Monetary Regime Choice in China: Policy Rules for Navigating Dark Corners

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January 2017

Abstract

This paper examines the performance of monetary policy rules when the economy finds itself in dark corners. This can occur when the real-sector experiences a sequence of negative shocks from world demand, while the central bank faces prolonged low world interest rates on its foreign reserve holdings. We examine variations of the current policy rules, based on variations of the Taylor rule with inters-rate instruments, in the context of strong restrictions on capital flows and a fixed exchange rate, and in the contract of restricted capital flows and a managed exchange rate. Our results show that a more flexible exchange rate and a more open capital account acts as a shock absorb er when the economy is in a "dark corner", this reducing the fall in real GDP and consumption. However, this benefit comes at a cost. Under the more flexible exchange rate and open capital account, in dark corners, employment is much lower than in the more closed environment. In the more open environment, the real exchange rate appreciates, with an increase in imported inputs, leading to a loss of foreign exchange reserves and lower employment.

Introduction and Outline

- Issues and facts: movement to a more open, more flexible exchange-rate regime
- Welfare gains
- Issues of loss of reserves, exchange-rate appreciation, loss of reserves
- Was there a significant change in connectedness among macroeconomic variabls? Diebold-Yilmuz method.

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- How to set policy rules in "dark corners" when bad things happen all at once.
- Model based on Chang, Liu, Spiegel
- Results show that a more flexibel rate acts as a shock absorber, for sure.
- But in dark corners, a more flexible regime leads to an appreciation, loss of reserves and a collapse in employment
- Reason: firms subsitittue in production away from domestic labor to imported intermediate goods.

Figure 1: IP and CPI Annual Growth Rates, 1998-2016

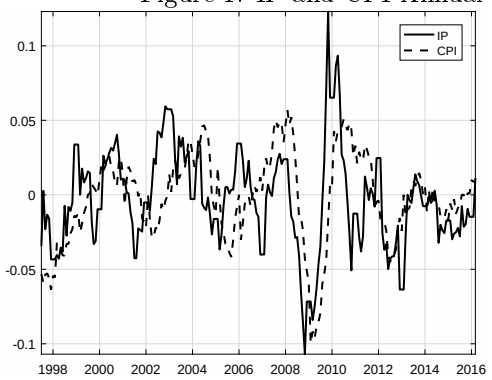


Figure 2: Annualized Growth Rates of Money and Foreign Exchange Reserves, 1998-2016

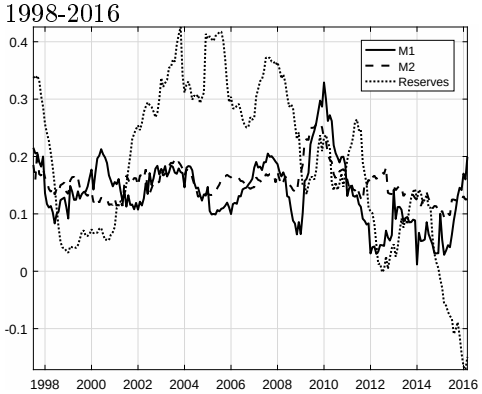
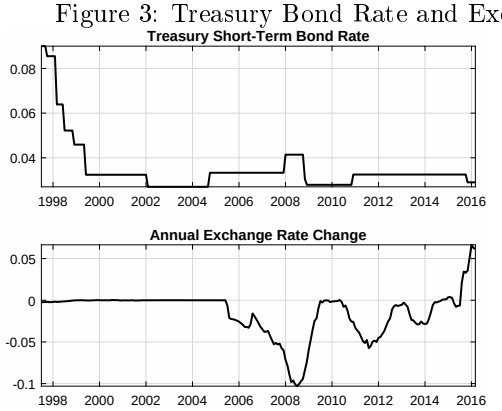


Figure 3: Treasury Bond Rate and Exchange Rate Growth, 1998-2016



Connectedness of Policy Targets

Table 1: Inward and Outward Connectedness: Before and After 2005

Industrial Production

	Pre-2005					Post-2005				
	IP	M2	Res	Ex.Rate	Bond Rate	IP	M2	Res	Ex.Rate	Bond Rate
In	0.748	0.092	0.092	0.037	0.031	0.812	0.048	0.028	0.075	0.036
Out	0.748	0.088	0.074	0.030	**0.164**	0.812	0.036	0.060	0.053	**0.140**

Real Money Supply

	Pre-2005					Post-2005				
	IP	M2	Res	Ex.Rate	Bond Rate	IP	M2	Res	Ex.Rate	Bond Rate
In	0.088	0.686	0.083	0.044	0.099	0.036	0.612	0.075	**0.143**	0.133
Out	0.092	0.686	0.030	0.074	**0.108**	0.048	0.612	0.098	**0.182**	0.072

Foreign Ex. Reserves

	Pre-2005					Post-2005				
	IP	M2	Res	Ex.Rate	Bond Rate	IP	M2	Res	Ex.Rate	Bond Rate
In	0.074	0.030	0.753	0.064	0.076	0.060	0.098	0.701	0.094	0.045
Out	0.092	0.083	0.753	0.044	**0.110**	0.028	0.075	0.701	0.061	0.067

Real Effective Exchange Rate

	Pre-2005					Post-2005				
	IP	M2	Res	Ex.Rate	Bond Rate	IP	M2	Res	Ex.Rate	Bond Rate
In	0.030	0.074	0.044	0.805	0.046	0.053	**0.182**	0.061	0.636	0.066
Out	0.037	0.044	0.064	0.805	0.029	0.075	**0.143**	0.094	0.636	**0.112**

Real Bond Rate

	Pre-2005					Post-2005				
	IP	M2	Res	Ex.Rate	Bond Rate	IP	M2	Res	Ex.Rate	Bond Rate
In	0.164	**0.108**	0.110	0.029	0.587	0.140	0.072	0.067	**0.112**	0.608
Out	0.031	0.099	0.076	0.046	0.587	0.036	**0.133**	0.045	0.066	0.608

Note: Lags for VAR at 5, Forecast horizon 24 months

- One of the results from the before/after 2005 measure is that the real effective exchange rate becomes more important.
- Industrial production, before and after the policy change, affects the real bond yield.
- However, before 2005, the real money supply affects the bond yield, but after 2005, there is stronger inward and outward connectedness between the real money supply and the real exchange rate.
- Foreign exchange reserves have stronger effects on the real bond return before 2005 but afterards have little or not direct effects on other variables.
- For the real effective exchange rate, before 2005, it generates little or no effects on the other variables
- After 2005, the real exchange rate affects and respons to M2 and has strong effects on the real bond yield.
- Finally, for the real bond yield, the main factor of importance before 2005 is the real money supply
- After 2005, the real exchange rate has strong effects on the bond yield, while in turn it has stronger effects on the real money supply.

The Model

- Captures frictions in the form of imperfect capital mobilily
- Takes the form of portfolio adjustment costs and imperfect substitutability of domestic and foreign bonds
- Nominal frictions in the form of Rothemberg pricing
- Just two shocks: to world demand and world interest rates.

Specification

Households and Utility

$$\boldsymbol{W}_t = \boldsymbol{E_t} \sum_{t=0}^{\infty} \beta^t \left\{ ln(C_t) + \Phi_m \left(\frac{M_t}{P_t} \right) - \Phi_l \frac{L_t^{1-\eta}}{1-\eta} \right\} \tag{1}$$

$$C_t + \frac{M_t}{P_t} + \frac{B_t + e_t B^*_{p,t}}{P_t} \left[i1 + \frac{\Omega_b}{2} \left(\frac{B_t}{B_t + e_t B^*_{p,t}} - \bar{\psi} \right)^2 \right]$$

$$\leq w_t L_t + \frac{M_{t-1}}{P_t} + \frac{R_{t-1} B_{t-1} + e_t R^*_{t-1} B^*_{p,t-1}}{P_t} + \frac{D_t}{P_t} \tag{2}$$

Euler Equations

$$\frac{\Phi_m}{\Lambda_t m_t} = 1 - \boldsymbol{E_t} \frac{\beta \Lambda_{t+1}}{\Lambda_t} \frac{1}{\pi_{t+1}} \tag{3}$$

$$w_t = \frac{\Phi_l L_t^{\eta}}{\Lambda_t} \tag{4}$$

$$\Omega_b(\psi_t - \bar{\psi}) = \boldsymbol{E_t} \frac{\beta \Lambda_{t+1}}{\Lambda_t} \frac{1}{\pi_{t+1}} \left[R_t - R_t^* \frac{e_{t+1}}{e_t} \right] \tag{5}$$

Production and Pricing: Imported Intermediate Goods and Labor:

$$Y_t(j) = \Gamma_t(j)^{\phi} \left[Z_t L_t(j) \right]^{1-\phi} \tag{6}$$

$$\lambda_{z,t} = Z_t / Z_{t-1}.$$

$$\Gamma_t = \Gamma_{h,t}^{\alpha} \Gamma_{f,t}^{1-\alpha} \tag{7}$$

$$q_t = e_t P_t^* / P_t :$$

$$q_{mt} = \tilde{\alpha} q_t^{1-\alpha} \tag{8}$$

$$q_t = \frac{1-\alpha}{\alpha} \frac{\mathit{\Gamma}_{h,t}}{\Gamma_{f,t}} \tag{9}$$

:

$$\nu_t = \tilde{\phi} q_{mtt}^{\phi} \left(\frac{w_t}{Z_t} \right)^{1-\phi} \tag{10}$$

$$\frac{w_t}{q_{mt}} = \frac{1-\phi}{\phi} \frac{\Gamma_t(j)}{L_t(j)} \tag{11}$$

Mark-Up Pricing

$$\nu_t = \frac{\theta_p - 1}{\theta_p} + \frac{\Omega_p}{\vartheta_p} \frac{C_t}{Y_t} \left[\left(\frac{\pi_t}{\pi} - 1 \right) \frac{\pi_t}{\pi} - \beta E_t \left(\frac{\pi_{t+1}}{\pi} - 1 \right) \frac{\pi_{t+1}}{\pi} \right] \tag{12}$$

Current Account and External Sector

$$ca_t = X_t - q_t \Gamma_{t,f} + \frac{e_t (R_{t-1}^* - 1) B_{t-1}^*}{P_t} \tag{13}$$

:

$$ca_t = e_t \frac{B_t^* - B_{t-1}^*}{P_t} \tag{14}$$

Stochastic shocks to world interest, world demand

$$\ln R^*_{t-1} = (1-\rho_r)\ln R^* + \rho_r \ln R^*_{t-1} + \sigma_r \epsilon_{r,t} \tag{15}$$

$$X_t = q_t^{\theta} \tilde{X}^*_t Z_t \tag{16}$$

$$\ln \tilde{X}^*_{t-1} = (1-\rho_x)\ln \tilde{X}^* + \rho_x \ln \tilde{X}^*_{t-1} + \sigma_x \epsilon_{x,t} \tag{17}$$

$$e_t(B^*_{g,t} - R^*_{t-1}B^*_{g,t-1}) \leq B^s_t - R_{t-1}B^s_{t-1} + M_t - M_{t-1} \tag{18}$$

Simulations of the Model

- Base version: $\Omega_b = .6$, a fixed exchange rate, and a Ramsey rule for the interest rate
- More flexible, open regime: Ω_b=.2, a specification of a standard Taylor rule domestic interest rate, and a Ramsey rule for the rate of change of the nominal exchange rate

Connectedness Properties of the Model: Any significant differences?

- We see that there are stronger measures of connectedness of the variables generated by the model than in the actual data.
- This should not be surprising, since the model-generated data come from well-defined stochastic processes.
- In one sense the connecteness measuers are broadly consistent with the connectedness measures of the actual data
- If there are any changes in the conncectedness measures, they are not markedly large between the two regimes
- Two important points stand out in this set of results, relative to the empirical results.

1. One is that the real exchange rate is the key variable, driving IP, M2 Foreign Reserves, and the bond yield.
2. Bond yield has strong effects on money supply in both versions

- But what stands out in this comparison is how little the connectedness measures change, under the two regimes.
- This is also true for the measures based on the actual data.

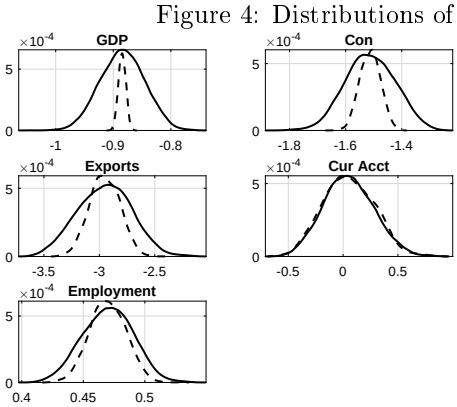
Table 2: Connectedness under Two Regimes

	Closed-Fixed Regime					Open-Flexible Regime				
Industrial Production										
	IP	M2	Res	RealER	B-Rate	IP	M2	Res	RealER	B-Rate
In	0.152	0.137	0.179	**0.238**		0.141	0,181	0,172	**0.214**	0.133
Out	0.152	0.158	0.145	0.152		0,141	0,141	0,142	0.141	0.149
Real Money Supply										
	IP	M2	Res	RealER	B-Rate	IP	M2	R	RealER	B-Rate
In	0.158	0.167	0.188	**0.231**	0.149	0.142	0.189	0.169	**0.216**	0.130
Out	0.137	0.167	0.142	0.134	0.134	0.181	0.189	0.188	0.185	0.212
Foreign Exchange Reserves										
	IP	M2	Res	RealER	B-Rate	IP	M2	Res	RealER	B-Rate
In	0.145	0.142	0.181	**0.234**	0.148	0.142	0.188	0.168	**0.213**	0.131
Out	0.179	0.188	0.181	0.179	0.179	0.172	0.169	0.168	0.170	0.169
Real Exchange Rate										
	IP	M2	Res	RealER	B-Rate	IP	M2	Res	RealER	B-Rate
In	0.152	0.134	0.179	**0.242**	0.15P2	0.141	0.185	0.170	**0.216**	0.131
Out	**0.238**	**0.231**	**0.234**	**0.242**	**0.241**	**0.214**	**0.216**	**0.213**	**0.216**	**0.215**
Real Bond Yield										
	IP	M2	Res	RealER	B-Rate	IP	M2	Res	RealER	B-Rage
In	0.152	0.134	0.179	**0.241**	0.152	0.149	**0.212**	0.169	**0.215**	0.124
Out	0.150	0.149	0.148	0.152	0.152	0.133	0.130	0.131	0.131	0.124

- Granted, the change in regime is not moving from the completely closed economy to a completely open economy.
- The movement is one from a fixed rate, financially closed model with a Ramsey Taylor rule, to a regime with a Taylor rule, a Ramsey rule for the exchange rate and a slightly more open capital account.
- Chang, Liu and Spiegel report a welfare gain, in terms of consumption compensation, from one regime to the other, of .79%, there appears to be little change.
- Despite the increase in welfare, little change in the connectedness of key macroeconomic variables, using data based on the overall simulation.
- For this reason we turn to the dynamics of the model when the economy falls into a dark corner.
- First let us look at the distribtuions

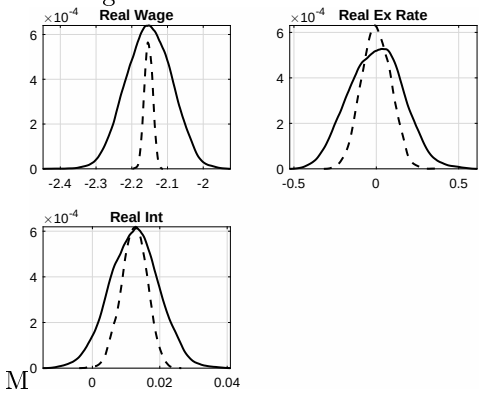
Distributions: Epanechnikov Kernel Estimation

Figure 4: Distributions of National Income Variables



_ _ _ _ _ Fixed/Closed Regime
_ _ _ Flexible/Open Regime

Figure 5: Distributions of Real Wage, Exchange Rate and Interest



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_ _ _ _ _ Fixed/Closed Regime

_ _ _ Flexible/Open Regime

- Shifting to a more flexible system acts as a shock absorber, reducing volaitity of GDP, consumption and real wages.
- However, oittle change in volatility of the real interest rate, real exchange rate and current accout.

Dark Corner Dynamics

- Dark corner originated with Blanchard.
- Two senses of a dark corner.
- One related to Mendoza and his analysis of sudden stops.
- In models with collateral constraints, small shocks can push the economy into a dark corner, in this case a Fisherian dark corner, in terms of a protracted debt/deflation process.
- But even in the absence of occasionally binding collateral constraints, dark corners can happen.
- Perhaps we can call it a Murphy's Law dark corner: anything than can go wrong, will go wrong. Corollary: Murphy was an optimist.
- There can be a succession of negative innovations in several stochastic variables impinging on the economy. There are times when it rains, it pours.
- While welfare is widely used for comparing regimes, Mendoza notes that welfare comparisons usually show small differences.
- Reason is that in long simulations, most of the time the economy is near its stochastic mean.

- Meaning most of the time, we are in normal times.
- But for monetary regimes, should we also compare what happens in the dark corners?
- We calculate dark corners in the following way:

1. Simulate the economy with both shocks for T = 10000.
2. Annualize the data.
3. Identify the periods when the log of GDP is two standard deviations below it stochastic mean, and that it is a minimum point with a neighborhood of plus and minus 50.
4. After these periods are isolated at period T_i^*, we then examine the behavior of key variables in terms of the means or medians.
5. We examine the dynamics of each variable from periods t-5 to t+5, five years before and five years after the bottoming out of the dark corner.
6. To understand the relative change of the variables we normalize each variable at unity for period t-4.

After these periods are isolated, at period T_i^*, we then examine the behavior of key variables

Benchmark Closed-Fixed Rate Regime

Figure 6: Adjustment under Closed/Fixed Regime: National Accounts

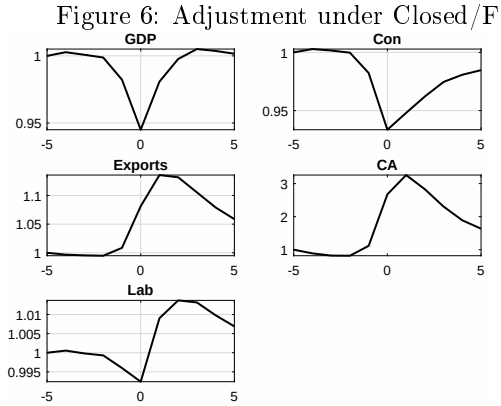
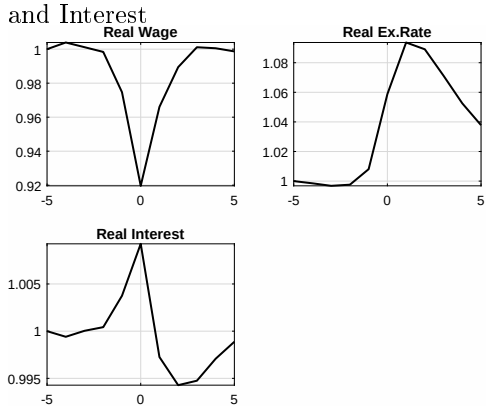


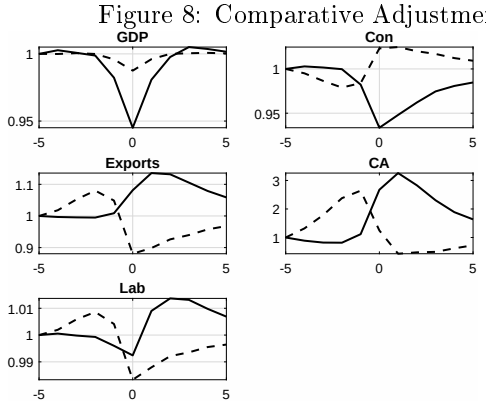
Figure 7: Adjustment under Closed/Fixed Regimes: Real Wage, Exchange Rate and Interest



- We see steep drops in GDP, conumption, with a rise in net exports and the current account.
- Steep drop in real wage, depreiation of the real exchange rate and rise in real interest rates.

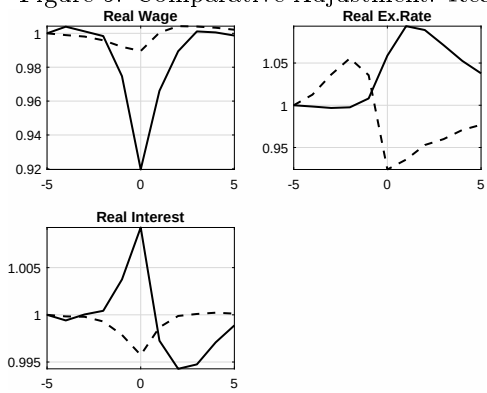
Comparative Adjustment in the Dark Corner

Figure 8: Comparative Adjustment: National Income Accounts



_ _ _ _ _ Fixed/Closed Regime
_ _ _ Flexible/Open Regime

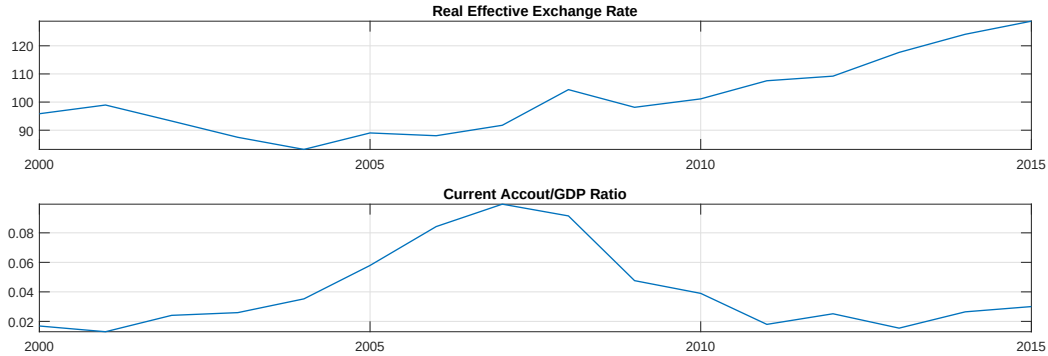
Figure 9: Comparative Adjustment: Real Wage, Exchange Rate and Interest



_ _ _ _ _ Fixed/Closed Regime
_ _ _ Flexible/Open Regime

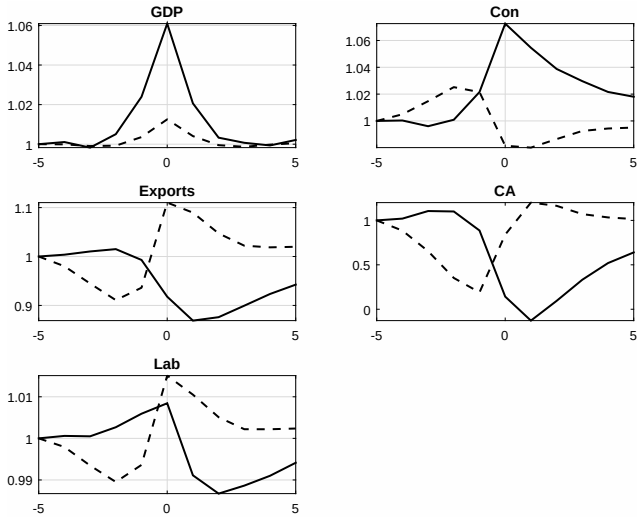
- More flexible system mitigates teh collapse in GDP, consumption and the real wage.
- We also see an appreciation of the real exchange rate, and a substitution from labor to imported intermediate goods.
- Net exports and current account are much worse (negative) under this regime.
- Recent experience since liberaliztion: appreciation of real exchange rate and deterioriation of current account.

Figure 10: Real Exchange Rate and Current Account/GDP Ratio



Dynamics under Expansionary Boom

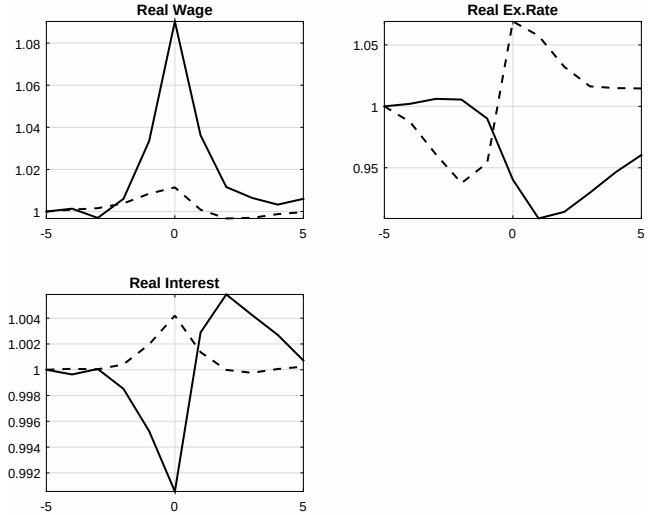
Figure 11: Comparative Adjustment in Expansion: National Income Accounts



_ _ _ _ _ Fixed/Closed Regime
_ _ _ Flexible Open Regime

Conclusion

Figure 12: Comparative Adjustemnt in Expansion: Real Wage, Exchange Rate and Interest



_ _ _ _ _ Fixed/Closed Regime
_ _ _ Flexible Open Regime