Financial Integration, Credit Market Imperfections and Consumption Smoothing

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Abstract

Contrary to standard theoretical reasoning, recent empirical research shows that financial integration is associated with higher consumption volatility in developing countries. This paper illustrates how domestic credit market imperfections can alter the standard predictions about the consumption smoothing possibilities under financial autarky and international financial integration. 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. If the international risk-sharing opportunities are nonexistent, households can secure themselves against the shocks in the non-traded sector 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. Under financial integration, international financial assets provide the insurance against domestic productivity shocks without affecting the relative prices, hence allowing the consumption to react more.

Key Words: Financial integration, consumption smoothing, credit market frictions, emerging markets, RBC models.

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1 Introduction

One of the perceived benefits of financial integration is international risk-sharing and consumption smoothing. Financial integration provides access to a wider range of assets, which act as cushion against domestic shocks. Theoretical studies (Mendoza (1994), Baxter and Crucini (1995), and Sutherland (1998)) have shown that the diversification of assets generates a lower consumption volatility compared to a financially less integrated system or a financial autarky. Empirical studies, on the other hand, have not robustly established a negative relationship between financial openness and consumption volatility for a large set of countries. While some evidence suggests that lower consumption volatility is associated with greater financial openness in developed economies, the results for developing countries are less optimistic. In their empirical study, Kose, Prasad and Terrones (2003) show that higher levels of financial integration in the 1990s are associated with higher consumption volatility relative to output volatility for developing countries. For a similar group of emerging markets, Bekaert, Harvey and Lundblad (2006) demonstrate that there is a weak positive correlation between the ratio of consumption growth volatility to income growth volatility and some forms of capital account openness.[1]

The purpose of this paper is to analyze how credit market imperfections in developing economies can alter the regular consumption-smoothing mechanisms provided by financial integration, and ask whether they are able to provide an explanation for the absence of a significant decrease, or an increase, in consumption volatility in the case of financial integration. The theoretical exercise shows that given the frictions, aggregate consumption and consumption relative to output can be more volatile under financial integration for certain parametrizations. The mechanism works through different relative price dynamics generated endogenously under financial integration and financial autarky.

The model I develop in the paper is 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

[1]See the next section for a more detailed summary of the evidence in these studies.

bound to the domestic financial system for any borrowing requirements. I assume, moreover, that 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 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 the 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.[2] 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 mechanism following a productivity shock in the non-traded sector is as follows. 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.[3] 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 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

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

[3]The terms of trade is defined as the ratio of the imported foreign good price to the exported home good price. Hence, terms of trade deterioration means an increase in this ratio.

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.[4]

The higher consumption volatility under financial integration results depend on the degree of risk-aversion of the households, as well as the elasticity of their labor supply. As the households become more risk-averse, the insurance international financial assets provide becomes more valuable. Moreover, as their total labor supply becomes more inelastic, adjusting labor effort becomes more costly in terms of welfare. In these two cases, the consumption and labor smoothing benefits of financial integration outweigh the dampening effects of relative prices observed in financial autarky.

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 summarizes some of the empirical

[4]The result that financial integration is not necessarily welfare improving to all parties is also discussed by Tille (2005). He shows that when the goods markets are characterized by rigidities and exchange rate pass-through is partial, the country with less volatile monetary shocks will lose from integration.

evidence on financial openness and consumption volatility. Section 3 presents the model economy. Section 4 discusses the model parametrization. Section 5 analyzes the frictions in the model and presents the results. Section 6 looks at sensitivity analysis. Section 7 describes the welfare results. Finally, section 8 concludes.

2 Review of Empirical Evidence on Financial Integration and Consumption Volatility

There are alternative ways to evaluate the extent of international risk-sharing and benefits of financial integration.[5] Financial openness facilitates borrowing and lending opportunities that can help the consumers smooth domestic shocks, and hence can help the economies achieve lower consumption growth volatilities. Therefore, a direct way to assess the benefits of financial integration is to analyze the relationship between consumption growth volatility and financial integration. Since financial openness can also affect the volatility of income growth, it is also important to examine the ratio of consumption growth volatility to GDP growth volatility. This ratio captures an economy's ability to smooth shocks.

Allowing for an extensive set of control variables, and using data from both the developed and developing countries, Kose, Prasad and Terrones (2003) investigate the relationship between financial integration and consumption growth volatility, in addition to the ratio of consumption growth volatility to GDP growth volatility. As proxies for financial integration, the authors use both gross capital flows (as a percentage of GDP) and an indicator of restrictions on capital account transactions. One of the interesting results they obtain is that the consumption growth volatility relative to output growth volatility is higher for more financially integrated developing economies during the 1990s–the decade during which they were financially more open. Moreover, their results show that increasing financial openness is significantly associated with rising relative volatility of consumption upto a threshold. Their results imply that smoothing of shocks, and hence reductions in the ratio of consumption volatility to GDP volatility occur in economies with gross capital flows

[5]See Kose, Prasad and Terrones (2007) for a detailed discussion, and the references within.

higher than 49%. On the other hand, their results display no significant relationship between the volatility of consumption growth and financial openness.

In a similar set-up, Bekaert, Harvey and Lundblad (2006) investigate the impact of financial liberalization on consumption growth volatility, and on the ratio of consumption growth volatility to GDP growth volatility. As measures of financial liberalization, they use both the equity market liberalization measures (official liberalization indicator and intensity measure), and capital account liberalization measures (International Monetary Fund's measure for restrictions on payments for the capital account transactions and Quinn's openness measure). They find that the financial liberalization is associated with lower consumption growth variability in a large cross-section, and that the effect of equity market liberalization is larger for countries with relatively more open capital accounts. When looking at emerging markets only, they do not find a significant relationship between financial liberalization and consumption growth variability. However, their results show a reduction in the ratio of consumption growth volatility to GDP growth volatility after equity market liberalizations in developing countries. The result for the enhanced ability to smooth shocks does not carry over to other types of capital account liberalizations, as the authors find a higher ratio associated with IMF's capital account openness measure.

As illustrated in these two studies, whether consumption growth (in absolute and relative terms) becomes less volatile with financial openness depends on the type and intensity of capital flows, as well as certain country characteristics. One of the country characteristics that might play a crucial role in facilitating consumption smoothing after liberalizations is the level of financial development. If the domestic financial frictions are too prevalent, then the countries might not be able to reap the benefits of financial openness. The model I present below incorporates some of the domestic financial frictions that are present in the developing countries (as documented by Tornell and Westermann (2002)), and investigates whether these frictions can hamper consumption smoothing in the case of financial integration.

3 The Model

This section presents the model for financial autarky and financial integration. 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 the investment and production of non-traded goods.

3.1 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.[6] P_t and $P_{T,t}$ are given by

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

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

3.2 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:

$$U_t^h = E_t \sum_{t=0}^{\infty} \beta^t [\log(C_t^h) - \tau_N L_{N,t} - \tau_H L_{H,t}] \tag{5}$$

where C_t^h is the consumption of the household, $L_{N,t}$ and $L_{H,t}$ denote labor supply in the non-traded and traded sectors, respectively.

3.2.1 Financial Autarky

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

$$P_t C_t^h + Z_t^h \leq W_{N,t} L_{N,t} + W_{H,t} L_{H,t} + R_{t-1} Z_{t-1}^h + \Pi_t, \tag{6}$$

where Z_t^h 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 $C_t^h, Z_t^h, L_{N,t}, L_{H,t}$ to maximize (5) subject to (6). The first order conditions give us the

[6] It must be noted that the model economy is a cashless economy, as in Woodford (2003), where currency only plays the role of convenient unit of account.

Euler equation and the labor supply equations in the two sectors:

$$E_t\left[\left(\frac{C_t^h}{C_{t+1}^h}\right)^{-1}\right] = \beta E_t\left[R_t\frac{P_t}{P_{t+1}}\right] \tag{7}$$

$$\frac{W_{N,t}}{P_t} = \tau_N C_t^h \tag{8}$$

$$\frac{W_{H,t}}{P_t} = \tau_H C_t^h. \tag{9}$$

3.2.2 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.[7,8] The budget constraint for the household in this case becomes:

$$P_t C_t^h + Z_t^h + \varepsilon_t \sum Q(s^{t+1} \mid s^t) B(s^{t+1}) \leq W_{N,t} L_{N,t} + W_{H,t} L_{H,t} + R_{t-1} Z_{t-1}^h + \Pi_t + \varepsilon_t B(s^t) \tag{10}$$

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:

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

[7]The assumption of an international state contingent portfolio allows us to analyze the most favorable form of financial integration. The mechanism and the results presented hold when I consider a single non-contingent bond. Results available upon request.

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

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

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

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

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 equilibrium 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 3.4.

3.3 Traded Goods Sector

Firms in the traded sector are perfectly competitive, and for simplicity I assume that 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:

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

3.4 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.[9]

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

[9]Introducing adjustment costs of capital do not change the volatility results presented in the next section; and they are available upon request.

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: if the borrowers have a lot of debt, they can choose to repudiate the debt contract. The way the financial institution manages the enforceability problem is that it requires the firms to pledge collateral in the loan contract.

In setting up the collateral constraint, I follow Kiyotaki and Moore (1997) closely. I assume that the financial institution can only collateralize the firm's physical assets –capital stock, because they do not have the right set of skills, or the firm owner's technology, to operate the firm.[10] In the case of debt repudiation, the financial institution can liquidate the pledged capital by paying a transaction cost proportional to the borrower's collateral, and pay back the lenders. Given the incentive compatibility considerations, the financial institution only finances firms whose debt repayment is less than or equal to the expected value of their collateral, net of liquidation costs. Specifically, if the firm owner in total owns capital $K_{N,t}$ period t, then he can borrow Z_t^o, as long as the total repayment in period $t+1$, is less than the amount the financial institution can get after liquidation in period $t+1$ (net of transaction costs). Therefore, the NT owner's borrowing constraint can be written as

$$R_t Z_t^o \leq m E_t(P_{N,t+1} K_{N,t}) \tag{22}$$

where R_t is the gross interest rate on the loan, and $(1-m)$ is the proportion of collateral that is paid as the transaction cost. 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.

[10]The assumption that only the owners have the right technology to produce the good is taken from Kiyotaki and Moore (1997). If this assumption is relaxed, then the financial institution can operate the firm after repudiation to obtain the output for that period. In this set-up, the borrowing constraint can be tied to the current value of output rather than the value of capital. The dynamics emerging in that model does not rely on the role of asset price movements in the reallocation and amplification mechanism presented in Kiyotaki and Moore (1997). Without that particular reallocation mechanism, the results described below do not hold.

NT owner's problem is to maximize utility

$$U_t^o = E_t \sum_{t=0}^{\infty} \upsilon^t \log(C_t^o) \tag{23}$$

subject to the budget constraint

$$P_{N,t}X_{N,t} + P_t C_t^o + R_{t-1}Z_{t-1}^o + W_{N,t}L_{N,t} \leq P_{N,t}Y_{N,t} + Z_t^o, \tag{24}$$

and the borrowing constraint in (22). The consumption bundle C_t^o 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 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 $C_t^o, L_{N,t}, K_{N,t}$ and Z_t^o are as follows:

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

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

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

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

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. To ensure that the borrowing constraint is

binding around the deterministic steady state, I assume that the variance of the stochastic shock processes are sufficiently small. 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

$$\frac{R_t}{1-\lambda_t C_t^o P_t} = \left[\upsilon E_t \left(\frac{C_t^o}{C_{t+1}^o}\frac{P_t}{P_{t+1}}\right)\right]^{-1} \tag{29}$$

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.

3.5 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:

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

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

3.6 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 of households' and NT owners' consumption:

$$C_t = \kappa C^h_t + (1-\kappa) C^o. \tag{47}$$

Finally, the loan market clearing at home implies:

$$\kappa Z^h_t = (1-\kappa) Z^o_t. \tag{48}$$

4 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 foreign 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.[11] 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.[12] Baxter

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

[12]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.

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.[13]

5 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 imperfections. In the absence of international risk-sharing opportunities, households can secure themselves only by adjusting labor effort, which has 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.[14] 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

$$q_t = \zeta \frac{C_t^h}{C_t^*} \tag{49}$$

where q_t is the real exchange rate and is defined as $q_t = \frac{\varepsilon_t P_t^*}{P_t}$. ζ is a constant that captures the initial state of the economies. Following Chari et. al (2001), I assume that the net foreign asset

[13] 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.

[14] This link was also highlighted by Tille (2005).

position of the two countries initially is zero, so that $\zeta = 1$. The log-linearized version of (49) is

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

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:

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

where C^h, C^o 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, implying that a better ability to smooth consumption under financial autarky. The ratio of standard deviations of consumption to output are 0.2037 and it is 0.1708, respectively under financial integration and autarky. For the given parametrization, the model suggests 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 yield higher consumption volatility.

5.1 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 first the fact that the pledged collateral is capital, which is augmented by the NT output itself (hence the price of the output and collateral are the same); and second due to the asymmetric information between the borrowers and the financial institution. The financial institution cannot observe the realization of the shock, but can observe the value of the collateral. The positive supply shock derives the price of the NT good down, which in return lowers 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.

This mechanism is different from the amplification mechanisms presented in Kiyotaki and Moore (1997), Cordoba and Ripoll (2004) or Kocherlakota (2000). In all three papers, the collateral the firm pledges is a non-reproducible factor, whose price is different from the price of the output.

Hence, what moves asset prices in their mechanisms is not directly the supply shocks, but rather changes in demand for the non-reproducible factor. A negative shock reduces the extent of production, which leads the firms to demand fewer inputs. A lower demand for the inputs derives the price of the collateral down, leading the firms to be more constrained. A second difference from Kiyotaki and Moore (1997) and Cordoba and Ripoll (2004) is that in their set up the constrained and unconstrained firms produce the same good, and the borrowing constraint leads to reallocation of resources between the different types of producers of the same good. In this paper's set-up, all the NT firms are borrowing constrained, and the traded good producers are not. Therefore, the model yields a reallocation mechanism between the traded goods sector and the non-traded goods sector as a result of the reaction of the households to the changes in the non-traded sector.

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.[15]

While the described transmission mechanism offers a prediction as to why consumption might be less reactive to productivity shocks under financial autarky, there are two dimensions it seems to be inconsistent with some stylized facts. First, the model suggests that the positive productivity shock leads to a decline in the labor input, investment and hence output in the non-traded sector on the impact of the shock. The prediction that labor demand and investment can decline on the impact of a positive technology shock is consistent with Basu, Fernald and Kimball (2006). However, their findings also show that output changes little on impact, which contradicts the response of non-traded output in the model. Secondly, as documented in Table 3, the model predicts that consumption of the households are weakly countercyclical, while the consumption of the NT firm owners are strongly procyclical. The strong procyclicality of the latter reflects the fact that the NT firm owners do not have any other assets to smooth their consumption patterns; hence, their consumption is very tightly linked to the movements in output. The households' consumption increases, due to higher wages, as the non-traded output decreases. The increase in traded output under autarky is not enough to generate an increase in GDP on impact, and therefore, consumption and GDP move in the opposite directions.

[15]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.

5.2 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.[16]

5.3 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 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.[17] 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.

[16] 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.

[17] 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.

6 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, elasticity of substitution between home and foreign goods, elasticity of labor supply, and substitutability of labor across the two sectors. First consider a utility function of the following form:

$$U_t^h = E_t \sum_{t=0}^{\infty} \beta^t [\frac{(C_t^h)^{1-\omega}}{1-\omega} - \tau \frac{\left[L_{N,t}^{1+\varphi} + L_{H,t}^{1+\varphi}\right]^{\frac{1+\chi}{1+\varphi}}}{1+\chi}] \tag{53}$$

where ω is the coefficient of relative risk aversion, $\frac{1}{\chi}$ is the Frisch elasticity of labor supply, and $\frac{1}{\varphi}$ is the elasticity of substitution between the labor efforts in the two sectors. The results in the previous section are obtained under the special parametrization where $\omega = 1$, $\chi = 0$ and $\varphi = 0$. Hence, the benchmark parametrization implies that the households are relatively less risk-averse, labor is perfectly elastic, and the labor efforts supplied to the two sectors are perfect substitutes. Since risk-sharing and labor reallocation across the two sectors constitute the important components of the transmission mechanism, I analyze how the results change when I assume a higher degree of risk-aversion, relatively inelastic degree of labor supply, and imperfect substitutability of labor between the two sectors.

Given the general form of the utility function in (53), the linearized risk-sharing condition (for financial integration) in (50) becomes

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

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

$$\begin{aligned} \hat{q}_t \quad = \quad & \left[\frac{\omega(\theta-1) + \kappa\frac{C^h}{C}}{\xi+\theta-1}\right](\hat{C}_t^h - \hat{C}_t^*) + \left[\frac{(1-\kappa)\frac{C^o}{C}}{\xi+\theta-1}\right](\hat{C}_t^o - \hat{C}_t^*) + \\ & \frac{(\theta-1)}{\xi+\theta-1}\left[\frac{\chi L_H^{1+\varphi} + \varphi L_N^{1+\varphi}}{L_N^{1+\varphi} + L_H^{1+\varphi}}\right]\hat{L}_{H,t} + \frac{(\theta-1)}{\xi+\theta-1}\left[\frac{(\chi-\varphi)L_N^{1+\varphi}}{L_N^{1+\varphi} + L_H^{1+\varphi}}\right]\hat{L}_{H,t} + o.t., \end{aligned} \tag{55}$$

where $o.t.$ stands for the terms involving the deviation of foreign labor efforts away from their steady states, which are negligible following home country shocks. Since equations (54) and (55) are the main differences between the dynamics under financial integration and autarky, the dynamics and the volatilities under the two set-ups will depend on the parameters ω, ξ, θ, χ and φ.

First, I analyze the sensitivity of results to the coefficient of risk-aversion, keeping the assumption that labor is perfectly elastic and labor efforts in the two sectors are perfect substitutes ($\chi = 0, \varphi = 0$). 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.[18] 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 higher under financial integration. Keeping everything else constant, as the traded and non-traded goods become less substitutable, the terms of trade and real exchange dynamics gain more importance for the consumption dynamics. As a result, the terms of trade responses to productivity shocks provide better consumption smoothing opportunities, even if households are slightly more risk-averse.[19] 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.

Next, I investigate the sensitivity of the results to the choice of elasticity of labor, still keeping

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

[19] In the limiting case where the traded and the non-traded goods are perfect substitutes ($\xi \to \infty$), the terms of trade and real exchange dynamics lose all their importance in explaining the cross-country consumption differentials, since $\hat{q} \to 0$.

the assumption of perfect substitutability of the labor efforts. When labor is relatively more inelastic, it becomes more costly for the workers to adjust labor efforts to insure themselves against productivity shocks. Therefore, they might not be able to smooth-consumption through labor movements as much. The middle panel in Table 7 presents the results for a common choice for the Frisch elasticity of 2 ($\chi = 0.5$) keeping other parameters at their initial values. When labor is relatively more inelastic, both consumption and labor volatilities relative to output are smaller under integration. Hence, when adjusting labor effort is more costly in terms of welfare, changes in labor do not lead to sufficiently large movements in the relative prices that would dampen fluctuations in consumption.

Finally, I analyze the importance of substitutability of labor efforts across the two sectors in understanding the role of labor allocation across the two sectors in the consumption smoothing process. I follow Horvath (2000) in specifying the substitutability in the labor preferences. The fact that labor efforts in the two sectors are not perfect substitutes implies a certain degree of labor specificity in the two sectors. The lower the degree of substitutability, the more difficult it can be for the workers to insure themselves by reallocating labor efforts from the non-traded sector to the traded one. Keeping the other parameters at their benchmark values, I present the volatility results for the elasticity of substitution equal to 2 ($\varphi = 0.5$) in the lower panel of Table 7. When it is more difficult to reallocate labor efforts across the sectors, total labor effort and output becomes less volatile, whereas consumption becomes more volatile. The same pattern is observed under both autarky and integration, and imperfect substitutability is not enough to hinder the consumption-smoothing effects of labor movements and relative prices.

7 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 Schmitt-Grohe and Uribe (2004), and Kim and Kim (2003), I solve the model using second order approximation.[20] The welfare criteria I use is the unconditional expectation of the second order Taylor expansion of agents' utility. Given

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

the utility function for the workers in (5) and the utility function for the NT owners in (23), the welfare criteria respectively become:

$$\mathbb{W}_t^h = E_t \sum_{t=0}^{\infty} \beta^t \left\{ \log(\bar{C}^h) + \frac{1}{\bar{C}^h}(C_t^h - \bar{C}^h) - \frac{1}{(\bar{C}^h)^2}(C_t^h - \bar{C}^h)^2 - L_{N,t} - L_{H,t} \right\} \tag{56}$$

$$\mathbb{W}_t^o = E_t \sum_{t=0}^{\infty} \upsilon^t \left\{ \log(\bar{C}^o) + \frac{1}{\bar{C}^o}(C_t^o - \bar{C}^o) - \frac{1}{(\bar{C}^o)^2}(C_t^o - \bar{C}^o)^2 \right\} \tag{57}$$

The upper panel of Table 8 presents the welfare gains and losses. 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.[21] On the other hand, the NT owners 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.

Finally, I assess the extent of risk-sharing opportunities under financial autarky. Cole and Obstfeld (1991) show that, under certain restrictive parametrizations, the terms of trade responses to productivity shocks provide perfect insurance. With log-utility, perfect insurance implies that the correlation between the real exchange rate and the ratio of domestic to foreign consumption is equal to 1 (see equation 50). The correlations between the real exchange rate and the relative

[21] 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.

consumptions are presented in the lower panel of Table 8. Given the benchmark parameterization of the model, the correlation between the real exchange rate with the ratio of household to foreign consumption is 0.4389 under autarky. Hence, for the households, the terms of trade dynamics bring about a little less than half insurance. It is also interesting to note that, the risk-sharing opportunities for the NT owners worsens under integration, as the correlation between the real exchange rate and the ratio of NT owners' consumption to foreign consumption becomes more negative. This complements the results on larger welfare losses for the NT owners under integration.

8 Conclusion

This paper illustrates how domestic financial frictions can alter the standard predictions about the lower variability of consumption under financial integration. The results show that, given certain parametrizations, consumption volatility (in absolute terms and as a ration of GDP volatility) is lower under financial autarky. The financial frictions make the non-traded sector inherently more volatile. Under financial integration, households can insure themselves against these fluctuations in the non-traded sector with international assets. This insurance helps them to keep their labor efforts unchanged, which 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, however, households react to changes in the non-traded sector by supplying more labor to the traded sector, which results in the deterioration of terms of trade. The deterioration of terms of trade under autarky has dampening effects on aggregate consumption, causing it to have lower volatility. 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 model depicted is a highly stylized one that highlights the role of domestic financial frictions in determining the consequences of international financial integration for consumption smoothing. While the volatility results are consistent with some empirical evidence, the model's some other predictions are at odds with the data (such as counter-cyclicality of consumption). Moreover, the

set-up relies on a high degree of labor elasticity to generate the high volatility reults. Therefore, the channels identified should not be taken as exhaustive explanations for the higher volatility and financial integration relationship found in some of the empirical studies, but rather as a demonstration for how credit market imperfections can alter consumption smoothing mechanisms. Studying alternative forms of credit credit market imperfections, and enriching the demand side of the model can be useful in identifying and assessing 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

	$\%std.dev$				$\frac{\%std.dev}{\%std.dev\ of\ Y}$		
	Y	C	C^h	C^o	C	L	q
Autarky	2.5596	0.4371	0.4430	5.4275	0.1708	0.9925	0.1912
Integration	2.8669	0.5839	0.5896	6.1097	0.2037	0.9803	0.1512

Notes:

- Y =*GDP*, C =*aggregate consumption*, C^h = *workers' consumption*, C^o = *NT owners' consumption*, L =*total labor supply*, q =real exchange rate
- The results are obtained for the benchmark parametrization in Table 1.

Table 3: Implied Correlations

	correlations with GDP						
	C	C^h	C^o	L	X	q	tot
Autarky	-0.0598	-0.1045	0.9698	0.9859	0.9785	-0.7683	-0.2425
Integration	-0.0189	-0.0553	0.9746	0.9783	0.9722	-0.8398	-0.3916

Notes:

- The correlations are obtained for the benchmark parametrization in Table 1.

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

	$\%std.dev$				$\frac{\%std.dev}{\%std.dev\ of\ Y}$		
	Y	C	C^h	C^o	C	L	q
Autarky	2.7697	0.4494	0.4494	5.9138	0.1623	0.9870	0.1802
Integration	2.9123	0.5895	0.5895	6.0962	0.2024	0.9879	0.1474

Notes:

- All the other parameters are kept at their values tabulated in Table 1, except for κ and m.

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

	$\omega = 1$	$\omega = 2$	$\omega = 3$
$\%std.dev\ of\ C$			
Autarky	0.4371	0.2271	0.1566
Integration	0.5839	0.3401	0.2049
$\frac{\%std.dev\ of\ C}{\%std.dev\ of\ Y}$			
Autarky	0.1708	0.1294	0.1035
Integration	0.2037	0.1175	0.0874

Notes:

- The first column re-reports the results for the benchmark parameter values in Table 2. For the last two columns, all the parameter values except for ω are kept at their benchmark values.

Table 6: Sensitivity of the results to the elasticity between tradables and non-tradables, ξ

	$\xi = 0.5$	$\xi = 0.4$	$\xi = 0.3$
$\%std.dev\ of\ C$			
Autarky	0.2271	0.2326	0.2383
Integration	0.3401	0.3497	0.3220
$\frac{\%std.dev\ of\ C}{\%std.dev\ of\ Y}$			
Autarky	0.1294	0.1099	0.0922
Integration	0.1175	0.1078	0.0973

Notes:

- The first column re-reports the results in Table 5 for $\omega = 2$. For the last two columns, $\omega = 2$, and the other parameters are kept at their benchmark values.

Table 7: Sensitivity of the results to the elasticity of labor supply ($\frac{1}{\chi}$) and the elasticity of substitution of labor across the sectors ($\frac{1}{\rho}$)

	$\%std.dev$			$\frac{\%std.dev}{\%std.dev\ of\ Y}$	
$\chi = 0, \rho = 0$	C	L	Y	C	L
Autarky	0.4371	2.5404	2.5596	0.1708	0.9925
Integration	0.5839	2.8104	2.8669	0.2037	0.9803
$\chi = 0.5, \rho = 0$					
Autarky	0.4373	0.9564	1.4143	0.3092	0.6762
Integration	0.5975	1.4193	2.2154	0.2697	0.6495
$\chi = 0, \rho = 0.5$					
Autarky	0.4498	1.1837	1.9928	0.2257	0.5940
Integration	0.6227	1.3259	2.3424	0.2658	0.5660

Notes:

- The first panel re-reports the results for the benchmark parameter values in Table 2. For the lower two panels, all the parameter values except for χ and ρ are kept at their benchmark values.

Table 8: Welfare Results

	Welfare Gains and Losses		
	C	C^h	C^o
Autarky	-1.3763	0.6643	-9.5386
Integration	-1.5443	1.0433	-11.8861
	Correlations with the real exchange rate		
	$\frac{C}{C^*}$	$\frac{C^h}{C^*}$	$\frac{C^o}{C^*}$
Autarky	0.4179	0.4389	-0.7885
Integration	0.9786	1	-0.8879

Notes:

- The first panel presents the numbers obtained by evaluating the welfare criteria in equations 56 and 57 in the text for the benchmark parameters.
- The second panel presents the correlations obtained for the benchmark parametrization in Table 1.

Figure 1: Responses to a Productivity Shock in the Nontraded Sector

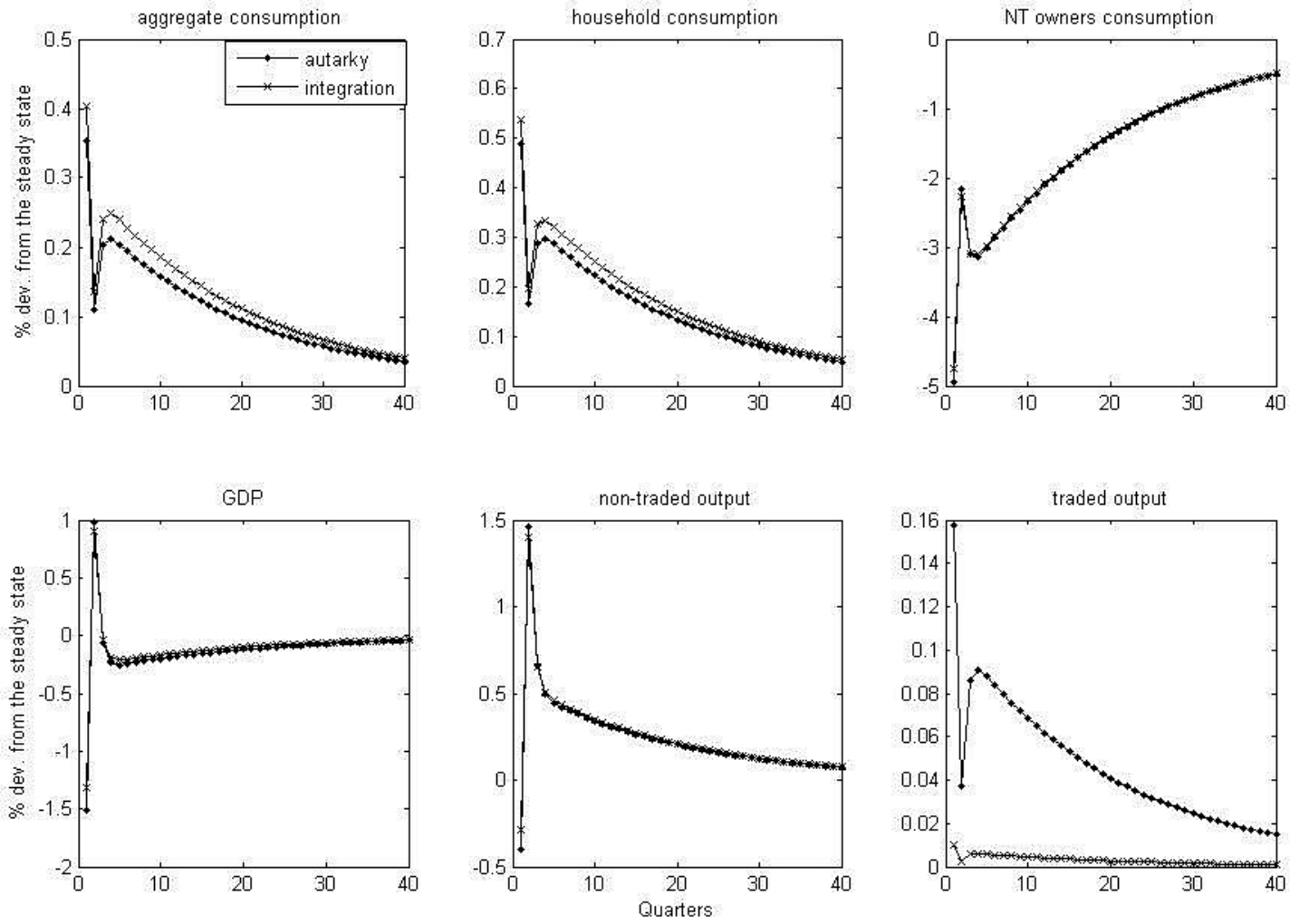

Figure 1 (continued)

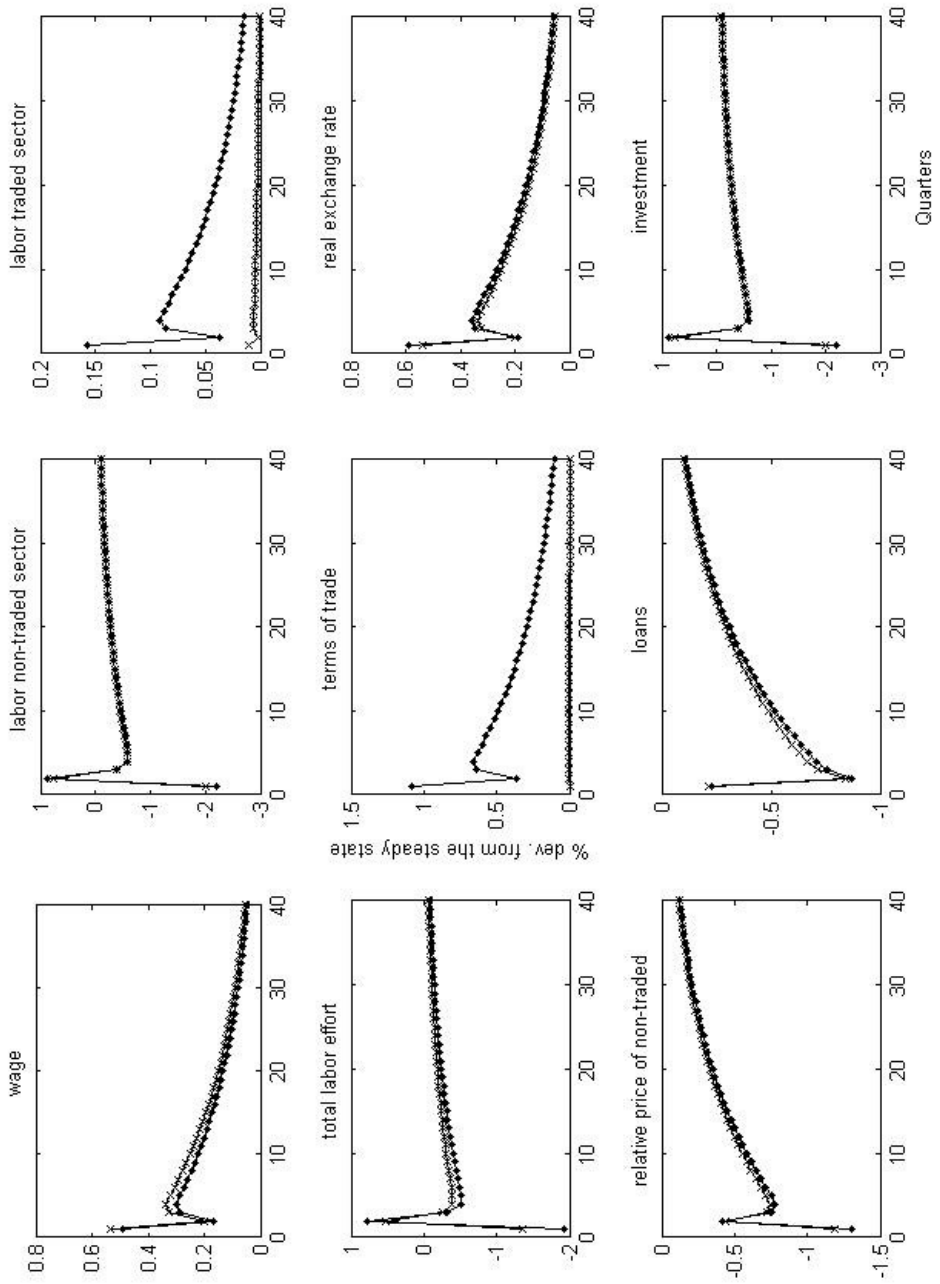

Figure 2: Sensitivity to the Enforceability Problem (m)