STOCK FLOW CONSISTENT MODELING FOR DEVELOPING ECONOMIES IN A GLOBAL FINANCIAL WORLD

CIRED

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Devrim Yilmaz & Antoine Godin

Agence Francaise de Developpement

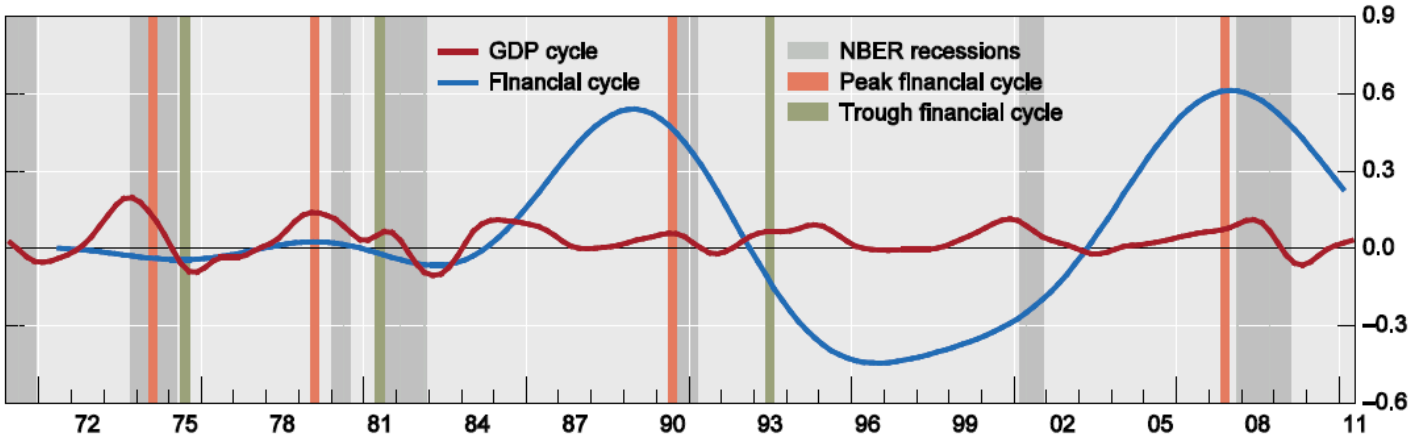
Background: The Financial Cycle

- Centre countries monetary policy is transmitted through leverage and cross border gross flows (particularly credit flows) even under floating exchange rate regimes (Rey, 2013)
- Other fundamentals such as high growth prospects and low public debt lose their significance when the global risk apetite is low (proxied by a high VIX) but interest rate differentials still have a statistically significant effect on the amount of capital inflows (Nier et al. 2014)
- Therefore, the popular trilemma faced by small open economies reduces to a dilemma, as the choice of exchange rate does not matter any more.
- Independent monetary policy can only be achieved through regulating the capital account.

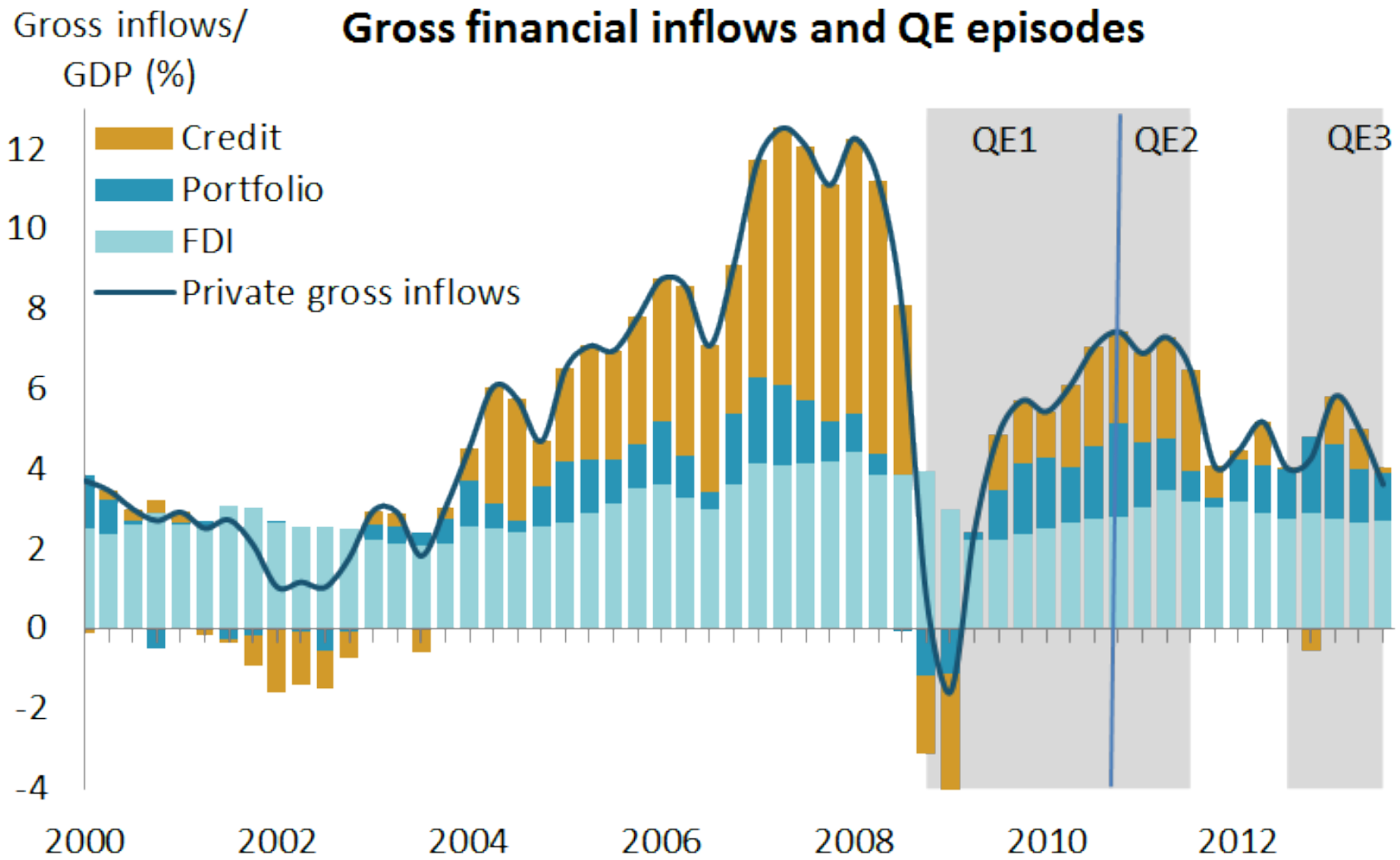
The Financial Cycle

Graph 1

The financial and business cycles in the United States



The Financial Cycle



Background: The Financial Cycle

- Public balances improve during the upswing of the financial cycle (Borio, 2012)
- For developing economies, financial cycle puts downward pressure on inflation via real appreciation of the currency (Cimoli et al 2016)
- Consumption booms and increase in investment due to appreciation
- Falling inflation and unemployment during the upswing, slumpflation during the downswing

The Model

- We assume world GDP to grow at a constant rate $\nu_{g,1}$, factored with cycles of frequency $\nu_{g,2}$

$$GDP_W = GDP_{W,0} \cdot (1 + \nu_{g,1})^t + \nu_{g,2}\sqrt{t} \cdot \sin(\nu_{g,3} t) \quad (1)$$

- Global financial flows (*GFF*) directed towards developing economies is assumed to be a share ν_f of world GDP, where the share follows the business cycle:

$$GFF = \nu_f \cdot GDP_{W,0} \cdot (1 + \nu_{g,1})^t \cdot \sin(\nu_{g,2} t) \quad (2)$$

- Foreign risk-free interest rate is of the same frequency of world's GDP cycle with a lag $(\nu_i, 3)$, as financial markets are forward looking.

$$i_F = \nu_{i,1} + \nu_{i,2} \cdot \cos(\nu_{g,2} t) \quad (3)$$

The model

- Foreign financial flows entering the domestic economy (GFF_D) is a share β_{GFF} of global financial flows ($GFF_D = \beta_{GFF} GFF$), the share depends on an arbitrage condition between foreign yield (r_F) and domestic yield (r_D) which factors in expected exchange rate movements ($\frac{\dot{e}^e_N}{e_N}$), discounted.

The Model

- The goods market is characterized by disequilibrium such that Aggregate Domestic Demand $\neq$ Gross Domestic Product. Firms form adaptive expectations about demand and produce according to these expectations.

$$\dot{Y}^e = \beta_y(\frac{Y^D}{p} - Y^e) + \alpha Y^e \tag{4}$$

- where Y^D is total aggegate demand and it is given by

$$Y^D = C + G + p \cdot I + X \tag{5}$$

- and unsold goods accumulate in inventories:

$$\dot{V} = Y^p - \frac{Y^D}{p}$$

The Model

- As in Franke (1996), Chiarella and Flaschel (2006, 2008, 2011), we assume firms have a desired inventory to expected sales ratio.

$$V^{Des} = \alpha_V Y^e \tag{6}$$

- Therefore, inventory investment becomes

$$I_V = (V^{Des} - V) \tag{7}$$

- and production in each period is

$$Y^P = Y^e + I_V \tag{8}$$

- The total financing needs of firms is given by desired investment over expected internal funds.

$$TFN_F = I^d - s_f \Pi_F^e \tag{9}$$

The Model

- Desired investment is given by

$$I^d = K\left(\kappa_0 + \kappa_1(r_f^e - \bar{r}) + \kappa_2(d - \bar{d})\right)/e_R \tag{10}$$

- Firms desire to finance a certain fraction of their total financing needs via foreign financial markets.

$$\dot{L}_F^{FX,des} = \beta_{LF} TFN_F \tag{11}$$
$$\dot{L}_F^{D,des} = (1 - \beta_{LF}) TFN_F \tag{12}$$

- This fraction follows a sigmoid function that depends on the expected arbitrage opportunity between domestic financing and foreign financing.

$$\beta_{LF} = \frac{1}{1 + e^{-\beta_{LF,1}\left(\frac{1+i^L-\lambda_f}{1+i^L}\right)+\beta_{LF,2}}} \tag{13}$$

The Model

- Firms have a desired price level, calculated to yield a target profit rate over unit costs.

$$p^{Des} = (1 + \mu)UC \tag{14}$$

- where markup takes into account demand conditions:

$$\mu = \mu_0 + \mu_1(\alpha_v - \frac{V}{Y^e}) \tag{15}$$

- Prices are sticky (the level of stickiness measured by β_p below) and adjust slowly towards their desired level

$$\dot{p} = \beta_p(p^{Des} - p) \tag{16}$$

The Model

- Banks purchase a moving fraction of the newly supplied government bonds ($\dot{B}^G$) every period.

$$\dot{B}_B^G = (1 - \Omega)\dot{B}^G \tag{17}$$

- As above, the banks desire to find a certain fraction β_{LB} of their financing needs from international markets.

$$\dot{L}_B^{FXdes} = \frac{\beta_{LB}(TFN_B)^e}{e_N^e} \tag{18}$$

- This ratio depends on the arbitrage opportunity between borrowing advances from the central bank at the policy rate and borrowing from abroad.

$$\beta_{LB} = \frac{1}{1 + e^{-\beta_{LB,1}\left(\frac{1+i^P-\lambda_b}{1+i^P}\right)+\beta_{LF,2}}} \tag{19}$$

The Model

- However, as in the case of firms, foreign financial markets ration the credit demand by domestic banks as:

$$rat^B = \rho_1 + \rho_2\left(\frac{\Pi_b^e}{Y^{PD}p}\right) \tag{20}$$

- Banks desire to hold foreign exchange on the asset side of their balance sheet.

$$R_B^{FX,des} = \chi(L_B^{FX} + Dep_F^{fx}) \tag{21}$$

- So the desired change in bank holdings of foreign exchange is

$$(\dot{R}_B^{FX})^{des} = \left[R_B^{FX,des} - R_B^{FX}\right] \tag{22}$$

The model

- The central bank conducts monetary policy using a variant of Taylor Rule which takes into account inflation and foreign policy rate.

$$i_P = \iota_1 + \frac{\dot{p}}{p} + \iota_2 i_F \tag{23}$$

- The central bank absorbs the supply of governments bonds in excess of demand by banks and the rest of the world.

$$\dot{B}^G_{CB} = \dot{B}^G - \dot{B}^G_B - \dot{B}^G_{ROW} \tag{24}$$

- The exchange rate policy of the central bank is countercyclical. In the case of positive capital flows, the central bank buys a certain fraction of these inflows. In the case of outflows, central bank sells foreign exchange to mitigate the depreciation of the currency, as long as reserves remain over a certain fraction of imports.

$$\begin{aligned} \dot{R}^{FX}_{CB} &= \phi GFF_D \text{ if } R^{FX}_{CB} > \epsilon IM, \ \& \ GFF_D \geq 0 && (25) \\ &= 0 \text{ if } R^{FX}_{CB} < \epsilon IM \, , \ \epsilon > 0 && (26) \end{aligned}$$

The model

- Wage negotiations are nominal and depend positively on employment rate and current inflation, with a degree of money illusion.

$$\dot{w}/w = \omega_0 + \omega_1 \frac{L}{Pop} + \omega_2 \hat{p} \tag{27}$$

- Households receive labour income, interest on their deposits, unemployment benefits and distributed profits of firms and spend on consumption. They do not hold any other financial assets. Total household savings thus become

$$S_h = (1 - \tau_w) wL + G_E + i_D D_h + (1 - s_f)\Pi_f - C_h \tag{28}$$

The model

- The exchange rate market is characterized by disequilibrium between flow FX demand and FX supply.

$$\dot{e}_N / e_N = \beta_{en}\left(\frac{D^{fx} - S^{fx}}{S^{fx}}\right) \tag{29}$$

- with D^{fx} is flow foreign exchange demand and S^{fx} is flow foreign exchange supply, given by

$$D^{fx} = IM + IA + (\dot{D}ep_F^{fx}) + (\dot{R}_B^{FX})^{des} \tag{30}$$

$$S^{fx} = X + GFF_D + \dot{L}_B^{FX} + \dot{L}_F^{FX} - \dot{R}_{CB}^{FX} \tag{31}$$

The model

- Domestic residents and firms/banks do not hold foreign assets. Therefore, the income account of the country is always negative and its absolute value is given by

$$|IA| = i_B^G B_{ROW}^G + i_B^{FXB} L_B^{FX} + i_F^{FXB} L_F^{FX} \tag{32}$$

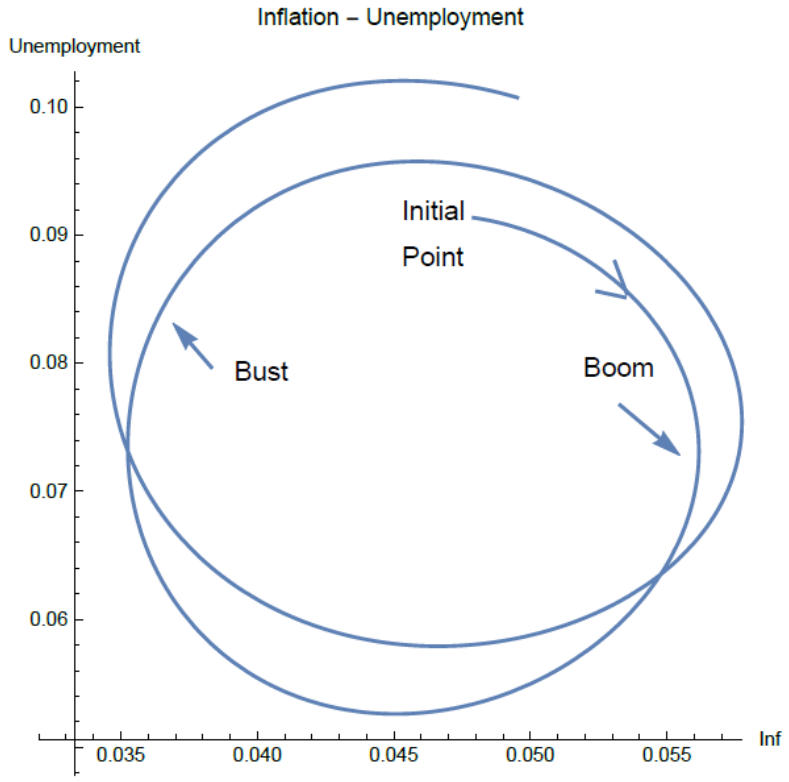
- From the balance of payments constraint,

$$\dot{R}^{FX} = X - IM + \dot{B}_{ROW}^G + \dot{L}_B^{FX} + \dot{L}_F^{FX} - |IA| \tag{33}$$

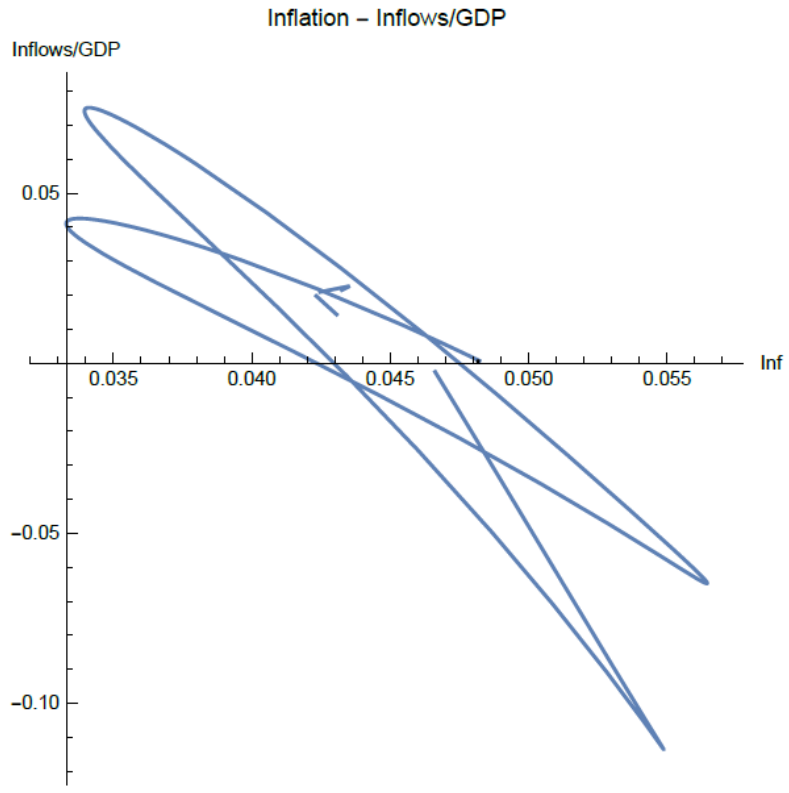
- As the only financial asset invested in by the rest of the world, the change in foreign holdings of government bonds is equal to financial capital inflows.

$$\dot{B}_{ROW}^G = GFF_D \tag{34}$$

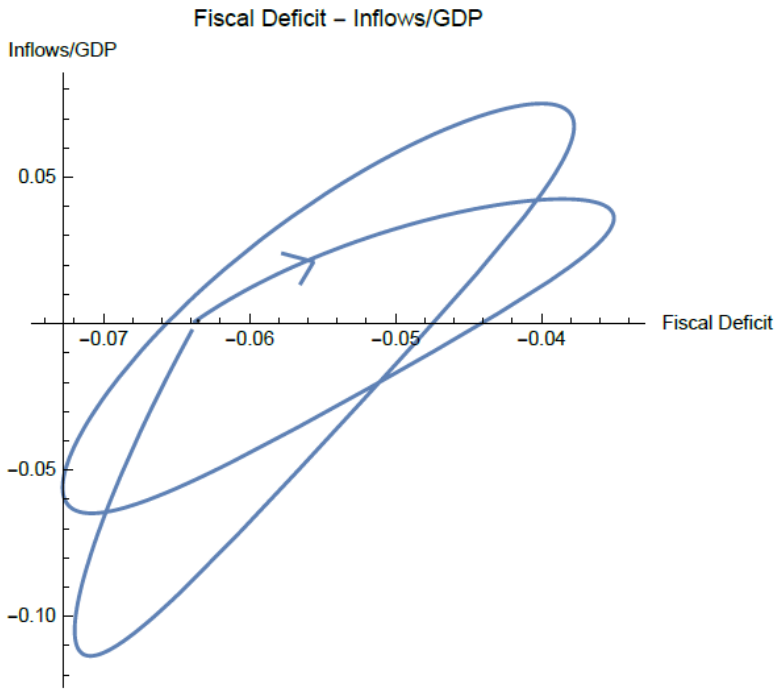
Simulating the system - Inflation - Unemployment



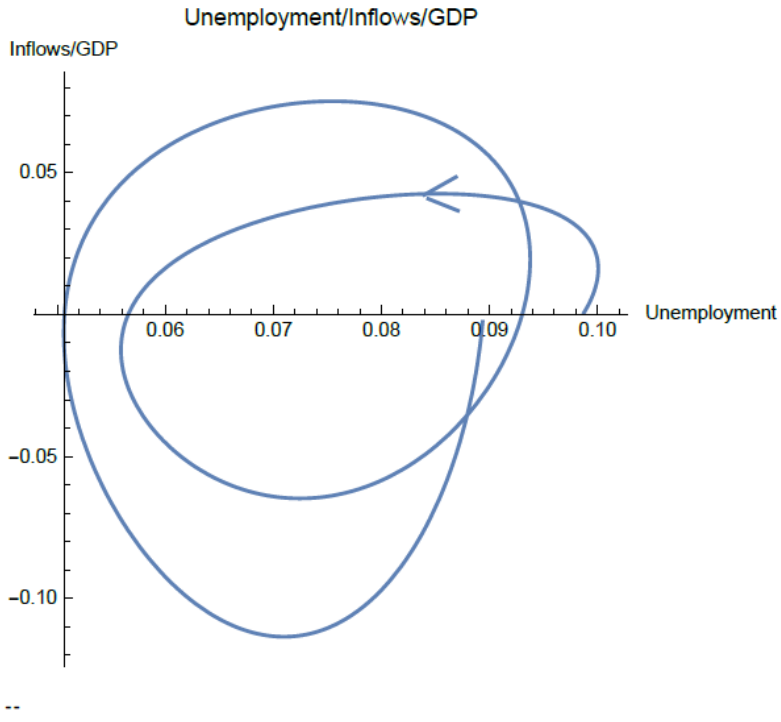
Simulating the system - Inflation - Inflows



Simulating the system - Exchange Rate



Simulating the system - Inflation



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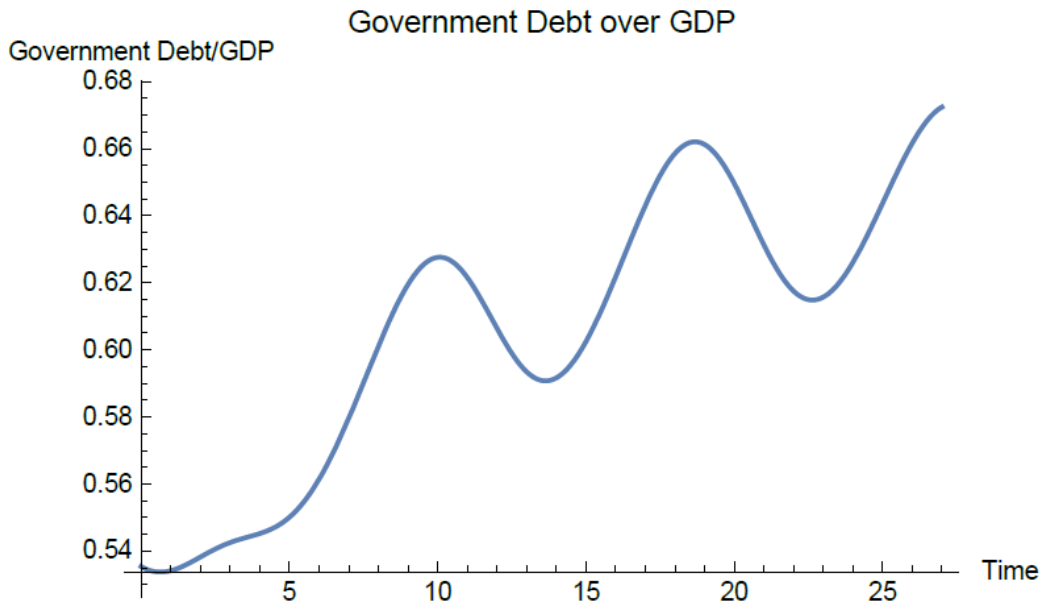
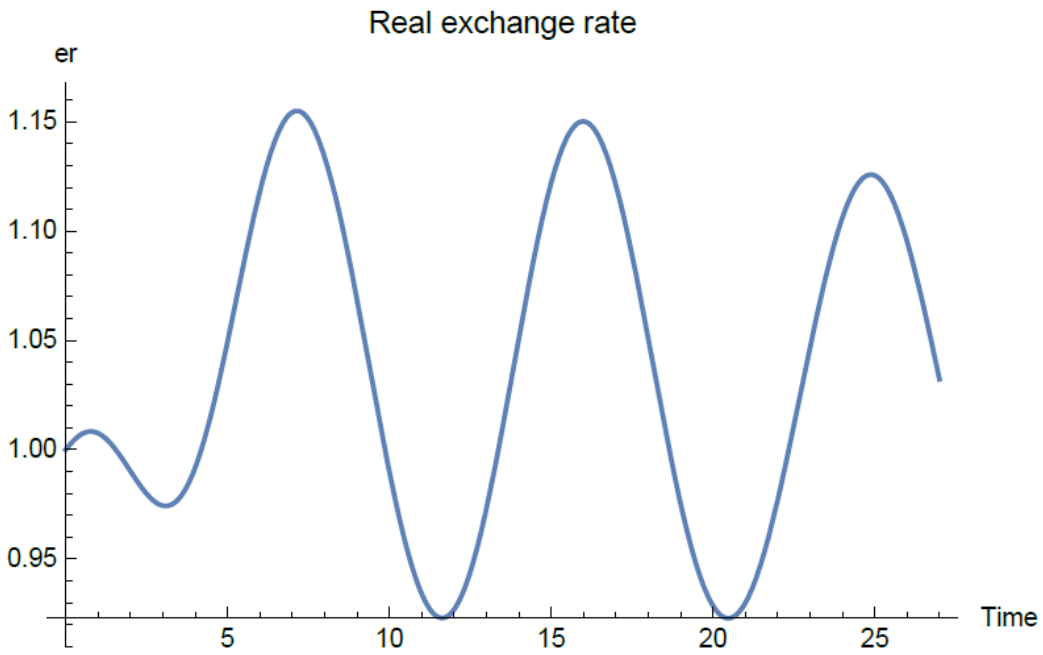
Simulating the system - Public Debt



Simulating the system - Real Exchange Rate



Conclusion

- Model of a small open developing economy with a financial cycle
- The model reproduces stylized facts in developing economies
- Still need some work: FDI, deeper analysis, and policy recommendations

Thank you!

yilmazsd@afd.fr