The real exchange rate and economic development. Evidence from Argentina (1914-2016)

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Insights

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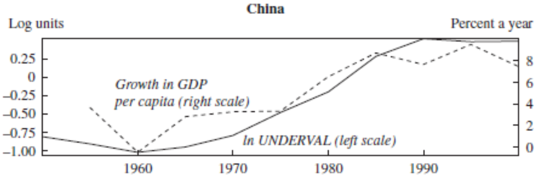
- Can an undervalued (high) RER boost economic activity?
- Is the RER a policy variable?
- *Traditionally, the RER has not been at the center of analyses of economic growth or in their practical policy incarnations* (Eichengreen (2008)).
- However, some developing countries that targeted an undervalued RER grew rapidly:



Source: Rodrik (2008)

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4. We provide the conditions under which a real depreciation can deliver growth $\Rightarrow$ successful nominal devaluations.
5. Although the scope of our work is more general, our case study is Argentina.

Why Argentina?

- Data available for the whole 20th century (and even before): della Paolera & Taylor (2003)

- Several exchange rate regimes that enriches the analysis:

  The Argentines alter their currency almost as frequently as they change their presidents. No people in the world take a keener interest in currency experiments than the Argentines.
  (Díaz-Alejandro (1970))

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- But their empirical assessments are too restrictive in terms of prior determination of exogeneity and endogeneity:

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- There're very few VAR studies, and they have short series.
- This tool allows us to provide novel insights into the effects of the RER over economic growth.
- It is still an unresolved issue how important the RER is and heated debates often arise around the exchange rate policy, specially in Argentina.

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3. Contribution of real devaluations to growth is heterogeneous among different episodes.

4. There's a pattern for real devaluations to promote growth:

    - Necessary condition: the RER level needs to remain high long enough.
    - Sufficient condition: the high RER level has to be a consequence of a successful nominal devaluation $\Rightarrow$ inflation remains moderate.

Related literature

- Alternative modeling (and evidence) about the RER-growth channel:
  - Hausmann et al. (2005): Growth accelerations tend to be correlated with increases in investment and trade, and with real exchange rate depreciations.
  - Rodrik (2008): undervalues in the RER reallocates resources in tradables, which are *special* in boosting growth.
  - Razmi et al. (2012): redistribution of income towards profits + *hidden* unemployment.
  - Levy-Yeyati et al. (2012): undervaluation redistributes wealth, fostering saving and investment and, hence, reducing unemployment.

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  - Levy-Yeyati et al. (2012): undervaluation redistributes wealth, fostering saving and investment and, hence, reducing unemployment.
- VAR evidence on the RER devaluations' effects over growth rather uses short time frames (not more than 25 years). It is heterogeneous:
  - Contractory: Kamina & Rogersb (2000) (Mexico, 1980:Q1-1996:Q2) and Berument & Pasaogullari (2003) (Turkey, 1987:Q1-2001:Q3).
  - Expansionary: Odusola & Akinlo (2001) (Nigeria, 1970:Q1-1995:Q4).
  - Non significant: Tang (2015) (China, 1994:M1-2012:M12).

Theoretical framework (non-technical summary)

- The RER of equilibrium should imply the same Marginal Revenue in tradables than in non-tradables:

$$\text{MgR}_T = \text{MgR}_N$$

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- A second-best solution for this is to have an undervalued RER:

$$Q \uparrow \longrightarrow \frac{P_T}{P_N} \uparrow$$

The assumed dynamics behind this theory

- The model economy:

$$
\begin{aligned}
\text{Output demand}: \quad & Y_t = C_t(Y_t^d) + I_t(Y_t^d, \mathbb{E}Q_{t+1}) + NX_t \\
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  - Output: $\downarrow C_t, \downarrow I_t \rightarrow \downarrow Y_t$

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- The long run:
  - Q_t converges to its equilibrium level.

Our empirical approach

- The structural VAR(p) model:

$$B_0 y_t = B_1 y_{t-1} + B_2 y_{t-2} + ... + B_p y_{t-p} + w_t$$

with $y_t \equiv [Q_t \quad \Delta Y_t \quad NX_t/Y_t \quad \Delta I_t \quad \Delta C_t]'$

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- The structural shocks:

$$w_t = B_0 u_t$$

where B_0 is the impact matrix.

The moving average (MA) representation

- The VAR(1) form:

$$\mathbf{y}_t = \mathbf{A}\mathbf{y}_{t-1} + U_t$$

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- The orthogonal IRFs:

$$\frac{\partial \mathbf{y}_{t+i}}{\partial w_t'} = \Theta_i$$

The identification scheme

- Recursiveness approach:

$$chol(\Sigma_u) = {B_0}^{-1}$$

such that $\Sigma_u = B_0^{-1} B_0^{-1'}$.

- Exact identification: degrees of freedom = num of restrictions ▸ Go

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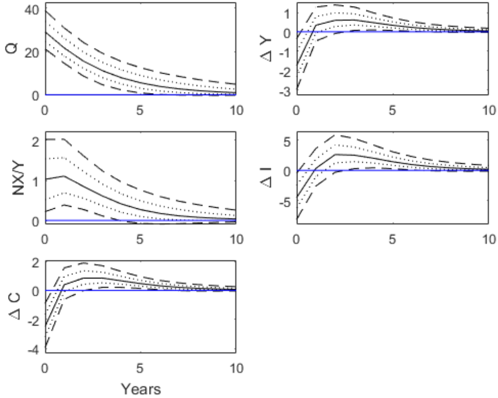
- w_t^1 is identified as a RER shock.
- w_t^j for $j = 2, \ldots, 5$ are left unidentified $\Rightarrow$ partial identification.
- Implications of the identifying assumptions ▸ Go

General results: IRFs

Figure: Responses to a one std RER shock: median estimates (—), 68% (· · ·), 95% (−−) CI



- Bootstrapping: Go
- Accumulated response: Go

IRFs

- Short run: a 29% increase in the level of the RER generates:
  - Output: -1.7% on impact and 0.3% the 1st year.
  - Consumption: -2.5% on impact and 0.4% the 1st year.
  - Investment: -4.5% on impact and 0.3% the 1st year.
  - Net exports: 1% on impact. Inverted J-curve (Marshall-Lerner condition met).
- Medium run:
  - Output: peak effect of 0.6% the 3rd year $\Rightarrow$ equal to Rodrik (2008).
  - Consumption: peak effect of 0.8% the 3rd year.
  - Investment: peak effect of 2.6% the 2nd year $\Rightarrow$ 1.4% in Razmi et al. (2012) (baseline, developing countries).
  - Net exports: 1.1% peak the 1st year.
- Persistence of the shock in all variables for more than 10 years.

Forecast error variance decomposition

Horizon	RER	Output	Net Exports	Investment	Consumption
1	98	12	33	7	15
2	97	13	36	8	17
3	97	14	37	10	18
10	96	15	39	12	19
∞	96	15	39	12	19

Shocks to the RER explain from:

- 12% to 15% of output variability.
- 33% to 39% of net exports variability.
- 7% to 12% of investment variability.
- 15% to 19% of consumption variability.
- Methodology: ▸ Go

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- Then we can run a counter-factual setting w_t^1 to zero ...

$$\tilde{F}(\hat{y}_{kt}^j) = y_{kt} - \hat{y}_{kt}^j \quad \Rightarrow \quad \tilde{F}(\hat{y}_{1t}^1) = y_{1t} - \hat{y}_{1t}^1$$

where

$$\hat{y}_{kt}^j = \sum_{i=0}^{t-1} \Theta_{kj,i} w_{j,t-i} \quad \Rightarrow \quad \hat{y}_{1t}^1 = \sum_{i=0}^{t-1} \Theta_{11,i} w_{1,t-i}$$

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$$\hat{y}_{kt}^j = \sum_{i=0}^{t-1} \Theta_{kj,i} w_{j,t-i} \quad \Rightarrow \quad \hat{y}_{1t}^1 = \sum_{i=0}^{t-1} \Theta_{11,i} w_{1,t-i}$$

- ... and we can interpret this counter-factual as the RER of equilibrium,

Can a high level of the RER deliver sustained growth?

- How do we define a high RER?
- It can be one that is higher that the **RER of equilibrium**: absent nominal disturbances.
- As Enders & Lee (1997) state that nominal disturbances dominate the time path of the RER in high inflation countries ...
- ...we can assume that w_t^1 is mainly driven by nominal disturbances in Argentina.
- Then we can run a counter-factual setting w_t^1 to zero ...

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- ...and we can interpret this counter-factual as the RER of equilibrium,
- Then values of the RER higher than this counter-factual would be considered as high.

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- Here we focus on the HD of $\Delta Y, NX/Y, \Delta I$ and ΔC:

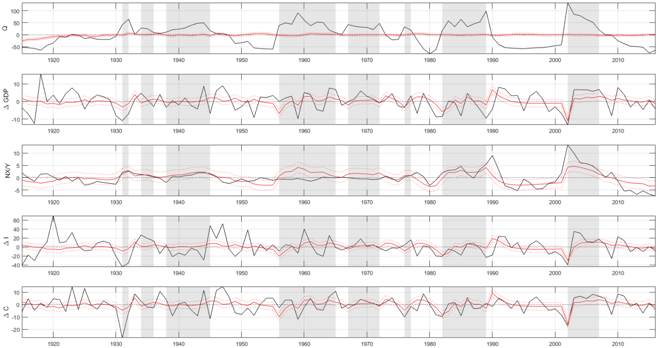
$$\hat{y}^1_{2t} = \sum_{i=0}^{t-1} \Theta_{21,i} w_{1,t-i}$$

$$\vdots = \quad \vdots$$

$$\hat{y}^1_{5t} = \sum_{i=0}^{t-1} \Theta_{51,i} w_{1,t-i}$$

Counter-factual and historical decompositions

Figure: Actual data (—), counter-factual/ hist dec (—), 68% (···) CI



- 1st panel: Counter-factual ⇒ periods of high RER: 1931-2; 1934-6; 1938-45; 1956-65; 1967-72; 1976-77; 1982-9; 2002-7.
- 2nd to 5th panels: Hist Dec ⇒ heterogeneous contribution of RER shocks.

The historical decomposition during high RER sub-periods

- Let us focus on the contribution of RER shocks to output during the high RER level sub-periods.

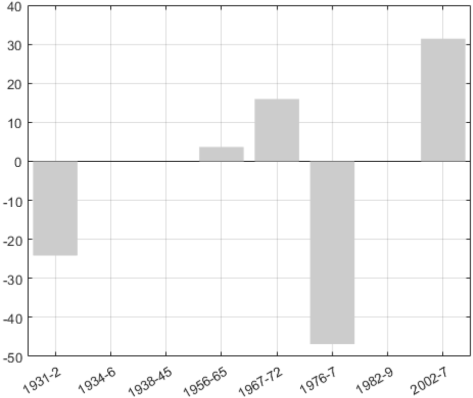
- We can obtain the median contribution for each sub-period by doing:

$$median\left(\frac{\hat{y}^1_{2,T_1}}{y_{2,T_1}};\ldots;\frac{\hat{y}^1_{2,T_N}}{y_{2,T_N}}\right)$$

where:

  - $\hat{y}^1_{2,T_i}$ is the cumulative effect of the RER shock on output growth at year i.
  - y_{2,T_i} is (detrended) output growth actual data at year i.
  - T_1 and T_N are the first and last years of each sub-period, respectively.

Contribution of RER shocks to output growth during high RER level years



- Negative effects: periods 1931-2 and 1976-7.
- Null effects: periods 1934-6, 1938-45 and 1982-9.
- Positive effects: periods 1956-65, 1967-72 and 2002-7.

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- So, one condition can be that the RER needs to remain high for more than three years to counterweight the initial negative impact of a rise.
- However, there are some other periods which are long but have no positive effects: 1938-45 and 1982-9.
- So, long periods can be a necessary but not sufficient condition.

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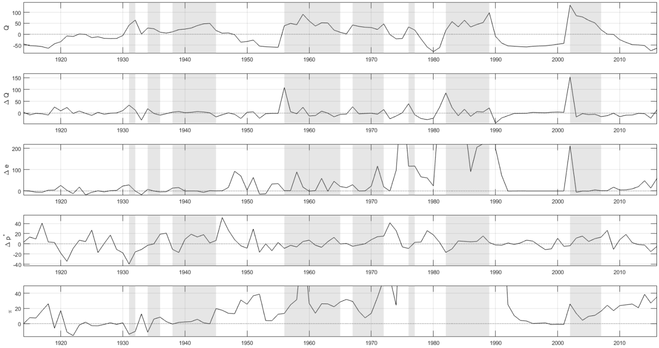

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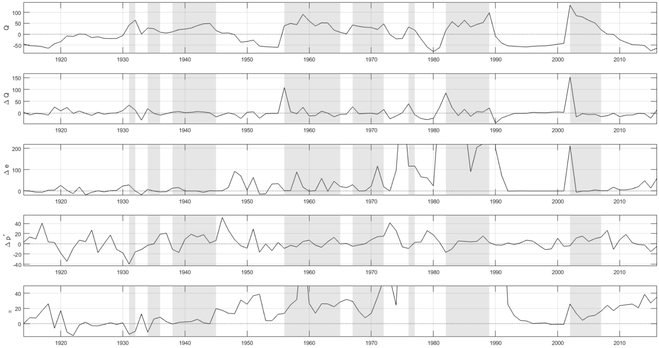

- 3rd panel: significant nominal devaluations before periods 1956-65, 1967-72 and 2002-7.
- 5th panel: moderate inflation in these periods.

The evidence in a nutshell

Period	Length	Real dev	Nominal dev	Exp prices	Inflation	Contribution
1931-2	short	moderate	moderate	low	low	negative
1934-6	short	low	low	moderate	low	null
1938-45	long	low	low	high	low	null
1956-65	long	high	high	moderate	moderate	low
1967-72	long	high	high	moderate	moderate	moderate
1976-7	short	moderate	high	low	high	negative
1982-9	long	high	high	moderate	high	null
2002-7	long	high	high	high	moderate	high

- Necessary condition: long length (more than three years).
- Sufficient conditions: moderate to high real devaluation (successful nominal devaluation).
  - Not more than moderate inflation: lower than 20%.
  - Effectiveness of nominal devaluations: Go

Conclusions

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- Alternative theory states that RER devaluation fosters investment in tradables and generates sustained growth.
- This alternative theory has been mostly backed up by a restrictive empirical methodology.
- We test this alternative theory by a less restrictive empirical methodology not much exploited in the literature so far: the Structural VAR.
- We find that real devaluations are contractory on impact but expansionary in the medium run.
- The contribution of RER shocks can be significant under certain conditions:

  1. The RER level remains high long enough.
  2. Hikes in the RER are preceded by successful nominal devaluations $\Rightarrow$ followed by low inflation.

Exact identification

- The variance-covariance matrix:

$$\begin{aligned} Var(u_t) &= Var(B_0^{-1} w_t) \\ \Sigma_u &= B_0^{-1} Var(w_t) B_0^{-1'} \\ &= B_0^{-1} I_K B_0^{-1'} \\ &= B_0^{-1} B_0^{-1'} \end{aligned} \quad (1)$$

where $Var(w_t) = I_K$ by definition.

- Σ_u: the covariance structure leaves has $K(K-1)/2$ degrees of freedom.

- $Chol(\Sigma_u) = B_0^{-1}$: Cholesky con provide that exact number of restrictions.

Back

Identifying assumptions

- Implications of the identifying assumption:
  1. All variables respond on impact to the innovation in the RER.
  2. No other shock (left unidentified here) can affect contemporaneously the RER.
- Let us define the RER as:

$$\Delta Q_t \approx \Delta e_t + \Delta p_t^* - \pi_t$$

  where ΔQ is the RER in variations, Δe is the nominal exchange rate in variations, Δp^* is the export prices in variations and π is local inflation.
- The 2^{nd} assumption implies that none of these variables respond on impact to the unidentified shocks.
  - This makes sense for Δp^* (see Kilian & Vega (2011)).
  - But not so much for Δe or $\pi \Rightarrow$ this VAR would not allow a fully structural approach.

Back

Bootstrapping

- We use bootstrapping methods to characterize the extent of uncertainty around the estimates.
- we generate 10,000 bootstrapped series by doing random draws of estimated residuals and feeding them back into the estimated series.
- For every bootstrapped series there is a B_0^{-1} impact matrix which we use to build responses' distributions.
- IRFs are plotted using median estimates, together with 68% and 95% confidence intervals.
- The variance decompositions are the median estimates.

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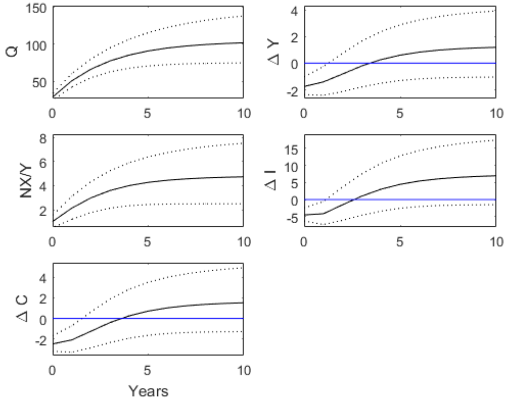
Accumulated responses

Figure: Accumulated responses to a one std RER shock: median estimates (—), 68% (· · ·) CI



Accumulated responses by the 10th year (similar to 5th year):

- Output: 1.2%.
- Consumption: 1.5%.
- Investment: 7%.
- Net exports: 5%. Back

The forecast error variance decomposition

1. Mean squared prediction error at the *h*-horizon:

$$MSPE(h) = \sum_{i=0}^{h-1} \Theta_i \Theta_i'$$

2. Contribution of shock *j* to variable *k* at horizon *h*:

$$MSPE_j^k(h) = \Theta_{kj,0}^2 + \ldots + \Theta_{kj,h-1}^2$$

3. Sum of the contribution of the *j* shocks to variable *k* at horizon *h*:

$$MSPE^k(h) = \sum_{j=1}^{K} \left(\Theta_{kj,0}^2 + \ldots + \Theta_{kj,h-1}^2\right)$$

4. Variance decomposition:

$$VarDec_j^k(h) = MSPE_j^k(h) / MSPE^k(h)$$

Back

Effectiveness of nominal devaluations

- As stated in the New Keynesian Phillips Curve (NKPC), actual inflation depends on the inflation expectations and the output gap:

$$\pi = \beta \mathbb{E}_t \pi_{t+1} + \kappa \tilde{y}_t$$

- Inflation expectations need to be low for the nominal devaluation to affect the RER and, hence, deliver output growth.

- The higher the (negative) output gap, the stronger the effect.

Back

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