

Business Cycles in Emerging Economies: The Role of Common Factors

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➤ **Motivation**

- Dynamic Factor Analysis
- A Dynamic Equilibrium Model
- Extensions

- **Two observations** from the theoretical and empirical literature on business cycles in emerging economies.

- **Observation 1:**

- **Interest rates are important driving forces** of business cycles in emerging economies

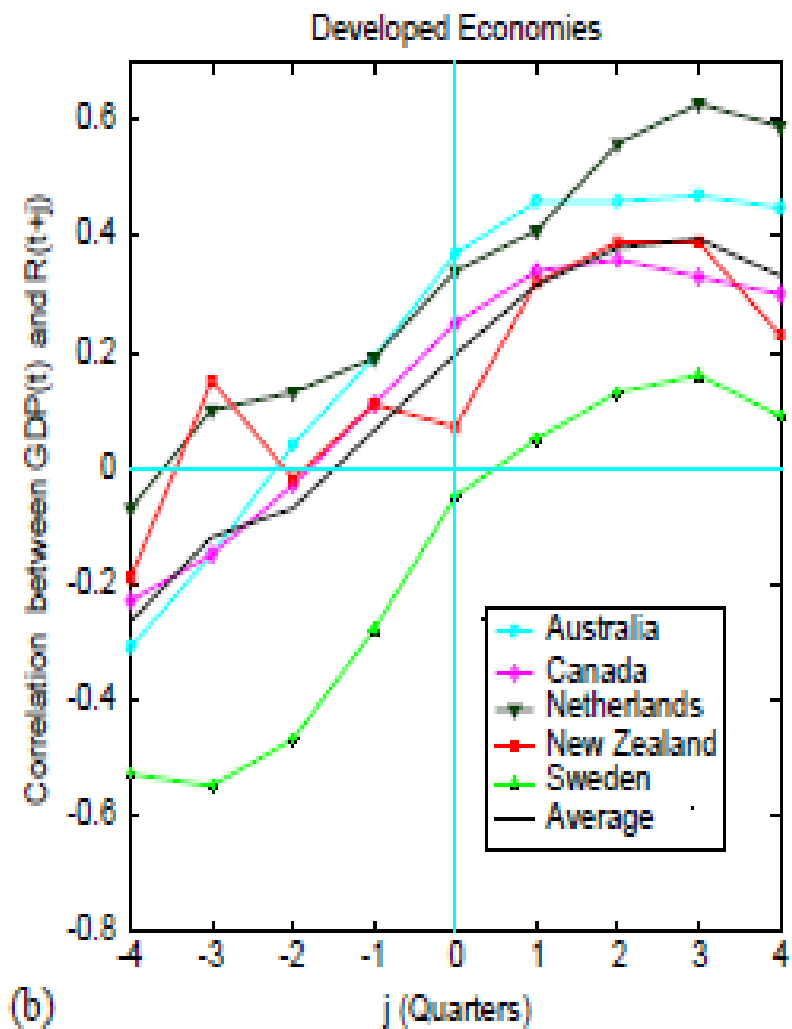
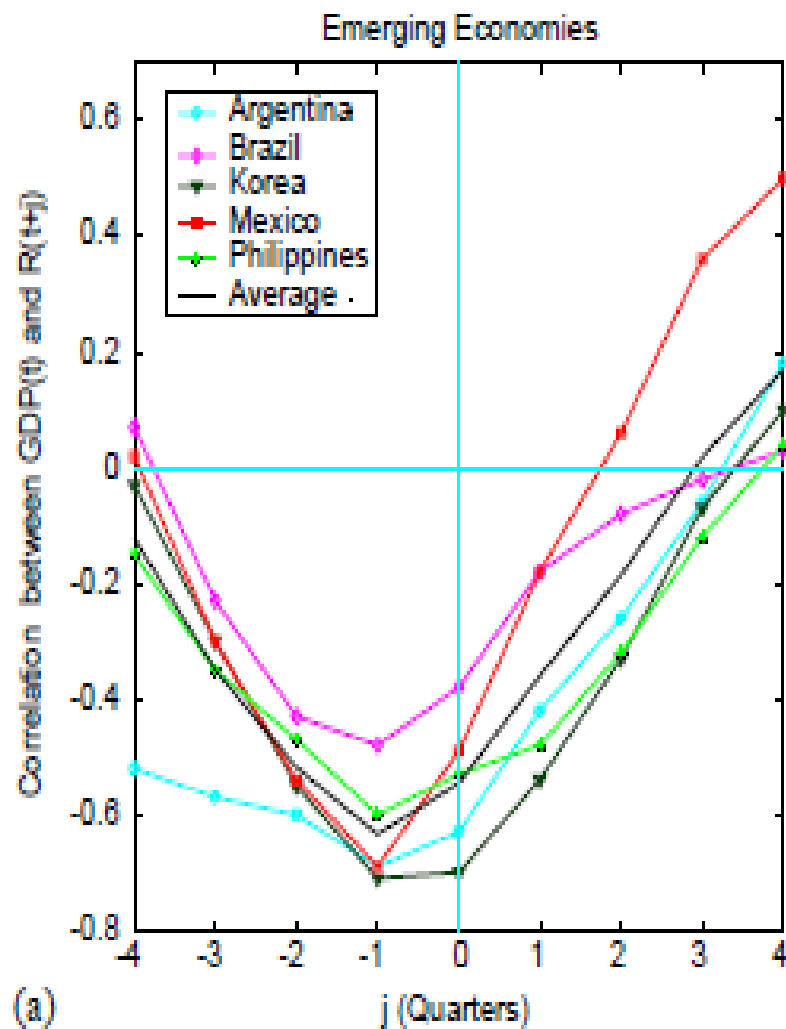
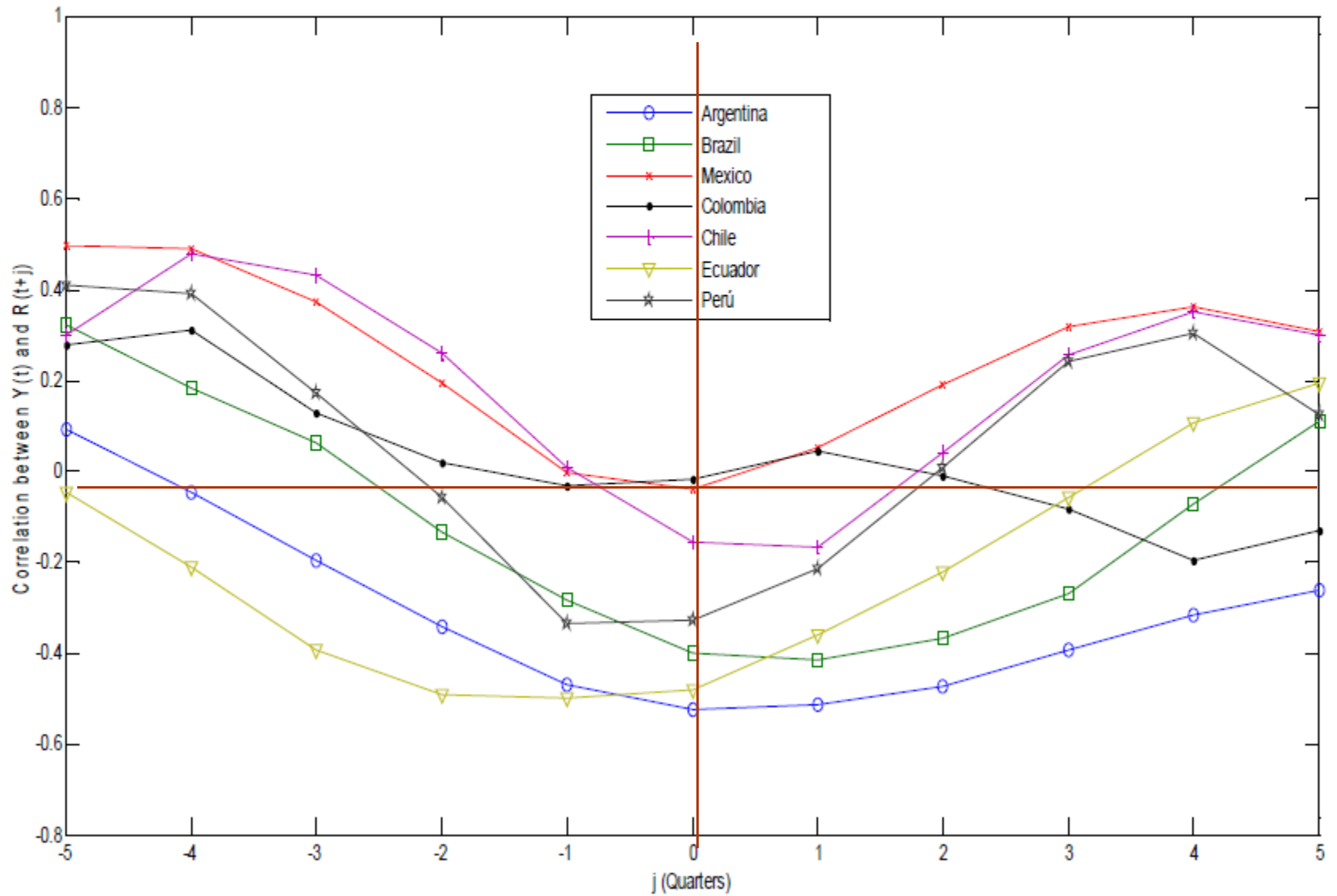


Fig. 3. Cross-correlations between GDP and interest rates.

Source: Neumeyer & Perri, (2005)

Figure 1a. Serial Correlations between Output and Interest Rates in Latin American Economies



- **Observation 1: References**

Neumeyer & Perri, (JME, 2005);

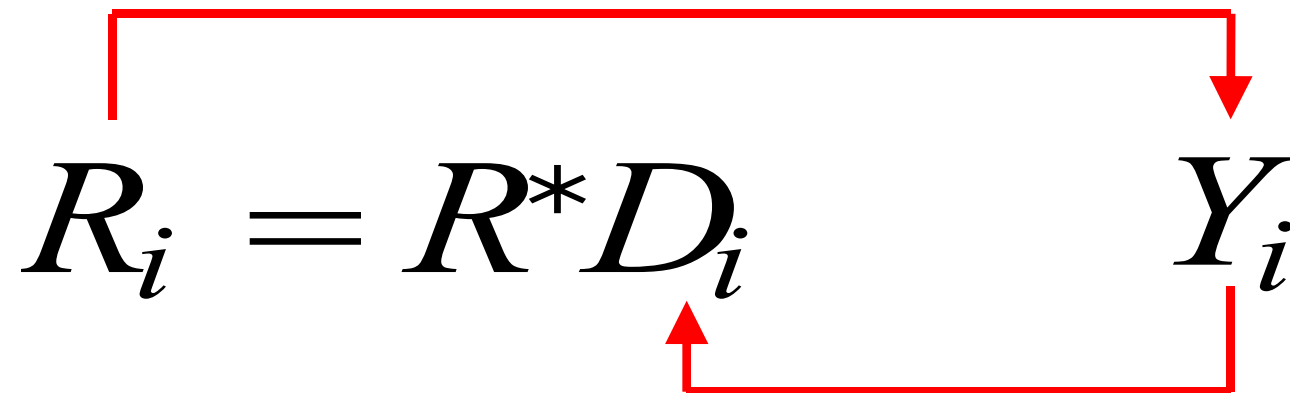
Uribe & Yue (JIE, 2006);

Oviedo (2005)

Chang & Fernández (2012)

- **Observation 1:**

- Key amplifying mechanism:



- **Observation 2:**

- Strong **comovement across countries** in
 - (i) Output fluctuations

Business Cycles in Latin America (excluding Argentina): 1993.Q4-2010.Q3

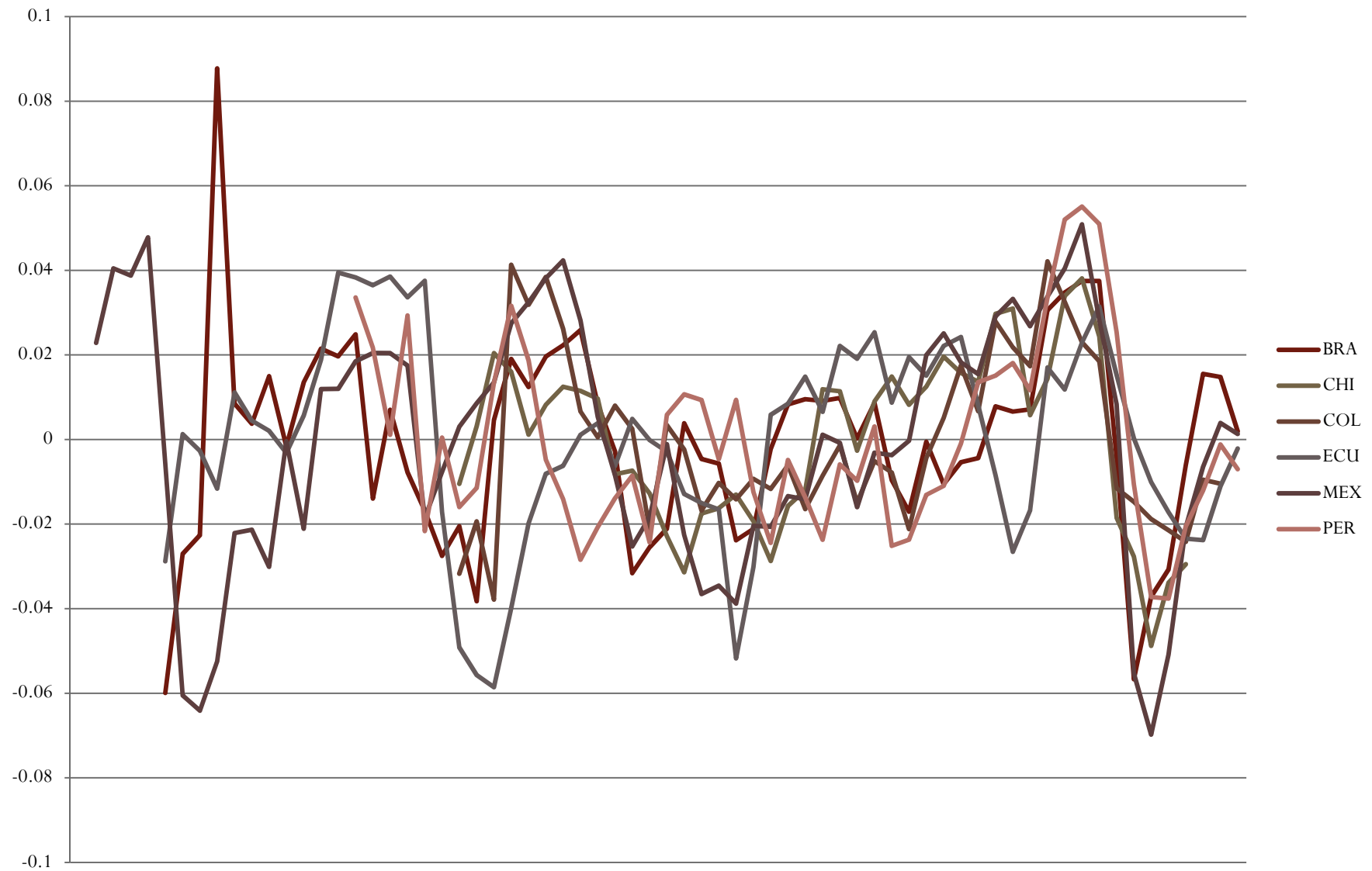


Table 2a. Correlations between Output Fluctuations in Latin American Economies

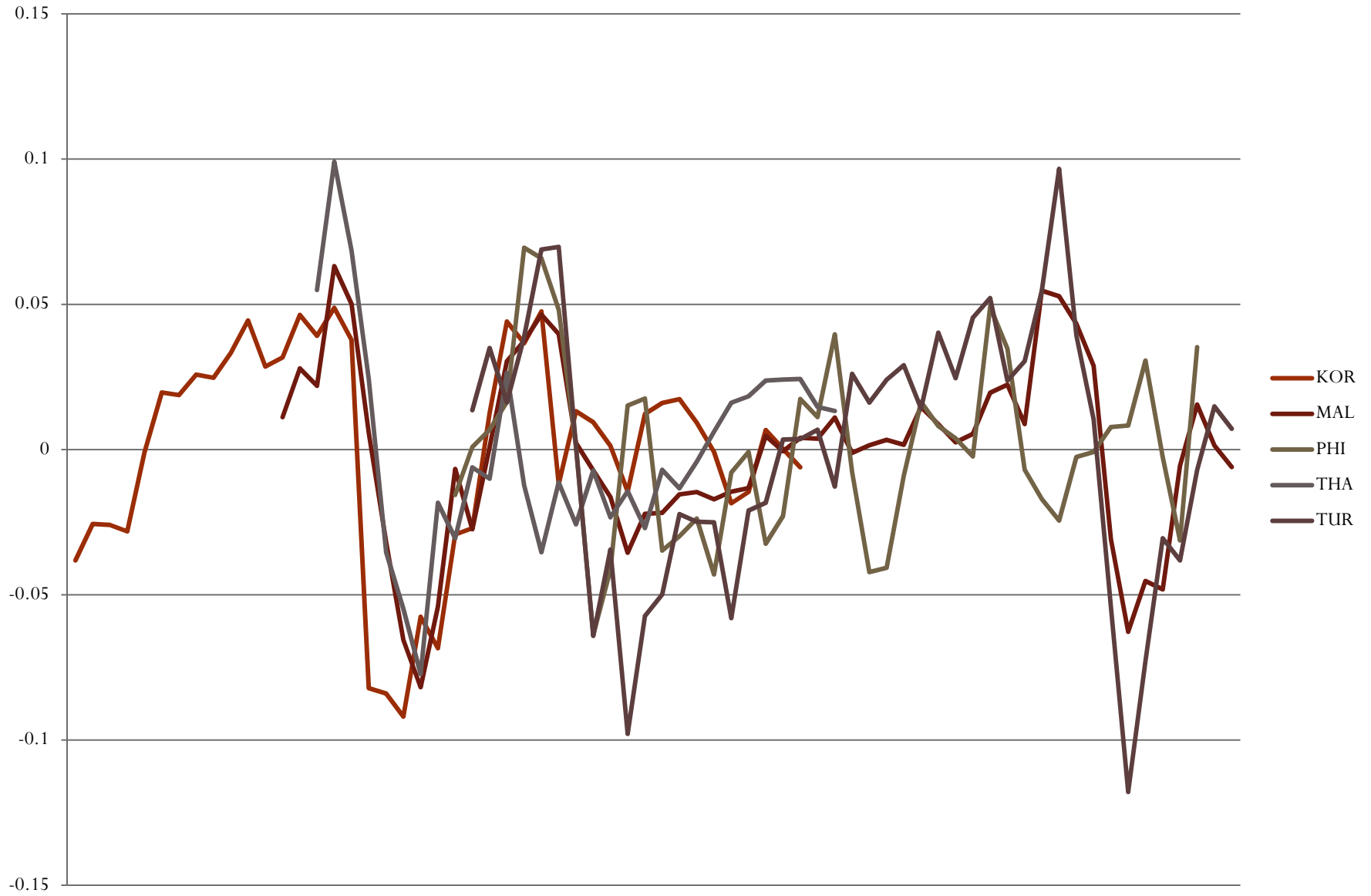
Country	Argentina	Brazil	Mexico	Colombia	Chile	Ecuador
Brazil	0.291**					
Mexico	0.698***	0.424***				
Colombia	0.016	0.429***	0.209*			
Chile	0.657***	0.571***	0.737***	0.619***		
Ecuador	0.315***	0.249**	0.173	0.502***	0.517***	
Perú	0.279**	0.378***	0.095	0.518***	0.532***	0.215*

Note: Series have been Hodrick Prescott filtered. See the Data Appendix for details about each variable series range and source. Output is measured without government expenditure. *** Indicates Pvalue significance at 1%, ** Indicates Pvalue significance at 5%, * Indicates Pvalue significance at 10%

**Seven Latin American Countries:
Principal Components Variance Decomposition**

Component	Output Cycle
First	0,60
Second	0,18
Third	0,10
Fourth	0,06
Fifth	0,03
Sixth	0,03
Seventh	0,02

Business Cycles in Asia: 1993.Q4-2010.Q3



- **Observation 2:**

- Strong **comovement across countries** in

- (i) Output fluctuations

- (ii) **Spreads**

Figure 2a. (Log) Latin American EMBI Spreads

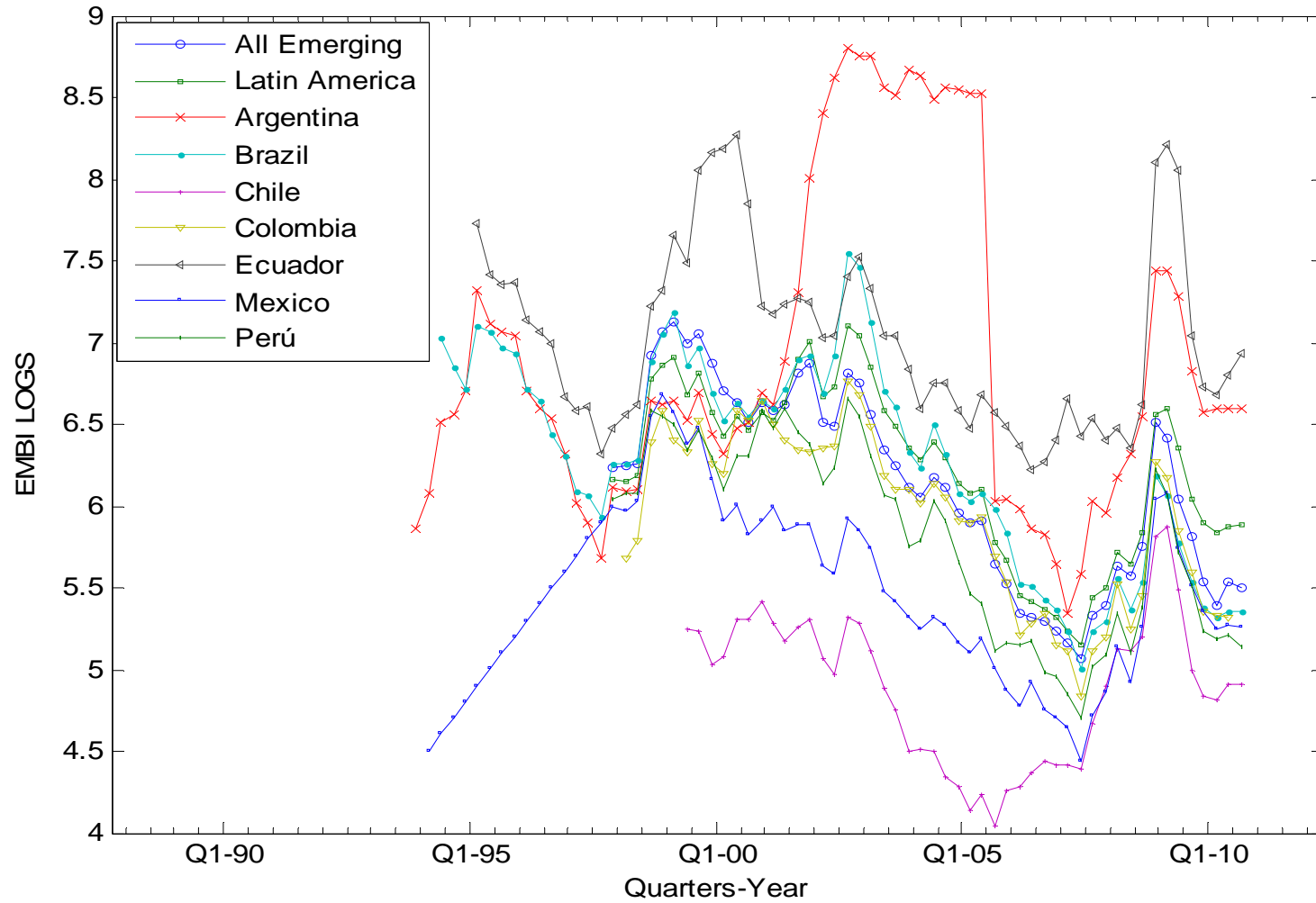


Table 3a. Correlations between Interest Rate Fluctuations in Latin American Economies

Country	Argentina	Brazil	Mexico	Colombia	Chile	Ecuador
Brazil	0.294**					
Mexico	-0.140	0.576***				
Colombia	0.098	0.721***	0.814***			
Chile	-0.231	0.499***	0.904***	0.868***		
Ecuador	0.078	0.439***	0.429***	0.452***	0.434***	
Perú	-0.051	0.721***	0.755***	0.934***	0.887***	0.454***

**Seven Latin American Countries:
Principal Components Variance Decomposition**

Component	Output Cycle	EMBI Cycle
First	0,60	0,72
Second	0,18	0,25
Third	0,10	0,02
Fourth	0,06	0,00
Fifth	0,03	0,00
Sixth	0,03	0,00
Seventh	0,02	0,00

Credit default swap en algunos países de América Latina

(puntos básicos)

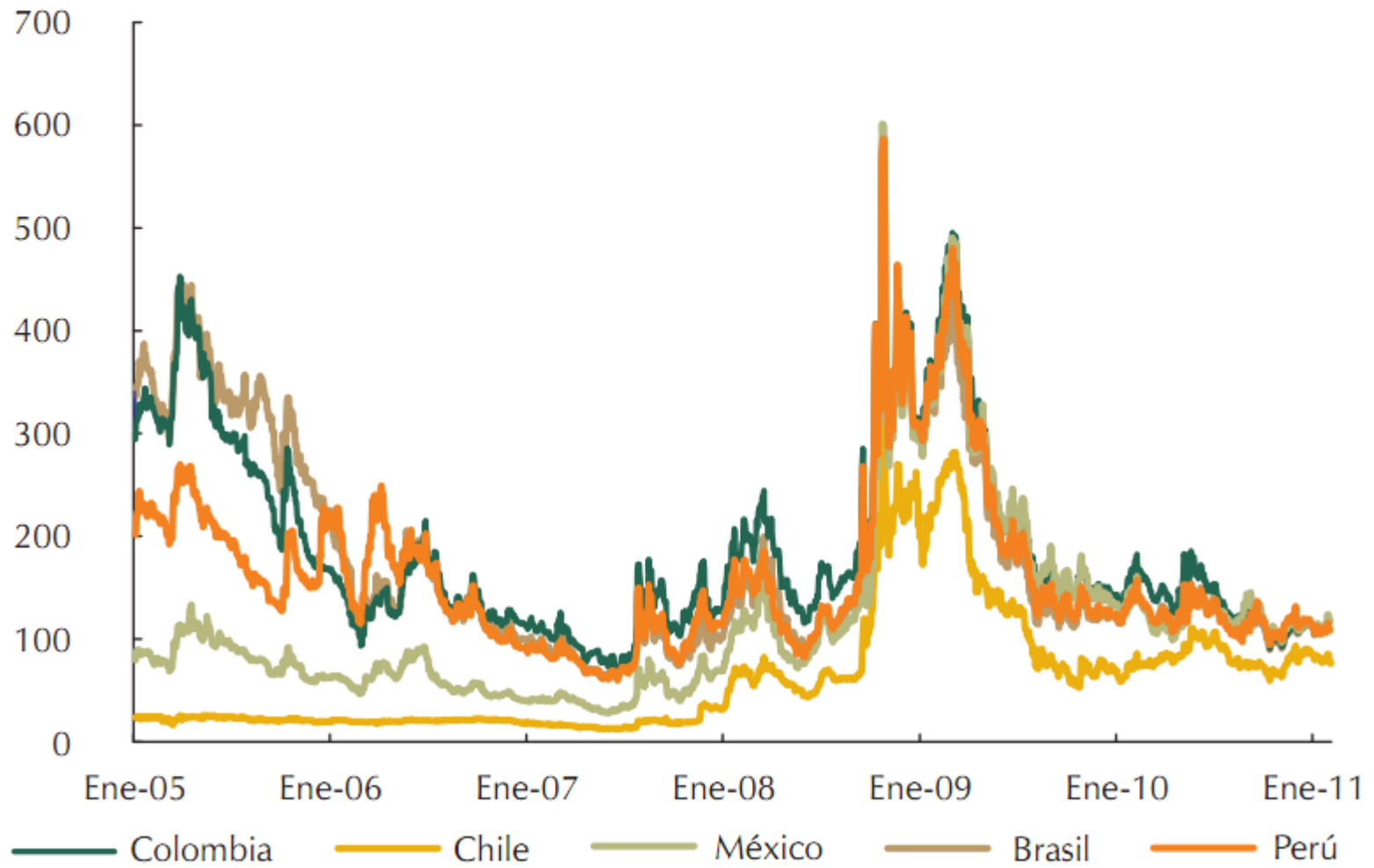


Table 4. Correlations across Regional EMBIs

	Full Range of Dataset		
Region	Latin America	Asia	East and North Africa
Asia	0.57***		
East and North Africa	0.72***	0.32**	
All Emerging	0.88***	0.58***	0.49***

Note: Series have been Hodrick Prescott filtered. See the Data Appendix for details about each variable series range and source. *** Indicates Pvalue significance at 1% ** Indicates Pvalue significance at 5% * Indicates Pvalue significance at 10%

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All Emerging	0.88***	0.58***	0.49***
	2000-2010		
Asia	0.61***		
East and North Africa	0.80***	0.38**	
All Emerging	0.95***	0.75***	0.73***
<p>Note: Series have been Hodrick Prescott filtered. See the Data Appendix for details about each variable series range and source. *** Indicates Pvalue significance at 1% ** Indicates Pvalue significance at 5% * Indicates Pvalue significance at 10%</p>			

- **Observation 2:**

- Strong comovement across countries in

- (i) Output fluctuations

- (ii) Spreads

- **Empirical literature:**

- Agonzález-Rozada y Levy Yeyati (EJ, 2008)*

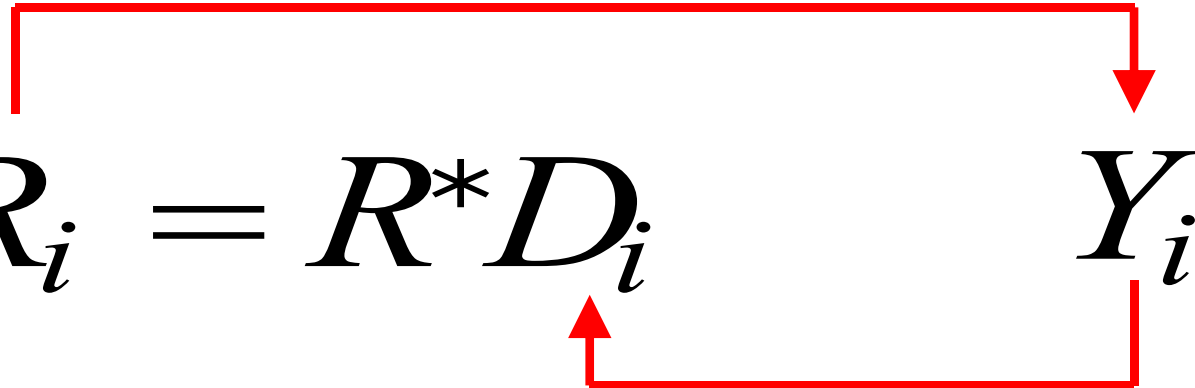
- Aiolfi et.al.(IMF, 2006)*

- McGuire and Schrijvers (BIS, 2003)*

- Dedu et.al. (2010)*

- There seems to be a **disconnect between the two observations** (& literatures):

Observation 1:

$$R_i = R^* D_i \quad Y_i$$


Observation 2 :

$$\text{corr}(Y_i, Y_j) \gg 0 \quad \text{corr}(R_i, R_j) \gg 0$$

- **What we do: two things**

1. We quantify the role of external factors in EMEs' business cycles using (atheoretical) dynamic factor models.

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2. We build an equilibrium business cycle model to account for these external forces.

↳ **Regional risk component** in the spreads

- **What we (prelim.) find: Two things**

1. **External factors matter** when accounting for business cycles in emerging economies.

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↳ Both regional and global

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2. In the model, **the regional risk acts as a powerful driving force** of the business cycle.

- **What we (prelim.) find: Two things**

1. **External factors matter** when accounting for business cycles in emerging economies.

↳ Both regional and global

2. In the model, **the regional risk acts as a powerful driving force** of the business cycle.

↳ 2008 Financial crisis: a good example

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- **What is a Dynamic Factor Model:**

1. A form to map a set of observables (**Y**) to another set of unobservables (**S**)

- **What is a Dynamic Factor Model:**

1. A form to map a set of observables (**Y**) to another set of unobservables (**S**)

2. A state space representation:

$$\mathbf{S}_{t+1} = \mathbf{F} \cdot \mathbf{S}_t + \mathbf{B} \cdot \epsilon_{t+1}$$

$$\mathbf{Y}_t = \mathbf{H} \cdot \mathbf{S}_t$$

- **Two applications:**

1. Using Regional EMBI spreads:

$$\widehat{EMBI}_t^J = \alpha_0^J Rg_t^J + \alpha_1^J G_t$$

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$$\widehat{EMBI}_t^J = \alpha_0^J Rg_t^J + \alpha_1^J G_t$$



$$G_t = \rho_G G_{t-1} + \varepsilon_t^G$$

$$Rg_t^J = \rho_{J,Rg} Rg_{t-1}^J + \varepsilon_{J,t}^{Rg}$$

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$$Rg_t^J = \rho_{J,Rg} Rg_{t-1}^J + \varepsilon_{J,t}^{Rg}$$



$$\mathbf{S}_t = [\hat{G}_t, Rg_t^{AL}, Rg_t^{AS}]$$

$$\mathbf{Y}_t = [\widehat{EMBI}_t^{AL}, \widehat{EMBI}_t^{AS}]$$

- **Two applications:**

2. Using country specific EMBlS or Output:

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- 2. Using country specific EMBIs or Output:

$$\widehat{EMBI}_{i,t} = \alpha_{0,i}^{J,D} D_{i,t}^J + \alpha_{1,i}^{J,D} Rg_t^J + \alpha_{2,i}^{J,D} G_t$$

$$\hat{y}_{i,t} = \alpha_{0,i}^{J,Y} D_{i,t}^J + \alpha_{1,i}^{J,Y} Rg_t^J + \alpha_{2,i}^{J,Y} G_t$$

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$$\begin{array}{l} \downarrow \\ \rightarrow \end{array} \begin{array}{l} G_t = \rho_G G_{t-1} + \varepsilon_t^G \\ Rg_t^J = \rho_{J,Rg} Rg_{t-1}^J + \varepsilon_{J,t}^{Rg} \\ D_{i,t}^J = \rho_{D,i,J} D_{i,t-1}^J + \varepsilon_{i,J,t}^D \end{array}$$

- **Two applications:**

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$$\widehat{EMBI}_{i,t} = \alpha_{0,i}^{J,D} D_{i,t}^J + \alpha_{1,i}^{J,D} Rg_t^J + \alpha_{2,i}^{J,D} G_t$$

$$\hat{y}_{i,t} = \alpha_{0,i}^{J,Y} D_{i,t}^J + \alpha_{1,i}^{J,Y} Rg_t^J + \alpha_{2,i}^{J,Y} G_t$$

$$\begin{aligned} G_t &= \rho_G G_{t-1} + \varepsilon_t^G \\ Rg_t^J &= \rho_{J,Rg} Rg_{t-1}^J + \varepsilon_{J,t}^{Rg} \\ D_{i,t}^J &= \rho_{D,i,J} D_{i,t-1}^J + \varepsilon_{i,J,t}^D \end{aligned}$$

$$\mathbf{S}_t = [D_{ARG,t}^{LA}; D_{BRA,t}^{LA}; D_{COL,t}^{LA}; D_{ECU,t}^{LA}; D_{MEX,t}^{LA}; D_{PER,t}^{LA}; Rg_t^{LA}; D_{PHI,t}^{AS}; D_{MAL,t}^{AS}; D_{KOR,t}^{AS}; Rg_t^{AS}; G_t]$$

$$\mathbf{Y}_t = \begin{bmatrix} \widehat{EMBI}_{ARG,t}; \widehat{EMBI}_{BRA,t}; \widehat{EMBI}_{COL,t}; \widehat{EMBI}_{ECU,t}; \widehat{EMBI}_{MEX,t}; \widehat{EMBI}_{PER,t}; \widehat{EMBI}_{PHI,t}; \widehat{EMBI}_{MAL,t}; \widehat{EMBI}_{KOR,t} \\ \hat{y}_{ARG,t}; \hat{y}_{BRA,t}; \hat{y}_{COL,t}; \hat{y}_{ECU,t}; \hat{y}_{MEX,t}; \hat{y}_{PER,t}; \hat{y}_{PHI,t}; \hat{y}_{MAL,t}; \hat{y}_{KOR,t} \end{bmatrix}$$

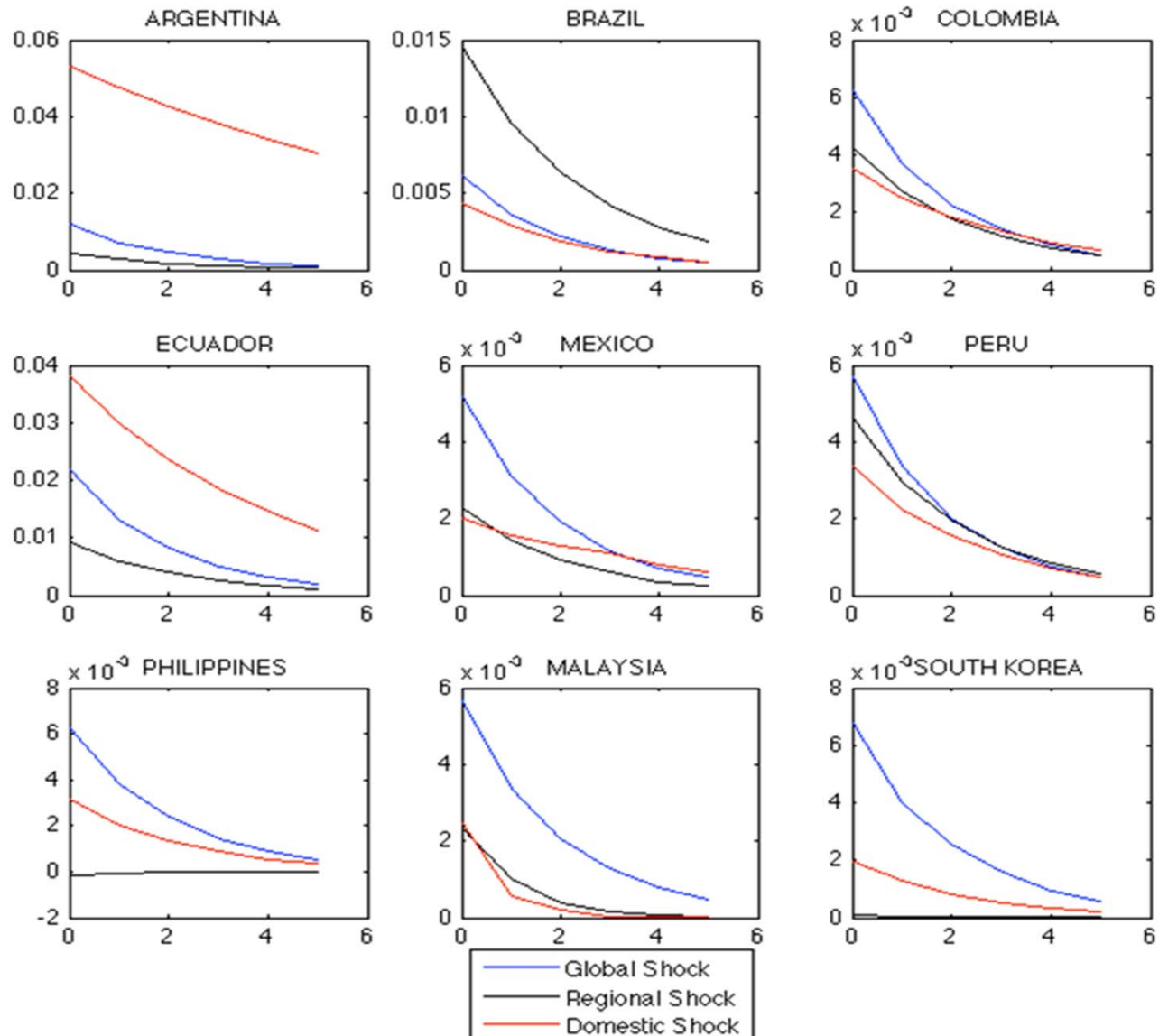
- **Results: Variance Decomposition**

LATIN AMERICA			
	GLOBAL	REGIONAL	
1	0.44	0.56	
5	0.32	0.68	
10	0.14	0.86	
20	0.01	0.99	
50	0.00	1.00	

- **Results: Variance Decomposition**

	EMBI			OUPUT		
	DOMESTIC	REGIONAL	GLOBAL	DOMESTIC	REGIONAL	GLOBAL
Argentina	0.94	0.03	0.03	0.77	0.01	0.22
Brazil	0.08	0.79	0.13	0.29	0.05	0.66
Colombia	0.18	0.12	0.70	0.71	0.16	0.13
Ecuador	0.72	0.05	0.23	0.98	0.00	0.02
Mexico	0.12	0.06	0.82	0.37	0.01	0.62
Peru	0.18	0.19	0.64	0.77	0.00	0.23
Philippines	0.21	0.00	0.79	0.83	0.16	0.00
Malaysia	0.09	0.13	0.78	0.01	0.27	0.72
South Korea	0.15	0.04	0.81	0.60	0.01	0.39
Turkey	0.52	0.00	0.47	0.57	0.00	0.43
South Africa	0.21	0.00	0.79	0.90	0.00	0.10

• Results: Impulse Response Functions



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- A Dynamic Equilibrium Model

**World
Capital/ Goods
Markets**

**Emerging
Economy 1**

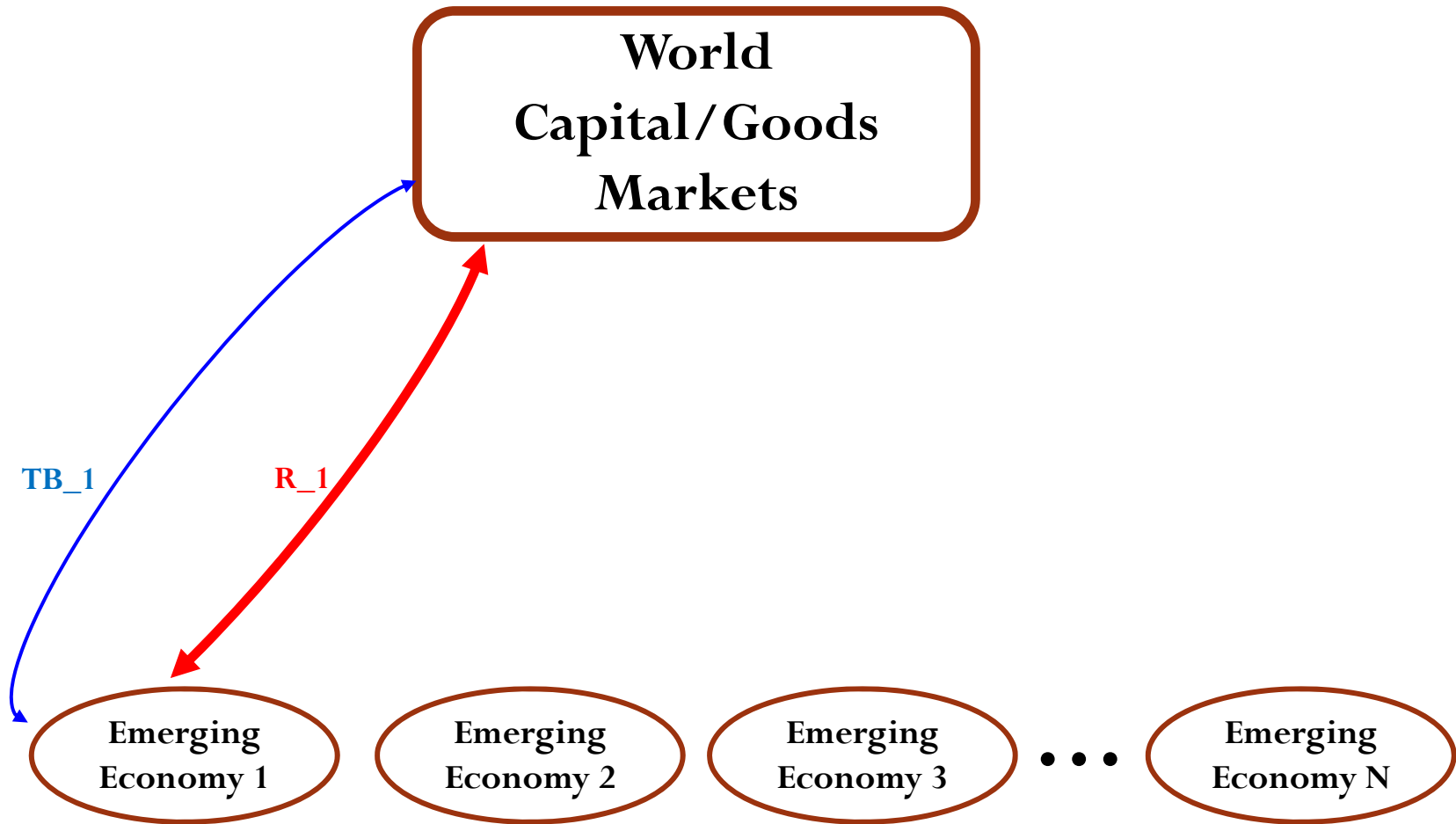
**Emerging
Economy 2**

**Emerging
Economy 3**

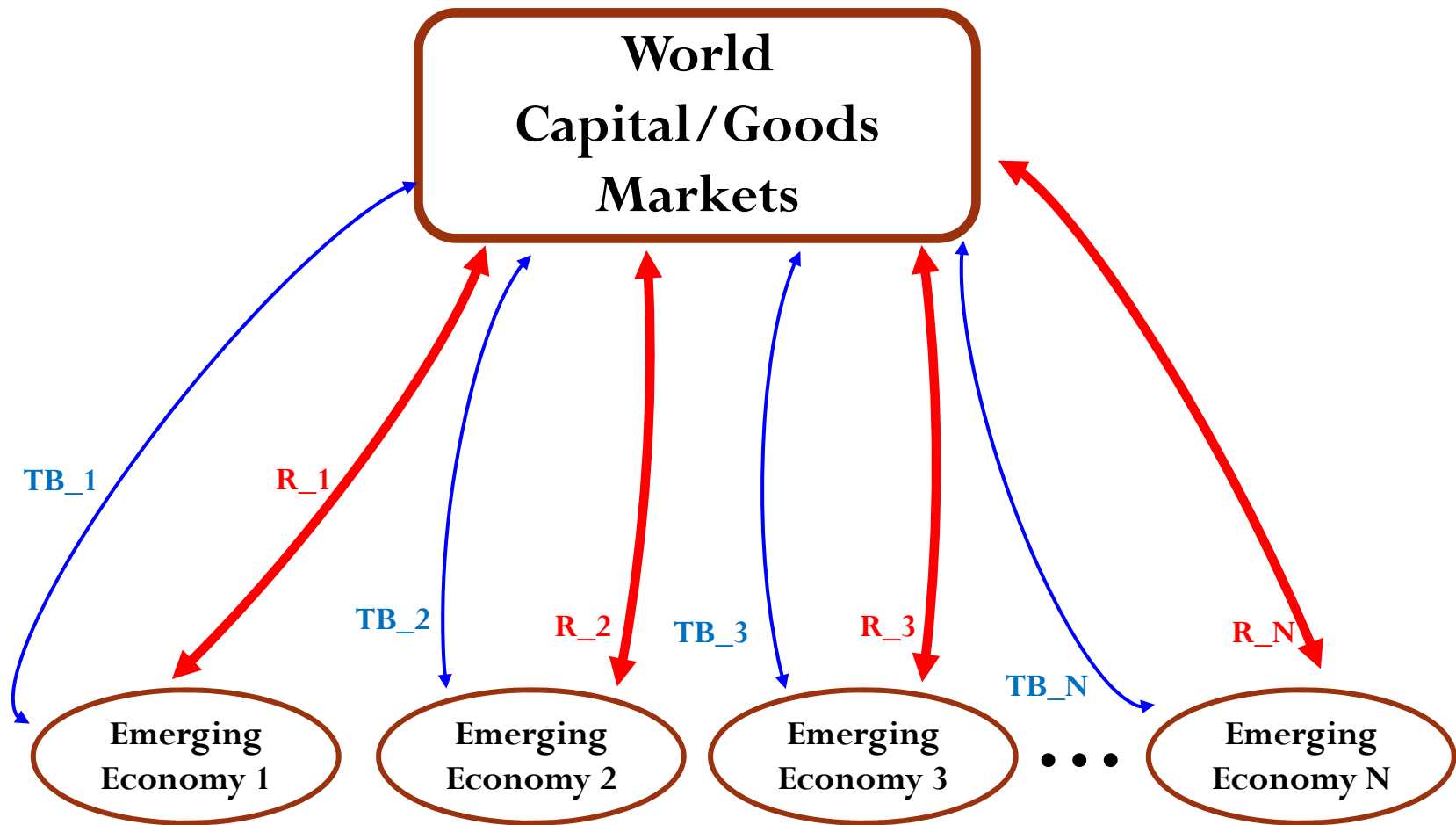
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**Emerging
Economy N**

- A Dynamic Equilibrium Model



- A Dynamic Equilibrium Model



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Model – Interest Rates

- Country i 's interest rate

$$R_{i,t} = R_t^* \cdot S_{i,t}$$

- Stochastic World Interest Rate

$$\hat{R}_t^* = \rho_1 \hat{R}_{t-1}^* + \varepsilon_t^R, \quad \varepsilon_t^R \sim (0, \sigma_{\varepsilon \hat{R}^*}^2)$$

- Country i 's Spread

$$S_{i,t} = RS_t \cdot D_{i,t}$$

Model – Interest Rates

- Regional Risk component in spread (Common Trend)

$$\widehat{RS}_t = \rho_{RS} \widehat{RS}_{t-1} + \varepsilon_t^{RS}, \quad \varepsilon_t^{RS} \sim (0, \sigma_{\varepsilon^{RS}}^2)$$

- Domestic component in spread

$$\widehat{D}_{i,t} = -\bar{\eta}_i E_t(\widehat{a}_{i,t+1}) + \varepsilon_{i,t}^{\widehat{D}}, \quad \varepsilon_{i,t}^{\widehat{D}} \sim (0, \sigma_{\varepsilon_i^{\widehat{D}}}^2)$$

$$\widehat{a}_{i,t} = \rho_{a,i} \widehat{a}_{i,t-1} + \varepsilon_{i,t}^{\widehat{a}}, \quad \varepsilon_{i,t}^{\widehat{a}} \sim (0, \sigma_{\varepsilon^{\widehat{a}_i}}^2)$$

Model – Interest Rates

- Comparison to the literature

Neumeyer & Perri

Uribe & Yue

$$\left\{ \begin{array}{l} R_{i,t} = R_t^* \cdot D_{i,t} \\ \hat{D}_{i,t} = -\bar{\eta}_i E_t(\hat{a}_{i,t+1}) + \varepsilon_{i,t}^{\hat{D}} \end{array} \right.$$

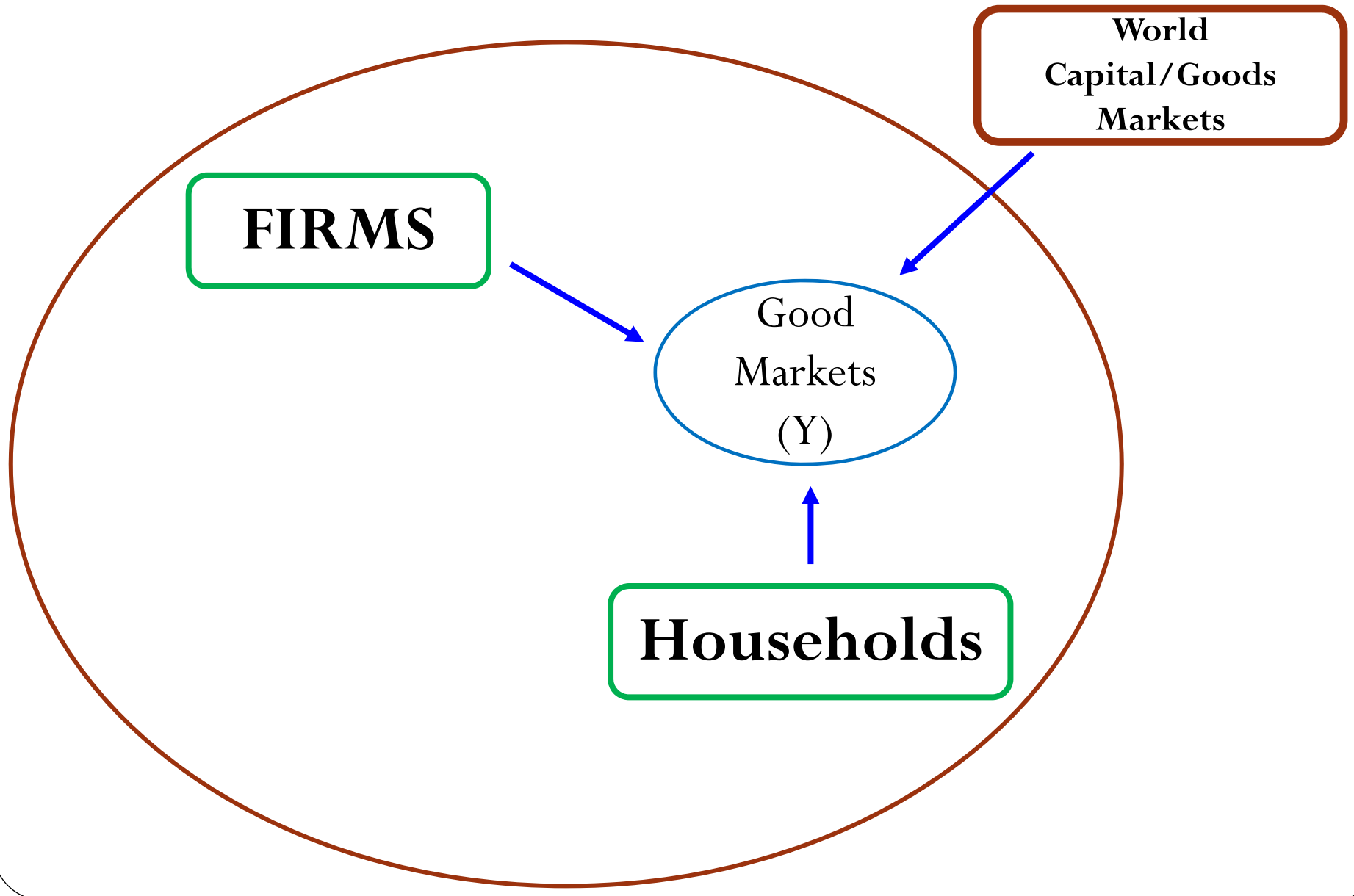
Fernández, Gulan
& Zamora

$$\left\{ \begin{array}{l} R_{i,t} = R_t^* \cdot S_{i,t} \\ S_{i,t} = RS_t \cdot D_{i,t} \\ \hat{D}_{i,t} = -\bar{\eta}_i E_t(\hat{a}_{i,t+1}) + \varepsilon_{i,t}^{\hat{D}} \\ \widehat{RS}_t = \rho_{RS} \widehat{RS}_{t-1} + \varepsilon_t^{RS} \end{array} \right.$$

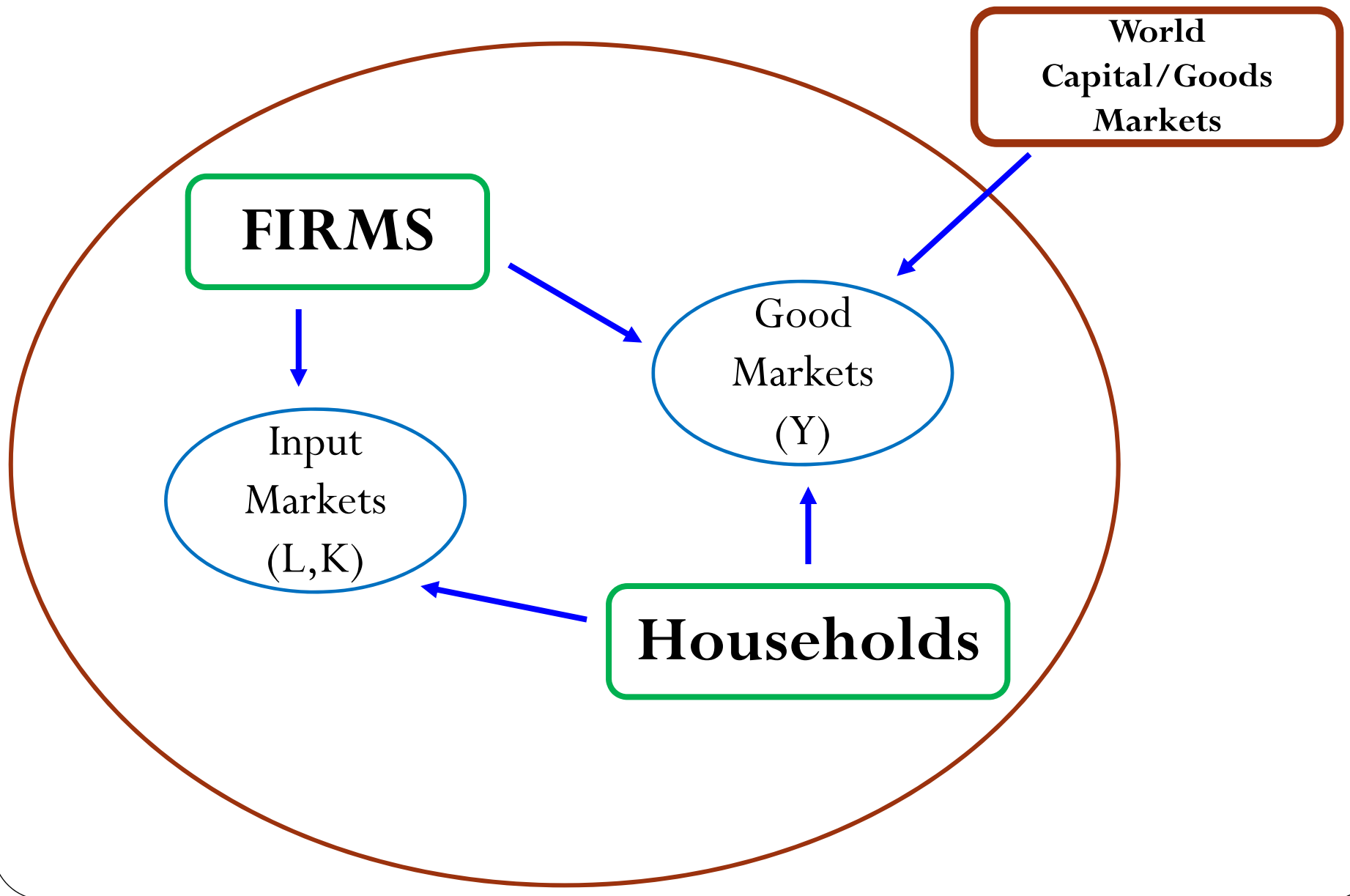
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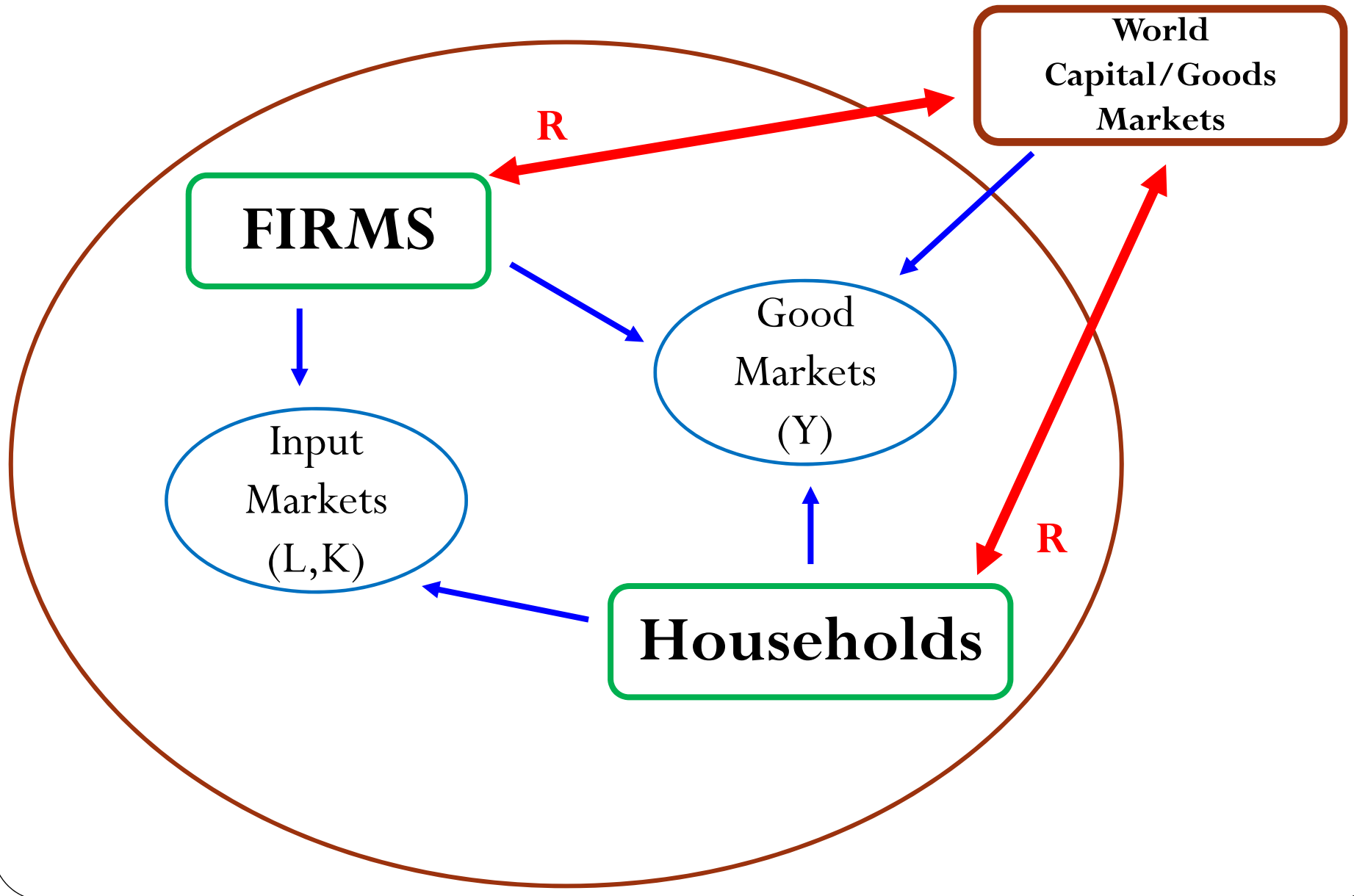
- **Nth Emerging economy**



- **Nth Emerging economy**



- **Nth Emerging Economy**



Model – Firms

- Cobb-Douglas Technology

$$Y_{i,t} = a_{i,t} K_{i,t}^{\alpha_i} [(1 + \gamma_i)^t l_{i,t}]^{1-\alpha_i}$$

- Benefits

$$\pi_{i,t} = Y_{i,t} - W_{i,t} l_{i,t} - r_{i,t} K_{i,t} - (R_{i,t-1} - 1) \theta_i W_{i,t} l_{i,t}$$

- F.O.C.s

$$r_{i,t} = \alpha_i a_{i,t} K_{i,t}^{\alpha_i - 1} [(1 + \gamma_i)^t l_{i,t}]^{1-\alpha_i}$$

$$W_{i,t} [1 + (R_{i,t-1} - 1) \theta_i] = (1 - \alpha_i) a_{i,t} K_{i,t}^{\alpha_i} (1 + \gamma_i)^{t(1-\alpha_i)} l_{i,t}^{-\alpha_i}$$

Model – Households

- Preferences

$$\sum_{t=0}^{\infty} \beta^t \left\{ \frac{1}{1-\sigma} [C_{i,t} - \psi_i (1 + \gamma_i)^t l_{i,t}^\nu]^{1-\sigma} \right\}$$

- Constraints

$$C_{i,t} + X_{i,t} + B_{i,t} + \frac{\kappa}{2} Y_{i,t} \left(\frac{B_{i,t}}{Y_{i,t}} - \bar{b}_i \right)^2 = W_{i,t} l_{i,t} + r_{i,t} K_{i,t} + B_{i,t-1} R_{i,t-1}$$

$$K_{i,t+1} = (1 - \delta_i) K_{i,t} + X_{i,t} - \frac{\phi_i}{2} K_{i,t} \left(\frac{K_{i,t+1}}{K_{i,t}} - (1 + \gamma_i) \right)^2$$

Model – Grl. Equilibrium

- Net Exports

$$NX_{i,t} = \frac{\left(Y_{i,t} - C_{i,t} - X_{i,t} - \frac{\kappa}{2} Y_{i,t} \left(\frac{B_{i,t}}{Y_{i,t}} - \bar{b}_i \right)^2 \right)}{Y_{i,t}}$$

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An experiment

- We simulate the model assuming that we observe data on RS. We assess the performance in matching the cycle in the EMEs of our sample.
- Dataset: 7 Latin American economies;
- 1994.Q1-2010.Q3

An experiment

- *Non Country specific parameters*

$$\hat{R}_t^* = \rho_1 \hat{R}_{t-1}^* + \varepsilon_t^R, \quad \varepsilon_t^R \sim (0, \sigma_{\varepsilon^R}^2)$$

OLS, 3-Month US-TBills

OLS, LatinAmerican EMBI

$$\widehat{RS}_t = \rho_{RS} \widehat{RS}_{t-1} + \varepsilon_t^{RS}, \quad \varepsilon_t^{RS} \sim (0, \sigma_{\varepsilon^{RS}}^2)$$

An experiment

- *Country specific parameters*

- *Four key parameters*

$$\hat{D}_{i,t} = -\bar{\eta}_i E_t(\hat{a}_{i,t+1}) + \varepsilon_{i,t}^{\hat{D}}, \quad \varepsilon_{i,t}^{\hat{D}} \sim \left(0, \sigma_{\varepsilon_i^{\hat{D}}}^2\right)$$

Calibrated at 0.95 as in NP

$$\hat{a}_{i,t} = \rho_{a,i} \hat{a}_{i,t-1} + \varepsilon_{i,t}^{\hat{a}}, \quad \varepsilon_{i,t}^{\hat{a}} \sim \left(0, \sigma_{\varepsilon_i^{\hat{a}}}^2\right)$$


An experiment

- *Country specific parameters*

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$$\hat{D}_{i,t} = -\bar{\eta}_i E_t(\hat{a}_{i,t+1}) + \varepsilon_{i,t}^{\hat{D}}, \quad \varepsilon_{i,t}^{\hat{D}} \sim \left(0, \sigma_{\varepsilon_i^{\hat{D}}}^2\right)$$

Jointly calibrated so as to:

(i) *match output's volatility*

(ii) *match dynamics of R_i*

$$\hat{a}_{i,t} = \rho_{a,i} \hat{a}_{i,t-1} + \varepsilon_{i,t}^{\hat{a}}, \quad \varepsilon_{i,t}^{\hat{a}} \sim \left(0, \sigma_{\varepsilon_i^{\hat{a}}}^2\right)$$

An experiment

- *Country specific parameters*

- *Four key parameters*

$$\bar{\eta}_i^2 = \frac{\left(\sigma_{\hat{R}_i}^2 \rho_{\hat{R}_i} - \sigma_{\hat{R}^*}^2 \rho_1 - \rho_{\hat{SR}} \sigma_{\hat{SR}}^2 \right)}{\rho_{\hat{a}}^3 \sigma_{\hat{a}_i}^2}$$

$$\sigma_{\hat{D}_i}^2 = \sigma_{\hat{R}_i}^2 - \sigma_{\hat{R}^*}^2 - \sigma_{\hat{SR}}^2 - \bar{\eta}_i^2 \rho_{\hat{a}}^2 \sigma_{\hat{a}_i}^2$$

An experiment

- *Country specific parameters*

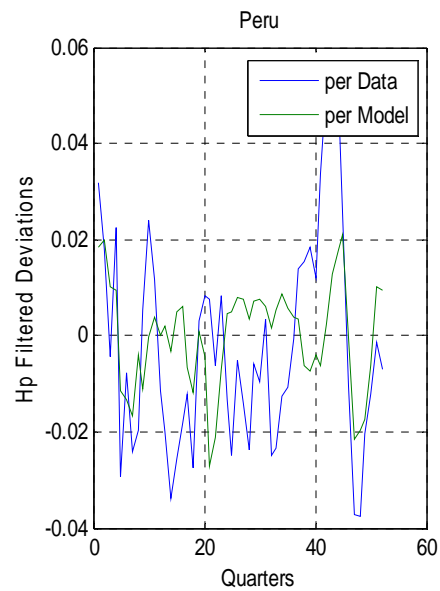
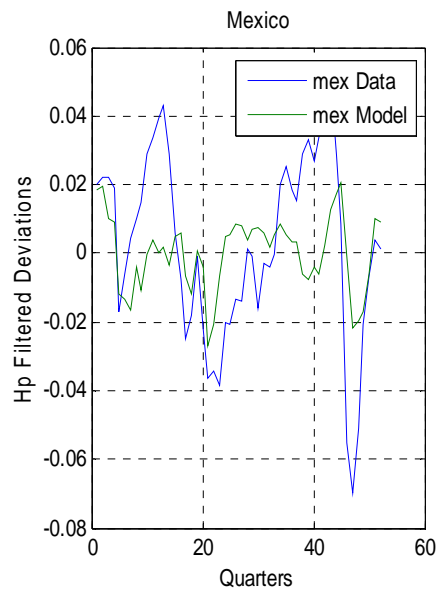
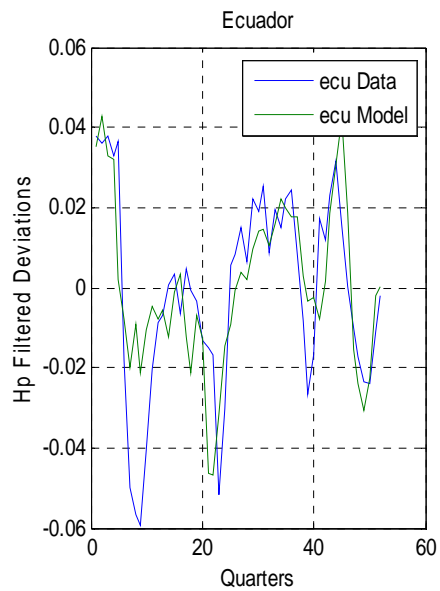
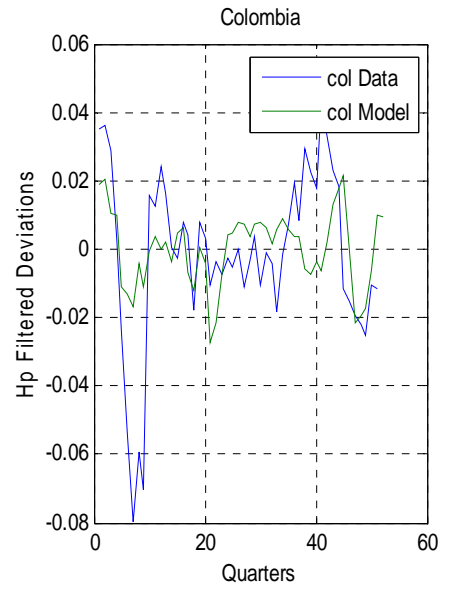
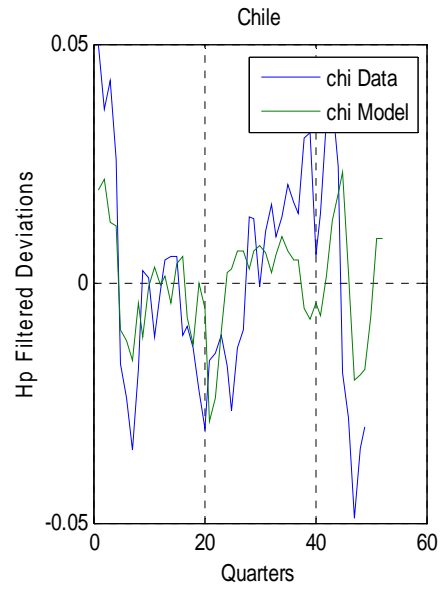
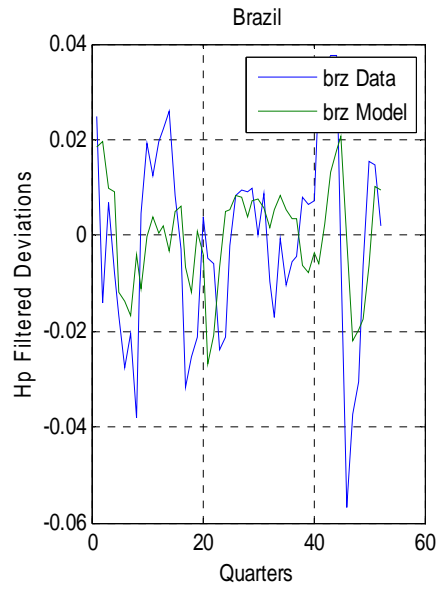
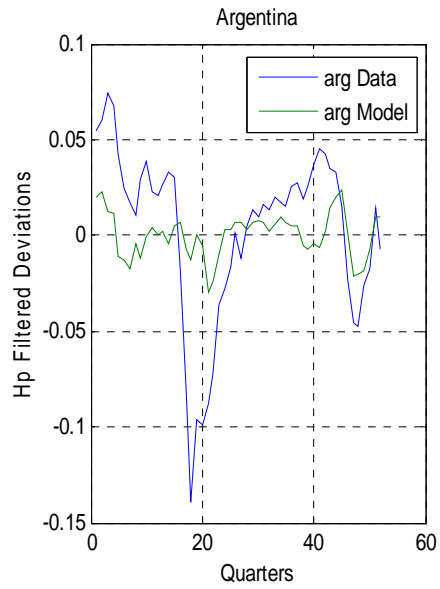
- *Other parameters calibrated from data:*

$$\{\gamma_i, \beta_i, \psi_i, \alpha_i, \delta_i, \bar{b}_i, \phi_i\}$$

- *Remaining parameters calibrated from other studies and identical across countries:*

$$\{\sigma, \nu, \theta, \kappa\}$$

Results



Index

- Motivation
- Dynamic Factor Analysis
- A Dynamic Equilibrium Model
- **Extensions**

Extensions we´re considering

- **Allow for common productivity shocks**
- **Other “real” common factors**
- **Estimate the model using full information**
- **Other regions (i.e. Asia, all EEs)**

Extensions we´re considering

- **Allow for common productivity shocks**
- **Other “real” common factors**
 - *Common shocks in terms of trade*
- **Estimate the model using full information**
- **Other regions (i.e. Asia, all EEs)**

Extensions we´re considering

- Allow for common productivity shocks
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- Estimate the model using full information
- Other regions (i.e. Asia, all EEs)

Gracias!