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Precautionary Demand for Foreign Assets in Sudden Stop Economies: An Assessment of the New Merchantilism[1]

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Abstract

Financial globalization was off to a rocky start in emerging economies hit by Sudden Stops in the 1990s. The surge in foreign reserves since then is viewed as a New Merchantilism in which reserves are a war-chest for defense against Sudden Stops. We conduct a quantitative assessment of this argument using a framework in which precautionary savings affect foreign assets via business cycle volatility, financial globalization, and endogenous Sudden Stops. Our results show that financial globalization and Sudden Stop risk are plausible explanations of the surge in reserves but cyclical volatility, which has declined in the globalization period, is not.

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"An absurdity does not cease to be an absurdity when we have discovered what were the appearances which made it plausible; and the Merchantile Theory could not fail to be seen in its true character when man began to explore into the foundations of things, and seek their premises from elementary facts, and not from the form and phrases of common discourse" (J. S. Mill (1848), Principles of Political Economy, p.5)

I. INTRODUCTION

The early stages of financial globalization in emerging economies were characterized by a series of financial debacles and economic crises known as *Sudden Stops*. The indexes of capital account liberalization constructed by Edwards (2005) and Chinn and Ito (2005) show that financial globalization started in emerging economies in the late 1980s (see Figure 1). The waves of Sudden Stops that followed began with the Mexican crisis of 1994–95. Table 1 lists 18 Sudden Stop episodes that occurred between 1994 and 2002. In addition, the period since the early 1990s witnessed a surge in foreign reserves in most Sudden Stop countries. As Table 1 shows, the median increase in reserves in these countries was 7.7 percent of GDP (measured as the cross-country median of the differences between each country's average reserves-to-GDP ratio from the year of the country's Sudden Stop to 2004 and the average from 1985 to the year of the Sudden Stop).[2] The increase was particularly sharp in the Asian Sudden Stop countries, where the median increase in reserves exceeded 13 percent of GDP![3]

A popular view in policy institutions and academic circles is that this large buildup of reserves represents a form of self-insurance that emerging economies have taken against the risk of future Sudden Stops. The argument is that Sudden Stop countries, having realized that the sudden loss of access to capital markets is a shortcoming of financial globalization, and aware of the limited financial mechanisms available to cope with Sudden Stops, opted for a New Merchantilism in which large holdings of reserves are a war-chest for defense against Sudden Stops. The studies by Aizenman and Lee (2007), Alfaro and Kanczuk (2006), Caballero and Panageas (2005), Choi, Sharma and Stromqvist (2007), Jeanne and Ranciere (2006) and Jeanne (2007) examine key theoretical and empirical features of this New Merchantilism, and the potential to develop better insurance mechanisms.

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[2] In most Sudden Stop countries the change in reserves has been much larger than the change in net foreign assets indicating large portfolio shifts that are beyond the scope of this paper. Our focus is on how much of the increase in assets can be explained by precautionary motives. Still, portfolio considerations can be important for studying the surge in reserves (Alfaro and Kanczuk, 2006; Jeanne 2007) and the dynamics of Sudden Stops (Durdu and Mendoza, 2006).

[3] Setting the breakpoint in the year of the Sudden Stop is not critical. Similar qualitative results showing a surge in reserves are obtained comparing average reserves of Sudden Stop countries for the 1986–2004 period with those for the 1970-1985 period. Since 1985 is often viewed as the starting year of the globalization process, we can also say that reserves surged along with financial globalization.

This paper conducts a quantitative assessment of the New Merchantilism. We use a dynamic stochastic general equilibrium framework of optimal precautionary demand for foreign assets in a small open economy with incomplete asset markets. We quantify the effects of three key factors that drive precautionary savings in this framework: (1) changes in the business cycle volatility of output, (2) financial globalization (i.e., the reduction of distortions affecting international asset trading), and (3) self-insurance against the risk of Sudden Stops.

The analysis proceeds in two stages. The first stage uses a canonical one-sector model of an endowment economy that faces non-insurable shocks in domestic income. These shocks are non-insurable because asset markets are incomplete, but the economy still has access to a frictionless credit market in which it can borrow or lend at the world's risk-free interest rate. The model is calibrated to match the variability and persistence of output in Sudden Stop economies, and then used to compute the optimal short- and long-run dynamics of foreign assets triggered by changes in output volatility and financial globalization.

The second stage of the analysis studies a two-sector production economy with liability dollarization and endogenous Sudden Stops. The economy has a tradable-goods sector and a non-tradable goods sector, and nontradables are produced with imported intermediate goods (which are priced in world markets). Liability dollarization is present because non-state-contingent debt is denominated in units of tradables. Here, we reexamine the adjustments in foreign assets driven by financial globalization and business cycle volatility under the assumption of a frictionless credit market. The main goal, however, is to quantify the increase in foreign assets that is justified by optimal self-insurance due to the risk of endogenous Sudden Stops. To this end, we introduce a collateral constraint that limits debt not to exceed a fraction of the value of total income in units of tradable goods. As Mendoza (2006a) explains, this credit-market imperfection causes endogenous Sudden Stops because of the strong amplification mechanism that results from combining liability dollarization with a Fisherian deflation of the relative price of nontradables. In this setup, the precautionary demand for foreign assets takes into account how foreign asset holdings alter the probability and the magnitude of Sudden Stops, both of which are equilibrium outcomes of the model.

The paper's quantitative analysis yields three main findings: First, financial globalization, even without Sudden Stops, can trigger significant increases in mean foreign asset holdings. Second, the risk of Sudden Stops can also produce significant increases in foreign assets, even when the long-run variability of output is unaffected by Sudden Stops. Third, changes in output volatility cannot explain the observed surge in foreign reserves. The models predict large increases in foreign assets in response to higher variability of income. In the data, however, there is no evidence of systematic increases in the standard deviation of cyclical output for Sudden Stop economies in the era of financial globalization (see Table 2 and Figures 2 and 3). In some of these countries volatility increased, but in many others it fell and this is also the case for the mean and median of the group. Looking at sectoral GDP volatility, we do find that the tradables GDP of Sudden Stop countries became more volatile (see Table 3), but not by the magnitudes that the model would require to explain the observed surge in reserves.

Our model also yields an important result in terms of the dynamics associated with the surge in reserves: The large buildup of foreign assets in response to financial globalization or Sudden Stop risk is a slow, gradual process characterized by current account surpluses and undervalued real exchange rates. These dynamics do not require central bank intervention to target the real exchange rate in efforts to promote exports. Hence, our results can resolve the dichotomy dividing self-insurance-based explanations of the surge in reserves (Aizenman and Lee, 2007) from those based on external surpluses and undervalued exchange rates (Dooley, Folkerts-Landau and Garber, 2003).

Our framework yields predictions for precautionary savings under two specifications of intertemporal preferences that have not been compared before: the Bewley-Aiyagari-Hugget, BAH, approach (which for a small open economy requires a constant, exogenous rate of time preference higher than the world interest rate) and the Uzawa-Epstein, UE, approach (which features an endogenous rate of time preference). The BAH approach is widely used in the precautionary savings literature, while the UE approach is often used in RBC models of small open economies with incomplete markets. Both approaches feature precautionary savings because agents build a buffer stock of savings to facilitate consumption smoothing. In particular, they assume that the marginal utility of consumption goes to infinity as consumption approaches zero, so agents are extremely averse to hold asset positions that leave them exposed to the risk of "very low" consumption at any point in time. However, the elasticity of mean foreign assets with respect to the interest rate differs sharply in the two approaches, and hence their quantitative implications for precautionary savings need to be studied separately.

The BAH approach requires a constant rate of time preference higher than the interest rate because, if the two rates are equal, optimal precautionary savings would imply accumulating an infinite amount of foreign assets: Agents desire a non-stochastic consumption stream, but they need an infinitely large buffer stock of assets to support it because income is stochastic and capital markets do not offer enough insurance instruments to diversify income risk fully. Mean foreign assets under this approach increase as the gap between the interest rate and the rate of time preference narrows, with mean foreign assets (and their elasticity) going to infinity as the rate of interest converges to the rate of time preference from below. Thus, at interest rates close to the rate of time preference, the BAH setup predicts that small variations in the interest rate trigger large adjustments in average foreign assets. By contrast, the UE approach models the rate of time preference as an increasing function of past consumption, but imposing conditions that limit the magnitude of this "impatience effect." This approach yields a long-run rate of time preference that converges to the world interest rate in a non-degenerate equilibrium, and a well-behaved stochastic stationary state in which mean asset holdings are less sensitive to changes in the world real interest rate. In fact, in our quantitative experiments, the elasticity of mean foreign assets in the UE setup is approximately constant at high or low interest rates.

A contribution of our analysis is that the effects of business cycle volatility, financial globalization and Sudden Stop risk on foreign assets are examined within a common framework and under alternative preference specifications. The existing literature has produced interesting results by examining these factors separately. Fogli and Perri (2006) study a two-country model in which the Great Moderation (the decline in relative output volatility of the United States vis-à-vis the rest of the world) leads to a build up of foreign assets in U.S. trading partners. The surge in foreign assets, however, is small relative to the magnitudes shown in Table 1. The Great Moderation has also resulted in higher output volatility of Sudden Stop economies relative to the United States, but driven largely by the moderation of U.S. business cycles—not by higher volatility in Sudden Stop economies (see Tables 2 and 4 and Figures 2 and 3). In our framework, this pattern of changes in relative volatility is akin to a permanent increase in the risk-free interest rate faced by Sudden Stop economies, which causes them to increase assets holdings due to similar effects as those that result from financial globalization. Thus, the surge in reserves in this scenario is *not* the direct result of self-insurance against higher business cycle volatility inside Sudden Stop countries, but the indirect result of lower U.S. volatility on the world interest rate.

Mendoza, Quadrini and Rios-Rull (2007) study how financial globalization affects foreign asset positions and their portfolio structure in a world composed of countries with varying degrees of financial development (i.e., asset market incompleteness) and inhabited by heterogenous agents that face non-insurable idiosyncratic risk. They find that financial integration leads to a large, gradual buildup of assets against the country with the highest degree of financial development. We focus instead on the implications of aggregate risk in a representative-agent small open economy, but our results are consistent with theirs in showing that financial globalization can lead to large increases in foreign asset holdings.

Mendoza (2002) and Durdu (2006) examine Sudden Stop models similar to the one studied here. Mendoza shows that when the model is calibrated to Mexican data, the shift from perfect credit markets to a world with Sudden Stops increases the average foreign assets-GDP ratio by 13.8 percentage points. Durdu examines how hedging and self-insurance options change with financial innovation in the form of GDP-indexed credit contracts.

The rest of the paper is organized as follows. Section 2 presents the one-sector model and examines its quantitative implications. Section 3 presents the two-sector model with liability dollarization and endogenous Sudden Stops. Section 4 concludes.

II. One-Sector Endowment Economy

A. Structure of the Model

Consider a small open economy inhabited by a representative agent, who consumes a composite good *c*. The agent's preferences are given by:

$$E_0\left[\sum_{t=0}^{\infty}\left\{\exp\left(-\sum_{\tau=0}^{t-1} v(c_\tau)\right)\right\}\frac{c_t^{1-\gamma}}{1-\gamma}\right], \tag{1}$$

$$v(c\ ) = \rho^{UE}\ln(1+c)\ \ or\ \ \ln(1+\rho^{BAH})$$

Period utility has constant-relative-risk-aversion (CRRA) form, with γ as the relative risk aversion coefficient. The time preference function *v(c)* takes one of two forms: (a) with the UE formulation, the rate of time preference is endogenous and given by $v(c) = \rho^{UE}\ln(1+c)$, where ρ^{UE}>0 measures the elasticity of the rate of time preference with respect to 1+*c*; (b) with the BAH formulation, the rate of time preference is given by the standard constant fraction 0<ρ^{BAH}<1 (i.e., the typical exogenous discount factor is $\beta \equiv 1/(1+\rho^{BAH})$).

The economy chooses consumption and foreign assets as to maximize (1) subject to the standard resource constraint:

$$c_t = \varepsilon_t y - b_{t+1} + b_t(1+r) + A \tag{2}$$

The economy's mean or trend income, *y*, is subject to random shocks, ε_t, which follow a first-order, irreducible Markov chain. Foreign assets, *b*, are one-period bonds traded in a frictionless global credit market. These bonds pay a net risk-free real interest rate equal to *r* (so the gross interest rate is given by $R \equiv 1+r$). Given that in the data absorption includes investment and government expenditures, and not just private consumption, we introduce a constant lump-sum level of exogenous absorption *A* that will allow us to calibrate the model to match output shares of *c* and *b* consistent with actual data.

B. Equilibrium

The optimization problem of this small open economy is analogous to the optimization problem of a single individual in the heterogenous-agents models of precautionary savings (e.g., Aiyagari, 1994 or Hugget, 1993). As in those models, CRRA utility implies that the marginal utility of consumption goes to infinity as consumption goes to zero from above, making the economy "extremely averse" to consumption and savings plans that would leave it exposed to the risk of "very low" consumption at any date and state of nature. To rule out these plans, agents in this economy impose on themselves Aiyagari's *Natural Debt Limit*, by which they never borrow more than the annuity value of the worst realization of income:

$b_{t+1} \geq -\min(\varepsilon_t y + A)/r$. In addition, following Aiyagari (1994), we can impose an ad-hoc debt limit ϕ such that $b_{t+1} \geq \phi \geq -\min(\varepsilon_t y + A)/r$.

The optimality condition of the economy's maximization problem is:

$$U_c(t) = \exp(-v(c_t))E_t[U_c(t+1)][1+r] \tag{3}$$

Note that $U_c(t)$ denotes the lifetime marginal utility of date-t consumption. In the BAH setup, $U_c(t)$ is just the standard period marginal utility of c_t. In the UE setup, however, $U_c(t)$ includes both the period marginal utility of c_t and the impatience effects by which changes in c_t affect the subjective discounting of all future utility flows after date *t*.

A competitive equilibrium for this small open economy is defined by stochastic sequences $[c_t, b_{t+1}]_{t=0}^{\infty}$ that satisfy the Euler equation (3) and the resource constraint (2) for all *t*. The structure of asset markets has important implications for this equilibrium. If the economy has access to complete insurance markets to fully diversify away all the risk of domestic income fluctuations, the equilibrium would feature a constant consumption stream and the economy's wealth position vis-à-vis the rest of the world would be time and state invariant. If the asset market is limited to non-state-contingent bonds, however, the wealth position changes over time and across states of nature, and consumption cannot attain a perfectly smooth path. With BAH preferences, the economy attains a well-defined long-run distribution of foreign assets (i.e., a well-defined stochastic stationary equilibrium), only if $\beta[1+r] < 1$.[4] With UE preferences, a well-defined long-run distribution of assets exists if $\rho^{UE} \leq \gamma$ (see Epstein, 1983). That is, UE preferences limit the size of impatience effects by requiring the elasticity of the rate of time preference with respect to consumption not to exceed the inverse of the elasticity of intertemporal substitution.[5]

The competitive equilibrium of the economy can be characterized in recursive form in terms of a decision rule for bonds at date t+1, *b′(b,*ε*)*, as a deterministic function of date-t assets *b* and the date-t realization of income ε, that solves the following Bellman equation:

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[4] In this case, the marginal benefit of an extra unit of foreign assets follows a non-negative supermartingale that converges almost surely to a nonnegative random variable (see Ch. 17 in Ljungqvist and Sargent, 2004). Thus, convergence is attained with the marginal benefit of savings remaining finite and moving randomly in the long run, and hence the long-run averages of assets and consumption also remain finite. In contrast, with $\beta(1+r) \geq 1$, assets diverge to infinity in the long run because marginal utility converges to zero almost surely, and with CRRA preferences this implies that consumption, and hence assets, diverge to infinity.

[5] Foreign assets converge to a well-defined long-run distribution because the rate of time preference increases (decreases) relative to the interest rate if consumption and assets rise (fall) too much in the long run, and this changes incentives for savings in favor of reducing (increasing) asset holdings.

$$V(b,\varepsilon) = \max_{b'} \left\{ \frac{c^{1-\gamma}}{1-\gamma} + \exp(-v(c))E[V(b',\varepsilon')] \right\} \tag{4}$$

$$s.t. \qquad c = \varepsilon y - b' + bR + A$$

In the quantitative analysis that follows, we solve this Bellman equation using value function iteration. Foreign assets take values defined over a discrete grid with *n* nodes: $(b,b') \in B = \{b_1 < b_2 < ... < b_n\}$. We set *n*=1000 to reduce numerical approximation error in the decision rule. The Markov process of income is defined by a vector of *j* realizations, $\varepsilon \in \mathrm{E} = \{\varepsilon_1 < \varepsilon_2 < ... < \varepsilon_j\}$ and an *j*x*j* transition probability matrix, $\pi(\varepsilon_{t+1} \mid \varepsilon_t)$. We use Tauchen and Hussey's (1991) quadrature algorithm (THQA) to transform time-series processes of income derived from actual data into Markov processes for model simulations.

C. Calibration

The baseline calibration of the model is designed so that the deterministic stationary equilibrium using UE preferences matches a set of statistics from the Mexican economy, including the ratio of net foreign assets to GDP. The calibration to Mexico is not critical for our key findings. As we discuss later, the results of sensitivity analysis show that our findings are robust to changes in parameters and in the variability and persistence of output in the range of those observed in the countries listed in Table 1.

The BAH setup does not have a well-defined *deterministic* stationary equilibrium, since without uncertainty $\beta R < 1$ implies that consumption falls at a gross rate of $(\beta R)^{1/\gamma}$ until the economy hits the debt limit ϕ. Hence, to complete the calibration of the BAH setup we keep all the parameters as in the UE setup and set ϕ and β to values such that the model with BAH preferences matches the long-run average of foreign assets and the cyclical standard deviation of consumption in the data.

The baseline calibration parameters are listed in Table 5. The coefficient of relative risk aversion is set to γ=2, which is the standard value in quantitative dynamic general equilibrium models. The mean of income is normalized to *y*=1 without loss of generality. Hence, the steady-state allocations can be interpreted as ratios relative to average GDP. The steady-state ratio of net foreign assets to GDP is set to -44 percent (*b*=-.44), which is the average of Mexico's net foreign assets-GDP ratio over the period 1985-2004 in the database constructed by Lane and Milesi-Ferretti (2006). The consumption-GDP ratio is set to 69.2 percent (*c*=0.692), in line with the average consumption-output ratio in Mexican data. The real interest rate is set to 5.9 percent (*R*=1.059), which is the average of Uribe and Yue's (2006) real interest rate including the EMBI spread for Mexico. The model does not take into account default risk, but since the real interest rate is constant, it seems more reasonable to set it at a constant representative of the effective financing cost of Mexico's foreign debt than to set it equal to the real interest rate on U.S. T-Bills. Given the values of y, c, b and R, the resource constraint implies that $A=y+b(R-1)-c=0.282$.

In the UE setup, the value of the time preference elasticity follows from the steady-state condition that sets the rate of time preference equal to R: $\rho^{UE} = \ln(R)/\ln(1+c) = 0.109$. This implies a subjective discount factor of $(1+c)^{-0.109} = 0.944$. In the BAH setup, we match Mexico's average net foreign assets of -44 percent and the standard deviation of consumption over the business cycle (3.28 percent) by setting ϕ=-0.51 and β=0.94, which implies $\rho^{BAH} = 0.064$. Notice that in theory, for any given ϕ<-0.44, there is a value of β high enough so that the model with BAH preferences yields an average of assets of -44 percent. However, we found that for ϕ<-1, the values of β that can yield this mean of assets result in stochastic steady states that assign non-trivial probabilities to very high debt ratios larger than 100 percent of GDP, and the variability of consumption exceeds the actual measure by large margins. The Lane-Milesi Ferretti database shows that emerging economies (defined as middle income developing countries) very rarely reach net foreign asset positions larger than GDP. On the other hand, with tight ad-hoc debt limits of 50 percent of GDP or less, the long-run distribution of assets predicts that the economy spends most of the time at the debt limit (i.e., the long-run probability of observing $b=\phi$ is "too high").

The Markov process of income shocks is set to match the standard deviation and first-order autocorrelation of the Hodrick-Prescott-filtered cyclical component of GDP in annual Mexican data for the 1965-2005 period ($\sigma_y = 3.301\%$ and $\rho_y = 0.597$ respectively). The HP filter ensures that cyclical GDP follows a stationary process, and the AR(1) specification ($y_t = \rho_y y_{t-1} + e_t$) cannot be rejected. Thus, the underlying standard deviation of output innovations is $\sigma_e = \sqrt{\sigma_y^2(1-\rho_y^2)} = 2.648$ percent. Using 5 nodes in the vector of realizations, THQA produces a Markov process for ε that yields 3.285 percent standard deviation in output with 0.550 autocorrelation and 2.64 percent standard deviation in output innovations. Hence, the Markov process is an accurate approximation to the actual time-series process of Mexico's cyclical GDP.

Before reviewing the quantitative findings, it is important to explain how precautionary savings are measured. Precautionary savings are defined as the savings that agents accumulate due to the presence of non-insurable idiosyncratic risk. Hence, precautionary savings are usually measured as the difference between the long-run average of assets predicted by a model and the level of assets that the same model would predict in the long run in the absence of uncertainty. In the BAH setup, this is the excess of the average assets in the stochastic steady state relative to the debt limit ϕ, because without uncertainty the BAH economy reduces its asset position until it hits ϕ. In contrast, precautionary savings in the UE setup is the excess of the long-run average of assets relative to a well-defined deterministic steady state obtained by equating the endogenous rate of time preference with the world interest rate. Because of this difference in the deterministic steady state of assets in the BAH and UE setups, it can also be informative to study changes in precautionary asset holdings by simply comparing long-run averages of foreign assets.

D. Baseline Results

Table 6 lists the statistical moments that characterize the stochastic steady state of the model under the baseline calibration for UE and BAH preferences. The table also shows results for alternative calibrations with higher output autocorrelation (ρ_y=0.7), higher and lower variability in output innovations (σ_e=4 percent and σ_e =2 percent, which yield σ_y=5 percent and σ_y =2.5 percent respectively) and higher risk aversion (γ=5).

The business cycle moments listed in the Baseline column of Table 6 are standard findings in intertemporal models of small open, endowment economies with incomplete asset markets. Consumption behavior is consistent with typical business cycle features: consumption is slightly less volatile than output, it displays positive correlation with GDP and positive serial autocorrelation. On the other hand, since precautionary asset demand with the aim of smoothing consumption is the main driving force of foreign asset dynamics in the model, the cyclical behavior of net exports and the current account is counterfactual. In particular, both external accounts are strongly positively correlated with output, while actual business cycles display countercyclical external accounts. We show in Section 3 that this result is reversed in the two-sector model with production.

The main result in Table 6 relates to the stock of precautionary savings. The Baseline results show that under UE preferences precautionary savings measure nearly 2.5 percent of GDP. Under BAH preferences, however, precautionary savings are nearly 5 times larger at 9.6 percent of GDP. The Baseline business cycle moments under both preferences specifications show important differences as a result. In particular, foreign assets fluctuate significantly more, are less correlated with output, and display higher serial autocorrelation in the UE setup than in the BAH setup. This is because the BAH setup matches Mexico's average net foreign assets-GDP ratio in the data by imposing an ad-hoc debt limit of 51 percent of GDP, and the probability of hitting it in the long run is 10.2 percent. Notice also that these significant differences in the characteristics of the stochastic steady states of the two setups are obtained with small differences in the behavior of the subjective discount factors. On average, the discount factors of the BAH and UE setup are virtually identical, and in the UE setup the standard deviation of the endogenous discount factor is very small, at about 4 percent of the variability of output. However, the endogenous discount factor is negatively correlated with GDP (since consumption is procyclical) and its fluctuations are highly persistent.

Table 6 shows that changes in the variability and persistence of output and in the degree of risk aversion preserve the qualitative features of the comparison across the BAH and UE Baseline results with small quantitative changes. Increases in ρ_y, σ_e and γ produce significant increases in precautionary savings, but the BAH setup always produces a larger stock of precautionary savings than the UE specification. With the autocorrelation of output at 0.7 or the standard deviation of output at 5 percent, precautionary savings in the BAH setup are about 4 times larger than in the UE setup, but the factor is just a little above 2 with the coefficient of relative risk aversion set at 5. The high-risk-aversion case is also the one that yields the largest precautionary savings in both setups (10.4 and 23.8 percent of GDP in the UE and BAH specifications respectively). Note also that both the UE and the BAH setups can generate outcomes in which consumption variability exceeds income variability (by about 8 percent in the simulations with ρ_y =0.7 and up to 25 percent in the UE scenario with γ=5). Kose, Prasad and Terrones (2003) identified consumption variability in excess of income variability as a puzzling feature of the data of emerging economies (see also Table 2). Our results suggest that self-insurance under incomplete asset markets may help explain this puzzle.

The high serial autocorrelation coefficients of foreign assets reported in Table 6 (0.99 in the UE baseline, 0.959 in the BAH baseline) indicate that the adjustment of foreign assets to its long-run average in the stochastic steady state is a slow, gradual process under both preference specifications. Figures 4–5 illustrate further this slow convergence. Figure 4 shows the transitional dynamics of the cumulative distribution function (CDF) of foreign assets in the BAH and UE Baseline simulations, starting from the lowest asset position with nontrivial probability in the stochastic steady state. The intuition is that as the economy's business cycle evolves, this is the lowest asset position that can be reached with positive probability in the long run. Once the economy hits this lowest asset position, the plots show the evolution of the CDFs of foreign assets as the economy returns to the stochastic steady state. The plots show CDFs after 2, 5, 10, and 15 years and also the long-run CDFs. Clearly, even after 15 years the CDFs are still distant from the long-run distributions.

Figure 5 shows the transitional dynamics of the foreign assets-GDP ratio in the Baseline simulations, plotted in percent relative to long-run averages. The transitional dynamics are computed as the forecast functions of the equilibrium Markov process of the foreign assets-GDP ratio conditional on initial conditions for which: (a) foreign assets take the lowest value with positive long-run probability; and (b) the income shock is neutral (i.e., ε=1). The plots show that convergence to the long-run average of assets takes about 40 years in the BAH setup and more than 80 years in the UE setup. Note, however, that while the initial condition for the BAH plot is a foreign assets-GDP ratio nearly 10 percentage points below the long-run average, with a long-run probability of 10.2 percent (which corresponds to the debt limit, ϕ), the initial condition for the UE plot is a ratio nearly 48 percentage points below the long-run average and with a long-run probability of only 0.1 percent. The two initial conditions defined by the criterion of having the "lowest positive long-run probability" are therefore different in the UE and BAH setups. Hence, Figures 4-5 show that convergence is slow in both models, but comparisons across the BAH and UE plots need to keep in mind this caveat.

E. Self-Insurance and Business Cycle Volatility

How much do changes in the cyclical variability of output affect foreign asset positions in the long run via self-insurance motives? Figure 6a shows the increase in precautionary savings as σ_e rises so that the standard deviation of GDP rises from 1 to 8 percent (keeping the serial autocorrelation of GDP constant). Figure 6b is a similar plot but for increases in the autocorrelation of GDP from 0 to 0.8. In this case we keep σ_e constant but the standard deviation of GDP still increases as its autocorrelation rises (since $\sigma_y^2 = \sigma_\varepsilon^2/(1-\rho_y^2)$).

Figures 6a shows that increases in output variability produce large increases in precautionary demand for foreign assets regardless of the preferences specification (although the BAH setup always yields higher precautionary savings than the UE setup). Figure 6b shows similar qualitative results when the autocorrelation of GDP rises, but quantitatively the effects on precautionary savings are weaker. If we examine the long-run averages of foreign asset-GDP ratios instead of precautionary savings, the UE setup produces larger (smaller) mean asset positions than the BAH setup at lower (higher) levels of output variability, but the elasticity of the average assets-GDP ratio to changes in the variability and persistence of output is higher with BAH preferences than with UE preferences.

Unfortunately, the data cast serious doubt on the hypothesis that foreign reserves have increased sharply in Sudden Stop countries because of increased output variability (see Table 2 and Figures 2 and 3). Figure 2 shows that output volatility is lower in the post-globalization period in more than half of the Sudden Stop countries. Figure 3 shows that the mean and median standard deviation of output in 20-year rolling windows have changed slightly in the 3 to 4.5 percent range, and in fact they have been in a steady decline since the late 1990s. Table 2 shows that the median standard deviation of GDP in Sudden Stop countries for the full 1965–2005 period is about 3.5 percent, and this volatility measure fell from 3.5 percent before the Globalization period (1965–1985) to 3.1 percent in the Globalization period (1986–2005). Hence, in several countries volatility *fell* rather than increased, and in this case the model predicts a reduction in foreign assets. Even for the subset of countries where volatility rose, only in the extreme cases of Peru and Thailand (which show the largest increases in volatility of about 3.5 percentage points before and after Globalization) we find evidence of volatility increases of the magnitude that can account for the observed increases in reserves reported in Table 1. Figure 6b indicates that the model with UE (BAH) preferences needs an increase in output volatility of more than 4 (1.5) percentage points to account for the observed surge in reserves as a result of self insurance.

We conclude from this analysis that while increases in the cyclical volatility of output can produce large increases in foreign asset positions, the evidence in the data does not show that output variability has increased sharply and systematically across Sudden Stop countries. Hence, higher long-run business cycle volatility does not seem a plausible explanation of the surge in reserves in these countries.

F. Financial Globalization Effects on Foreign Assets

We study next the effects of financial globalization on foreign asset holdings and precautionary savings. To this end, we introduce into the model a time-invariant distortionary tax on foreign asset returns at rate τ that is intended to represent the combined effect of all forms of controls on capital account transactions and global asset trading costs proportional to asset returns. The revenue or outlays generated by this "effective tax" (depending on whether b is positive or negative) are rebated to agents as a lump sum transfer $T_t = b_t r \tau$, but agents take T_t as given. Thus, the agents' budget constraint is now

$$c_t = \varepsilon_t y - b_{t+1} + b_t\left[1 + r(1-\tau)\right] + T_t + A$$

The resource constraint of the economy remains as in eq. (2).

For the economy with BAH preferences, we can still write the recursive competitive equilibrium as the solution of a single Bellman equation by taking advantage of the fact that the equilibrium of the economy distorted by τ is equivalent to that of an economy without distortions but with a lower discount factor. In particular, if we define τ^R as the tax on R equivalent to the corresponding tax on r (i.e., the value of τ^R that satisfies $R(1-\tau^R) = 1 + r(1-\tau)$, which is $\tau^R = r\tau / R$), the competitive equilibrium is given by the same Bellman equation as in (4) but with the discount factor set as $\exp(-v(c))(1-\tau^R)$. This equivalence does not hold for the UE setup because of the endogenous discount factor. In this case, however, we approximate the recursive competitive equilibrium by solving equation. (4) subject to the following budget constraint: $c = \varepsilon y - b' + b[1 + r(1-\tau)] + r\tau\bar{b} + A$. This formulation uses a time-invariant lump sum transfer set at $r\tau\bar{b}$, where $\bar{b}$ is the long-run average of foreign assets. This guarantees that at the average of the stochastic steady state the solution of the Bellman equation for the model with UE preferences satisfies the optimality conditions of the competitive equilibrium, and for values of b other than $\bar{b}$ it reduces the size of the wealth effects that would be introduced by ignoring the lump-sum rebate and simply using the resource constraint as in (2). We checked the accuracy of this approximation by applying it to the model with BAH preferences and then comparing the results with the exact competitive equilibrium solutions obtained using the tax-adjusted discount factor. For values of $\tau \leq 0.84$ the two algorithms yield average asset-GDP ratios that are at most 1/10 of a percent apart.

We consider tax rates that range from 0 to 27 percent, and we adjust the calibration so that at a zero tax rate the BAH setup approaches the complete-markets equilibrium (i.e., we set β=1/R, so that the domestic rate of time preference matches the world interest rate). Hence, in this case the lack of financial integration (which implies nonzero values of τ) represents also the "severity" of market incompleteness, as reflected in the gap between the tax-adjusted rate of time preference and the world real interest rate.

Figure 7a and 7b plot the long-run averages of foreign assets and precautionary savings against the tax on capital flows under both BAH and UE preferences. For the BAH setup, we show curves for three values of ϕ: the natural debt limit, ϕ = -2, and ϕ = -1 (which imply limits of -200 and -100 percent of average GDP respectively). As the tax approaches zero, b and precautionary savings go to infinity because we approach $\beta R(1-\tau^k)=1$ and agents desire an infinity amount of self-insurance. Conversely, at high tax rates the relationship between taxes and mean asset holdings vanishes as the economy spends most of the time at the debt limit. This occurs at tax rates in excess of 10 percent for all three scenarios of ϕ. In contrast, at tax rates between 0.5 and 10 percent, the BAH setup predicts that the long-run average b/y ratio increases sharply as the tax falls even by small amounts. Thus, this setup predicts that in the early stages of financial globalization foreign assets may respond little to the opening of the capital account, while later on, further financial integration efforts that may imply small changes in effective distortions on asset trading (small changes in τ) produce large changes in the long-run average of b/y. These effects are the strongest if the only limit on debt is the natural debt limit. In this case, a cut in τ from 8 percent to 0.5 percent increases the mean b/y ratio from -10 times GDP to about -154 percent of GDP, and precautionary savings rise from 81 percent to about 9.4 times GDP. But the effects are still large with much tighter debt limits. With ϕ=-1, the same tax cut increases average b/y from -90 percent to a positive position of about 20 percent of GDP, and precautionary savings rise from 10 to 120 percent of GDP.

The effects of financial globalization using UE preferences also show large increases in the long-run average of the ratio of foreign assets to GDP. In this case, cutting τ from 8 to 0.5 percent increases the long-run average of foreign assets from -156 percent of GDP to almost -45 percent of GDP. On the other hand, precautionary savings are approximately unchanged. This result highlights a key difference between the BAH and UE preference specifications: When τ changes, the UE setup separates the savings effect resulting from the increase in the post-tax return on assets even without uncertainty (i.e., the deterministic steady state of b

rises as τ falls because the return to savings rises and the rate of time preference adjusts accordingly), from the effect due solely to precautionary savings (i.e., the effect on the excess of mean foreign asset holding in the stochastic model relative to the deterministic steady state). In the BAH setup the two effects cannot be separated because the deterministic steady state is invariant to the tax (since without uncertainty assets fall until they hit ϕ for any $\tau>0$). Thus, while the model predicts large increases in foreign assets as a result of financial globalization under both BAH and UE preferences, the results of the UE setup suggest that the fraction that can be attributed to precautionary savings per se could be small.

Two important additional observations should be noted about these results. First, whether financial globalization is a good explanation of the observed surge in reserves in Sudden Stop economies depends on the timing and magnitude of the removal of barriers to international asset trading (i.e., how high was τ when globalization started and how much has it fallen). Certainly, the results in Figures 7a-b indicate that if Sudden Stop economies have moved closer to a regime of unrestricted global asset trading (as the indicators in Figure 1 suggest), the expected increases in foreign assets can be easily as large as those observed in the data. Second, the results also depend on the degree of completeness of the global capital markets that can be accessed with financial globalization. The exercise in this Section assumes that in the BAH setting, $\tau=0$ implies that those global capital markets provide perfect insurance. In contrast, the results under the UE specification maintain market incompleteness even when $\tau=0$. The fact that both specifications predict large increases in foreign assets as financial globalization strengthens suggests that the strong assumption of market completeness at $\tau=0$ is the BAH setup is not critical for the result. The large differences in precautionary savings across the BAH and UE setups, however, do hinge on this assumption.

The large increase in the long-run average of foreign assets as a result of financial integration, and the slow transitional dynamics of foreign assets documented earlier, echo the results of Mendoza, Quadrini and Rios-Rull (2007). However, the results are driven by different mechanisms in the two studies. Mendoza et al. obtain their results because of the adjustments in the within-country and cross-country distributions of wealth of two countries with different degrees of market incompleteness. As the countries move from financial autarky to financial globalization, the risk-free interest rate rises relative to autarky for the less-financially-developed country, and this rise alters precautionary savings behavior across individuals within the country leading to an increase in aggregate net foreign assets. Wealthy agents that save reap the gains of this increase, while poor agents that borrow are made significantly worse off. There is no aggregate risk but their model is calibrated to the observed variability of household earnings and firm profits, which is substantially higher than overall GDP variability. In contrast, our results focus only on aggregate uncertainty and the savings response of a single representative agent.

In summary, we find that financial globalization can be an important force driving the sharp increase in foreign reserves in Sudden Stop economies (and in emerging economies in general). The role of "pure" precautionary savings, however, is not as clear because we can get results in the setup with UE preferences where the large increase in foreign assets is due to the increased incentives for saving in foreign assets even in the absence of uncertainty.

III. Two-Sector Production Economy

A. Structure of the Model

The two-sector model differs from the one-sector model in four key respects:

1) Consumption includes tradable goods (c^T) and nontradable goods (c^N) with aggregate consumption defined by a constant-elasticity-of-substitution (CES) function:

$$c(c_t^T, c_t^N) = \left[a\left(c_t^T\right)^{-\mu} + (1-a)\left(c_t^N\right)^{-\mu}\right]^{-\frac{1}{\mu}}, \quad a > 0,\ \mu \geq -1. \tag{5}$$

The elasticity of substitution between tradables and nontradables is given by $1/(1+\mu)$, and the CES weighting factor is given by a.

2) Nontradable goods are produced by a representative firm using imported intermediate goods (m) as the single variable input of a neoclassical production technology:

$$y_t^N = z_t Z m_t^{\alpha}, \qquad 0 \leq \alpha \leq 1. \tag{6}$$

Z represents the trend level of total factor productivity (TFP) and it also includes the effects of any fixed factors, z_t is a stochastic TFP shock, and α is the share of imported inputs in gross output. The domestic market of nontradable goods and the world market of intermediate goods are competitive, and thus the profit-maximizing demand for imported inputs is given by a standard marginal productivity rule:

$$p_t^N \alpha z_t Z m_t^{\alpha-1} = p^m \tag{7}$$

In this expression, p^m represents the world-determined price of imported inputs relative to tradable consumer goods, which is kept constant for simplicity, and p_t^N denotes the price of nontradables relative to tradables, which is determined inside the small open economy. At equilibrium, this price must also match the household's marginal rate of substitution between tradables and nontradables:

$$p_t^N = \left(\frac{1-a}{a}\right)\left(\frac{c_t^T}{c_t^N}\right)^{1+\mu} \tag{8}$$

3) The economy has new budget and resource constraints. The budget constraint of households in the competitive equilibrium is:

$$c_t^T + p_t^N c_t^N = \varepsilon_t^T y^T + A^T + \pi_t^N + p_t^N A^N - b_{t+1} + b_t R \quad (9)$$

where $\pi_t^N = p_t^N y_t^N - p^m m_t$ represents profits from firms in the nontradables sector. The technology in (6) has decreasing returns, and profits are positive and equal to 1-α of the value of nontradables output. These profits are also equal to the value of nontradables GDP in units of tradables (i.e., gross output minus the cost of intermediate goods). The endowment of tradables is stochastic, so the economy now faces two Markov shocks, one hitting tradables output and one hitting TFP in nontradables. Given the firm's optimality condition (7), the definition of profits, and market clearing in the nontradables sector, it follows that the sectoral resource constraints are:

$$c_t^T = \varepsilon_t^T y^T - b_{t+1} + b_t (1 + r) + A^T - p^m m_t \quad (10)$$

$$c_t^N = y_t^N + A^N \quad (11)$$

Constraint (10) assumes that foreign assets are denominated in units of tradables, so this economy displays liability dollarization (when it borrows, its debt is in units of tradables).

4) We consider the possibility that agents face a collateral constraint in asset markets. In particular, lenders limit credit to a fraction κ of the market value of the total income of domestic agents in units of tradables, and up to a maximum Ω:[6]

$$b_{t+1} \geq -\kappa \left[\varepsilon_t^T y^T + \pi_t^N \right] \geq \Omega \quad (12)$$

The value of income in the right-hand-side of (12) is equal *at equilibrium* to the economy's total GDP valued at tradables goods prices, so (12) can be viewed as a constraint on the economy's debt-GDP ratio. The constraint is endogenous, however, because the bond position and the price and production of nontradables are endogenous, and there is feedback between borrowing decisions and the value of nontradables GDP (as explained below).

It is critical to note that agents take as given the price of nontradables. Hence, they do not internalize the effect of their consumption and bond decisions on the equilibrium price, and therefore the effects of changes in the equilibrium price and production of nontradables on the ability to borrow are also not internalized. As a result, the model features a credit-market externality by which individual choices affect the economy's ability to borrow (see Uribe, 2006 and Korinek, 2007).

[6] This rules out equilibria in which the constraint could be satisfied at very high debt levels that prop up c^T and p^N. For example, Ω could be set at the debt that would be contracted without credit constraints (i.e., creditors do not lend more than what they would have without the constraint).

B. Equilibrium and Amplification with Debt-Deflation

The characteristics of the equilibrium of the one-sector economy described in *2.2* extend to the two-sector economy. In particular, the CES aggregator preserves the Inada condition that makes period marginal utility go to infinity as c^T or c^N go to zero from above. Hence, agents will self-insure to rule out stochastic intertemporal sequences that could expose them to the risk of "very low" consumption of tradables. The natural debt limit that guarantees this outcome is $b_{t+1} \geq -\min(\varepsilon_t^T y^T + A^T - p^m m_t)/r$.[7] Since tradables income is only a fraction of total income, this natural debt limit is tighter than the one in the one-sector economy. The agents may also face a higher degree of market incompleteness inasmuch as there is no vehicle to self-insure directly against the risk of fluctuations in nontradables income. Endogenous changes in the price and output of nontradables can, however, provide implicit insurance depending on how substitutable are tradables and nontradables in consumption (i.e., on the value of μ) and on the equilibrium correlation between nontradables and tradables income (both valued at tradables goods prices).

The collateral constraint (12) introduces a borrowing limit that is "occasionally binding." As explained in Mendoza (2005) and (2006a), in the states in which this constraint binds, the Euler equation for tradables consumption includes an endogenous Lagrange multiplier η_t that represents the shadow value of the credit limit:

$$U_{c^T}(t) = \exp[-v(C(c_t^T, c_t^N))]E_t[U_{c^T}(t+1)R] + \eta_t \tag{13}$$

If we define the effective interest rate as $\tilde{R}_{t+1} \equiv U_{c^T}(t) / \left(\exp[-v(C(c_t^T, c_t^N))]E_t[U_{c^T}(t+1)]\right)$, it follows that the binding credit constraint adds an interest rate premium equal to $E_t[\tilde{R}_{t+1} - R] = \eta_t / \left(\exp[-v(C(c_t^T, c_t^N))]E_t[U_{c^T}(t+1)]\right)$. This premium can be interpreted as the premium that lenders would charge borrowers in order to ensure that the credit constraint is not violated. In turn, the justification for the constraint could be limited contract enforcement by which lenders can confiscate only κ of a defaulting borrower's total income.

Suppose that the economy has just enough debt so that an adverse shock of standard magnitude triggers the credit constraint. Tradables consumption falls because agents cannot borrow as much as they wanted. In turn, at the "initial" level of nontradables output, the decline in tradables consumption makes the price of nontradables fall. But as this price falls so does the value of the marginal product of imported inputs, and hence demand for these

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[7] Note that agents take profits and the price of nontradables as given, so their individual natural debt limit is $b_{t+1} \geq -\min(\varepsilon_t^T y^T + A^T + \pi_t^N + p_t^N A^N)/r$, but with this debt limit there could still be equilibrium sequences where tradables consumption is nonpositive. The resource constraint (10) implies that at equilibrium the natural debt limit must be $b_{t+1} \geq -\min(\varepsilon_t^T y^T + A^T - p^m m_t)/r$.

inputs and the output of nontradables fall. Up to this point, the credit transmission mechanism is similar to the one widely studied in Sudden Stop models with balance sheet effects (e.g., Calvo, 1998). If the price and output of nontradables fall, however, the value of the total income in units of tradables falls, tightening the constraint further and setting in motion Irving Fisher's (1933) classic debt-deflation amplification mechanism.[8]

The possibility of endogenous Sudden Stops strengthens precautionary savings incentives.[9] Sudden Stops and the probability of Sudden Stops are endogenous, so agents make optimal self-insurance plans taking into account the endogenous link between choices of foreign asset holdings and the magnitude and likelihood of Sudden Stops. As a result, the economy builds a buffer stock of savings so as to minimize the risk of landing in states of nature in which debt is high enough for a Sudden Stop to trigger massive consumption collapses. Hence, we should expect the economy with Sudden Stops to converge to a higher average of foreign assets than without Sudden Stops. In the quantitative analysis that follows we explore the differences between these two environments.

The equilibrium of the two-sector economy in recursive form is characterized by a decision rule for $t+1$ foreign assets, $b'(b, \varepsilon^T, z)$, as a deterministic function of date-t assets and the date-t realization of shocks, that solves this Bellman equation:

$$V(b,\varepsilon^T,z)=\max_{b',m}\left\{\begin{array}{l}\dfrac{\left[\left[a\left(c_t^T\right)^{-\mu}+(1-a)\left(c_t^N\right)^{-\mu}\right]^{-\frac{1}{\mu}}\right]^{1-\gamma}}{1-\gamma}+\\ \qquad\qquad \exp\left(-v\left(\left[a\left(c_t^T\right)^{-\mu}+(1-a)\left(c_t^N\right)^{-\mu}\right]^{-\frac{1}{\mu}}\right)\right)E[V(b',\varepsilon^{T\prime},z')]\end{array}\right\}$$

$$\begin{aligned} s.t.\qquad & c^T=\varepsilon^T y^T-b'+bR+A^T-p^m m \qquad (14)\\ & c^N=zZm^\alpha+A^N\\ & b'\geq-\kappa\left[\varepsilon^T y^T+(1-\alpha)p^N zZm^\alpha\right]\end{aligned}$$

As in the case of the one-sector model, we solve this Bellman equation for both the BAH and UE discount factors using value function iteration.[10] The grid of bond values B has 1000

[8] Mendoza (2005) provides an illustrative deterministic example of this mechanism. He shows that the Fisherian deflation converges to a unique equilibrium that amplifies balance sheet effects, resulting in much larger adjustments in debt, consumption and the nontradables price than a setup with balance sheet effects but no Fisherian deflation.

[9] Aizenman and Lee (2007) derive an analytical result with similar features in a Diamond-Dybvig-style model. They showed that a discrete liquidity shock increases the need for precautionary savings.

[10] It is straightforward, but lengthy, to show that the solution to the Bellman equation (14) corresponds to the competitive equilibrium. In particular, the solution satisfies the Euler equation (13), the resource constraints (10) and (11), the optimality conditions for demand of imported inputs (eq. (7)) and sectoral consumption

(continued…)

evenly-spaced nodes. The Markov process of shocks includes shocks to tradables GDP, which are in the set $\varepsilon^T \in \{\varepsilon_1^T < \varepsilon_2^T < ... < \varepsilon_j^T\}$ with *j* realizations, and shocks to nontradables TFP, which are in the set $z \in \{z_1 < z_2 < ... < z_h\}$ with *h* realizations. Thus, the transition probability matrix of these shocks, $\pi((\varepsilon_{t+1}^T, z_{t+1}) \mid (\varepsilon_t^T, z_t))$, has dimensions (*j*x*h*)x(*j*x*h*).

When the model is solved assuming a frictionless credit market (i.e., without the credit constraint), the equilibrium relative price of nontradables is determined after the Bellman equation has been solved. In particular, the policy function $b'(b,\varepsilon^T,z)$ and the resource constraints can be used to determine the equilibrium consumption allocations of tradables and nontradables, and the equilibrium price of nontradables follows from equation (8).

The case with the credit constraint is more complicated because the equilibrium price of nontradables needs to be solved for together with the Bellman equation. The algorithm we use evaluates each candidate choice $b' \in B$ for each triple in (b,ε^T,z) in the state space. A first pass assumes that the constraint does not bind, takes a particular set of values (b',b,ε^T,z) and computes the corresponding c^T, c^N, m, and p^N that satisfy jointly the resource constraints and conditions (7)–(8). If the credit constraint does not bind, these solutions are passed on to the Bellman equation's maximization step, which searches for the value-maximizing choice of b' in *B*. If the constraint binds, we take the corresponding "current" state triple (b,ε^T,z) and solve for b', c^T, c^N, m and p^N that satisfy jointly the resource constraints, conditions (7)–(8) and the credit constraint with equality. Note that this nonlinear simultaneous equation system yields, for a given triple (b,ε^T,z) and all $b' \in B$ for which the collateral constraint is violated in the first pass, the same constrained value of b'.

C. Calibration

The baseline calibration parameters for the two-sector economy are listed in Table 5. Mendoza (2002) calibrated a model with tradables and nontradables for Mexico using sectoral data, and our calibration follows closely his. We keep the values γ=2, b=-0.44 and R=1.059 from the calibration of the one-sector model. The steady-state relative price of nontradables, the world price of intermediate goods and total GDP in units of tradables are normalized to p^N=1, p^m=1 and $y^T + p^N y^N - p^m m = 1$. Hence, the steady-state allocations can be interpreted as ratios relative to total GDP in units of tradables. We use the same elasticity-of-substitution parameter as Mendoza's, μ=0.316, which corresponds to an estimate for Mexico

allocations (eq. (8)). Note also that, when the credit constraint binds, the algorithm uses a pricing function for nontradables that does not depend on b'.

obtained by Ostry and Reinhart (1992). We also set several steady-state sectoral consumption and production ratios to match Mendoza's averages obtained from Mexican data at current prices. The ratio of nontradables-to-tradables GDP is $(p^N y^N - p^m m)/y^T = 1.543$, which given $p^N=1$, $p^m=1$ and $y^T + p^N y^N = 1$ implies that $y^T = 1/(1+1.543) = 0.393$ and $(p^N y^N - p^m m) = 1.543/(1+1.543) = 0.607$.

The share of imported input costs to gross output of nontradables is $\alpha=0.2$. 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 (2006b). With $\alpha=0.2$ and the GDP of nontradables calculated above, gross output of nontradables (i.e., nontradables GDP plus imported inputs) is equal to $0.71/(1-\alpha)=0.758$. It follows then that the trend level of TFP in nontradables is equal to $Z=0.758^{1-\alpha}/\alpha^{\alpha}=1.106$ and then condition (7) implies that the steady-state level of imported inputs is $m=(\alpha Z)^{1/(1-\alpha)}=0.152$.

Mendoza's (2002) estimates of the sectoral consumption-GDP ratios in Mexican data are $c^T/y^T=0.665$ and $p^N c^N/(p^N y^N - p^m m)=0.71$. Given these ratios and the values of tradables and nontradables GDP, it follows that $c^T=0.261$ and $c^N=0.431$. The value of the coefficient a in the CES aggregator is set so that $p^N=1$ given the values of μ, c^T, and c^N. This requires $a=0.341$. As in the one-sector model, we introduce constant lump-sum levels of exogenous absorption A^T and A^N to make the model consistent with the observed expenditure shares of investment and government expenditures. In addition, these transfers redistribute income across sectors so that the private sectoral consumption shares match those in the data. Hence, A^T is set so that the calibrated values of y^T, c^T, m, b and R are consistent with the steady-state resource constraint for tradables: $A^T=y^T+br-m-c^T=-0.046$. Similarly, A^N is set so that y^N and c^N are consistent with the nontradables resource constraint: $A^N=y^N-c^N=0.328$.

The time preference elasticity in the UE setup is $\rho^{UE} = \ln(R)/\ln(1+C(c^T,c^N)) = 0.1867$. This implies the same steady-state subjective discount factor as in the one-sector model (0.944). In the BAH setup, we set $\phi=-0.7$ and $\beta=0.94395$ (or $\rho^{BAH} = 0.0594$) so as to match Mexico's mean of net foreign assets and variability of aggregate consumption.

The data necessary to construct a reliable estimate of TFP shocks in the nontradables sector are not available. Hence we followed Mendoza (2006b) in using a two-stage "identification-by-simulation" strategy: In the first stage, we proxy TFP shocks in nontradables with nontradables GDP, and use THQA to construct a Markov process for ε^T and z to approximate a VAR(1) estimated with the HP-filtered cyclical components of tradables and nontradables GDP from Mexican data for the 1965-2005 period. The nontradables sector is defined as services plus industry minus manufacturing. The VAR model is $y_t = \rho \cdot y_{t-1} + e_t$ where

y_t=[y_t^T y_t^N], ρ is a 2x2 matrix of autocorrelation coefficients, and e_t=[e_t^T e_t^N] is a vector of error terms with variance-covariance matrix cova(e). The estimates of ρ and cova(e) are:

$$\rho = \begin{bmatrix} 1.088\ * & 0.564\ * \\ -0.655\ * & 0.154 \end{bmatrix}, \quad \text{cova}(e) = \begin{bmatrix} 0.000601 & 0.000472 \\ 0.000472 & 0.000572 \end{bmatrix} \tag{15}$$

An asterisk denotes coefficients that are statistically significant at the 99 percent confidence level. Interestingly, the VAR results indicate that most of the persistence in the fluctuations of nontradables GDP follows from spillovers from tradables GDP (since the autocorrelation term for nontradables GDP is not significantly different from zero).

The unconditional standard deviations of tradables and nontradables output in the data are $\sigma_{y^T} = 0.0336$ and $\sigma_{y^N} = 0.0327$, the first-order autocorrelations are $\rho_{y^T} = 0.575$ and $\rho_{y^N} = 0.603$, and the correlation between the two is $\rho_{y^T, y^N} = 0.772$. Thus cyclical fluctuations in the output of the two sectors have similar magnitude and persistence, and they are positively correlated with each other. Passing the estimates in (15) to the TQHA program and using three realizations for ε^T and z (which imply 9 (ε^T,z) pairs) we obtain a Markov process that, after solving the model, produces standard deviations of 0.0301 and 0.0246 for GDP of tradables and nontradables respectively, with serial autocorrelations of 0.539 for tradables and 0.577 for nontradables, and correlation between the two equal to 0.791. Thus, using nontradables GDP as a proxy for nontradables TFP we obtained a Markov process that approximates well the actual cyclical behavior of each sector's GDP, except that the variability of nontradables GDP (which is endogenous in the model) is underestimated—the model yields 2.46 percent instead of 3.27 percent in the data.

The second stage of the identification process adjusts the elements of ρ and cova(e) that involve nontradables TFP so as to produce a baseline simulation of the model that yields a closer approximation to the unconditional moments of tradables and nontradables GDP in the data (particularly the standard deviation of the latter). We leave unchanged the elements of ρ that were statistically significant in the results reported in (15). The closest approximation to the moments in the data produced the following unconditional moments: $\hat{\sigma}_{y^T} = 0.0334$, $\hat{\sigma}_{y^N} = 0.0305$, $\hat{\rho}_{y^T} = 0.587$, $\hat{\rho}_{y^N} = 0.483$, and $\hat{\rho}_{y^T, y^N} = 0.516$. The identifying restrictions that produced these results imply the following VAR structure for tradables GDP and nontradables TFP:

$$\rho = \begin{bmatrix} 1.088 & 0.564 \\ -0.655 & 0.300 \end{bmatrix}, \quad \text{cova}(e) = \begin{bmatrix} 0.000601 & 0.00055 \\ 0.00055 & 0.0012 \end{bmatrix} \tag{16}$$

D. Baseline Results

Table 7 reports the business cycle moments that characterize the stochastic steady state of the two-sector model with production under BAH and UE preferences. The table shows moments for foreign assets, the current account-output ratio, the price of nontradables, imports of intermediate goods, and sectoral and aggregate consumption and output. Consumption of tradables is less volatile than tradables output, and consumption of nontradables, for which there is no storage technology that can be used to smooth consumption, is more volatile than nontradables output. Aggregate consumption in units of tradables is less volatile than output (also in units of tradables) with UE preferences, but more volatile than output with BAH preferences. Both consumption and output in units of tradables are more volatile with BAH preferences than with UE preferences.

In terms of matching key characteristics of actual business cycles, the two sector model improves upon the one-sector model in two important respects: First, it produces countercyclical fluctuations in the current account and net exports. The correlations of the current account-output ratio with output in units of tradables are -0.14 and -0.48 with UE and BAH preferences, respectively. Hence, agents in this model economy build up debt in the expansion phase of the business cycle, which is an important feature of the dynamics of debt observed in emerging economies. Second, the model is also in line with the data in predicting large, procyclical and persistent fluctuations in the relative price of nontradables (i.e., the real exchange rate). The coefficients of variation of the price of nontradables are 6.7 and 8.1 percent with UE and BAH preferences respectively, more than twice the variability of output in units of tradables, and the correlations with output in units of tradables are 0.75 and 0.88 respectively. The first-order autocorrelation of the price of nontradables is almost 0.5 with both preferences specifications.

The two-sector model is consistent with the one-sector model in predicting that precautionary savings are larger in the BAH setup than in the UE setup (25.3 percent of the long-run average of GDP in the former v. 1.6 percent in the latter). Moreover, comparing across the one-sector and two-sector models, the UE setup shows that precautionary savings are lower in the two-sector economy (2.5 percent in the one-sector model v. 1.6 percent in the two-sector model). Precautionary savings in the BAH one-sector and two-sector baseline economies are not easily comparable because they were calibrated with different values of ϕ. We show below, however, that when the comparison is made for common debt limits, the BAH setup also predicts that precautionary savings are generally smaller in the two-sector model than in the one-sector model. We will also show that this result is related to an implicit hedge provided by the equilibrium co-movement between the incomes from tradables and nontradables.

E. Revisiting the Effects of Volatility and Financial Globalization on Foreign Assets

The conclusions derived from the one-sector model regarding the effects of business cycle volatility and financial globalization on foreign assets extend to the two-sector production economy. Increases in the volatility of tradables output and/or nontradables TFP can lead to large increases in the long-run average of foreign assets. However, the data do not show evidence of systematic volatility changes in this direction in Sudden Stop countries (in light of this and to save space we do not add tables and charts showing the results of our numerical analysis for the effects of volatility changes in the two-sector model). Table 3 shows that the volatility of tradables GDP increased in about half of the Sudden Stop countries, but only in five of them are the increases of the size that the model with either BAH or UE preferences would need to predict large changes in reserves. Volatility in the nontradables sector has increased only in a few of the Sudden Stop countries, with the median showing virtually no change. Hence, we conclude again that, while the model predicts that increases in output volatility could explain large increases in foreign asset positions, there is no systematic evidence in the data showing that output volatility has increased nearly as much the model would require, and in several countries it has fallen or remained about the same (particularly in the nontradables sector).

Figure 8 shows the effects of financial globalization on the long-run average of foreign assets and precautionary savings in the two-sector model with BAH and UE preferences. We also include plots for the one-sector model for comparison. The two main results from the one-sector model are preserved: (1) financial globalization produces large increases in the foreign asset position, which increase at a linear rate with UE preferences, and at a sharply increasing rate in the BAH setup; (2) precautionary savings also rise at a fast increasing rate in the BAH setup while they are nearly invariant to the degree of financial globalization in the UE setup.

Comparing across one- and two-sector models we find that with BAH preferences both the long-run average of foreign assets and precautionary savings are uniformly smaller in the two-sector economy. With UE preferences, however, mean foreign assets are smaller in the one-sector model at levels of barriers to capital mobility equivalent to taxes of 10 percent or more. At lower taxes the one- and two-sector models with UE preferences predict about the same long-run averages of foreign assets. By contrast, precautionary savings are uniformly smaller in the two-sector UE setup. Despite these differences, the effects of financial globalization on mean foreign assets and precautionary saving remain large, particularly as financial globalization approaches the full removal of barriers to international asset trading.

The smaller precautionary savings effects in the two-sector model reflect the fact that the equilibrium correlation between tradables income and nontradables income valued at tradables goods prices is negative (at about -0.4 in both UE and BAH setups). Hence, when the economy suffers a negative shock to tradables GDP, the value of nontradables income rises providing an implicit hedge that reduces the need for precautionary savings. Since y^T and y^N are positively correlated, the negative correlation between y^T and $p^N y^N$ is driven by the negative correlations between the price of nontradables and the output of each sector. In turn, these price correlations depend on the elasticity of substitution between tradables and nontradables in consumption and on the response of the supply of nontradable goods, which depends on technology parameters and the price of imported inputs.

In conclusion, in our two-sector model, financial globalization remains an important factor that could account for large increases in the foreign asset positions observed in Sudden Stop economies. In this case, however, the increases are less pronounced than in the one-sector model because the endogenous fluctuations in the price and output of notradables provide an implicit hedge that reduces the need for precautionary savings.

F. Self-Insurance Against Sudden Stops: How Large Should the War-Chest be?

We move now to quantify the changes in precautionary demand for foreign assets induced by the introduction of Sudden Stop risk. We consider a baseline scenario in which the collateral constraint limits debt not to exceed 50 percent of GDP valued in units of tradables (κ=0.5). Table 7 shows the business cycle moments of the stochastic steady states under BAH and UE preferences. A standard finding from the debt-deflation models of Sudden Stops is that long-run business cycle statistics are not altered significantly by credit-market imperfections. A comparison of the moments with and without credit constraints in Table 7 shows that this is the case here as well. Hence, the model's endogenous Sudden Stops are infrequent (but positive probability) events nested within "normal" business cycles, and these business cycles are approximately the same as those that would be observed in the absence of credit constraints.

In terms of the long-run average of foreign assets and precautionary savings, the long-run average of assets in the BAH (UE) setup increases from -44.7 (-42.4) percent without Sudden Stop risk to -24.3 (-37.8) percent when Sudden Stops are possible. Since in the UE setup the deterministic stationary state of foreign assets is the same with or without credit constraints, precautionary savings with UE preferences increase by the same amount as the long-run average of foreign assets: -37.8-(-42.4)=4.6 percent. Thus, with UE preferences the risk of Sudden Stops leads to an increase in precautionary asset holdings of about 4.6 percent of long-run GDP.

Quantifying the change in precautionary savings with BAH preferences is less obvious because the debt limit (which is also the debt to which the economy converges in the long run in the absence of uncertainty) changes from -0.7 without Sudden Stop risk to -0.5 with Sudden Stop risk. The long-run average of foreign assets rises 20.4 percentage points of GDP from one scenario to the other, but since the credit limit itself rises by 20 percentage points, the overall change in precautionary savings is only about ½ of a percentage point. Hence, relative to the corresponding credit limits, precautionary savings are about the same with or without Sudden Stop risk in the BAH setup. However, if we consider the build up of precautionary asset holdings from the perspective of an economy where Sudden Stop risk has just been introduced, the model predicts that agents would need to build up their war-chest of foreign assets by 20.4 percentage points of GDP in the long-run. This “transitional” measure of the extra precautionary savings that need to be accumulated as a result of the structural change implied by the introduction of Sudden Stop risk is perhaps a better measure of the effect that Sudden Stops have on self-insurance in the BAH setup.

Figure 9 illustrates Sudden Stop dynamics under the two preference specifications. The plots illustrate the amplification and persistence of the response of the model’s endogenous variables to shocks of standard magnitude when the credit constraint binds. To be precise, the plots show the differences in percent deviations from long-run averages in the economy with credit constraints relative to the economy with perfect credit markets in response to initial negative shocks to tradables output and nontradables TFP, and conditional on an initial debt ratio at which the credit constraint binds. The shocks are the pair (ε^T, z) in the Markov chain that yields the closest approximation to one-standard-deviation shocks.[11] The initial foreign asset position is -48.7 percent of long-run GDP. The probability of reaching this debt ratio in the long run is 0.9 (1.1) percent in the BAH (UE) setup.

The foreign assets plot illustrates the dynamics of precautionary savings. Initially, both BAH and UE setups show negative values because the initial foreign assets (-0.487) are smaller than the corresponding long-run averages by a larger gap when credit constraints are present than when they are absent. In the UE setup the gap is about -4 percentage points of GDP initially, while in the BAH setup the gap is nearly five times larger in absolute value. This result reflects the smaller change in mean foreign assets relative to perfect credit markets in the UE setup. In terms of persistence, foreign assets take a long time to converge. In the BAH setup, a gap of about -4 percentage points of GDP still remains after 50 years. In contrast, the negative gap closes in about 5 years in the UE setup, but after that the gap climbs to 1.5 percent and returns to zero very slowly. This moderate “overshooting” of the asset position is an implication of the endogenous rate of time preference.

The plots for the current account-output ratio, nontradables consumption, the price of nontradables, aggregate consumption and total output in units of tradables illustrate the ability of the debt-deflation mechanism to produce endogenous Sudden Stops in response to one-standard-deviation shocks. Qualitatively, the features of the Sudden Stops are identical in the BAH and UE setups: a current account reversal, a collapse in the price of nontradables, and declines in sectoral and aggregate consumption and output, all of which represent amplified responses to the shocks induced by the Fisherian debt deflation. Quantitatively, the BAH setup produces larger Sudden Stops than the UE setup. In the BAH (UE) setup, the

[11] Since the discrete Markov chain is not a perfect approximation, the shocks are equivalent to 1.25 and 1.05 times the standard deviation of tradables output and nontradables TFP respectively.

current account reversal reaches 3.5 (2.5) percentage points of GDP, the fall in nontradables output is about 2.5 (1.5) percent, the real depreciation is 9 (6) percent, the decline in aggregate consumption is 5 (3) percent and the drop in output is 7 (5) percent.

The transitional dynamics in Figure 9 show that Sudden Stop economies can go through prolonged periods in which they build up foreign assets, display persistent current account surpluses, and maintain undervalued real exchange rates, and these "imbalances" grow smaller gradually over time. The qualitative features of this adjustment are consistent with the recent experience of several Sudden Stop countries, particularly in Asia. Moreover, the current account surplus and undervalued real exchange rate are by-products of the build up of precautionary savings in the aftermath of Sudden Stops, or following financial globalization. They do not require intentional exchange rate management by central banks.

The plots in Figure 9 illustrate Sudden Stops from a particular initial condition of foreign assets (i.e. -48.7 percent of long-run GDP). There are many other debt positions, however, that also trigger Sudden Stops. Figure 10 shows the current account reversals and price collapses that occur on impact when negative one-standard-deviation ε^T and z shocks hit the economy at different initial conditions of foreign assets. For values of $b \geq -0.482$, the credit constraint does not bind and hence there is zero amplification and no Sudden Stops. For $-0.578 < b < -0.482$, the constraint binds and there are Sudden Stops. This Sudden Stop region can be split into two parts. One part includes Sudden Stops that are so large (with current account reversals of up to 100 percentage points of GDP) that precautionary savings rules them out in the long run. In Figure 10, this part of the Sudden Stop region is defined by foreign asset positions to the left of the long-run probability borders of the UE and BAH setups (which are located at about the 50 percent debt ratio in both cases). The second part of the Sudden Stop region is on the right side of these borders. This is the "long-run Sudden Stop region," where there are Sudden Stops with positive long-run probability. This region includes the case illustrated in Figure 9 as well as other Sudden Stop episodes that produce effects more than twice as large.[12] The cumulative probability of all long-run Sudden Stop states is 3.88 (7.85) percent in the BAH (UE) setup.

Once the economy hits a debt position at which standard shocks trigger a Sudden Stop, how long does it take for precautionary accumulation of foreign assets to provide enough self-insurance to minimize the probability of returning to that debt position? The answer to this question is illustrated in Figure 11. This figure plots the transitional CDFs of foreign assets for the BAH and UE setups starting from the initial asset position that generated the Sudden

[12] The initial condition b/y=-0.487 used in Fig. 9 is almost at the border of the long-run Sudden Stop region with the region where the credit constraint does not bind, so it produces a relatively moderate Sudden Stop (which is also closer to the magnitudes observed in the data).

Stop shown in Figure 9 (-48.7 percent of GDP). The probability of reaching this debt ratio is minimized when the economy reaches the stochastic steady state (as noted before, the long-run probabilities of *b*=-0.487 are 1.1 and 0.9 percent in the UE and BAH setups respectively). The CDF plots for the BAH and UE setups show that this process takes more than 15 years. After two years, the probability of hitting again the -48.7 percent debt ratio is 21 percent in the UE setup and 40 percent in the BAH setup. After 15 years, the probability is 3.4 percent in the UE setup and 4.7 percent in the BAH setup. Thus, the model predicts that, while precautionary savings provide substantial self-insurance to reduce the probability of Sudden Stops sharply in the long run, the process of building this war-chest of assets is long and gradual.

IV. Conclusions

This paper examines the recent surge in foreign reserves in Sudden Stop countries from the perspective of a dynamic, stochastic general equilibrium framework of optimal precautionary demand for foreign assets in a small open economy. The framework allows for two formulations of preferences with different implications for self-insurance behavior (the Bewley-Aiygari-Hugget setup and the Uzawa-Epstein setup). We use this framework to study a one-sector endowment economy and a two-sector production economy with “liability dollarization” (i.e., debt denominated in units of tradables but leveraged partly on the income from the nontradables sector). The two-sector model features a credit constraint that produces endogenous Sudden Stops driven by Irving Fisher’s debt-deflation mechanism. The constraint limits debt not to exceed a fraction of total income in units of tradables. When the constraint binds, the price and income of the nontradables sector collapse and this reduces further the agents’ ability to borrow. As a result, the responses of macroeconomic variables to shocks of standard magnitude show significant amplification and persistence.

The self-insurance framework studied in this paper features three key mechanisms that drive precautionary demand for foreign assets: increases in the cyclical volatility of output, international financial integration, and Sudden Stop risk. Our quantitative analysis shows that all three mechanisms can produce large changes in foreign asset holdings. Output volatility cannot explain the observed surge in reserves, however, because output volatility has not increased in Sudden Stop countries. By contrast, financial integration and Sudden Stop risk produce large increases in foreign asset holdings that are comparable to observed surges in reserves, and the data do show that the process of far-reaching financial globalization and the emergence of Sudden Stop risk coincided with the build up of reserves.

We also found that the adjustments in foreign assets and key macroeconomic aggregates triggered by financial globalization and Sudden Stop risk follow a protracted and gradual process. This process features persistent current account surpluses and undervalued real exchange rates that are reverted slowly. The probability of Sudden Stops declines slowly, as it takes over 50 years to attain its minimum level in the long run. Financial globalization also progresses in nonlinear fashion in the economy with BAH preferences. In its early stages, large changes in barriers to global asset trading produce small changes in foreign asset positions, but as a regime of perfect capital mobility is approached, small changes in restrictions affecting global asset markets produce large changes in asset positions.

The two-sector production economy has interesting implications for business cycle co-movements and precautionary savings. The model yields countercyclical fluctuations in the current account and net exports, and large, persistent fluctuations in the real exchange rate. In addition, the model features an implicit hedging mechanism because tradables income and nontradables income in units of tradables are negatively correlated at equilibrium. Hence, when an adverse, non-diversifiable shock hits tradables income, the value of nontradables income rises, and the higher consumption of nontradables offsets some of the adverse effect of the fall in tradables income. As a result, the buffer stocks of assets implied by precautionary savings are smaller in the two-sector model than in the one-sector model. This outcome, however, depends on the elasticity of substitution between tradables and nontradables in consumption, and on features of preferences and technology that drive the equilibrium of the market of nontradables.

One caveat of our analysis of financial globalization is that we abstract from efficiency gains. If an emerging economy that opens the capital account has relatively little capital, its marginal return will be high and this would trigger an investment boom that gives an incentive to borrow instead of saving. The investment boom, however, should not be directly attributed to financial integration but to the removal of distortions on capital accumulation. Mendoza and Tesar (1998) and Gourinchas and Jeanne (2006) showed that the efficiency and welfare gains of removing these distortions, even when the economy is in financial autarky, are much larger than the extra gains that result from the shift from financial autarky to financial globalization. A second caveat is that we did not consider the possibility of sovereign default. Alfaro and Kanczuk (2006) showed, however, that given the choice of a portfolio of "defaultable debt" and reserve assets, the optimal choice is to hold zero reserves. Hence, default considerations do not seem useful for explaining the surge in reserves.

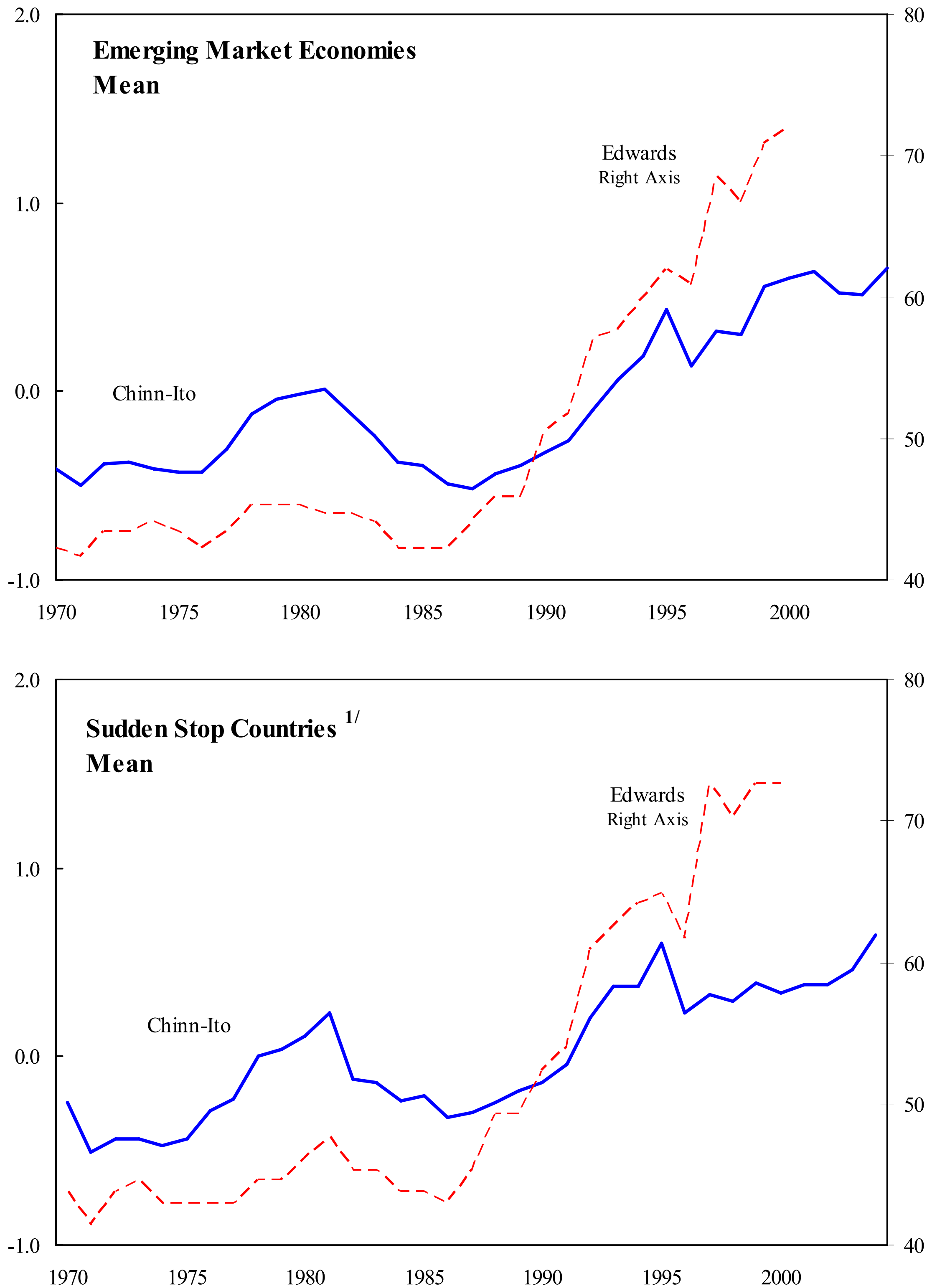
Precautionary demand for foreign assets arises from distortions on financial markets (incomplete insurance markets, credit constraints, etc.), and hence it is suboptimal from a normative standpoint. This raises two important normative questions that we did not address in this paper: What are the welfare costs that result from these distortions? And, are there policy strategies that can yield outcomes sufficiently superior, relative to precautionary savings under the status quo, to outweigh their implementation costs?

Results in the literature shed some light on these questions. On one hand, the classic Lucas result showing that the welfare cost of consumption volatility in representative-agent models with CRRA utility is negligible, regardless of the asset market structure and as long as growth and business cycles are unrelated, suggests that the overall welfare cost of precautionary savings should be small. Indeed, international Real-Business-Cycle models predict that the cost of moving from perfect world capital markets to financial autarky is negligible on average over the long run. On the other hand, Durdu and Mendoza (2006) showed that welfare costs conditional on a Sudden Stop state are high. They also found, however, that attempting to prevent these Sudden Stops with a credit facility that aims to defuse the debt-deflation process can result in distortions with even larger costs, unless the facility functions with a complex state-contingent policy. Caballero and Panageas (2006) showed that precautionary savings can be highly undesirable for emerging economies that hope to attain higher long-run growth rates, and in this case arrangements that can provide financing when Sudden Stops hit are welfare-improving.

If we move away from the representative-agent paradigm, the costs of precautionary savings and financial globalization for countries with underdeveloped financial systems can be large, and distributed regressively across the population (see Mendoza et al. (2007)). The best policy response is to promote the development of domestic financial systems in emerging economies. Beyond this obvious response, the class of policy recommendations that are effective for dealing with the adverse distributional implications of financial globalization without financial development are yet to be identified.

In the final analysis, we conclude that the argument behind the New Merchantilism is only partially correct. On one hand, our findings do show that the aim to minimize Sudden Stop risk can lead to a surge in foreign asset holdings. On the other hand, the New Merchantilism cannot be defended by arguing that business cycle volatility has increased, because this is not observed in the data. The New Mechantilism also fails inasmuch as frameworks like ours, or the one developed by Mendoza et al (2007), predict that financial globalization can be a strong driving force of the rise in reserves. Self-insurance behavior is part of the mechanism by which globalization affects foreign asset holdings in these models, but this is unrelated to a desire to build a war-chest for defense against Sudden Stops. Instead, it is a consequence of the removal of barriers to global asset trading given the underdevelopment of the financial markets that agents in Sudden Stop economies can access.

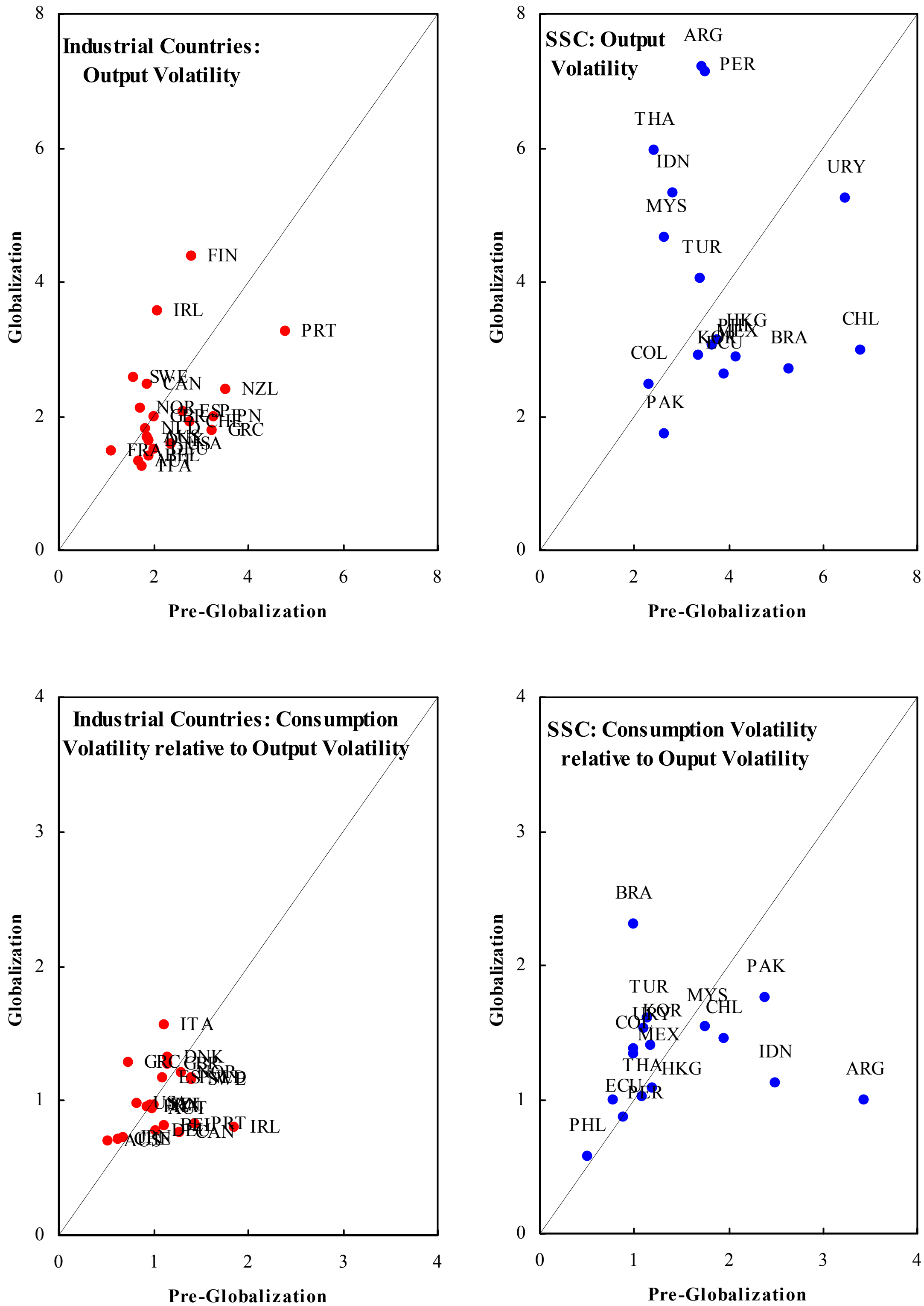
Figure 1. Emerging Market Economies: Financial Integration



Source: Authors' calculations.

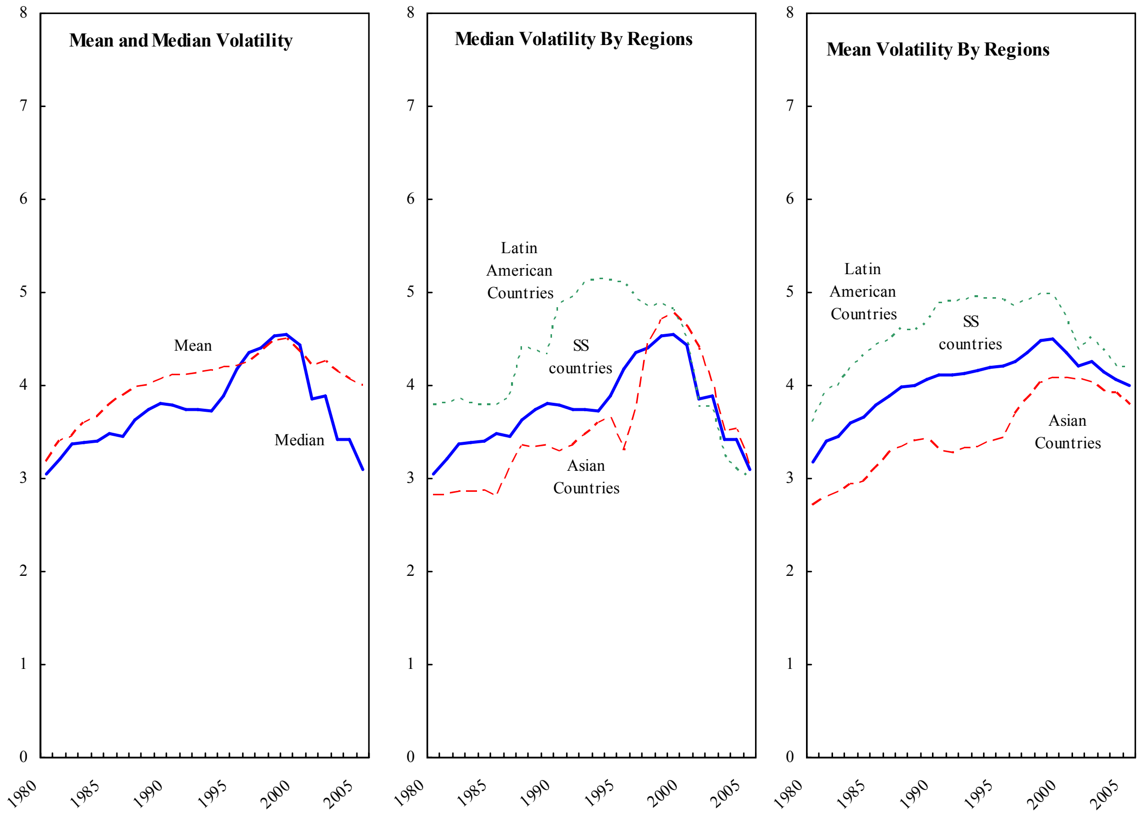
1/ See Table 1 for a definition of sudden stop countries.

Figure 2. Output and Consumption Volatility: Sample of Countries
(Percent)



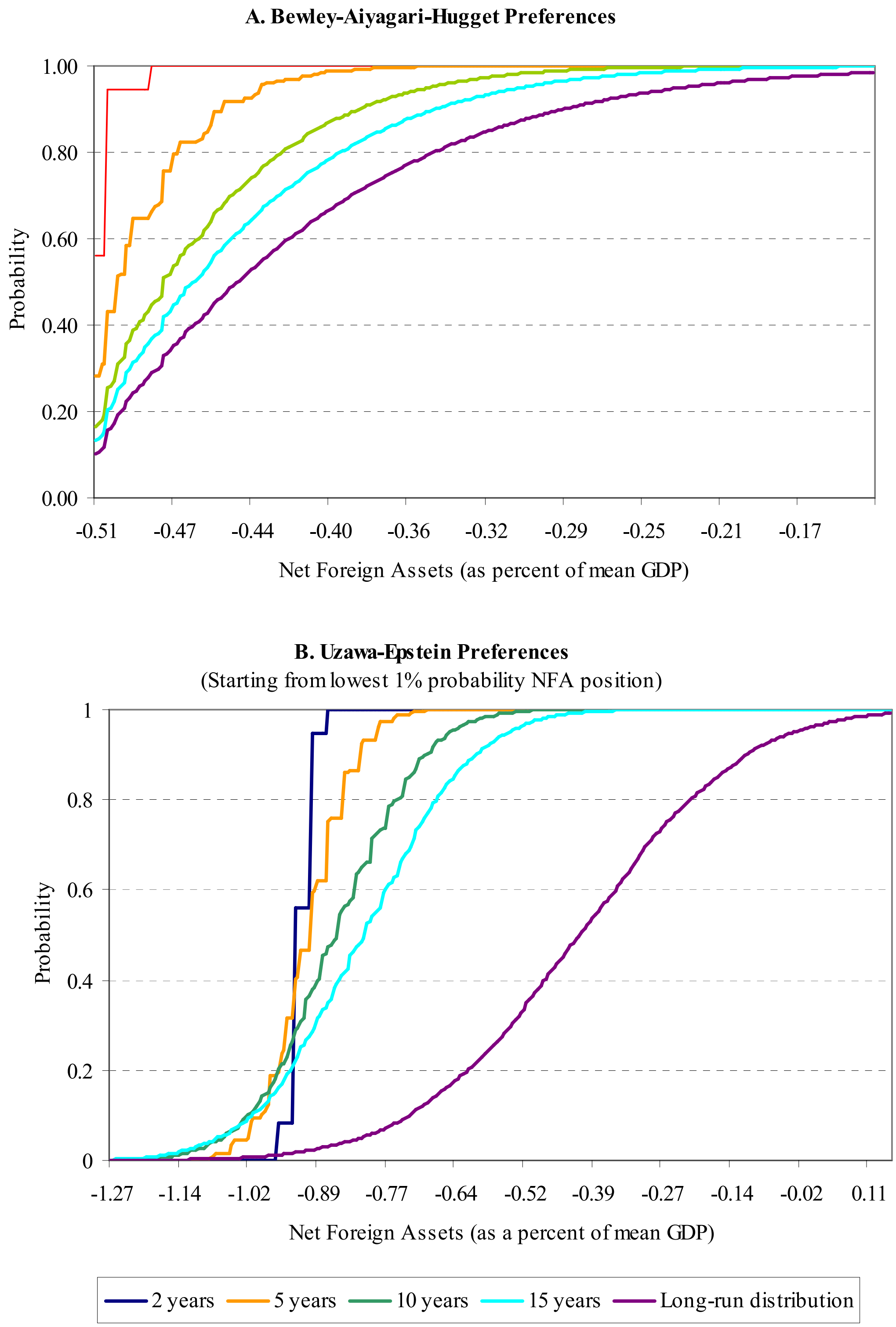
Source: Authors' calculations
Note: Pre-Globalization and globalization refer to the 1966–1985 and 1986–2005 periods, respectively. See Table 1 for a definition of sudden stop countries.

Figure 3. Sudden Stop Countries: Rolling Standard Deviation of Output Volatility[1/]
(Percent)



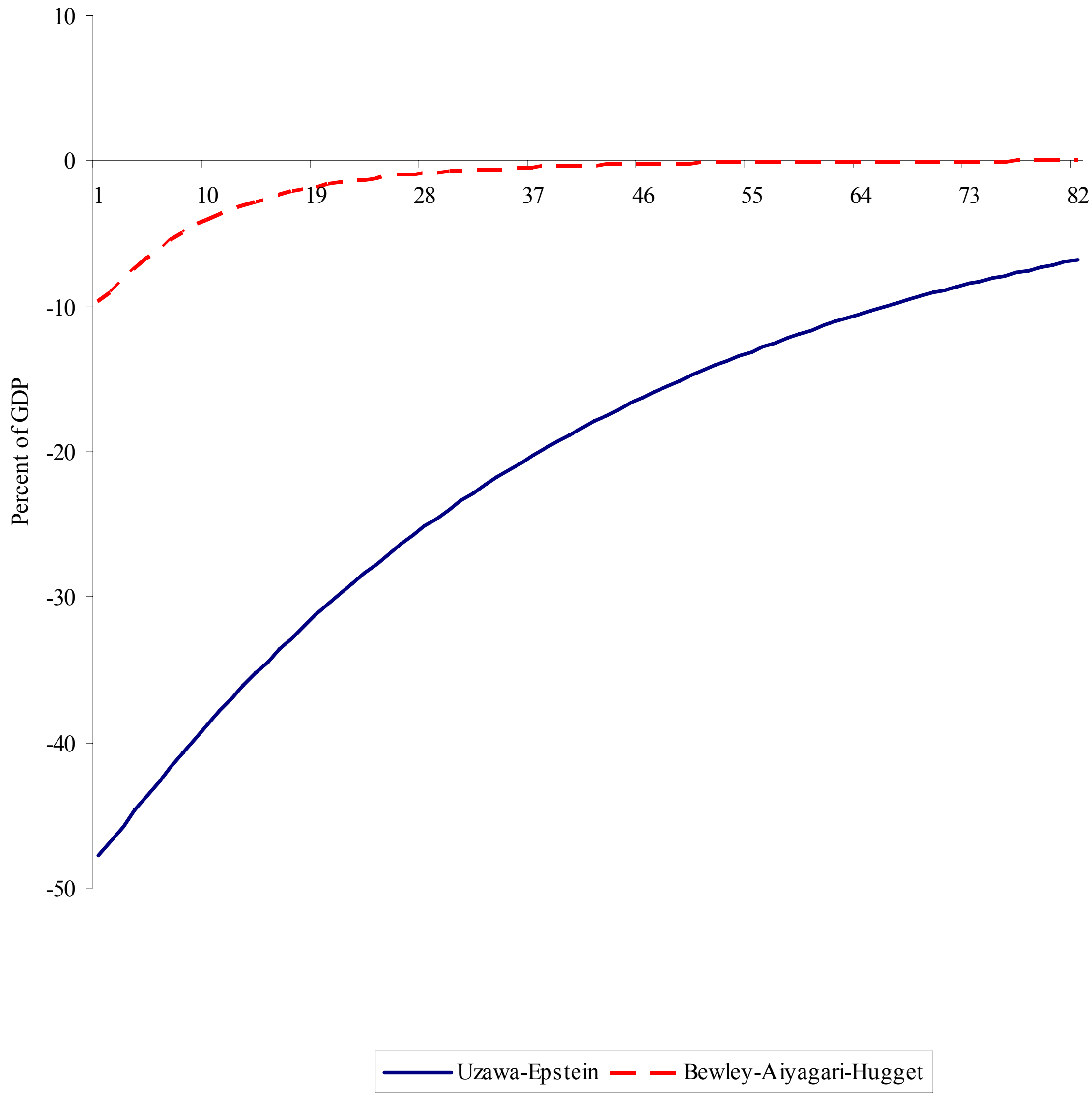
Source: Authors' calculations.
1/ Twenty-year rolling standard deviation. See Table 1 for a definition of sudden stop countries.

Figure 4. One-Sector Model: Transitional Cumulative Distributions Functions



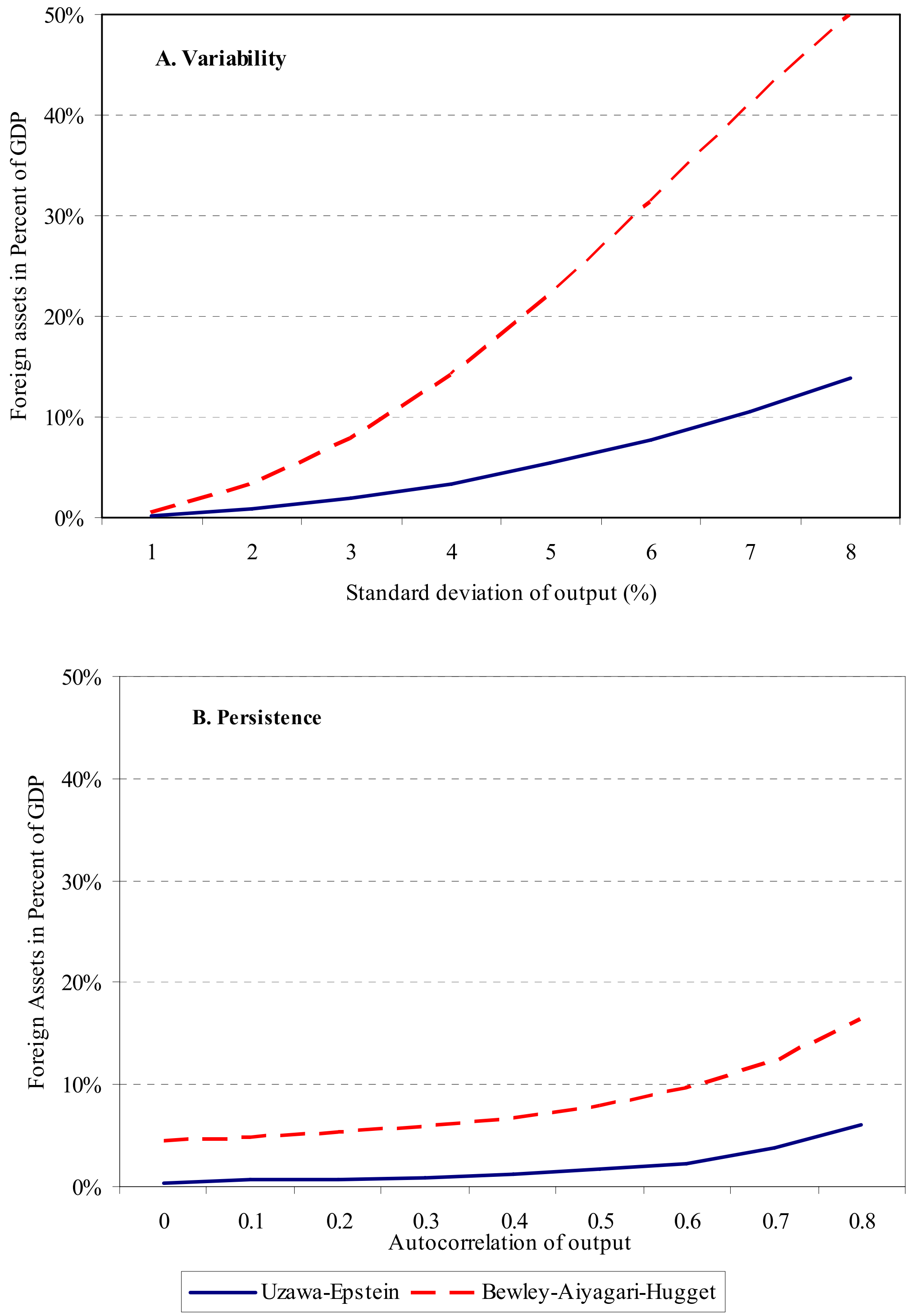
Source: Authors' calculations.

Figure 5. One-Sector Model: Transitional Dynamics of Foreign Assets (As percent of GDP. Forecast functions conditional on lowest positive probability asset position and neutral shocks at date 1).



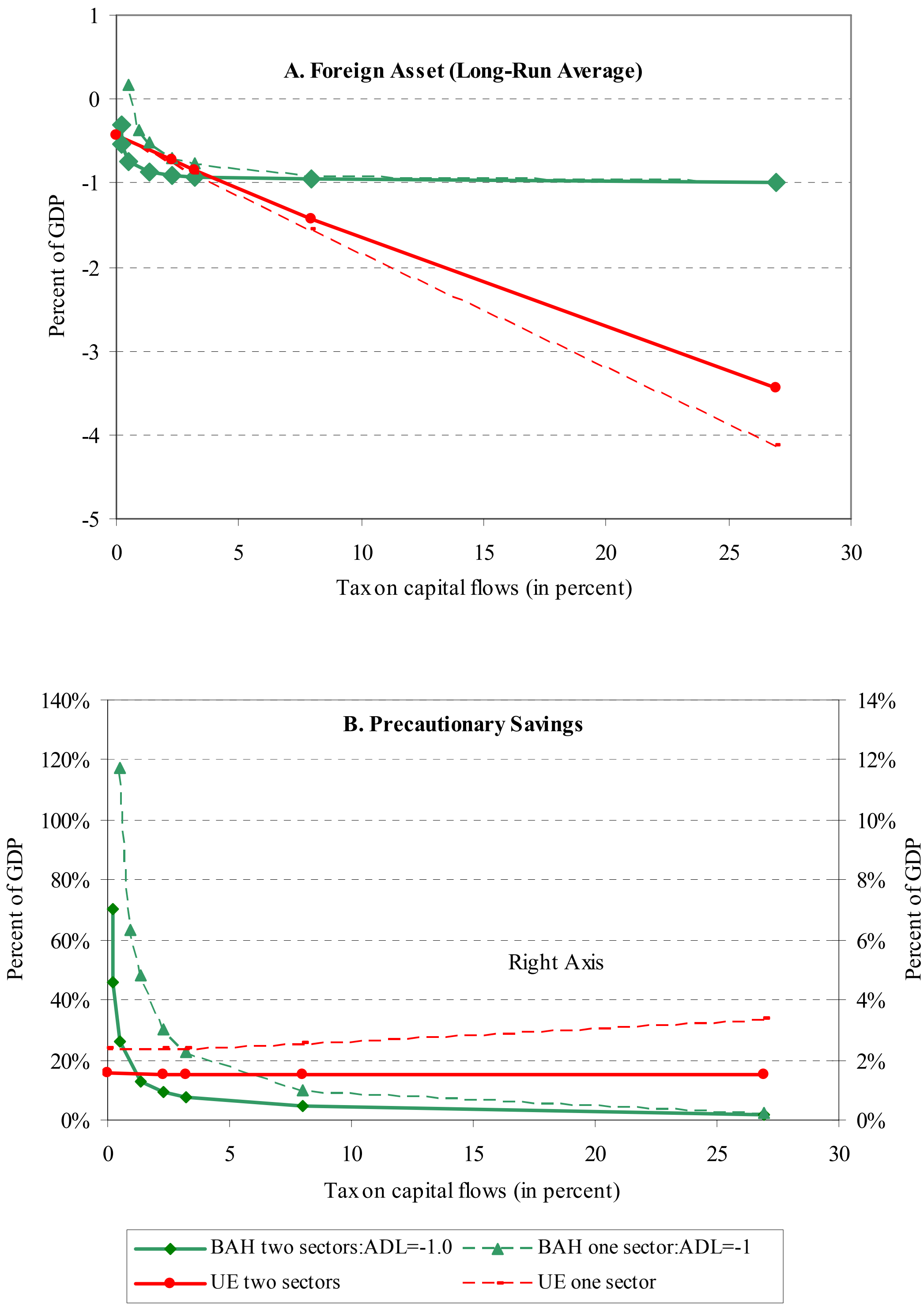
Source: Authors' calculations

Figure 6. Effects of Variability and Persistence of Output on Precautionary Demand of Foreign Assets



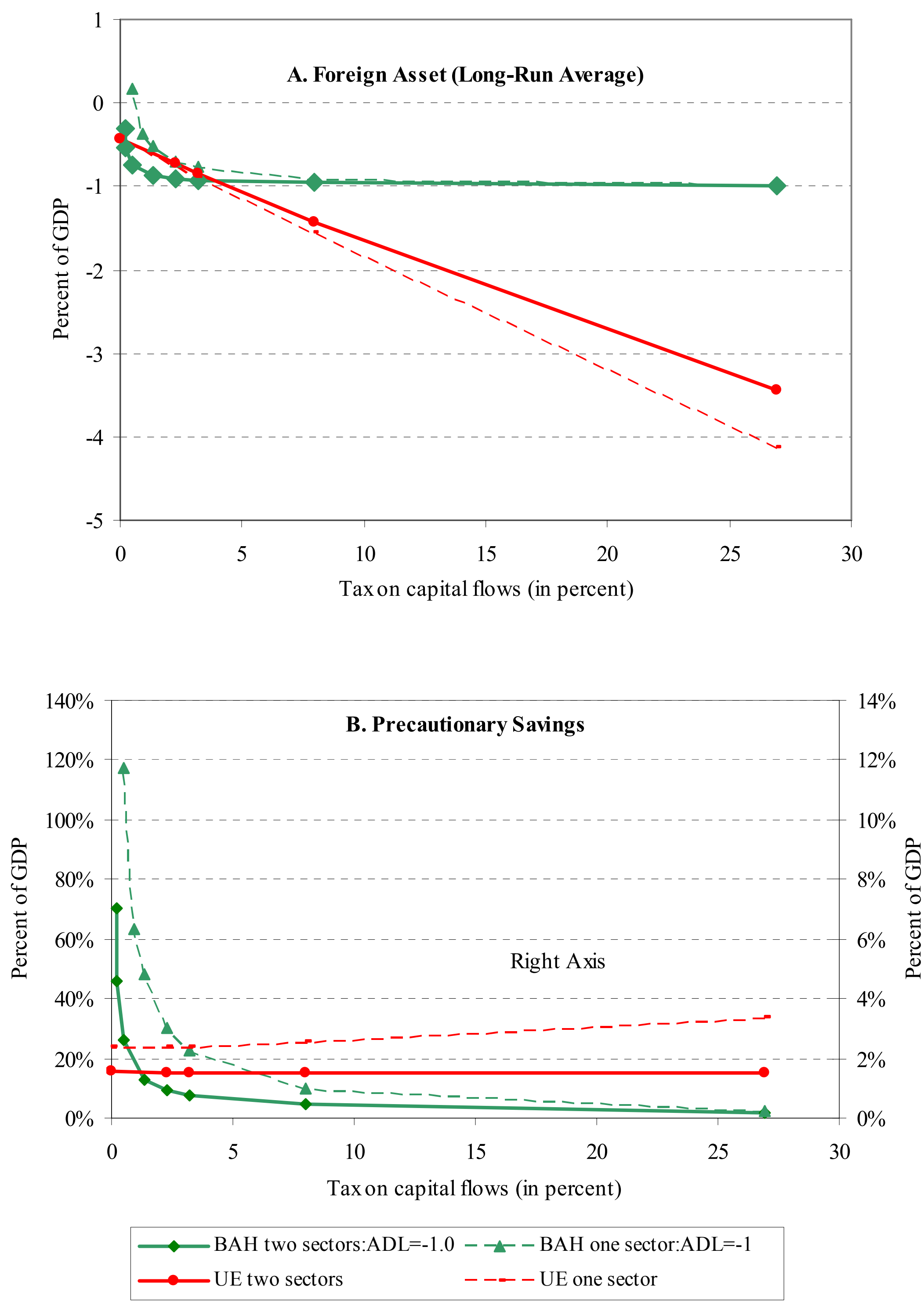
Source: Authors' calculations

Figure 7. One-Sector Model: Financial Globalization, Foreign Assets, and Precautionary Savings



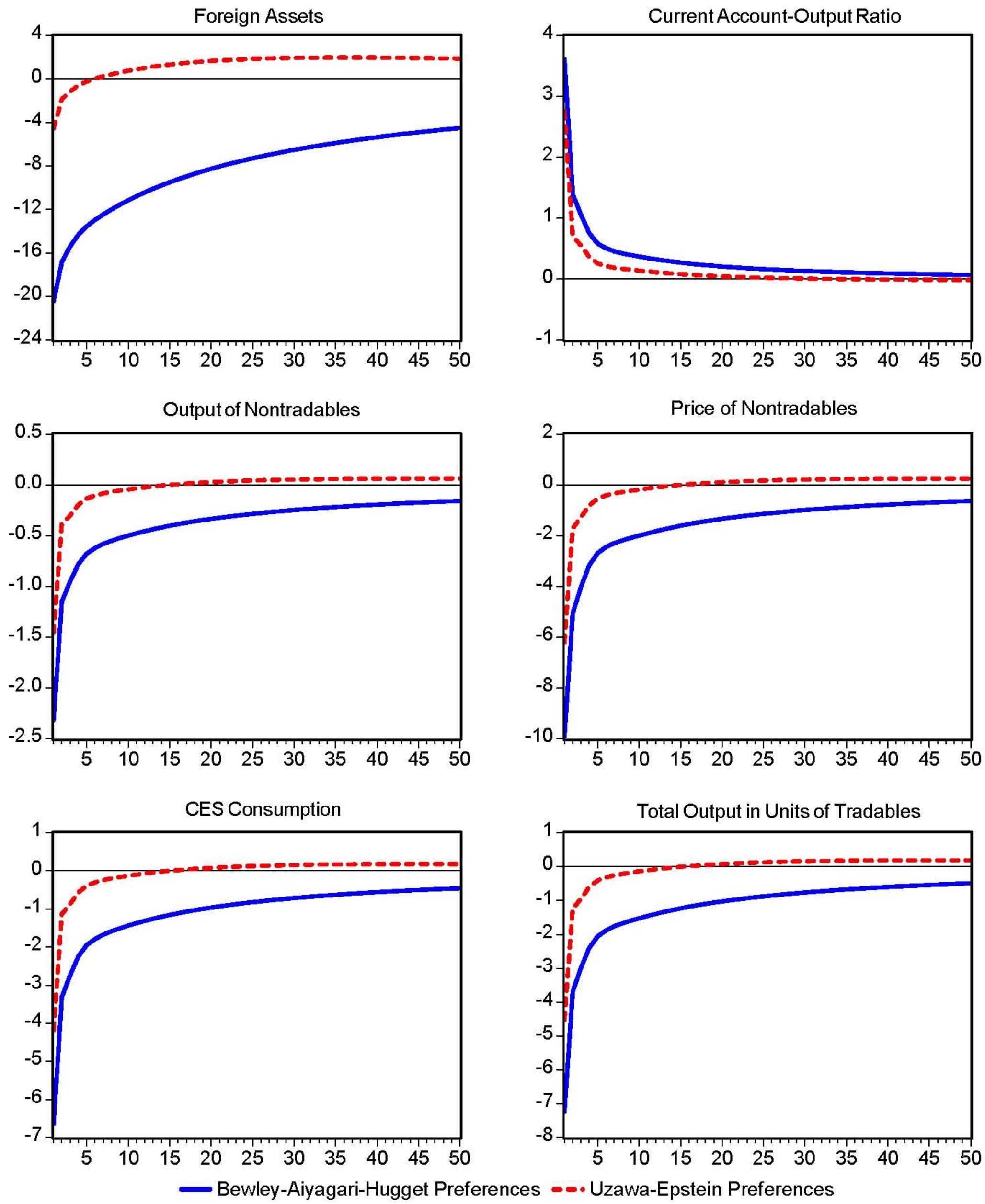
Source: Authors' calculations.

Figure 8. One- and Two-Sector Models: Financial Globalization, Foreign Assets and Precautionary Savings.



Source: Authors' calculations.

Figure 9. Sudden Stops under Alternative Preference Specifications
(excess deviations from a long run average relative to frictionless economy)



Note: The plots show forecast functions of equilibrium Markov processes in response to initial negative shocks to tradables output and TFP in nontradables, and an initial ratio of foreign assets to long-run GDP of -48.7 percent. The data are plotted as differences in percent deviations from long-run averages in the economies with credit constraints relative to those in the economies with perfect credit markets. Foreign assets are in percent of the long-run average of GDP.

Figure 10. Amplication Effects on Impact in the Sudden Stop Region
(Differences in deviations from mean with and without credit constrainst in response to one s.d. shocks)

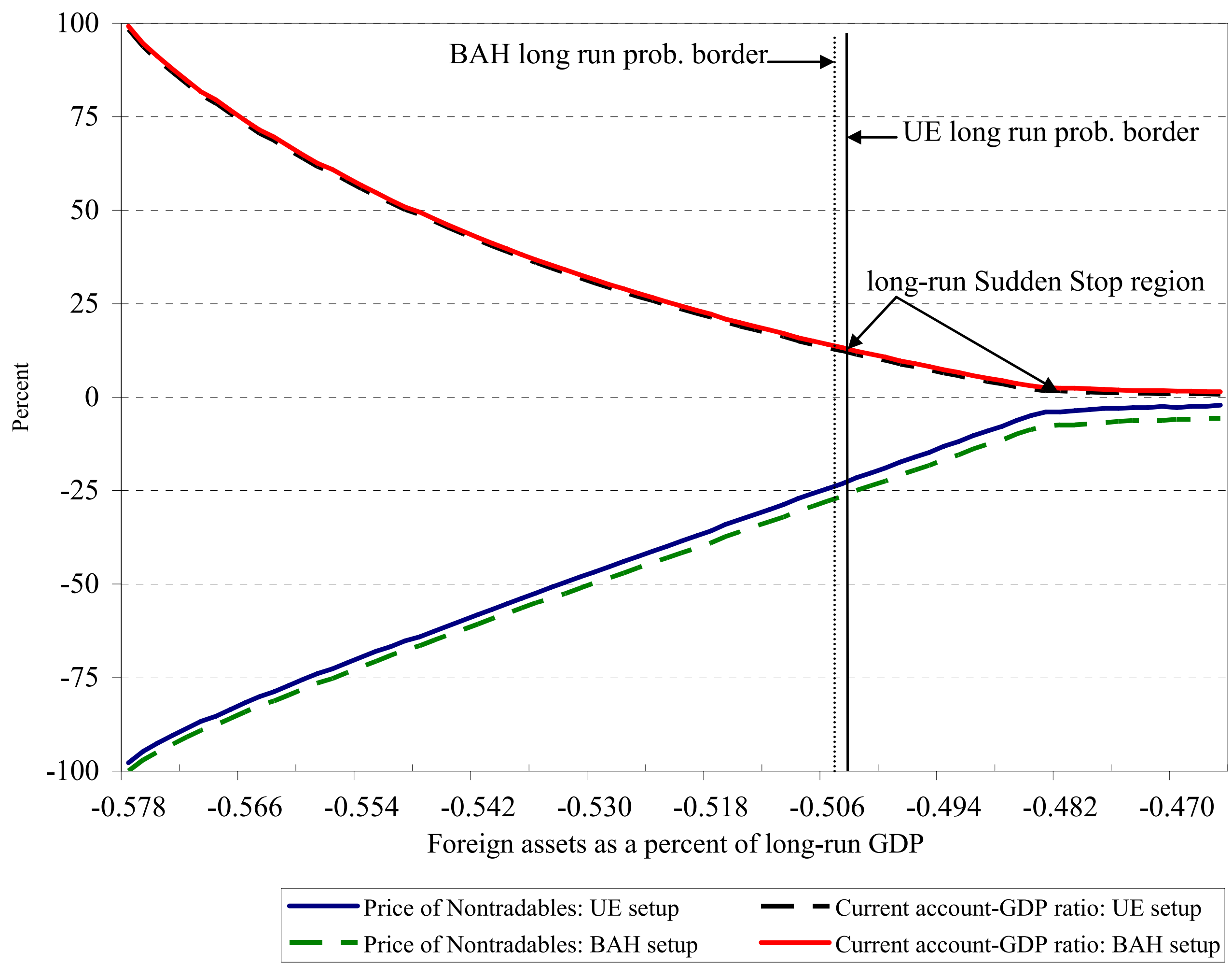
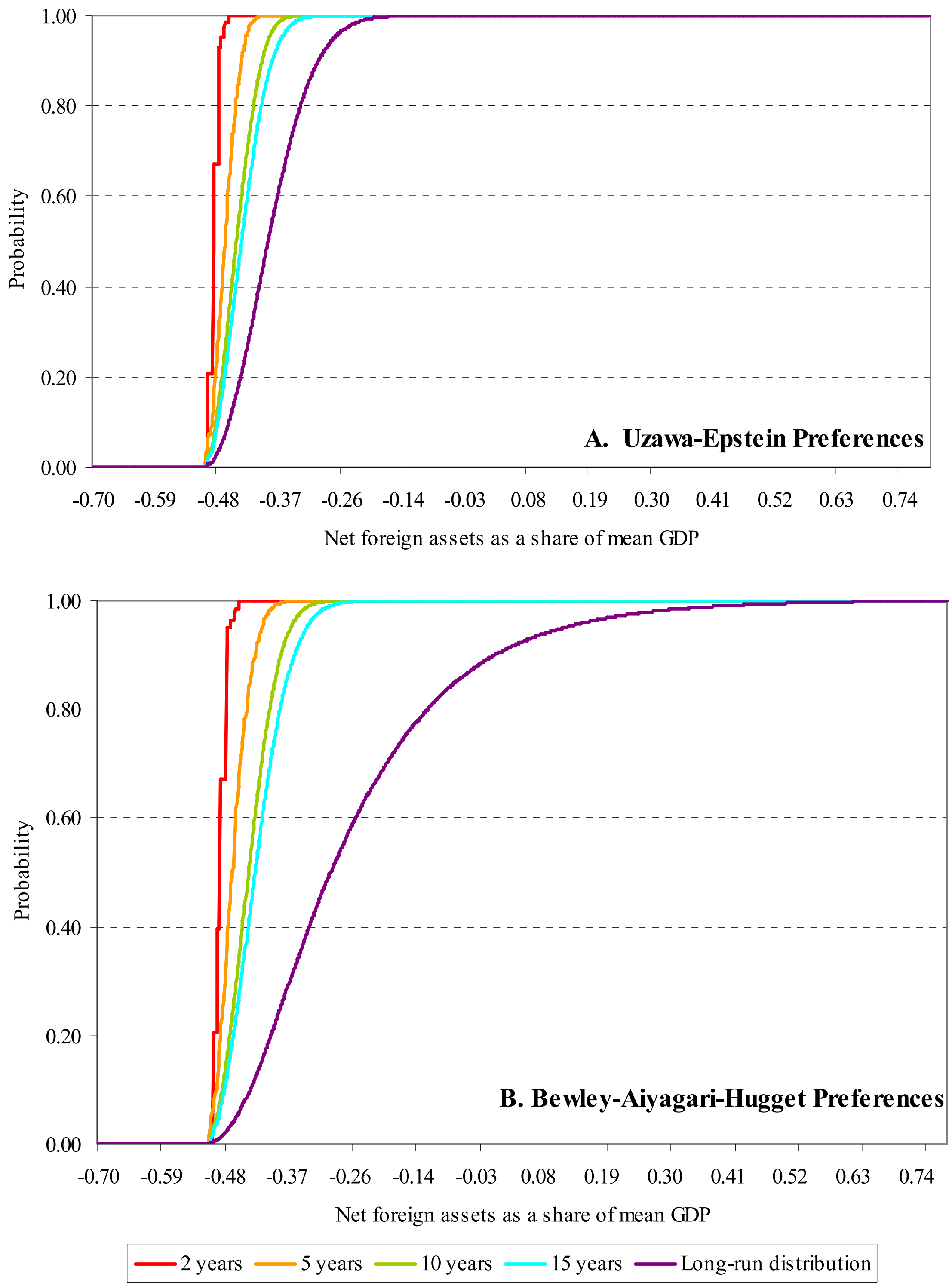


Figure 11. Transitional Cumulative Distributions in the Binding Economy



Source: Authors' calculations.

Table 1. International Reserve Position in Sudden Stop Economies [1/]

(Percent of GDP)

Country	Year of Sudden Stop [2/]	Before [3/]	After [4/]	Difference
Argentina I	1994	3.20	8.62	5.42
Argentina II	2001	5.04	11.54	6.51
Brazil	1998	4.36	7.65	3.30
Chile	1998	16.93	20.49	3.57
Colombia	1998	9.24	12.21	2.97
Ecuador	1999	7.35	3.89	-3.46
Hong Kong	1998	34.16	68.85	34.69
Indonesia	1997	6.53	18.69	12.17
Korea	1997	5.03	21.26	16.23
Mexico	1994	4.64	7.29	2.65
Malaysia	1997	25.18	39.54	14.36
Pakistan	1998	1.90	8.51	6.61
Peru	1998	9.25	16.66	7.41
Philippines	1997	6.05	16.69	10.65
Russia	1998	3.05	12.46	9.41
Thailand	1997	14.84	28.01	13.17
Turkey	2001	5.67	13.57	7.90
Uruguay	2002	7.18	20.06	12.87
Median		6.29	15.12	7.66
Median Asian Countries		6.53	21.26	13.17

Source: Authors' calculations

1/ Refers to the emerging market economies that experienced a sudden stop during the past two-decades.

2/ We include Sudden Stop episodes that are included in various empirical studies of Sudden Stops, such as Calvo, et. al. (2004), Cavallo and Frankel (2004), and Rothenberg and Warnock (2006).

3/ Covers the period since 1985 to the year before the sudden stop.

4/ Covers the period since the year after the sudden stop till 2004.

Table 2. Business Cycles and Financial Globalization

	Output				Consumption relative to Output			
	Full	Pre-Globalization (1)	Globalization (2)	Ratio (1)/(2)	Full	Pre-Globalization (1)	Globalization (2)	Ratio (1)/(2)
Industrial Countries								
United States	1.90	2.38	1.57	1.52	0.89	0.83	0.98	0.85
United Kingdom	1.90	2.01	2.00	1.01	1.21	1.15	1.28	0.90
France	1.22	1.13	1.49	0.76	0.97	0.94	0.95	0.99
Germany	1.68	2.02	1.51	1.34	0.94	1.02	0.77	1.32
Japan	2.62	3.29	1.98	1.66	0.70	0.68	0.72	0.95
Mean Industrial Countries	2.14	2.33	2.10	1.11	1.03	1.08	1.00	1.08
Median Industrial Countries	1.90	2.01	1.90	1.06	0.99	1.11	0.96	1.15
EME								
Sudden Stop Countries [1/]								
Argentina	5.48	3.46	7.20	0.48	1.68	3.44	1.00	3.45
Brazil	4.14	5.28	2.70	1.95	1.34	0.99	2.30	0.43
Chile	4.88	6.79	2.98	2.28	1.98	1.95	1.46	1.34
Colombia	2.26	2.33	2.47	0.94	1.23	1.00	1.34	0.74
Ecuador	3.15	3.93	2.62	1.50	0.89	0.89	0.87	1.03
Mexico	3.27	3.67	3.06	1.20	1.14	0.99	1.38	0.72
Peru	5.19	3.51	7.13	0.49	1.03	0.77	1.00	0.77
Uruguay	5.45	6.48	5.25	1.24	1.29	1.17	1.41	0.84
Hong Kong	3.50	3.78	3.12	1.21	1.09	1.20	1.08	1.11
Indonesia	4.11	2.81	5.32	0.53	1.51	2.51	1.12	2.25
Korea	3.19	3.36	2.90	1.16	1.24	1.10	1.53	0.72
Malaysia	3.54	2.64	4.66	0.57	1.61	1.75	1.54	1.13
Pakistan	2.18	2.63	1.72	1.53	2.25	2.39	1.76	1.36
Philippines	3.33	4.16	2.88	1.44	0.54	0.52	0.58	0.89
Thailand	4.23	2.44	5.97	0.41	1.03	1.09	1.02	1.07
Turkey	3.52	3.40	4.06	0.84	1.43	1.13	1.60	0.71
Mean SSC	3.84	3.79	4.00	1.11	1.33	1.43	1.31	1.16
Median SSC	3.53	3.48	3.09	1.18	1.26	1.12	1.36	0.96
Mean EME's	*3.77*	*3.75*	*3.64*	*1.03*	*1.30*	*1.42*	*1.26*	*1.12*
Median EME's	*3.53*	*3.57*	*3.09*	*1.15*	*1.27*	*1.18*	*1.19*	*0.99*

Source: Authors' calculations. Pre-Globalization and Globalization refer to the 1966-1985 and 1986-2005 periods, respectively.
1/ See Table 1 for a definition of sudden stop countries.

Table 3. Sectoral Volatility and Financial Gloabilization

	Tradable Output				Non-tradable Output			
	Full	Pre-Globalization (1)	Globalization (2)	Ratio (1)/(2)	Full	Pre-Globalization (1)	Globalization (2)	Ratio (1)/(2)
Industrial Countries								
United States	3.93	4.52	3.50	1.29	1.47	1.30	1.62	0.81
United Kingdom	4.91	6.43	3.54	1.81	2.07	2.37	1.81	1.30
France	4.19	4.97	3.62	1.37	1.24	0.88	1.48	0.60
Germany	2.82	2.54	3.07	0.83	1.44	1.57	1.38	1.14
Japan	3.68	4.06	3.75	1.08	2.51	3.23	1.68	1.92
Mean Industrial Countries	3.39	3.68	3.25	1.13	1.03	1.08	1.00	1.08
Median Industrial Countries	3.34	3.84	3.25	1.18	0.99	1.11	0.96	1.15
EME								
Sudden Stop Countries 1/								
Argentina	5.48	3.93	6.92	0.57	5.24	3.81	6.54	0.58
Brazil	4.44	4.50	4.39	1.02	4.03	4.85	3.12	1.55
Chile	5.99	.	5.99	.	3.74	.	3.74	.
Colombia	4.82	2.83	6.34	0.45	3.15	2.21	3.99	0.55
Ecuador	6.80	4.74	8.60	0.55	5.45	5.80	5.07	1.14
Mexico	3.36	3.07	3.70	0.83	3.27	3.53	3.00	1.18
Peru	5.74	4.72	7.38	0.64	5.05	3.32	6.94	0.48
Uruguay	5.98	6.41	6.46	0.99	5.80	6.88	5.59	1.23
Hong Kong	5.33	.	5.33	.	2.06	.	2.06	.
Indonesia	3.02	2.55	3.56	0.72	5.30	3.91	6.74	0.58
Korea	4.59	5.11	4.17	1.22	2.79	2.74	2.84	0.97
Malaysia	4.17	3.33	4.81	0.69	4.58	3.23	5.28	0.61
Pakistan	2.62	3.27	2.22	1.47	2.49	3.02	1.47	2.06
Philippines	3.08	3.78	2.74	1.38	3.98	5.06	3.25	1.56
Thailand	4.03	2.88	5.42	0.53	4.76	2.96	6.59	0.45
Turkey	3.44	3.12	3.75	0.83	3.72	4.06	3.50	1.16
Mean SSC	4.56	3.87	5.11	0.85	4.09	3.95	4.36	1.01
Median SSC	4.52	3.56	5.07	0.77	4.00	3.67	3.87	1.06
Mean EME's	*4.51*	*4.04*	*4.82*	*0.84*	*4.22*	*4.37*	*3.67*	1.19
Median EME's	*4.43*	*3.78*	*4.28*	*0.88*	*3.93*	*3.91*	*3.38*	1.16

Source: Authors' calculations. Pre-Globalization and Globalization refer to the 1966-1985 and 1986-2005 periods, respectively.
1/ See Table 1 for a definition of sudden stop countries.

Table 4. Volatility—Relative to the US

	Output			Consumption		
	Full	Pre-Globalization (1)	Globalization (2)	Full	Pre-Globalization (1)	Globalization (2)
Industrial Countries						
United States	1.00	1.00	1.00	1.00	1.00	1.00
United Kingdom	1.00	0.85	1.27	1.36	1.18	1.66
France	0.64	0.47	0.95	0.69	0.54	0.92
Germany	0.88	0.85	0.96	0.93	1.05	0.76
Japan	1.38	1.38	1.26	1.07	1.14	0.93
Mean Industrial Countries	1.13	0.98	1.34	1.03	1.08	1.00
Median Industrial Countries	1.00	0.85	1.21	0.99	1.11	0.96
EME						
Sudden Stop Countries 1/						
Argentina	2.88	1.45	4.59	5.42	6.04	4.68
Brazil	2.18	2.22	1.72	3.25	2.65	4.04
Chile	2.56	2.86	1.90	5.67	6.71	2.83
Colombia	1.19	0.98	1.57	1.63	1.18	2.16
Ecuador	1.66	1.65	1.67	1.65	1.77	1.48
Mexico	1.72	1.54	1.95	2.18	1.85	2.74
Peru	2.73	1.48	4.54	3.13	1.37	4.63
Uruguay	2.86	2.73	3.35	4.12	3.86	4.80
Hong Kong	1.84	1.59	1.99	2.25	2.30	2.20
Indonesia	2.16	1.18	3.39	3.65	3.58	3.86
Korea	1.68	1.41	1.85	2.32	1.88	2.89
Malaysia	1.86	1.11	2.97	3.35	2.35	4.68
Pakistan	1.14	1.11	1.10	2.88	3.20	1.97
Philippines	1.75	1.75	1.84	1.05	1.09	1.08
Thailand	2.23	1.03	3.81	2.57	1.35	3.97
Turkey	1.85	1.43	2.59	2.96	1.96	4.24
Mean SSC	2.02	1.59	2.55	3.00	2.70	3.27
Median SSC	1.86	1.47	1.97	2.92	2.13	3.37
Mean EME's	*1.98*	*1.58*	*2.32*	*2.93*	*2.68*	*2.90*
Median EME's	*1.86*	*1.50*	*1.97*	*2.80*	*2.25*	*2.78*

Source: Authors' calculations. Pre-Globalization and Globalization refer to the 1966-1985 and 1986-2005 periods, respectively.

1/ See Table 1 for a definition of sudden stop countries.

Table 5. Calibration of the One-and- Two-Sector Models

Notation	Parameter/Variable	Value
1. One-sector model		
ρ^{BAH}	Rate of time preference in the BAH setup	0.064
ρ^{UE}	Rate of time preference elasticity in the UE setup	0.109
γ	Coefficient of relative risk aversion	2.000
ϖ	Ad-hoc debt limit	-0.510
R	Gross world interest rate	1.059
y	Mean output	1.000
c	Consumption-output ratio	0.692
b	Net foreign assets-output ratio	-0.440
σ_e	Standard deviation of output innovations	0.026
θ_y	Autocorrelation of output	0.597
A	Lump-sum absorption	0.282
2. Two-sector model		
ρ^{BAH}	Rate of time preference in the BAH setup	0.059
ρ^{UE}	Rate of time preference elasticity in the UE setup	0.187
γ	Coefficient of relative risk aversion	2.000
μ	Elasticity of substitution	0.316
a	CES weight of tradable consumption	0.341
ϖ	Ad-hoc debt limit	-0.700
α	Share of imported inputs	0.200
R	Gross world interest rate	1.059
b	Net foreign assets-output ratio	-0.440
p^N	Relative price of nontradables	1.000
p^m	Price of imported input	1.000
$y^T + p^N y^N$	Output in units of tradables	1.000
c^T/y^T	Tradable consumption-output ratio	0.665
c^N/y^N	Nontradable consumption-output ratio	0.710
$p^N y^N/y^T$	Nontradable-tradable output ratio	1.543
A^T	Lump-sum absorption of tradables	0.106
A^N	Lump-sum absorption of nontradables	0.176

Note: BAH refers to Bewley-Aiyagari-Hugget, UE refers to Uzawa-Epstein. CES refers to constant elasticity of substitution.

Table 6. Statistical Moments of the Stochastic Stationary State of the One-Sector Economy

	Baseline		Auto Corr 0.7		Std Dev. 5%		Std Dev. 2.5%		Risk Aver. 5.0	
	UE	BAH	UE	BAH	UE	BAH	UE	BAH	UE	BAH
Precautionary savings [1/]	0.02	0.10	0.04	0.12	0.05	0.22	0.01	0.05	0.10	0.24
Means										
Output	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Consumption	0.69	0.69	0.69	0.70	0.70	0.70	0.69	0.69	0.70	0.70
Foreign assets	-0.42	-0.42	-0.41	-0.39	-0.39	-0.30	-0.43	-0.46	-0.34	-0.28
Trade balance [2/]	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02
Discount factor	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94	0.94
Coefficients of variation (in percent)										
Output	3.28	3.28	3.63	3.63	4.97	4.97	2.49	2.49	3.28	3.28
Consumption	3.13	3.26	3.92	3.92	4.72	4.66	2.38	2.59	4.11	3.11
Foreign assets	24.41	10.11	29.73	13.39	36.97	20.28	18.52	6.33	40.92	20.10
Current account [2/]	2.68	2.02	2.77	2.08	4.08	3.42	2.03	1.40	2.81	2.48
Trade balance [2/]	3.04	2.11	3.27	2.23	4.62	3.66	2.30	1.44	3.72	2.78
Discount factor	0.14	0.00	0.18	0.00	0.21	0.00	0.11	0.00	0.18	0.00
Normalized coefficients of variation (relative to output)										
Consumption	0.95	0.99	1.08	1.08	0.95	0.94	0.96	1.04	1.25	0.95
Foreign assets	7.43	3.08	8.19	3.69	7.43	4.08	7.44	2.55	12.46	6.12
Current account [2/]	0.82	0.62	0.76	0.57	0.82	0.69	0.82	0.56	0.86	0.75
Trade balance [2/]	0.92	0.64	0.90	0.61	0.93	0.74	0.93	0.58	1.13	0.85
Discount factor	0.04	0.00	0.05	0.00	0.04	0.00	0.04	0.00	0.06	0.00
Output correlations										
Consumption	0.42	0.75	0.48	0.78	0.42	0.67	0.42	0.81	0.26	0.54
Foreign assets	0.32	0.56	0.34	0.53	0.32	0.44	0.32	0.62	0.19	0.33
Current account [2/]	0.97	0.85	0.97	0.83	0.97	0.89	0.97	0.81	0.99	0.93
Trade balance [2/]	0.76	0.70	0.68	0.63	0.76	0.73	0.76	0.67	0.66	0.74
Discount factor	-0.42	0.00	-0.48	0.00	-0.42	0.00	-0.42	0.00	-0.26	0.00
Autocorrelations										
Output	0.59	0.59	0.69	0.69	0.59	0.59	0.59	0.59	0.59	0.59
Consumption	0.97	0.84	0.97	0.88	0.97	0.88	0.97	0.81	0.99	0.93
Foreign assets	0.99	0.96	0.99	0.98	0.99	0.98	0.99	0.94	1.00	0.99
Current account [2/]	0.57	0.51	0.67	0.62	0.57	0.54	0.57	0.49	0.59	0.56
Trade balance [2/]	0.67	0.55	0.76	0.67	0.67	0.59	0.67	0.52	0.76	0.64
Discount factor	0.98	0.00	0.98	0.00	0.98	0.00	0.97	0.00	0.99	0.00

Source: Authors' calculations.
1/ Precautionary savings are measured as defined in the text.
1/ Current account and trade balance are measured in percent of output.

Table 7. Statistical Moments of the Stochastic Stationary State of the Two-Sector Economy

	Baseline			
	UE		BAH	
	Econ w/ perfect credit markets	Econ w/ binding credit constraints	Econ w/ perfect credit markets	Econ w/ binding credit constraints
Precautionary savings [1/]	0.02	0.06	0.25	0.26
Means				
Consumption of tradables	0.262	0.264	0.261	0.269
Consumption of nontradables	0.431	0.432	0.430	0.435
Consumption	0.360	0.362	0.359	0.366
Price of nontradables	1.005	1.011	1.003	1.027
Net foreign assets	-0.424	-0.378	-0.447	-0.243
Current Account-GDP ratio	0.000	0.000	0.000	0.000
Tradables GDP	0.393	0.393	0.393	0.393
GDP in units of tradables	1.002	1.006	1.000	1.019
Nontradables GDP	0.607	0.608	0.606	0.610
Imported input	0.152	0.153	0.152	0.156
Coefficients of variation (in percent)				
Consumption of tradables	1.643	1.523	3.139	2.993
Consumption of nontradables	5.369	5.379	4.926	4.896
Consumption	3.626	3.634	3.169	3.109
Price of nontradables	6.622	6.550	8.099	8.053
Net foreign assets	19.824	16.436	42.960	76.574
Current Account-GDP ratio	1.453	1.416	1.950	1.939
Tradables GDP	3.345	3.345	3.345	3.345
GDP in units of tradables	2.213	2.184	3.292	3.271
Nontradables GDP	3.050	3.059	2.797	2.793
Imported input	3.805	3.688	5.846	5.754
Correlation with GDP				
Consumption of tradables	0.374	0.341	0.804	0.803
Consumption of nontradables	-0.579	-0.579	-0.562	-0.591
Consumption	-0.471	-0.482	-0.247	-0.293
Price of nontradables	0.749	0.740	0.867	0.873
Net foreign assets	0.266	0.151	0.437	0.408
Current Account-GDP ratio	-0.141	-0.142	-0.474	-0.497
Nontradables GDP	-0.579	-0.579	-0.562	-0.591
Imported input	0.833	0.826	0.929	0.931
First-order autocorrelation				
Consumption of tradables	0.961	0.920	0.908	0.897
Consumption of nontradables	0.483	0.484	0.505	0.502
Consumption	0.528	0.525	0.663	0.650
Price of nontradables	0.460	0.451	0.489	0.485
Net foreign assets	0.985	0.974	0.995	0.994
Current Account-GDP ratio	0.489	0.477	0.456	0.455
Tradables GDP	0.587	0.587	0.587	0.587
GDP in units of tradables	0.674	0.653	0.673	0.660
Nontradables GDP	0.483	0.484	0.505	0.502
Imported input	0.514	0.484	0.577	0.565

Source: Authors' calculations.

1/ Precautionary savings are measured as defined in the text.

References

Aiyagari, S. Rao, 1994, "Uninsured Idiosyncratic Risk and Aggregate Saving," *Quarterly Journal of Economics,* Vol. 109, No. 3, pp. 17–31.

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

Alfaro, Laura, and Fabio Kanczuk 2006, "Optimal Reserve Management and Sovereign Debt" (unpublished; Cambridge, Massachussets: Harvard Business School).

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

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

———, Alejandro Izquierdo, and Luis Mejia, 2004, "On the Empirics of Sudden Stops: The Relevance of Balance-Sheet Effects," NBER Working Papers 10520, (Cambridge: National Bureau of Economic Research).

Cavallo, Eduardo, and Jeffrey Frankel, 2004, "Does Openness to Trade Make Countries More Vulnerable to Sudden Stops, or Less? Using Gravity to Establish Causality" (unpublished; Cambridge, Massachussets: Harvard University).

Chinn, Menzie, and Hiro Ito, 2005, "What Matters for Financial Development? Capital Controls, Institutions, and Interactions," forthcoming in *Journal of Development Economics.*

Choi, Woon Gyu, and David Cook, 2003, "Liability Dollarization and the Bank Balance Sheet Channel," *Journal of International Economics,* Vol. 64, No. 2, pp. 247–75.

Choi, Woon Gyu, Sunil Sharma, and Maria Stromqvist, 2007, "Capital Flows, Financial Integration, and International Reserve Holdings: The Recent Experience of Emerging Markets and Advanced Economies," IMF Working Paper (Washington: International Monetary Fund).

Dooley Michael, David Folkerts-Landau, and Peter Garber, 2003, "An essay on the revived Bretton Woods System," NBER Working paper No. 9971 (Cambridge: National Bureau of Economic Research).

Durdu, C. Bora, 2006, "Quantitative Implications of Indexed Bonds in Small Open Economies," Working Paper 2006-12 (Washington: Congressional Budget Office).

——— and Enrique G. Mendoza, 2006, "Are Asset Price Guarantees Useful for Preventing Sudden Stops?: The Globalization Hazard-Moral Hazard Tradeoff of Asset Price Guarantees," *Journal of International Economics,* Vol. 69, pp. 84–119.

Edwards, Sebastian, 2005, "Capital Controls, Sudden Stops and Current Account Reversals,"NBER Working Paper 11170 (Cambridge: National Bureau of Economic Research).

Epstein, Larry G., 1983, "Stationary Cardinal Utility and Optimal Growth under Uncertainity," *Journal of Economic Theory,* Vol. 31, pp. 133–52.

Fisher, Irving, 1933, "The Debt-Deflation Theory of Great Depressions," *Econometrica* Vol. 1, pp. 337–57.

Fogli, Allessandra and Fabrizio Perri, 2006, "The Great Moderation and the US External Imbalances," NBER Working Papers 12708. (Cambridge: National Bureau of Economic Research).

Gourinchas, Pierre-Olivier, and Olivier Jeanne, 2006, "The Elusive Gains from International Financial Integration," *Review of Economic Studies,* Vol. 73, No. 3, pp. 715–40.

Hugget, Mark, 1993, "The Risk Free Rate in Heterogenous-Agent, Incomplete-Insurance Economies," *Journal of Economic Dynamics and Control,* Vol. 17, No. 5–6, pp. 953–69.

Jeanne, Olivier, 2007, "International Reserves in Emerging Markets Countries: Too Much of a Good Thing?" forthcoming in *Brookings Papers in Economic Activity*.

——— and Romain Rancière, 2006, "The Optimal Level of International Reserves for Emerging Market Countries: Formulas and Applications," IMF Working Paper 06/229 (Washington: International Monetary Fund).

Korinek, Anton, 2007, "Excessive Dollar Borrowing in Emerging Markets: Balance Sheet Effects and Macroeconomic Externalities" (unpublished; New York City, NY: Columbia University).

Kose, Ayhan, Eswar Prasad, and Marco Terrones, 2003, "Financial Integration and Macroeconomic Volatility," *IMF Staff Papers,* Vol. 50, Special Issue, pp. 119–42.

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”. IMF Working Paper 06/69 (Washington: International Monetary Fund).

Ljungqvist, Lars, and Thomas J. Sargent, 2004, *Recursive Macroeconomic Theory*, (Cambridge: MIT Press).

Mendoza, Enrique G., 2002, “Credit, Prices, and Crashes: Business Cycles with a Sudden Stop,” in *Preventing Currency Crises in Emerging Markets*, ed. By Frankel, Jeffrey and Sebastian Edwards (Chicago: University of Chicago Press).

———, 2005, “Real Exchange Rate Volatility and the Price of Nontradables in Sudden-Stop Prone Economies,” *Economia,* Fall, pp. 103–48.

———, 2006a, “Lessons from the Debt-Deflation Theory of Sudden Stops,” NBER Working Paper 11966 (Cambridge: National Bureau of Economic Research).

———, 2006b, “Endogenous Sudden Stops in a Business Cycle Model with Collateral Constraints: A Fisherian Deflation of Tobin’s Q,” NBER Working Paper 12564 (Cambridge: National Bureau of Economic Research).

——— and Linda Tesar, 1998, “The International Ramifications of Tax Reforms; Supply-Side Economics in a Global Economy,” *American Economic Review,* Vol. 88, pp. 226–45.

Mendoza, Enrique G,. Vincenzo Quadrini and Jose Victor Rios-Rull, 2007, “Financial Integration, Financial Deepness and Global Imbalances,” NBER Working Paper 12909 (Cambridge: National Bureau of Economic Research).

Milesi-Ferretti, Gian Maria, and Assaf Razin, 2000, “Current Account Reversals and Currency Crises: Empirical Regularities,” in *Currency Crises*, ed. by Paul Krugram (Chicago: University of Chicago Press).

Ostry, Jonathan D., and Carmen M. Reinhart, 1992, “Private Saving and Terms of Trade Shocks,” *IMF Staff Papers*, Vol. 39, pp. 495–517.

Rothemberg, Alexander and Francis E. Warnock, 2006, “Sudden Flight and True Sudden Stops,” NBER Working Paper 12726 (Cambridge: National Bureau of Economic Research).

Tauchen, George, Robert Hussey, 1991, "Quadrature-based Methods for Obtaining Approximate Solutions to Nonlinear Asset Pricing Models," *Econometrica*, Vol. 59, No. 2, pp. 371–96.

Uribe, Martin, 2006, "Individual Versus Aggregate Collateral Constraints and the Overborrowing Syndrome," NBER Working Paper 12260 (Cambridge: Bureau of Economic Research).

——— and Zhanwei Vivian Yue, 2006, "Country Spreads and Emerging Countries: Who Drives Whom?," *Journal of International Economics*, Vol. 69, pp. 6–36.