Financial Integration, Credit Market Imperfections and Consumption Smoothing

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Abstract

Recent empirical research by Kose, Prasad and Terrones (2003) shows that financial integration is associated with higher consumption volatility in developing countries. This paper provides one possible explanation as to how international financial integration can increase consumption volatility in a developing country facing credit market imperfections. I use a two country international real business cycle model where the non-traded sector in the small country faces borrowing constraints due to contract enforceability problems. Financial integration provides households insurance against domestic risks that are amplified by the financial imperfections. If the international risk-sharing opportunities are nonexistent, households can secure themselves only by adjusting their labor effort, which leads to changes in sectorial output and terms of trade. The deterioration of the terms of trade acts as a dampening effect on consumption, causing it to be less volatile under financial autarky relative to financial integration.

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1 Introduction

One of the perceived benefits of financial integration is that it allows for international risk-sharing and consumption smoothing through lending and borrowing in the international financial markets. Financial integration provides access to a wider range of assets, which acts as a cushion against domestic shocks. This diversification generates a lower consumption volatility compared to a financially less integrated system or a financial autarky. Accordingly, theoretical studies by Mendoza (1994), Baxter and Crucini (1995), and Sutherland (1998), to name a few, have shown that despite its ambiguous effect on output volatility, financial integration leads to a decrease in consumption volatility. Contrary to these theoretical implications, however, Kose, Prasad and Terrones (2003) show that higher levels of financial integration in the 1990s are associated with higher consumption volatility for developing countries. The authors note that this result cannot be explained by the fact that some of these countries have undergone crises in this period because consumption volatility relative to output volatility has also increased.[1]

In this paper, I provide a theoretical model that rationalizes this puzzling evidence, by incorporating domestic financial imperfections into the analysis of international risk-sharing.[2] The aim is to show that aggregate consumption (and consumption relative to output) can become more volatile under financial integration once domestic financial frictions are taken into account. To that end, I develop a two country real business cycle model, where one of the countries represents an emerging market economy. This smaller economy features two credit market imperfections that are characteristic of developing countries as shown by Tornell and Westermann (2003). First, I assume that the non-traded sector firms cannot borrow internationally; they are bound to domestic financial system for any borrowing requirements. I assume, moreover, that even when they borrow from the domestic financial system, they face collateral constraints due to contract enforcement problems. As in Tornell and Westermann (2003), their borrowing cannot exceed a given proportion of their existing capital stock. These frictions make the non-traded sector inherently more volatile. Financial integration affects how the

[1] The authors also show that in developed countries higher levels of financial integration is associated with lower consumption volatility. This negative relation is in accordance with the previous theoretical studies.

[2] On the empirical side, Eozenou (2005) builds on the evidence by Kose et. al. (2003) by introducing an interaction term between financial integration and financial development. He shows that the adverse effects of financial integration on consumption volatility can be mitigated with financial development.

households respond to this volatility.

I analyze the impact of financial integration on the emerging market country by comparing two scenarios. The first setup depicts a financial autarky where the economy is closed to trading of any international assets. The second scenario involves financial integration, where households are allowed to hold international state contingent portfolios, and hence are able to fully insure themselves against domestic risks that are amplified by the financial imperfections.[3] In the autarky scenario, however, where the international risk-sharing opportunities are nonexistent, households can secure themselves only by adjusting their labor effort, which leads to changes in sectorial output and relative prices (e.g. terms of trade).

The novelty of the model originates from this inherent difference in households' response to domestic shocks under the two scenarios. I show that, under the financial integration scenario, international risk-sharing opportunities cause the terms of trade dynamics to be smoother than the autarky case where the terms of trade is subject to change. Smoother terms of trade dynamics allow consumption to be more responsive to disturbances, which in turn leads to a higher consumption volatility under financial integration.[4]

More specifically, due to the credit markets imperfections, the non-traded sector firms are required to pledge existing capital stock, which is denominated in the relative price of the non-traded goods, as collateral. Therefore, when faced with a productivity shock, value of the collateral decreases causing the firms to be more constrained. A stricter constraint implies that loans and demand for labor in the non-traded sector decrease. Under financial autarky households have no assets, so the only sources of income they have are from loans and labor supplied to the two sectors. When the demand for loans and for labor in the non-traded sector decrease, households insure themselves by supplying more labor to the traded sector. Higher labor supply in the traded sector leads to more output, and to terms of trade deterioration. As a result of the terms of trade deterioration, the consumption bundle becomes more expensive, dampening the reaction of consumption to productivity shocks. Under financial integration, however, households

[3]In either of these scenarios, the non-traded sector firm owners are not allowed to hold the international portfolios.

[4]In a similar fashion, Paasche (2001) shows how in the presence of financial frictions, a productivity shock in a small open economy might trigger terms of trade movements that spread the crisis to another small open economy.

have international assets to insure themselves with. Therefore, they do not react to the changes in the non-traded sector, and the terms of trade do not move. Without the dampening effect of the terms of trade, reaction of consumption to productivity changes can be higher, causing aggregate consumption to be more volatile. Higher consumption volatility under financial integration is associated with lower levels of welfare in the aggregate, due to big welfare losses of the non-traded good firm owners, even though the households are still better off under financial integration.

Credit market frictions, similar to the ones depicted in this paper, have widely been used in explaining financial crises and instability of small open economies. Aghion, Bacchetta and Banerjee (2004), Tornell and Westermann (2002), and Arellano and Mendoza (2002) are a few examples that focus on such imperfections in the context of small open economies. Because the main goal of this strand of literature is to understand financial crises, most of these studies do not look at the role of domestic financial frictions in the context of international financial integration. One exception is Aghion, Bacchetta and Banerjee (2004), who show how capital account liberalization might destabilize a small country that has an intermediate level of financial development. In their analysis, they mainly focus on the volatility of investment and output, and do not discuss the implications for consumption. Levchenko (2005), on the other hand, focuses on the impact of financial liberalization on consumption volatility. He shows that in the countries with underdeveloped financial markets, domestic risk-sharing arrangements might deteriorate in the face of financial integration. As a results, individual consumptions might become more volatile, but aggregate consumption volatility will nevertheless decrease.

The rest of the paper is organized as follows: next section presents the model economy. Section 3 discusses the model parametrization. Section 4 analyzes the frictions in the model and presents the results. Section 5 looks at sensitivity analysis. Section 6 describes the welfare results. Finally, section 7 concludes.

2 The Model

This section presents the model for financial autarky and integration, where the latter yields higher consumption volatility than the former. It is a two-country model with infinitely lived agents. The world is populated with a continuum of agents on the interval [0,1]. A mass n of households belongs to country H (home), while $1-n$ belongs to F

(foreign). I assume that home is an emerging market economy with an underdeveloped financial system, and foreign is a large economy with perfect financial markets. Each country produces a traded and a non-traded good. In the home country, there are two types of consumers: households and the owners of the non-traded sector firms (from here on NT owners). Households make up fraction κ of the population, own the home traded goods firms, and provide labor to both the traded and the non-traded goods sectors. NT owners make up fraction $1-\kappa$ of the population, and they borrow from the households to be able to finance their investment and production of non-traded goods.

2.1 Consumption Baskets and Price Indices

Both the households and the NT owners consume the same consumption basket, C_t, which is a composite index of traded and non-traded consumption goods, C_T and C_N, respectively:

$$C_t = [\gamma^{\frac{1}{\xi}} C_{T,t}^{\frac{\xi-1}{\xi}} + (1-\gamma)^{\frac{1}{\xi}} C_{N,t}^{\frac{\xi-1}{\xi}}]^{\frac{\xi}{1-\xi}} \tag{1}$$

where $\xi \geq 0$ is the elasticity of substitution between traded and non-traded goods, and γ is the share of traded goods in the consumption basket. Consumption of the traded goods, C_T, is a composite of home and foreign traded goods, C_H and C_F,respectively:

$$C_{T,t} = [n^{\frac{1}{\theta}} C_{H,t}^{\frac{\theta-1}{\theta}} + (1-n)^{\frac{1}{\theta}} C_{F,t}^{\frac{\theta-1}{\theta}}]^{\frac{\theta}{1-\theta}} \tag{2}$$

where $\theta \geq 0$ is the elasticity of substitution between home and foreign traded goods. The general price index for consumption, P_t, the price index for the traded goods, $P_{T,t}$, and the price index for the non-traded goods, $P_{N,t}$, are denominated in units of domestic currency.[5] P_t and $P_{T,t}$ are given by

$$P_t = [\gamma P_{T,t}^{1-\xi} + (1-\gamma) P_{N,t}^{1-\xi}]^{\frac{1}{1-\xi}} \tag{3}$$

$$P_{T,t} = [n P_{H,t}^{1-\theta} + (1-n) P_{F,t}^{1-\theta}]^{\frac{1}{1-\theta}}. \tag{4}$$

[5]It must be noted that the model economy is a cashless economy where currency only plays the role of convenient unit of account.

2.2 Households

Households consume the consumption basket, own the traded sector firms, provide labor to the production of traded and non-traded goods, and lend to the non-traded goods firms. The objective of a household is to maximize:

$$U'_t = E_t \sum_{t=0}^{\infty} \beta^t [\log(C'_t) - \tau_N L_{N,t} - \tau_H L_{H,t}] \tag{5}$$

where C'_t is the consumption of the household, $L_{N,t}$ and $L_{H,t}$ denote labor supply in the non-traded and traded sectors respectively.

2.2.1 Financial Autarky

Under financial autarky, home households are not allowed to trade any assets with foreign households. The budget constraint in this case becomes

$$P_t C'_t + Z'_t \leq W_{N,t} L_{N,t} + W_{H,t} L_{H,t} + R_{t-1} Z'_{t-1} + \Pi_t \tag{6}$$

where Z'_t is the amount loans given to the non-traded sector, and R_{t-1} is the gross interest rate on the loans, paid in period t. $W_{N,t}$ and $W_{H,t}$ are the wage rates in the traded and non-traded goods sectors, respectively. Π_t denotes the profits from owning the traded goods firms. The households choose $C'_t, Z'_t, L_{N,t}, L_{H,t}$ to maximize (5) subject to (6). The first order conditions give us the Euler equation, and the labor supply equations in the two sectors:

$$E_t \left[\left(\frac{C'_t}{C'_{t+1}} \right)^{-1} \right] = \beta E_t \left[R_t \frac{P_t}{P_{t+1}} \right] \tag{7}$$

$$\frac{W_{N,t}}{P_t} = \tau_N C'_t \tag{8}$$

$$\frac{W_{H,t}}{P_t} = \tau_H C'_t \tag{9}$$

2.2.2 Financial Integration

When the home country is financially integrated with the foreign country, households can fully insure themselves against domestic shocks. They are able to do so by holding

an international state contingent portfolio, which yield a return in terms of the foreign country's currency.[6,7] The budget constraint for the household in this case becomes:

$$P_t C'_t + Z'_t + \varepsilon_t \sum Q(s^{t+1} \mid s^t) B(s^{t+1}) \leq W_{N,t} L_{N,t} + W_{H,t} L_{H,t} + R_{t-1} Z'_{t-1} + \Pi_t + \varepsilon_t B(s^t) \tag{10}$$

where s^t denotes the state of the nature, ε_t is the nominal exchange rate, $B(s^t)$ is the market value of (in units of foreign currency) a portfolio of the state contingent securities held at the end of period t, and $Q(s^{t+1} \mid s^t)$ is the pricing kernel of the state contingent portfolio. In this case, in addition to the choice variables under financial autarky, the household also chooses $B(s^{t+1})$ in maximizing (5) subject to (10). The first order conditions in this case are:

$$\beta E_t \left[R_t \left(\frac{C_{t+1}}{C_t} \right)^{-1} \frac{P_t}{P_{t+1}} \right] = 1 \tag{11}$$

$$Q(s^{t+1} \mid s^t) = \beta \Pr(s^{t+1}|s^t) \frac{\varepsilon(s^{t+1})}{\varepsilon(s^t)} \left(\frac{C(s^{t+1})}{C(s^t)} \right)^{-1} \frac{P(s^t)}{P(s^{t+1})} \tag{12}$$

$$\frac{W_{N,t}}{P_t} = \tau_N C_t \tag{13}$$

$$\frac{W_{H,t}}{P_t} = \tau_H C_t \tag{14}$$

Combining (11) and (12), I get the no-arbitrage condition between the returns on the loans and the international portfolio:

$$\sum_{s^{t+1}} Q(s^{t+1} \mid s^t) = \frac{1}{R_t} \sum_{s^{t+1}} \frac{\varepsilon(s^{t+1})}{\varepsilon(s^t)}. \tag{15}$$

The no-arbitrage condition implies that households are indifferent between giving out loans to the non-traded sector firms and holding the international portfolio. The equi-

[6]The assumption of an international state contingent portfolio allows us to analyze the most favaroble form of financial integration. The mechanism and the results presented hold when I consider a single non-contingent bond. See the Appendix for the description and results of the model with a non-contingent bond.

[7]Having bonds denominated in currency is convenient particularly here, since denomination in units of consumption would imply implicit trading of foreign non-traded goods.

librium amount of loans is then pinned down by the demand for loans of the NT owners, which is always positive in equilibrium as discussed in section 2.4.

2.3 Traded Goods Sector

Firms in the traded sector are perfectly competitive, and they produce the home traded good using only labor. The typical competitive firm maximizes its profits choosing labor:

$$\max P_{H,t}Y_{H,t} + \varepsilon_t P^*_{H,t}Y^*_{H,t} - W_{H,t}L_{H,t} \tag{16}$$

subject to:

$$Y_{H,t} + Y^*_{H,t} = A_{H,t}L_{H,t} \tag{17}$$

where $Y_{H,t}$ and $Y^*_{H,t}$ are the amounts of traded good sold at home and abroad, $L_{H,t}$ is labor used in the production, and $A_{H,t}$ is the productivity shock in the traded goods sector. From the firms's optimization and using the fact that the firm is perfectly competitive, I get:

$$\frac{W_{H,t}}{A_{H,t}} = P_{H,t} \tag{18}$$

I assume that there are no goods market frictions so that the law of one price for the home good holds:

$$P_{H,t} = \varepsilon_t P^*_{H,t} \tag{19}$$

2.4 Non-Traded Goods Sector

There is a continuum of agents, each of whom own a non-traded good firm. They combine labor services of the households with the capital they own to produce the non-traded good with a Cobb-Douglas technology that takes the following form:

$$Y_{N,t} = A_{N,t}L^{\eta}_{N,t}K^{1-\eta}_{N,t-1} \tag{20}$$

where K_N is the capital they own, L_N is the labor, and $A_{N,t}$ is the productivity shock common to all non-traded goods firms. The parameter $0 \leq \eta \leq 1$, denotes the share

of labor in the production of the non-traded goods. Capital stock is augmented by investment, $X_{N,t}$, with previous period's non-traded good output allocated to investment in the following way:

$$X_{N,t} = K_{N,t} - (1-\delta)K_{N,t-1} \tag{21}$$

where δ is the depreciation rate.

To be able to invest and produce, NT owners need to get loans each period because they do not have adequate accumulated assets, or net worth, to undertake the investment. Following Tornell and Westermann's (2002) empirical evidence, I assume that the non-traded goods firms cannot borrow internationally. They rely on the domestic financial system, mainly on the domestic banks. I assume that there is a financial institution, not explicitly modeled, that collects deposits from the households and lends them out to the NT owners. Furthermore, I assume that the credit contracts are subject to enforceability problems. The enforceability problem arises because the borrowers can divert the borrowed funds to other uses, and the financial system is not developed enough to monitor the firms. The way the financial institution manages the enforceability problem is that it requires the firms to pledge collateral in the loan contract. Firm owners offer next period's expected value of capital stock as collateral to the financial institution. In the case of debt repudiation, the financial institution pays a transaction cost proportional to the borrower's collateral to liquidate the pledged capital, and pay back the lenders. Given the incentive compatibility scheme, the financial institution finances firms whose debt repayment is less than or equal to the expected value of their capital, net of liquidation costs. Therefore the NT owner's borrowing constraint becomes

$$R_t Z_t^{''} \leq m E_t(P_{N,t+1} K_{N,t}) \tag{22}$$

where $Z_t^{''}$ is the nominal amount of borrowing, and R_t is the gross interest rate on the loan. The parameter m represents the severity of the enforceability problem and therefore the level of financial development. The higher the parameter m, the less severe the enforceability problem, and the more relaxed the borrowing constraint is.

NT owner's problem is to maximize utility

$$U_t^{''} = E_t \sum_{t=0}^{\infty} \upsilon^t \log(C_t^{''}) \tag{23}$$

subject to the budget constraint

$$P_{N,t}X_{N,t} + P_t C_t^{''} + R_{t-1}Z_{t-1}^{''} + W_{N,t}L_{N,t} \leq P_{N,t}Y_{N,t} + Z_t^{''}, \tag{24}$$

and the borrowing constraint in (22). The consumption bundle $C_t^{''}$ is the same as the household's consumption bundle and is given by (1) and (2). I assume that the discount factor of the NT owners, υ, is smaller than the discount factor of the worker households, β. As first shown by Carlstrom and Fuerst (1997), this assumption ensures that the borrowers will not be able to accumulate adequate assets, and be borrowing constrained in the steady state.

The first order conditions to the NT owner's problem with respect to $C_t^{''}, L_{N,t}, K_{N,t}$ and $Z_t^{''}$ are as follows:

$$\mu_t = \frac{1}{C_t^{''} P_t} \tag{25}$$

$$\frac{W_{N,t}}{P_{N,t}} = \eta \frac{Y_{N,t}}{L_{N,t}} \tag{26}$$

$$\mu_t = \upsilon E_t \left\{ \mu_{t+1} \left[(1-\eta) \frac{P_{N,t+1}}{P_{N,t}} \frac{Y_{N,t+1}}{K_{N,t}} + (1-\delta) \frac{P_{N,t+1}}{P_{N,t}} \right] + m\lambda_t \frac{P_{N,t+1}}{P_{N,t}} \right\} \tag{27}$$

$$\lambda_t = \mu_t \frac{1}{R_t} - \upsilon E_t \left\{ \mu_{t+1} \right\} \tag{28}$$

where μ_t is the lagrange multiplier on the budget constraint and λ_t is the multiplier on the borrowing constraint. There are two important things to note. First, equation (28) in the steady state implies that λ_t is always greater than zero since $\frac{1}{R} = \beta$ and $\beta > \upsilon$. Therefore, the borrowing constraint is always binding in and around the steady state.[8] The fact that the borrowing constraint is always binding and the optimality conditions jointly identify the amount of loans demanded in equilibrium. Secondly, the effective interest rate that the NT owners face, i.e., inverse of their intertemporal price of consumption, is higher than the domestic interest rate. Substituting equation (25) into equation (28) and rearranging the terms, I can write the expression for the effective interest rate as

[8]To ensure that the borrowing constraint is binding around the deterministic steady state, one must assume that the variance of the stochastic shock processes are sufficiently small.

$$\frac{R_t}{1-\lambda_t C_t'' P_t} = \left[\upsilon E_t \left(\frac{C_t''}{C_{t+1}''}\frac{P_t}{P_{t+1}}\right)\right]^{-1}. \tag{29}$$

which is greater than R_t. Equation (29) implies that, the higher the marginal benefit of borrowing (λ_t), the higher the effective interest rate NT owners face.

2.5 Foreign Country

The foreign country is populated with a representative household who owns both the traded and non-traded goods firms, provide labor to both sectors and consume the consumption bundle. The consumer's problem is to maximize utility:

$$U_t^* = E_t \sum_{t=0}^{\infty} \beta^t [\log(C_t^*) - \tau_N L_{N,t}^* - \tau_F L_{F,t}^*] \tag{30}$$

subject to

$$P_t^* C_t^* \leq W_{N,t}^* L_{N,t}^* + W_{F,t}^* L_{F,t}^* + \Pi_t^* \tag{31}$$

under financial autarky. The first order conditions of this problem are:

$$\frac{W_{N,t}^*}{P_t^*} = \tau_N^* C_t^* \tag{32}$$

$$\frac{W_{F,t}^*}{P_t^*} = \tau_F^* C_t^* \tag{33}$$

Under financial integration the budget constraint becomes

$$P_t^* C_t^* + \sum_{s^{t+1}} Q(s^{t+1} \mid s^t) B^*(s^{t+1}) \leq W_{N,t}^* L_{N,t}^* + W_{F,t}^* L_{F,t}^* + B^*(s^t) + \Pi_t^* \tag{34}$$

and the additional optimality condition is:

$$Q(s^{t+1} \mid s^t) = \beta \Pr(s^{t+1} \mid s^t) \left(\frac{C^*(s^{t+1})}{C^*(s^t)}\right)^{-1} \frac{P^*(s^t)}{P^*(s^{t+1})} \tag{35}$$

The problem of a representative foreign traded goods firm is symmetric to the home traded goods firm. From their optimization, I get:

$$\frac{W^*_{F,t}}{A^*_{F,t}} = P^*_{F,t}. \tag{36}$$

I assume that the law of one price holds also for the foreign goods, so I get $P_{F,t} = \varepsilon_t P^*_{F,t}$.

The non-traded goods firms in the foreign country are owned by the foreign households, therefore, they are not constrained in their borrowing. The objective of the competitive non-traded goods firm is to maximize the discounted value of the profits using households marginal utility as the discount factor:

$$E_t \sum_{t=0}^{\infty} \beta^t \left(\frac{C^*_0}{C^*_t} \right) \Pi^*_t \tag{37}$$

where the profits are defined as

$$\Pi^*_t = P^*_{N,t} Y^*_{N,t} - W^*_{N,t} L^*_{N,t} - P^*_{N,t} X^*_{N,t}. \tag{38}$$

The optimization problem of the non-traded goods firm is subject to the production function

$$Y^*_{N,t} = A^*_{N,t} (L^*_{N,t})^{\eta} (K^*_{N,t-1})^{1-\eta} \tag{39}$$

and the capital accumulation equation

$$X^*_{N,t} = K^*_{N,t} - (1-\delta) K^*_{N,t-1}. \tag{40}$$

The equilibrium conditions for the foreign non-traded sector are:

$$\frac{W^*_{N,t}}{P^*_{N,t}} = \eta \frac{Y^*_{N,t}}{L^*_{N,t}} \tag{41}$$

$$\frac{P^*_{N,t}}{P^*_t} = \beta E_t \left\{ \left(\frac{C^*(s^{t+1})}{C^*(s^t)} \right)^{-1} \frac{P^*_{N,t+1}}{P^*_{t+1}} \left[\frac{(1-\eta) Y^*_{N,t+1}}{K^*_{N,t}} + 1 - \delta \right] \right\}. \tag{42}$$

2.6 Equilibrium

The equilibrium is defined as a sequence of endogenous prices and quantities that solve all the agents' and firms' optimization problems and satisfy the market clearing conditions. Market clearing conditions in the traded and non-traded goods sectors are given by:

$$nC_{H,t} + (1-n)C^*_{H,t} = Y_{H,t} + Y^*_{H,t} \tag{43}$$

$$nC_{F,t} + (1-n)C^*_{F,t} = Y_{F,t} + Y^*_{F,t} \tag{44}$$

$$Y_{N,t} = C_{N,t} + X_{N,t} \tag{45}$$

$$Y^*_{N,t} = C^*_{N,t} + X^*_{N,t} \tag{46}$$

Aggregate home consumption is defined as the sum ofI households' and NT owners' consumption:

$$C_t = \kappa C'_t + (1-\kappa)C'' \tag{47}$$

Finally, the loan market clearing at home implies:

$$\kappa Z'_t = (1-\kappa)Z''_t. \tag{48}$$

3 Model Parametrization

The quarterly discount factor of the workers, β, is set equal to 0.99, which implies a real interest rate of 4 percent, and the discount factor of the NT owners, υ, is set to 0.98. The weight of labor efforts in the utility, τ_N and τ_H are assumed to be constant across the two sectors, and set equal to 1. Since the home country is assumed to be a small country and the foreign country can be thought of as the rest of the world, home country's size parameter n is assumed to be 0.05. The share of labor in the production of tradable, η, and the depreciation rate δ are taken from Backus, Kehoe and Kydland (1992) and are set equal to 0.64 and 0.025, respectively. The elasticity of substitution between tradable and non-tradable goods, ξ, is taken from Stockman and Tesar (1995) to be 0.5, and the share of traded goods in the consumption basket, γ, is set equal to 0.5. The elasticity of substitution between home and tradable goods, θ, is chosen to be 1.5 following Backus, Kehoe and Kydland (1994).

Two key parameters in this analysis is the share of households in the population, κ,

and the debt to collateral ratio, m. To start with I choose κ to be 0.8, and m to be 0.8, so that the implied quarterly debt to GDP ratio in the steady state is 0.07. The particular choice of m and κ makes the implied annual debt to GDP ratio equal to the mean credit to private sector to GDP ratio of 58 non-OECD countries.[9] I try different values for m and κ to show how the credit constraints on the non-traded sector's borrowing and the existence of NT owners who do not have access to international asset markets affect the results.

Following the real business cycle literature, I set the autocorrelation of the shocks in the traded and the non-traded sectors equal to 0.95. Following Baxter and Crucini (1995), I assume that the standard deviation of the shocks to the traded sector (at home and in the foreign country) is 0.007. Most estimates in literature shows that the standard deviation of productivity shocks to the non-tradable sector is roughly half of the standard deviation to the tradable sector. In line with those findings, I set the standard deviation of the productivity shocks equal to 0.0035.[10] Baxter and Crucini (1995) finds little evidence for spillover effects in technology shocks, so I assume there are no spillover effects. I also assume that the productivity shocks are not correlated across sectors or countries.[11]

4 Access to International Financial Markets, Sectorial Differences and Volatility

The model presented features two credit market imperfections. The first is the existence of a set of agents, NT owners, who do not have access to international financial markets even when the asset markets are integrated. The second is the credit constraint the non-traded goods firms face due to enforceability problems. These frictions make the output and the prices in the non-traded sector inherently more volatile. Access to international financial markets allows households to share the risks that are amplified by the financial

[9] The data is from the World Development Indicators. The list of countries is available upon request.

[10] One can assume that the productivity shocks are more volatile in the emerging markets. Increasing the standard deviation of shocks in the home country, affects consumption and output volatility under autarky more than under integration. However, the qualitative results do not change. Results available upon request.

[11] I have made sensitivity analyses with respect to the standard deviation of the productivity shocks in the non-tradable sector and correlation of shocks across sectors. The qualitative results remain the same in all these sensitivity analyses. Results are available upon request.

imperfections. In the absence of international risk-sharing opportunities, households can secure themselves only by adjusting labor effort, which will have repercussions on sectorial output and relative prices.

To illustrate the relationship between access to international asset markets and relative prices, consider the relation between the real exchange rate and the consumption differential between the two countries under financial integration.[12] When the agents can trade state contingent assets internationally, the real exchange rate will be proportional to the ratio of the marginal utilities of consumption as noted by Chari et.al (2001) and Tille (2005) among others. Equating (12) to (35), I get

$$q_t = \varphi \frac{C'_t}{C^*_t} \tag{49}$$

where q_t is the real exchange rate and is defined as $q_t = \frac{\varepsilon_t P^*_t}{P_t}$. φ is a constant that captures the initial state of the economies. Following Chari et. al (2001), I assume that the net foreign asset position of the two countries initially is zero, so that $\varphi = 1$. The log-linearized version of (49) is

$$\hat{q}_t = \hat{C}'_t - \hat{C}^*_t, \tag{50}$$

which implies that the fluctuations in the real exchange rate are associated with the consumption differential between the households and foreigners.

Under financial autarky, there is no trade in assets; therefore, the trade in goods must be balanced each period. The balanced trade condition requires the value of the imports at home to be equal to the values of exports:

$$nP_{F,t}C_{F,t} = (1-n)\varepsilon_t P^*_{H,t} C^*_{H,t} \tag{51}$$

Substituting in the expressions for the relative prices from the firms' optimization and consumption of each good from the consumers' intratemporal optimization, and rearranging the terms I get the following log-linearized equation:

[12] This link was also highlighted by Tille (2005) who shows that financial integration is not necessarily welfare improving to all parties in the presence of monetary shocks. He shows that when the goods markets are characterized by goods market rigidities, the country with less volatile monetary shocks will lose from integration.

$$\hat{q}_t = \left[\frac{\theta - 1 + \kappa\frac{C'}{C}}{\xi + \theta - 1}\right](\hat{C}'_t - \hat{C}^*_t) + \left[\frac{(1-\kappa)\frac{C^e}{C}}{\xi + \theta - 1}\right](\hat{C}''_t - \hat{C}^*_t) \tag{52}$$

where C', C'' and C are the steady state values of households' and NT owners' consumption and aggregate consumption, respectively. The linearized version of the balanced trade condition implies that the dynamics of the real exchange rate is not only associated with the consumption differential between the households and the foreigners but also between the NT owners and the foreigners. The inherent volatility of NT owners' consumption due to credit constraints and their lack of international insurance is reflected onto volatility of the real exchange rate, and onto relative prices. Also, κ, the share of households' in the population is an important determinant of the dynamics under financial autarky and integration.

The quantitative results from the model are presented in Table 2. The standard deviation of aggregate consumption under financial autarky is 0.4371, where as it is 0.5839 under integration. In addition to generating a higher volatility of consumption volatility, the model also generates a higher relative volatility of consumption to output under integration. The ratio of standard deviations of consumption to output are 0.2037 and it is 0.1708, respectively under financial integration and autarky. The results of the frictionless model where there are no borrowing constraints and the non-traded sector firms are owned by households (home country and foreign country become symmetric except for their sizes) are summarized in Table 3. Both consumption and consumption relative to output are less volatile under financial integration in that set up. These results suggest that if a small country has a malfunctioning financial system with unequal access to international markets and enforceability problems, despite the premises of risk-sharing, international financial integration can lead to an increase the consumption volatility.

4.1 Asymmetric Credit Conditions and Terms of Trade Dynamics

To illustrate how relative prices are smoothed out under financial integration, allowing consumption to be more responsive to shocks, I analyze the dynamic behavior of the economy following a productivity shock in the domestic non-traded sector. Figure 1

shows the responses to a 1% shock that decays with a coefficient of 0.95. First, both under financial integration and autarky, the real wage in the non-traded (from now on NT) sector increases. Labor mobility between the two sectors causes the wage rate to increase also in the traded goods sector. Secondly, the positive supply shock causes the relative price of the non-traded goods to decrease. The NT owners' borrowing is constrained by the value of their capital stock which is denominated in the price of non-traded goods. Lower relative price of the non-traded goods causes the value of the non-traded goods firm's collateral to decrease, making them more credit constrained. The result that firms become more constrained following a positive shock is due to the asymmetric information the borrowers and the financial institution have. The financial institution cannot observe the realization of the shock, but can observe the value of the collateral. With lower value of collateral, the firm owners borrow less, and as a result invest less and demand less labor.

Households are affected by the changes in the non-traded goods sector in two ways. First, the amount of loans they supply decreases, meaning they will have less income from lending in the next period. Secondly, the amount of income they get from the NT sector decreases due to the lower demand for labor in that sector. Without any access to international borrowing under financial autarky, the only way the workers can increase consumption in response to the positive productivity shock is by increasing labor efforts in the traded goods sector. Increase in the labor effort causes the home traded good to become relatively more abundant, causing its relative price to decrease. When the home traded good becomes relatively cheaper, the terms of trade (the price of home imports over price of exports) worsens. The deterioration in the terms of trade causes the home consumption bundle to become relatively more expensive, causing a dampening effect on the increase in consumption. As a result, terms of trade deterioration under financial autarky mitigates the reaction of consumption to the productivity shock, causing consumption to be less volatile.

Under financial integration, however, the households have access to assets that they can insure themselves with. Therefore, they do not react to the fall in loans and labor demand in the NT sector by increasing labor effort in the traded sector, but rather by borrowing from abroad. Consequently, the labor supply and thus the output in the traded sector does not increase, leaving the terms of trade constant. Without any change in the terms of trade, the consumption increases by a larger percentage under financial

integration than under autarky, causing consumption to be more volatile.

Another way to see how terms of trade effects causes the consumption to be less volatile under autarky, is by comparing (52) to (50), the two equations that constitute the main difference between the dynamics of the two set ups. Notice that equation (52) simplifies in the limit to (50) as $\theta \to \infty$. As θ approaches infinity, the home and the foreign traded goods become perfect substitutes. This suggests that, under financial autarky, when the home good becomes more abundant and relatively cheaper after a positive productivity shock, all the home consumers would consume only $H$and not F. The terms of trade effects disappear and the dynamics under financial integration and autarky coincide.[13]

4.2 The Severity of the Enforceability Problem

An interesting experiment is to see how the results are affected by the severity of the credit market imperfections. Figure 2 plots the relative volatility of consumption to output across different values of m (ranging from 0.1 to 1). Higher values of m corresponds to a higher level of financial development since the borrowing constraint is relaxed and the firms can borrow more. Relaxing the borrowing constraint decreases the relative volatility of consumption for both financial autarky and integration. However it is not sufficient to reverse the results and have financial integration less volatile. In essence, $m = 1$ means that the NT firms can borrow up to the full value of their collateral, still imposing a restriction on their borrowing. Therefore, setting m equal to 1 does not correspond to a case without the credit market imperfections.[14]

4.3 Asymmetric Access to International Assets

Another interesting extension would be to see the impact of the number of NT owners. Ideally one would like to disentangle the impact of different frictions in the model on the volatility results by varying κ. However, the parameter $(1- \kappa)$ simultaneously governs the share of the population that is left out of international asset markets and the size

[13]Corsetti, Dedola and Leduc (2003) also note, in a different set up with tradable and non-tradable goods, that agents can achieve complete market results under financial autarky through terms of trade movements.

[14]In the steady state $m = 1.0101$ makes the NT owners' consumption zero. Therefore, the maximum value I can give to m is a little larger than 1 to ensure nonnegativity of NT owners' consumption.

of the non-traded sector. The impacts of varying κ might be driven by changes in the size of the non-traded sector or by changes in the share of population that has access to international risk-sharing.

In this experiment, I set κ equal to 0.9999.[15] This parametrization implies that the home population is made up of mainly households who all have access to international asset markets under financial integration, and that the non-traded sector is very small in the home country. As can be seen from the results in Table 4, output becomes more volatile in both set-ups, more so under autarky. Under integration, consumption volatilities do not change by much, but under autarky NT owners consumption become significantly more volatile and households' consumption become slightly more volatile.

5 Sensitivity Analysis

In this section, I analyze sensitivity of the results to the choice of the coefficient of risk-aversion, elasticity of substitution between traded and non-traded goods, and elasticity of substitution between home and foreign goods. First consider a utility function of the following form:

$$U_t = E_t \sum_{t=0}^{\infty} \beta^t [\frac{(C_t')^{1-\omega}}{1-\omega} - \tau_N L_{N,t} - \tau_H L_{H,t}] \tag{53}$$

where ω is the coefficient of relative risk aversion.[16] Given this utility function, the linearized condition for risk-sharing condition (for financial integration) in (50) becomes

$$\hat{q}_t = \omega(\hat{C}_t' - \hat{C}_t^*). \tag{54}$$

Under financial autarky the balanced trade condition in (52) becomes

$$\hat{q}_t = \left[\frac{\omega(\theta-1) + \kappa\frac{C'}{C}}{\xi + \theta - 1}\right](\hat{C}_t' - \hat{C}_t^*) + \left[\frac{(1-\kappa)\frac{C''}{C}}{\xi + \theta - 1}\right](\hat{C}_t'' - \hat{C}_t^*) \tag{55}$$

Since equations (54) and (55) constitute the main difference between the dynamics under financial integration and autarky, the volatilities under the two set ups might be sensitive

[15] The model cannot be solved for $\kappa = 1$; therefore I set $\kappa = 0.9999$, to bring the model as close to a standard model as possible.

[16] Log utility is a special case of constant relative risk aversion function where ω is set equal to 1.

to the parameters ω, ξ and θ.

Table 5 shows the results for different values of ω, keeping ξ and θ at their initial values (0.5 and 1.5, respectively). The finding that financial integration can increase volatility of consumption holds for ω equal to 2 and 3. The second finding that relative volatility of consumption to output volatility is higher under financial integration does not hold for ω equal to 2 nor 3. As people become more risk-averse, the benefits of risk-sharing for households outweigh the costs of worsening terms of trade, and they can better cushion themselves against domestic shocks through international assets.

A common choice of coefficient of risk aversion in the literature is 2. Therefore, I try to see if there is a plausible value of ξ that would make the relative volatility of consumption lower under financial autarky for ω equal to 2.[17] The last panel of Table 6 shows that ξ needs to be 0.3, to recover the finding that relative volatility of consumption can be more volatile under financial integration. In short, if one assumes that the traded and the non-traded goods in developing countries is slightly less substitutable than what the literature assumes (usually for developed countries), the main findings of the paper is robust to choosing a risk aversion coefficient of 2.

6 Welfare Results

To see if the higher volatility under financial integration leads to lower welfare results, I evaluate the welfare criteria for autarky and integration. Following Shmitt-Grohe and Uribe (2004), and Kim and Kim (2003), I solve the model using second order approximation.[18] The welfare criteria I use is the unconditional expectation of the second order Taylor expansion of agents' utility. Given the utility function for the workers in (5) and the utility function for the NT owners in (23), the welfare criteria respectively become:

$$\mathbb{W}'_t = E_t \sum_{t=0}^{\infty} \beta^t \left\{ \log(\bar{C}') + \frac{1}{\bar{C}'}(C'_t - \bar{C}') - \frac{1}{(\bar{C}')^2}(C'_t - \bar{C}')^2 - L_{N,t} - L_{H,t} \right\} \tag{56}$$

[17] I also tried different values of θ for this purpose. The results are not sensitive to the choice of θ.

[18] I solve the model using the procedure adopted by Collard and Juillard (2001) in the package Dynare.

$$\mathbb{W}_t'' = E_t \sum_{t=0}^{\infty} \upsilon^t \left\{ \log(\bar{C}'') + \frac{1}{\bar{C}''}(C_t'' - \bar{C}'') - \frac{1}{(\bar{C}'')^2}(C_t'' - \bar{C}'')^2 \right\} \tag{57}$$

When I evaluate the welfare criterion for the households under financial autarky and integration, I get 0.6643 and 1.0433, respectively. Even though the volatility of the households' consumption is higher, their welfare is still higher under financial integration due to the insurance the assets bring. The risk-sharing under financial integration allows the households to have less disutility from labor, since they adjust their asset holdings rather than labor effort in the face of shocks.[19] On the other hand, the NT workers are better off under financial autarky. Their welfare loss is 9.5386 and 11.8861, respectively under autarky and integration. NT owners are worse off under integration not only because their consumption is more volatile, but also because they are left out of risk-sharing. For the aggregate welfare measure, I use the weighted sum of the welfare of the two groups, where the weights are the size of the workers and the NT owners in the economy. The weighted sum of the welfare of the two types of households is -1.3763 and -1.5443 under autarky and integration, respectively. The fact that the welfare losses of the NT owners are much bigger under integration causes the aggregate welfare to be lower under integration. Thus, transition from autarky to integration is not Pareto-optimal under the parametrization of the model.

7 Conclusion

This paper shows that financial integration can lead to higher consumption volatility in the developing countries with domestic credit market imperfections. The financial frictions make the non-traded sector inherently more volatile. Under financial integration,t he households can insure themselves against these fluctuations in the non-traded sector with the international assets. This insurance allows them not to adjust their labor efforts in the face of shocks to the non-traded sector. This allows the fluctuations in the relative prices and terms of trade to be smoothed out. With smoother terms of trade, aggregate consumption can respond fully to the productivity changes. When the international assets do not exist, households react to changes in the non-traded sector by supplying

[19]The expected level of labor disutility is higher under autarky, which causes the welfare number to be smaller despite a lower level of consumption volatility.

more labor to the traded sector, which results in the deterioration of terms of trade. The deterioration of terms of trade under autarky have dampening effects on aggregate consumption, causing it to have lower volatility. These results are robust to the choice of coefficient of risk-aversion if one assumes an elasticity of substitution between the traded and non-traded goods slightly lower than what the literature assumes. Despite their more volatile consumption, the households are still better off in terms of welfare under financial integration due to risk-sharing. The NT owners, however, have lower welfare under integration because they are left out of risk-sharing. Also, the aggregate welfare is lower under financial integration.

The mechanism described in this paper shows how financial integration might increase consumption volatility by reducing the volatility of the terms of trade. This paper depicts a highly stylized model that highlights the role of domestic financial frictions in determining the consequences of financial integration. Consistent with the empirical evidence, the model is able to generate higher absolute and relative (with respect to GDP) consumption volatility as a result of financial integration. However, these figures are lower than what is observed in the data. Enrichments of the demand side dynamics would be required to reconcile these observed differences. The channel identified in this paper is one way financial integration might cause consumption volatility to increase, but in no way it is meant to be exhaustive. It is of great importance to identify and assess other possible channels.

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Table 1: Benchmark Parameters

Discount factor of the workers	$\beta = 0.99$
Discount factor of the entrepreneurs	$\upsilon = 0.98$
Weight of labor effort in the utility	$\tau_N = \tau_H = 1$
Home country's size	$n = 0.05$
Elasticity of substitution between tradables and nontradables	$\xi = 0.5$
Share of tradables in the consumption basket	$\gamma = 0.5$
Elasticity of substitution between home and foreign tradable goods	$\theta = 1.5$
Share of labor in the production of tradables	$\eta = 0.64$
Depreciation rate	$\delta = 0.025$
Share of workers in the population	$\kappa = 0.8$
Debt to collateral ratio	$m = 0.8$
Standard deviation of productivity shocks to the tradable sector	$\sigma_T = 0.007$
Standard deviation of productivity shocks to the non-tradable sector	$\sigma_N = 0.0035$

Table 2: Implied Volatilities of the Model

	Autarky	Integration
$\frac{\sigma_c}{\sigma_y}$	0.1708	0.2037
σ_y	2.5596	2.8669
σ_c	0.4371	0.5839
$\sigma_{c'}$	0.4430	0.5896
σ_{c^e}	5.4275	6.1097

Reported figures are the standard deviations of each variable in percentages.
y =GDP, C =aggregate consumption, C' = workers' consumption, C^e =entrepreneurs' consumption, q = real exchange rate

Table 3: Impled Volatilities of the Standard- Frictionless Model

	Autarky	Integration
$\frac{\sigma_c}{\sigma_y}$	1.0687	0.5457
σ_y	0.5213	0.9540
σ_c	0.5571	0.5206

Table 4: Implied Volatilities of the Limiting Case, $\kappa = 0.9999, m = 0.8$

	Autarky	Integration
$\frac{\sigma_c}{\sigma_y}$	0.1623	0.2024
σ_y	2.7697	2.9123
σ_c	0.4494	0.5895
$\sigma_{c'}$	0.4494	0.5895
σ_{c^e}	5.9138	6.0962

Table 5: Sensitivity of the results to the coefficient of risk-aversion

	$\omega = 1$	$\omega = 2$	$\omega = 3$
Standard Deviation of Consumption, σ_c			
Autarky	0.4371	0.2271	0.1566
Integration	0.5839	0.3401	0.2049
Standard Deviation of Consumption Relative to Output, $\frac{\sigma_c}{\sigma_y}$			
Autarky	0.1708	0.1294	0.1035
Integration	0.2037	0.1175	0.0874

Table 6: Sensitivity of the results to the elasticity between tradables and non-tradables (for $\omega = 2$)

	$\xi = 0.5$	$\xi = 0.4$	$\xi = 0.3$
Standard Deviation of Consumption, σ_c			
Autarky	0.2271	0.2326	0.2383
Integration	0.3401	0.3497	0.3220
Standard Deviation of Consumption Relative to Output, $\frac{\sigma_c}{\sigma_y}$			
Autarky	0.1294	0.1099	0.0922
Integration	0.1175	0.1078	0.0973

Figure 1: Responses to a Productivity Shock in the Non-traded Sector

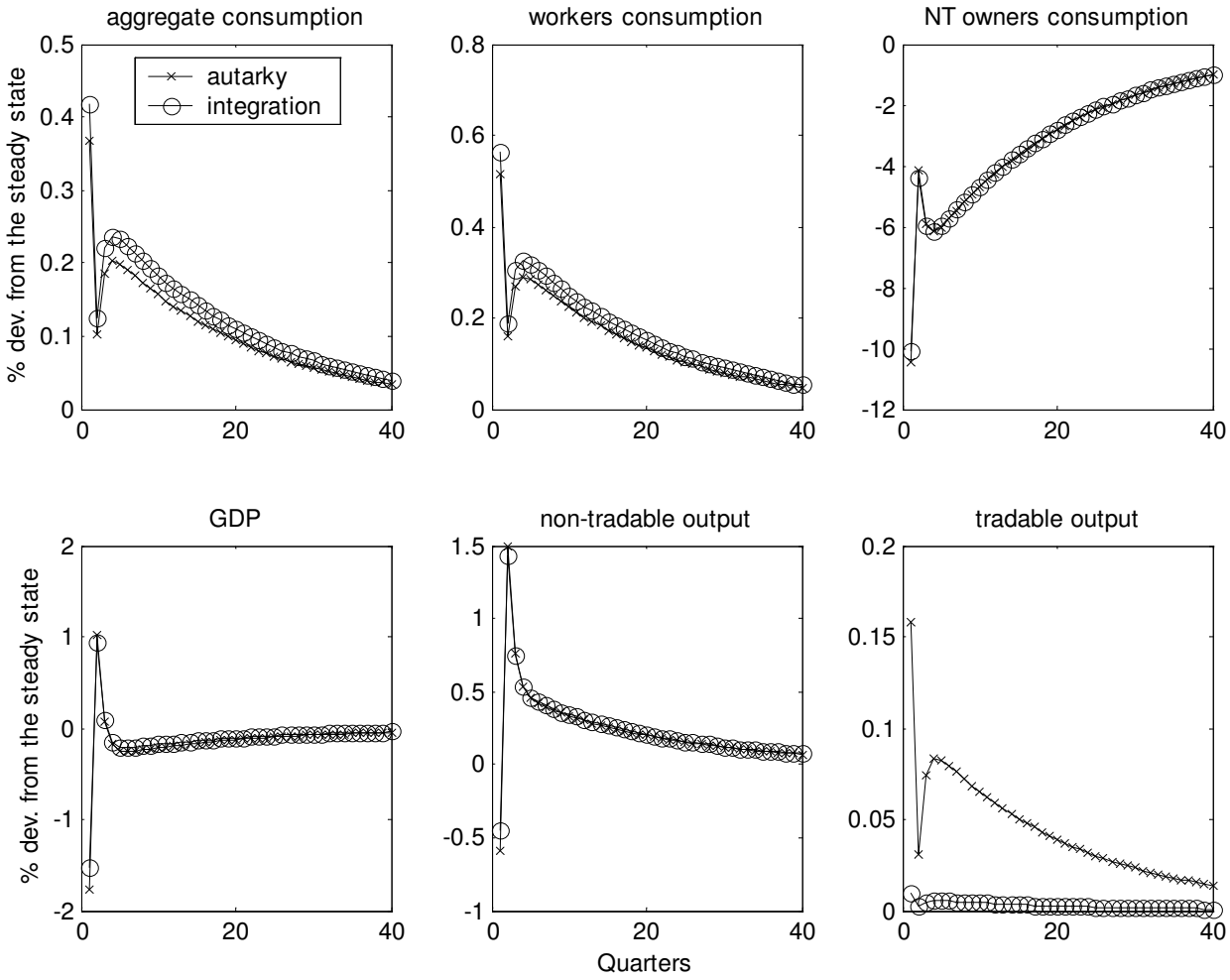


Figure 1 (continued)

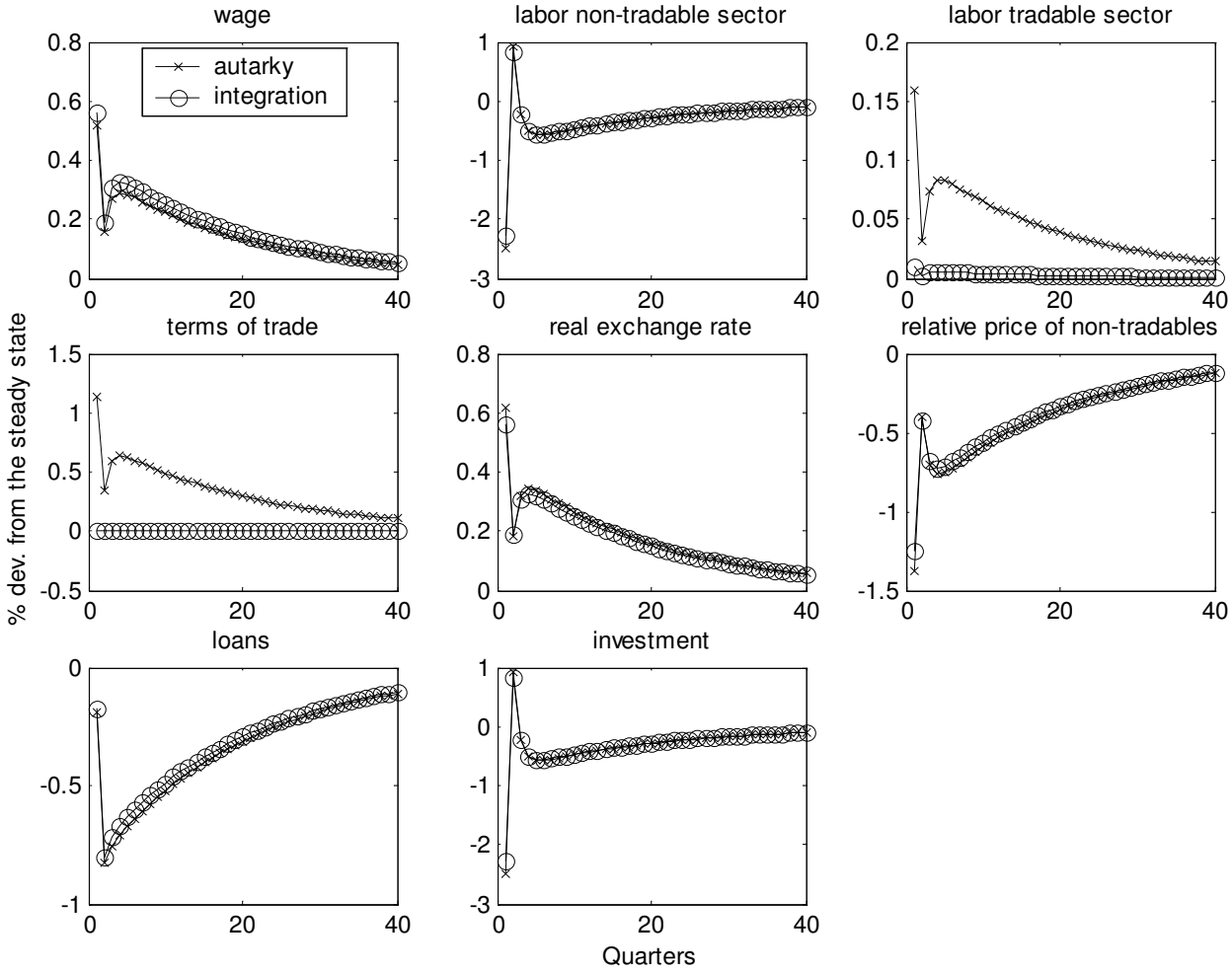
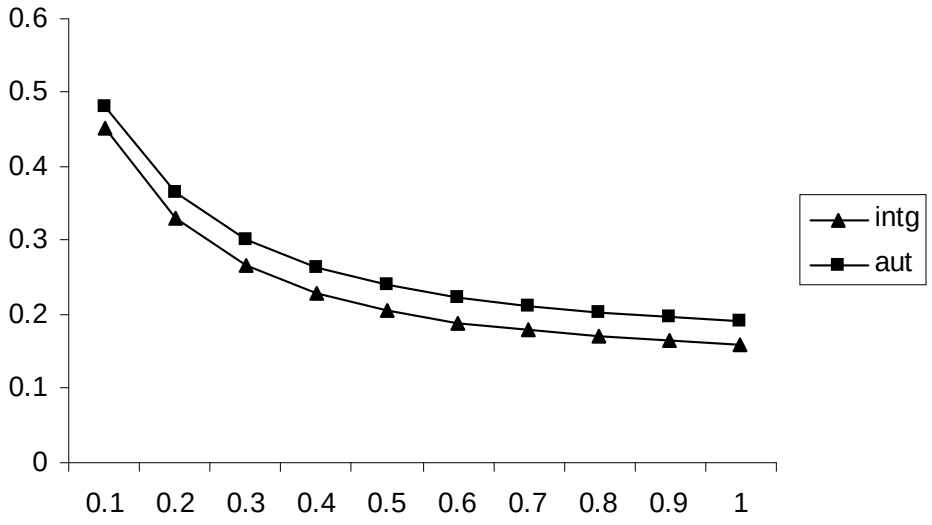


Figure 2: Sensitivity to the Enforceability Problem Parameter (m)



*The figure shows the ratio of standard deviation of consumption to output.

Appendix

This appendix presents the model, where the households are allowed to hold non-contingent bonds rather than the state contingent assets as the form of international borrowing and lending. Under this set-up, the worker households maximize utility, defined in (5), subject to

$$P_t C'_t + Z'_t + \varepsilon_t B_t \leq W_{N,t} L_{N,t} + W_{H,t} L_{H,t} + R_{t-1} Z'_{t-1} + \Pi_t + \varepsilon_t R^*_{t-1} B_{t-1} - \frac{\varphi}{2} B_t^2 \varepsilon_t$$

where B_t is the non-contingent bond denominated in foreign currency, R^*_{t-1} is the foreign interest rate and $\frac{\varphi}{2} B_t^2$ is the cost of adjusting bond holdings.[1] The first order conditions for the choices of consumption, labor and loans are unchanged. The new Euler equation for the bond-holdings is:

$$\beta E_t \left[R^*_t \left(\frac{C_{t+1}}{C_t} \right)^{-1} \frac{P_t}{P_{t+1}} \frac{\varepsilon_{t+1}}{\varepsilon_t} \right] = 1 + \varphi B_t.$$

Combining this Euler equation for bond holdings with the one for loans, I get the no-arbitrage condition:

$$E_t \left[\frac{\varepsilon_{t+1}}{\varepsilon_t} \right] = (1 + \varphi B_t) \frac{R_t}{R^*_t}$$

which implies that for $\varphi = 0$,the interest rate differential between the foreign bonds and domestic loans ashould be equal to the expected rate of depreciation. Unlike the financial autarky model, the home country can run current account deficits(surpluses) by borrowing(lending) in the international financial markets. The current account for the home country can be defined as

$$(1 - n) \varepsilon_t P^*_{H,t} C^*_{H,t} - n P_{F,t} C_{F,t} = n \kappa \varepsilon_t (B_t - R^*_{t-1} B_{t-1}).$$

The representative foreign household faces a similar budget constraint:

[1] The assumption of the cost of adjusting bond holdings is necessary for the stationarity of the model. See Schmitt-Grohe and Uribe (2003) for alternative ways of making models with incomplete markets stationary.

$$P_t^* C_t^* + B_t^* \leq W_{N,t}^* L_{N,t}^* + W_{F,t}^* L_{F,t}^* + B_{t-1}^* + \Pi_t^* - \frac{\varphi}{2} B_t^{*2}.$$

The Euler equation for the foreign household is

$$\beta E_t \left[R_t^* \left(\frac{C_{t+1}}{C_t} \right)^{-1} \frac{P_t^*}{P_{t+1}^*} \right] = 1 + \varphi B_t^*.$$

Equilibrium requires that the bonds be zero in net supply, which imples:

$$n\kappa B_t + (1-n) B_t^* = 0.$$

The solution of the model can be found by combining these new first order conditions with the other optimality and equilibrium conditions of the model. The implied standard deviations of the model (for the same calibration as the financial autarky and integration models, and setting $\varphi = 0.001$) are summarized in Table A1:

Table A1: Impled Volatilities

	Autarky	Bond Economy
$\frac{\sigma_c}{\sigma_y}$	0.1708	0.2054
σ_y	2.5596	2.3132
σ_c	0.4371	0.4751
$\sigma_{c'}$	0.4430	0.4807
σ_{c^e}	5.4275	4.8675

The results show that allowing the households to trade non-contingent bonds increases consumption volatility. The dynamics of the model with non-contingent bonds are very similar to the one with the state contingent portfolio as seen in Figure A1. Therefore, the mechanism presented in this paper holds regardless of the form of financial integration.

Figure A1: Responses to a Productivity Shock in the Non-traded Sector

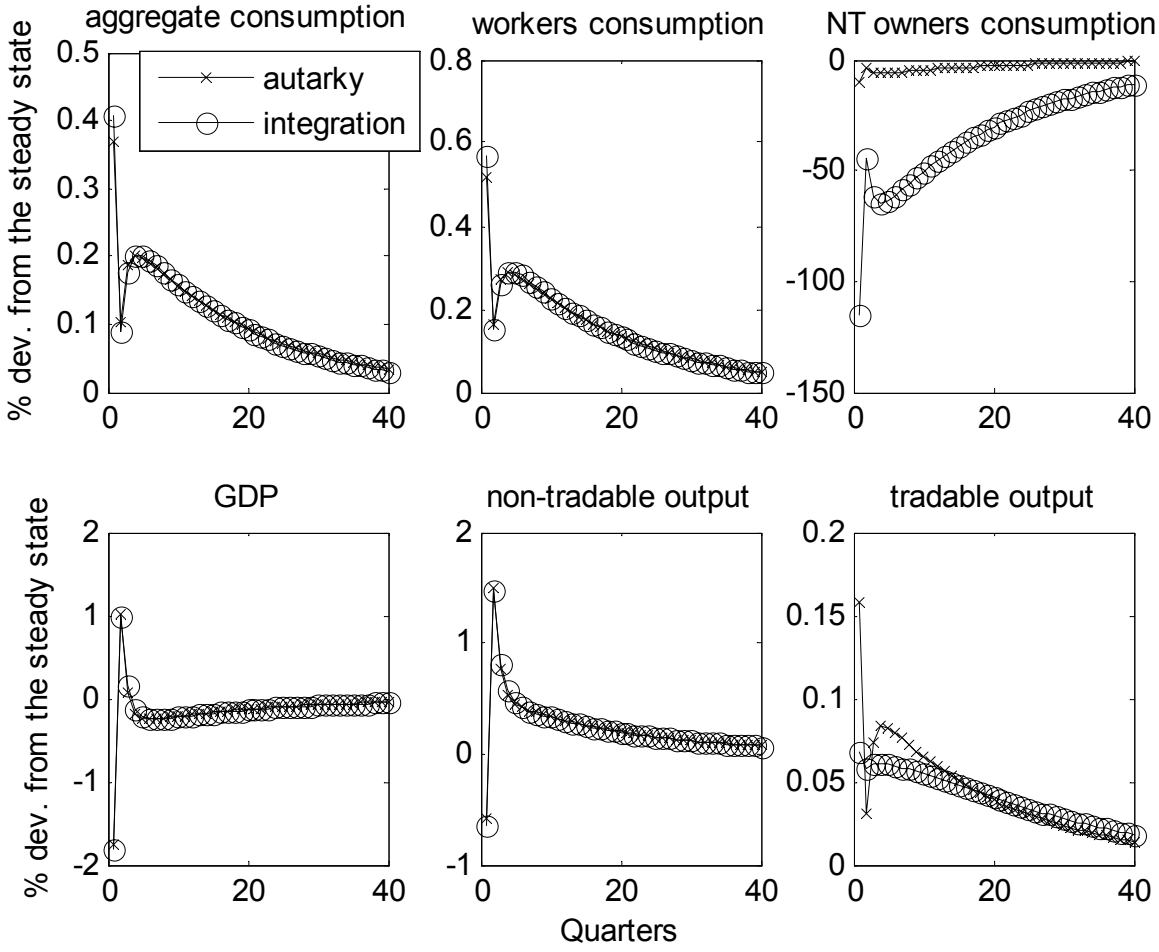


Figure A1 (cont'd)