Financial Integration, Credit Market Imperfections and Consumption Smoothing

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Abstract

This paper shows that 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 each country produces a traded and a non-traded good. I assume that one of the countries is small and faces two financial frictions. First, the non-traded goods sector faces borrowing constraints due to enforceability problems. Second, the owners of the non-traded sector firms do not have access to international asset markets even when the country is financially integrated with the rest of the world. The interaction of these two frictions may cause consumption volatility to increase (in absolute terms and relative output volatility) as a result of financial integration. This is consistent with the empirical evidence for developing countries. Such evidence cannot be rationalized in the context of the standard international real business cycle model.

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1 Introduction

As more countries remove the restrictions on their capital accounts and as more financial systems get deregulated, assessing the costs and benefits of international financial integration has become an issue of great importance.\(^1\) The goals of financial integration are to allocate capital efficiently, and to allow for international risk-sharing and consumption smoothing through lending and borrowing in the international financial markets. By allowing the agents to hold a wider range of assets, financial integration can help consumers cushion themselves against domestic shocks, which generates lower consumption volatility than under a financially less integrated system or autarky. A number of theoretical studies have shown that despite the ambiguous impact of financial integration on output volatility, consumption volatility always decreases. Mendoza (1994), Baxter and Crucini (1995), and Sutherland (1998) are a few examples among the many.

The empirical evidence for the industrialized countries is supportive of the hypothesized benefits of financial integration. Basu and Taylor (1999) and Buch, Dopke and Pierdzioch (2002) show that financial openness has helped smoothing business cycle volatility in industrialized countries. The evidence for developing countries, however, is less optimistic. Studies show that developing countries do not necessarily benefit from international financial integration. One example is Kose, Prasad, and Terrones (2003) who investigate the issue for 76 countries, 55 of which are developing. Their evidence shows that higher levels of financial integration in the 1990s are associated with higher consumption volatility in the developing countries. They 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.

The aim of this paper is to rationalize this puzzling evidence by incorporating domestic financial imperfections into the analysis of international risk-sharing. It has been shown, in different contexts, that financial frictions have important implications for business cycles.\(^2\) Credit frictions have also widely been used in explaining financial crises and instability of

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\(^1\)See Agenor (2001) for a review.

\(^2\)See e.g., Bernanke, Gertler, and Gilchrist (2000) among many others.
small open economies. Aghion, Bacchetta and Banerjee (2000), 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, 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 (2000), 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.

The contribution of my paper is to show that the benefits of international risk-sharing (namely consumption smoothing) might not be achieved if a small country has a malfunctioning financial system. In other words, consumption (and consumption relative to output) can become more volatile under financial integration once domestic financial frictions are taken into account.

I develop a two country real business cycle model, where one of the countries is relatively small. Both countries produce a traded and a non-traded good. While domestic credit markets are perfect in the large country, the small country has asymmetric credit conditions facing the two sectors. The traded goods sector is assumed to be owned by households and is not credit constrained, while the non-traded sector is assumed to be owned by entrepreneurs who need to borrow from the domestic financial system (for example domestic banks) to invest for next period’s production. As in Tornell and Westermann (2003), their borrowing cannot exceed a given proportion of their existing capital stock. Tornell and Westermann (2003) find that traded sector firms have access to international financing, but the non-traded sector is dependent on domestic credit markets, namely the domestic banking system. Because the financial systems in these countries are underdeveloped, there are severe information problems, which result in the existence of constraints to the non-traded sector’s borrowing. I analyze the impact of financial integration by comparing two scenarios. The first is financial autarky where the economy is closed to trade of any international assets. Then I look at a set up with financial integration, where worker households are allowed to hold a set of international state contingent assets, but the non-traded sector firm owners are not.
The main finding of the paper is that consumption and consumption relative to output (of the small country) are more volatile in the financial integration set up compared to autarky. The difference comes from reactions of workers to the distortions in the non-traded sector that result in different terms of trade dynamics under the two asset market structures. The distortions are caused by the fact that the non-traded sector firm pledges existing capital stock, which is denominated in the relative price of the non-tradables, 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 workers 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, workers 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, workers 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 workers are still better off under financial integration.

The rest of the paper is organized as follows: the next section presents the structure of the model. 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

I build 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 \(1 - n\) belong to \(F\) (foreign). I assume that home is a small open economy with underdeveloped financial system, and foreign is a large economy with perfect financial markets. Each country produces a traded and a nontraded good. In the home country, there are two types of households: workers and owners of the non-traded sector firms. Workers in the home country make up fraction \(\kappa\) of the population, provide labor to both the traded and the non-traded goods sectors, and own the home traded goods firms. Owners of the non-traded goods firms (NT owners from here on) make up fraction \(1 - \kappa\) of the population. To be able to finance their investment and production of non-traded goods, they borrow from the workers, and in doing so they face a borrowing constraint.

### 2.1 Consumption Baskets and Price Indices

Both type of households 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:

\[
C_t = [\gamma \frac{\xi_{T,t}^{\xi_{T,t} - 1}}{\xi_{T,t}^{\xi_{T,t} - 1}} + (1 - \gamma) \frac{\xi_{N,t}^{\xi_{N,t} - 1}}{\xi_{N,t}^{\xi_{N,t} - 1}}]^{\frac{1}{\xi_{T,t} - \xi_{N,t} + 1}}
\]

where \(\xi \geq 0\) is the elasticity of substitution between traded and non-traded goods, and \(\gamma\) 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:

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

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. \(P_t\) and \(P_{T,t}\) are given by

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

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

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

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

where $C_t'$ is the consumption of the worker 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

$$P_t C_t' + Z_t' \leq W_{N,t} L_{N,t} + W_{H,t} L_{H,t} + R_{t-1} Z_{t-1} + \Pi_t$$

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. $\Pi_t$ denotes the profits from owning the traded goods firms. The workers 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:

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

$$\frac{W_{N,t}}{P_t} = \tau_N C_t'$$

$$\frac{W_{H,t}}{P_t} = \tau_H C_t'$$
2.2.2 Financial Integration

When the home country is financially integrated with the foreign country, worker households can hold international state contingent assets that yield a return in terms of the foreign country’s currency. By holding these assets these households can insure themselves against domestic shocks.\(^3\) 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, \(\varepsilon_t\) 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:

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

\[
Q(s^{t+1} \mid s^t) = \beta P_t \left( \frac{\varepsilon(s^{t+1})}{\varepsilon(s^t)} \right) \left( \frac{C(s^{t+1})}{C(s^t)} \right)^{-1} \frac{P(s^t)}{P(s^{t+1})} \tag{12}
\]

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

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

Combining \((11)\) and \((12)\), I get the arbitrage condition between the returns on the loans and state-contingent bonds:

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

\(^3\)The market for international trading of the traded goods firms’ equity is not considered as an additional way of financial integration since the households are the owners of these firms, households borrowing from abroad implies that the traded goods firms get international financing. Also, the equities would be redundant assets given the state contingent securities.
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:

\[
\max P_{H,t} Y_{H,t} + \varepsilon_t P_{H,t}' Y_{H,t}' - W_{H,t} L_{H,t}
\]

subject to:

\[
Y_{H,t} + Y_{H,t}' = A_{H,t} L_{H,t}
\]

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:

\[
\frac{W_{H,t}}{A_{H,t}} = P_{H,t}
\]

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

\[
P_{H,t} = \varepsilon_t P_{H,t}'
\]

2.4 Non-Traded Goods Sector

There is a continuum households who produce the non-traded goods. They combine labor services of the worker households with the capital they own to produce the non-traded good with a Cobb-Douglas technology that takes the following form:

\[
Y_{N,t} = A_{N,t} L_N^\eta K_{N,t}^{1-\eta}
\]

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:
\[ X_{N,t} = K_{N,t} - (1 - \delta)K_{N,t-1} \]  

(21)

where \( \delta \) 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, mostly banks. I assume that there is a financial institution, not explicitly modeled, that takes deposits from the workers and lends them out to NT owners. Furthermore, I assume that the credit contracts are subject to enforceability problems. The enforceability problem arises because the NT owners 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. NT owners offer the 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 dispose the firms output and pay back the lenders. 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

\[ R_t Z_t'' \leq mE_t(P_{N,t+1}K_{N,t}) \]  

(22)

where \( Z_t'' \) is the nominal amount the NT owner borrows, 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 the NT owners can borrow.

NT owner’s problem is to maximize utility

\[ U_t'' = E_t \sum_{t=0}^{\infty} \psi^t \log(C_t'') \]  

(23)

subject to the budget constraint
\[ P_{N,t}X_{N,t} + P_t C''_t + R_{t-1}Z''_{t-1} + W_{N,t}L_{N,t} \leq P_{N,t}Y_{N,t} + Z''_t, \]  

(24)

and the borrowing constraint in (22). The consumption bundle \( C''_t \) is the same as the workers' consumption bundle and is given by (1) and (2). I assume that the discount factor of the NT owners, \( \nu \), is smaller than the discount factor of the worker households, \( \beta \). This assumption ensures that the NT owners 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:

\[ \mu_t = \frac{1}{C''_t P_t} \]  

(25)

\[ \frac{W_{N,t}}{P_{N,t}} = \frac{Y_{N,t}}{L_{N,t}} \]  

(26)

\[ \mu_t = \nu E_t \left\{ \mu_{t+1} \left[ (1 - \eta) \frac{P_{N,t+1} Y_{N,t+1}}{P_{N,t} K_{N,t}} + (1 - \delta) \frac{P_{N,t+1}}{P_{N,t}} \right] + m \lambda''_t \frac{P_{N,t+1}}{P_{N,t}} \right\} \]  

(27)

\[ \lambda''_t = \frac{1}{C''_t P_t} \frac{1}{R_t} - \nu E_t \left\{ \frac{1}{C''_{t+1} P_{t+1}} \right\} \]  

(28)

where \( \mu_t \) is the lagrange multiplier on the budget constraint and \( \lambda''_t \) is the multiplier on the borrowing constraint. In the steady state equation (28) implies that \( \lambda''_t \) is always greater than zero since \( \frac{1}{\nu} = \beta \) and \( \beta > \nu \). Therefore, the borrowing constraint is always binding in and around the steady state.

### 2.5 Foreign Country

I assume that there is only one type of agent in the foreign country, households, and that they own 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:

\[ U^*_t = E_t \sum_{t=0}^{\infty} \beta^t [\log(C^*_t) - \tau_N L^*_N - \tau_F L^*_F] \]  

(29)
subject to

$$P^*_t C^*_t \leq W^*_{N,t} L^*_{N,t} + W^*_{F,t} L^*_{F,t} + \Pi^*_t$$  \hspace{1cm} (30)

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

$$\frac{W^*_{N,t}}{P^*_t} = \tau^*_N C^*_t$$  \hspace{1cm} (31)

$$\frac{W^*_{F,t}}{P^*_t} = \tau^*_F C^*_t$$  \hspace{1cm} (32)

Under financial integration the budget constraint becomes

$$P^*_t C^*_t + \sum_{s^{t+1}} Q(s^{t+1} | s^t) B^*(s^{t+1}) \leq W^*_{N,t} L^*_{N,t} + W^*_{F,t} L^*_{F,t} + B^*(s^t) + \Pi^*_t$$  \hspace{1cm} (33)

and the additional first order condition is:

$$Q(s^{t+1} | s^t) = \beta \Pr(s^{t+1} | s^t) \left( \frac{C^*(s^{t+1})}{C^*(s^t)} \right)^{-1} \frac{P^*(s^t)}{P^*(s^{t+1})}$$  \hspace{1cm} (34)

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

$$\frac{W^*_F}{A^*_F} = P^*_F.$$  \hspace{1cm} (35)

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

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:

$$E_t \sum_{t=0}^{\infty} \beta^t \left( \frac{C^*_t}{C^*_0} \right) \Pi^*_t$$  \hspace{1cm} (36)

where the profits are defined as
\[ \Pi_t^* = P_{N,t}^* Y_{N,t}^* - W_{N,t}^* L_{N,t}^* - P_{N,t}^* X_{N,t}^*. \]  

(37)

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

\[ Y_{N,t}^* = A_{N,t}^* (L_{N,t}^*)^\eta (K_{N,t-1}^*)^{1-\eta} \]  

(38)

and the capital accumulation equation

\[ X_{N,t}^* = K_{N,t}^* - (1 - \delta) K_{N,t-1}^*. \]  

(39)

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

\[ \frac{W_{N,t}^*}{P_{N,t}^*} = \frac{Y_{N,t}^*}{L_{N,t}^*} \]  

(40)

\[ \frac{P_{N,t}^*}{P_t^*} = \beta E_t \left\{ \left( \frac{C^* (s^t+1)}{C^* (s^t)} \right)^{-1} \frac{P_{N,t+1}^*}{P_{t+1}^*} \left[ \frac{(1 - \eta) Y_{N,t+1}^*}{K_{N,t}^*} + 1 - \delta \right] \right\}. \]  

(41)

\subsection*{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:

\[ nC_{H,t} + (1 - n) C_{H,t}^* = Y_{H,t} \]  

(42)

\[ nC_{F,t} + (1 - n) C_{F,t}^* = Y_{F,t}^* \]  

(43)

\[ Y_{N,t} = C_{N,t} + X_{N,t} \]  

(44)

\[ Y_{N,t}^* = C_{N,t}^* + X_{N,t}^* \]  

(45)
Aggregate consumption at home is made up of the consumption of worker households and NT owners, and is given by:

\[ C_t = \kappa C'_t + (1 - \kappa)C''_t \tag{46} \]

Finally the loan market clearing at home implies:

\[ \kappa Z'_t = (1 - \kappa)Z''_t. \tag{47} \]

3 Model Parametrization

The quarterly discount factor of the workers, \( \beta \), is set equal to 0.99, which implies a real interest rate of 4 percent, and the discount factor of the NT owners, \( \upsilon \), is set to 0.98. The weight of labor efforts in the utility, \( \tau_N \) and \( \tau_H \) 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, \( \eta \), and the depreciation rate \( \delta \) 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, \( \xi \), is taken from Stockman and Tesar (1995) to be 0.5, and the share of tradeables in the consumption basket, \( \gamma \), is set equal to 0.5. The elasticity of substitution between home and tradable goods, \( \theta \), is chosen to be 1.5 following Backus, Kehoe and Kydland (1994).

Two key parameters in this analysis is the share of workers in the population, \( \kappa \), and the debt to collateral ratio, \( m \). To start with I choose \( \kappa \) 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 mean of credit to private sector to GDP ratio of 58 non-OECD countries is 0.28, so the particular choice of \( m \) and \( \kappa \) makes the implied annual debt to GDP ratio equal to the one in data.\(^4\) I try different values for \( m \) and \( \kappa \) to show how the credit constraints on the non-traded sector’s borrowing and

\(^4\)The data is from the World Bank, and can be found at www.worldbank.org/research/projects/finstructure/database.htm. The list of countries is available upon request.
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 nontradable 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. 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.⁵

4 Access to International Financial Markets, Sectorial Differences and Volatility

There are two frictions in the model I have presented that makes the set up different from a standard two sector real business cycle model. 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 borrowing constraint the non-traded goods firms face due to enforceability problems. The interaction of the two frictions affect the volatility differently before and after financial integration. Also the fact that the traded goods sector gets international financing after integration, and the non-traded sector does not causes the relative prices and sectorial outputs to have different dynamics under financial integration and autarky.

Integration of the asset markets will change the relation between the real exchange rate and the consumption differential between the two countries.⁶ When the agents can trade state...

⁵I have made sensitivity analyses with respect to the standard deviation of the productivity shocks in the nontradable sector and correlation of shocks across sectors. The qualitative results remain the same in all these sensitivity analyses. Results available upon request.

⁶This link was also highlighted by Tille (in press) who shows that financial integration is not necessarily
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 (in press) among others. Equating (12) to (34), I get

$$q_t = \varphi \frac{C_t'}{C_t^*}$$

(48)

where $q_t$ is the real exchange rate and is defined as $q_t = \frac{\varepsilon_t P_t'^*}{P_t}$, $\varphi$ 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 (48) is

$$\dot{q}_t = \dot{C}_t' - \dot{C}_t^*$$

(49)

which implies that the fluctuations in the real exchange rate mostly affect the domestic workers’ consumption since the foreign country is assumed to be large enough to have a stable consumption level, and not be affected by the small country’s shocks.

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:

$$nP_{F,t}C_{F,t} = (1 - n)\varepsilon_t P_{H,t}C_{H,t}$$

(50)

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:

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

(51)

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.
where $C'$, $C''$ and $C$ are the steady state values of workers’ 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 workers and the foreigners but also between the NT owners and the foreigners. Also, $\kappa$, the share of workers’ 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, whereas 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

The main reason why consumption volatility is lower under financial autarky can be attributed to the differences in terms of trade dynamics. The best way to understand the relationship between the financial imperfection, asset market integration and consumption is to analyze the impulse response functions to shocks 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 goes up. 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. With lower value of collateral, they borrow less, and as a result invest less and demand less labor.

Workers are affected by the reaction of the non-traded goods firms 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 workers 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 (51) to (49), the two equations that constitute the main difference between the dynamics of the two set ups. Notice that equation (51) simplifies in the limit to (49) as $\theta \to \infty$. As $\theta$ 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 autarky coincide.\footnote{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.}

### 4.2 The Severity of the Enforceability Problem

An interesting experiment is to see how the results are affected by the severity of the contract enforceability problem. Figure 3 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.\footnote{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.}

### 4.3 Asymmetric Access to International Assets

To disentangle the impact of different frictions in the model on the volatility results, and to analyze the role of NT owners play in the set up, I set $\kappa$ equal to 0.9999.\footnote{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.} This parametrization implies that the home population is made up of mainly workers who all have access to international asset markets under financial integration. As can be seen from the results in Table 4, the volatility of consumption is still less volatile under financial autarky, but the relative volatility of consumption to output is lower under integration. Having NT owners who are not allowed to hold international assets (going from the results in Table 4 to Table 2) increases aggregate consumption volatility under both autarky and integration. The NT owners’ consumption is much more volatile than workers’ consumption because their consumption
depends on borrowing (which is constrained) and the productivity shocks in the non-traded goods sector. When the share of NT owners in the population goes up, aggregate consumption gets more affected by their consumption, and therefore the aggregate volatility goes up. An important thing to note is that the volatility of consumption increases by a larger percentage in the financial integration set up (12.4% as opposed to 5.5%). Under financial integration, aggregate consumption volatility goes up as the number of NT owners go up also because the NT owners are left out of international risk-sharing. Thus, it is more costly to have borrowing constrained agents under financial integration.

5 Sensitivity Analysis

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

\[ U_t = E_t \sum_{i=0}^{\infty} \beta^i \left[ \frac{(C^i_t)^{1-\omega}}{1-\omega} - \tau_N L_{N,t} - \tau_H L_{H,t} \right] \]  

where \( \omega \) is the coefficient of relative risk aversion.\(^{10}\) Given this utility function, the linearized condition for risk-sharing condition (for financial integration) in (49) becomes

\[ \hat{q}_t = \omega (\hat{C}_t^t - \hat{C}_t^*) \]  

Under financial autarky the balanced trade condition in (51) becomes

\[ \hat{q}_t = \left[ \frac{\omega(\theta - 1) + \kappa C^e}{\xi + \theta - 1} \right] (\hat{C}^t_t - \hat{C}^*_t) + \left[ \frac{(1 - \kappa) C^e}{\xi + \theta - 1} \right] (\hat{C}^e_t - \hat{C}^*_t) \]  

Since equations (53) and (54) constitute the main difference between the dynamics under financial integration and autarky, the volatilities under the two set ups might be sensitive to the parameters \( \omega, \xi \) and \( \theta \).

\(^{10}\)Log utility is a special case of constant relative risk aversion function where \( \omega \) is set equal to 1.
Table 5 shows the results for different values of \( \omega \), keeping \( \xi \) and \( \theta \) at their initial values (0.5 and 1.5, respectively). The finding that financial integration can increase volatility of consumption holds for \( \omega \) equal to 2 but not 3. The second finding that relative volatility of consumption to output volatility is higher under financial integration does not hold for \( \omega \) equal to 2 or 3. As people become more risk-averse, the benefits of risk-sharing for workers 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 \( \xi \) that would make the relative volatility of consumption lower under financial autarky for \( \omega \) equal to 2.\(^1\) The last panel of Table 5 shows that as soon as I set \( \xi \) to be 0.4, the main finding is restored. 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.\(^2\)

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.\(^3\) 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:

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

11 I also tried different values of \( \theta \) for this purpose. The results are not sensitive to the choice of \( \theta \).  
12 For \( \omega = 3 \), there is no plausible value of \( \xi \) that makes consumption, in absolute terms and relative to output, less volatile under financial autarky.  
13 I solve the model using the procedure adopted by Collard and Juillard (2001) in the package Dynare.
\[
W_t^n = E_t \sum_{t=0}^{\infty} \nu_t \left\{ \log(C_t^n) + \frac{1}{C_t^n} (C_t^n - C_t^\nu) - \frac{1}{(C_t^n)^2} (C_t^n - C_t^\nu)^2 \right\}
\] (56)

When I evaluate the welfare criterion for the workers under financial autarky and integration, I get 0.6643 and 1.0433, respectively. Even though the volatility of the workers' consumption is higher, their welfare is still higher under financial integration due to the insurance the assets bring. 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. The fact that the welfare losses of the NT owners are much bigger under integration causes the aggregate welfare to be lower under integration. The weighted sum of the welfare of the two types of households is -1.3763 and -1.5443 under autarky and integration, respectively. The aggregate welfare loss is smaller under autarky. Thus, in the aggregate, the small economy is better off under autarky.

7 Conclusion

This paper shows that developing countries with domestic credit market imperfections do not necessarily benefit from international financial integration in terms of consumption smoothing. The theory of international risk-sharing suggests that through international lending and borrowing, countries can cushion themselves against domestic shocks and therefore have a smoother consumption path. The evidence for developing countries, however, shows that consumption volatility (in absolute terms and relative to output volatility) has increased as a result of financial integration. In this paper, I propose one explanation as to why volatility might be going up.

To that end, I develop a two country real business cycle model, where the small country is characterized with enforceability problems in the non-traded sector’s borrowing. The owners of the non-traded sector firms borrow from worker households to be able to invest, and face borrowing constraints in doing so due to the enforceability problem. The traded goods sector is assumed to be owned by worker households, and not credit constrained. Financial integration is
analyzed by comparing the set up where workers are allowed hold state contingent international
bonds (but NT owners are not) to the set up where none of the agents are allowed to hold any
international assets (financial autarky).

The results show that aggregate consumption volatility, in absolute terms and relative to
output, is higher under financial integration. International assets provide insurance to workers,
which causes them not to react to the changes in the non-traded sector. This leaves terms of
trade constant, allowing aggregate consumption to respond fully to the productivity changes.
When these assets do not exist, workers react to changes in the non-traded sector by supplying
more labor to the traded sector, and that causes deterioration of terms of trade. The terms
of trade under autarky have dampening effects on aggregate consumption, causing it to have
lower volatility. Secondly, leaving NT owners, whose consumption depends heavily on debt,
out of international risk-sharing under integration increases consumption volatility more than
proportionately. 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 workers 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.

This is a highly stylized model that highlights the role of domestic financial frictions in
determining the consequences of financial integration. Although the model generates higher
volatility of consumption and consumption relative to GDP as a result of integration, the
consumption volatility numbers are lower than what is observed in the data. It would be
interesting to enrich the demand side to be able to match the standard deviations to the
data. Also, it would be interesting to empirically see how large the effects of credit market
imperfections on financial integration results are. All these issues will be addressed in future
research.
References


Table 1: Benchmark Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount factor of the workers</td>
<td>$\beta = 0.99$</td>
</tr>
<tr>
<td>Discount factor of the entrepreneurs</td>
<td>$\nu = 0.98$</td>
</tr>
<tr>
<td>Weight of labor effort in the utility</td>
<td>$\tau_N = \tau_H = 1$</td>
</tr>
<tr>
<td>Home country’s size</td>
<td>$n = 0.05$</td>
</tr>
<tr>
<td>Elasticity of substitution between tradeables and nontradeables</td>
<td>$\xi = 0.5$</td>
</tr>
<tr>
<td>Share of tradables in the consumption basket</td>
<td>$\gamma = 0.5$</td>
</tr>
<tr>
<td>Elasticity of substitution between home and foreign tradable goods</td>
<td>$\theta = 1.5$</td>
</tr>
<tr>
<td>Share of labor in the production of tradeables</td>
<td>$\eta = 0.64$</td>
</tr>
<tr>
<td>Depreciation rate</td>
<td>$\delta = 0.025$</td>
</tr>
<tr>
<td>Share of workers in the population</td>
<td>$\kappa = 0.8$</td>
</tr>
<tr>
<td>Debt to collateral ratio</td>
<td>$m = 0.8$</td>
</tr>
<tr>
<td>Standard deviation of productivity shocks to the tradable sector</td>
<td>$\sigma_T = 0.007$</td>
</tr>
<tr>
<td>Standard deviation of productivity shocks to the nontradable sector</td>
<td>$\sigma_N = 0.0035$</td>
</tr>
</tbody>
</table>
### Table 2: Implied Volatilities of the Model

<table>
<thead>
<tr>
<th></th>
<th>Autarky</th>
<th>Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_c$</td>
<td>0.4371</td>
<td>0.5896</td>
</tr>
<tr>
<td>$\sigma_y$</td>
<td>2.5596</td>
<td>2.8669</td>
</tr>
<tr>
<td>$\sigma_c^0$</td>
<td>0.4430</td>
<td>0.5896</td>
</tr>
<tr>
<td>$\sigma_c^e$</td>
<td>5.4275</td>
<td>6.1097</td>
</tr>
</tbody>
</table>

*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: Implied Volatilities of the Standard-Frictionless Model

<table>
<thead>
<tr>
<th></th>
<th>Autarky</th>
<th>Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_c$</td>
<td>0.4143</td>
<td>0.5571</td>
</tr>
<tr>
<td>$\sigma_y$</td>
<td>0.5213</td>
<td>0.9540</td>
</tr>
<tr>
<td>$\sigma_c^0$</td>
<td>0.4143</td>
<td>0.5571</td>
</tr>
<tr>
<td>$\sigma_c^e$</td>
<td>5.9138</td>
<td>6.0962</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th></th>
<th>Autarky</th>
<th>Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sigma_c$</td>
<td>0.1893</td>
<td>0.1783</td>
</tr>
<tr>
<td>$\sigma_y$</td>
<td>2.1889</td>
<td>2.9123</td>
</tr>
<tr>
<td>$\sigma_c^0$</td>
<td>0.4143</td>
<td>0.5195</td>
</tr>
<tr>
<td>$\sigma_c^e$</td>
<td>0.4143</td>
<td>0.5195</td>
</tr>
<tr>
<td>$\sigma_c^e$</td>
<td>5.9138</td>
<td>6.0962</td>
</tr>
</tbody>
</table>
Table 5A: Sensitivity of the results to the coefficient of risk-aversion

<table>
<thead>
<tr>
<th></th>
<th>$\omega = 1$</th>
<th>$\omega = 2$</th>
<th>$\omega = 3$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Deviation of Consumption, $\sigma_c$</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autarky</td>
<td>0.4371</td>
<td>0.2271</td>
<td>0.1866</td>
</tr>
<tr>
<td>Integration</td>
<td>0.5839</td>
<td>0.3401</td>
<td>0.1749</td>
</tr>
</tbody>
</table>

|                     |              |              |              |
| **Standard Deviation of Consumption Relative to Output, $\frac{\sigma_c}{\sigma_y}$** |              |              |              |
| Autarky             | 0.1708       | 0.1294       | 0.1089       |
| Integration         | 0.2037       | 0.1175       | 0.0746       |

Table 5B: Sensitivity of the results to the elasticity between tradeables and non-tradeables (for $\omega = 2$)

<table>
<thead>
<tr>
<th></th>
<th>$\xi = 0.5$</th>
<th>$\xi = 0.4$</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Standard Deviation of Consumption, $\sigma_c$</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Autarky</td>
<td>0.2271</td>
<td>0.2326</td>
</tr>
<tr>
<td>Integration</td>
<td>0.3401</td>
<td>0.3497</td>
</tr>
</tbody>
</table>

|                     |              |              |
| **Standard Deviation of Consumption Relative to Output, $\frac{\sigma_c}{\sigma_y}$** |              |              |
| Autarky             | 0.1294       | 0.1099       |
| Integration         | 0.1175       | 0.1130       |
Figure 1: Responses to a Productivity Shock in the Non-traded Sector
Figure 1 (continued)
Figure 2: Responses to a Productivity Shock in the Traded Sector
Figure 2 (continued)

- **Wage**
  - Integration vs. Autarky

- **Labor Non-Tradable Sector**

- **Labor Tradable Sector**

- **Terms of Trade**
  - % dev. from the steady state

- **Real Exchange Rate**
  - % dev. from the steady state

- **Relative Price of Non-Tradables**
  - % dev. from the steady state

- **Loans**
  - % dev. from the steady state

- **Investment**
  - % dev. from the steady state

- **Quarters**
  - % dev. from the steady state
Figure 3: Sensitivity to the Enforceability Problem Parameter (m)

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