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Trade balance volatility and consumption structures in small open economies

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HIGHLIGHTS

- Tradables consumption shares justify the difference in trade balance volatility.
- These measures are related through fluctuations in collateral prices.
- This study employs nonlinear stochastic simulations for endowment economies.
- A collateral constraint explains plausible size and diversity of the volatility.
- Researchers must select the form of collateral constraint carefully.

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ABSTRACT

This paper aims to explain the difference in trade balance volatility between emerging and developed small open economies under a simple endowment economy model. The results of the nonlinear simulations with occasionally binding collateral constraints show that in a model with collateral capital, the difference can be explained by the share of tradables in consumption.

1. Introduction

The small open economy (SOE) literature focuses on the fact that the trade balance volatility are larger in emerging economies than in developed countries (e.g. Uribe and Schmitt-Grohé, 2016). While it is often attributed to the properties of shocks (e.g. Aguiar and Gopinath, 2007), Uribe and Schmitt-Grohé's review finds several other perspectives. This paper focuses on the difference in consumption structures, specifically the share of tradables in consumption. I interpret the stylized fact by Acemoglu (2009) on the industrial structure represented by the production shares in terms of the consumption structure. That is, the share of tradables consumption tends to be larger in emerging economies than in developed economies.[2] Assuming this together with the difference in the trade balance volatility above, one can expect a positive relationship between trade balance volatility and the consumption shares of tradables. This is confirmed by the data in Fig. 1, where the correlation is 0.831 ($s.e. = 0.118$).[3]

This paper examines whether this positive relationship results from a simple endowment economy model. First, I examine a model without borrowing constraints and find that this relationship holds. However, the magnitudes of the trade balance volatility predicted by the model are larger than the data, since the unrestricted borrowing capacity of the household allows them to consume more foreign goods in response to shocks. To address this problem, I introduce an occasionally binding collateral constraint, which has two effects: it promotes precautionary saving

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2 I will elaborate the theoretical justification of this interpretation in the subsequent section.

3 The data on trade balances are from Aguiar and Gopinath (2007). Following Bianchi (2011), tradables refer to the goods in manufacturing and primary sectors, and nontradables to the rest of the components of GDP. The tradables shares are for 2000 and calculated using the World Development Indicator database; data for Canada and Israel are omitted.

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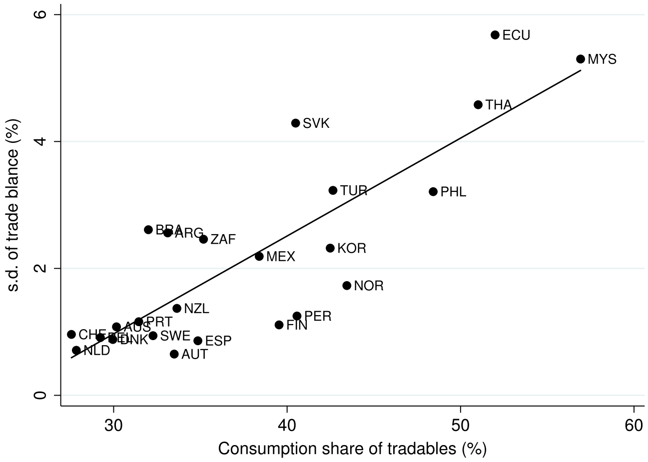

Fig. 1. Share of tradables and trade balance volatility.

and amplifies shocks (Mendoza, 2010). While the former mediates the magnitudes of trade balance volatility, the latter produces their diversity according to the type of collateral and consumption structure. I examine two common types of collateral: income and capital. The simulation results show that the latter yields a positive relationship. This is because a larger share of tradables consumption leads to deeper decline of the capital price in response to negative shocks, which tightens the collateral constraint, preventing the household from borrowing. As a result, trade balance becomes more volatile. In contrast, the opposite holds with income collateral. These results suggest the importance of the form of collateral constraint.

The remainder of this paper proceeds as follows. Section 2 presents the model and describes its equilibrium conditions. Section 3 reports the quantitative analyses. Section 4 concludes.

2. The model

2.1. Setup

The basic structure of the model follows Bianchi (2011). Consider an SOE with tradables and nontradables in infinite discrete time $t = 0, 1, 2, \ldots$. Only tradables can be traded internationally; nontradables are consumed domestically. The utility of the representative household at time t is given by $U_t = E_t \sum_{s=t}^{\infty} \beta^{s-t} u(c_s)$, where $\beta \in (0, 1)$, $u(c) = c^{1-\sigma}/(1-\sigma)$, and $\sigma > 0$. Let c_t denote a CES composite of tradables and nontradables consumption c_t^T and c_t^N, respectively, given by $c_t = [\omega(c_t^T)^{-\eta} + (1-\omega)(c_t^N)^{-\eta}]^{-\frac{1}{\eta}}$, where $\eta > 1$ and ω is the share of tradables in consumption. I examine the equilibria in which the household borrows from foreigners with constant gross interest rate R, where $\beta R < 1$. The borrowings are expressed as negative numbers of bond holdings b_t and the trade balance tb_t is defined by $(b_{t+1}/R - b_t)/(y_t^T + p_t y_t^N)$.

I consider three versions for the remaining parts. The first is a model without a collateral constraint ("unconstrained model"). The budget constraint here is:

$$c_t^T + p_t c_t^N + b_{t+1}/R = b_t + y_t^T + p_t y_t^N, \tag{1}$$

as in Bianchi (2011), where tradables are the numéraire and p_t denotes the nontradables' price. The second model ("income model") is Bianchi's (2011) original model, which contains a collateral constraint:

$$b_{t+1}/R \geq -\kappa(y_t^T + p_t y_t^N), \tag{2}$$

where κ is the leverage limit. This is one of the common forms in two-sector SOE models, which Bianchi et al. (2016) also adopt. Finally, I examine a model with collateral capital ("capital model") following Bianchi and Mendoza (2013) and Korinek and Mendoza (2014). I assume production functions $y_t^T = z_t^T (k_t^T)^{\alpha_T} (l_t^T)^{1-\alpha_T}$ and $y_t^N = z_t^N (k_t^N)^{\alpha_N} (l_t^N)^{1-\alpha_N}$, where z_t^T and z_t^N are productivities, k_t^T and k_t^N are capital, l_t^T and l_t^N are labor, and α_T and α_N are the capital shares. The budget constraint is:

$$\begin{aligned} c_t^T + p_t c_t^N + b_{t+1}/R + q_t^T k_{t+1}^T + q_t^N k_{t+1}^N \\ = b_t + q_t^T k_t^T + q_t^N k_t^N + z_t^T (k_t^T)^{\alpha_T} (l_t^T)^{1-\alpha_T} \\ + p_t z_t^N (k_t^N)^{\alpha_N} (l_t^N)^{1-\alpha_N} \end{aligned} \tag{3}$$

where q_t^T and q_t^N are capital prices. For simplicity, I assume that the household provides one unit of capital and labor inelastically for each sector. The collateral constraint is:

$$b_{t+1}/R \geq -\phi q_t^T k_{t+1}^T. \tag{4}$$

2.2. Equilibrium

A competitive equilibrium for each model is a set of allocations $\{(b_{t+1}, c_t^T, c_t^N)_{t=0}^{\infty}\}$ or $\{(b_{t+1}, c_t^T, c_t^N, k_{t+1}^T, k_{t+1}^N)_{t=0}^{\infty}\}$ such that (i) the household maximizes U_t subject to budget constraint (1) or (3) and collateral constraint (if any) (2) or (4), given b_0, R, (and k_0^T, k_0^N), and $\{(y_t^T, y_t^N)_{t=0}^{\infty}\}$ or $\{(z_t^T, z_t^N)_{t=0}^{\infty}\}$; (ii) consistency conditions $c_t^T = C_t^T$, $c_t^N = C_t^N$, and $b_t = B_t$ (and $k_t^T = K_t^T$, $k_t^N = K_t^N$), where the capital letters are aggregate variables; and (iii) market clearing conditions $c_t^T + B_{t+1}/R = y_t^T + B_t$, and $c_t^N = y_t^N$ (and $k_t^T = 1$, $k_t^N = 1$, $l_t^T = 1$, $l_t^N = 1$) are satisfied for all t.

The first order conditions (FOCs) for the unconstrained model are:

$$u_T(c_t) = \beta R E_t(u_T(c_{t+1}))$$

$$p_t = \frac{u_N(c^T, y^N)}{u_T(c^T, y^N)} = \frac{1-\omega}{\omega} \left(\frac{c_t^T}{y_t^N} \right)^{1+\eta}, \tag{5}$$

where $u_T \equiv \partial u/\partial c^T$ and $u_N \equiv \partial u/\partial c^N$. Those for the income model are:

$$u_T(c_t) = \beta R E_t(u_T(c_{t+1})) + \mu_t^i$$

$$\mu_t^i (b_{t+1}/R + \kappa(y_t^T + p_t y_t^N)) = 0$$

$$\mu_t^i \geq 0$$

and p_t is as in (5), where μ_t^i is the Lagrange multiplier for (2). Finally, letting μ_t^k the Lagrange multiplier for (4), the FOCs for the capital model become:

$$u_T(c_t) = \beta R E_t(u_T(c_{t+1})) + \mu_t^k$$

$$\mu_t^k (b_{t+1}/R + \phi q_t^T k_{t+1}^T) = 0$$

$$\mu_t^k \geq 0$$

$$q_t^T = \frac{\beta E_t[u_T(c_{t+1})(q_{t+1}^T + \alpha_T z_{t+1}^T (k_{t+1}^T)^{\alpha_T - 1} (l_{t+1}^T)^{1-\alpha_T})]}{u_T(c_t) - \phi \mu_t^k}, \tag{6}$$

and p_t is as in (5). Substituting $k_{t+1}^T = 1$ and $l_{t+1}^T = 1$, (6) becomes:

$$q_t^T = \frac{\beta E_t[u_T(c_{t+1})(q_{t+1}^T + \alpha_T y_{t+1}^T)]}{u_T(c_t) - \phi \mu_t^k}. \tag{7}$$

These FOCs show that we can also treat the capital model as a version of an endowment economy, and we can express the process of z_t^T or z_t^N as that of y_t^T or y_t^N, respectively. Note also that the FOCs for the unconstrained and income models do not change under the budget constraint (3). The only difference is that q_t^T and q_t^N are determined, which do not affect the path of the other variables.