# Monetary Policy in a Small Open Economy with Multiple Monetary Assets

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# Motivation

- As the world becomes more integrated, most economies are small and open. The New Open Economy Macroeconomics literature has grown rapidly in the last two decades. The role of nominal variables like money, interest rate and exchange rate in short run is emphasized in recent New Keynesian literature. However, recent DSGE macroeconomic models often ignore quantity of money as an immediate target of monetary policy.
- The discussion of monetary policy in a SOE centers around stabilizing exchange rate, for example, see McCallum (2007). Money as a potential monetary policy instrument is completely being ignored. This is due to empirical evidence of a fragile relation between money and macroeconomic variables, such as in Bernanke and Blinder (1988), and Sims (1980).

# Motivation

- The issue of money measurement has been brought up: the financial market is replete with various kinds of monetary assets which are not perfect substitutes. Hence, the traditional way of aggregating money at central banks is no longer appropriate.
- Barnett (1978) proposed a method to aggregate monetary assets based on microeconomics and index number theory, the Divisia measure of money, which assigns a different weight to each monetary asset based on both quantity and price.
- Since Divisia monetary aggregate and monetary aggregation theory became available from the 1980s, hundreds of papers, including Chrystal and MacDonald (1994), Belongia (1996), Barnett and Chauvet (2010), Belongia and Ireland (2015), have shown that money still shares a strong relationship with aggregate economic activity.

# Motivation

- Though hundreds of theoretical and empirical works have been repeatedly showing that Divisia measure is strictly preferable to its official simple-sum counterpart, however, the availability of the simple-sum has continued. Many central banks in the world keep reporting simple-sum measure of money supply.
- Chrystal and MacDonald (1994) used the term 'Barnett critique' to refer to the misleading and potential distortion of economic inferences if simple-sum measure keeps being used.
- In the context of a small open economy, money as a potential monetary policy instrument is completely being ignored. Moreover, the matter of money measurement has not been touched in such an environment.

# Research questions

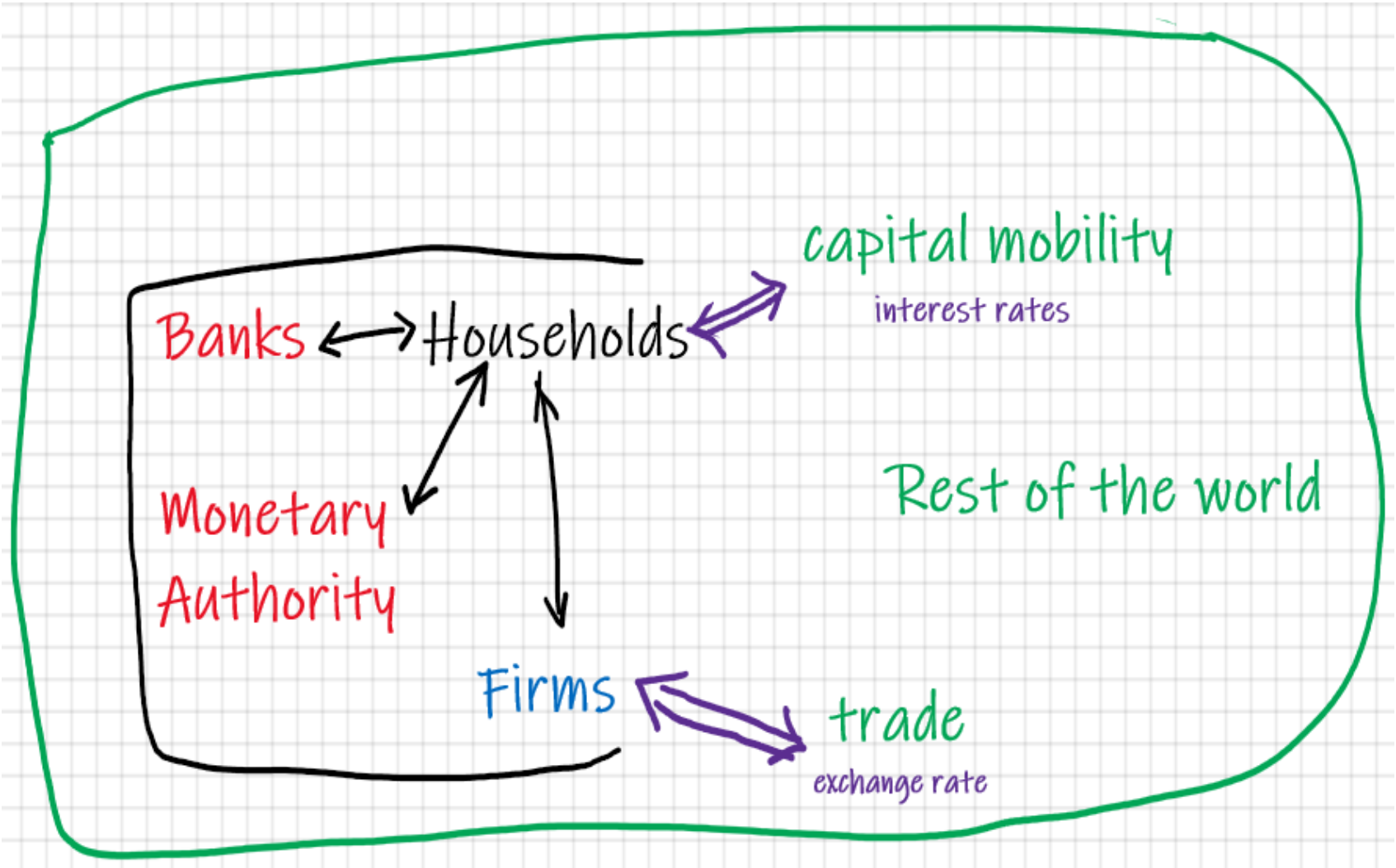
To emphasize the influence of nominal sector on the real sector in a small open economy with multiple monetary assets, I revisit the issue of money measurement.

- I ask the 'old' question in a 'new' context: Does the measurement of money matter? To answer this question, I examine the responses of different measures of money supply, including the official simple-sum, monetary base and Divisia to various macroeconomic shocks. I create a theoretical benchmark to compare these responses.

- How does the openness affect the behavior of money and the stability of other macroeconomic variables?

# The framework

Figure: A small open economy vs the rest of the world



# Overall model

I construct a model based on the recent developed micro founded, dynamic and stochastic New Keynesian model for small open economy with home-bias in consumption, similar to that in Faia and Monacelli (2008).

- Households
- Foreigners
- Production firms
- (Private) financial institutions (commercial banks)
- Central bank

# Different money measures

I introduce two types of monetary assets to the economy, cash and deposits. I borrow the idea of Belongia and Ireland (2014) to create a

- Theoretical benchmark of money measure

$$M_t = \left[ \nu^{\frac{1}{\omega}} Ca_t^{\frac{\omega-1}{\omega}} + (1-\nu)^{\frac{1}{\omega}} D_t^{\frac{\omega-1}{\omega}} \right]^{\frac{\omega}{\omega-1}} \quad (1)$$

- Simple sum measure

$$SM_t = Ca_t + D_t \quad (2)$$

- Monetary base

$$MB_t = Ca_t + \tau D_t \quad (3)$$

# Divisia money measure

Divisia index aggregates monetary assets based on both quantity and price, see Barnett (1978,1980) for more details.

- User cost price of currency and deposits

$$u_t^{Ca} = (r_t - 0)/(1 + r_t) \text{ and } u_t^{D} = (r_t - r_t^{D})/(1 + r_t) \quad (4)$$

- Expenditure share of currency and deposits

$$s_t^{Ca} = \frac{u_t^{Ca} Ca_t}{u_t^{Ca} Ca_t + u_t^{D} D_t} \text{ and } s_t^{D} = \frac{u_t^{D} D_t}{u_t^{Ca} Ca_t + u_t^{D} D_t} \quad (5)$$

- The growth rate of Divisia (quantity) index is the weighted average growth rate of all component assets.

$$1 + g_t^{Q} = (Ca_t/Ca_{t-1})^{(s_t^{Ca}+s_{t-1}^{Ca})/2}(D_t/D_{t-1})^{(s_t^{D}+s_{t-1}^{D})/2} \quad (6)$$

# Various shocks to the economy

- Preference shock

$$\ln(h_t) = \rho_h \ln(h_{t-1}) + \varepsilon_{h,t}$$

- Home technology/productivity shock

$$\ln(z_t) = \ln(z) + \varepsilon_{z,t}$$

- Monetary policy shock

$$r_t = (1-\rho_r)r + \rho_r r_{t-1} + (1-\rho_r)\rho_\pi(\pi_{H,t} - \pi_H) + \varepsilon_{r,t}$$

- Shock to Foreign productivity

$$\ln(z_t^f) = (1-\rho_z^f)\ln(z^f) + \rho_z^f \ln(z_{t-1}^f) + \varepsilon_{z,t}^f$$

- Shock to Foreign demand

$$\ln(c_t^f) = \rho_c^f \ln(c_{t-1}^f) + \varepsilon_{c,t}^f$$

- Shock to Foreign inflation

$$\pi_t^f = (1-\rho_p^f)\pi^f + \rho_p^f \pi_{t-1}^f + \varepsilon_{p,t}^f$$

# Preliminary results (1)

I compare the responses of different measures of money w.r.t to various shocks.

- While Divisa index tracks almost perfectly the movement of the theoretical benchmark of money, monetary base fails in some cases and simple sum measure behaves very differently in most cases.
- I vary the parameters for sensitivity analysis and to check the robustness of the results. The conclusion remains the same.

Figure: Impulse responses of growth rates of different money measures w.r.t domestic shocks under variation of elasticity of substitution between cash and deposit

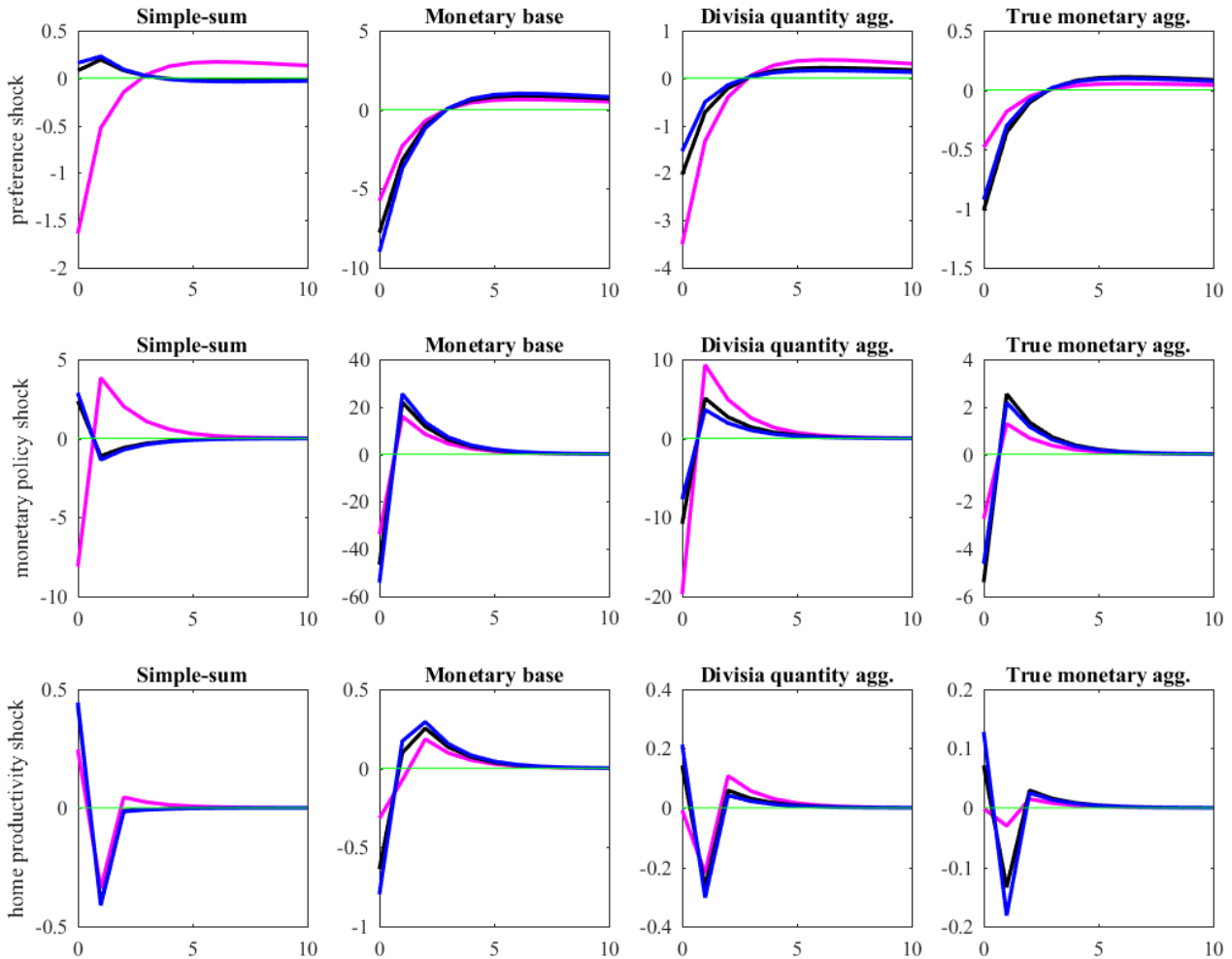


Figure: Impulse responses of growth rates of different money measures w.r.t domestic shocks under variation of elasticity of substitution between domestic and foreign goods in households' consumption

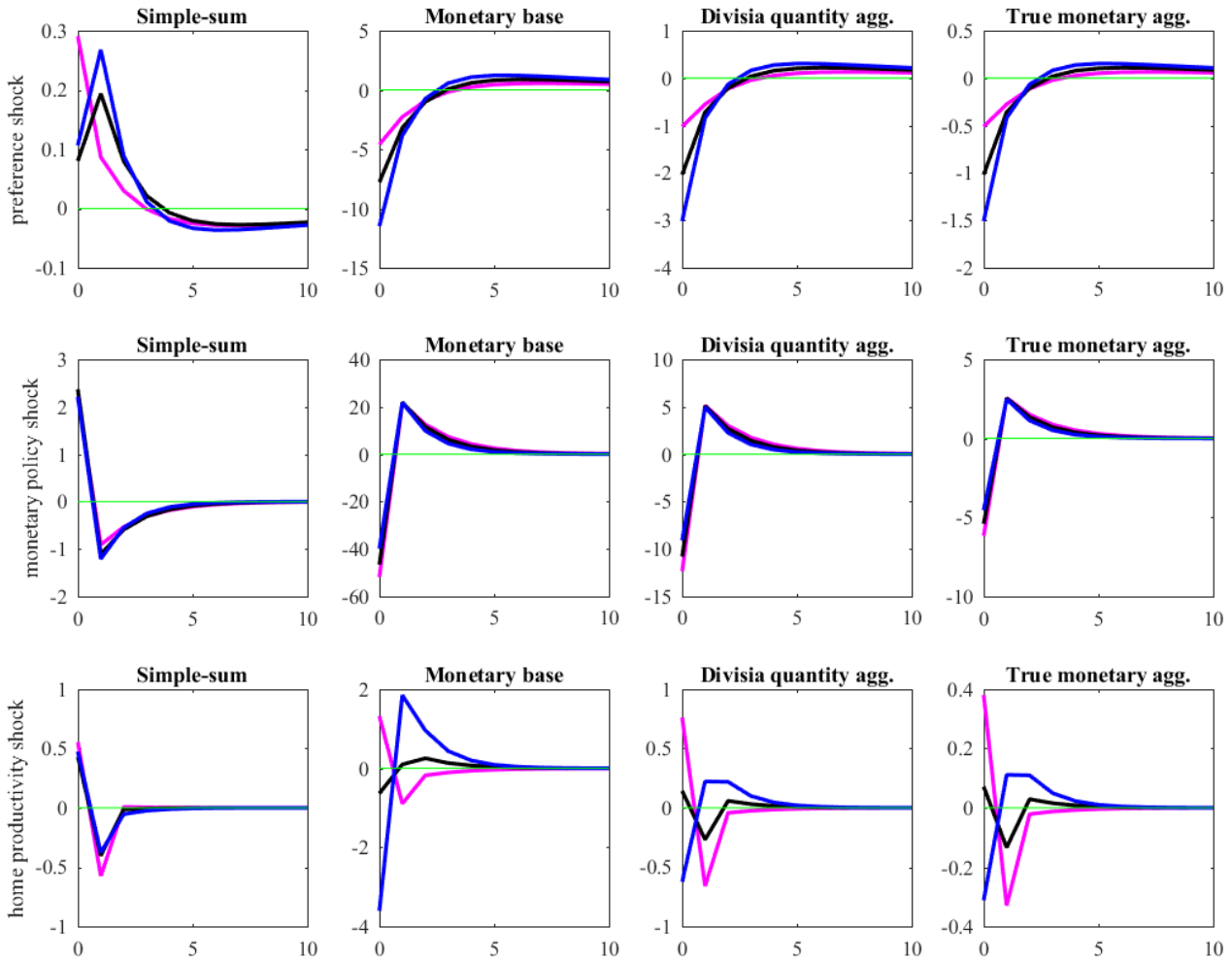
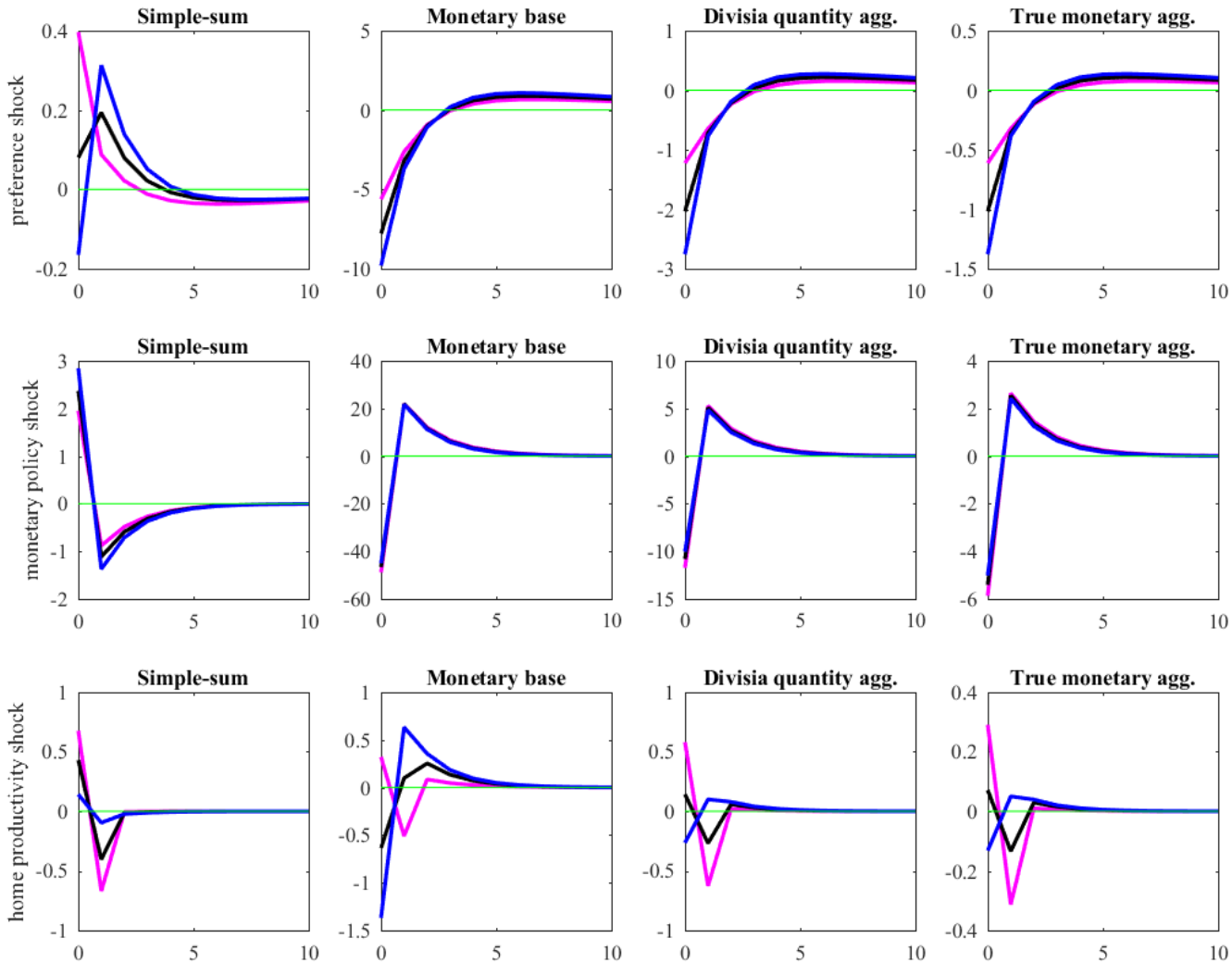


Figure: Impulse responses of growth rates of different money measures w.r.t domestic shocks under variation of the level of openness



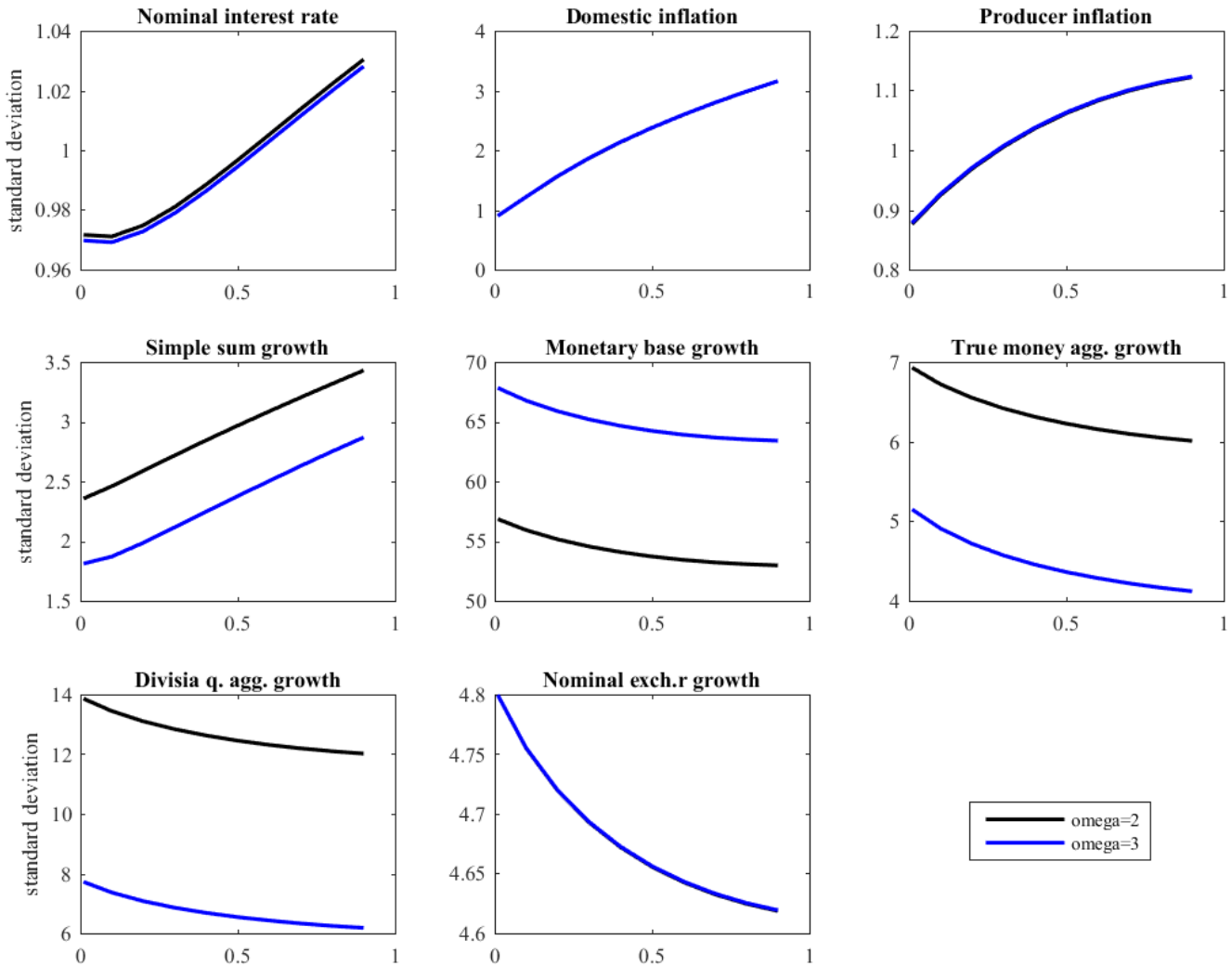
# Preliminary results (2)

I further look at the volatility of macroeconomic variables under different levels of openness.

- As the economy becomes more open, consumption becomes less home biased. Nominal interest rate and domestic inflation fluctuate more as the economy becomes more open while the growth rate of exchange rate and theoretical money benchmark become more stable.

- Once again, at various levels of openness, Divisa index follows the correct trend of the theoretical money benchmark, while simple sum does not. This pattern does not change under different financial structure.

Figure: Volatility of macroeconomic variables under variation of the level of openness from 0 to 1



- This paper revisits the issue of money measurement in the context of a small open economy using the recent highly micro founded DSGE model. The results are consistent with other papers in the literature advocating the use of Divisia index and eliminating the use of simple sum in monetary aggregation.

- In the future work, I plan to examine different regimes of money policy targeting different intermediate instrument, namely, interest rate, money supply, and exchange rate. To find the optimal monetary policy rule, I plan to evaluate the representative household welfare under each regime.

# Contribution

- This paper is among the first (theoretical) works of Divisia measure in a small open economy. I construct a New Keynesian model with multiple monetary assets by introducing the banking sector and compare the behavior of different measures of money.
- It is also the first paper to analyze the effect of openness (home bias in consumption) to the volatility of macroeconomic variables in a such an economy.

## Main References

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