, if a country only opens to equity flows but allows no debt, a Sudden Stop cannot occur because the external credit constraints are irrelevant. The downside, however, is that the economy is not able to smooth consumption as well. Using compensating variation measures as Gourinchas and Jeanne (2006), we compare welfare under various types of liberalization and find that liberalizing both equity and

debt is welfare improving with the largest gains seen in the first ten years post-globalization. In contrast, the method of globalization has trivial impacts on welfare in the long run.

2 An Equilibrium Model of Sudden Stops and Debt Deflations

The model is related to Mendoza and Smith (2006) but extended to include both tradeables and non-tradeables, imported factor inputs, liability dollarization, and endogenous dividends. Like Mendoza and Smith (2006) the model can be summarized as a general equilibrium asset-pricing model. Domestic agents are modeled as a representative-agent small open economy subject to non-diversifiable productivity shocks. The risk-averse domestic residents trade bonds and equity with the rest of the world. Their ability to borrow is limited by a collateral constraint and a short-selling constraint places a lower bound on their equity holdings. Foreign agents are made of two entities: a set of foreign securities firms specialized in trading equity of the small open economy, and the usual global credit market of non-state-contingent, one-period bonds that determines the world's real interest rate via the standard small-open-economy assumption. Foreign traders face higher costs than domestic agents in trading the small open economy's equity. Collateral constraints and trading costs are modeled following Aiyagari and Gertler (1999). [4]

2.1 Domestic Firms

The small open economy has two sectors, tradeables and nontradeables. The price of tradeables goods is the numeraire, and it is assumed to be set in world markets and equal to 1 for simplicity. The tradeables output is in the form of a stochastic endowment Y_t^T .

The nontradeables sector is conformed by a large number of identical firms that use labor (L_t) and imported intermediate goods (m_t) as variable factors of production, along with a fixed supply of capital (K). Firms produce this good using a Cobb-Douglas technology $exp(\varepsilon_t)L_t^a m_t^b K^{1-a-b}$ where $exp(\varepsilon_t)$ is a Markov productivity shock. Firms choose variable inputs in order to maximize

[4] They examined a closed economy in which households face portfolio adjustment costs, securities firms face margin requirements, and income, consumption, and the risk-free real interest rate are exogenous random processes. In contrast, in the small open economy examined here domestic households face margin requirements, foreign traders are subject to trading costs, and consumption and income are endogenous.

profits:

$$p_t^n \exp(\varepsilon_t) L_t^a m_t^b K^{1-a-b} - w_t L_t - p_t^{m*} m_t \tag{2.1}$$

The assumption that the stock of capital is an exogenous constant is adopted for simplicity. Factor demands for $t = 0, ..., \infty$ are given by standard marginal productivity condition:

$$a p_t^n \exp(\varepsilon_t) L_t^{a-1} m_t^b K^{1-a-b} = w_t \tag{2.2}$$

$$b p_t^n \exp(\varepsilon_t) L_t^a m_t^{b-1} K^{1-a-b} = p_t^{m*} \tag{2.3}$$

Dividend payments for $t = 0, ..., \infty$ are thus given by:

$$d_t = (1 - a - b) p_t^n \exp(\varepsilon_t) L_t^a m_t^b K^{-a-b} \tag{2.4}$$

Productivity shocks follow a two-point, symmetric Markov chain. This specification minimizes the size of the exogenous state space E without restricting the variance and first-order autocorrelation of the shocks. The shocks take a high or low value, so $E = \varepsilon_H, \varepsilon_L$. Symmetry implies that $\varepsilon_L = -\varepsilon_H$. Transition probabilities follow the simple persistence rule (Backus et al. (1989)):
$\pi_{\varepsilon_i \varepsilon_j} = (1 - \vartheta)\Pi(\varepsilon_j) + \vartheta I_{\varepsilon_i \varepsilon_j}$
$I_{\varepsilon_i \varepsilon_j} = 1$ if $i = j$ and 0 otherwise, for $i, j = L, H$. Under these assumptions, the shocks have zero mean, their variance is $(\varepsilon_H)^2$, and their autocorrelation coefficient is given by ϑ.

2.1.1 Households

A large number of identical, infinitely-lived households inhabit the small open economy. Their preferences are represented by Epstein (1983) Stationary Cardinal Utility (SCU) function with an endogenous subjective rate of time preference:

$$U = E\left[\sum_{t=0}^{\infty} exp(-\sum_{\tau=0}^{\tau-1} \nu(c_\tau)) u(c_t)\right] \tag{2.5}$$

where c_t represents a CES composite good of tradeable and nontradeable goods:

$$c(c_t^T, c_t^N) = [z(c_t^T)^{-\mu} + (1-z)(c_t^N)^{-\mu}]^{-1/\mu}, \quad z > 0, \quad \mu \geq -1$$

The elasticity of substitution between tradeables and nontradeables is given by $1/(1+\mu)$, and the CES weighting factor is given by z.

Preferences with endogenous impatience play a central role in stochastic small open economy models with incomplete insurance markets because foreign asset holdings diverge to infinity with the standard assumption of an exogenous rate of time preference equal to the world's interest rate. Preferences with a constant rate of impatience support a well-defined stochastic steady state only if the rate of interest is set lower than the rate of time preference arbitrarily, but in this case the mean foreign asset position is largely determined by the ad-hoc difference between the two rates (see Arellano and Mendoza (2003) for details). In models with credit constraints, endogenous impatience is also crucial for supporting stationary equilibria in which these constraints bind.

Households maximize SCU subject to the following period budget constraint:

$$c_t^T + p_t^N c_t^N = y_t^T + \alpha_t K d_t + w_t + q_t(\alpha_t - \alpha_{t+1})K - b_{t+1} + b_t R(\zeta_t) \tag{2.6}$$

where α_t and α_{t+1} are beginning- and end-of-period shares of the domestic capital stock owned by domestic households, b_t and b_{t+1} are holdings of one-period international bonds denominated in units of tradeables, q_t is the price of equity, and R is the world gross real interest rate. The aggregate supply of labor is inelastic and set to 1 for simplicity.

Constraint 2.6 along with the resource constraint that consumption of tradeables must equal the production of tradeables, assumes that foreign assets are denominated in units of tradeables, so this economy displays liability dollarization (when it borrows, its debt is in units of tradeables).

In addition to the budget constraint, households face a margin requirement according to which they cannot borrow more than a fraction κ of the value of assets offered as collateral:

$$b_{t+1} \geq -\kappa q_t \alpha_t K \tag{2.7}$$

Households also face a short-selling constraint $\alpha_t \geq \chi$ for $-\infty < \chi < 1$ and $t = 1, ..., \infty$. The case in which χ is positive can be interpreted as a portfolio requirement, or as a constraint stating that only a fraction of the capital stock of the emerging economy is tradeable in international equity markets. The constraint $\alpha_t \geq \chi$ is needed to ensure that the state space of portfolio holdings is compact and that the margin requirement is not irrelevant. If unlimited short selling of equity were possible, domestic agents could always undo the effect of the margin constraint. The lower bound on equity also serves to support well-behaved equilibria as in other general-equilibrium, incomplete-markets models of asset trading because of the potential for the portfolio $\alpha_t + b_t$ to become unbounded otherwise.

The first-order conditions of the household's problem are:

$$U_{c_t^T}(\cdot) = \lambda_t$$

$$U_{c_t^N}(\cdot) = p_t^N \lambda_t$$

$$q_t(\lambda_t - \eta_t \kappa) = E_t[\lambda_{t+1}(d_{t+1} + q_{t+1})] + \upsilon_t$$

$$\lambda_t - \eta_t = E_t[\lambda_{t+1} R]$$

$U_{c_t^T}(\cdot)$ and $U_{c_t^N}(\cdot)$ denote the lifetime marginal utilities of date-t consumption of tradeables and nontradeables respectively, and λ_t , η_t , and υ_t are the nonnegative Lagrange multipliers on the budget constraint, the margin constraint, and the short-selling constraint respectively.

The optimality conditions for α_{t+1} and b_{t+1} are analogous to those in Mendoza and Smith (2006), hence it follows that the implications for asset pricing are also analogous. In particular, the following two relationships also hold in this setup:

$$E_t[R_{t+1}^q - R] = \frac{\eta_t(1-\kappa) - \upsilon_t/q_t - cov_t(\lambda_{t+1}, R_{t+1}^q)}{E_t[\lambda_{t+1}]}$$

$$q_t = E_t\left(\sum_{i=0}^{\infty}\left[\prod_{j=0}^{i}\left(\frac{\lambda_{t+j}}{E_{t+j}[\lambda_{t+1+j}R] + \eta_{t+j}(1-\kappa)}\right)\right] M_{t+1+i} d_{t+1+i}\right)$$

There is, however, an important difference with Mendoza and Smith (2006): the stochastic dividend stream in the right-hand-side of the expression is now given by $d_t = (1-a-b)p_t^n \exp(\varepsilon_t) L_t^a m_t^b K^{-a-b}$. Hence, when the credit constraint binds, it will make the price of nontradeables fall because consumption of tradeables declines. This, in turn, will reduce dividends, thereby reducing the asset price valuations of the household, and feeding back into a tighter borrowing constraint (i.e. in this setup there is a connection between the real exchange rate, or the goods price of nontradeables, and the value of capital). In addition, the lower nontradeables price reduces the value of the marginal products of labor and imported inputs, hence lowering factor demands, and thus the output of nontradeables. Since we can rewrite dividends as $d_t = (1-a-b)p_t^n \frac{\exp(\varepsilon_t) L_t^a m_t^b K^{1-a-b}}{K}$, it follows that the decline in output also reduces the dividend rate, so asset valuations fall because of both lower relative prices and lower output. In contrast, in Mendoza and Smith (2006) dividends are independent of the dynamics driving consumption, debt, and asset prices regardless of whether the financial frictions bind or not [5].

2.1.2 Foreign Securities Firms

Foreign securities firms are modeled in the same way as in Mendoza and Smith (2006). They maximize the present discounted value of dividends paid to their global shareholders, facing trading costs that are quadratic in the volume of trades (Aiyagari and Gertler (1999)) and in a fixed recurrent cost. These costs represent the disadvantaged position from which foreign traders operate relative to domestic agents, which may result from informational frictions (i.e., domestic residents may be better informed on economic and political variables relevant for determining the earnings prospects of local firms), or from country-specific institutional features or government policies that favor domestic residents. The recurrent cost represents fixed costs for participating in an emerging equity market that foreign traders incur just to be ready to trade, even if they do not actually trade in any given period.

Foreign traders choose α_{t+1} for $t = 0, ..., \infty$ so as to maximize the value of foreign securities

[5] Since Mendoza and Smith (2006) focuses on how the occasionally binding margin constraints impact the stochastic discount factor to cause a drop in asset prices, that model assumes that dividends are exogenous

firms per unit of capital:

$$D/K = E_0 \left[\sum_{t=0}^{\infty} M_t^* \left(\alpha_t^*(d_t + q_t) - q_t \alpha_{t+1}^* - q_t \left(\frac{\phi}{2} \right) (\alpha_{t+1}^* - \alpha_t^* + \theta)^2 \right) \right] \tag{2.8}$$

where $M_0 = 1$ and M_t^* for $t = 1, ..., \infty$ are the exogenous marginal rates of substitution between date-t consumption and date-0 consumption for the world's representative consumer. For simplicity, these marginal rates of substitution are set to match the world real interest rate, so $M_t^* = R_t$. Trading costs are given by $q_t(\phi/2)(\alpha_{t+1}^* - \alpha_t^* + \theta)^2$. The recurrent entry cost is θ and ϕ is an adjustment cost coefficient that determines the price elasticity of the foreign trader's demand for equity, as shown below. Note that θ induces an asymmetry in the manner in which trading costs operate. With $\theta = 0$, the total cost of increasing or reducing equity holdings by a given amount is the same, but with $\theta > 0$ the total cost of reducing equity holdings is higher.

An important implication of the incompleteness of asset markets is that, despite asset trading between foreign and domestic agents, the stochastic sequences of their discount factors, M_{t+1+i}^* and M_{t+1+i} for $i = 0, .., \infty$, are not equalized. With complete markets, or under perfect foresight, both sequences are equal to the reciprocal of the world interest rate (compounded i periods). Under uncertainty and incomplete markets, however, this is not the case even with an exogenous, risk-free world interest rate. In particular, domestic stochastic discount factors are endogenous and reflect the effects of margin calls.

The solution to the above problem features the following "partial adjustment" asset demand function:

$$\alpha_{t+1}^* - \alpha_t^* = \frac{1}{\phi} \left(\frac{q_t^f}{q_t} - 1 \right) - \theta$$

where $q_t^f \equiv E_t \left(\sum_{i=0}^{\infty} M_{t+1+i}^* d_{t+1+i} \right)$. The behavior of the fundamentals price differs from that in the Mendoza-Smith setup because, as explained above, the stream of dividends is now affected by the endogenous equilibrium response of the nontradeables price and the output of nontradeables to the shocks hitting the economy and the effects of the financial frictions–in fact, because of the latter, it is not very appropriate to call it the "fundamentals" price in this model. Intuitively, if dividends fall when the credit constraint binds because of the adverse effects on the nontradeables

price and output, the "fundamentals price" also falls, but this means that at equilibrium, the actual equity price has to fall even more than it would if the fundamentals price were invariant to the financial frictions, because it is still true in this setup that foreigners only buy more domestic equity when the market price is lower than the fundamentals price.

2.1.3 Competitive Equilibrium

Given the Markov process of productivity shocks and the initial conditions $(b_0, \alpha_0, \alpha_0^*)$, a competitive equilibrium is defined by stochastic sequences of allocations $[c_t^T, c_t^N, L_t, m_t, b_{t+1}, \alpha_{t+1}, \alpha_{t+1}^*]_{t=0}^{\infty}$ and prices $[w_t, p_t^n, d_t, q_t, R_t^q]_{t=0}^{\infty}$ such that: (a) domestic firms maximize dividends subject to the Cobb-Douglas technology, taking factor and goods prices as given, (b) households maximize SCU subject to the budget constraint, the margin constraint, and the short-selling constraint, taking as given factor prices, goods prices, the world interest rate and asset prices, (c) foreign securities firms maximize the expected present value of dividends net of trading costs, taking as given asset prices, and (d) the market-clearing conditions for equity, labor, and goods markets hold.

3 Recursive equilibrium and solution method

The model's competitive equilibrium is solved by reformulating it in recursive form and applying a numerical solution method. Since the fundamentals price is endogenous in this setup (instead of just a function of exogenous shocks as in Mendoza and Smith (2006), we use the solution method that Durdu and Mendoza (2006) applied to a similar model in which, because of the presence of price guarantees, the fundamentals price was endogenous. In particular, we start by using $\hat{G}(\alpha, b, \varepsilon)$ as a conjectured fundamentals price function, then define a recursive problem that solves the model conditional on this conjecture, and then we iterate to convergence so that the conjecture is correct in the final solution.

Imposing market clearing in the equity market and inverting the foreign trader's demand function to use it as pricing function, the optimal plans of the domestic economy can be represented by the following dynamic programming problem:

$$V(\alpha,b,\varepsilon)=\max_{\alpha',b',c^T,c^N}\frac{c(c^T,c^N)^{1-\sigma}-1}{1-\sigma}+exp(-\beta[Ln(1+c(c^T,c^N))])E[V(\alpha',b',\varepsilon')] \tag{3.1}$$

subject to:

$$c^T=y^T+[\alpha(1-b)+a(1-\alpha)-1]\,p^n\exp(\varepsilon)m^bK^{1-a-b}+\left(\frac{\hat{G}(\alpha,b,\varepsilon)K}{1+a(\alpha-\alpha'+\theta)}\right)-b'+bR$$

$$c^N=\exp(\varepsilon)m^bK^{1-a-b}$$

$$p^n=\left(\frac{1-z}{z}\right)\left(\frac{c^T}{\exp(\varepsilon)m^bK^{1-a-b}}\right)^{1+\mu}$$

$$p^{m*}=bp^n\exp(\varepsilon)m^{b-1}K^{1-a-b}$$

$$b'\geq-\kappa\left(\frac{\hat{G}(\alpha,b,\varepsilon)}{1+a(\alpha-\alpha'+\theta)}\right)(\alpha-\alpha')K\alpha'$$

The constraints of the problem follow from: (1) the resource constraint in tradeables, (2) the market-clearing condition for nontradeables, (3) the optimality condition for sectoral allocation of consumption, (4) the optimality condition for demand of imported inputs, and (5) the borrowing constraint. For each ε, each set of pairs (α,α'), (b,b') in the state space, and given the conjectured $\hat{G}(\alpha,b,\varepsilon)$, we can solve the system of the first four equations for c^T,c^N,p^n,m.

The solutions of the above problem are represented by the optimal decision rules $\alpha'(\alpha,b,\varepsilon)$ and $b'(\alpha,b,\varepsilon)$ and the associated optimal consumption plan implied by the budget constraint. The problem is solved by value function iteration using an acceleration routine that splits each set of n iterations so that the first h execute the maximization step in the right-hand-side of the Bellman equation, and the remainder n-h simulate the equation forward using the last iteration's decision rules.

Given $\alpha'(\alpha,b,\varepsilon)$ and $b'(\alpha,b,\varepsilon)$ and the Markov process for ε, we can use the conditions that $q_t^f\equiv E_t\left(\sum_{i=0}^{\infty}M_{t+1+i}^*d_{t+1+i}\right)$ and $d_t=(1-a-b)p_t^n\exp(\varepsilon_t)L_t^am_t^bK^{-a-b}$ to calculate an "actual" fundamentals price function $G(\alpha,b,\varepsilon)$. Notice this can be reduced to simple recursive formula (a "value function") since we use R^* for the stochastic discount factor of the foreign traders, and

since the stream of dividends can be expressed as the following recursive function $d(\alpha, b, \varepsilon) = (1 - a - b)p^n(\alpha, b, \varepsilon)\exp(\varepsilon)m(\alpha, b, \varepsilon)^b K^{-a-b}$, where $p^n(\alpha, b, \varepsilon)$ and $m(\alpha, b, \varepsilon)$ are the optimal rules for nontradeables price and imported inputs that follow from $\alpha'(\alpha, b, \varepsilon)$ and $b'(\alpha, b, \varepsilon)$. If $\hat{G}(\alpha, b, \varepsilon)$ and $G(\alpha, b, \varepsilon)$ differ by more than a convergence criterion, we update $\hat{G}(\alpha, b, \varepsilon)$ and solve again the value function.

3.1 Financial Liberalization and the Transitional Dynamics of the Model

To understand the impacts of financial liberalization on the probability of a Sudden Stop and on the external capital structure, the transitional dynamics of the model as well as the long run moments need to be determined. In the context of this model, an economy has a closed capital account when $\alpha = 1$ and $b = 0$. In this case the capital stock is owned completely by the domestic agents and there are no outstanding debt obligations. Taking these as the initial conditions for a closed economy, the policy experiment is to calculate the transitional dynamics if the capital account is opened in a once and for all fashion so that agents are allowed to alter their equity and debt positions. The optimal decision rules $\alpha'(\alpha, b, \varepsilon)$ and $b'(\alpha, b, \varepsilon)$ are used to generate forecast functions for the basic key macro variables during transition from a closed economy to an open economy. These forecast functions are conditioned on the capital account initially being closed, so that domestic capital stock is fully owned by the domestic agents and the foreign debt position is zero. The forecast functions trace the dynamics of these variables until they converge to the stochastic steady state with financial globalization. In contrast to an impulse response, we want to isolate the transitional dynamics from the response to technology shocks. Therefore, we take the forecast function conditional on a positive technology shock occurring and the corresponding forecast function conditioned on a negative shock and multiply them by the associated long run probabilities of each state. [6] Forecast functions have the advantage that they preserve all the non-linear aspects of the model's stochastic competitive equilibrium captured in the decision rules.

[6] Using this technique, output remains constant along the transition path, since capital is fixed and the influence of the symmetric influence of the technology shocks cancel out.

4 Quantitative results

This section studies the quantitative predictions of the model by examining the results of numerical simulations starting from a baseline case calibrated to Mexican data.

4.1 Functional forms and baseline calibration

The numerical analysis uses these standard functional forms for preferences and technology:

$$F(K, L_t) = exp(\varepsilon_t) L_t^a m_t^b K^{1-a-b} \tag{4.1}$$

$$u(c_t) = \frac{[c_t]^{(1-\sigma)} - 1}{1-\sigma} \tag{4.2}$$

$$\nu(c_t) = \beta[Ln(1 + c_t)] \tag{4.3}$$

$$c(c_t^T, c_t^N) = [z(c_t^T)^{-\mu} + (1-z)(c_t^N)^{-\mu}]^{-1/\mu} \tag{4.4}$$

The parameter a is the labor income share, σ is the coefficient of relative risk aversion, β is the elasticity of the rate of time preference with respect to $1 + c_t$. $0 < \beta \leq \sigma$ is required to satisfy the conditions identified by Epstein (1983) to ensure that SCU yields well-behaved dynamics.

The calibration of the model with tradeables and nontradeables for Mexico using sectoral data follows closely Durdu et al. (2008) . The steady-state relative price of nontradeables, the world price of intermediate goods and total GDP in units of tradeables are normalized to $p^n = 1$, $p^m = 1$ and $y^T + p^N y^N - p^m = 1$. Hence, the steady-state allocations can be interpreted as ratios relative to total GDP in units of tradeables. We use the same elasticity of substitution parameter as Durdu et al. (2008), $\mu = 0.316$, which corresponds to an estimate for Mexico obtained by Ostry and Reinhart (1992).

The share of imported input costs to gross output of nontradeables is $b = 0.2$. In the deterministic steady state, this factor share yields a ratio of imported inputs to total GDP of 13 percent, which

matches the ratio for Mexico reported in Mendoza (2006). Given Durdu et al. (2008) estimates of the sectoral consumption-GDP ratios in Mexican data,it follows that $z = 0.341$.

The Markov process of productivity shocks is set so that the standard deviation and first-order autocorrelation of GDP match the standard deviation and first-order autocorrelation of the HP-filtered quarterly cyclical component of Mexico's GDP reported in Mendoza (2006). In terms of the simple persistence rule defined in equation (4), this requires $\varepsilon_H = 0.01785$ and $\vartheta = 0.683$.

The solution algorithm also needs values for preference and technology parameters (σ, β, R) and financial-frictions parameters (κ, ϕ, θ). Parameter values are assigned following a calibration technique similar to the one used in real business cycle (RBC) theory. RBC calibration sets parameter values so that the deterministic stationary state of a model economy matches observed empirical regularities. Since collateral and short-selling constraints at work in international capital markets are a combination of government regulations and private contractual practices, and trading costs are a mixture of pecuniary and economic costs that are difficult to measure. Therefore, the baseline calibration applies financial frictions parameters so as to yield unique equity and bond positions but yet steady-state allocations and prices are virtually identical to those of the frictionless stationary state.

The calibration yields a deterministic stationary state that replicates Mexico's 1970-95 average GDP shares of private consumption, net exports, investment, and government expenditures at current prices. For the model to mimic the consumption and net export shares, it is necessary to make adjustments for investment and government expenditures. The calibration assumes that government expenditures are financed with a constant consumption tax set at $\tau = 0.092/0.684 = 0.135$, which is close to Mexico's actual value-added tax rate. This tax vanishes from the Euler equations but it does distort labor supply. Still, keeping the tax state- and time-invariant implies that its effects on the stochastic dynamics are minimal. To adjust for investment expenditures, the calibration adds an autonomous (time and state invariant) level of private expenditures equal to match the Mexican data. The capital stock is normalized at $K = 1$ without loss of generality. Mexican data from the System of National Accounts yield an average labor income share for the period 1988-96 of 0.341. Consistent with estimates from many countries, we adopted a labor share of $\gamma = 0.65$.

Steady-state consumption is then calculated using steady-state output and the requirement that the consumption-GDP ratio matches the average from Mexican data (0.684).

The coefficient of relative risk aversion and the gross real interest rate are set to standard RBC values: $\sigma = 1.1$ and $R = (1.065)^{1/4}$. The interest rate and the dividend rate determine then the steady-state fundamentals price. Finally, given c, the value of the time preference elasticity β is derived from the steady-state Euler equation for bonds, which implies $\beta = Ln(R)/Ln(1+c) = 0.187$. For the baseline economy with financial frictions we set $\phi = 3.0$, $\theta = 0.004$, and $\kappa = 0.9$. Consistent with Mendoza and Smith (2006) we choose an adjustment cost parameter of $\phi = 3.0$ in order to generate some the the equity price response to a Sudden Stop. $\theta = 0.004$ was chosen to insure that the fixed cost of trading was less than 0.3% of the steady state equity price. $\kappa = 0.9$ delivers a steady state debt to GDP ratio close to the average debt to GDP ratio for non-industrials in 2004 of 18%. Because these financial frictions are difficult measure, sensitivity analysis shows the relative importance of each friction.

4.2 Exploring the Transitional Dynamics of the Model Economy

Figure 6 explores the impact financial liberalization has on the transitional dynamics of the key endogenous macro variables in the model economy. Upon liberalization of the capital account, the world interest rate becomes the relevant inter-temporal price of consumption driving the dynamics of the macro variables. As is evident in the top panel of Figure 6, consumption increases relative to its former steady state since the marginal benefit of consuming is temporarily greater than the marginal benefit of forgoing consumption. Ten years after liberalization, the economy's consumption ends up lower than it was prior to liberalization since agents choose to transfer future consumption forward to maximize utility. Given SCU, agents choose to move even more consumption forward as the rate of time preference increases with current consumption, amplifying the intertemporal adjustment. Higher current consumption and lower future consumption implies that agents wealth must fall today and rise in the future.

The rise in consumption increases equity prices via two channels, directly through the marginal rate of substitution and the indirectly through the goods price of non-tradeables. Since equity

prices are determined by the discounted stream of dividends, higher relative current consumption lowers the marginal rate of substitution (the effective discount rate), driving up equity prices. There is a secondary impact on equity price via the price of non-tradeables. While consumption of both tradeables and non-tradeables rise, given the elasticity of substitution between the goods, tradeables increase by more driving up initially the goods price of non-tradeables reflected in the upper right panel on Figure 6. Since dividends are a function of the goods price of tradeables, this rise in price of tradeables contributes to the rise in equity prices, evidenced in the second panel on the left in Figure 6.

A lower cost of consuming today, however, does not necessarily translate into higher debt levels. Agents have the option to sell equity or buy foreign debt to smooth consumption. A lower cost of borrowing, encourages domestic agents to take on foreign debt (the third panel on the right). Simultaneously, two factors encourage domestic consumers to sell-off equity. First, as mentioned above equity prices increase dramatically due to the lower cost of capital and a higher prce of non-tradeables, providing the incentive for the domestic agents to sell. Second, domestic consumers can diversify their shocks to labor income and better smooth their consumption by selling equity to foreigners. Figure 6 shows a rapid portfolio re-balancing on the part of domestic agents within the SOE, in that there is both accumulation of foreign debt and an initial sell-off of domestic equity within the first ten years after liberalization. As the fourth plot in the right-hand side of Figure 6 shows the portfolio re-balancing leads to a dramatic rise in the debt to equity ratio.

Despite the initial increases in equity prices, as agents sell-off equity the portfolio adjustment costs leads to declines in the price of equity. This reversal in equity prices, coupled with the surge in debt and decline in the equity position forces the occasionally binding collateral constraint to become relevant. As seen in the bottom left panel on Figure 6, ten years post liberalization the collateral constraint is at risk of binding and a Sudden Stop has a 15% chance of occurring. Fifteen years after globalization the probability spikes to 70%, the current account deficit turns positive, and consumption, equity prices and the price of non-tradeables (the real exchange rate) bottom out consistent with a Sudden Stop.

To isolate the interaction between debt, equity and equity prices that force the constraint

to suddenly become relevant Figure 7 examines the relationship between the probability of the margin constraint binding and the various components of the margin constraint five to fifty years after globalization. Looking at the top panel, we can see equity prices falling over this period due to the adjustment costs from selling off equity. While the decline in equity prices is much smaller than the rapid rise in prices immediately after liberalization, it is clear that they seem to be falling prior to the rise in the probability of the Sudden Stop. This first panel therefore confirms the boom bust cycle that Martell and Stulz (2003) find in the empirical examination of equity returns in liberalized economies. Second, there is a slow but steady fall in domestic ownership of the domestic capital stock, which helps to increase the debt to equity ratio up near critical levels. Last, before the rise in probability of a Sudden Stop we can see this rapid increase in foreign debt. Because of the simultaneous adjustment of these three macro variables, the debt to equity ratio suddenly becomes too high making a Sudden Stop very likely. From this baseline simulation it is clear that the high probability of a Sudden Stop is limited to the transition from a closed to open. The probability of a Sudden Stop is 28% in the long run as pre-cautionary saving by the consumers reduces the risk of a Sudden Stop happening. Not only does this model deliver a high probability of a Sudden Stop within the first fifteen years of globalization, which is consistent with the episodes the emerging market has experienced, this model delivers a long run probability of a Sudden Stop roughly three times as large as Mendoza and Smith (2006). Having a two sector model where production of non-tradeables depends on imports increases the volatility of asset prices raising the likelihood of a Sudden Stop even in the long run despite precautionary savings.

To highlight the importance of the financial frictions to the external capital structure in the short and long run, Figure 8 compares the transition path post globalization in an economy without collateral constraints to one where they are relevant. As expected without collateral constraints the consumption path is much smoother, which leads to a smoother path for the relative price of non-tradeables and equity prices. Without collateral constraints the current account goes into deficit upon opening and gradually returns to its steady state level. In terms of the external debt and equity positions, the second column of graphs supports the large role collateral constraints play. Without these frictions, domestic equity ownership falls slightly post liberalization as domestic agents take

advantage of the equity price spike. But within ten years post globalization the domestic ownership is essentially 100% and the debt liabilities are approaching 40% of GDP. Except for the initial fall in equity ownership these graphs track fairly well what has happened to the industrial countries.[7] If collateral constraints are non-trivial, ten years after globalization as the probability of a Sudden Stop increases, the debt position slows dramatically and starts to reverse slightly, reaching a high of only 14% of GDP, leaving the debt to equity ratio significantly lower at 9.5% versus 23% in the case where the frictions are not relevant.

The long run means of the external capital structure are also affected by the magnitude of the financial frictions. Table 1 compares the debt to GDP ratio and debt to equity ratio under various parameterizations. As portfolio adjustment costs and recurrent trading costs vary, the net debt to GDP ratio varies from 15.8% to 11.9%. These changes are small relative to the comparison between the baseline model and the model without collateral constraints. In the model with less frictions the equity to debt ratio surges to 37.6% versus 15.8% in the baseline calibration. As long as the collateral constraint is at risk of binding, agents choose to hold much less debt relative to equity or GDP in the long run.

4.3 Sensitivity Analysis

The high debt to equity ratios and accompanying spike in the probability that a Sudden Stop will occur within twenty years of liberalization is robust to changes in preference, technology, and financing parameters as Figure 9 indicates. The sensitivity analysis shows that altering slightly these parameters changes the timing and magnitude of the variables but not the basic story of the transition. In terms of preference changes, increasing the coefficient of relative risk aversion decreases the max probability of a Sudden Stop to roughly 45% approximately fifteen years after globalization. With a higher risk aversion parameter, domestic agents are likely to want to move less consumption forward and more concerned with precautionary savings, forcing the debt to equity ratio lower, which is seen in the 2nd plot on the left of Figure 9. Increasing shock persistence to 0.8%, on the other hand decreases the likelihood of a Sudden Stop to a max of just under 60% but

[7] The model is unable to capture a positive net equity position due to the fact there are only equity liabilities not equity assets (the domestic agents cannot buy foreign equity).

makes a crisis more likely to occur quicker post-globalization.

Because the parameters that characterize the financial frictions are more difficult to calibrate, it is important to show how sensitive our results may be to changes in both the recurrent entry cost (θ) and the adjustment cost coefficient (ϕ) that determines the price elasticity of the foreign trader's demand for equity. As the right hand side of Figure 9 shows, once again the basic story does not change but the probability of Sudden Stop and how soon after liberalization a Sudden Stop is likely to occur does seem very much affected by the calibration of the financial frictions. As portfolio adjustment cost increase the likelihood of a Sudden Stop falls significantly to a high of 48% in the twelfth year after liberalization. The intuition for this is clear. Higher adjustment costs make it more costly for the foreign security firm to buy equity, reducing demand for domestic equity. If less domestic equity is sold, the likelihood of a debt deflation crisis falls. The same pattern is apparent with the recurrent entry cost for foreigners trading equity in the emerging market. A higher cost of trading drives down the probability and the timing of a crisis.

The fact that the magnitude of the financial frictions impacts the chance of a crisis and timing of the crisis may actually be important for explaining the heterogeneity in the timing of Sudden Stops across various emerging markets. Sudden Stops varied a lot in the relation to the date of liberalization within an economy. Furthermore, many countries have liberalized without a Sudden Stop. Figure 9 suggests that it is countries where equity trading costs are relatively high may be able to avoid Sudden Stops in both the short and long run, due to the fact that domestic agents hold onto more domestic equity.

Although Sudden Stops are less probable in the long run, after calibrating our model to the Mexican economy the transitional dynamics suggest this probability increases dramatically soon after liberalization, demonstrating the importance of studying the short run dynamics separately from the long-run. The boom-bust in equity prices as well as the shifting of consumers portfolios away from risky domestic equity towards foreign bonds increases the probability that a Sudden Stop occurs to roughly 70% in the first fifteen years after globalization. Since this model shows that financial frictions may lead to a Sudden Stop soon after globalization, one obvious solution to avoiding Sudden Stops would be to only open the equity market in order to avoid the debt deflation

cycle occurring.

4.4 How to Liberalize?

For the above results we attempted to match dynamics of the Mexican economy after complete liberalization of their capital account in 1989. [8] Given that many countries do not liberalize both debt and equity simultaneously, Figure 10, Table 2, and Table 3 compare the impact on the transitional dynamics, long run moments, and welfare for Mexico under various liberalization scenarios. As Figure 10 shows, the method of opening can have significant effects for the macro variables during transition. Three liberalization scenarios are examined: opening just equity, just bonds, and both equity and bonds. Panel one plots the consumption path post liberalization. Opening just equity and both debt and equity generate the highest consumption gains post-liberalization. From the second panel on the left, we can see the current account adjustment under a debt only liberalization is much smaller and recovers sooner than the other two liberalization policies. Debt positions are larger and more persistent under debt only, reflected in the debt plot and the debt to equity plot. Interestingly, with only debt allowed the long run probability of a Sudden Stop increases but the economy does not experience a spike in the likelihood of a Sudden Stop fifteen years out. Finally from Figure 10 we can see by only allowing domestic equity to be traded we completely eliminate the risk of a Sudden Stop because the country will never be subject to a binding collateral constraint.

4.5 Welfare Implications

While opening just equity certainly may eliminate exposure to Sudden Stops does it lower the level of risk sharing significantly? Measuring the welfare gains from liberalization contingent on particular liberalization policies helps to quantify these trade-offs. We compare welfare during transition relative to the closed economy, using Hicksian equivalent variation as Gourinchas and Jeanne (2006). This work differs from Gourinchas and Jeanne (2006) for three main reasons. First, we are not only interested in the overall welfare benefits of liberalization but how these benefits

[8] According to Aspe (1993) while domestic equity ostensibly was sold to foreigners as far back as 1972, it was not until supplemental legislation was passed in 1989 that portfolio equity and FDI actually began.

depend on the way in which the capital account was opened. Second, unlike Gourinchas and Jeanne (2006) agents take on net debt positions and sell equity not only due to cost of capital changes that occur upon opening but also for risk sharing reasons. Therefore, we are able to isolate the risk sharing gains from liberalization distinct from cost of capital changes. Third, we compare welfare at various points along the transition path. For each potential liberalization policy (just bonds, just equity, or both) we calculate U_{open} along the expected transition path and compare it to U_{closed}. With shocks to the world interest rates as well as occasionally binding collateral constraints there is no closed form solution to welfare in the closed or open economy and must be computed by solving numerically for the saddle-point stable equilibrium. Hicksian equivalent variation essentially determines the percentage increase in the country's consumption that would be needed to provide the country with the same welfare under autarky as it can obtain with financial liberalization. The calculation is represented in equation (4.5).

$$\eta = (\frac{U_{open}}{U_{closed}})^{\frac{1}{1-\sigma}} - 1 \tag{4.5}$$

U_{open} calculates the expected utility as of date $t = 0$ which is when the liberalization actually takes place. These welfare calculations assume the consumers in the domestic economy did not anticipate the change in policy.

Table 2 presents the welfare comparisons for several time periods post liberalization. Looking at the entire transition as well as the sub-periods, the results confirm the findings of Mendoza (1991) and Gourinchas and Jeanne (2006) that while financial liberalization does improve welfare the gains are relatively small. For the entire transition the gain is under 0.05%. The highest welfare gains are realized in the first five years and fall progressively from there. In the long run, the gains from liberalizing must be negative because Mexico pays interest on its debt in the stochastic steady state which translates into lower consumption than in financial autarky. In terms of the various liberalization policies, after the first five years allowing consumers to smooth consumption by buying foreign debt and buying/selling domestic equity provides the highest welfare gains. In the first five years the welfare gains from liberalizing debt over liberalizing both is slightly higher. Since agents cannot sell equity, there is less equity price volatility and higher equity positions making a

debt deflation crisis less likely. Over the entire transition, liberalizing both debt and equity exhibits the highest welfare gains, suggesting that the decrease in risk sharing that occurs due to multiple assets being traded is more important to welfare than the elimination of the risk of a Sudden Stop.

The last line on Table 2 examines the welfare gains from globalization in the model without collateral constraints. Comparing the welfare gains in this case to the baseline model where both equity and debt are liberalized but frictions exist, the welfare gains are fairly similar. The largest difference in welfare between the two models occurs in the first fifteen years, coinciding with the period where the probability of a Sudden Stop is highest.

Table 3 compares how the method of liberalization of the capital account impacts the long run moments of the data. In terms of the means of the data, all three liberalization policies deliver similar impacts on consumption and equity prices, yet have differing impacts on the portfolio composition as would be expected. Consistent with the welfare story from Table 2, liberalization policies greatly impact the probability of a Sudden Stop and the volatility of consumption, measured by the standard deviation. Opening just equity, eliminates the probability of a Sudden Stop but increases consumption volatility substantially more to 2.239, versus 2.197 in the model where both equity and debt are liberalized. Consumption volatility is lowest, 2.160, when both equity and debt are liberalized but collateral constraints are trivial. In this case agents can risk share without risky a debt deflation crisis.

5 Conclusions

This paper shows how financial frictions contribute to both the prevalence of Sudden Stops and the short equity positions experienced by many emerging market economies in the wake of financial globalization. Theoretically, we show how an economy with financial frictions is more prone to Sudden Stops post globalization as the domestic agents attempt to re-balance their portfolios in order to smooth their consumption. The long run risk sharing gains that financial liberalization elicits, therefore come at a cost. For Mexico, as they transitioned from closed to open, we found they had a 70% chance of a Sudden Stop occurring in the fifteenth year after the economy globalized. Despite the risk of a crisis, by opening the Mexican economy to both foreign debt and the sell-

ing/buying of domestic equity, welfare gains from risk-sharing are just under 1.0% in the five years post-liberalization. The high probability of a Sudden Stop, encourages many emerging markets to re-arrange the liability side of their balance sheet. This helps to explain why the external capital structure of many emerging markets is short equity, in stark contrast to the industrial countries who tend to be long equity and short debt.

6 References

Aiyagari, S. Rao, and Mark Gertler. 1999. "'Overreacion' of Asset Prices in General Equilibrium." *Review of Economic Dynamics* 2(1), pp. 3–35.

Aizenman, Joshua, and Jaewoo Lee. 2007. "International Reserves: Precautionary versus Mercantilist Views, Theory and Evidence." *Open Economies* .

Alfaro, Laura, and Fabio Kanczuk. 2006. "Optimal Reserve Management and Soverign Debt." Working paper.

Arellano, Cristina, and Enrique G. Mendoza. 2003. "Credit Frictions and 'Sudden Stops' in Small Open Economies: An Equilibrium Business Cycle Framework for Emerging Markets Crises." In *Dynamic Macroeconomic Analysis: Theory and Policy in General Equilibrium*, eds. Sumru Altug, Jagjit S. Chadha, and Charles Nolan, chap. 7. Cambridge, UK: Cambridge University Press, pp. 335–405.

Aspe, Pedro. 1993. Cambridge, MA: MIT Press.

Backus, David K., Allan W. Gregory, and Stanley E. Zin. 1989. "Risk Premiums in the Term Structure: Evidence from Artificial Economies." *Journal of Monetary Economics* 24, pp. 371–400.

Bekaert, Geert, and Campbell R. Harvey. 2000. "Capital Flows and the Behavior of Emerging Market Equity Returns." In *Capital Flows and the Emerging Economies: Theory, Evidence, and Controversies*, ed. Sebastian Edwards, chap. 6. NBER Conference Report, Chicago: University of Chicago Press, pp. 159–194.

Caballero, Ricardo J., and Stavros Panageas. 2006. "Hedging Sudden Stops and Precautionary Contractions." *Journal of Development Economics* .

Calvo, Guillermo A. 1998. "Capital Flows and Capital Market Crises: The Simple Economics of Sudden Stops." *Journal of Applied Economics* 1(1), pp. 35–54.

Chinn, Menzie D., and Hiro Ito. 2007. "A New Measure of Financial Openness." Working paper, University of Wisconsin.

Choi, Woon Gyu, Sunil Sharma, and Maria Stromqvist. 2007. "Capital Flows, Intergration, and International Reserve Holdings: The Recent Experience Experience of Emerging Markets and Advance Economies." Working paper, IMF, Washington, DC.

Christiano, Lawrence J., Christopher Gust, and Jorge Roldos. 2000. "Monetary Policy in a Financial Crisis." Unpublished manuscript.

Demirguc-Kunt, Asli, and Enrica Detragiarche. 1998. "Financial Liberalization and Financial Fragility." International Monetary Fund Working Paper no 98/83.

Durdu, Ceyhun Bora, and Enrique Mendoza. 2006. "Are asset price guraantees useful for preventing Sudden Stops?: A Quantitative Analysis of Globalization Hazard-Moral Hazard Tradeoff." *Journal of International Economics* .

Durdu, Ceyhun Bora, Enrique Mendoza, and Marco Terrones. 2008. "Precautionary Demand for Foreign Assets in Sudden Stop Economies: An Assessment of the New Merchantilism." *Journal of Development Economics* .

Epstein, Larry G. 1983. "Stationary Cardinal Utility and Cardinal Growth under Uncertainty." *Journal of Economic Theory* 31(1), pp. 133–152.

Glick, Reuven, and Michael Hutchinson. 2001. "Banking and Currency Crisis: How Common are Twins?" In *Financial Crises in Emerging Markets*, eds. Reuven Glick, Ramon Moreno, and Mark M. Spiegel. Conference at the Center for Pacific Basin Monetary and Economic Studies at the Federal Reserve Bank of San Francisco, Sept. 23-24, 1999, Cambridge, UK: Cambridge University Press.

Gourinchas, Pierre-Olivier, and Olivier Jeanne. 2006. "The Elusive Gains from International Financial Integration." *Review of Economic Studies* 73(3), pp. 715–741.

Henry, Peter Blair. 2000. "Stock market Liberalization, Economic Reform, and Emerging Market Equity Prices." *Journal of Monetary Economics* 55(2), pp. 529–564.

Jeanne, Olivier. 2007. "International Reserves in Emerging Marketss Countries: Too Much of a Good Thing?" *BPEA* .

Jeanne, Olivier, and Romain Ranciere. 2006. "The Optimal Level of International Reserves for Emerging Market Countries: Formulas and Applications." WP 06/229, IMF.

Kaminsky, Graciela L., and Carmen M. Reinhart. 1999. "The Twin Crises: The Cause of Banking and Balance–of–Payments Problems." *The American Economic Review* 89(3), pp. 473–500.

Kraay, Art. 1998. "In Search of Macroecconomic Effects of Capital Account Liberalization." World Bank, Development Research Group, Washington, DC.

Lane, Philip R., and Gian Maria Milesi-Ferretti. 2006. "The External Wealth of Nations Mark II: Revised and Extended Estimates of Foreign Assets and Liabilities, 1970-2004." Tech. rep., IMF.

Martell, Rodolfo, and Rene Stulz. 2003. "Equity-Market Liberalizations as Country IPO's." *The American Economic Review* 93(2), pp. 97–101.

Mendoza, Enrique G. 1991. "Real Business Cycles in a Small Open Economy." *The American Economic Review* 91(4), pp. 797–818.

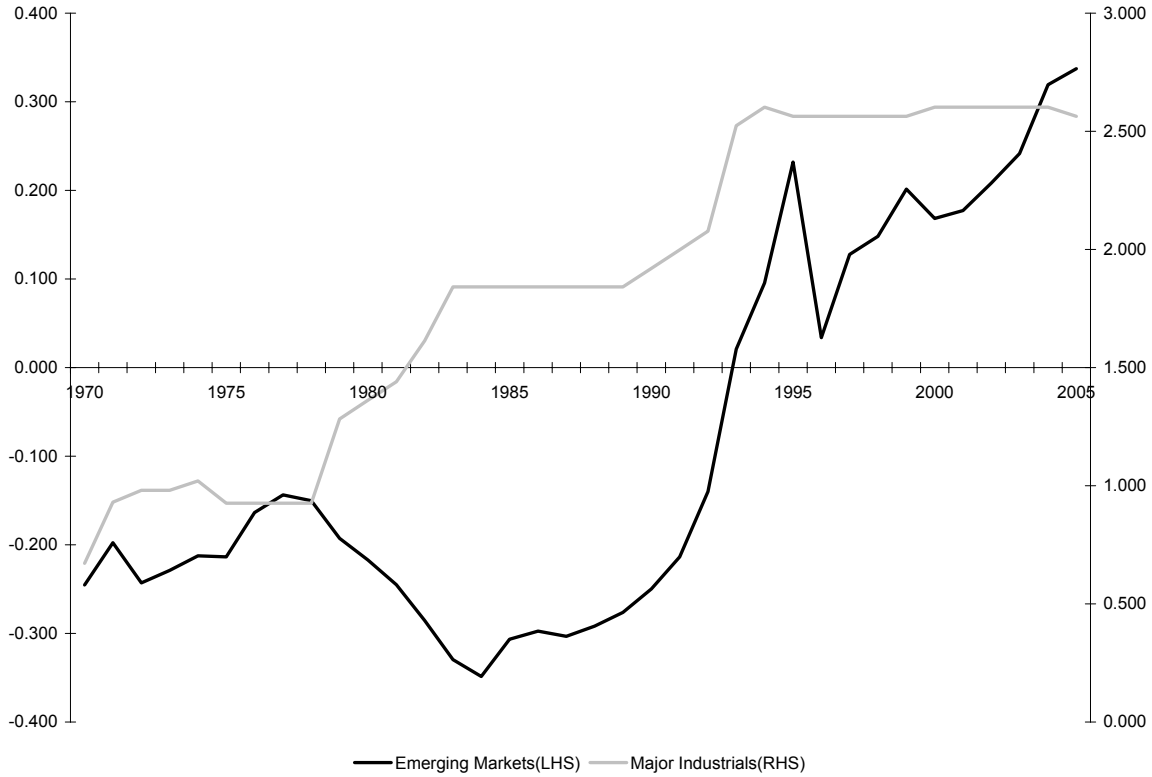
Mendoza, Enrique G. 2006. "Endogenous Sudden Stops in a Business Cycle Model with Collateral Constraints: A Fisherian Deflation of Tobin's Q." Working Paper 12564, National Bureau of Economic Research, Cambridge, MA.

Mendoza, Enrique G., and Katherine A. Smith. 2006. "Quantitative Implications of a Debt-Deflation Theory of Sudden Stops and Asset Prices." *Journal of International Economics* 70, pp. 82–114.

Ostry, J., and C. Reinhart. 1992. "Private saving and terms of trade shocks: Evidence from developing countries." Imf staff papers.

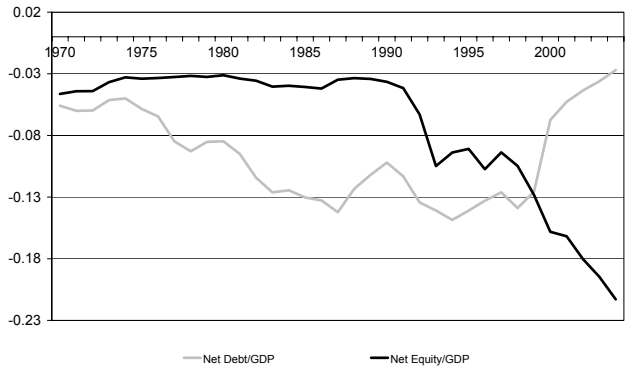
A Figures

Figure 1: Financial Integration Measures



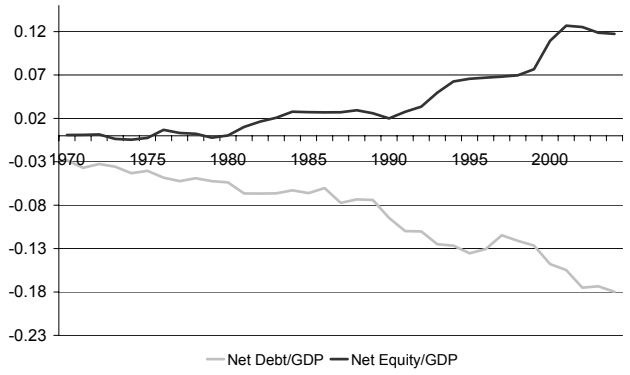
Source: Chinn and Ito (2007)

Figure 2: External Capital Structure (GDP weighted): Emerging Markets



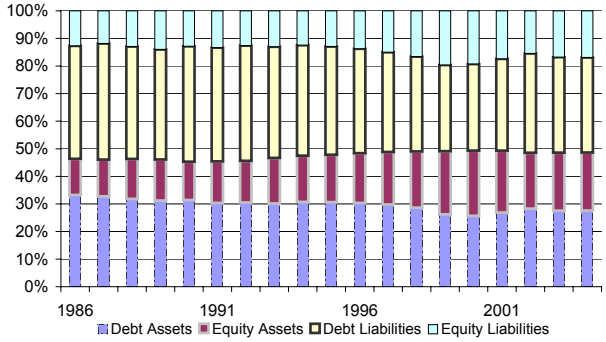
Source: Lane and Milesi-Ferretti (2006)

Figure 3: External Capital Structure: Major Industrials



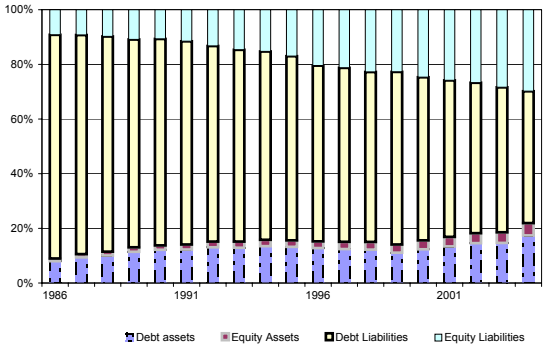
Source: Lane and Milesi-Ferretti (2006)

Figure 4: Decomposition of the External Capital Structure: Major Industrials



Source: Lane and Milesi-Ferretti (2006)

Figure 5: Decomposition of the External Capital Structure: Emerging Markets



Source: Lane and Milesi-Ferretti (2006)

Figure 6: Transitional Dynamics for Key Macro Variables

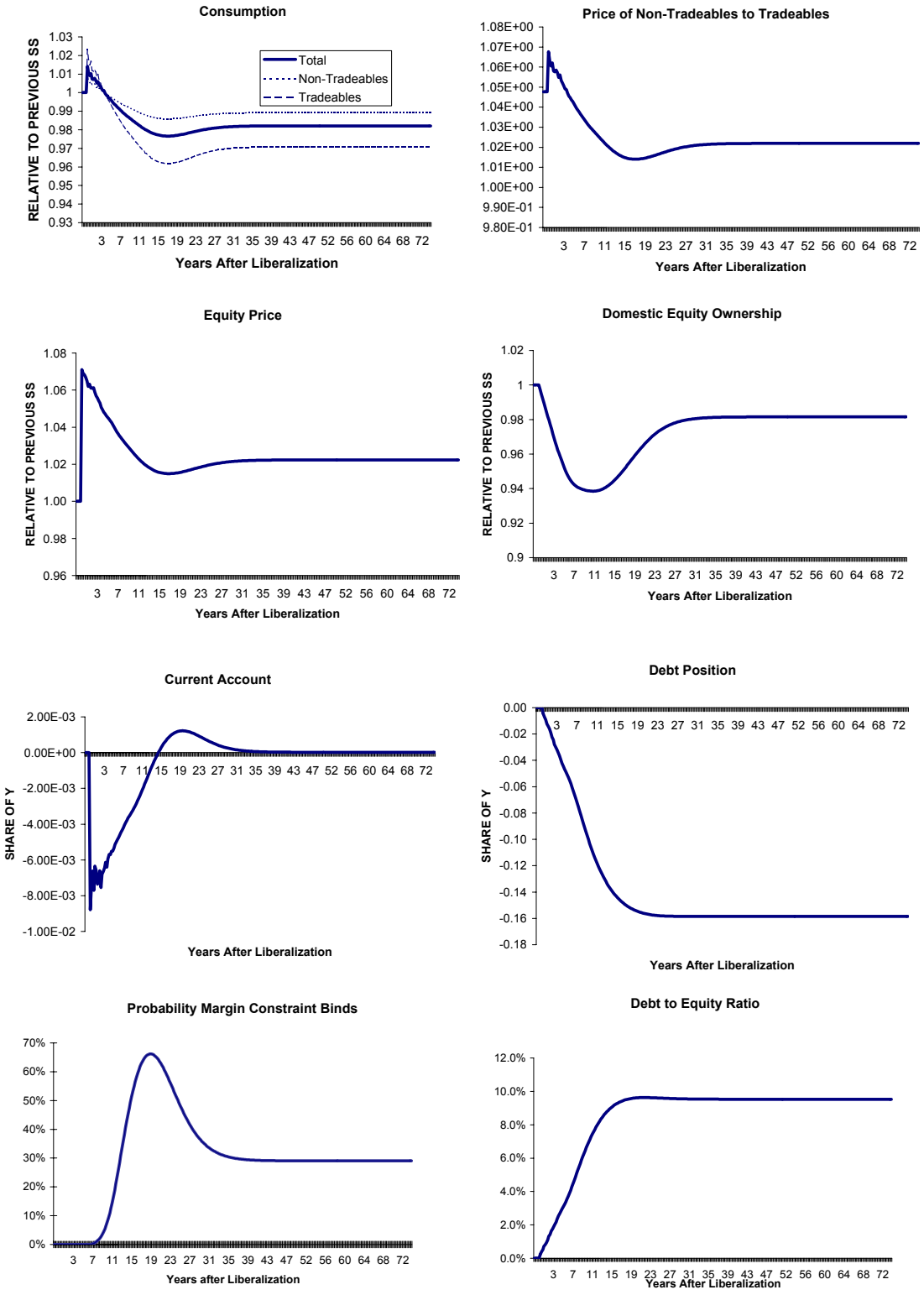
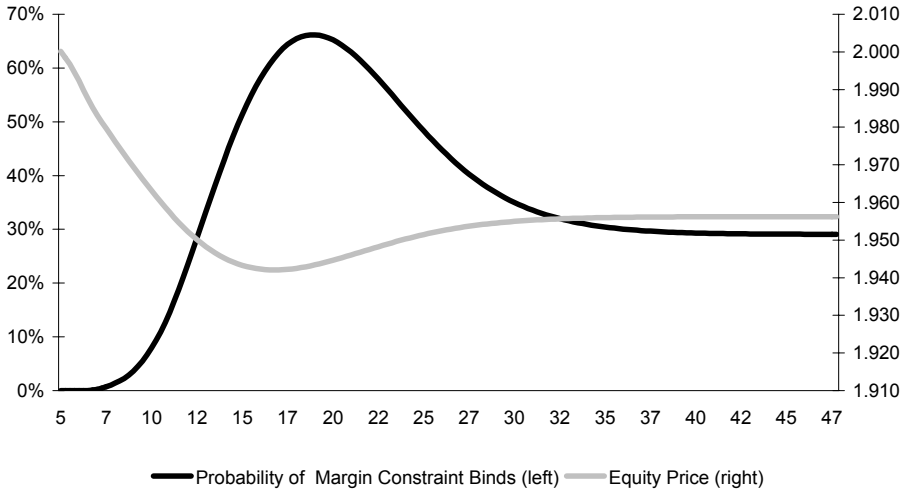
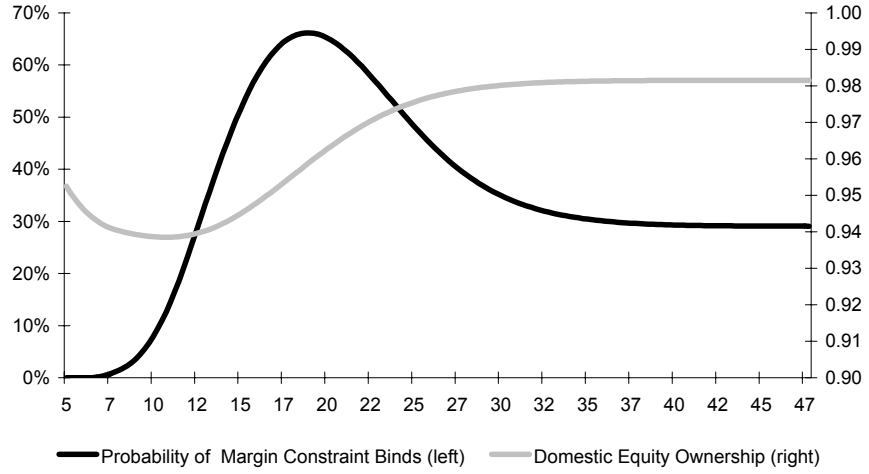


Figure 7: The Components of the Collateral Constraint





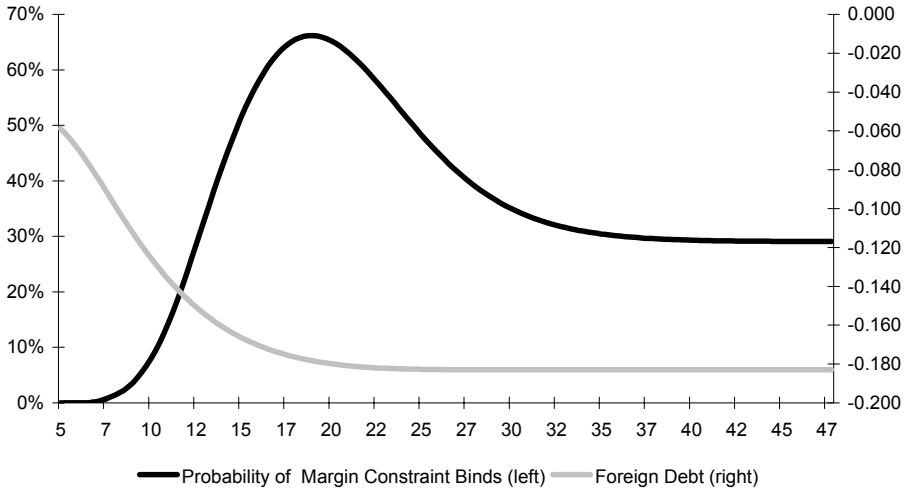


Figure 8: Comparison to Economy Without Collateral Constraints

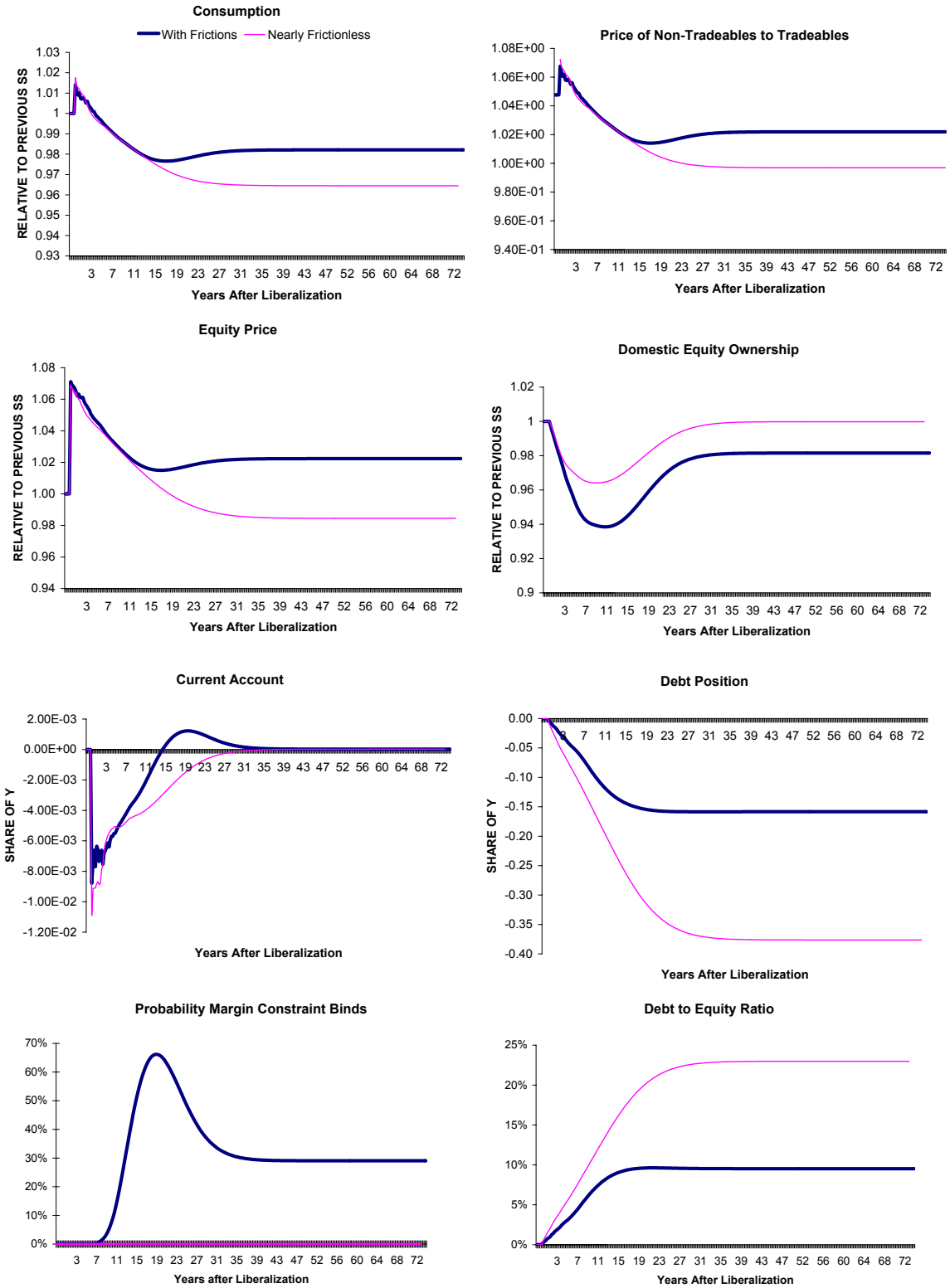


Figure 9: Sensitivity Analysis

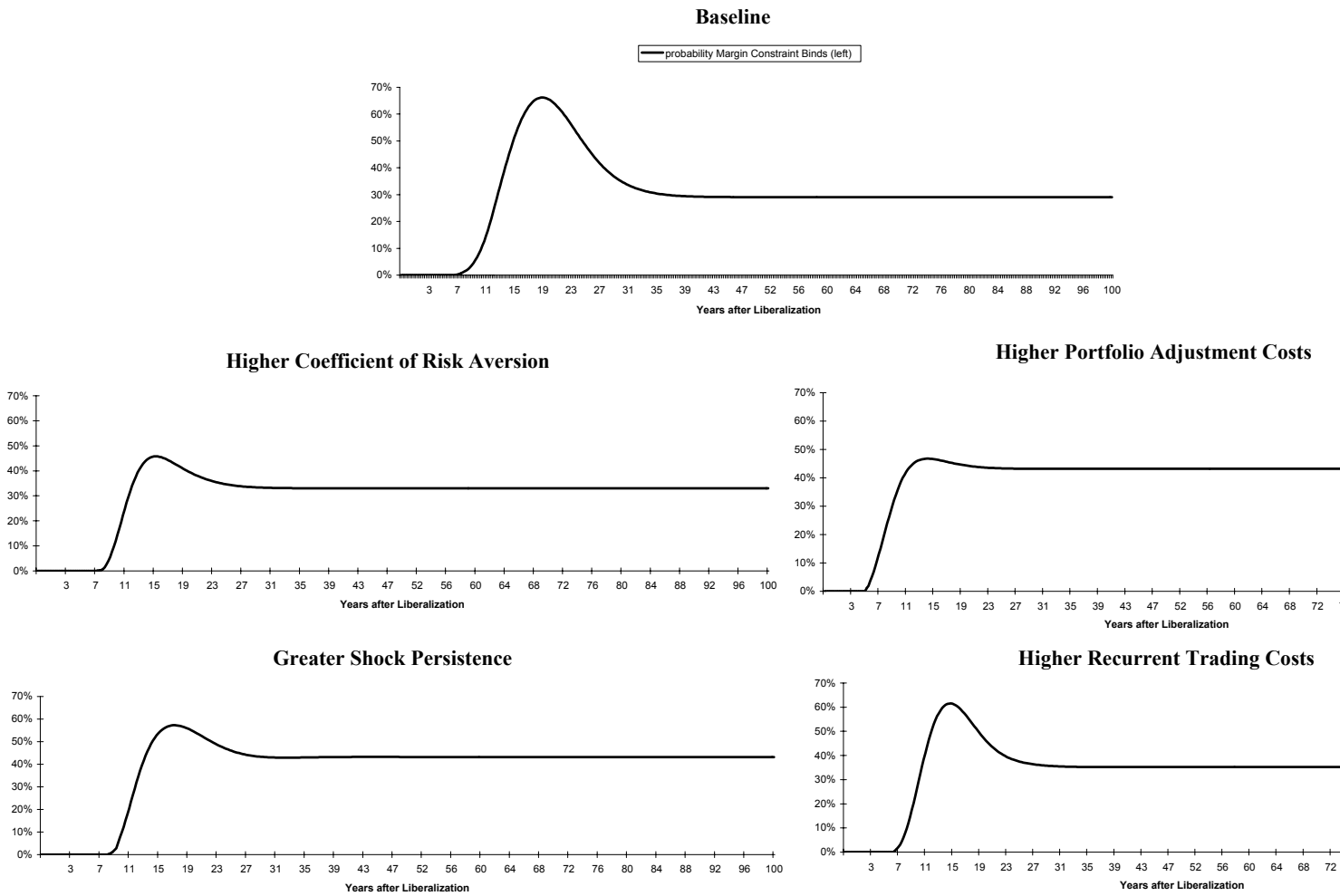


Figure 10: Comparing Ways To Liberalize

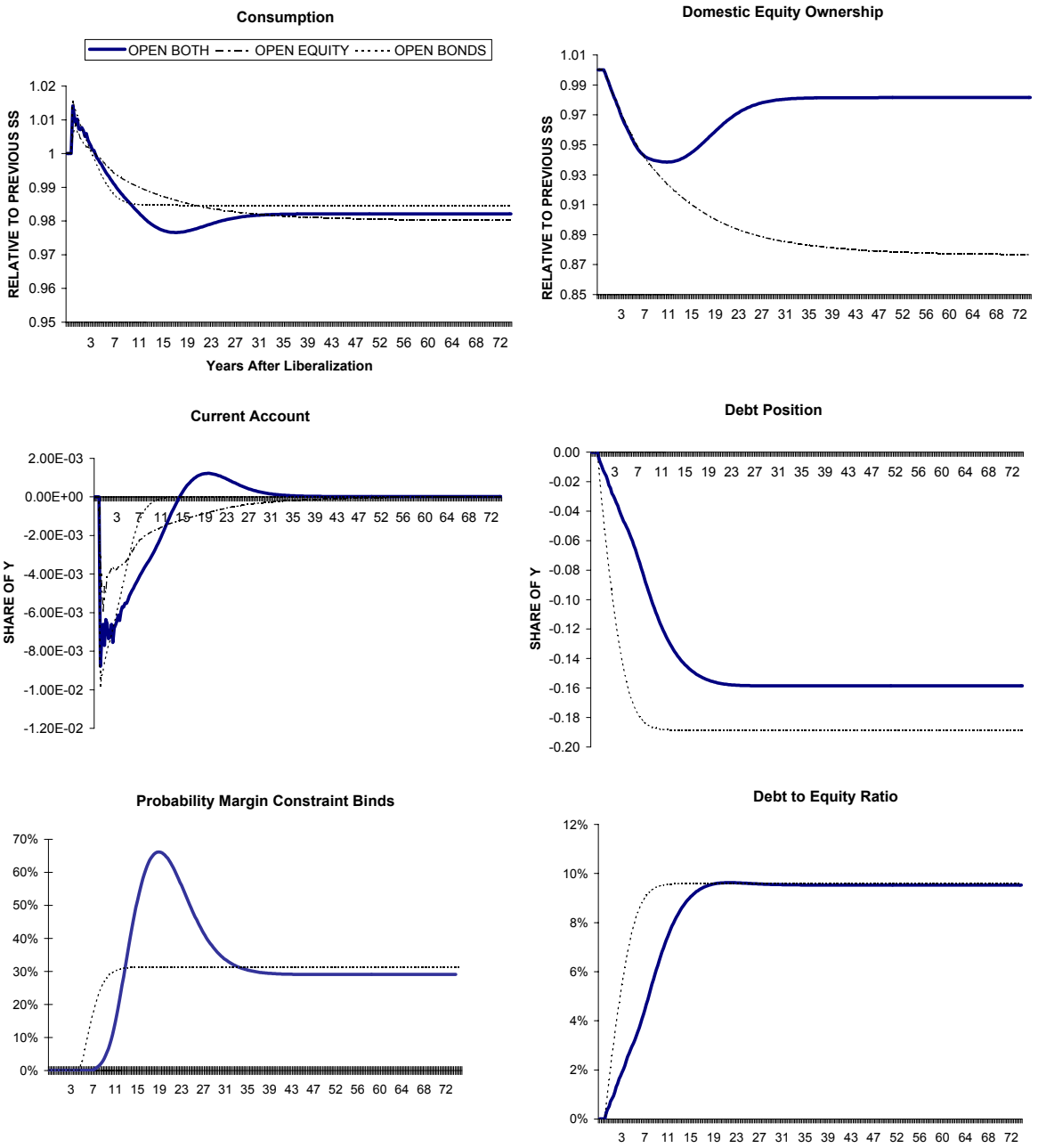


Table 1: Long Run Means of External Capital Structure Post-Capital Account Liberalization

	Net Debt Position As a Percent of GDP	Net Debt Position As a Percent of Equity Position
Without Collateral Constraints	37.6%	23.0%
Financial Frictions Baseline	15.8%	9.5%
Low portfolio adjustment costs	10.0%	9.4%
Low recurrent trading costs	11.9%	8.0%

Table 2: Welfare Comparisons Along Transition Path: Hicksian Equivalent Variation

	Years After Liberalization				
	First Year	First Five Years	First Ten Years	First Fifteen Years	Short and Long Run
Method of Liberalization					
I. Liberalize Just Bonds	0.47%	0.77%	0.52%	0.27%	0.037%
II. Liberalize Just Equity	0.22%	0.42%	0.33%	0.19%	0.021%
III. Liberalize Both	0.39%	0.71%	0.57%	0.33%	0.044%
IV. Liberalize Both (No Collateral Constraint)	0.50%	0.82%	0.63%	0.38%	0.045%

Notes: Welfare is measured as compensating variation, Lucas (1990)

Table 3: Long Run Business Cycle Moments

	mean	standard deviation (%)	standard deviation relative to GDP	correlation with GDP	first-order auto correlation
I. Liberalize Just Equity					
GDP	1.154	1.089	1.000	1.000	0.675
consumption	0.700	2.239	2.056	0.998	0.668
tradeables	0.267	1.222	1.122	0.941	0.670
non-tradeables	0.434	2.899	2.663	1.000	0.675
equity price	1.948	0.693	0.637	-0.815	0.834
price of non-tradeables/tradeables	1.019	2.366	2.173	-0.973	0.716
current account - GDP ratio	0.0001	0.201	0.184	-0.944	0.658
II. Liberalize Both					
GDP	1.155	1.078	1.000	1.000	0.674
consumption	0.702	2.197	2.038	0.995	0.665
tradeables	0.268	1.227	1.139	0.879	0.652
non-tradeables	0.434	2.868	2.661	1.000	0.674
equity price	1.956	0.653	0.606	-0.723	0.682
price of non-tradeables/tradeables	1.022	2.478	2.299	-0.950	0.711
current account - GDP ratio	0.000	0.276	0.256	-0.656	0.675
debt - GDP ratio	0.158	0.397	0.368	0.298	0.855
debt - equity ratio	0.093	0.450	0.418	-0.705	0.876
III. No Collateral Constraint					
GDP	1.150	1.061	1.000	1.000	0.619
consumption	0.689	2.160	2.036	0.993	0.535
tradeables	0.260	1.196	1.127	0.831	0.181
non-tradeables	0.429	2.843	2.679	1.000	0.619
equity price	1.884	0.812	0.765	-0.777	0.771
price of non-tradeables/tradeables	0.997	2.588	2.439	-0.940	0.795
current account - GDP ratio	0.000	0.290	0.273	-0.530	0.022
debt - GDP ratio	0.376	0.245	0.231	0.146	0.025
debt - equity ratio	0.231	1.018	0.959	-0.918	0.840