Financial Intermediation, Exchange Rates, and Unconventional Policy in an Open Economy

Roberto Chang (with L. Céspedes and A. Velasco)

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Motivation

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- Even in countries committed to inflation targeting and not only during crises.
- For Latin America, see Céspedes, Chang and Velasco (2014)

Some Questions

- What are the positive and normative effects of unconventional policies in open economies?
- What is, in particular, the rationale behind exchange rate related policies such as forex intervention, provision of foreign exchange liquidity, reserves accummulation?
- Are unconventional policies effective and justifiable all the time or only during crises?

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2. Obtain lessons for unconventional policies, including credit facilities and foreign exchange intervention.

Key Aspects of the Model

A minimum list of ingredients:

- Two goods, tradables and nontradables
- Two periods
- Firms borrow from home banks which, in turn, borrow from abroad

==> Interaction between the real exchange rate, interest rates, and financial intermediation.

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- A real exchange rate depreciation has ambiguous effects on loan supply: it can reduce the net worth of the banks but it increases the *leverage ratio.*
- The leverage ratio effect is novel but intuitive: a depreciation increases loan rates and hence the banks' *pledgeable income.*

Main Results: Equilibria

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- If it does, there is a positive interest rate spread and the real exchange rate is more depreciated than in the absence of financial frictions, resulting in an inefficiently low level of financial intermediation, investment, and welfare.

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- Key to intuition: leverage.

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- Lending to domestic agents (*direct lending*) affects real outcomes only if financial constraints bind.
- In that case, government credit is more effective if directed towards banks (*discount lending*)
- The reason, once more, is leverage

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- We show this to be *equivalent* to the government lending tradables.
- Hence the effects of sterilized interventions are explained not by the impact of the intervention on asset prices but, rather, by the impact of the sterilizing operation on financial constraints.

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- Hence, self fulfilling crises can occur.
- A commitment to defend the exchange rate can prevent such crises.
- Potential justification for episodes of reserves accumulation.

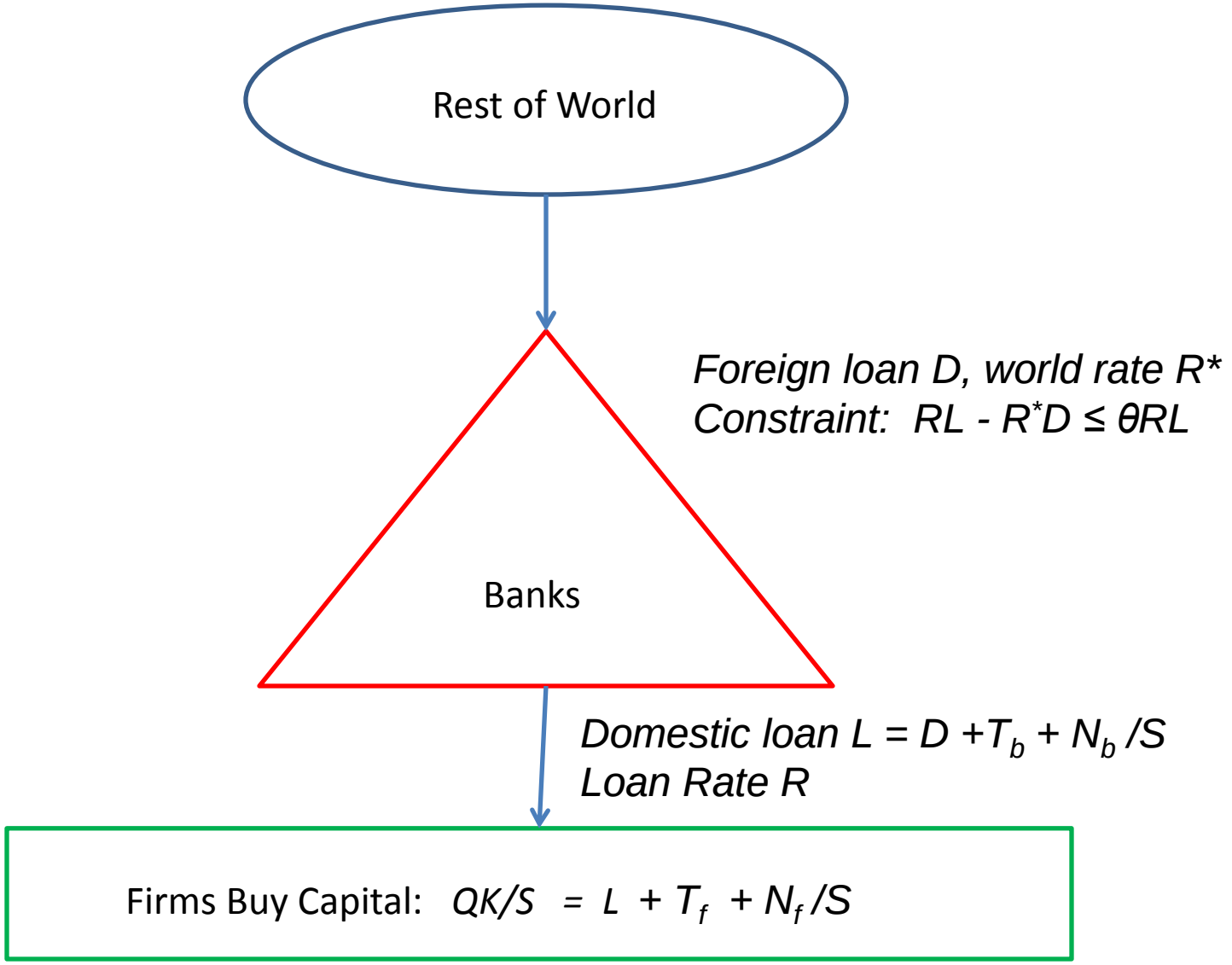
Most Closely Related Papers

- Gertler and Kiyotaki (2010) in *Handbook of Mon Econ*
- Chang and Velasco (2016)
- Aoki, Benigno, Kiyotaki (2016)

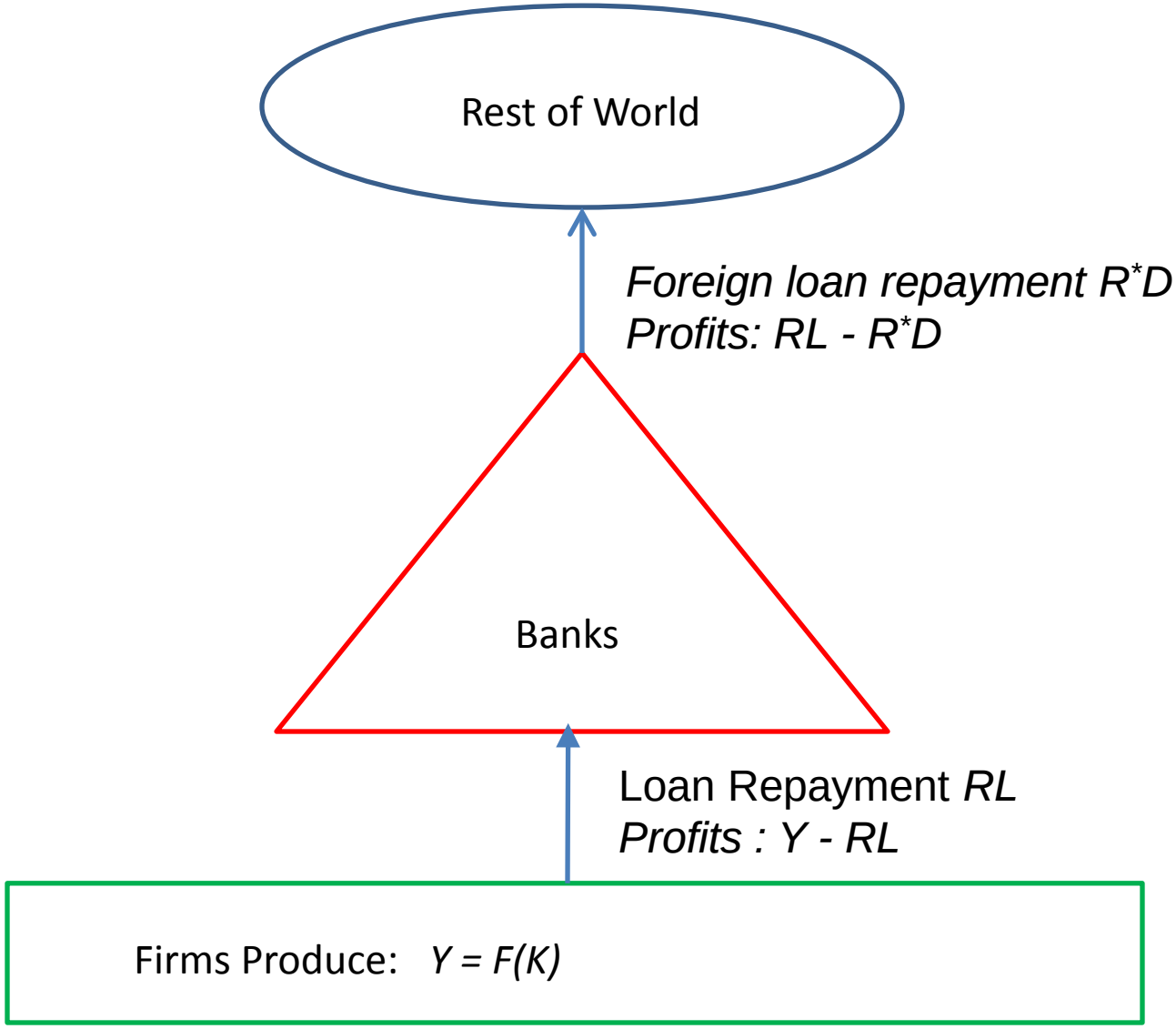
The Model

The Model

- Small open economy, two periods, two goods (tradables and nontradables)
- Households own firms and banks



Investment Period



Repayment Period

Capital Production

Capital is a Cobb Douglas aggregate of tradables and nontradables.

==> Price of capital in terms of home goods:

$$Q = S^{1-\gamma}$$

where S is the price of tradables in terms of nontradables, i.e. the *real exchange rate*.

==> Derived demand for nontradables:

$$I_H = \gamma QK = \gamma S^{1-\gamma} K$$

Firms

Firms ' demand for capital:

$$\begin{aligned} \alpha A K^{\alpha-1} &= RQ/S \\ &= RS^{-\gamma} \end{aligned}$$

since $Q = S^{1-\gamma}$

$==>$ The demand for capital falls with the price of capital ($S^{-\gamma}$, in tradables) and the financial cost R.

Banks

Banks maximize final profits:

$$\Pi^b = RL - R^* D$$

subject to a first period budget constraint

$$L = D + T_b + \frac{N_b}{S}$$

and a *collateral constraint*

$$RL - R^* D \geq \theta RL$$

- That firms cannot borrow directly from the world market can be rationalized as an extreme version of Holmstrom and Tirole (1997) and others.

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- $(1-\theta)RL$ is the bank's *pledgeable income* (Holmstrom-Tirole). It increases with the loan rate R.

Banks' Loan Supply

- If the collateral constraint does *not* bind, R must equal R^*, the amount of loans is determined by demand, and

$$L^s \leq \frac{1}{\theta}\left[T_b + \frac{N_b}{S}\right]$$

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$$L^s \leq \frac{1}{\theta}\left[T_b + \frac{N_b}{S}\right]$$

- If it binds,

$$L^s = \frac{R^*}{R^* - (1-\theta)R}\left[T_b + \frac{N_b}{S}\right] = \frac{1}{1-\phi(1-\theta)}\left[T_b + \frac{N_b}{S}\right]$$

where $\phi = R/R^*$ is the interest rate *spread.*

Characterizing Equilibrium

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$$R = S^{\gamma+(1-\alpha)(1-\gamma)} \alpha A \left(\frac{\gamma}{N}\right)^{1-\alpha}$$

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   ==> Key link between S and R

3. Defining S_0 by

$$R^* = S_0^{\gamma+(1-\alpha)(1-\gamma)} \alpha A \left(\frac{\gamma}{N}\right)^{1-\alpha}$$

   we get a simpler expression in terms of the spread:

$$\phi = \frac{R}{R^*} = \left(\frac{S}{S_0}\right)^{\gamma+(1-\alpha)(1-\gamma)}$$

Equilibrium Loan Supply

Equilibrium relation between loan supply and the real exchange rate:

$$\begin{aligned} L^s &\in [0, \frac{1}{\theta}(T_b + \frac{N_b}{S_0})] \text{ if } S = S_0 \\ &= \frac{1}{1-\phi(1-\theta)}\left[T_b + \frac{N_b}{S}\right] \text{ if } S > S_0 \end{aligned}$$

with the link between the exchange rate and the loan rate

$$\phi = \frac{R}{R^*} = \left(\frac{S}{S_0}\right)^{\gamma+(1-\alpha)(1-\gamma)}$$

- In the constrained region, L^s can increase or decrease with S, reflecting a *net worth* effect versus a *leverage ratio* effect. In fact,

$$\frac{S}{L^s}\frac{\partial L^s}{\partial S} = -\left[\frac{N_b/S}{T_b + N_b/S}\right] + \frac{\phi(1-\theta)}{1-\phi(1-\theta)}\left[\gamma + (1-\alpha)(1-\gamma)\right]$$

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- For now, assume the leverage ratio effect dominates, as in Figure 1.

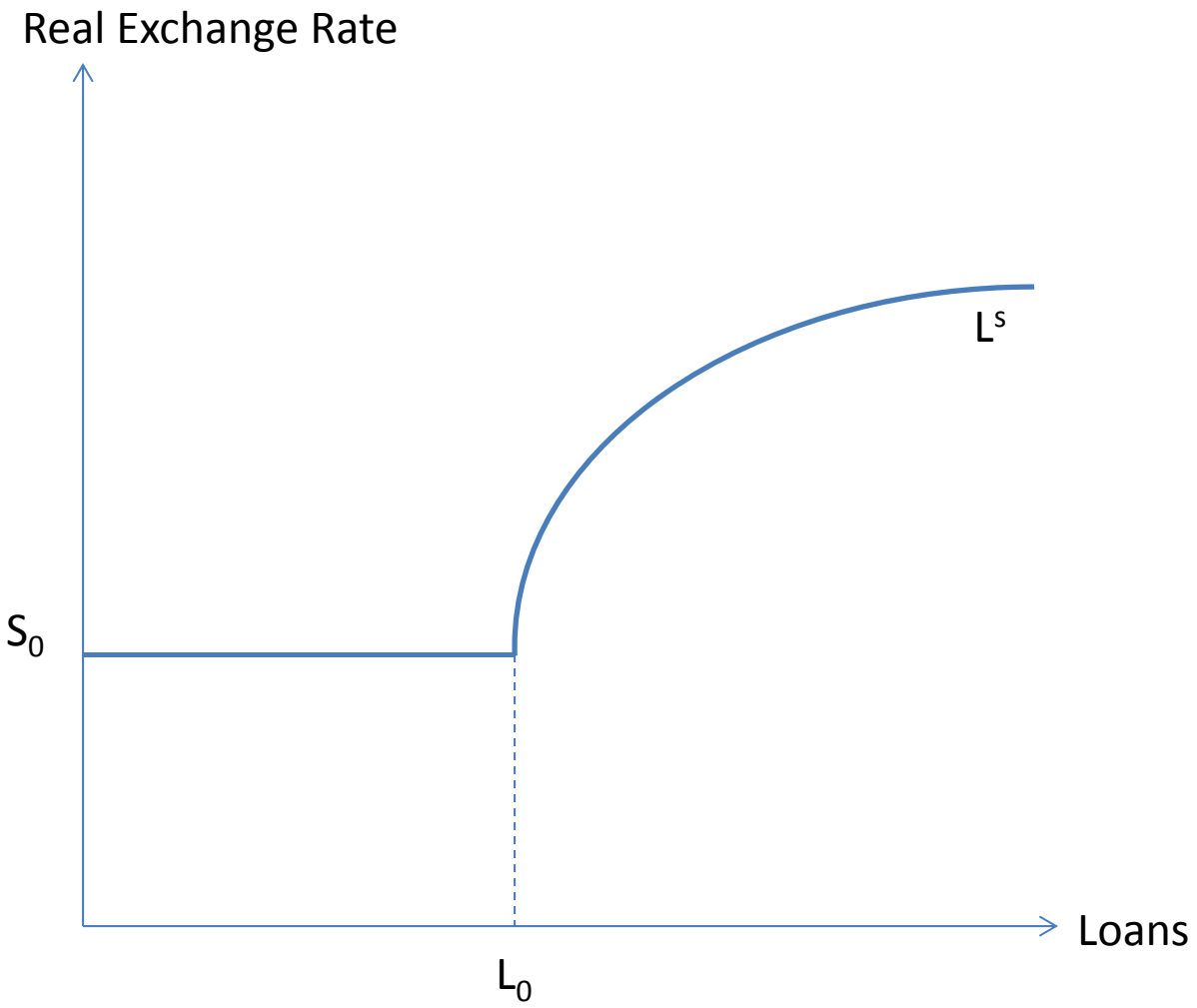

Figure 1

Loan Demand

From the firm's budget constraint,

$$\begin{aligned} L^d &= \frac{QK}{S} - (T_f + \frac{N_f}{S}) \\ &= S^{-\gamma}\frac{N}{\gamma S^{1-\gamma}} - (T_f + \frac{N_f}{S}), \text{ that is,} \\ L^d &= \frac{N}{\gamma S} - (T_f + \frac{N_f}{S}) \end{aligned}$$

We assume that L^d decreases with the real exchange rate.

Equilibria

In Figure 2, the equilibrium exchange rate is $S^e = S_0$, and the economy is financially *unconstrained*. In this case, of course, $R = R^*$ and $\phi = 1$.

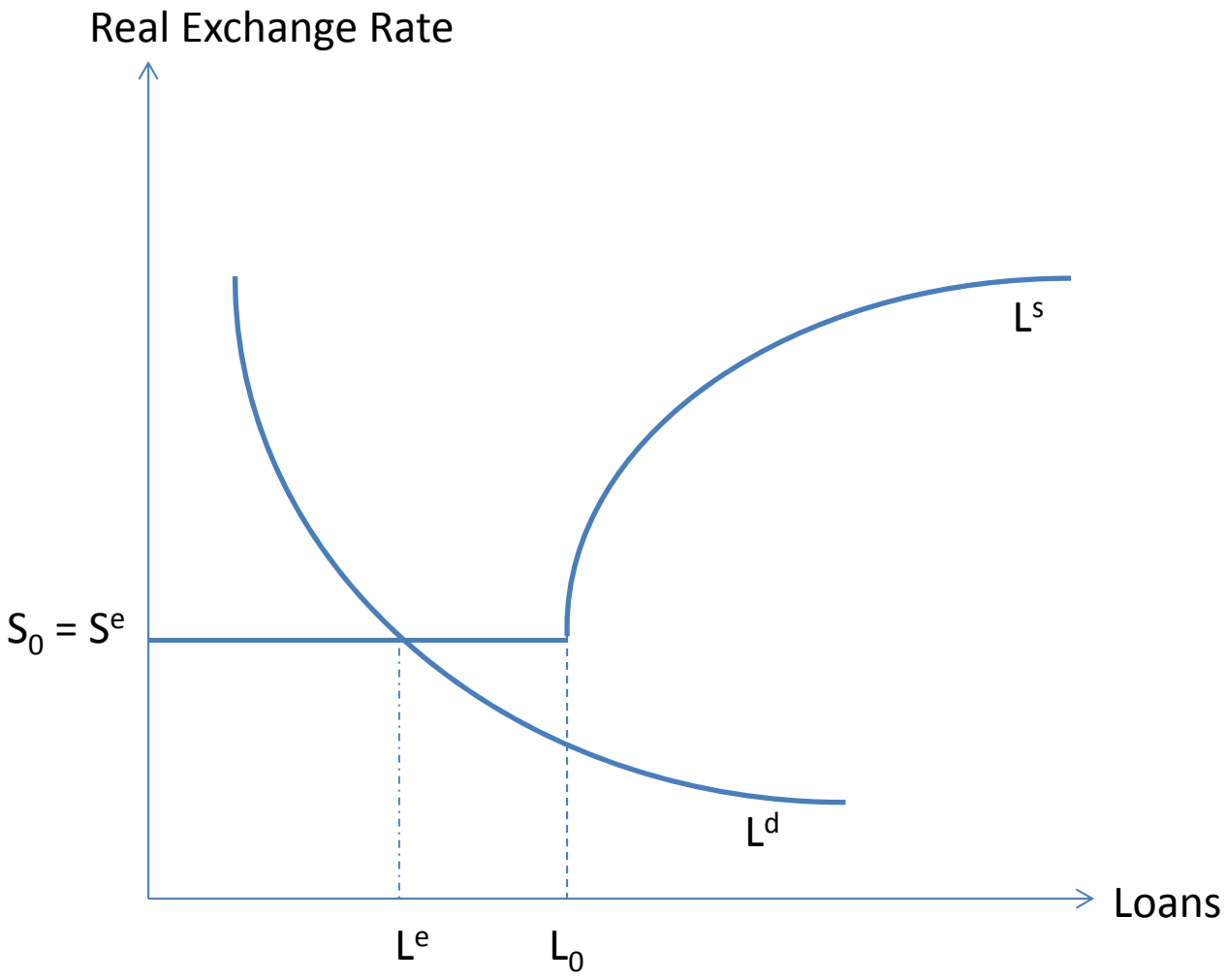

Figure 2

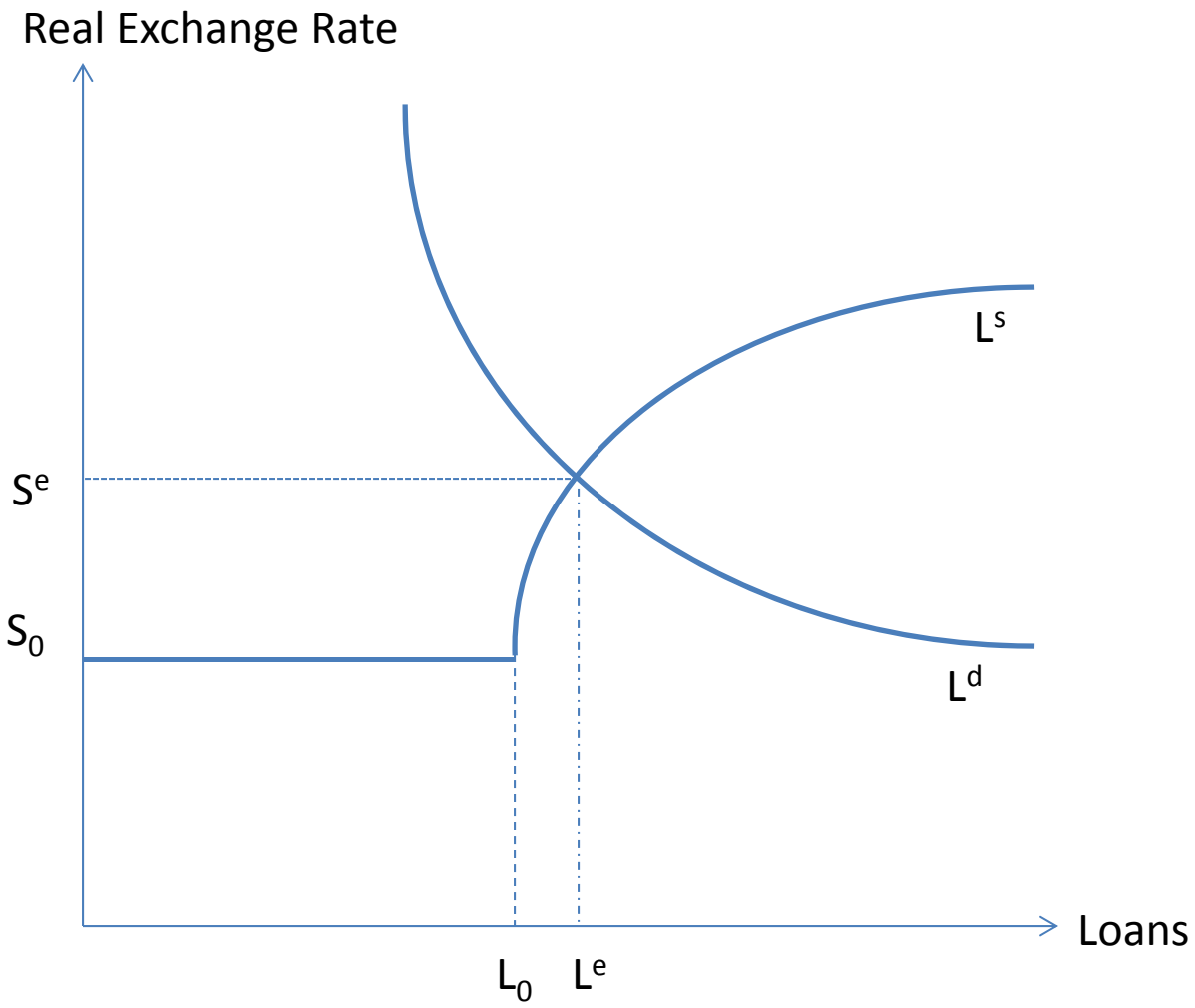

Figure 3

In Figure 3, the demand curve cuts the supply schedule at a loan amount L^e that exceeds L_0. The equilibrium real exchange rate is then given by $S^e > S_0$. The interest *spread* ϕ must be greater than one; equivalently, $R > R^*$. The collateral constraint binds.

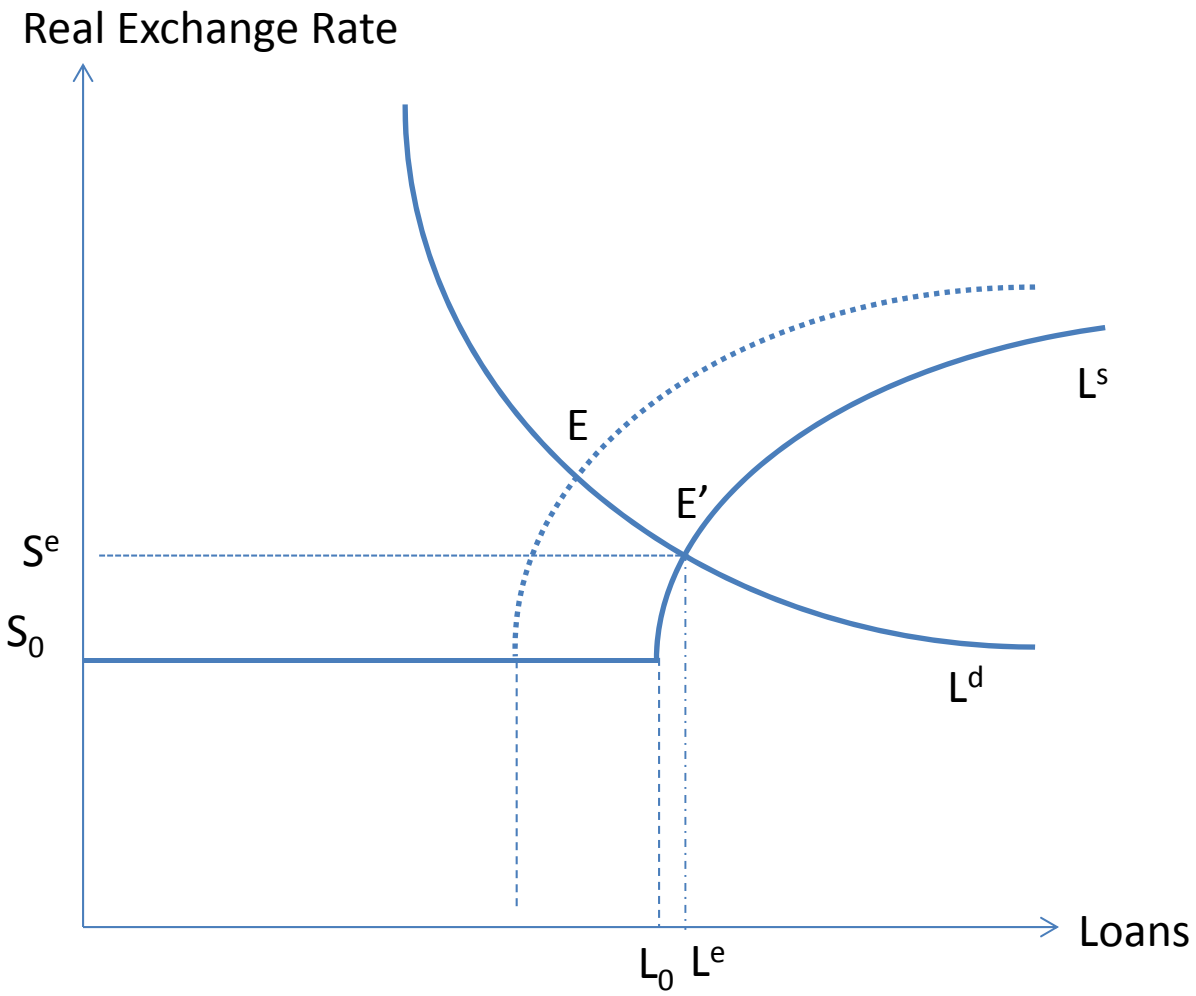

Figure 4

A fall in θ represents less stringent collateral requirements. This moves the point L_0 to the right and (via leverage ratio) increases the slope of the loan supply curve if $S > S^0$. The result is depicted in Figure 4.

Policy Analysis

Policy: Redistribution and Net Worth

- Suppose that the government taxes away some of the firms' *nontradables* endowment and gives the proceeds to the banks.

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- This can be regarded as a bank recapitalization policy financed with a corporate tax.

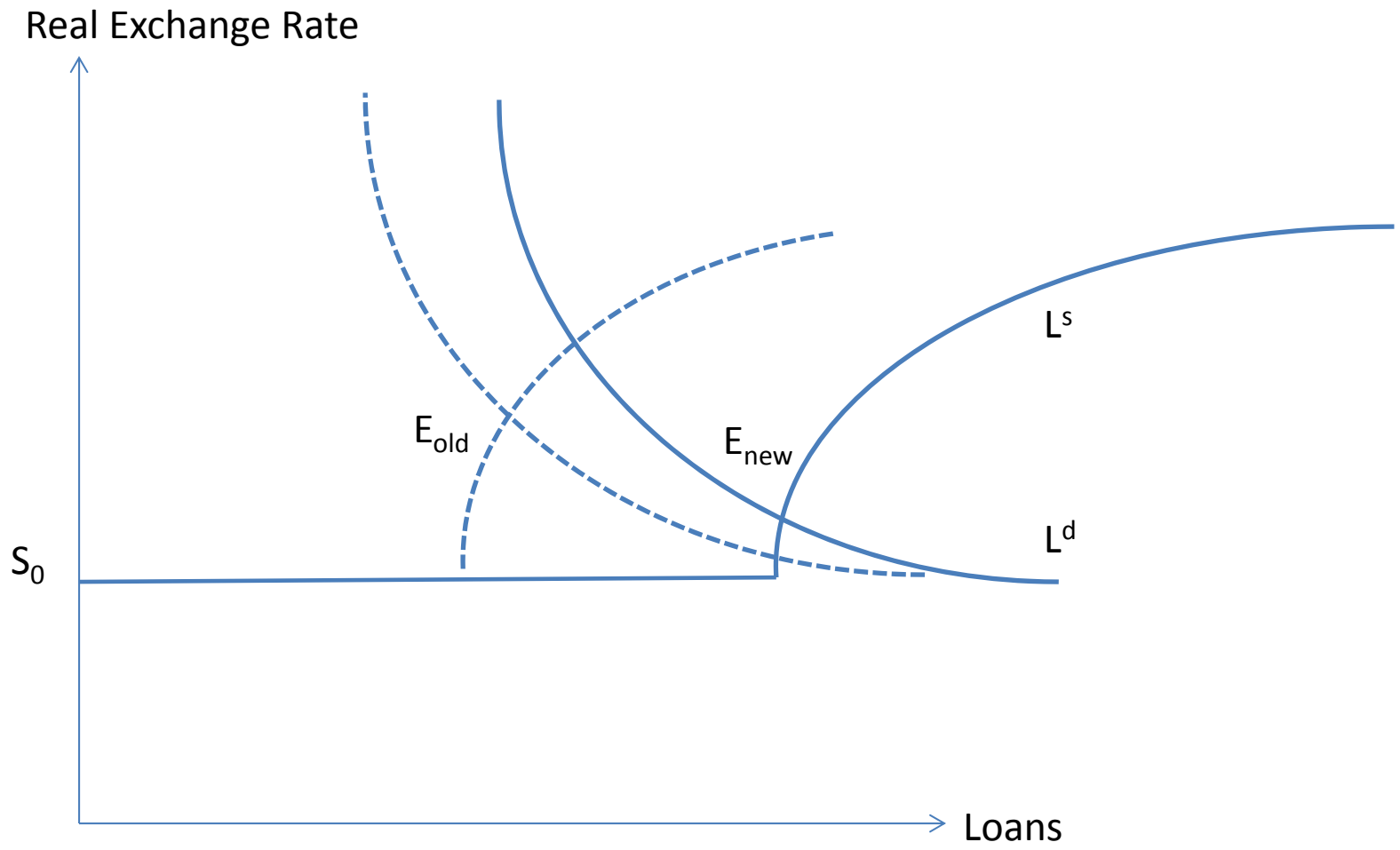

Figure 5

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- Intuition: at any S, moving a unit of nontradables from firms to banks increases the demand for loans by $1/S$ but the supply of loans by $1/S$ times the leverage ratio.

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- Financial intermediation increases, exchange rate strengthens, the spread ϕ and the lending interest rate R fall. Domestic consumption and welfare improve.
- The policy is *irrelevant* if financial constraints do *not* bind.

Policy: Credit Programs

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- If they do, the outcome depends on whether the credit is given to firms or to banks.

Direct Lending

- Suppose that the government lends F *to the firms* at the market interest rate R.
- In the second period, the government collects RF in debt repayments, cancels its foreign debt, and transfers any difference $(R - R^*)F$ to the household.
- The only change in computing outcomes is that the equilibrium in the market for loans is given not by $L^d = L^s$ but by $L^d = L^s + F$.
- If the constraint was initially binding, the policy results in increased *total* intermediation, a stronger real exchange rate, and a lower interest spread (Figure 6).
- Some crowding out: Private intermediation must fall, since the exchange rate appreciates and R and ϕ fall.

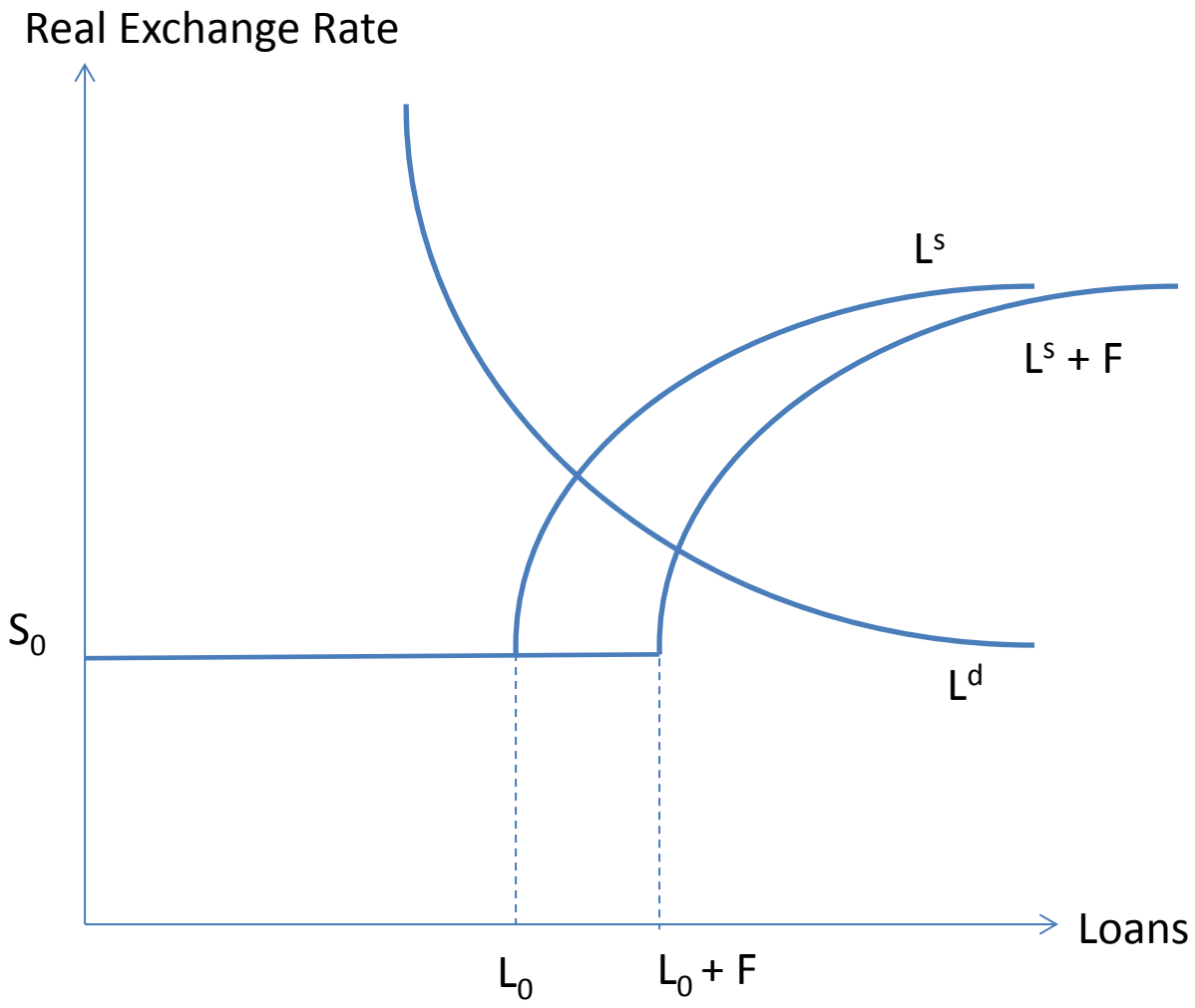

Figure 6

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- Loan supply now becomes

$$L \leq \frac{1}{1-\phi(1-\theta)}[(T_b + \frac{N_b}{S}) + F]$$

$==>$ The bank's loan supply increases by F times the leverage ratio.

- As shown in Figure 7, the horizontal displacement of the bank's loan supply curve is greater than F.

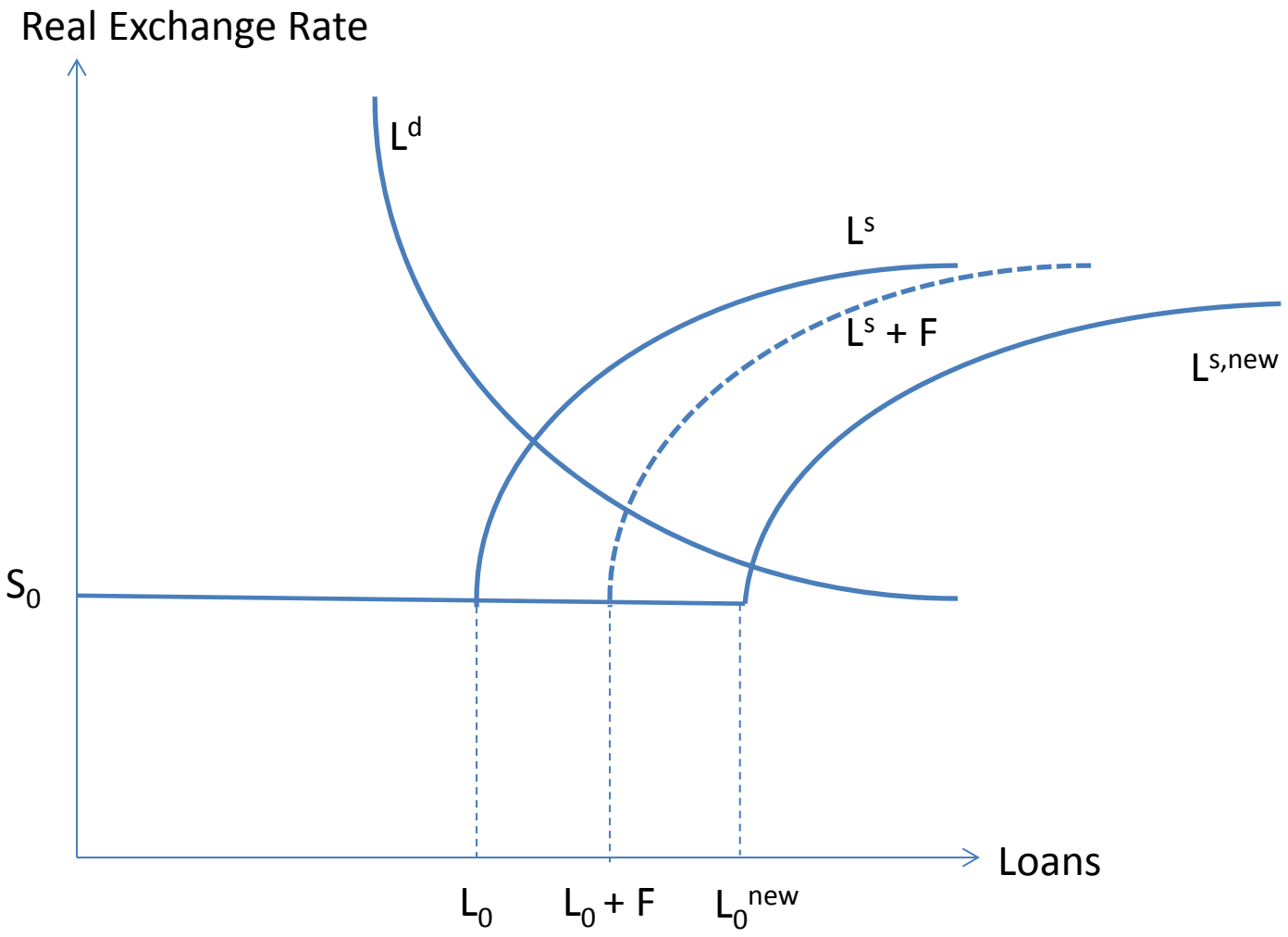

Figure 7

- As shown in Figure 7, the horizontal displacement of the bank's loan supply curve is greater than F.
- Financial intermediation is greater and the exchange rate stronger than when the government lends F directly to the firms.

Sterilized Exchange Market Intervention

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- The outcome is then exactly *the same* as with *direct lending*.

Similarly: If the government sterilizes forex intervention by increasing credit *to the banks* rather than to firms, charging the banks R^*/S interest per unit of nontradables lent, the outcome is the same as with *discount* lending.

A cosmetic point: if the typical bank has an initial amount of *government securities*, one may assume that the sterilizing operation is to use the nontradables raised by selling F to retire those securities. Then again (under additional but natural assumptions) the outcome is exactly *the same* as with discount lending.

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- Neither portfolio balance effects nor signaling effects are present in this model

Equilibrium Multiplicity

Multiple Equilibria and Implications

In our basic formulation, the leverage effect of a real exchange rate depreciation dominates the net worth effect.

For this to be the case, the elasticity of the spread with respect to S must be large enough.

For more general formulations, the elasticity may be low, and the loan supply curve can change shape.

- In the paper, we extend the analysis to a more general C.E.S. function for capital production:

$$K = \left[\gamma^{1/\lambda} I_H^{1-1/\lambda} + (1-\gamma)^{1/\lambda} I_F^{1-1/\lambda}\right]^{\lambda/(\lambda-1)}$$

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- We can then obtain multiple equilibria, as in Figure 9 (for small λ)

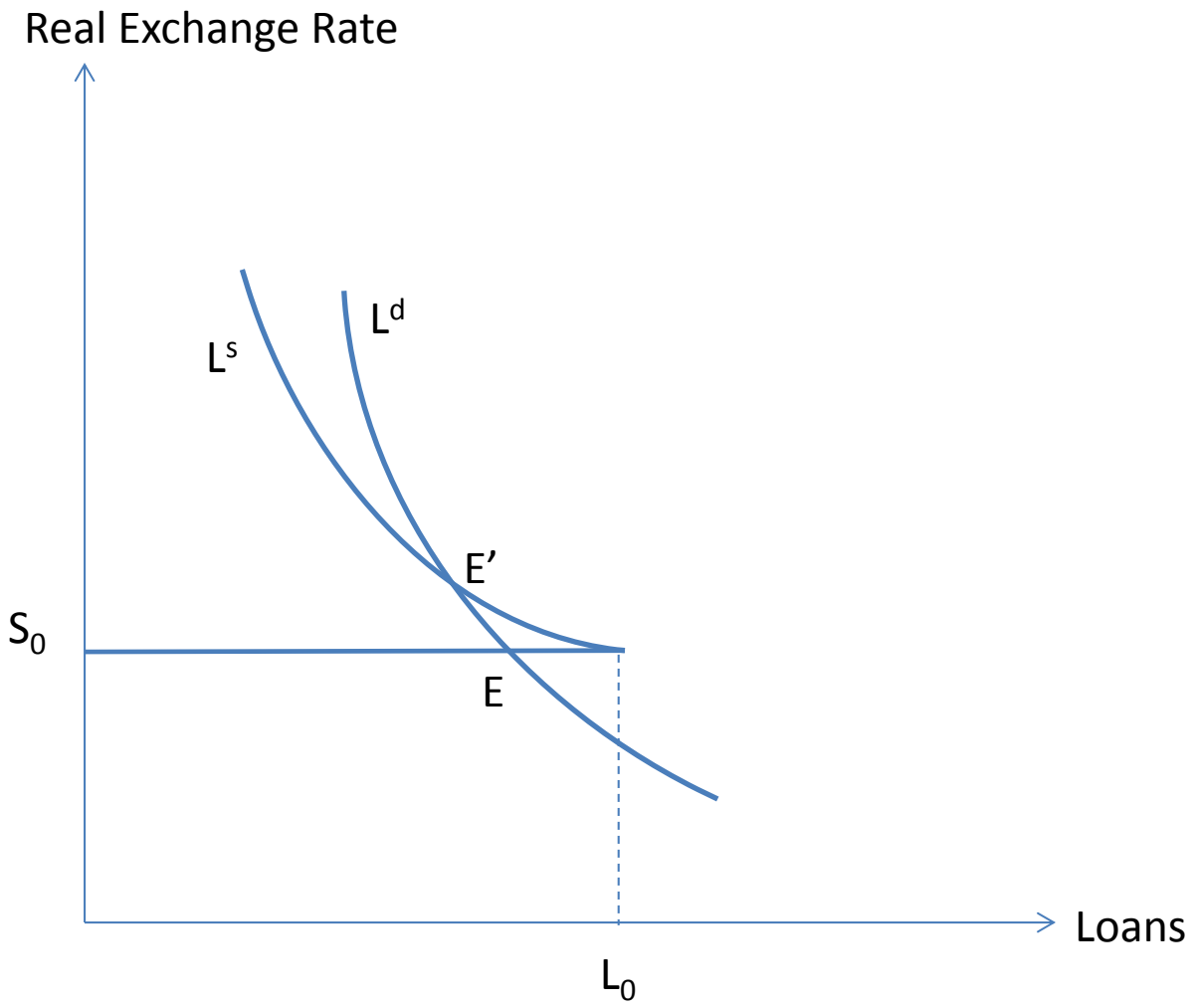

Figure 9

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- Self fulfilling "crises" are possible
- In such a crisis, the exchange rate depreciates, spreads increase, financial intermediation collapses, and investment and welfare fall
- The leverage ratio falls in a crisis, but this is an *endogenous* outcome

- If multiple equilibria are possible, a government commitment to "do all it takes " to prevent the real exchange rate from depreciating excessively can kill the bad equilibrium.

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- But to make the claim believable, the government may find it necessary to have access to a large enough "war chest" of tradables available to intervene.

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1. Model can be extended in several directions (money, uncertainty, dynamics), e.g. Chang and Velasco (2016)
2. The model justifies unconventional policies in crisis periods. On the other hand, the unconventional policies studied here are unnecessary in tranquil times.
3. Several suggestions for empirical work (for example, on the links between exchange rate, spreads, and leverage).