Capital Flows and Business Cycles in Latin America during 1920s-30s. A Second Look from a Neoclassical Perspective.

Central Bank Workshop on Macroeconomic Modelling/2008

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MOTIVATION

- Standard References in Emerging Market-Business Cycles:
  - Terms of Trade.
  - Procyclical Fiscal Policies.
  - Permanent shocks to trend.
  - **Exogenous Shocks to Foreign Financial Markets.**

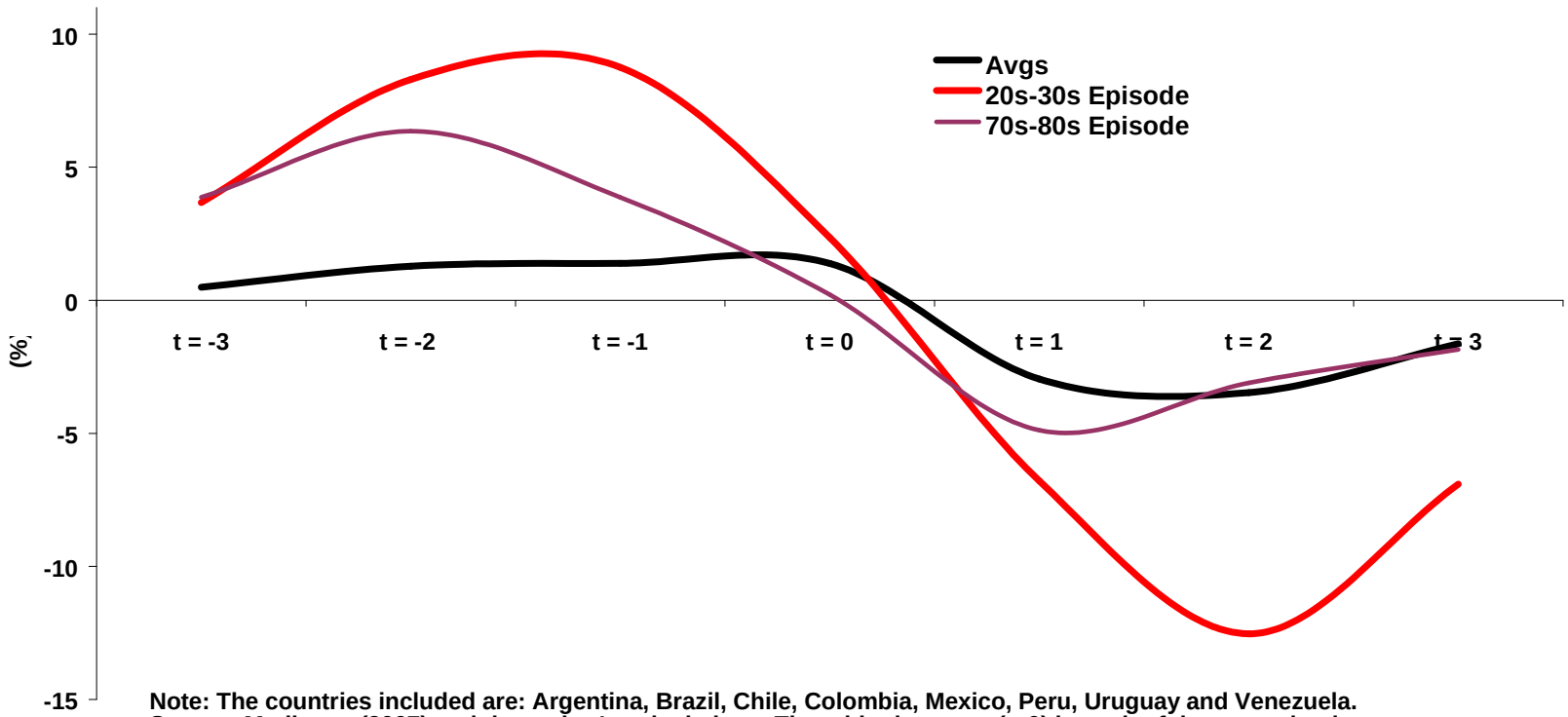
MOTIVATION

- A Stylized Fact.
  1. The most volatile business cycles in EM - Latin American economies in particular - have been observed in *combination with sizeable swings in capital flows.*

MOTIVATION

- A Stylized Fact.

Fig. 1.1. Average Real GDP pc Cycle (HP-Filtered) in 8 Latin American countries. Average (1910-2001) Vs Capital Inflows/Outflows in two episodes.



Note: The countries included are: Argentina, Brazil, Chile, Colombia, Mexico, Peru, Uruguay and Venezuela. Source: Madisson (2007) and the author's calculations. The midpoint years (t=0) in each of the two episodes are: 1931 and 1983.

MOTIVATION

- Goal: *Use the "historical laboratory" of the 1920s-30s in Latin America to study the role of external shocks to foreign financial markets in driving business cycles in EM.*

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- *Exogenous Shocks to Foreign Financial Markets: References.*
  - **1980's Debt Crisis:** Diaz-Alejandro (1983).

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  - **Foreign interest shocks & Financial Frictions in a DSGE set-up:**

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    - Uribe and Yue (2006, *JIE*)
    - Chang and Fernandez (2008)

MOTIVATION

- *Why is this relevant? Why is the 1920s-30s episode of interest?*.

1. Can the neoclassical general equilibrium dynamic macro. models used today (DSGE's) explain this episode? Can the lessons from this episode enhance the ability of DSGE's to account for EM's fluctuations?

2. Foreign financial shocks appear to be as relevant in explaining business cycles in LA as nearly a century ago!

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3. Testing the model's performance in accounting for the 1920s-30s episode.
4. The role of countercyclical policy.

MOTIVATION

- *Main Findings*.

1. The size of capital flows to LA in the 1920s was unprecendeted can only be matched by the 80s and 90s, with significant real consequences. A key transmission mechanism was the credit channel.

2. When the credit channel is embedded into a DSGE setup, the model does account for the transmission mechanism through which foreign financial conditions drove business cycles in 1920s: Boom of mid-20's and bust of late 1920s.

3. When the model is expanded in order to account for the role of countercyclical monetary policy, it accounts for a portion (but not all) of the recovery phase.

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Capital Flows to LA in the 1920s-30s:

- Quantities: Bond Issues

New Foreign Bonds Issues in US Markets

Period	TOTAL Gross Nominal Value (US$ M)	From Latin America	
		(US$ M)	(%)
1920	497	45	9
1921 - 1923	1808	568	31
1924 - 1925	2045	345	17
1926 - 1928	3713	1038	28
1929 - 1931	1805	377	21
1932 - 1935	85	2	2

Source: Avella (2007)

Capital Flows to LA in the 1920s-30s:

- Quantities: Private Funds

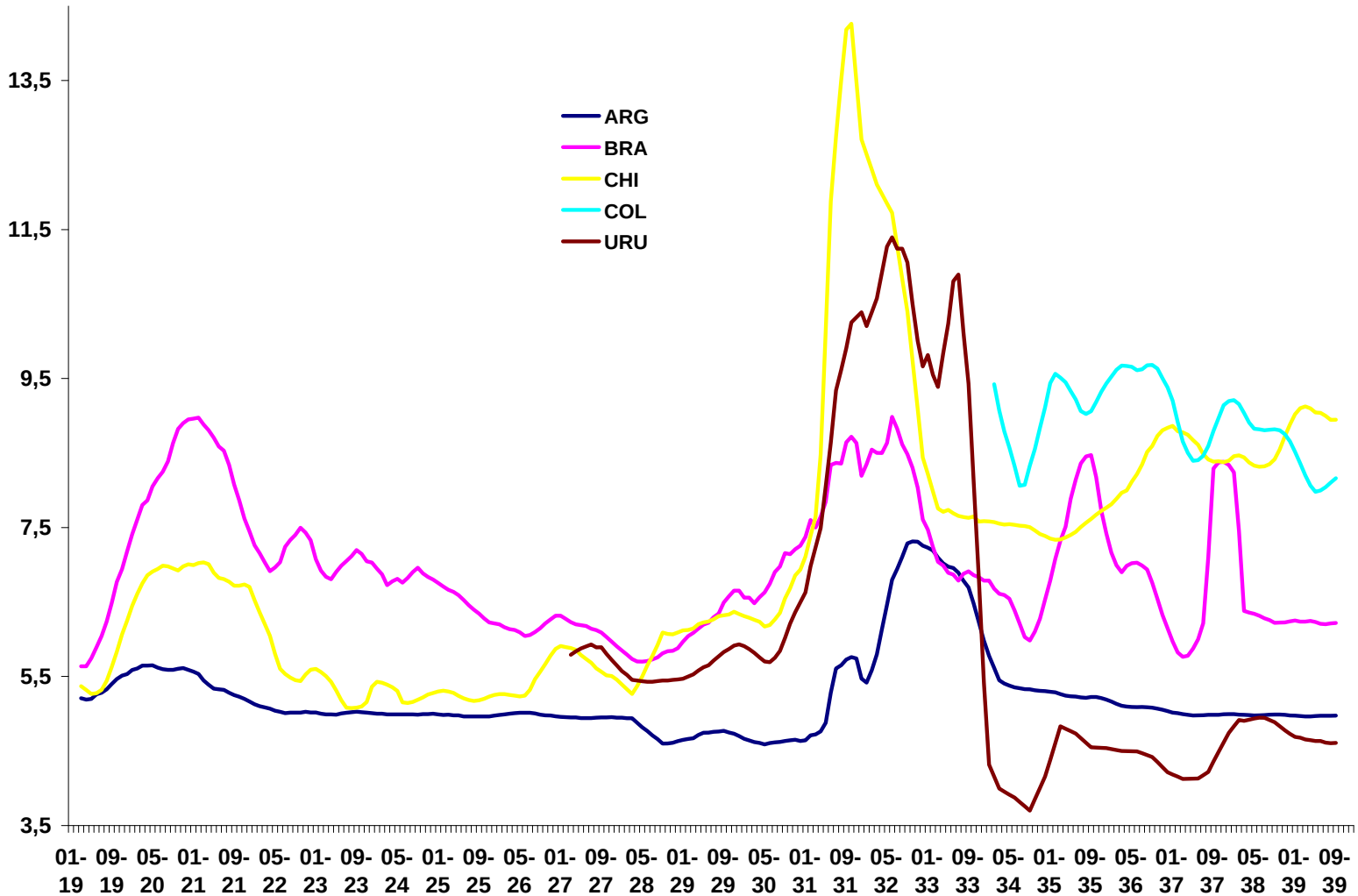
Gross Supply of US Private Funds to Latin America (US$ M)

Periodo	Total	Argentina	Brazil	Chile	Colombia	Peru	Others
1921 - 1923	411	151	139	62	7	3	50
1924 - 1925	317	257	9	18	13	15	5
1926 - 1928	990	263	198	178	**183**	94	74
1929 - 1931	288	171	41	64	2	2	8

Source: Avella (2007)

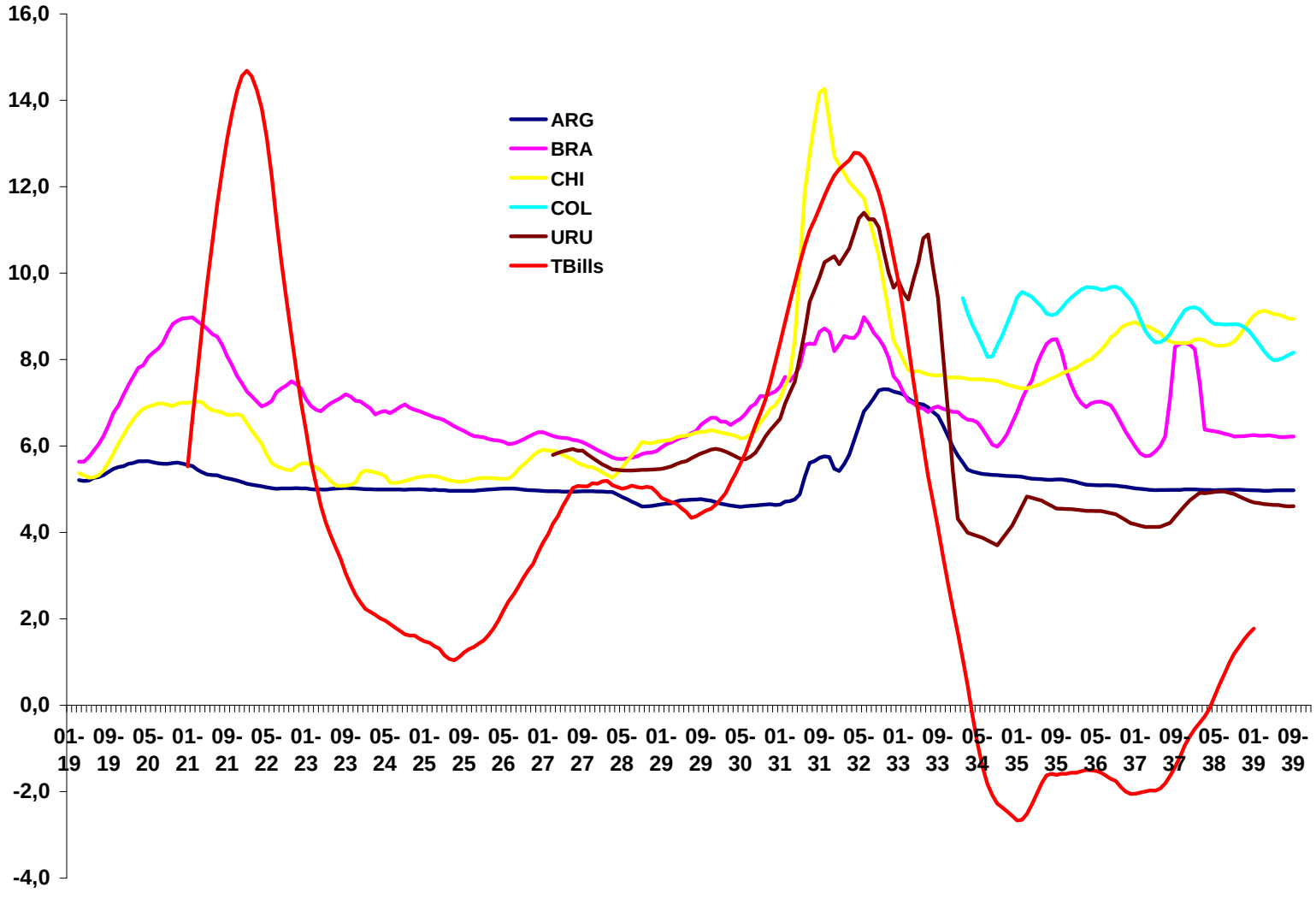
Capital Flows to LA in the 1920s-30s:

- Prices: Government Bond Yields



Capital Flows to LA in the 1920s-30s:

- Prices: Government Bond Yields & Real T-Bills Yields



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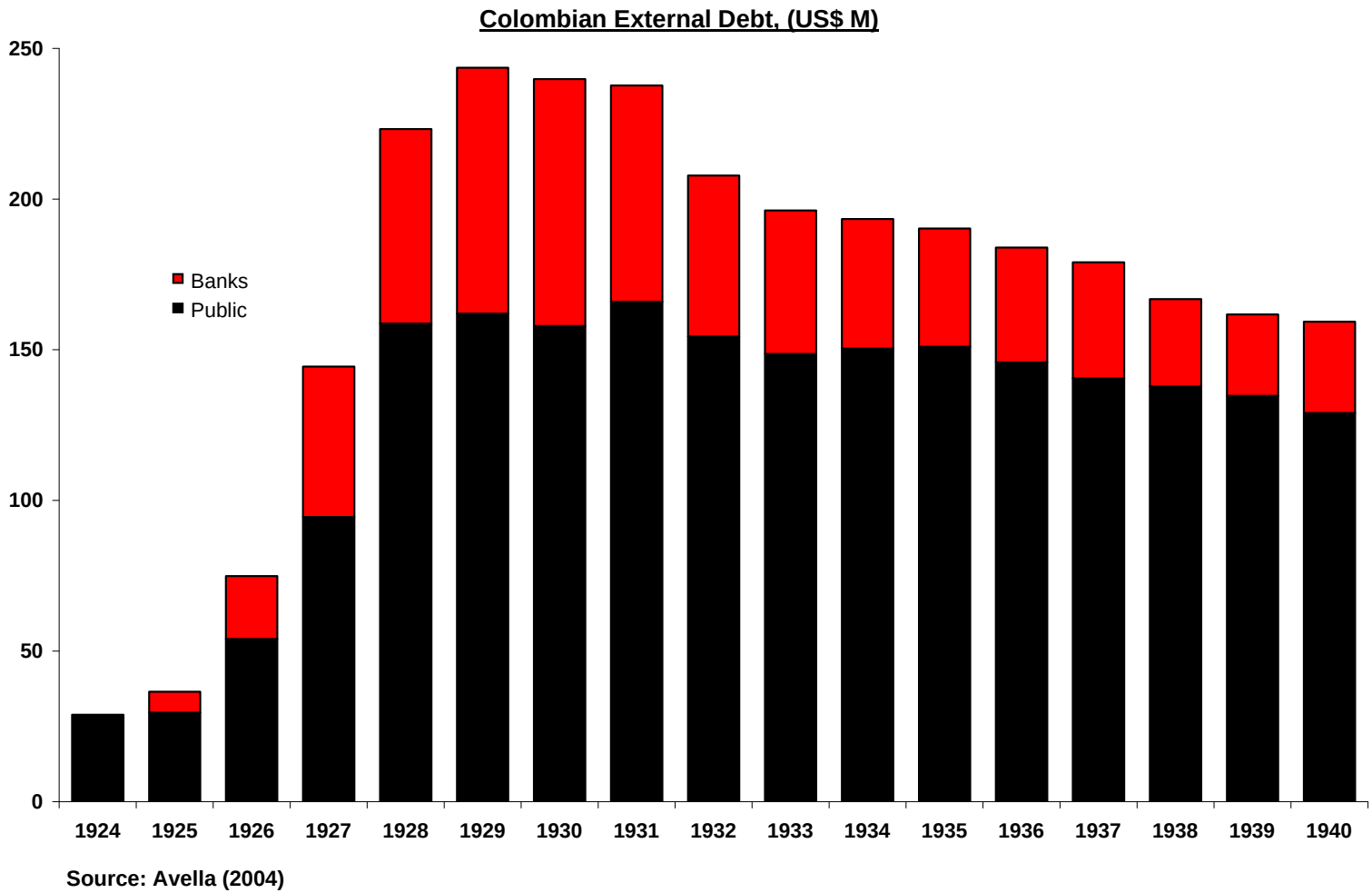
- A Closer Look to Colombia:



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Macroeconomic Indicators

Year	Loans by the Financial System to GDP (%)	Mortgages: Annual Average Interest Rates (%)	Construction Sector Index (1925=100).	Real Exchange Rate Index (1925=100).
1923		13,8		120
1924	1.1	13,9		106
1925	6.7	12.1	100	100
1926	7.1	11.2	200	89
1927	8.1	11.6	202	79
1928	8.0	11.2	325	73
1929	8.7	12,4	246	83
1930	9.6	15,1	163	104
1931	9.5	14,4	139	110
1932	7.7	10.6	143	124
1933	6.2	9.1	177	141
1934	4.0	10.0	159	163
1935	4.3	10,1	202	187
1936	4.7	10.6	216	169

Sources: See Paper.

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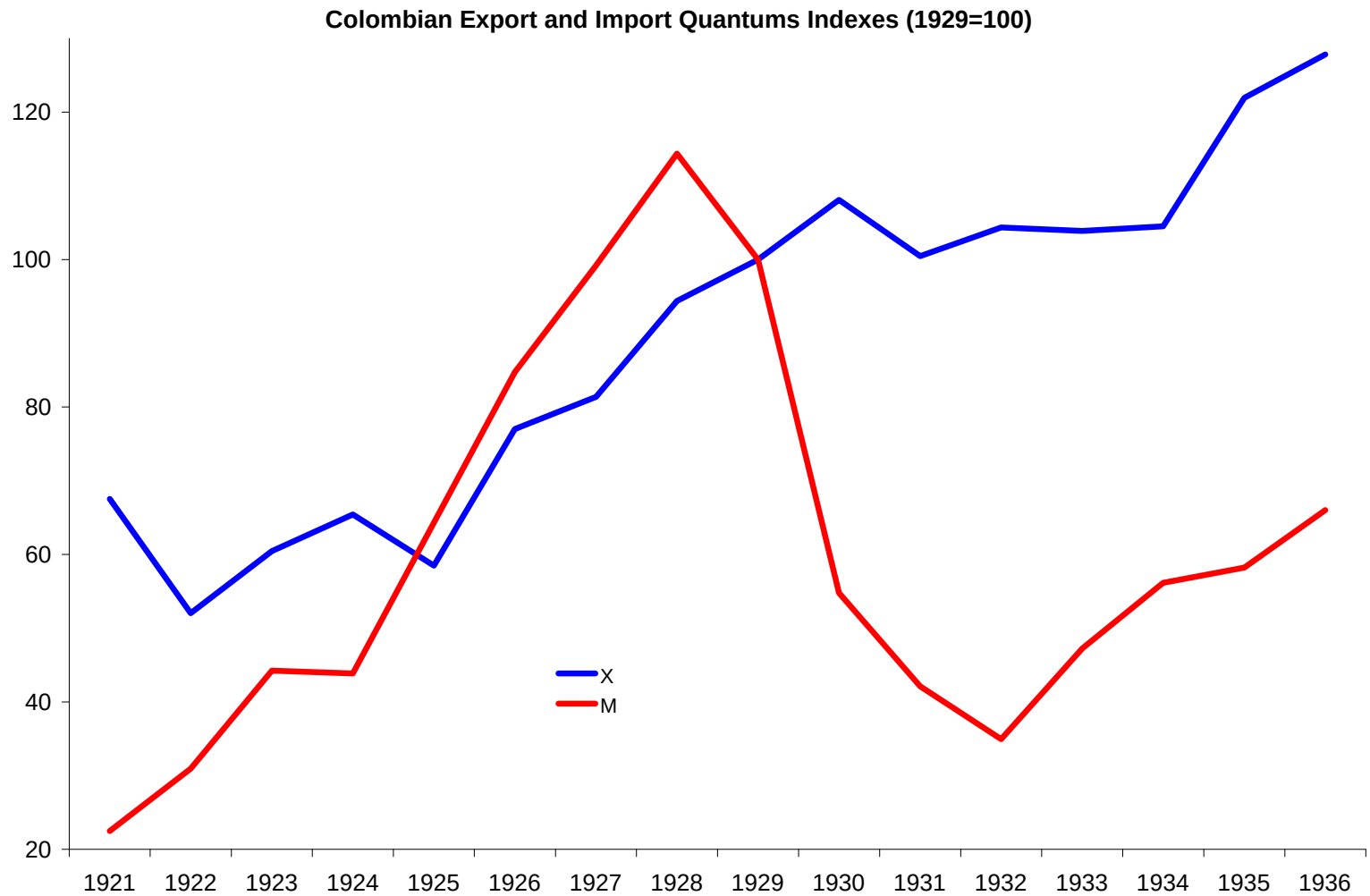

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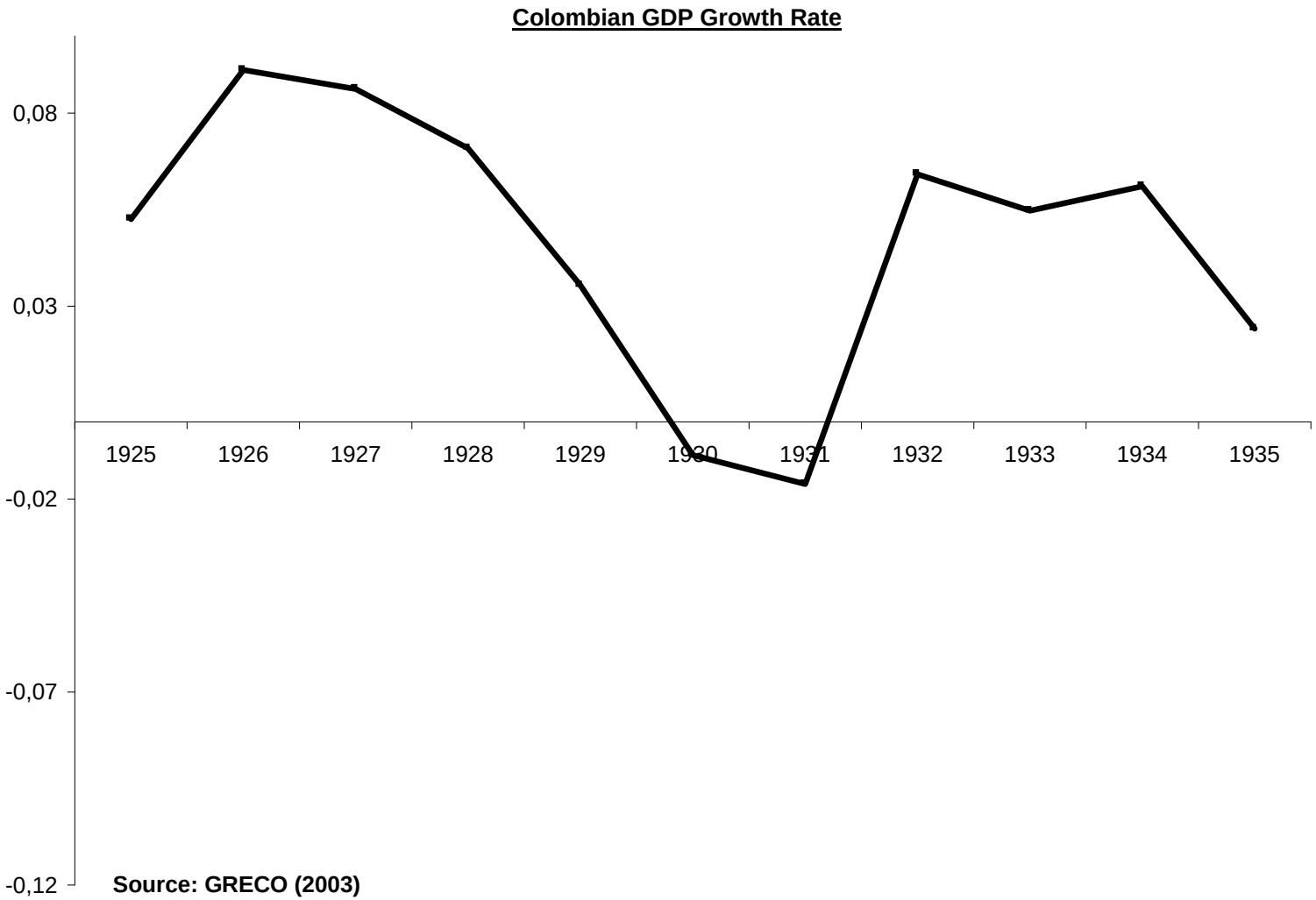

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A GRL. EQUILIBRIUM FRAMEWORK

- **Households:**

$$U = E_0 \sum_{t=0}^{\infty} \beta^t u(c_t^i, h_t^i)$$

$$d_t^i = R_{t-1}^d d_{t-1}^i + c_t^i + i_t^i + \Phi(k_{t+1}^i, k_t^i) - w_t h_t^i - u_t k_t^i$$

$$k_{t+1}^i = (1-\delta)k_t^i + i_t^i$$

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

A GRL. EQUILIBRIUM FRAMEWORK

- **Firms:**

$$y_t^f = F\left(k_t^f, h_t^f\right)$$

$$\kappa_t \geq \eta\left(w_t h_t^f\right); \quad \eta \geq 0$$

$$w_t\left[1+\eta\left(\frac{R_t^d-1}{R_t^d}\right)\right] = F_2\left(k_t^f, h_t^f\right)$$

$$u_t = F_1\left(k_t^f, h_t^f\right)$$

A GRL. EQUILIBRIUM FRAMEWORK

- **Banks:**

$$\pi_t^{Banks} = R_t^d d_t - \Psi\left(d_t - \overline{d}\right) - d_t R_t$$

$$R_t^d = \frac{R_t}{\left[1 - \Psi'\left(d_t - \overline{d}\right)\right]}$$

A GRL. EQUILIBRIUM FRAMEWORK

- **Driving Forces:**

$$R_t^* = R^* \left(R_{t-1}^*, \epsilon_t^{R^*} \right); \quad \epsilon_t^{R^*} i.i.d.(0, \sigma_{R^*})$$

$$R_t = R \left(\Gamma_t, R_t^*, R_{t-1}, \epsilon_t^R \right); \quad \epsilon_t^R i.i.d.(0, \sigma_R)$$

A GRL. EQUILIBRIUM FRAMEWORK

- **Competitive Equilibrium:**

$$D_t = d_t^i$$

$$TB_t = Y_t - C_t - I_t - \Phi(K_{t+1}, K_t) - \Psi(D_t - \overline{d})$$

$$KA_t = (R_{t-1} - 1)\, D_{t-1} - TB_t$$

A GRL. EQUILIBRIUM FRAMEWORK

Definition

A Competitive Equilibrium for the small open economy is the set of stochastic processess for

- Allocations:

$$\{C_t, K_t, D_t, H_t, Y_t, I_t, TB_t, KA_t\}_{t=0}^{\infty}$$

- Prices

$$\{w_t, u_t, R_t, R_t^d, \lambda_t\}_{t=0}^{\infty}$$

satisfying the optimality conditions and budget constraints for the three agents (Households, Banks, Firms), the no-Ponzi conditions; given the exogenous processes for $\{R_t^*; R_t\}_{t=0}^{\infty}$, and initial conditions for $\{K_0, D_{-1}, R_0^*, R_0\}$.

A GRL. EQUILIBRIUM FRAMEWORK

- **Parameterization:**

$$F\left(k_t, h_t\right) = \left(k_t\right)^{\alpha}\left(h_t\right)^{1-\alpha}; \quad \alpha = 1/3$$

$$K_{t+1} = (1-\delta)K_t + I_t; \quad \delta = 0.1$$

$$u\left(c_t, h_t\right) = \frac{\left(c_t - \theta\frac{h_t^{\omega}}{\omega}\right)^{1-\sigma}}{1-\sigma}; \quad \sigma = 2,\ \omega = 1.6, \quad \theta\,|_{h^{SS}=0.28}$$

$$\Phi\left(K_{t+1}, K_t\right) = \frac{\phi}{2}\left(K_{t+1} - K_t\right)^2; \quad \phi = \ 72.8 \text{ (Uribe and Yue, 2006)}$$

A GRL. EQUILIBRIUM FRAMEWORK

- **Parameterization (cont.):**

$$\Psi\left(D_t - \overline{d}\right) = \frac{\psi}{2}\left(D_t - \overline{d}\right)^2; \quad \psi = 0.001, \quad \overline{d}\,|_{(TB/Y)^{SS}=-0.02}$$

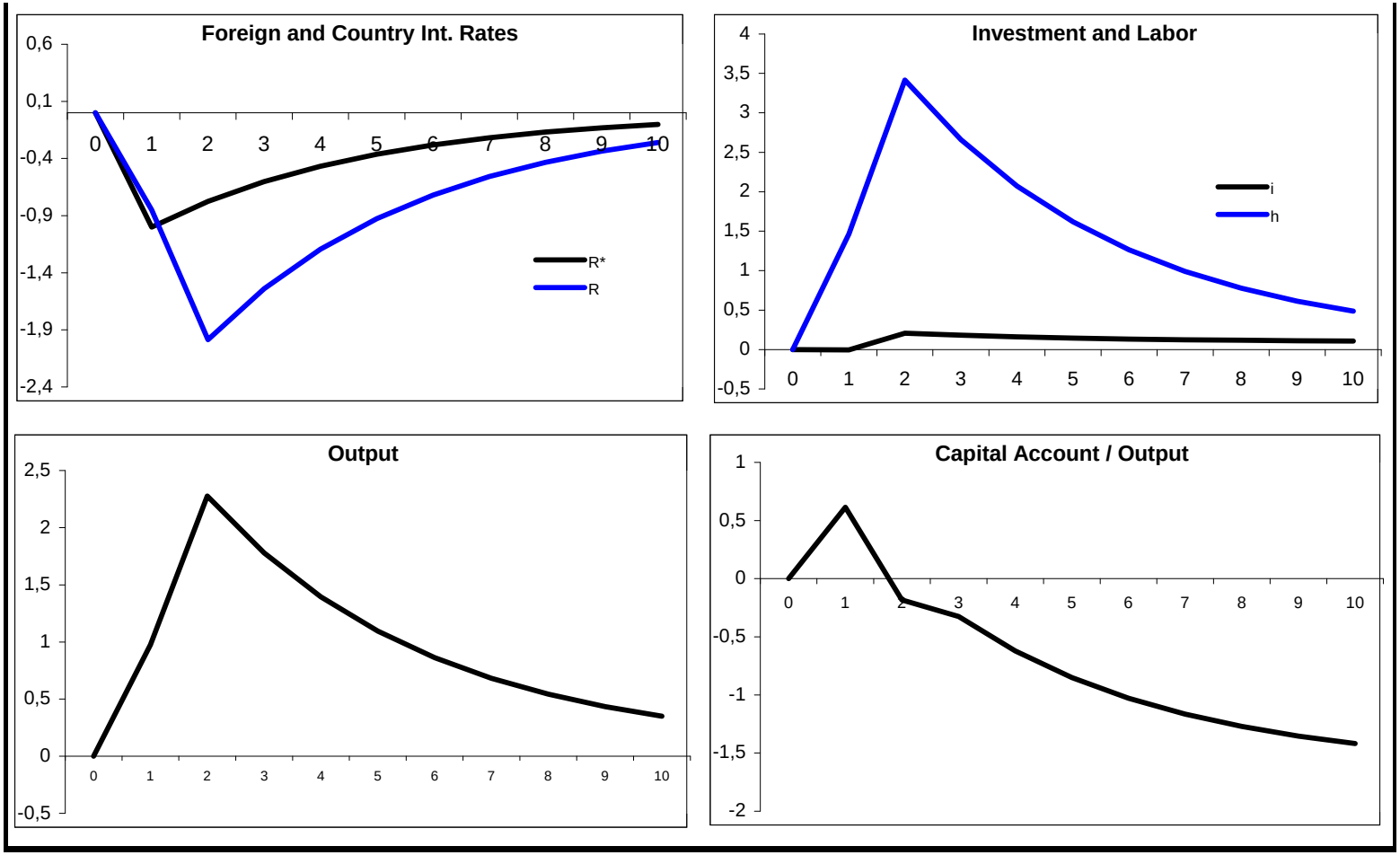
$$\kappa_t = \eta w_t h_t; \quad \eta = 1.2 \ \text{(Uribe and Yue, 2006)}$$

$$\widehat{R}^*_t \equiv \ln\left(R^*_t/R^*\right) = \rho_{R^*}\ln\left(R^*_{t-1}/R^*\right) + \epsilon^{R^*}_t; \ \rho^{OLS}_{R^*} = 0.78, \ R^* = 1.04$$

$$\begin{aligned} \widehat{R}_t &\equiv \ln\left(R_t/R\right) = \rho_{R^*}\ln\left(R^*_t/R^*\right) + \rho_{R^*_-}\ln\left(R^*_{t-1}/R^*\right); \\ \text{with } \rho_{R^*} &= 0.85, \ \rho_{R^*_-} = 0.05, \quad R = 1.11 \end{aligned}$$

Impulse Response Functions

- **IRF after a negative 100-basis points shock to Foreign Interest Rate, $\epsilon_t^{R^*}$:**



Note: Values are percentage deviations from steady state levels.

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The Model's Solution

Corollary

To a first order approx. around the non-stochastic steady state, the competitive equilibrium dynamics are depicted by the equations:

$$\begin{aligned} x_{1,t+1} &= M(\Theta)\, x_{1t} + v_{t+1} \\ x_{2,t} &= C(\Theta)\, x_{1,t} \end{aligned}$$

where: - x_1 *is the vector of states*

$$x_{1,t} = \left[K_t, D_t, R_t^*\right]'$$

- x_2 *is the vector of controls*

$$x_{2,t} = \left[Y_t, C_t, H_t, I_t, TB_t, KA_t, w_t, u_t, R_t, R_t^d, \lambda_t\right]'$$

The Model's Solution

Corollary

(cont.) The system:

$$\begin{aligned} x_{1,t+1} &= M(\Theta)\, x_{1t} + v_{t+1} \\ x_{2,t} &= C(\Theta)\, x_{1,t} \end{aligned}$$

can be compactly written as a law of motion

$$\Psi_{t+1} = \Phi(\Theta)\Psi_t + Bv_{t+1}$$

which, together with a measurement equation,

$$X_t = \Gamma\Psi_t$$

are the starting point for a time invariant Kalman filter, with which one can recursively construct optimal one-step-ahead forecast of the entire vector Ψ_{t+1}.

A Simulation-Based Experiment

- **A simulation-based experiment to test the model's performance:**
  1. Write the model solution as

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$$X = \{R_t^*\}_{t=1920}^{1940}$$

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  3. Set the measurement equation, $X_t = \Gamma\Psi_t$, and use the Kalman filter to recursively construct one-step-ahead optimal forecasts of the entire vector,
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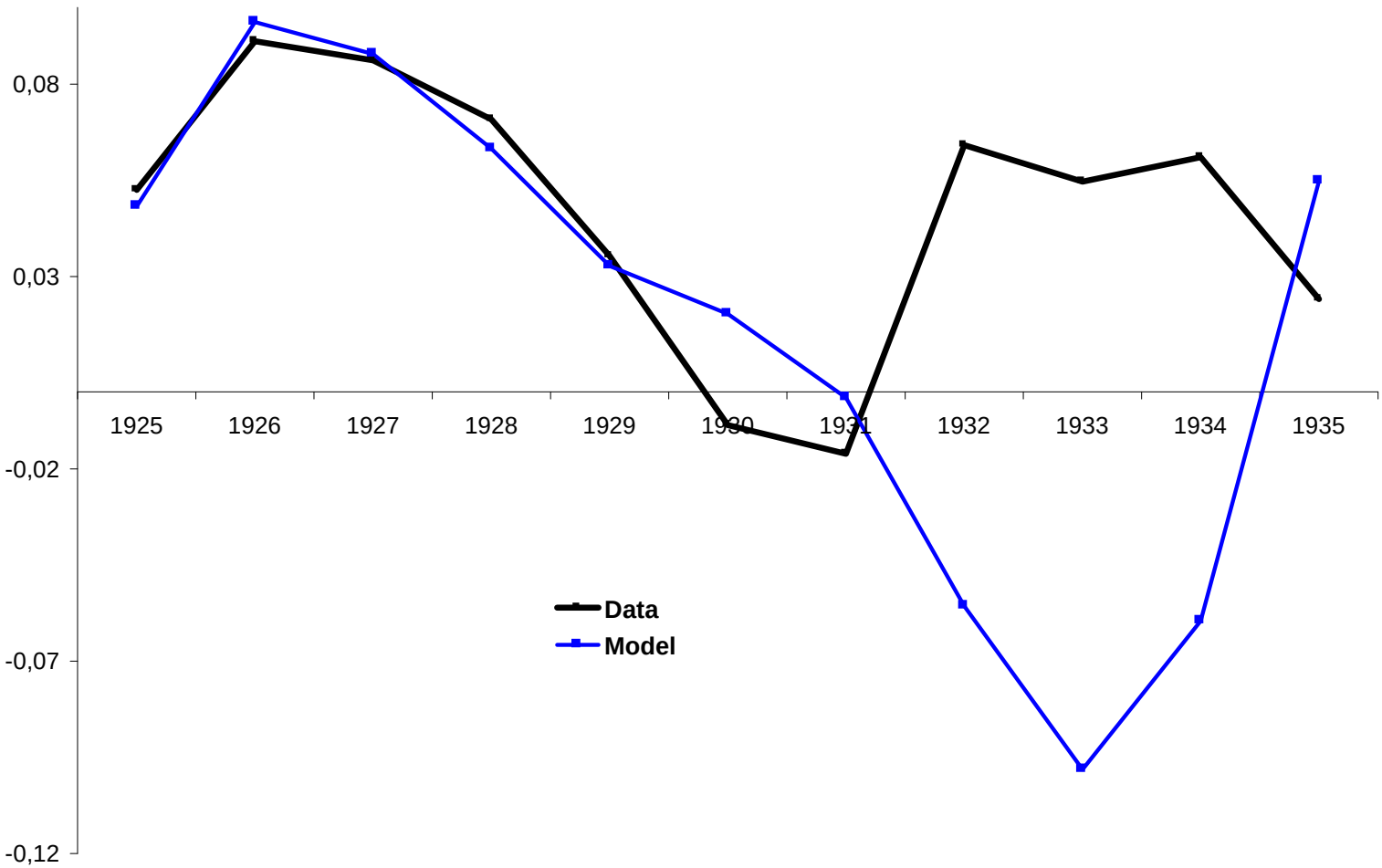
  3. Set the measurement equation, $X_t = \Gamma\Psi_t$, and use the Kalman filter to recursively construct one-step-ahead optimal forecasts of the entire vector,
  $$\left\{\widehat{\Psi}_t\right\}_{t=1920}^{1940}$$
  4. Derive population moments and other statistics form the simulated time series and compare them to the observed ones.

Results

- **Simulated and observed Real GDP growth in Colombia, 1925-1935:**



Results

- **Simulated and observed Moments in Colombian Macro. Variables, 1925-1935:**

Variable (X)	s.d(X) / s.d(Y)	cov(X)	Cross Correlation of X_(0) with Y_(-1)	Y_(0)	Y_(+1)
Empirical Moments: Colombian Yearly data, 1925-1940					
Y	1,0	0.61 0,063	0.61 0,063	1.00 0,000	0.61 0,063
C	1,9	0,39 0,263	0,22 0,549	0,55 0,081	0,54 0,108
I	6,3	0,50 0,145	0,44 0,203	0,89 0,000	0,67 0,034
TB/Y	0,7	0,57 0,088	-0,31 0,381	-0,74 0,009	-0,84 0,003
R*	1,1	0,57 0,000	-0,37 0,290	-0,26 0,444	-0,31 0,390
Simulated Moments					
Y	1,0	0.87 0,001	0.87 0,001	1.00 0,000	0.87 0,001
C	1,6	0.92 0,000	0.65 0,040	0.92 0,000	0.99 0,000
I	0,1	0.88 0,001	0.95 0,000	0.96 0,000	0.74 0,014
TB/Y	0,3	0.74 0,014	0.41 0,243	-0.04 0,906	-0.71 0,020
R*	1,1	0.57 0,000	0.77 0,010	0.44 0,180	-0.21 0,560

Note: Moments taken from HP-filtered empirical and simulated variables. Small numbers are p-values for the Null of no significance.

Results

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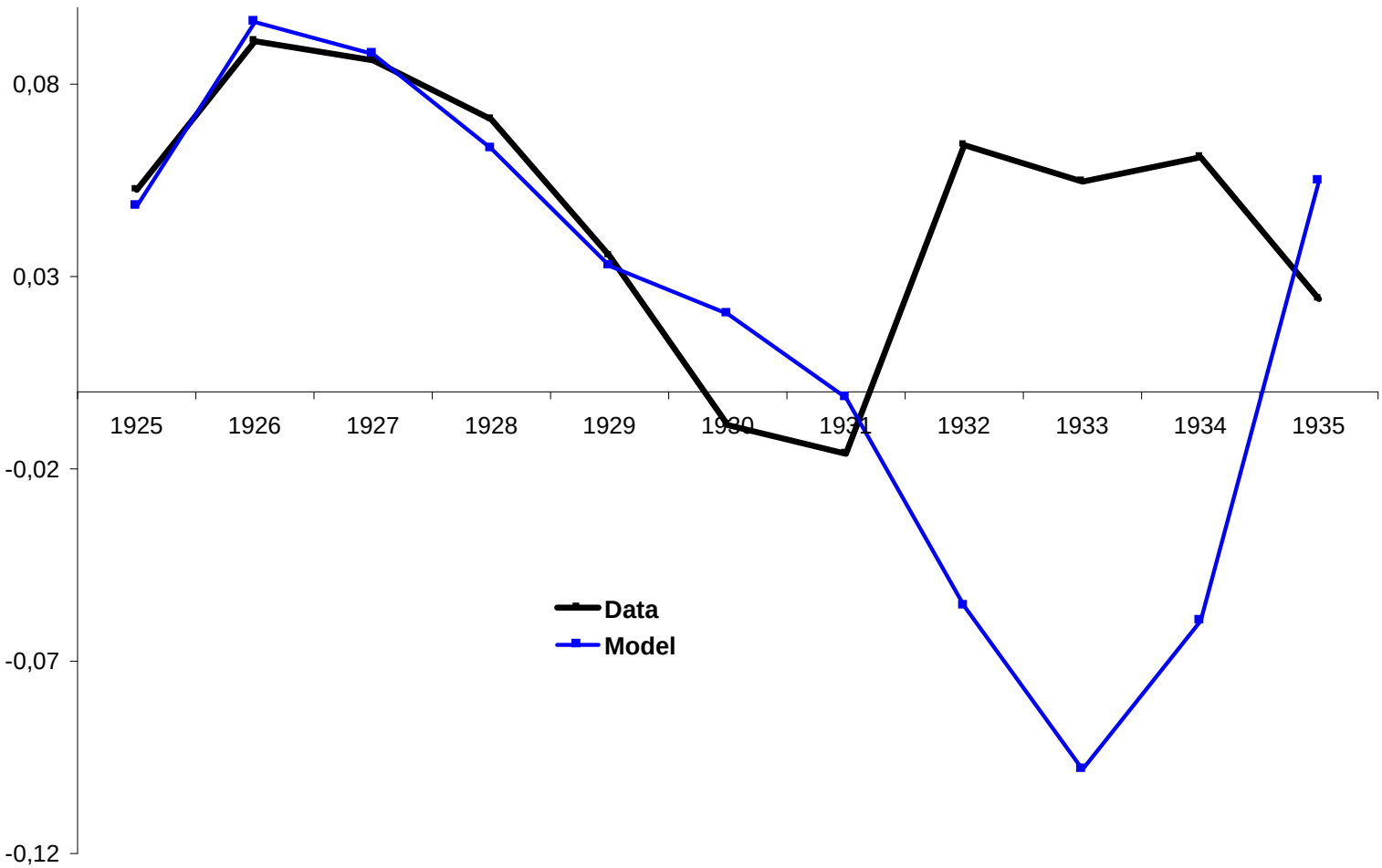

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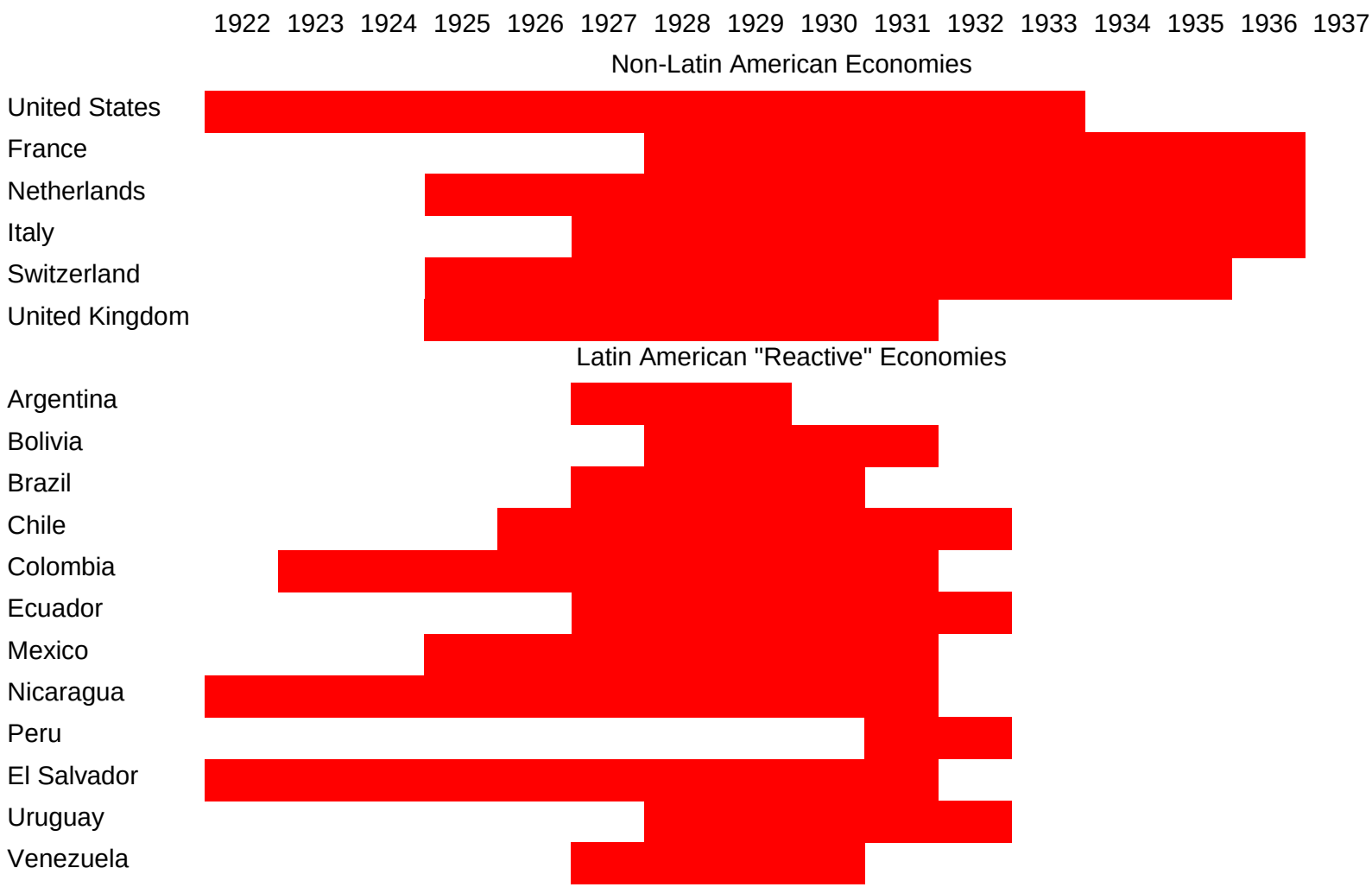
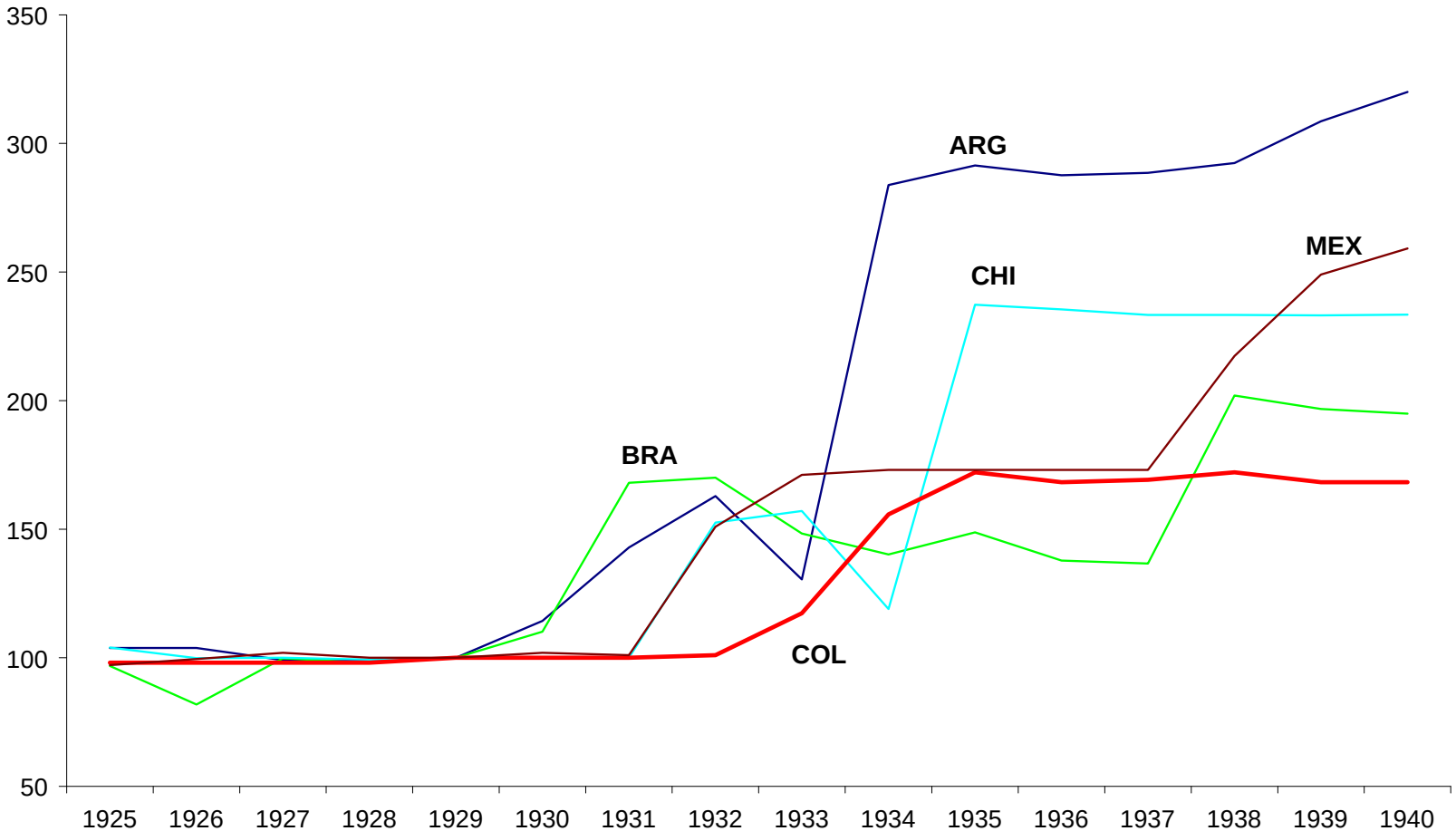
Gold Standard

- **"Reactive" Countries abandon the Gold Standard early:**



Exchange Rate and Monetary Policy

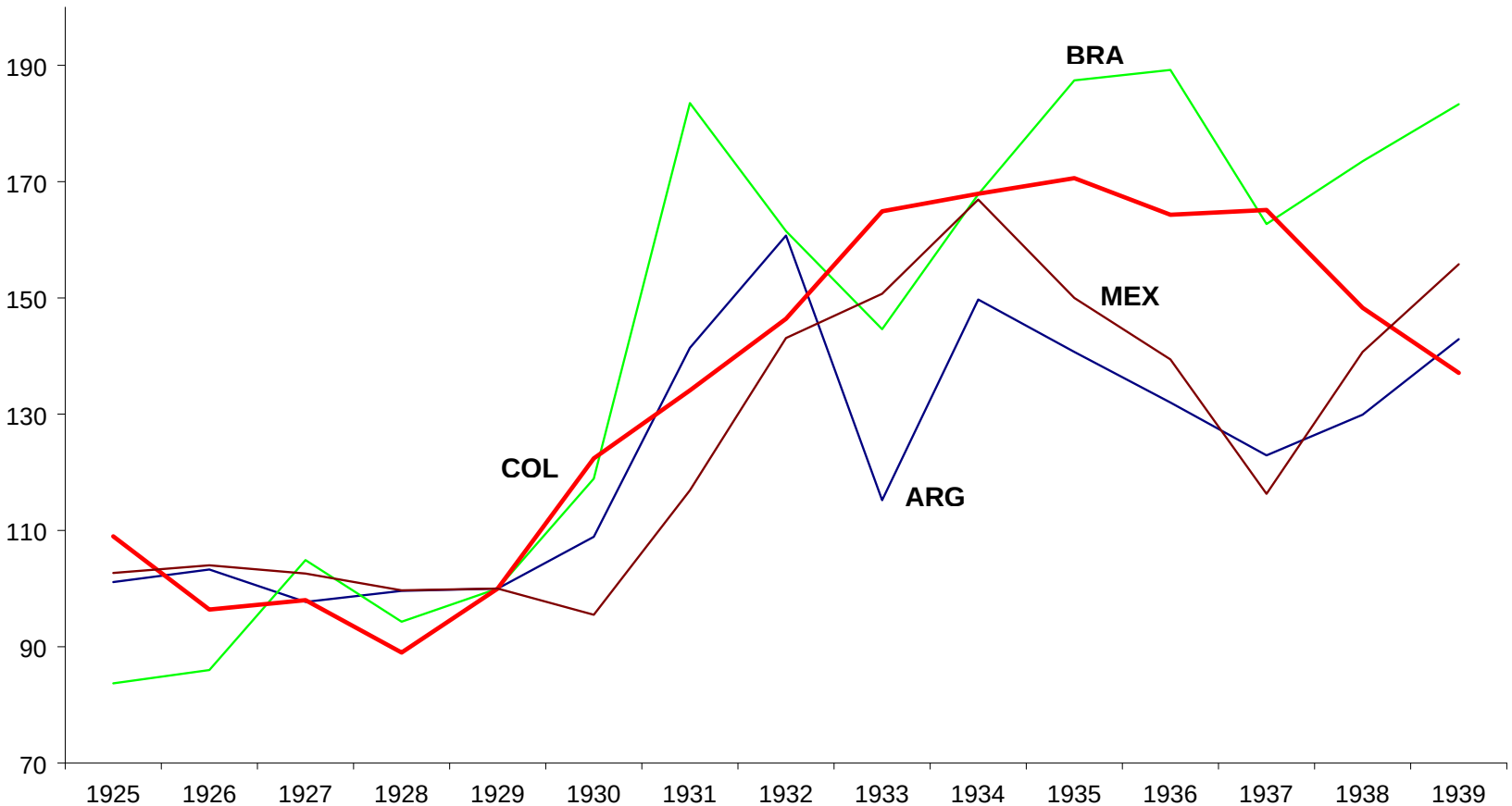
- Nominal Exchange rate Indexes (1929=100) in Latin American Countries:



Source: OxLat and GRECO

Exchange Rate and Monetary Policy

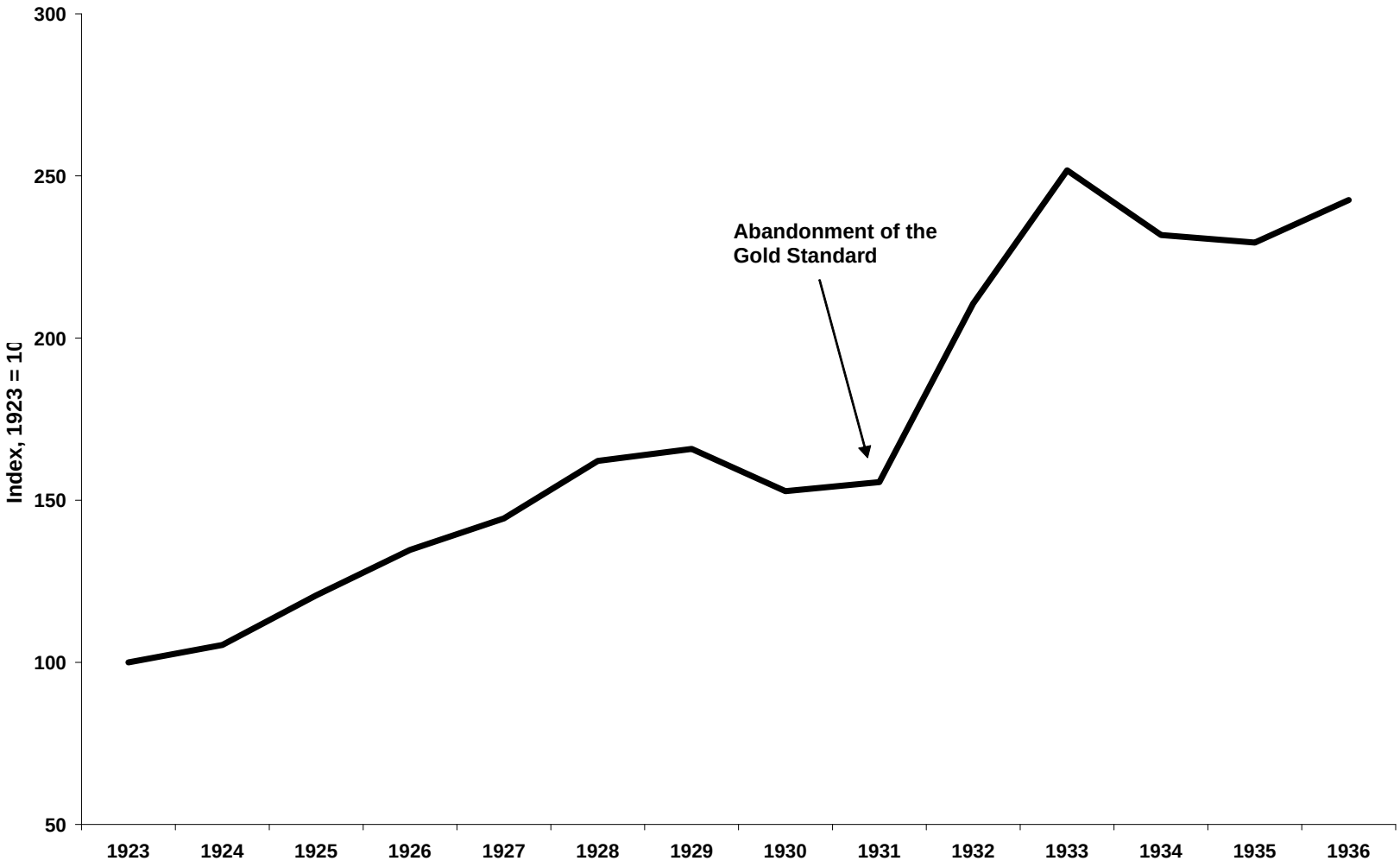
- Real Import Exchange rate Indexes (1929=100) in Latin American Countries:



Source: Diaz Alejandro (1983)

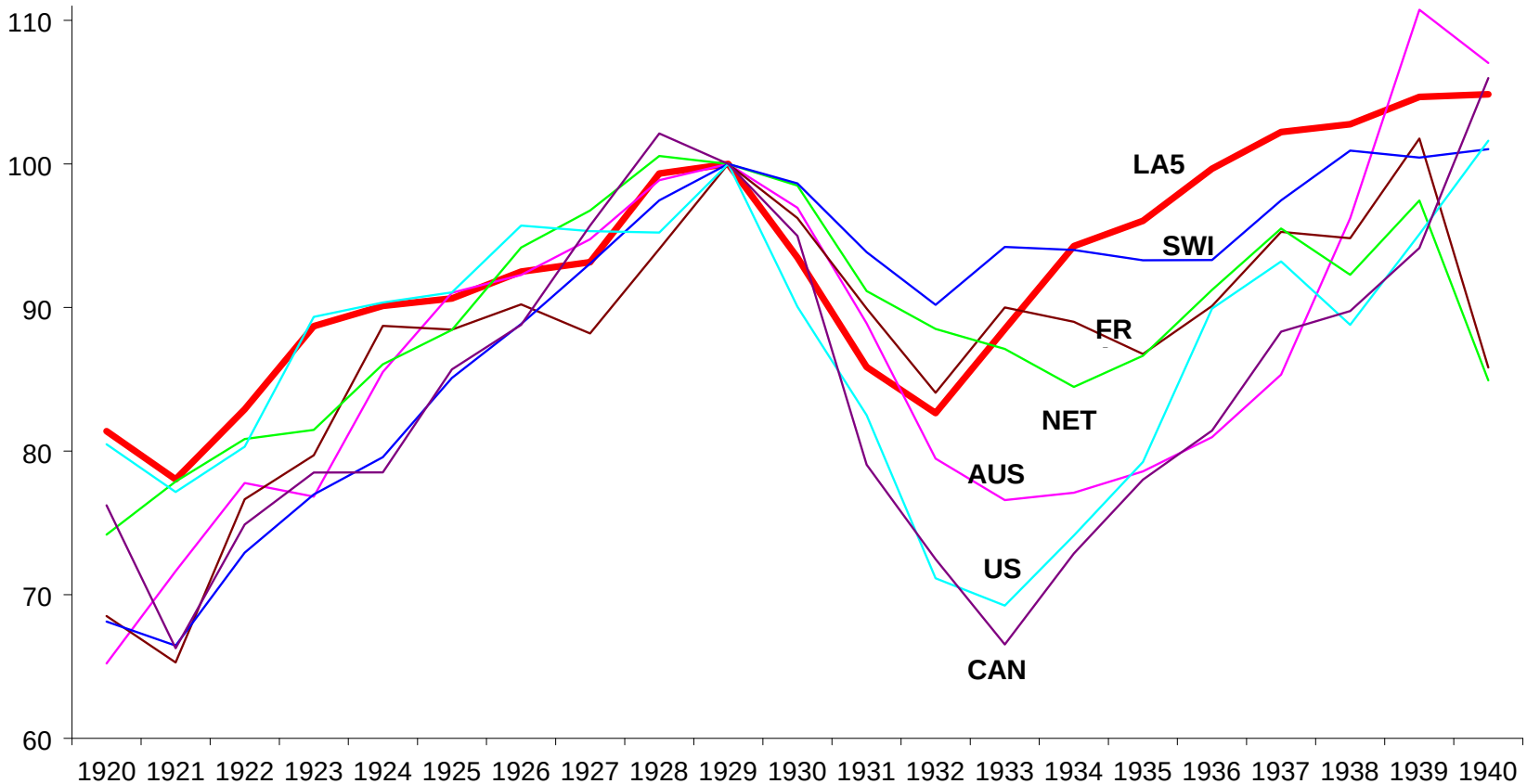
Exchange Rate and Monetary Policy

- Real Money Supply in Colombia:



An Early Recovery

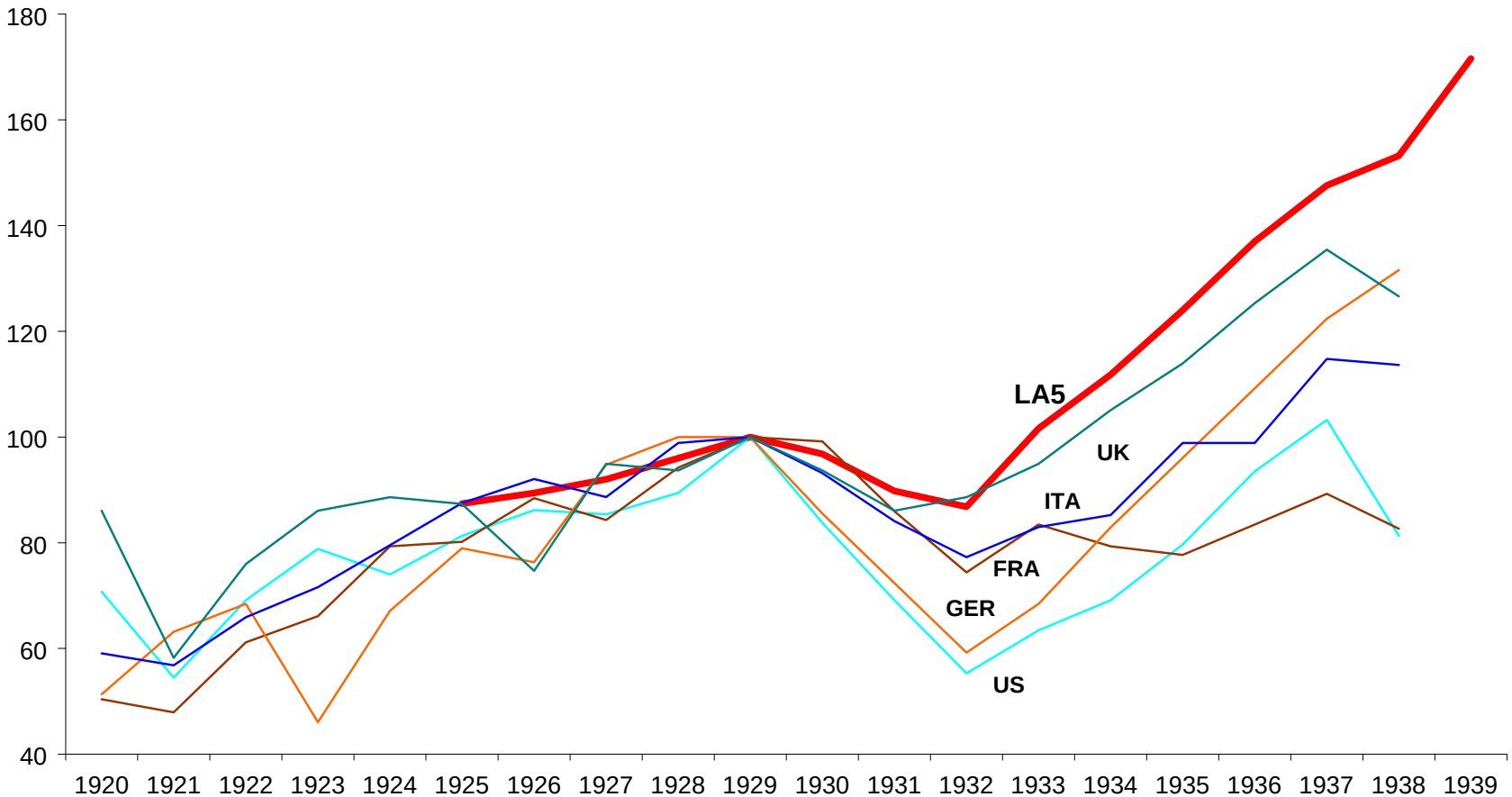
- Real GDP pc indexes (1929=100) in 5 Latin American countries against other non-LA countries:



Source: Maddison.

An Early Recovery

- Real Industrial Output indexes (1929=100) in 5 Latin American countries against other non-LA countries:



Source: Kehoe and Prescot (2007) and Thorp (1984)

A GRL. EQUILIBRIUM FRAMEWORK

- **Households:**

$$U = E_0 \sum_{t=0}^{\infty} \beta^t u(c_t^i, h_t^i)$$

$$P_t c_t^i \leq M_{t-1}^i - N_t^i$$

$$\frac{M_t^i}{P_t} + i_t^i = w_t h_t^i + u_t k_t^i + \frac{R_t^n N_t^i}{P_t}$$

$$k_{t+1}^i = (1-\delta) k_t^i + i_t^i$$

A GRL. EQUILIBRIUM FRAMEWORK

- **Firms: (Identical)**

$$y_t^f = F\left(k_t^f, h_t^f\right)$$

$$\kappa_t \geq \eta\left(w_t h_t^f\right); \quad \eta \geq 0$$

$$w_t\left[1+\eta\left(\frac{R_t^d-1}{R_t^d}\right)\right] = F_2\left(k_t^f, h_t^f\right)$$

$$u_t = F_1\left(k_t^f, h_t^f\right)$$

A GRL. EQUILIBRIUM FRAMEWORK

- **Banks:**

$$\pi_t^{Banks} = R_t^f \left(N_t + \left(g_t - 1 \right) M_{t-1} \right) - \int_0^1 R_t^n N_t^i di$$

A GRL. EQUILIBRIUM FRAMEWORK

- **Closing the Model: The Central Bank,**

$$M_t = g_t M_{t-1}$$

$$\ln g_{t+1} = (1-\rho)\ln \overline{g} + \rho \ln g_t + \varepsilon^g_{t+1}; \text{ with } \overline{g} \text{ calibrated to be } 1.084$$

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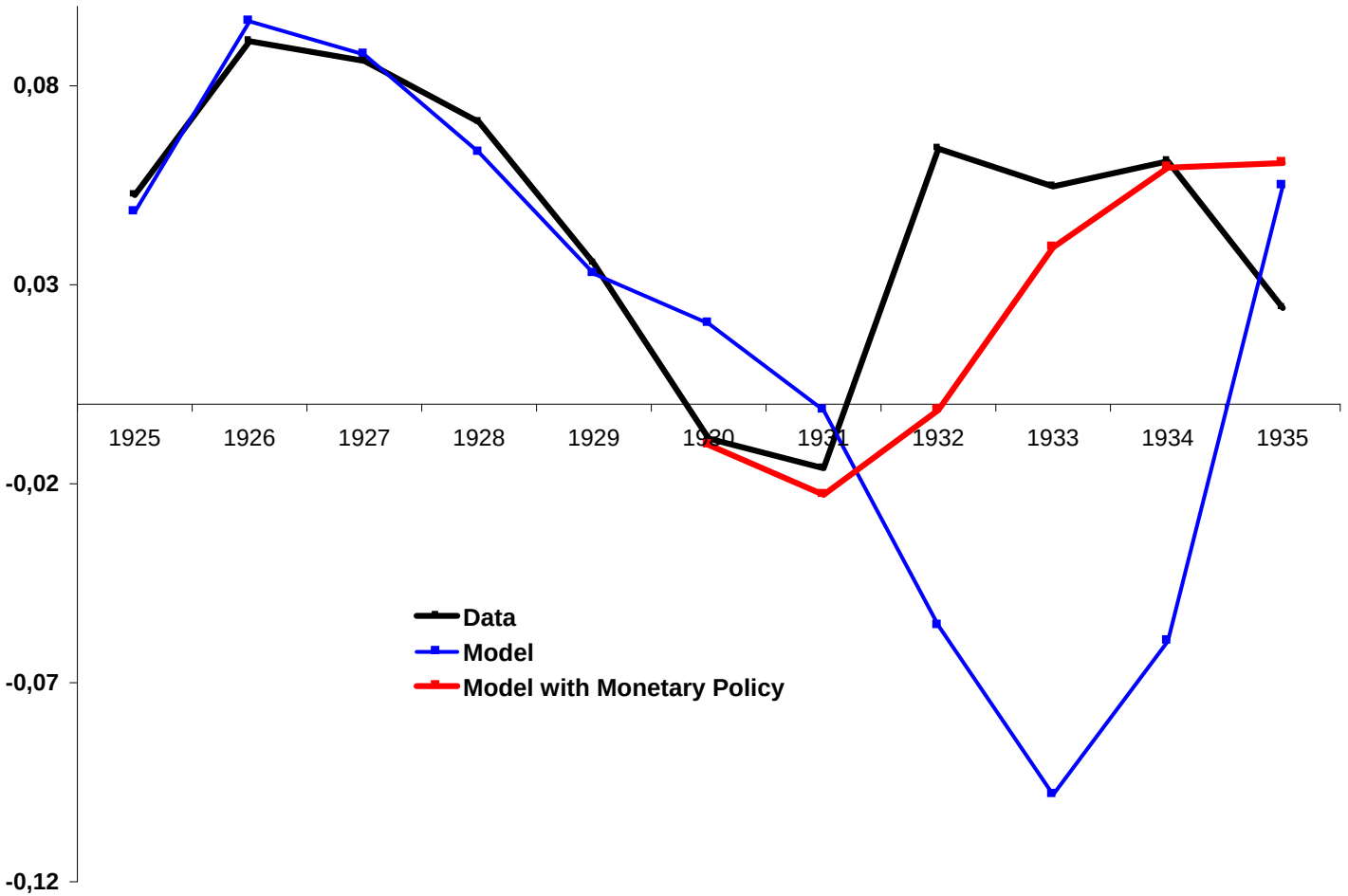
  4. Derive population moments and other statistics form the simulated time series and compare them to the observed ones.

Results

- **Simulated and observed Real GDP growth in Colombia, 1925-1935:**



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- The model: rationalizes this within a general equilibrium framework coupled with financial frictions and random shocks to the world interest rate and the domestic stock of money.

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  - Unify both models: allow a suddenly binding external contraint from 1929.