Optimal Devaluations

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- Which is the optimal response of monetary policy in a small open economy, following a shock to commodity prices?

- For many countries, exports of **commodities** are a sizeable fraction of GDP.

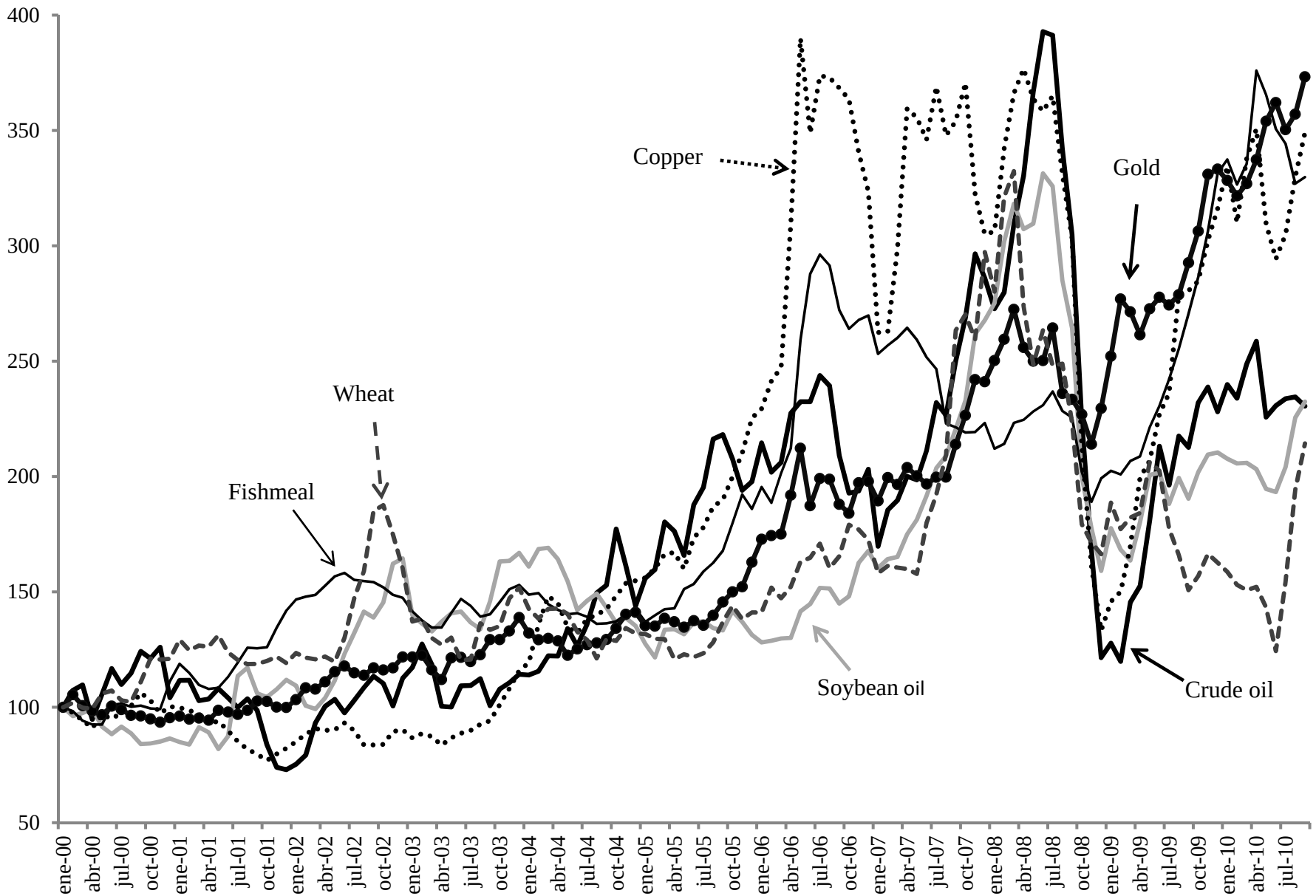
- Shocks to commodity prices are very large.

TABLE 1. Principal commodity exports in selected countries

Panel A	Principal commodity exports (monthly averages since Jan 2000)			Share in good exports (%)			
	C1	*C2*	*C3*	*C1*	*C2*	*C3*	*Total*
Argentina	Soybean and products	Petroleum and products	Wheat	23	9	4	36
Australia	Coal	Iron ore	Gold	14	9	5	28
Brazil	Soybean and products	Petroleum and products	Iron oxides	9	8	7	24
Chile	Copper	Marine products		45	7	-	52
Iceland	Marine products	Aluminium		53	25	-	78
New Zealand	Diary produce	Meat and edible offal	Wood and products	19	13	7	39
Norway	Petroleum and products	Marine products		57	5	-	62
Peru	Copper	Gold	Marine products	20	19	8	47

Panel B	Aggregate shares (%)		
	Goods/Total Exports	*Total Exports/GDP*	*Goods/GDP*
Argentina	87	22	6.7%
Australia	78	20	4.4%
Brazil	87	13	2.7%
Chile	83	39	16.8%
Iceland	65	37	18.7%
New Zealand	74	30	8.6%
Norway	76	44	20.7%
Peru	87	22	9.0%

Sources: National statistics agencies. Columns labeled *C1-C3* report the most important commodities and their shares in total exports of goods. Column labeled *Total* reports the share of the three principal commodities on total good exports. Commodity exports data are monthly and the last observation varies by country: Argentina, Jan2000 - Jun2010; Australia, Jan2000 - Oct2010; Brazil, Jan2000 - Oct2010; Chile, Jan2000 - Nov2010; Iceland, Jan2000 - Oct2010; New Zealand, Jan2000 - Oct2010; Norway, Jan2000 - Oct2010; and Peru, Jan2000 - Sep2010.


400
350
300
250
200
150
100
50
Copper
Gold
Wheat
Fishmeal
Soybean oil
Crude oil
ene-00
abr-00
jul-00
oct-00
ene-01
abr-01
jul-01
oct-01
ene-02
abr-02
jul-02
oct-02
ene-03
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- Implications for monetary and exchange rate policy when there are price rigidities?

- In recent years, there has been a move towards inflation targeting.

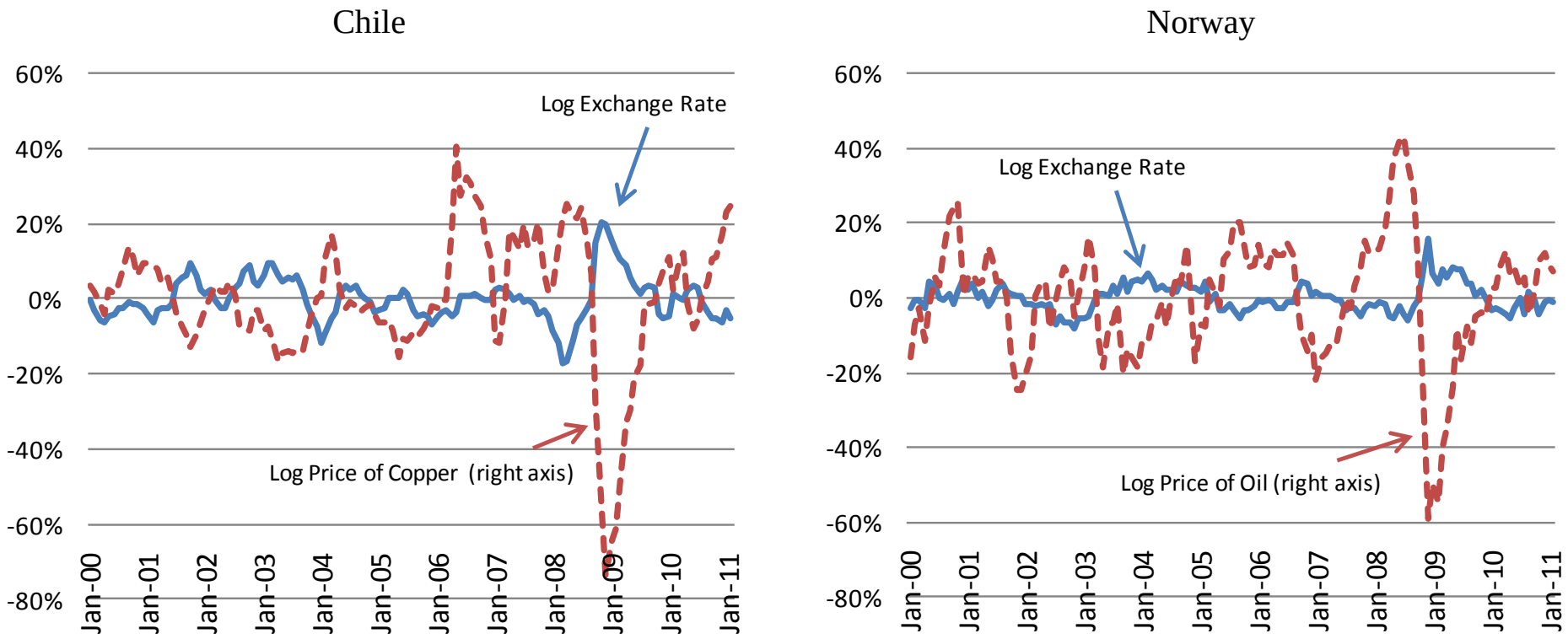
- By now, all countries in the Table - with the exception of Argentina - became inflation targeters.

- The exchange rate freely floats.

- Evidence on exchange rate movements in inflation targeting countries.

HP-Filtered Exchange Rate and Commodity Price

Data shown as percentage deviation from trend



Note: Series are first logged and then HP-filtered with a smoothing parameter of 14400

Summary Statistics Exchange Rate and Commodity Price

Data shown as percentage deviation from trend

	In US dollars		In Euros	
	Std. Deviation	Correlation	Std. Deviation	Correlation
Chile				
Exchange Rate	0.0506	-0.4729	0.0580	-0.5132
Price of Copper	0.1241		0.1266	
Norway				
Exchange Rate	0.0559	-0.5438	0.0316	-0.4332
Price of Oil	0.1459		0.1374	

Note: Data is first logged and then HP-filtered with a smoothing parameter of 14400

- There is still "fear of floating" (Calvo and Reinhart).

- Chile intervened twice since 2000
  - April 2008: announced a program to gradually buy reserves for an amount equivalent to 40% of stock of reserves. Value of peso: 450.
  - January 2011: announced a similar program when the value of the peso was at 475.

- Justification for interventions: Exchange rate too low. Terms of trade too high.

- Are these good reasons to abandon price stability?

- Gali-Monacelli (2005): No, price stability is optimal, let the exchange rate float.

- Qualifications: De Paoli (2008), Faia Monacelli (2008), ...

- But.....

1. There are no commodities in the model. Main feature of the "old" SOE tradition (Dornbusch 1975 plus...) is absent.

2. Cannot justify the observed volatility of the exchange rate. Does the observed volatility justify the fear of floating?

3. Increases in the foreign price of the importable (negative shocks to the terms of trade) are expansionary in the existing models.

- In this paper we explicitly model commodities. In line with the SOE tradition.

- In addition, we allow for flexible fiscal instruments. (Correia, Nicolini and Teles 2004, Adao, Correia and Teles 2009, Correia, Farhi, Nicolini and Teles 2010, Farhi, Gopinath and Itskhoki, 2011)

- Advantage of making explicit all existing distortions.

- The transmission mechanism of exchange rate movements changes substantially.

- The model has the potential to reproduce the volatility of the nominal exchange rate and the commovements with the terms of trade.

- Still, there are cases in which price stability is optimal.

- The interaction between fiscal and monetary instruments is at the core of the argument.

The Model

- Discrete time, stochastic, cashless economy.
- Ramsey Government: exogenous expenditures.
- Fiscal policy: labor τ_t^n, consumption τ_t^c, final good exports τ_t^h, final good import taxes τ_t^f.
- Complete markets.

Preferences

$$E_0 \sum_{t=0}^{\infty} \beta^t U\left(H\left(C_t^h, C_t^f\right), N_t\right)$$

- $H\left(C_t^h, C_t^f\right)$ is a function homogeneous of degree one.

- The optimality conditions are

$$\frac{H_{Ch}(t)}{H_{Cf}(t)} = \frac{P_t^h}{P_t^f}$$

$$\frac{U_C(t) H_{Ch}(t)}{-U_N(t)} = \frac{P_t^h (1+\tau_t^c)}{W_t (1-\tau_t^n)}$$

$$\frac{U_C(t) H_{Ch}(t)}{P_t^h (1+\tau_t^c)} = \beta Q_{t,t+1}^* \frac{S_t}{S_{t+1}} \frac{U_C(t+1) H_{Ch}(t+1)}{P_{t+1}^h \left(1+\tau_{t+1}^c\right)}$$

Final good firms

$$Y_t^h = \left[\int_0^1 y_{it}^{\frac{\theta-1}{\theta}} di \right]^{\frac{\theta}{\theta-1}},$$

where $\theta > 1$

- The firm's problem implies the cost minimization condition

$$y_{it} = Y_t^h \left(\frac{P_{it}^h}{P_t^h} \right)^{-\theta}$$

Commodities sector

- Commodity z is imported
- Commodity x is produced according to the technology

$$X_t = A_t \left(n_t^x\right)^\rho,$$

- Set $\rho = 1$.
- Profit maximization then requires

$$P_t^x A_t = W_t.$$

- Because the two commodities can be freely traded, the law of one price holds:

$$\begin{aligned} P_t^x &= S_t P_t^{x*} \\ P_t^z &= S_t P_t^{z*}. \end{aligned}$$

- P_t^{x*} and P_t^{z*} denote the foreign currency prices of the x and z commodities.

Intermediate good firms

- Technology is Cobb-Douglas on labor and the two commodities.

- The nominal marginal cost function is

$$MC_t = \frac{\left(P_t^x\right)^{\eta_1}\left(P_t^z\right)^{\eta_2} W_t^{\eta_3}}{Z_t}.$$

  where Z_t is a productivity shock.

- Using the solution for factor prices

$$MC_t = S_t MC^*\left(\mu^t\right) = S_t \frac{\left(P_t^{x*}\right)^{\eta_1+\eta_3}\left(P_t^{z*}\right)^{\eta_2} A_t^{\eta_3}}{Z_t}.$$

- Note the exponent on P_t^{x*}.

Price setting

- We assume Calvo price rigidity.

- In each period, intermediate good firms are able to reoptimize nominal prices with a constant probability $0 < \alpha < 1$.

- Those that get the chance to set a new price will set it according to

$$p_t^h = \frac{\theta}{\theta - 1} E_t \sum_{j=0}^{\infty} \eta_{t,j} \frac{\left(P_{t+j}^x\right)^{\eta_1} \left(P_{t+j}^z\right)^{\eta_2} W_{t+j}^{\eta_3}}{Z_{t+j}},$$

  where $\eta_{t,j}$ are weights associated to state contingent prices.

Implications of price stability

- A monetary policy that successfully stabilizes the domestic price of the final good must stabilize the marginal cost.

- But

$$MC = S_t \frac{(P_t^{x*})^{\eta_1+\eta_3} (P_t^{z*})^{\eta_2} A_t^{\eta_3}}{Z_t}$$

  so stabilizing marginal costs implies

$$S_t = \frac{1}{MC} \frac{Z_t}{(P_t^{x*})^{\eta_1+\eta_3} (P_t^{z*})^{\eta_2} A_t^{\eta_3}}$$

- Thus, the volatility of the nominal exchange rate depends on the volatility of the exogenous shocks $(P_t^{x*}, P_t^{z*}, A_t, Z_t)$

- In addition, the correlation between S_t and P_t^{x*} will be negative, as in Table 2.

- Fluctuations on the exchange rate depend on movements on commodity prices and productivity shocks, as well as on properties of the input-output matrix (η^1, η^2, η^3).

- This is the main transmission mechanism of exchange rate movements.

Foreign sector and feasibility

- The demand for the home final good is

$$C_t^{h*} = (K_t^*)^{\gamma} \left(P_t^{h*}\right)^{-\gamma}$$

  where $\gamma > 1$

- The law of one price on domestic and foreign final goods then requires

$$\begin{aligned} P_t^h \left(1 + \tau_t^h\right) &= S_t P_t^{h*} \\ P_t^f &= S_t P_t^{f*} \left(1 + \tau_t^m\right) \end{aligned}$$

- Other equilibrium conditions: country budget constraint, labor, domestic production.

The second best solution

- By Diamond and Mirlees homogenous taxation result, the margin between domestic and foreign consumption will not be distorted.

- In addition, as the elasticity of demand for the final domestic good is constant, the optimal mark up will be constant.

- Therefore, the taxes τ_t^h, τ_t^m are constant, satisfying

$$\begin{aligned} \frac{\theta}{\theta - 1} &= (1 + \tau_t^m) \\ \left(1 + \tau_t^h\right) \frac{\theta}{\theta - 1} &= \left(\frac{\gamma}{\gamma - 1}\right) \end{aligned}$$

- In general, time and state varying labor income taxes will move to satisfy

$$\frac{U_C(t) H_{C^h}(t)}{-U_N(t)} = \frac{P_t^h (1+\tau_t^c)}{W_t (1-\tau_t^n)}$$

while consumption taxes will move to satisfy the parity condition

$$\frac{U_C(t) H_{C^h}(t)}{P_t^h (1+\tau_t^c)} = \beta Q_{t,t+1}^* \frac{S_t}{S_{t+1}} \frac{U_C(t+1) H_{C^h}(t+1)}{P_{t+1}^h \left(1+\tau_{t+1}^c\right)}$$

- Price stability is a feature of the second best.

- In general, labor and consumption taxes must move with shocks.

- Thus, the nominal exchange rate must move so as to stabilize domestic marginal costs, as discussed above

$$S_t = \frac{1}{MC} \frac{Z_t}{\left(P_t^{x*}\right)^{1-\eta_2} \left(P_t^{z*}\right)^{\eta_2} A_t^{\eta_3}}$$

- For example, in the particular case of $\ln P_t^{z*} = \ln P^{z*}$, and ignoring productivity shocks $(A_t = A, Z_t = Z)$, then

$$\ln S_t = k - (1 - \eta_2) \ln P_t^{x*}$$

so

$$V(\ln S_t) = (1 - \eta_2)^2 V(\ln P_t^{x*})$$

$$Cov(\ln S_t, \ln P_t^{x*}) = -(1 - \eta_2) V(\ln P_t^{x*})$$

A particular case

- The previous result requires flexible tax instruments.

- It is standard in the recent monetary policy literature to impose the restriction $\tau_t^j = \tau^j$ for all j.

- We show that if

$$U(C, N, m) = \frac{C^{1-\sigma}}{1-\sigma} - \frac{N^{1+\psi}}{1+\psi}, \quad \sigma, \psi > 0$$

  the optimal values for τ_t^c, τ_t^n are constant across states and periods.

Numerical Solutions

- Can the model reproduce the behavior of the nominal exchange rate in Chile?
- We numerically solve the model and show the answer is Yes!
- Are the parameters reasonable?
- Preferences such that price stability is optimal
- Parameters of the cost function in the sector with the price frictions.

Parameters in numerical experiment

Symbol	*Description*	*Value*
ω	Preferences	0.6
κ	Preferences	20
ψ	Preferences	1
β	Discount factor	0.987
ρ	Technology commodity	0.1
η_1	Technology intermediate	0.01
η_2	Technology intermediate	0.29
η_3	Technology intermediate	0.70
G^h	Government consumption	0.30
K^*	Foreign demand	1
γ	Foreign demand elasticity	2
P_t^{f*}	Foreign final good price	1
a^x	Parameter home commodity price	0.16
b^x	Parameter home commodity price	0.96
σ^x	Sd deviation shock home commodity price	0.15
$\rho\left(\varepsilon_t^x, \varepsilon_t^z\right)$	Correlation shock home commodity vs bundle shock	0.1

Volatility and correlation in numerical experiment

	Model	Norway	Chile
Standard deviation of $\log S_t$	0.064	0.056	0.051
Correlation of $\log S_t$ with $\log P_t^{x*}$	-0.49	-0.47	-0.54

Conclusions:

- We developed a model with commodities where the transmission mechanism is very different from the standard SOE model.

- Details that matter: preferences and the input-output matrix.

- Variations on the model of this paper can be applied to specific countries to take into account the specific features.
  - Sticky wages
  - Different sectors.

- Better coordination of fiscal and monetary policy in SOE for stabilization policy?

- Old K versus New K.

- From dependence (past), to independence (present), to partners (future?).