Online Supplement to

“International Credit Supply Shocks

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S1 Model Derivations

This Supplement (not for publication) reports the full set of equilibrium conditions of the model. It then derives expressions for the terms of trade and the credit market equilibrium, discusses the slope of the credit demand, and finally analyzes the response to a change in χ for the small open economy case that is relevant to support the VAR identification and interpret the empirical results.

S1.1 Equilibrium Conditions

A competitive equilibrium for our economy is a collection of quantities $\{c_1, c_2, c_1^*, c_2^*, d, e, f\}$ and prices $\{q, \mu, R^b, R^d, R^e, \tau_1, \tau_2, s_1, s_2\}$ such that:

1. Domestic households maximize their utility subject to their budget and collateral constraint:

$$
\begin{aligned}
1-\mu &= \beta R^b, \\
1-\mu &= \beta R \frac{s_2}{s_1}, \\
(1-\mu\theta)q &= \kappa, \\
(1+\eta)s_1 f &\leq \theta q, \\
c_1 &= \tau_1^{\alpha-1} y + (1+\eta)s_1 f, \\
c_2 &= \tau_2^{\alpha-1} y - (1+\eta)s_2 R f,
\end{aligned}
$$

   with $\mu \geq 0$, and where $\kappa \equiv v'(1)/\bar{c} > 0$ is the marginal utility of housing in units of marginal utility of consumption.

2. Foreign households maximize their utility subject to their budget constraint:

$$
\begin{aligned}
1 &= \beta^* R^d, \\
1+\psi'(e) &= \beta^* R^e, \\
c_1^* &= \tau_1^{\alpha^*} y^* - [d + e + \psi(e)], \\
c_2^* &= \tau_2^{\alpha^*} y^* + R^d d + R^e e
\end{aligned}
$$

3. Financial intermediaries maximize their profits subject to their balance sheet and leverage constraints:

$$
\begin{aligned}
R &= \chi R^e + (1-\chi) R^d + \phi'(\eta f), \\
(1+\eta) f &= d + e, \\
e &= \chi(1+\eta) f.
\end{aligned}
$$

4. Goods market clear in every period:

$$\begin{aligned}
ny &= n\alpha\tau_1^{1-\alpha}c_1 + (1-n)\alpha^*\tau_1^{1-\alpha^*}c_1^*, \\
ny &= n\alpha\tau_2^{1-\alpha}c_2 + (1-n)\alpha^*\tau_2^{1-\alpha^*}c_2^*, \\
(1-n)y^* &= n\left(1-\alpha\right)\tau_1^{-\alpha}c_1 + (1-n)\left(1-\alpha^*\right)\tau_1^{-\alpha^*}c_1^*, \\
(1-n)y^* &= n\left(1-\alpha\right)\tau_2^{-\alpha}c_2 + (1-n)\left(1-\alpha^*\right)\tau_2^{-\alpha^*}c_2^*.
\end{aligned}$$

5. The real exchange rate is related to the terms of trade in every period according to:

$$s_1 = \tau_1^{\alpha-\alpha^*} \qquad\qquad s_2 = \tau_2^{\alpha-\alpha^*}.$$

There are 18 equations for 16 variables. Two goods market equilibrium conditions (one in each period) are redundant by Walras's Law.

S1.2 Small Open Economy Case

We now take the limit for $n \to 0$ so that the Home country becomes a small open economy, consistent with our identification assumption in the VAR analysis.

S1.2.1 Goods Market and the Terms of Trade

We start from the goods market equilibrium:

$$ny = n\alpha\tau^{1-\alpha}c + (1-n)\alpha^*\tau^{1-\alpha^*}c^*, \tag{1}$$

$$(1-n)y^* = n\left(1-\alpha\right)\tau^{-\alpha}c + (1-n)\left(1-\alpha^*\right)\tau^{-\alpha^*}c^*, \tag{2}$$

where we dropped the time subscript as these expressions are static and have the same form in both periods. Rewrite these conditions as

$$y = \alpha\tau^{1-\alpha}c + \frac{1-n}{n}\alpha^*\tau^{1-\alpha^*}c^*, \tag{3}$$

$$y^* = \frac{n}{1-n}\left(1-\alpha\right)\tau^{-\alpha}c + (1-n)\left(1-\alpha^*\right)\tau^{-\alpha^*}c^*. \tag{4}$$

Next, use the relationship between the consumption shares, the country size, and the degree of openness ($\alpha = 1-(1-n)\lambda$ and $\alpha^* = n\lambda$) to obtain

$$y = [1-(1-n)\lambda]\tau^{(1-n)\lambda}c + \frac{1-n}{n}n\lambda\tau^{1-n\lambda}c^*, \tag{5}$$

$$y^* = \frac{n}{1-n}(1-n)\lambda\tau^{(1-n)\lambda-1}c + \left(1-n\lambda\right)\tau^{-n\lambda}c^*. \tag{6}$$

Simplifying and taking the limit for n that goes to zero, the previous expressions yield

$$\begin{aligned} y &= (1-\lambda)\tau^{\lambda}c + \lambda\tau c^{*}, && (7) \\ y^{*} &= c^{*}, && (8) \end{aligned}$$

which imply that Home demand does not affect the equilibrium in the market for Foreign goods and that Foreign consumption is exogenous.

As housing is in fixed supply, in equilibrium, the Home household budget constraint in the first period becomes

$$c_1 = \tau_1^{1-\lambda}(1+\eta)f + \tau_1^{-\lambda}y, \tag{9}$$

where we have used the relation above between the real exchange rate and the terms of trade. Now replace this expression in the Home goods market equilibrium and solve for the terms of trade to obtain a relation between the terms of trade and credit

$$\tau_1 = \frac{\lambda y}{\lambda y^{*} + (1-\lambda)(1+\eta)f},$$

and thus

$$s_1 = \left[\frac{\lambda y}{\lambda y^{*} + (1-\lambda)(1+\eta)f}\right]^{1-\lambda}. \tag{10}$$

Intuitively, higher credit implies higher Home demand, and hence an appreciation of the terms of trade (and consequently of the real exchange rate).

In period 2, the budget constraint of the Home representative household is

$$c_2 = \tau_2^{-\lambda}y - \tau_2^{1-\lambda}(1+\eta)Rf.$$

Substitute again into the goods market equilibrium to obtain the terms of trade

$$\tau_2 = \frac{\lambda y}{\lambda y^{*} - (1-\lambda)(1+\eta)Rf}, \tag{11}$$

and and hence the real exchange rate

$$s_2 = \left[\frac{\lambda y}{\lambda y^{*} - (1-\lambda)(1+\eta)Rf}\right]^{1-\lambda}. \tag{12}$$

The terms of trade in period 2 depend on both debt and the lending rate. Intuitively, high debt or lending interest rates in period 1 imply lower resources (and therefore demand) in period 2, and therefore a depreciation.

S1.2.2 Credit Market

Next, we can characterize the equilibrium in the credit market.

Credit Supply. We start with the credit supply. Substituting the expressions for the return on deposit and the return on equity in the zero profit condition for financial intermediaries, together with the binding capital constraint, yields an expression for credit supply

$$R = \frac{1 + \chi\psi' \left[\chi(1+\eta)f\right]}{\beta^*} + \frac{\eta\phi'(\eta f)}{1+\eta}.$$

This expression is independent of country size and thus holds also in the limit for $n \to 0$.

Credit Demand. Next, we move on to the credit demand. Start from the optimal choice of housing services. If the borrowing constraint is not binding ($\mu = 0$), the equilibrium conditions for domestic households reduce to to $q = \kappa$ (the first order condition for housing services), $(1+\eta)s_1 f < \theta q$ (the non-binding collateral constraint), and the consumption Euler equation

$$R = \frac{1}{\beta}\frac{s_1}{s_2}.$$

Consider now the equilibrium with binding borrowing constraint ($\mu > 0$). In this case, we can solve for the Lagrange multiplier from the Euler equation to yield

$$\mu = 1 - \beta R \frac{s_2}{s_1}. \tag{13}$$

Substituting this expression into the housing pricing equation we have

$$\left(1 - \theta + \theta\beta R\frac{s_2}{s_1}\right) q = \kappa. \tag{14}$$

And solving for q and substituting into the borrowing constraint with equality yields

$$(1+\eta)s_1 f = \frac{\theta\kappa}{1 - \theta + \theta\beta R s_2/s_1}, \tag{15}$$

which can be solved to obtain

$$R = \frac{1}{\beta}\frac{s_1}{s_2}\left[\frac{\kappa}{(1+\eta)s_1 f} - \frac{1-\theta}{\theta}\right].$$

S1.3 Slope of Credit Demand

Debt valuation effects associated with the real exchange rate may generate a credit demand function with a segment that is not downward sloping. Here we study the conditions under which credit demand is well-behaved.

Start from the region in which the collateral constraint is not binding. Substituting the expressions of the real exchange rate gives

$$R = \frac{1}{\beta}\left[\frac{\lambda y^* - (1-\lambda)(1+\eta)Rf}{\lambda y^* + (1-\lambda)(1+\eta)f}\right]^{1-\lambda}.$$

Now define the function

$$G_1(f,R) \equiv \frac{1}{\beta}\left[\frac{\lambda y^* - (1-\lambda)(1+\eta)Rf}{\lambda y^* + (1-\lambda)(1+\eta)f}\right]^{1-\lambda} - R,$$

so that we can apply the implicit function theorem. In particular, we have that

$$\frac{\partial R}{\partial f} = -\frac{\partial G_1/\partial f}{\partial G_1/\partial R}. \tag{16}$$

The derivative at the numerator is

$$\frac{\partial G_1}{\partial f} = -\frac{1}{\beta}\left(\frac{s_1}{s_2}\right)^{\lambda}\frac{\lambda y^*(1+\eta)(R+1)}{[\lambda y^* + (1-\lambda)(1+\eta)f]^2} < 0.$$

The derivative at the denominator is

$$\frac{\partial G_1}{\partial R} = -\left[1 + \frac{1}{\beta}\left(\frac{s_1}{s_2}\right)^{\lambda}\frac{(1+\eta)f}{\lambda y^* + (1-\lambda)(1+\eta)f}\right] < 0.$$

As both numerator and denominator of (16) are negative, in the region where the collateral constraint does not bind, the credit demand function will be negatively sloped.

Next, move to the region where the collateral constraint is binding. To simplify the analysis, start from the limiting case of $\theta = 1$. In this simpler case, substituting for the real exchange rate at time 2, we can construct the function

$$G_2(f,R) \equiv \frac{\kappa}{\beta(1+\eta)f}\left[\frac{\lambda y^* - (1-\lambda)(1+\eta)Rf}{\lambda y}\right]^{1-\lambda} - R$$

The slope of credit demand if the collateral constraint binds is

$$\frac{\partial R}{\partial f} = -\frac{\partial G_2/\partial f}{\partial G_2/\partial R}. \tag{17}$$

And the derivative at the numerator is

$$\frac{\partial G_2}{\partial f} = -\frac{\kappa}{\beta(1+\eta)s_2 f}\left[\frac{1}{f} + \frac{(1+\eta)s_2^{1-\lambda}R}{\lambda y}\right] < 0,$$

while the derivative at the denominator is

$$\frac{\partial G_2}{\partial R} = -\left(1 + \frac{\kappa s_2^{1-\lambda}}{\beta \lambda y}\right) < 0.$$

In the limiting case of 100 percent LTV, credit demand continues unequivocally to be downward sloping. A simple continuity argument suggests that the result carries through for high enough values of θ. Indeed, in our numerical example in which we set θ to the high value of 92% (close to the average maximum LTV in our country sample of about 90%), credit demand is downward sloping when the collateral constraint binds.

S1.4 The Transmission of an International Credit Supply Shock

This appendix derives analytically the approximate response of the economy to a change in χ. We focus on the region in which the collateral constraint binds. For small enough changes in χ, a log-linear approximation provides an accurate description of the impact of the credit supply shock.[1]

Start from the expression (10) for the real exchange rate in period 1 that can be rewritten as

$$s_1 = \left[\frac{y^*}{y} + \frac{1-\lambda}{\lambda}\frac{(1+\eta)f}{y}\right]^{\lambda-1}.$$

The linear approximation around a steady state with binding constraint is

$$s_1 = \bar{s}_1 - (1-\lambda)\left[\frac{y^*}{y} + \frac{1-\lambda}{\lambda}\frac{(1+\eta)\bar{f}}{y}\right]^{\lambda-2}\frac{1-\lambda}{\lambda}\frac{1+\eta}{y}\left(f-\bar{f}\right).$$

Using the expression for s_1, we can write the last expression as

$$s_1 - \bar{s}_1 = -\frac{(1-\lambda)^2(1+\eta)}{\lambda y}\bar{s}_1^{1+\frac{1}{1-\lambda}}\left(f-\bar{f}\right).$$

Dividing by $\bar{s}_1$ and $\bar{f}$ we get

$$\hat{s}_1 = -\frac{(1-\lambda)^2}{\lambda y}\bar{s}_1^{\frac{1}{1-\lambda}}(1+\eta)\bar{f}\hat{f}. \tag{18}$$

[1] We denote the steady state value of a generic variable x with $\bar{x}$ and the log-deviation from steady state as $\hat{x} \equiv (x-\bar{x})/\bar{x}$.

Now consider period 2 and rewrite s_2 as

$$s_2 = \left[\frac{y^*}{y} + \frac{1-\lambda}{\lambda}\frac{(1+\eta)Rf}{y}\right]^{\lambda-1}.$$

The linear approximation around the steady state is

$$s_2 = \bar{s}_2 + (1-\lambda)\left[\frac{y^*}{y} + \frac{1-\lambda}{\lambda}\frac{(1+\eta)\bar{R}\bar{f}}{y}\right]^{\lambda-2}\frac{1-\lambda}{\lambda}\frac{1+\eta}{y}\left[\bar{R}\left(f-\bar{f}\right) + \bar{f}\left(R-\bar{R}\right)\right].$$

Using the expression for s_2, we can write the last expression as

$$s_2 - \bar{s}_2 = \frac{(1-\lambda)^2(1+\eta)}{\lambda y}\bar{s}_2^{1+\frac{1}{1-\lambda}}\left[\bar{R}\left(f-\bar{f}\right) + \bar{f}\left(R-\bar{R}\right)\right].$$

Dividing by $\bar{s}_2$, $\bar{f}$, and $\bar{R}$ we get

$$\hat{s}_2 = \frac{(1-\lambda)^2}{\lambda y}\bar{s}_2^{\frac{1}{1-\lambda}}(1+\eta)\bar{R}\bar{f}\left(\hat{R}+\hat{f}\right). \tag{19}$$

The credit demand schedule can be rewritten as

$$R = \frac{1}{\beta}\left[\frac{\kappa}{(1+\eta)s_2 f} - \frac{s_1}{s_2}\frac{1-\theta}{\theta}\right]$$

And its linear approximation is

$$R = \bar{R} - \frac{1}{\beta}\frac{\kappa}{(1+\eta)\bar{s}_2\bar{f}^2}\left(f_1-\bar{f}\right) - \frac{1}{\beta}\frac{\kappa}{(1+\eta)\bar{s}_2^2\bar{f}}(s_2-\bar{s}_2) - \frac{1-\theta}{\beta\theta}\frac{1}{\bar{s}_2}(s_1-\bar{s}_1) + \frac{1-\theta}{\beta\theta}\frac{\bar{s}_1}{\bar{s}_2^2}(s_2-\bar{s}_2).$$

Dividing by $\bar{R}$, we get

$$\hat{R} = -\frac{1}{\beta\bar{R}}\left[\frac{\kappa}{(1+\eta)\bar{s}_2\bar{f}}\left(\hat{s}_2+\hat{f}\right) + \frac{1-\theta}{\theta}\frac{\bar{s}_1}{\bar{s}_2}(\hat{s}_1-\hat{s}_2)\right]. \tag{20}$$

Finally, the expression for credit supply is

$$R = \frac{1}{\beta^*} + \frac{\chi\psi'[\chi(1+\eta)f]}{\beta^*} + \frac{\eta\phi'(\eta f)}{1+\eta},$$

and its linear approximation is

$$R - \bar{R} = \left[\frac{\psi'}{\beta^*} + \frac{\bar{\chi}(1+\eta)\bar{f}\psi''}{\beta^*}\right](\chi-\bar{\chi}) + \frac{\bar{\chi}^2\psi''(1+\eta)}{\beta^*}(f-\bar{f}) + \frac{\eta^2\phi''}{1+\eta}(f-\bar{f}),$$

where ψ' and ψ'' represent the first and second derivatives of the equity adjustment cost function, respectively, evaluated at steady state. Dividing through by the steady state real interest rate and expressing variables in percentage deviations from steady state, we obtain

$$\hat{R} = \frac{\bar{\chi}}{\beta^* \bar{R}}[\psi' + \bar{\chi}(1+\eta)\psi'' \bar{f}]\hat{\chi} + \frac{\bar{f}}{\beta^* \bar{R}}\left[\bar{\chi}^2 \psi''(1+\eta) + \frac{\eta^2 \phi''}{1+\eta}\right]\hat{f}. \tag{21}$$

Expressions (18)-(21) constitute a linear system of four equations in four unknowns $\{\hat{s}_1, \hat{s}_2, \hat{R}, \hat{f}\}$ that depend on $\hat{\chi}$. Thus, we can write the solution as

$$\hat{z} = \Gamma \hat{\chi},$$

where

$$z' \equiv \begin{bmatrix} \hat{s}_1 & \hat{s}_2 & \hat{R} & \hat{f} \end{bmatrix}$$

and $\Gamma \equiv A^{-1}B$, with

$$A \equiv \begin{bmatrix} 1 & 0 & 0 & a_{14} \\ 0 & 1 & a_{23} & a_{24} \\ a_{31} & 1 & 1 & a_{34} \\ 0 & 0 & 1 & a_{44} \end{bmatrix},$$

and

$$B' \equiv \begin{bmatrix} 0 & 0 & 0 & b_{41} \end{bmatrix}.$$

The coefficients of the matrix A are

$$\begin{aligned} a_{14} &\equiv \frac{(1-\lambda)^2}{\lambda y} \bar{s}_1^{\frac{1}{1-\lambda}}(1+\eta)\bar{f} > 0 \\ a_{23} = a_{24} &\equiv -\frac{(1-\lambda)^2}{\lambda y} \bar{s}_2^{\frac{1}{1-\lambda}}(1+\eta)\bar{R}\bar{f} < 0 \\ a_{31} &\equiv \frac{1}{\beta \bar{R}} \frac{1-\theta}{\theta} \frac{\bar{s}_1}{\bar{s}_2} > 0 \\ a_{34} &\equiv \frac{\kappa}{\beta \bar{R} \bar{s}_2 (1+\eta) \bar{f}} > 0 \\ a_{44} &\equiv -\frac{\bar{f}}{\beta^* \bar{R}}\left[\bar{\chi}^2 \psi''(1+\eta) + \frac{\eta^2 \phi''}{1+\eta}\right] < 0 \end{aligned}$$

and the non-zero coefficient of the vector B is

$$b_{41} \equiv \frac{\bar{\chi}}{\beta^* \bar{R}}[\psi' + \bar{\chi}(1+\eta)\psi'' \bar{f}] > 0.$$

After inverting the matrix A, we can write the solution as

$$\begin{aligned}
\hat{s}_1 &\equiv \frac{a_{14}b_{41}(a_{23}-1)}{d}\hat{\chi} \\
\hat{s}_2 &\equiv -\frac{b_{41}a_{23}(1-a_{24}+a_{14}a_{31})}{d}\hat{\chi} \\
\hat{R} &\equiv \frac{b_{41}(a_{23}-a_{34}+a_{14}a_{31})}{d}\hat{\chi} \\
\hat{f} &\equiv -\frac{b_{41}(a_{23}-1)}{d}\hat{\chi},
\end{aligned}$$

where

$$d \equiv a_{44} - a_{34} + a_{14}a_{31} + a_{23}(1-a_{44}).$$

In the limit, for $\theta \to 1$, we have that $a_{31} = 0$ and hence $d < 0$. In this case it is easy to see that

$$\frac{\partial \hat{s}_1}{\partial \hat{\chi}} > 0 \qquad \frac{\partial \hat{R}}{\partial \hat{\chi}} > 0 \qquad \frac{\partial \hat{f}}{\partial \hat{\chi}} < 0.$$

Therefore, in response to a positive international credit supply shock (a fall in χ), the real exchange rate appreciates, the real lending rate falls, and the amount of credit extended to the Home economy increases.

Given that we are in the region in which the collateral constraint binds, the approximated response of house prices is

$$\hat{q} = \hat{s}_1 + \hat{f} \Rightarrow \frac{\partial \hat{q}}{\partial \hat{\chi}} = \frac{\partial \hat{s}_1}{\partial \hat{\chi}} + \frac{\partial \hat{f}}{\partial \hat{\chi}}.$$

Substituting the values of the partial derivatives above gives

$$\frac{\partial \hat{q}}{\partial \hat{\chi}} = \frac{b_{41}(a_{23}-1)(a_{14}-1)}{d},$$

which is positive as long as $a_{14} > 1$—a condition that is always satisfied for large enough levels of credit over GDP.

Finally, the response of consumption to the credit shock is

$$\frac{\partial c_1}{\partial \chi} = (1+\eta)\bar{s}_1\frac{\partial f}{\partial \chi} + \left[(1+\eta)\bar{f} - \frac{\lambda}{1-\lambda}\bar{s}_1^{-\left(1+\frac{\lambda}{1-\lambda}\right)}y\right]\frac{\partial s_1}{\partial \chi}$$

A positive international credit supply shock increases consumption, both directly (the first term in the expression above) and indirectly because the real exchange rate appreciation makes the domestic endowment more valuable (the second term in square brackets). The appreciation of the real exchange rate, however, also reduces the purchasing power of credit denominated in foreign currency (the first term in square brackets). The overall effect is ambiguous, although our numerical simulations suggest consumption increases in response to a positive shocks for reasonable values of the parameters.

S2 Additional Empirical Results and VAR Robustness

This Supplement (not for publication) reports additional stylized facts and empirical results, including a a battery of robustness checks on the panel VAR results.

S2.1 Time-Varying Share of Foreign Currency Liabilities

In the model we assume that the share of foreign currency credit $(1/(1+\eta))$ is constant over time. In fact, $1/(1+\eta)$ is an equilibrium variable that may vary over time in response to shocks. At the country level, however, the data suggest relatively little time variation. To illustrate this point, we divide our sample in two sub-samples and we plot the average share of foreign currency credit during the first period through the Asian financial crisis (the 1985-1999 period) against the average share thereafter (the 2000-2015 period).

Figure S.1 shows that most country data points are close to the 45 degree line, suggesting that the shares have not changed much over time. Specifically, the correlation between the two set of shares is 0.9 and highly statistically significant.

S2.2 VAR Robustness

In this section, we analyze the robustness of our empirical results. First, we consider a specification in which both contemporaneous and lagged domestic variables are excluded from the leverage equation. Second, we consider specifications in which we control for the possible presence of common country-specific shocks that could invalidate our identification assumption. The US and international business cycle are interrelated and both can affect US Broker-Dealer leverage. To control for common shocks, we augment our baseline specification with world GDP or world equity prices, ordering these two variables before leverage in the system. We consider world equity prices as this variable is forward looking.

The results from these experiments (reported in in figures S.2-S.3, respectively) show that our baseline results are fairly robust. Both the impulse responses and the forecast error variance decompositions remain close to the baseline, with some quantitative differences. In particular, we find stronger impacts of the shock when we restrict the feedback from the lagged country variables to the leverage equation, and slightly weaker effects when we control for world GDP and especially world equity prices.

We note here that world equity prices capture a broad set of factors, including risk premia, also reflected in leverage. It is therefore remarkable that the results are only quantitatively somewhat different but the sign of the response in unchanged for all variables.

In the baseline PVAR model, the identification of the leverage shock rests on a small open economy assumption that might not apply to larger economies like Germany, the United Kingdom, Japan, and Switzerland (like the United States, which for this reason is excluded from the analysis). In Figure S.5 we we drop these larger economies from the sample and, for comparison, we also plots our baseline impulse responses (solid line with circles). The results are virtually unchanged.

S2.3 VARs vs. Local Projections

While VARs provide a rich set of statistics on the dynamic properties of a system, these models might be misspecified along multiple dimensions. The Local Projection (LP) methodology, developed by Jorda (2005) and applied in a similar setting to ours in Jorda et al. (2015) provides a more limited set of statistics but it is more robust to mis-specification. As we noted earlier, in the context of a PVAR model with a large number of countries, lag selection is particularly challenging.

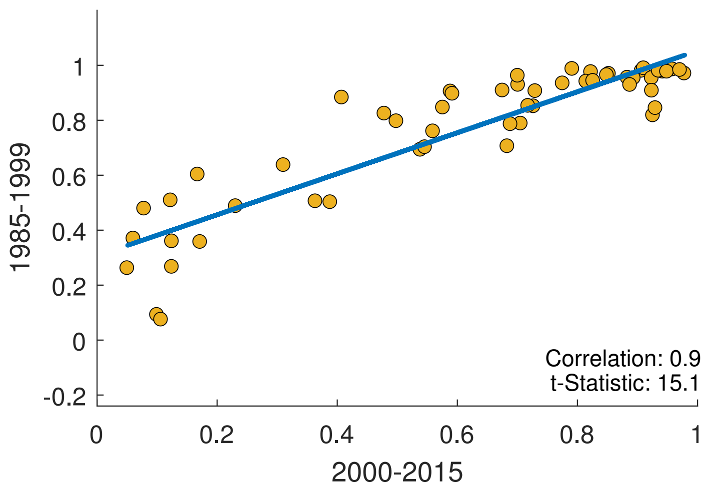
To check robustness on our results in this direction, we compute the LPs for each country, and each variable in our VAR, based on a specification in which Broker-Dealer leverage is treated as an exogenous variable from the perspective of the small open economy. We then compute a mean group LP as the average of the country LPs like in the case of the VARs. The LP, in fact, is a dynamic regression, and coefficient heterogeneity would render a pooled estimate inconsistent like in a standard dynamic panel data model context (e.g., Pesaran and Smith (1995)

Figure S.6 reports the results and shows that the LP methodology yields essentially the same results over the relevant projection horizons for all variables except the exchange rate at forecast step 3, 4, and 5. And if we use the real effective exchange rate rather than the bilateral exchange rate vis-a-vis the US dollar, the results are essentially the same also in the case of the exchange rate response (Figure S.7) because the response of the effective rate is less volatile than the bilateral real exchange rate.

S2.4 VARs on Different Groups of Countries ('bins'): The Role of Exchange Rate Flexibility

In this section, we report the results we obtain from estimating our panel VAR model on different groups of countries, or 'bins', focusing on the role of exchange rate flexibility. As we explain in the main text, this is an alternative way of looking at the heterogeneity in the effects of the international credit supply shock. The impulse responses are reported in Figure S.8.

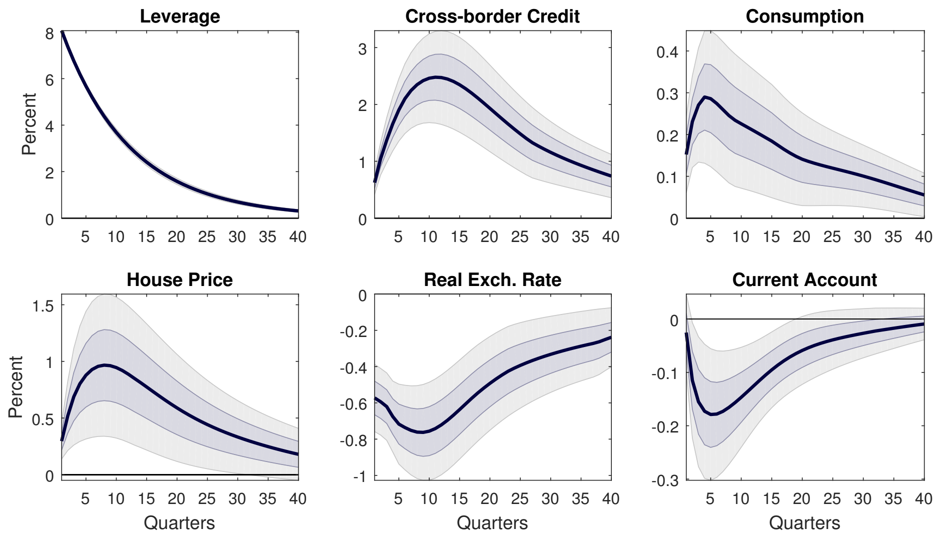
Figure S.1 Shares of Foreign Currency Liabilities Before and After the Asian Crisis Over Sub-samples.



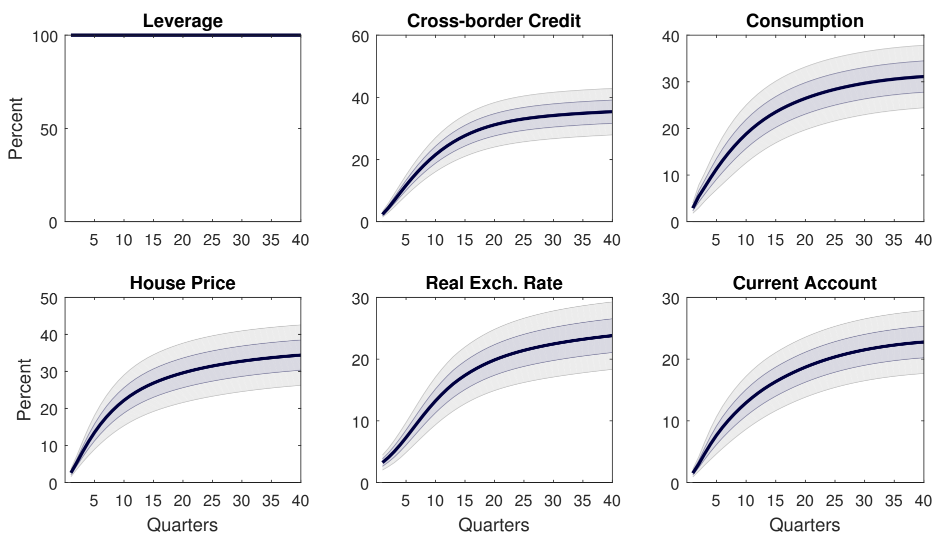
Note. Shares of foreign currency liabilities over total liabilities computed over the 1985-1999 sample (y-axis) and the 2000-2015 sample (x-axis). The shares are computed using the currency breakdown of cross-border bank claims (the data used in the baseline VAR in the paper) provided by the BIS.

Figure S.2 Impulse Responses and Forecast Error Variance Decompositions: Restricted Model.

(A) Impulse responses



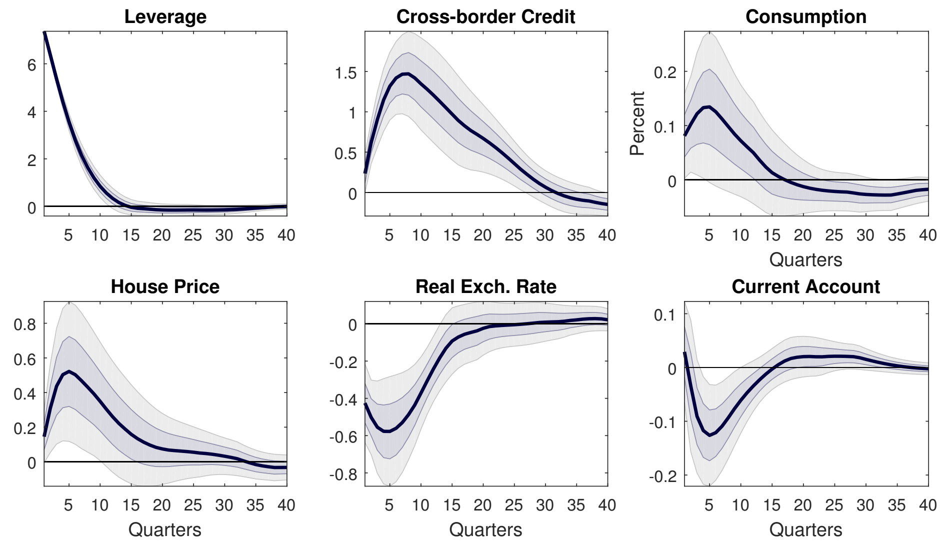
(B) Forecast error variance decompositions



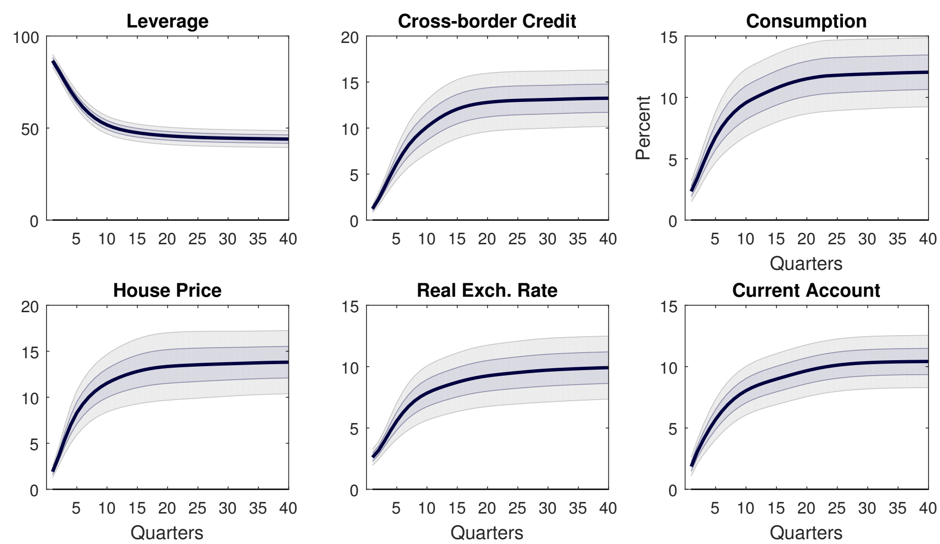
Note. Mean group impulse responses and forecast error variance decompositions to a one standard deviation (7.5%) increase in the leverage of US Broker-Dealers. The dark and light shaded areas are the one and two standard deviation confidence intervals, respectively. No lagged country variable enters the leverage equation.

Figure S.3 Impulse Responses and Forecast Error Variance Decompositions: Controlling for World GDP.

(A) Impulse responses



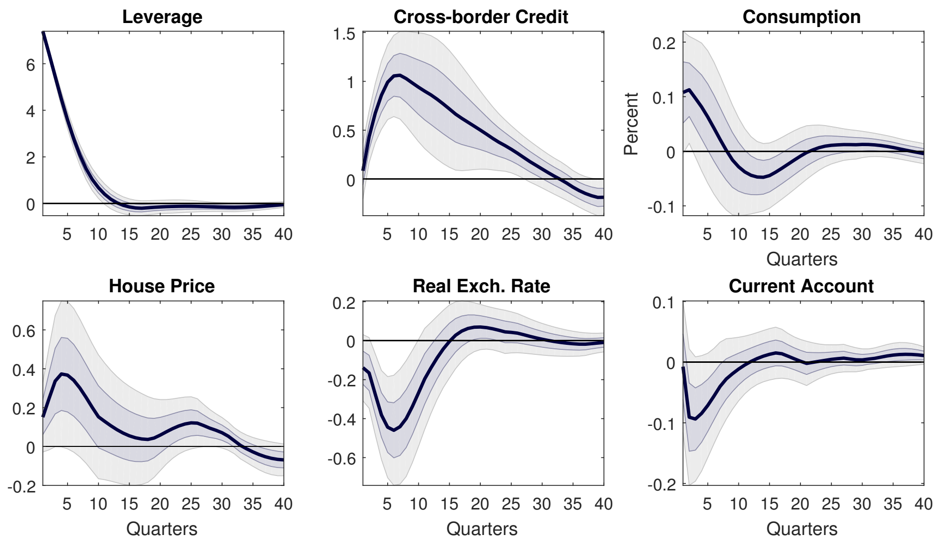
(B) Forecast error variance decompositions



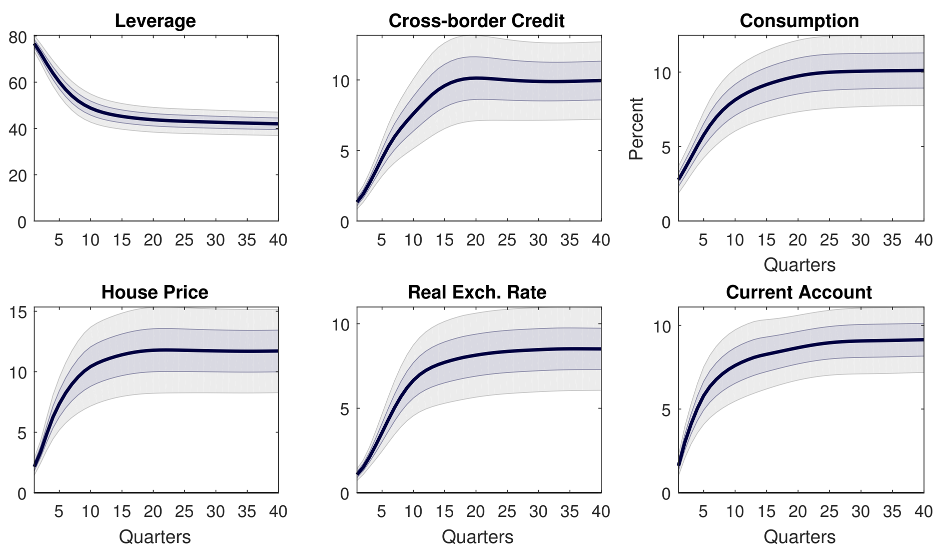
Note. Mean group impulse responses and forecast error variance decompositions to a one standard deviation (7.5%) increase in the leverage of US Broker-Dealers. The dark and light shaded areas are the one and two standard deviation confidence intervals, respectively. World GDP added to the country VARs and ordered first in the system.

Figure S.4 IMPULSE RESPONSES AND FORECAST ERROR VARIANCE DECOMPOSITIONS: CONTROLLING FOR WORLD EQUITY PRICES.

(A) Impulse responses

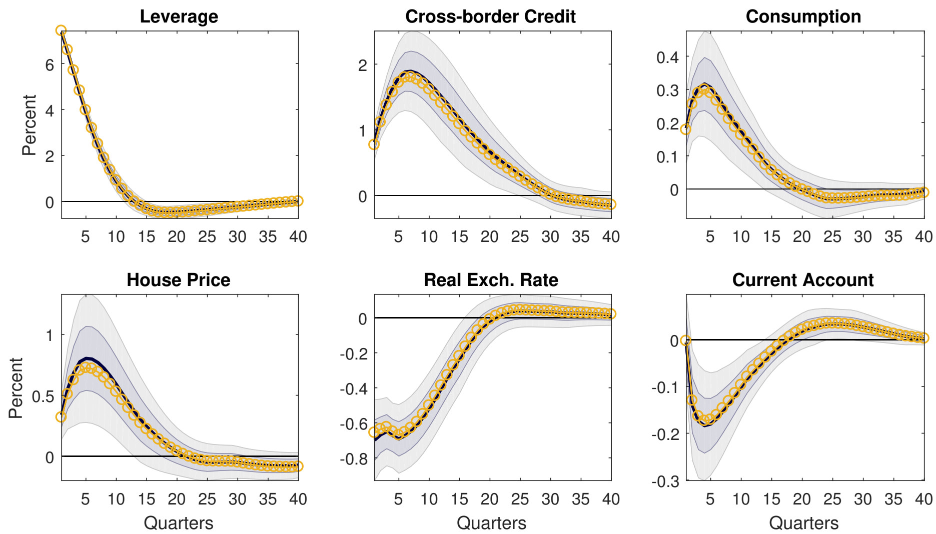


(B) Forecast error variance decompositions



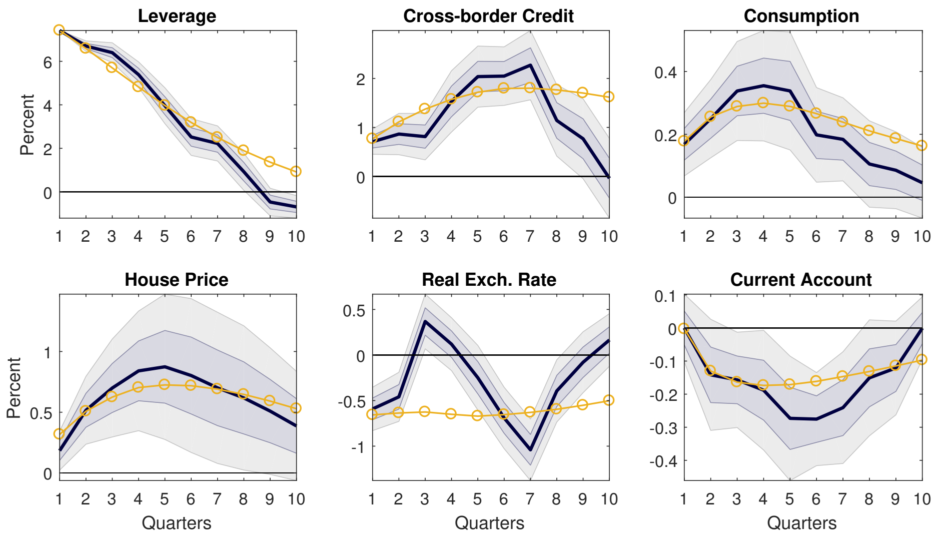
NOTE. Mean group impulse responses and forecast error variance decompositions to a one standard deviation (7.5%) increase in the leverage of US Broker-Dealers. The dark and light shaded areas are the one and two standard deviation confidence intervals, respectively. World equity prices added to the country VARs and ordered first in the system.

Figure S.5 Impulse Responses to an International Credit Supply Shock Excluding Larger Economies.



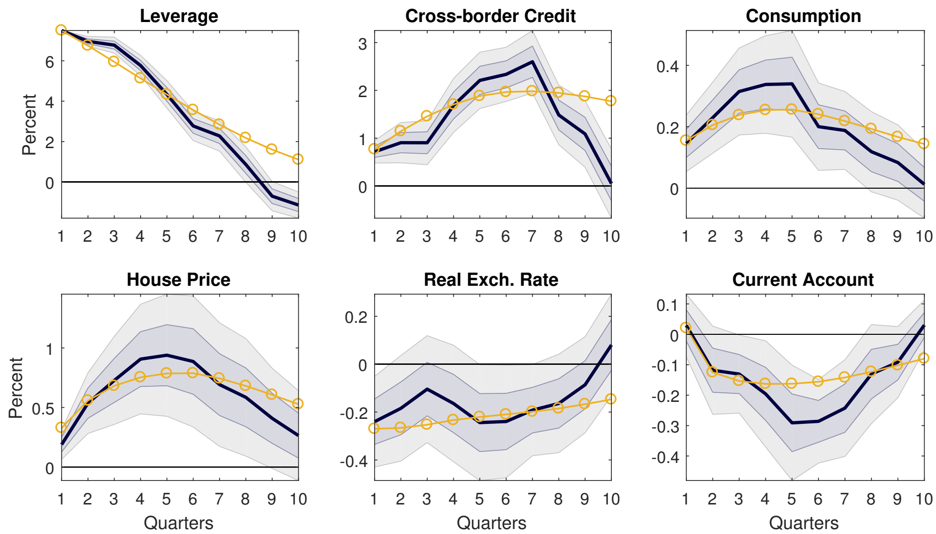
Note. Impulse responses to a one standard deviation (7.5%) increase in the leverage of US Broker-Dealers. The dark and light shaded areas are the one and two standard deviation confidence intervals, respectively. Countries dropped: Germany, the United Kingdom, Japan, and Switzerland. The line with circles is the baseline estimate reported in the paper.

Figure S.6 VARs vs. LPs with Bilateral Exchange Rate.



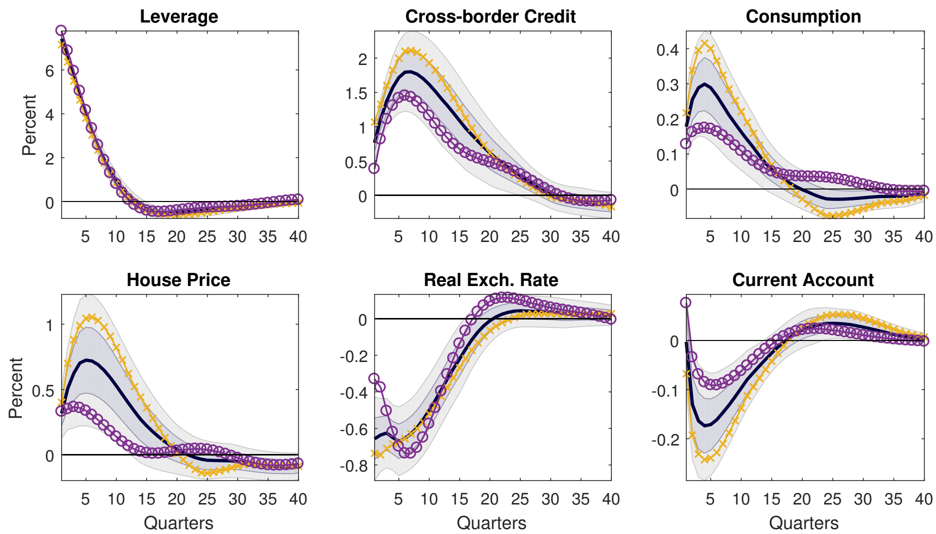
Note. LPs onto a one-standard deviation (7.5%) increase in US Broker-Dealers. The dark and light shaded areas are the one and two standard deviation confidence intervals. The solid line with circles is the impulse response from our baseline PVAR specification. Both LPs and VARs are mean group estimates.

Figure S.7 VARs vs. LPs with Effective Exchange Rate.



Note. LPs onto a one-standard deviation (7.5%) increase in US Broker-Dealers. The dark and light shaded areas are the one- and two-standard deviation confidence intervals. The solid line with circles is the impulse response from the baseline PVAR. Both LPs and VARs are mean group estimates.

Figure S.8 Impulse Responses: High and Low Exchange Rate Flexibility.



Note. Mean Group impulse responses to a one-standard deviation (7.5%) increase in the leverage of US Broker-Dealers. The dark and light shaded areas are the one- and two-standard deviation confidence intervals, respectively. The solid line with crosses and circles represents the mean group estimate for 'Low' (below median value) and 'High' (above median value) exchange rate flexibility from the annual "fine" classification of Ilzetzki et al. (2010) (average over the 2000-2010 period).

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