ECON 6356
International Finance and Macroeconomics

Lecture 3 (part 3): Business Cycles in Emerging Countries - Interest Rate Shocks

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Fall 2023

Princeton University Press, 2017

slides

chapter 6

Interest Rate Shocks

These slides are an adjusted version of the materials for Chapter 6 of the OEM book provided by the authors

Motivation

• Interest-rate shocks are generally believed to be a major source of fluctuations for emerging countries.

• The next slide displays country interest rates and output for 7 emerging economies between 1994:Q1 and 2001:Q4.

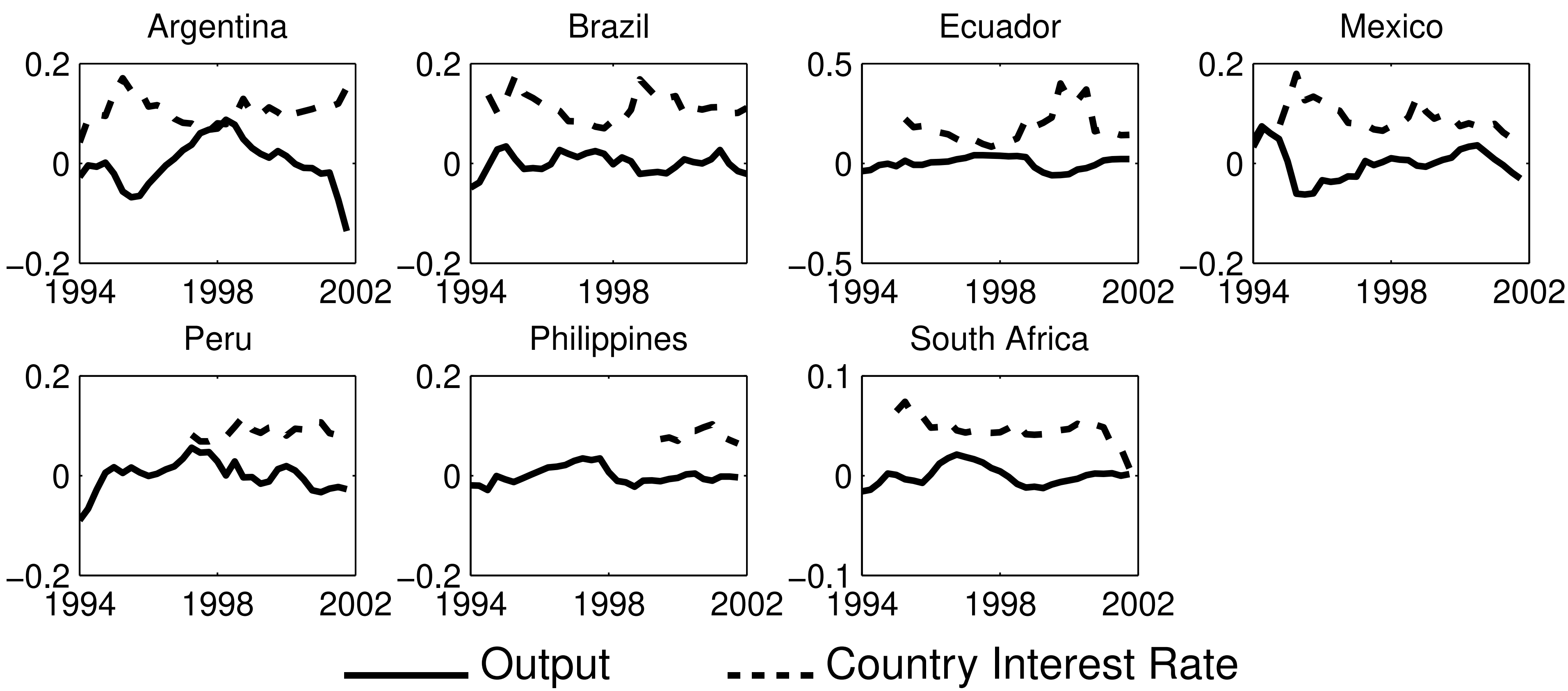
• Why is there one interest rate per country, as opposed to just one world interest rate?

- One reason is that each country has a different default risk, which is reflected in a country-specific interest-rate premium.
- The most commonly-used measure of country spreads is J.P. Morgan's EMBI+ bond index (Emerging Market Bond Index).

• The figures in the next slide suggests that output and country interest rates are negatively correlated.

• **Primary References:** Neumeyer and Perri (JME, 2005) and Uribe and Yue (JIE, 2006).

Negative Comovement Between Interest Rates and Output



Correlations: Argentina -0.67; Brazil -0.51, Ecuador -0.80, Mexico -0.58, Peru -0.37, The Philippines -0.02, South Africa -0.07.

Who Drives Whom?

• The observed negative correlation between output and the interest rate does not necessarily indicate that movements in the interest rate cause movements in output.

• Addressing this question requires a combination of data and theory.

• We will study two ways of combining data and theory:

1. **SVAR analysis:** here the emphasis is in the S. Converting a simple VAR into an SVAR requires the imposition of **identifying assumptions**, which are necessarily theoretical in nature.
2. **Estimated DSGE** model.

The main difference between these two approaches is how much weight they place on data and theory. We begin with approach (1).

SVAR Analysis, Uribe and Yue (2006)

$$A \begin{bmatrix} \widehat{y}_t \\ \widehat{\imath}_t \\ tby_t \\ \widehat{R}_t^{us} \\ \widehat{R}_t \end{bmatrix} = B \begin{bmatrix} \widehat{y}_{t-1} \\ \widehat{\imath}_{t-1} \\ tby_{t-1} \\ \widehat{R}_{t-1}^{us} \\ \widehat{R}_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon_t^y \\ \epsilon_t^i \\ \epsilon_t^{tby} \\ \epsilon_t^{rus} \\ \epsilon_t^r \end{bmatrix},$$

where y_t=output, i_t=investment, tby_t=trade-balance-to-GDP ratio, R_t^{us}=U.S. interest rate, and R_t=country interest rate.

• **Identification Assumptions:**
A is lower triangular ($A(i,j) = 0\ \forall j > i$).
R_t^{US} follows a univariate process ($A(4,j) = B(4,j) = 0\ \forall j \neq 4$).
• **Countries:** Argentina, Brazil, Ecuador, Mexico, Peru, The Philippines, South Africa.
• **Sample Period:** 1994:Q1 - 2001:Q4.

Comments On Identification

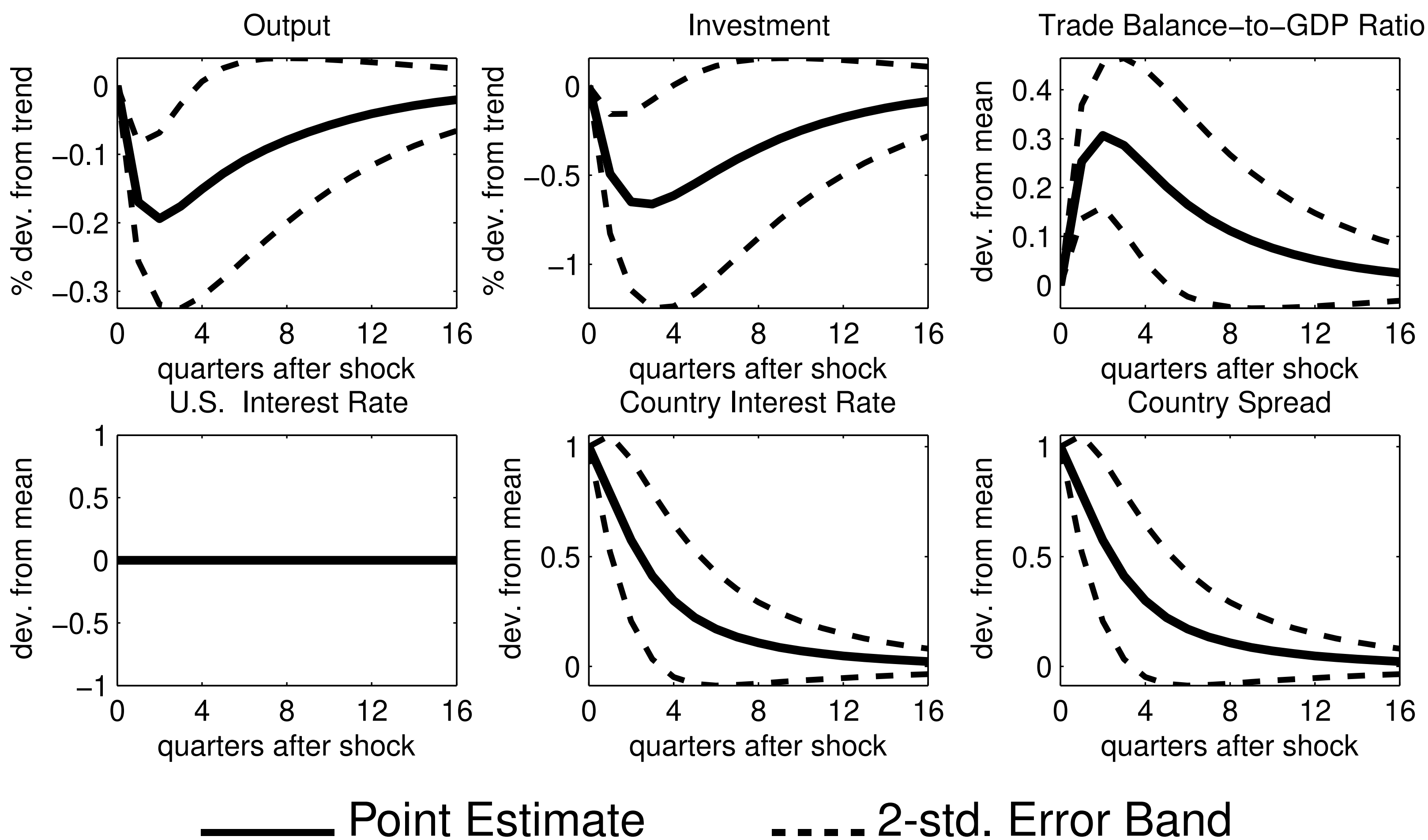
• A lower triangular implies that shocks to real variables (output, investment, and the trade balance) affect the country interest rate contemporaneously...

... but shocks to the U.S. interest rate or to the country interest rate affect real variables with a lag. This makes sense, because real variables (think about starting investment projects, hiring and firing decisions, etc.) should respond more slowly than financial variables.

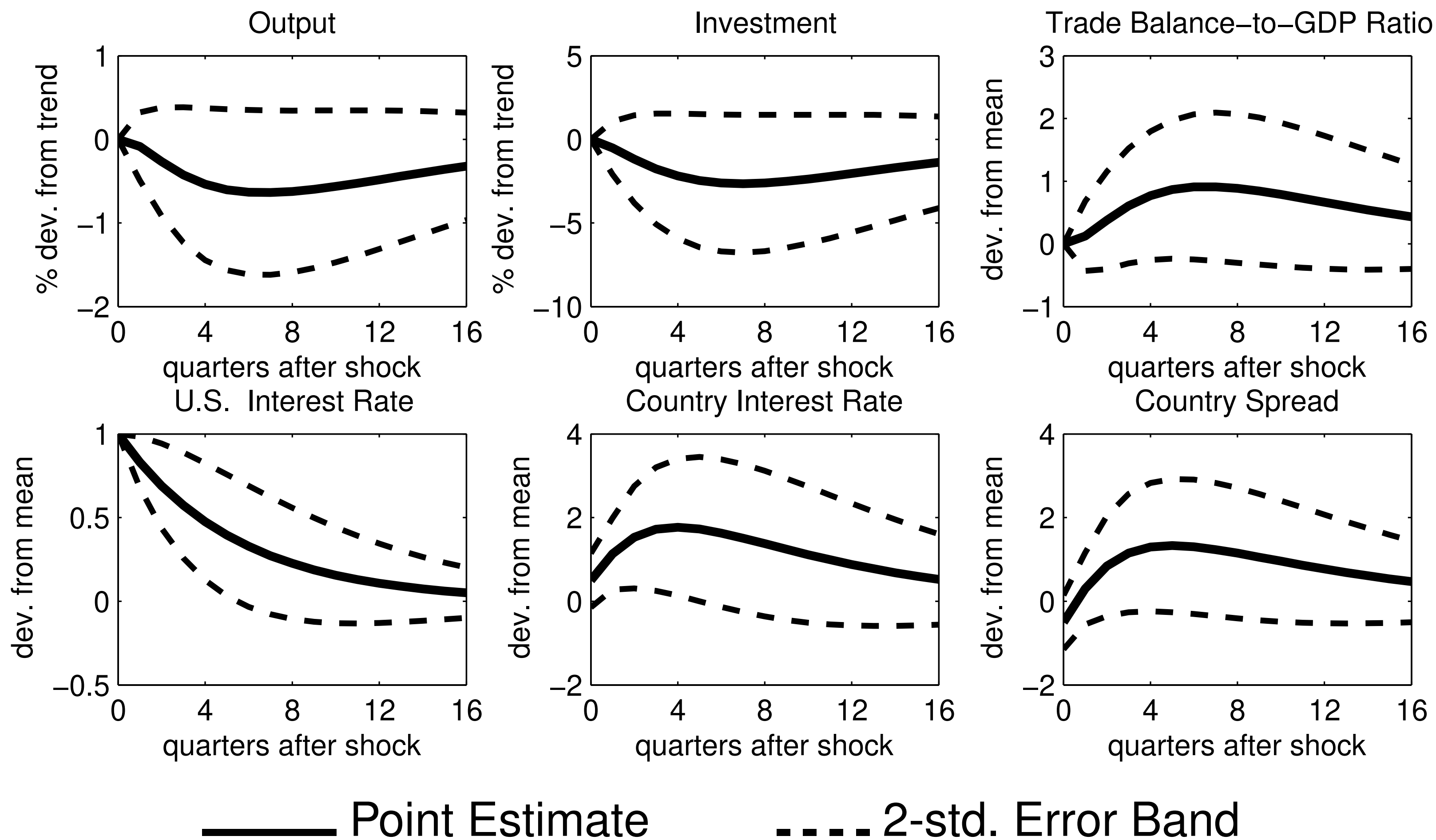
• Assuming that R_t^{us} is univariate is sensible because one should not expect individual emerging countries to affect interest rates in the U.S.

• **Implications of Identifying Restrictions:**
– ϵ_t^{rus} and ϵ_t^r can be interpreted as exogenous U.S.-interest-rate and country-spread shocks, respectively.
– The identification scheme is vague about the nature of ϵ_t^y, ϵ_t^i, and ϵ_t^{tby}. This is not a problem, because our interest is to understand the effects of interest-rate shocks.

Impulse Response To A Country-Spread Shock, ϵ_t^r



Impulse Response To A U.S. Interest-Rate Shock, ϵ_t^{rus}



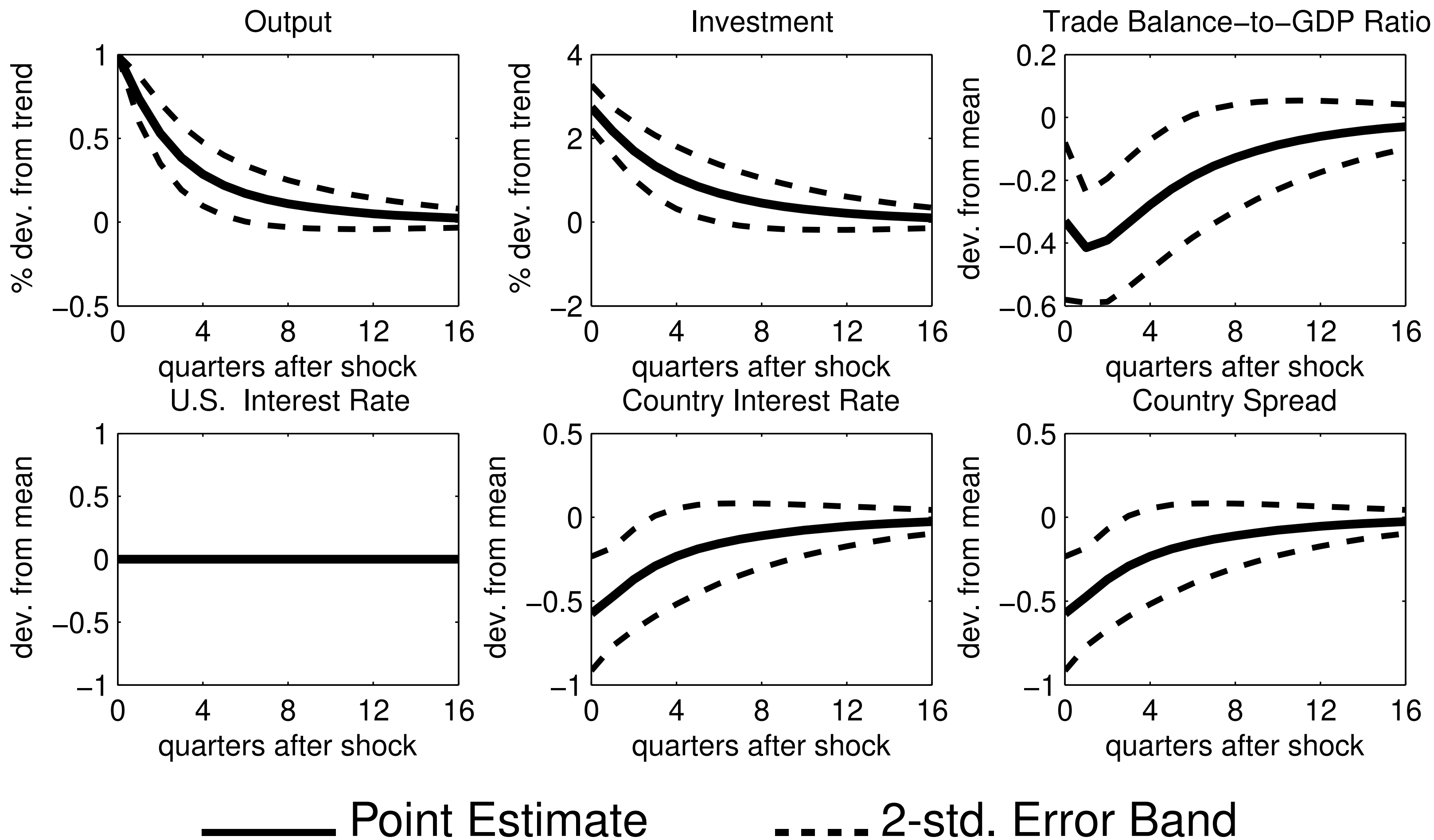
Observations on Responses to ϵ_t^r and ϵ_t^{rus}

• Country-spread and US-interest-rate shocks cause sizable contractions in output and investment and a sizable improvement in the trade-balance-to-GDP ratio (i.e., domestic absorption contracts relatively more than output).

• The response to US-interest-rate shocks is estimated with significant uncertainty. One reason is that by design, R_t^{us} does not vary across countries.

• US-interest-rate shocks cause a large, delayed overshooting of country spreads.

Impulse Response To An Output Shock, ϵ_t^y



Observations on Response to ϵ_t^y

• An output shock causes expansions in output and investment, and a deterioration of the trade-balance-to-GDP ratio, resembling a technology shock or a terms-of-trade shock in the SOE-RBC model.

• More importantly for the purpose of the present analysis, the output shock drives down the country spread, thus lowering the country's cost of borrowing.

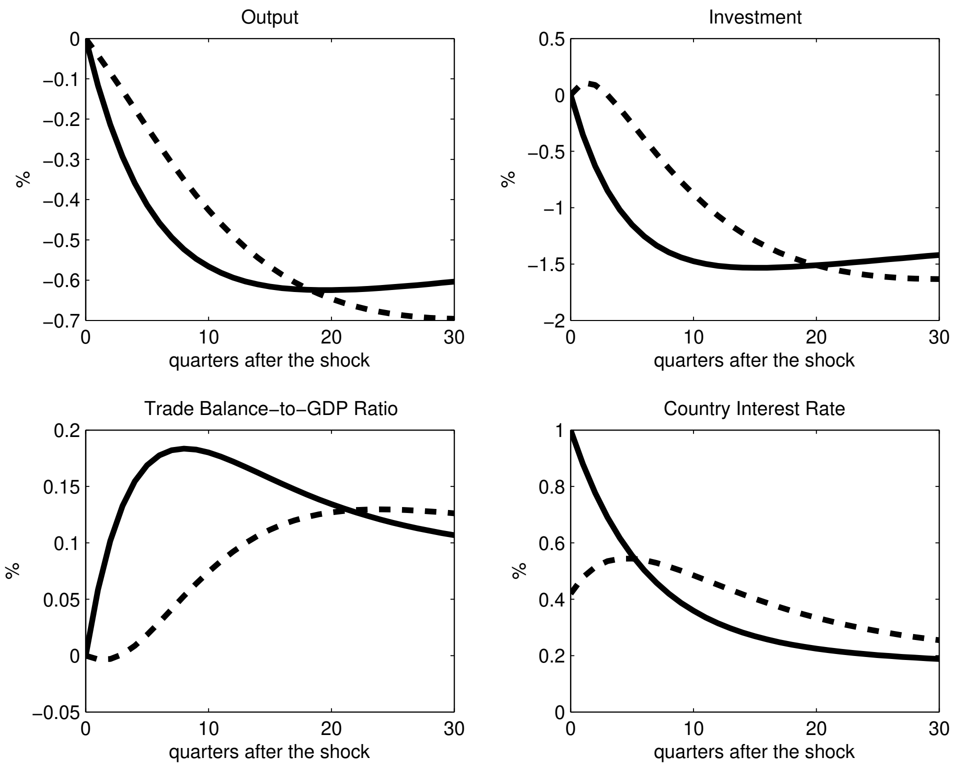
• Recall that the present identification scheme is vague with respect to the precise nature of ϵ_t^y. It could represent a mix of shocks of diverse natures, such as technology shocks, terms-of-trade shocks, etc.

Robustness To Expanding The Temporal And Country Coverage of the Data

Expanded Time Span: 1994:Q1 to 2012:Q4.

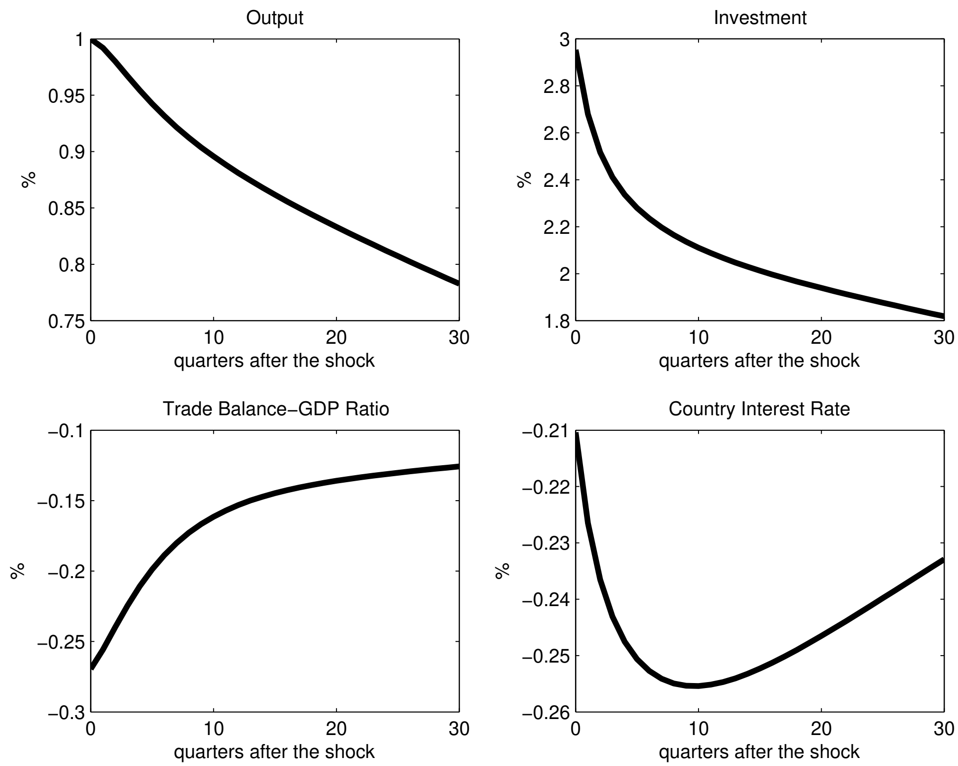
Expanded Country Set: Argentina, Brazil, Bulgaria, Chile, Colombia, Ecuador, Hungary, South Korea, Malaysia, Mexico, Peru, South Africa, Thailand, Turkey, and Uruguay.

Responses to Country-Spread and U.S.-Interest-Rate Shocks: Expanded Data



1% increase in country-spread (solid) and US-int.-rate (broken). Output and investment in % dev. from trend; TB/GDP and country int. rate in percentage point dev. from mean.

Responses to an Output Shock: Expanded Data



1% output shock. Output and investment in % dev. from trend; TB/GDP and country int. rate in percentage point dev. from mean.

Observations on Robustness Analysis

The baseline empirical results are robust to extending the temporal and cross-sectional dimensions of the panel, especially along the following dimensions:

• Increases in the U.S.-interest-rate and country-spread cause contractions in output and investment.

• Increases in the U.S.-interest-rate and country-spread cause an improvement in the trade-balance-to-GDP ratio (or, equivalently, a proportionally larger contraction in domestic absorption than in output).

• U.S.-interest-rate shocks cause a delayed increase in country spreads.

• Output shocks cause an expansion in investment, a deterioration of the trade-balance-to-GDP ratio, and, more importantly, a fall in country spreads.

Decomposition of Forecast-Error Variances

Let $x_t \equiv [\widehat{y}_t \, \widehat{i}_t \, tby_t \, \widehat{R}_t^{us} \, \widehat{R}_t]'$. Then the SVAR can be written as

$$Ax_{t+h} = Bx_{t+h-1} + \epsilon_{t+h}$$

And its MA(∞) representation is

$$x_{t+h} = \sum_{j=0}^{\infty} C_j \epsilon_{t+h-j}, \text{ with } C_j \equiv \left(A^{-1}B\right)^j A^{-1}$$

The forecast of x_{t+h} in t is

$$E_t x_{t+h} = \sum_{j=h}^{\infty} C_j \epsilon_{t+h-j}$$

And the associated forecast error, denoted FE_t^h, is

$$FE_t^h = \sum_{j=0}^{h-1} C_j \epsilon_{t+h-j}$$

Then the forecast-error variance at horizon h, denoted FEV^h, is

$$FEV^h = \sum_{j=0}^{h-1} C_j \Sigma_\epsilon C_j', \text{ where } \Sigma_\epsilon \equiv E[\epsilon_t \epsilon_t']$$

The forecast-error variance attributable to shock i (the i-th element of ϵ_t), denoted $FEV^{h,i}$, is

$$FEV^{h,i} = \sum_{j=0}^{h-1} (C_j \Lambda_i) \Sigma_\epsilon (C_j \Lambda_i)',$$

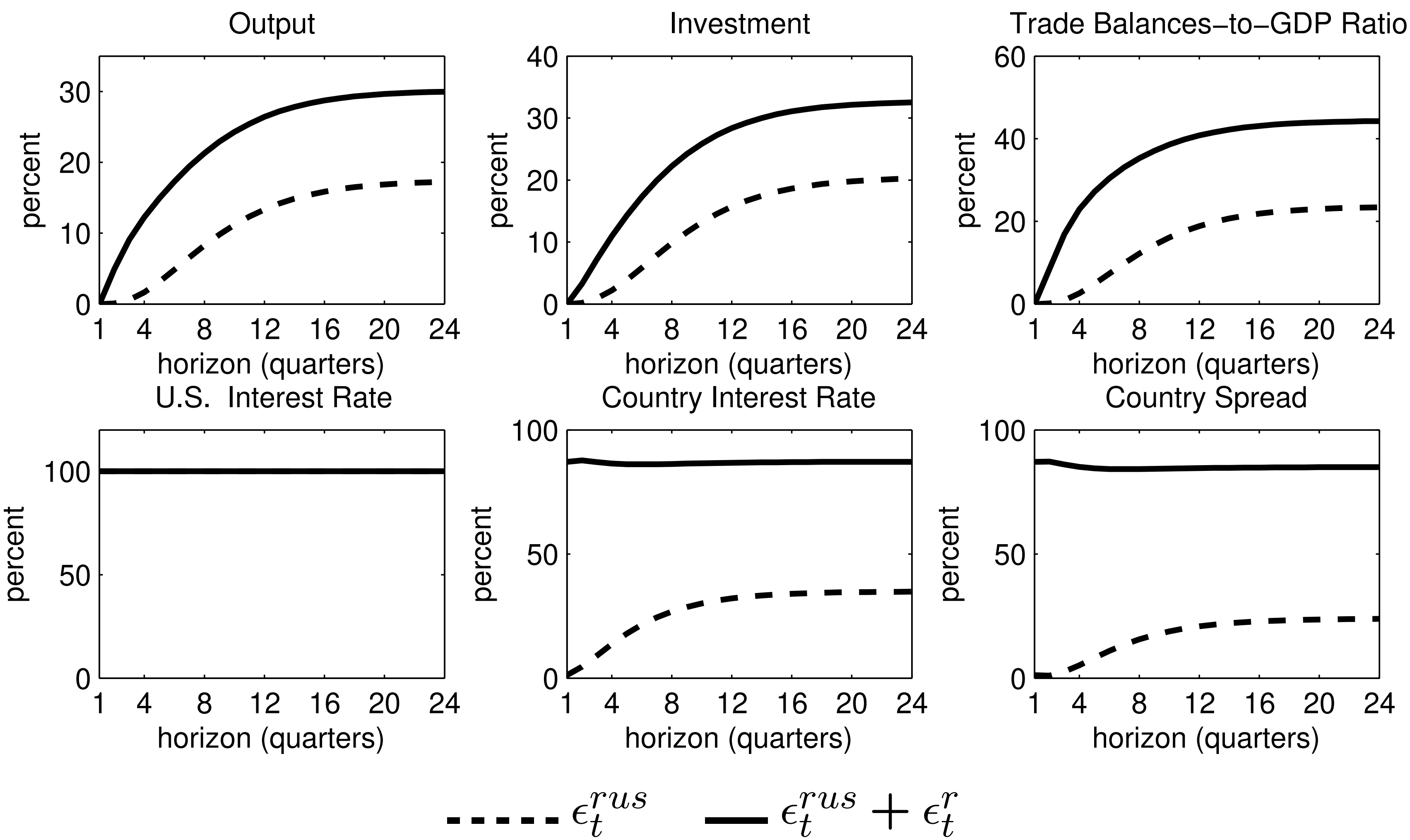
where Λ_i is a square conformable matrix with all zeros except for diagonal element (i,i) which equals unity.

The share of forecast-error variance of variable k (i.e. k-th element of x_t) at horizon h attributable to shock i, denoted $SFEV_k^{h,i}$, is given by

$$SFEV_k^{h,i} = \frac{FEV_{kk}^{h,i}}{FEV_{kk}^{h}},$$

where kk denotes the k-th diagonal element. This is called a forecast-error variance decomposition. As the horizon become large, $h \to \infty$, the forecast-error variance of variable k due to shock i converges to the unconditional variance of k due to i. The next slide presents the forecast-error variance decomposition implied by the estimated SVAR system.

Estimated Forecast-Error Variance Decomposition



Observations on the Forecast-Error Variance Decompositions

• Jointly, country-spread and US-interest-rate shocks (ϵ_t^r and ϵ_t^{rus}) explain

– 30% of movements in output.

– 32% of movements in investment.

– 44% of movements in the trade-balance-to-GDP ratio.

– 85% of movements in country-spreads.

• About 60% of movements in country spreads is explained by country-spread shocks.

Alternative Identification Scheme: Why Not Place the Country Spread First in the SVAR System?

SVAR Prediction Under This Specification: Output and investment expand in response to an increase in the U.S. interest rate.

Problematic: It’s difficult to rationalize this implication on theoretical grounds.

DSGE Analysis

Motivation

• The SVAR analysis is based on loose theoretical restrictions.

• Does the propagation mechanism of interest rate shocks (ϵ_t^{rus} and ϵ_t^r) implied by the estimated SVAR model concur with the one implied by an optimizing DSGE open economy model?
• If so, the identified interest-rate shocks would be more compelling since the effects they generate would be consistent with the optimizing behavior of households and firms.

Strategy: (1) Build a DSGE model of the open economy. (2) Feed the model with the estimated processes for R_t^{us} and R_t (the last 2 equations of the SVAR). (3) Compare the impulse responses predicted by the SVAR and DSGE models.

The Theoretical Model (Uribe and Yue, 2006)

Open economy model with three frictions:

- Working-capital constraint on firms
- Gestation lags and convex adjustment costs in investment
- Habit formation

Firms and Working Capital Constraints

$$\max F(k_t, h_t) - u_t k_t - w_t h_t \left[1 + \frac{\eta(R_t^d - 1)}{R_t^d}\right]$$

where $F(\cdot, \cdot)$ is a production function, h_t =labor, k_t =capital, w_t =wage rate, and R_t^d =gross interest rate. The parameter η governs the strength of the working-capital constraint. The implied demand for labor is

$$F_h(k_t, h_t) = w_t \left[1 + \eta \left(\frac{R_t^d - 1}{R_t^d}\right)\right]$$

The working-capital constraint is a financial friction that allows for a supply-side effect of interest rate shocks.

Intuition: An increase in the interest rate increases the (financial) cost of labor, inducing a contraction in labor demand.

Capital Accumulation: Gestation Lags and Convex Adjustment Costs

$$i_t = \frac{1}{4}\sum_{i=0}^{3} s_{it}.$$

$$s_{i+1t+1} = s_{it}, \quad i = 0, 1, 2$$

$$k_{t+1} = (1-\delta)k_t + k_t\Phi\left(\frac{s_{3t}}{k_t}\right)$$

where i_t=investment, s_{it}=number of investment projects started in period $t-i$, for $i = 0, 1, 2, 3$ (4-period gestation lag); k_t=capital stock. Function $\Phi(\cdot)$ captures convex adjustment costs (note that $\Phi(\cdot)$ must be concave).

Households and Habit Formation

$$\max E_0 \sum_{t=0}^{\infty} \beta^t U(c_t - \mu \tilde{c}_{t-1}, h_t),$$

subject to

$$d_t = R_{t-1} d_{t-1} - w_t h_t - u_t k_t + c_t + i_t + \Psi(d_t)$$

$$\lim_{j \to \infty} E_t \frac{d_{t+j+1}}{\prod_{s=0}^{j} R_{t+s}} \leq 0$$

The function $\Psi(d_t)$ is convex; it introduces portfolio adjustment costs and gives rise to an effective interest rate, R_t^d, satisfying

$$R_t^d = \frac{R_t}{1 - \Psi'(d_t)}.$$

Driving Forces

$$\begin{aligned}
\widehat{R}_t &= 0.63\widehat{R}_{t-1} + 0.50\widehat{R}^{us}_t + 0.35\widehat{R}^{us}_{t-1} - 0.79\widehat{y}_t \\
&+ 0.61\widehat{y}_{t-1} + 0.11\widehat{\imath}_t - 0.12\widehat{\imath}_{t-1} + 0.29 tby_t \\
&- 0.19 tby_{t-1} + \epsilon^r_t,
\end{aligned}$$

$$\widehat{R}^{us}_t = 0.83\widehat{R}^{us}_{t-1} + \epsilon^{rus}_t,$$

where ϵ^r_t and ϵ^{rus}_t are mean-zero, iid, innovations with standard deviations equal to 0.031 and 0.007, respectively.

Functional Forms

$$U(c - \mu\tilde{c}, h) = \frac{\left[c - \mu\tilde{c} - \omega^{-1}h^{\omega}\right]^{1-\gamma} - 1}{1-\gamma}$$

$$F(k, h) = k^{\alpha}h^{1-\alpha}$$

$$\Phi(x) = x - \frac{\phi}{2}(x - \delta)^2; \quad \phi > 0$$

$$\Psi(d) = \frac{\psi}{2}(d - \bar{d})^2$$

Calibrated Parameters (Quarterly)

$$\omega = 1.45$$

$$\gamma = 2$$

$$\alpha = 0.32$$

$$R = \beta^{-1} = 1.0277$$

$$\delta = 0.025$$

$$\frac{tb}{y} = 0.02$$

Estimating ϕ, ψ, η, and μ

Criterion: Minimize the distance between empirical and theoretical impulse response functions.

Formally, ϕ, ψ, η, and μ are set so as to minimize

$$[IR^e - IR^m(\psi, \phi, \eta, \mu)]' \Sigma_{IR^e}^{-1} [IR^e - IR^m(\psi, \phi, \eta, \mu)],$$

Result of estimation:

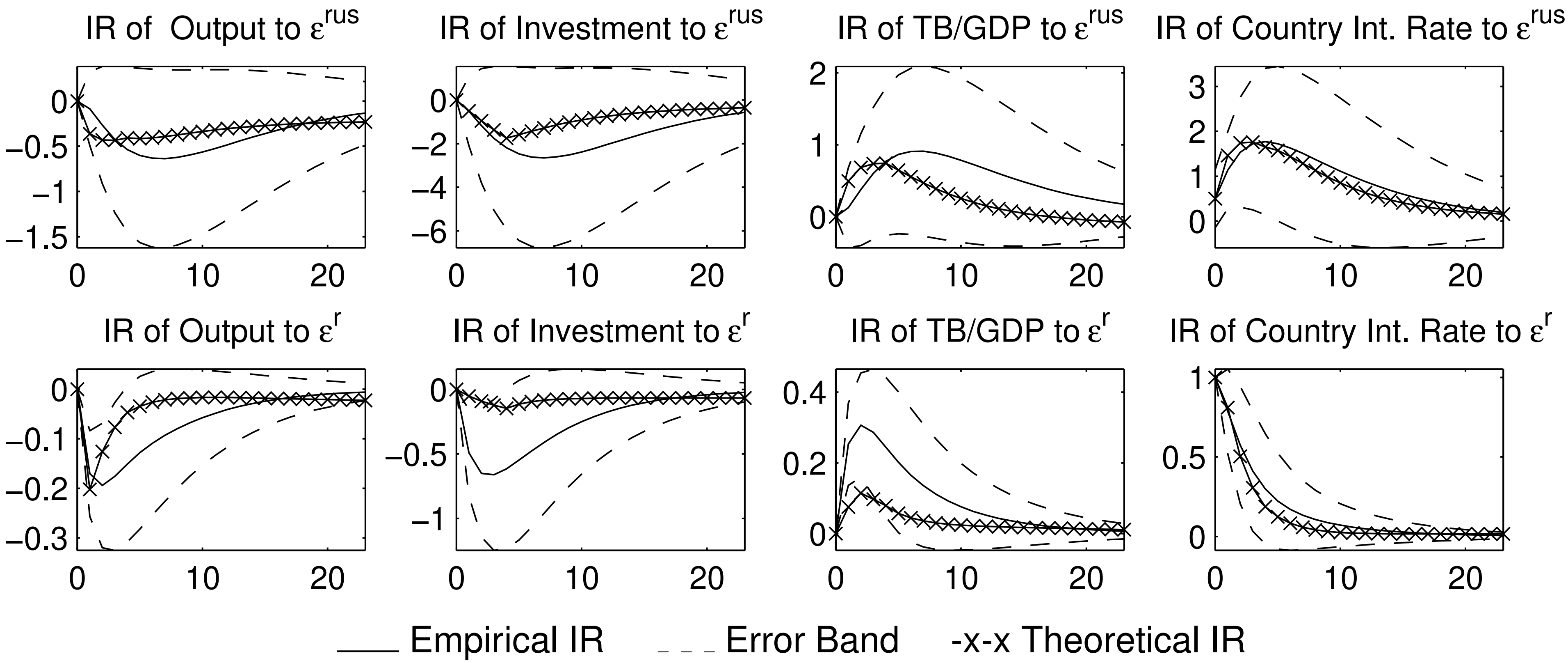
$$\psi = 0.00042$$

$$\phi = 72.8$$

$$\eta = 1.20$$

$$\mu = 0.20$$

Theoretical and Estimated Impulse Response Functions



Observations on the Theoretical Impulse Responses

• The theoretical model replicates well a number of key features of the estimated IRFs:

– Output and investment contract in response to an increase in ϵ_t^{rus} or ϵ_t^{r}.

– The trade balance improves in response to an increase in ϵ_t^{rus} or ϵ_t^{r}.

– The country interest rate, R_t, displays a hump-shaped response to an increase in ϵ_t^{rus}.

• These findings suggest that the identification assumptions imposed in the SVAR analysis are successful in isolating U.S.-interest-rate and country-spread shocks.

Conditional Standard Deviations
Implied by the SVAR and Theoretical Models

	ϵ_t^{rus}		ϵ_t^{r}		Unconditional
Variable	SVAR	Theory	SVAR	Theory	SVAR
$\widehat{y}$	1.5	1.6	1.3	1.3	3.7
$\widehat{\imath}$	6.4	3.6	5.0	2.0	14.2
tby	2.1	1.6	2.0	0.9	4.4
$\widehat{R}^{us}$	1.3	1.3	0	0	1.3
$\widehat{R}$	3.8	3.5	4.7	4.4	6.5

Observations on Conditional Volatilities

• SOE model does well at capturing importance of U.S.-interest-rate and country-spread shocks in explaining movements in output and country interest rates.

• The SOE model does a good job at accounting for variations in the trade balance due to U.S.-interest-rate shocks.

• But the SOE model underpredicts the volatilities of investment and the trade balance caused by country-spread shocks.

• SOE model implies that ϵ_t^{rus} and ϵ_t^r jointly explain 32 percent of fluctuations in output $((1.6311^2 + 1.2779^2)/3.6583^2 = 0.32)$, almost same as SVAR $((1.5274^2 + 1.3030^2)/3.6583^2 = 0.30)$. But SOE model assigns less importance to ϵ_t^{rus} and ϵ_t^r in accounting for variations in i_t and tby_t than does the SVAR.

• Overall, identified ϵ_t^{rus} and ϵ_t^r shocks are sensible and economically important.

Shocks to Global Risk Premia

• What is the effect of movements in global risk premia on real and financial variables in emerging economies?

• Akinci (2013) expands the SVAR studied above to include the spread between the U.S. Baa corporate bond rate and the 20-year U.S. Treasury bond yield.

• Baa corporate bonds carry a medium degree of default risk: 13% cumulative default risk over 20 years, compared with less than 1% for Aaa rated bonds (highest rating by Moody's) and more than 70% for C rated bonds (lowest rating).

The Augmented SVAR

$$A \begin{bmatrix} \widehat{y}_t \\ \widehat{\imath}_t \\ tby_t \\ \widehat{R}^{us}_t \\ \widehat{S}^{us}_t \\ \widehat{R}_t \end{bmatrix} = B(L) \begin{bmatrix} \widehat{y}_{t-1} \\ \widehat{\imath}_{t-1} \\ tby_{t-1} \\ \widehat{R}^{us}_{t-1} \\ \widehat{S}^{us}_{t-1} \\ \widehat{R}_{t-1} \end{bmatrix} + \begin{bmatrix} \epsilon^y_t \\ \epsilon^i_t \\ \epsilon^{tby}_t \\ \epsilon^{rus}_t \\ \epsilon^{sus}_t \\ \epsilon^r_t \end{bmatrix},$$

$S^{us}_t =$ U.S. corporate bond spread.

Identification: same as Uribe and Yue (2006). But now, pair $[R^{us}_t \, S^{us}_t]'$ follows bivariate process.

$\Rightarrow \epsilon^{sus}_t$ can be interpreted as an innovation to the U.S. risk premium.

Same interpretation as before for other innovations.

Countries: Argentina, Brazil, Mexico, Peru, South Africa, Turkey.
Sample: 1994:Q1 to 2011:Q3.

Predictions of SVAR with Global Risk Premium Shocks

• Interest rate shocks, i.e., $[\epsilon_t^{rus}\ \epsilon_t^{sus}\ \epsilon_t^{r}]$, jointly explain 42% of the variance of output $\Rightarrow$ reinforces the result obtained by Uribe and Yue (2006).

• The global risk-premium shock takes over the role previously played by the U.S. interest rate: ϵ_t^{sus} explains 18% of the variance of output whereas ϵ_t^{rus} explains only 6%.

• The country spread shock, ϵ_t^{r}, continues to be an important driver of aggregate fluctuations in emerging countries, accounting for 18% of the observed variance of output.

• Effects of global risk-premium shocks is mediated by the country premium: a 1 percentage point increase in ϵ_t^{sus} raises the country premium by 1.3 percentage points.

Chapter Summary

• Interest-rate shocks represent an **important driver of business cycles in emerging countries**, accounting for 30 to 42 percent of the variance of output.

• Of the 30 to 42 percent of output variance explained by interest rate shocks, **half is due to a global component** (U.S.-interest-rate shocks and U.S.-risk-premium shocks) and the **other half is due to country-specific spread** shocks.

• In response to an *increase in the interest rate*, output and investment contract and the *trade balance improves*.

• An increase in the U.S. interest rate or in the U.S. risk premium produces an overshooting in country spreads, that is, the country spread increases by more than one for one.

• The majority of movements in country spreads (more than 60 percent) is explained by country spread shocks.