A Stochastic General Equilibrium Model with Partial Dollarization

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"Foreign Currency Related Risk Taking by Financial Institutions, Firms and Households"

Central Reserve Bank of Peru

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Motivation

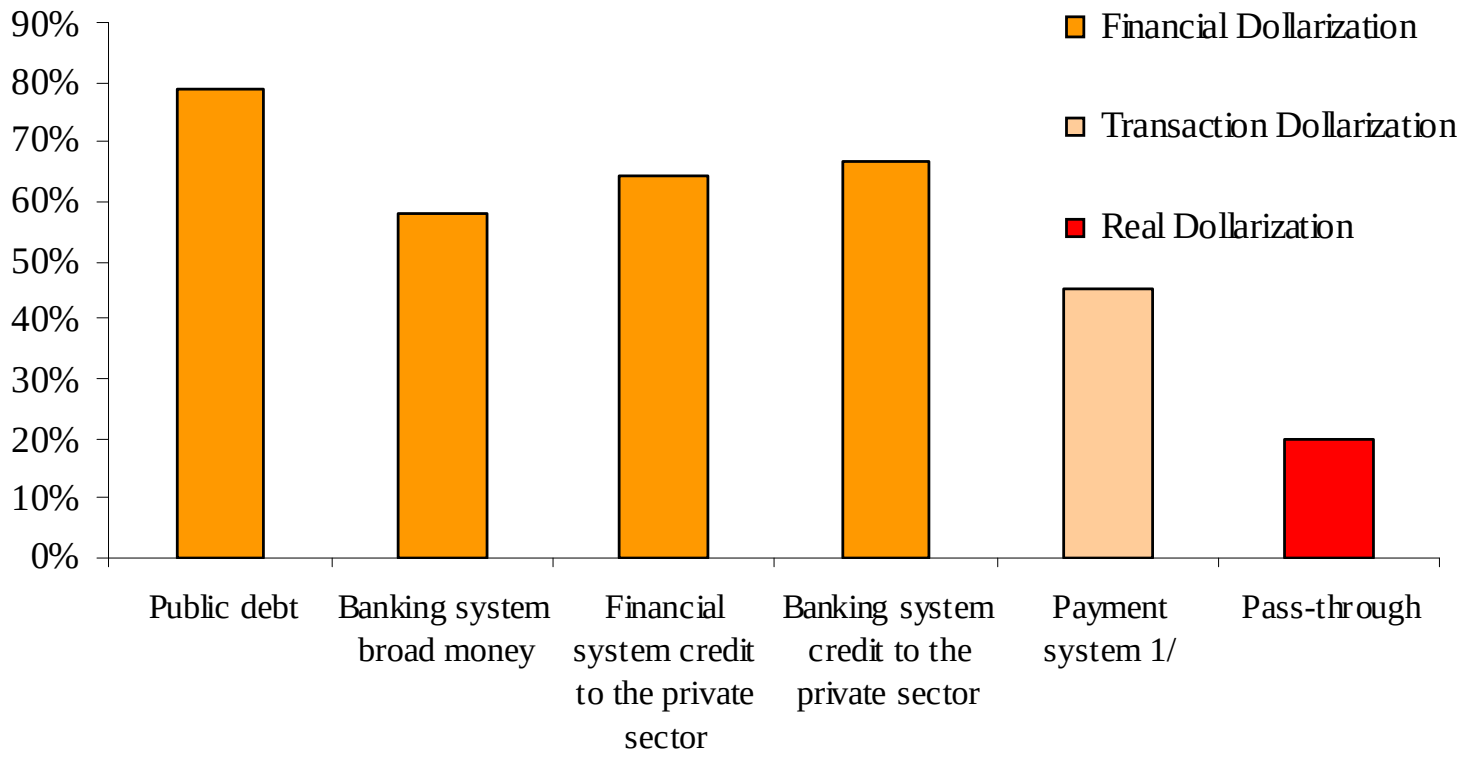
Types of Partial Dollarization

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 Dollarization (PD): Prices are indexed to changes in the exchange rate
- Financial Dollarization (FD): Dollars are used as a store of value

Motivation

Peru is one of the most highly dollarized economies + IT



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

Motivation

Why dollarization is important for policy makers?

- Limitations of the Central Bank in stabilizing 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 dollarization to understand the transmission mechancism.
- Use the model to account for the effects of partial dollarization.
- Estimate the model using Bayesian techniques.
- Policy evaluation (MEGA-D).

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 and Peruvian data
- Use the model for policy analysis (forecast).

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- Exchange rate intervention.

Dollarisation: Some Related Literature

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- **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

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

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

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

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In log linear form

$$u_{ct}^{CS} = u_{ct} - \Lambda(\omega)\left[\left(1-\delta^{cs}\right) i_t + \delta^{cs} i_t^*\right]$$

MUC is affected by both domestic and foreign interest rate.

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 Dollarization

Entrepreneurs: expected real return of investing in capital

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

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Risk premium depends on debt relative to net worth:

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

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

Extension 4:

Exchange rate intervention

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

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Iterate forward and solve for s_t:

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

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

Data and Estimation

- Sample 1995:01..2007:04. 10 observable variables

$$x_t = \left\{ \triangle c_t, \triangle y_t, \triangle inv_t, rer_t, \triangle s_t, \triangle tot_t, i_t, i_{t,}^* \pi_t, \pi_t^m \right\}'$$

- 11 Shocks: One permanent global tech shock and 10 AR(1) shocks: technology, domestic inflation mark-up, intermediate imported mark-up, monetary, preference, foreign monetary policy, investment, UIP,PPP, and foreign technology.
- Unit root shock in the model. Consistency between data and model
- Nominal interest rate and inflation have been detrended considering the structural break (inflation target).

Estimation

- Bayesian methods to estimate model´s parameters (Ψ)

  Priors $\Pi(\Psi)$ and Likelihood Function: $L(\{x_t\}_{t=1}^{T} \mid \Psi)$

- Random-Walk Metropolis-Hastings algorithm to obtain 250,000 draws from the posterior distribution. (acceptation rate 0.25-0.35).
- From which we also obtain posterior second moments and impulse response functions.
- Compute the marginal likelihood of each model using the modified harmonic mean estimator.

Result 1: Model Comparison

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

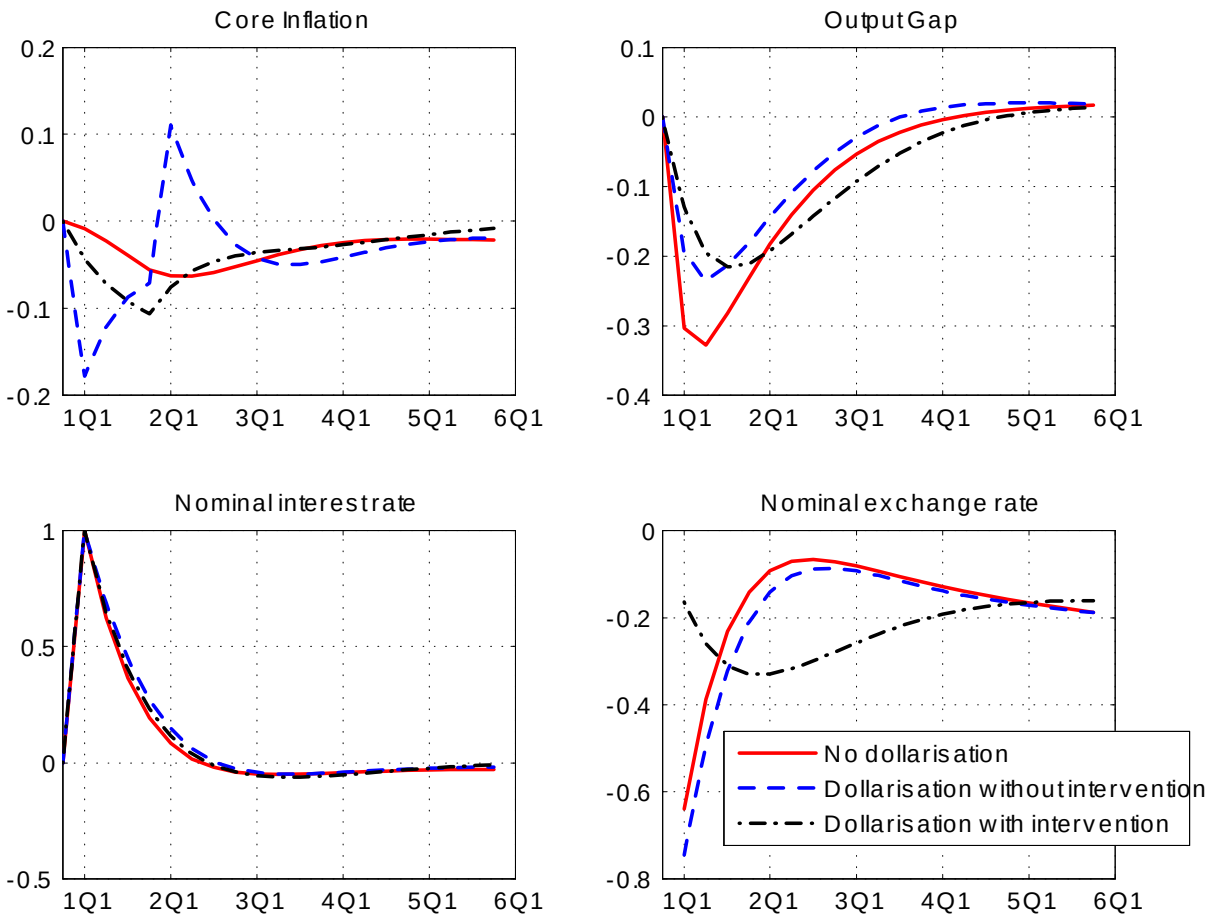
	Benchmark	CS	PD	FD	CS+PD+FD
Log-Marginal	**-950.98**	**-948.61**	**-947.86**	**-945.32**	**-944.88**

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

- Real frictions are important in all models
- Prices 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)
- Elasticity of risk premium to Debt/Net worth ratio is similar to other studies ($\chi = 0.03$)
- Taylor Rule: $\varphi_\pi = 2.29, \varphi_y = 0.26, \varphi_s = 0.80, \varphi_i = 0.06$
- Dollarization $\delta^{cs} = 0.46$, $\delta^{pd} = 0.12, \delta^{fd} = 0.59$

Results: Transmission mechanism, contractive monetary policy shock.

Dollarisation counterfactual



Results: Transmission mechanism, increase in foreign interest rate.

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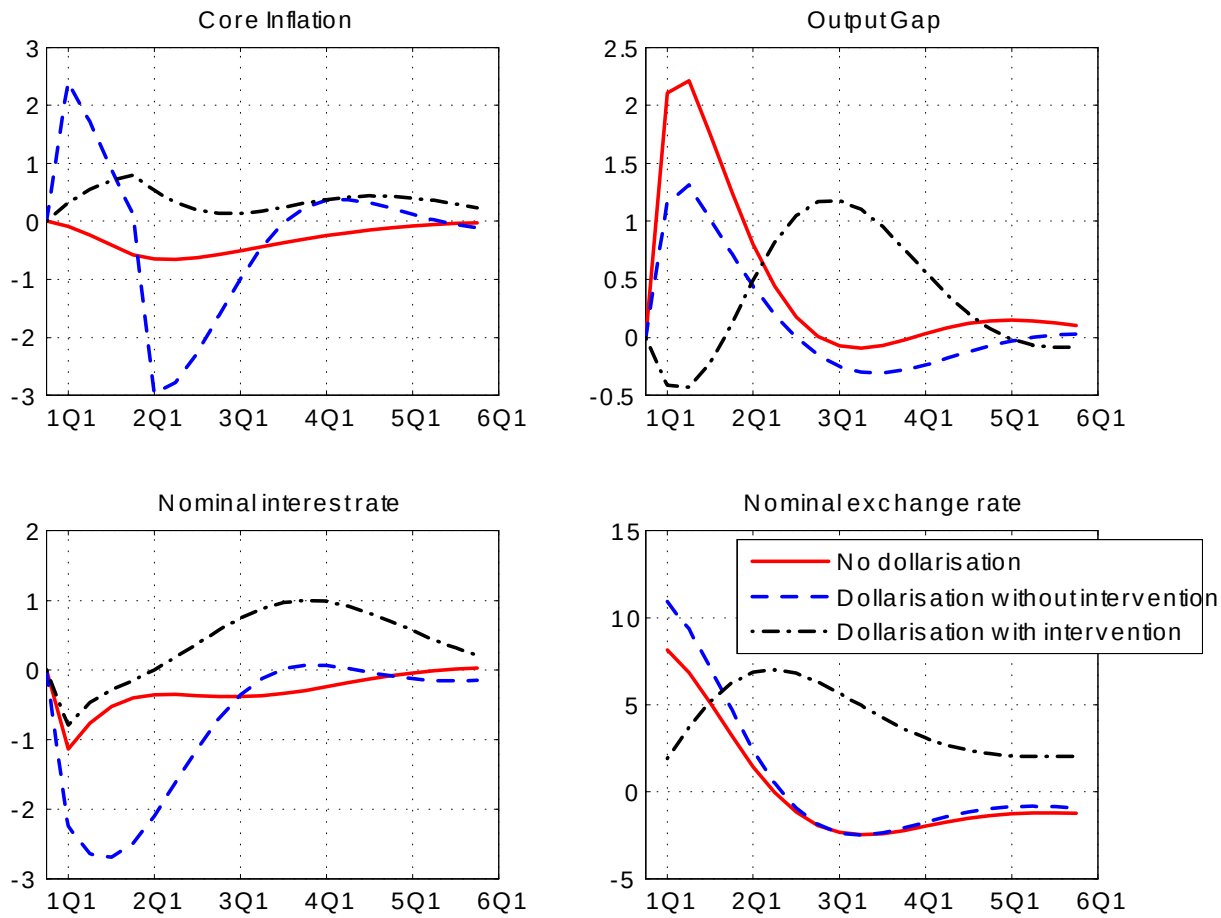
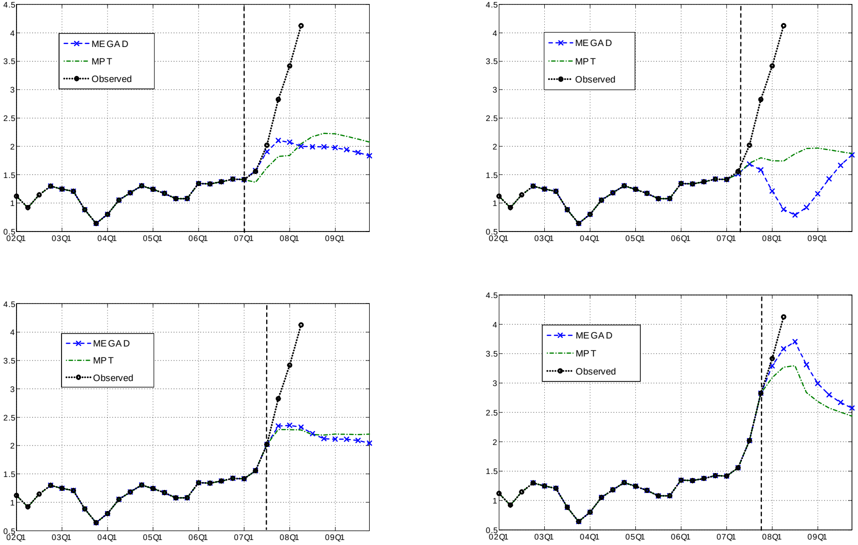


Forecasting

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



Concluding remarks and extensions

- The estimation and model evaluation validate the three forms of partial dollarization. However FD is the more important.
- Exchange rate intervention can help to ameliorate the effects of partial dollarization.
- Extensions for further work:
  - Include non-tradables goods (Balassa-Samuelson effect should be important).
  - Financial versus nominal frictions in emerging markets economices.
  - Dollarisaton as a endogenous decision (but this is problematic).
  - Change in policy regime.
  - Evaluate forecast