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Adjustment to small, large, and sunspot shocks in open economies with stock collateral constraints☆,☆☆

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ABSTRACT

This paper characterizes analytically the adjustment of an open economy with a stock collateral constraint to fundamental and nonfundamental shocks. In the model, external borrowing is limited by the value of physical capital. Three results are established: (1) Adjustment to external shocks is nonlinear. In response to small negative output shocks, the economy adjusts as prescribed by the intertemporal approach to the current account, with increases in debt, deficits in the trade and current account balances, and no significant movement in the price of collateral. By contrast, in response to large negative output shocks the economy experiences a sudden stop with debt deleveraging, trade and current account reversals, and a Fisherian deflation of asset prices. (2) Generically, weak fundamentals (low output and high external debt) give rise to multiple equilibria. (3) In this case, the economy is prone to self-fulfilling sudden stops driven by downward revisions of expectations about the value of collateral.

Ajustes a choques pequeños, grandes y *sunspots* en economías abiertas con restricciones sobre el colateral

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RESUMEN

Este artículo caracteriza de manera analítica el ajuste de una economía abierta con restricciones sobre el colateral a choques fundamentales y no fundamentales. En el modelo, el endeudamiento externo está limitado por el valor del capital físico. Se establecen tres resultados: (1) El ajuste a los choques externos es no lineal. En respuesta a choques de producción negativos pequeños, la economía se ajusta según lo dictado por el enfoque intertemporal de la cuenta corriente, con incrementos en la deuda, los déficits en la balanza comercial y de cuenta corriente, y sin movimientos significativos en el precio del colateral. Al contrario, en respuesta a los choques de producción negativos grandes la economía experimenta una parada súbita en los flujos de capitales con reducción del apalancamiento de la deuda, reversión de la balanza comercial y de cuenta corriente, y una deflación de Fisher de los precios de los activos. (2) En líneas generales, unos fundamentales débiles (baja producción y deuda externa alta) dan lugar a equilibrios múltiples. (3) En este caso, la economía es susceptible de paradas súbitas autocumplidas impulsadas por las revisiones a la baja de las expectativas acerca del valor del colateral.

1. Introduction

This paper characterizes analytically the adjustment of an open economy with a stock collateral constraint to small and large fundamental shocks and to nonfundamental (or sunspot) shocks. In a model driven by productivity shocks, we derive a threshold for

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the magnitude of negative shocks. For negative realizations of the shocks that are smaller than this threshold, the presence of the collateral constraint does not affect the adjustment. In particular, in response to a negative productivity shock, the economy adjusts as prescribed by the intertemporal approach to the current account. That is, it borrows internationally to smooth consumption, which causes a deterioration of the trade balance and a deterioration of the current account. Along this adjustment, the equilibrium price of collateral is unaffected. By contrast, if the size of the negative productivity shock is larger than the aforementioned threshold, then the presence of the constraint amplifies the adjustment. Instead of borrowing from abroad to smooth consumption, the economy is forced to deleverage. As a consequence the current account and the trade balance display surpluses, and consumption contracts by more than the decline in output. In addition, the deleveraging induces a massive desire to sell capital, resulting in a Fisherian deflation of Tobin's q and fire sales.

These results complement existing ones derived numerically in the context of calibrated models. For example, in a model calibrated to Mexico Mendoza (2010) finds that the unconditional standard deviation of output is about the same in versions of his model with and without the stock collateral constraint—a finding he interprets as indicating that the presence of collateral constraints does not amplify regular business cycles. At the same time, Mendoza finds that aggregate dynamics are amplified in periods in which negative shocks are so large that the collateral constraint binds.

Open economies with collateral constraints are vulnerable not just to fundamental sources of uncertainty, but also to nonfundamental ones. A problem that plagues this type of economies is that under plausible parameterizations, the equilibrium may fail to be unique. The possibility of equilibrium multiplicity in open-economy models with collateral constraints has been suggested by Mendoza (2005) and by Jeanne and Korinek (2010). The former study considers a model with a flow collateral constraint in which external borrowing is limited by the value of output and the latter considers a model with a stock collateral constraint, like the one studied in the present analysis. Both papers present a heuristic analysis of the problem and are focused on providing conditions for uniqueness. In this regard, the contribution of the present paper is to prove the existence of multiple equilibria formally and to characterize the associated equilibrium dynamics.

Essentially, the problem that arises is that if an unconstrained equilibrium exists, often a second equilibrium exists in which the collateral constraint is binding. This situation is more likely to occur when economic fundamentals are weak, that is, when the country is highly indebted and output is depressed. In the equilibrium with the binding collateral constraint, negative beliefs bring the price of capital down, causing a tightening of the collateral constraint. In turn, the decline in the value of collateral forces agents to deleverage leading to a fire sale of capital. Because the stock of capital is fixed in the short run, the fire sale depresses asset prices, validating the negative beliefs. The resulting self-fulfilling crisis carries all the characteristics of a sudden stop, namely, reversals in the trade and current-account balances and a contraction in aggregate demand. In addition, we show that these confidence crises are welfare decreasing, as they force households to deviate from consumption smoothing. In this sense, the deleveraging that occurs in a self-fulfilling crisis can be interpreted as underborrowing.

The remainder of the paper is organized in six sections. Section 2 presents an open economy model with a stock collateral constraint. Section 3 characterizes the steady-state equilibrium. Section 4 characterizes the equilibrium adjustment to regular-sized shocks. Section 5 characterizes the equilibrium adjustment to large shocks. Section 6 proves the existence of multiple equilibria and characterizes the dynamics of self-fulfilling financial crises. Section 7 concludes.

2. The model

Consider a perfect-foresight small open economy populated by a large number of households with preferences given by the utility function

$$\sum_{t=0}^{\infty}\beta^t \ln c_t,$$

where c_t denotes consumption and $\beta \in (0,1)$ denotes the subjective discount factor. The sequential budget constraint of the household is assumed to be of the form

$$c_t + d_t + q_t(k_{t+1} - k_t) = y_t + \frac{d_{t+1}}{1+r}, \tag{1}$$

where d_t denotes debt acquired in period $t-1$ and due in period t, k_t denotes the stock of physical capital in period t, q_t denotes the price of one unit of capital in terms of consumption in period t, y_t denotes output in period t, and $r>0$ denotes a constant interest rate on debt. For simplicity, we assume a zero depreciation rate of physical capital. Output is produced with the technology

$$y_t = A_t k_t^{\alpha}, \tag{2}$$

where A_t is an exogenous and deterministic productivity factor, and $\alpha \in (0,1)$ is a parameter.

Assume that borrowing is limited by a constant fraction $\kappa>0$ of the value of physical capital. Formally,

$$d_{t+1} \le \kappa q_t k_{t+1}. \tag{3}$$

The parameter κ can be interpreted as the fraction of assets that lenders could seize from the borrower in the event of a default. Under this interpretation, the above borrowing constraint is an incentive compatibility restriction, which ensures that the borrower never walks away from his external debt obligations.[1]

The above collateral constraint pertains to the class of stock collateral constraints, because the pledgeable object, physical capital, is a stock. Because the price of capital, q_t, is taken as given by the individual household, but is endogenously determined in equilibrium, the collateral constraint introduces a pecuniary externality. An increase in the aggregate demand for capital drives up q_t, allowing the individual household to borrow more. Similarly, a fall in the aggregate demand for capital drives q_t down, which may force households to deleverage. Individual households understand this mechanism, but fail to internalize it, because, due to their atomistic nature they correctly realize that their own demand for capital is too small to affect its price. This externality and its implications for prudential policy was first stressed in the context of an open economy model by Auernheimer and García-Saltos (2000). It has been extensively studied by subsequent authors in the context of both stock and flow collateral constraint models.[2]

The household chooses sequences $c_t>0$, d_{t+1}, and $k_{t+1}\ge 0$ to maximize its lifetime utility subject to the sequential budget constraint (1), the production technology (2), and the collateral constraint (3), taking as given the sequence of prices q_t and the

[1] Alternatively, one could assume that borrowing is limited by the expected value of capital at the time debt is due. In this case, the right-hand side of the collateral constraint would be $\kappa q_{t+1} k_{t+1}$. See, for example, Devereux, Young, and Yu (2015).

[2] See, for example, Mendoza (2002, 2005, 2010), Uribe (2006, 2007), Lorenzoni (2008), Jeanne and Korinek (2010), Korinek (2011), Bianchi (2011), and Benigno, Chen, Otrok, Rebucci, and Young (2013, 2014).