MEGA-D: DSGE Model with dollarization for the peruvian economy.

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OUTLINE

- Motivation: The need for modelling dollarisation.
- The model: Main ingredients.
- Modelling dollarisation.
- Bayesian estimation of the model.
- Some results.
- Forecasting.
- Conclusion and future plans.

Motivation: The need for modeling dollarisation

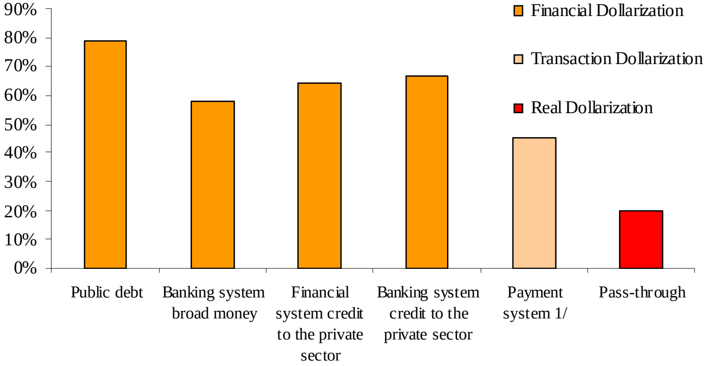
Types of Partial Dollarisation

Definition: Partial replacement of the domestic currency by a foreign currency (i.e. US dollars) in its basic functions

- **Currency Substitution (CS)**: Dollars accepted as a medium of payment.
- **Price Dollarisation (PD)**: Prices are indexed to changes in the exchange rate.
- **Financial Dollarisation (FD)**: Dollars are used as a store of value.

Motivation

Peru is one of the most highly dollarised economies + IT



Other LA countries: Bolivia, Nicaragua, Paraguay and Uruguay.

Motivation

Why Dollarisation is important for policy makers?

- Limitations of the Central Bank in stabilising inflation and output
- Transmission mechanism of monetary policy: Demand and supply side effects of dollarization.
- Affects objectives of the central bank: Exchange-rate smoothing versus interest rate smoothing.
- Regulatory and prudential issues: currency mismatches and balance-sheet effects.

Motivation

Goal of the paper

- To develop a DSGE model with partial Dollarisation in order to understand the effects of dollarisation over:
  - The Monetary policy transmission mechanism.
  - The propagation of external shocks.
- Estimate the model using Bayesian techniques.
- Policy evaluation: Policy analisys, forecasting, optimal policy projections.

Motivation

What do we do?

- Add to a standard sticky-price SOE model 3 forms of partial dollarization: CS, PD and FD
- Estimate the model using Bayesian Methods with Peruvian data
- Use the model for policy analysis (forecast).

The model

Main ingredients

- 2 main economic agents:
  - Households.
    - Ricardian
    - Non Ricardian
  - Firms (final goods, intermediate goods, importers, commodity sector, capital and entrepreneurs).
- Government: fiscal and monetary policy.
- External economy.
- Domestic financial market.

The model

Main ingredients

- Small open economy (limiting case of a two-country model)
- Baseline model includes:
  - 2 types of tradable goods (home produced and imported goods) + 1 commodity good.
  - External habit formation in consumption.
  - Slow adjustment in real wages (real rigidities).
  - Capital accumulation with adjustment cost to investment and financial accelerator.
  - Incomplete financial markets.
  - Incomplete pass-through of exchange rate to imported prices.
  - Local currency pricing for exports (non-commodities).
- Model include three types of dollarisation (transactions, prices, financial).

Dollarisation: Some Related Literature

- **Transaction dollarisation:** Felices and Tuesta (2006), Castillo (2006a), Batini, Levine and Pearlman (2006):Transaction costs induce a relative demand for foreign currency. Mechanism works through the marginal utility of consumption (weakens the interest rate channel)
- **Price dollarisation:** Ize and Parrado (2004), Castillo and Montoro (2004) Castillo (2006b): Endogenously some firms decide to set prices in dollars (makes the exchange rate channel stronger).
- **Financial dollarisation:** Céspedes Chang and Velasco (2005), Gertler, Gilchrist and Natalucci (2006), Tovar (2006): Open economy financial accelerator. FD1=Working capital Dollarisation
- **Exchange rate intervention:** Bofinger y Wollmershäuser (2003), Adolfson et.al. (2007, Riskbank), Florian, Salas and Vega (2007): intervention affects risk premium in the UIP.

Extension 1: Currency substitution

Utility function for Ricardian and Non Ricardian Households

$$U = \xi_t \log \left\{ \left[b \left(C_t^j - hC_{t-1} \right)^{\frac{\omega-1}{\omega}} + (1-b)\, Z_{t+i}^{j}{}^{\frac{\omega-1}{\omega}} \right]^{\frac{\omega}{\omega-1}} - \frac{\left(L_t^j \right)^{1+\eta}}{1+\eta} \right\}$$

where Z_{t+i}^j is a money aggregate defined as

$$Z_{t+i}^j = \left(\frac{M_{t+i}^j}{P_{t+i}} \right)^{1-\delta^{cs}} \left(\frac{D_{t+i}^j S_{t+i}}{P_{t+i}} \right)^{\delta^{cs}}$$

Extension 1: Currency substitution

Ricardian and Non-Ricardian Households differ in the Budget constrain.

Ricardian Households:

$$C_t^R + \frac{M_t^{S,R}}{P_t} + \frac{M_t^{D,R} S_t}{P_t} + \frac{B_t^R}{P_t} + \frac{B_t^{*,R} S_t}{P_t} = \frac{W_t}{P_t} L_t^R + \frac{T_t^R}{P_t} + \frac{M_{t-1}^{S,R}}{P_t} + \frac{M_{t-1}^{D,R} S_t}{P_t} +$$

$$\ldots + (1 + i_{t-1}) \frac{B_{t-1}^R}{P_t} + (1 + i_{t-1}^*) \Psi_B \left(\frac{B_{t-1}^{*,R}}{B_{t-1}} \frac{S_{t-1}}{P_{t-1}} \right) \frac{S_t B_{t-1}^{*,R}}{P_t} + \Gamma_t^R$$

Non-Ricardian Households:

$$C_t^{NR} + \frac{M_t^{S,NR}}{P_t} + \frac{M_t^{D,NR} S_t}{P_t} = \frac{W_t}{P_t} L_t^{NR} + \frac{T_t^{NR}}{P_t} + \frac{M_{t-1}^{S,NR}}{P_t} + \frac{M_{t-1}^{D,NR} S_t}{P_t}$$

Extension 2: Price dollarisation

$$
\begin{aligned}
\pi_{Ht} &= \left(1-\delta^{pd}\right)\pi_{s,t} + \delta^{pd}\left(\pi_{d,t} + ds_t\right) \\
\pi_{s,t} - \lambda_{\pi_s}\pi_{s,t-1} &= \beta\left(E_t\pi_{s,t+1} - \lambda_{\pi_s}\pi_{s,t}\right) + \kappa_S mc_t^D \\
\pi_{d,t} - \lambda_{\pi_d}\pi_{d,t-1} &= \beta\left(E_t\pi_{d,t+1} - \lambda_{\pi_d}\pi_{d,t}\right) + \kappa_{PD} mc_t^S
\end{aligned}
$$

- Increases the sensitivity of domestic inflation, π_{Ht} to the depreciation of the nominal exchange rate.

Extension 3: Financial dollarisation

Entrepreneurs: expected real return of investing in capital

$$E_t\left[R^{KH}_{t+1}\right] = (1+RP_t)\,E_t\left[\left((1+i^*_t)\,\frac{DS_{t+1}}{\Pi_{t+1}}\right)^{\delta^{FD}}\left(\frac{1+i_t}{\Pi_{t+1}}\right)^{1-\delta^{FD}}\right]$$

External finance premium depends on debt relative to net worth:

$$RP_t = \left(\frac{D_t}{N_t}\right)^{\chi}$$

$$\begin{aligned} N_t &= \left(R^{KH}_t\right)Q_{t-1}K_{t-1} \\ &\quad -(1+RP_{t-1})\left[\left((1+i^*_{t-1})\,\frac{DS_t}{\Pi_t}\right)^{\delta^{FD}}\left(\frac{1+i_{t-1}}{\Pi_t}\right)^{1-\delta^{FD}}\right]D_{t-1} \end{aligned}$$

Posibility of contractive depreciations.

Extension 4: Exchange rate interventions I

Introduce a "backward-looking" behavior in the exchange rate expectations:

$$E_t^{\exp} s_{t+1} = (1 - \lambda_s)\, E_t s_{t+1} + \lambda_s s_{t-1}$$

The UIP becomes:

$$i_t - i_t^* = (1 - \lambda_s)\, E_t \Delta s_{t+1} - \lambda_s \Delta s_t + prem_t$$

Iterate forward and solve for s_t:

$$s_t = s_{t-1} - \frac{1}{\lambda_s} \sum_{j=0}^{\infty} \left(\frac{1 - \lambda_s}{\lambda_s} \right)^j \left[i_{t+j} - i_{t+j}^* - prem_{t+j} \right]$$

$$\text{when} \begin{cases} \lambda_s \longrightarrow 1 : & s_t = s_{t-1} \\ \lambda_s \longrightarrow 0 : & s_t = \sum_{j=0}^{\infty} \left[i_{t+j} - i_{t+j}^* - prem_{t+j} \right] \end{cases}$$

Extension 4: Exchange rate interventions II

- Introduce Interventions directly in to the UIP equation.

$$i_t - i_t^* = (1 - \lambda_s) E_t \Delta s_{t+1} - \lambda_s \Delta s_t + prem_t$$

- Due to the incorporation of a transaction cost on the demand of foreign bonds the $prem_t$ is:

$$prem_t = \phi_b (b_t^* - b_t)$$

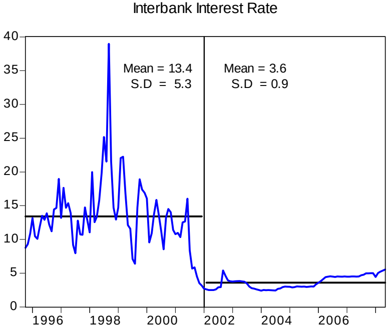
- Incorporate an intervention rule:

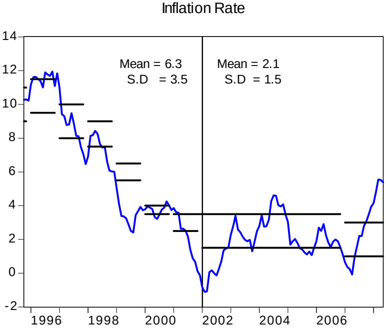
$$Intervention_t = b_t^* - b_t = -\alpha_{int} \Delta s_t$$

- This rule perform better than a Taylor rule with exchange rate response when responding to external financial shocks.

Estimation: Some problems

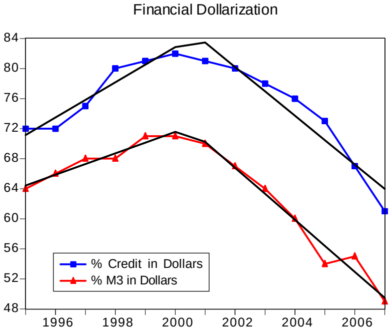
Strucutural change due to changes in policy regime in 2002 (IT + Interest rate): interest rate is less volatile and inflation has decreased.





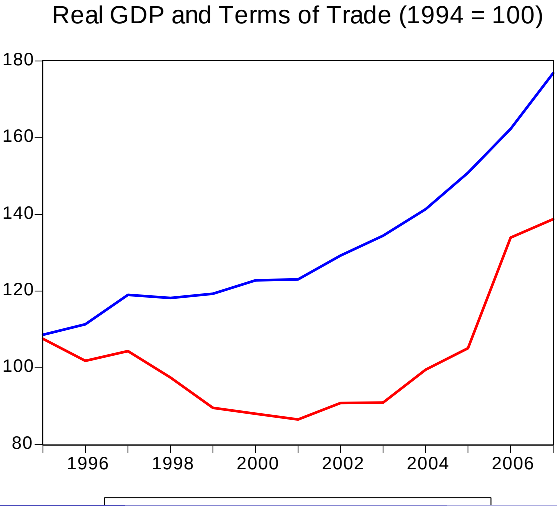
Estimation: Some problems

Instability of "parameters" (dollarisation, openness)



Estimation: Some problems

More than a unit root (i.e. productivity, terms of trade)



Estimation

Methodology

- Bayesian Methods to estimate the model (Dynare)
- Quarterly data from 1995 to 2006 (estimation by sub-samples due to structural break).
- Non-stationary observable variables in differences (consistency between data and model).
- Include a common stochastic trend.
- De-trend inflation and interest rate by "target" of inflation.
- Observable variables: output, core inflation, interest rate, exchange rate, consumption, investment,terms of trade, foreign output, foreign interest rate and foreign inflation.

Estimation

Result 1: Model Comparison

- Based on Bayes Factor: model with three types of dollarization dominates the rest of the models
- Main ingredient: financial Dollarisation.
- CS and PD do not add that much relative to FD.

	Benchmark	CS	PD	FD	CS+PD+FD
Log-Marginal	**-950.98**	**-948.61**	**-947.86**	**-945.32**	**-944.88**

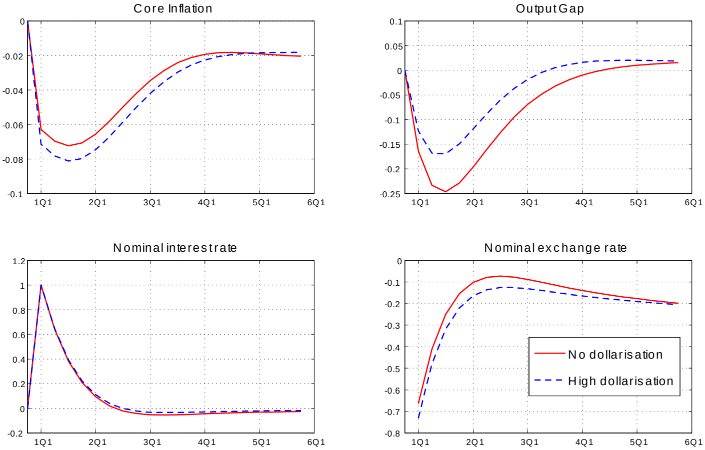
Estimation

Result 2: Parameter Estimates (CS+PD+FD)

- Real frictions are important in all models.
- Price are not that sticky. Firms change prices every 2 quarters.
- Price indexation is present:$\lambda_P = 0.5$
- Relative large standard deviations of shocks (compared to developed economies).
- Taylor Rule has changed after 2002: (higher response to inflation, less to output and exchange rate).
- Some parameters cannot be well identified (i.e. different stickyness for prices in soles and US$).
- Dollarization $\delta^{cs} = 0.46$, $\delta^{pd} = 0.12, \delta^{fd} = 0.59$

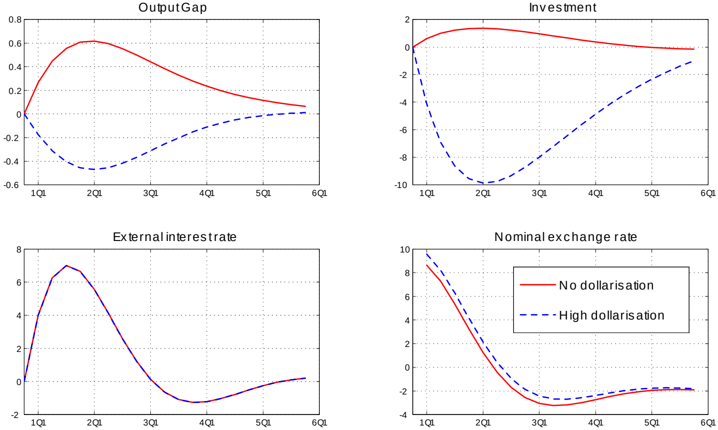
Transmission mechanism: Contractionary monetary policy shock.

Dollarisation counterfactual



Transmission mechanism: Increase in foreign interest rate.

Dollarisation counterfactual



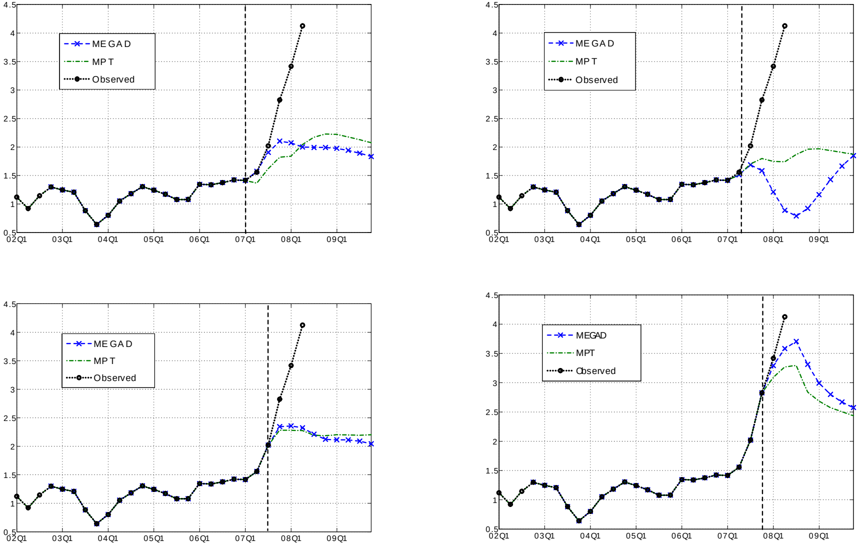
Forecasting

The agenda

- Implementation:
  - Use of two toolboxes (Dynare + Iris).
  - Main task is to complete the initial point of forecasting:Observed and Unobserved variables.
  - The Initial point of forecast: Estimation of unobservable variables using the Kalman Filter.
  - Model exogenous variables as AR process (i.e. foreign output, government expenditure, etc).
  - But include forecasts associated to observable exogenous variables.
  - Perform the forecasting exercise.

Forecasting

First forecasting exercise with MEGA-D: CORE INFLATION (vintages 2007.I : 2007.IV)



Conclusions

- Dollarisation reduces the effect of monetary policy on the output gap: Weaknes the interest rate channel.
- Dollarisation increases the importance of the exchange rate channel.
- Dollarisation increases the vulnerability of the economy to external shocks and can make depreciations contractionary.
- Eliminating dollarisation will increase the efficiency of monetary policy.

Future plans

- Present forecast to the monetary policy committee.
- Analyse shocks decomposition (historical and forecast).
- Analyse unobservable variables (i.e. natural interest rate).
- Re-estimate the model.
- Optimal monetary policy in dollarised economies.

"THANK YOU"