An Estimated DSGE Model with Financial and Employment Frictions for the Romanian Economy

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July, 2013

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- Extending the standard New-Keynesian model to answer (some of) the new questions being asked in macroeconomics particularizing to the case of Romania.

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- Model used in presentation: Christiano L.,Trabandt M., Walentin K.(2011): "Introducing financial frictions and unemployment into a small open economy model"

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- Introducing entrepreneurs that manage and accumulate the economy's capital. Subject to idiosyncratic and net worth shocks whose impact are similar to aggregate "demand" effects.
- Households offer labor services through employment agencies. Framework offers variation in both the extensive (employment) and intensive (hours per worker) margins. Exogenous and endogenous separation.

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- Analysing ex-post the forces that moved the real variables.

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– Assumes net worth is measured through a market index (BET-C).

Baseline Model (I)

Domestic good retailers:

$$Y_t = \left[\int_0^1 Y_{i,t}^{1/\lambda_d} di \right]^{\lambda_d}$$

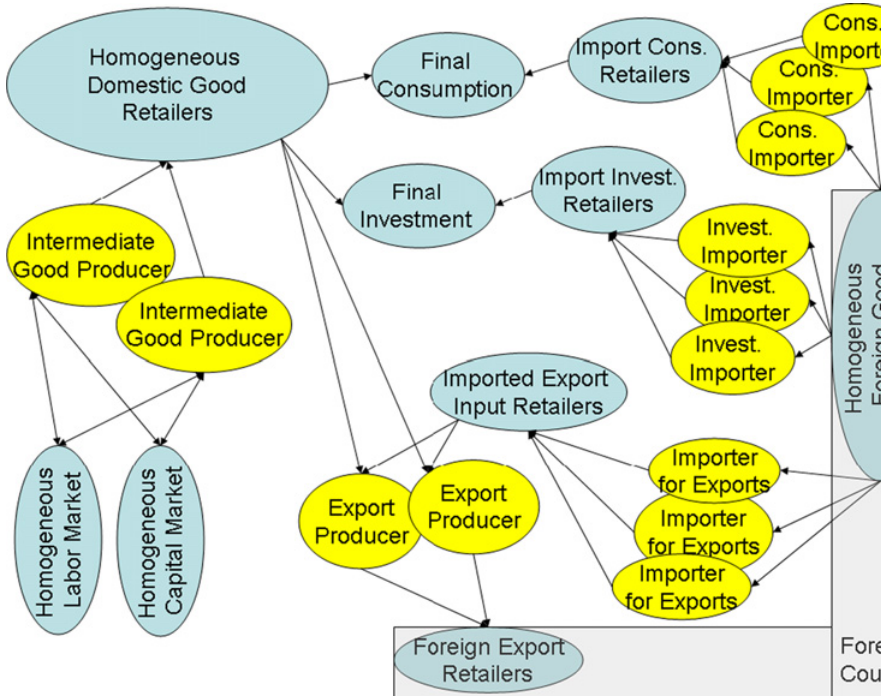
Intermediate good producers(Calvo):

$$Y_{i,t} = \left(z_t H_{i,t}\right)^{1-\alpha} \epsilon_t K_{i,t}^{\alpha}$$

Marginal Cost:

$$mc_t = \tau_t^d (r_t^k)^{\alpha} (\bar{w}_t R_t^f)^{1-\alpha} \left(\frac{1}{\alpha}\right)^{\alpha}.$$

$$\cdot \left(\frac{1}{1-\alpha}\right)^{1-\alpha}, \text{where} \quad R_t^f = \nu^f R_t + 1 - \nu^f$$



Baseline Model (II)

- Allocating the final domestic good:

$$Y_t = G_t + C_t^d + I_t^d + \int_0^1 X_{i,t}^d di$$

- Retailers:

$$C_t^m = \left[\int_0^1 (C_{i,t}^m)^{1/\lambda_{m,c}} di \right]^{\lambda_{m,c}} \quad I_t^m = \left[\int_0^1 (I_{i,t}^m)^{1/\lambda_{m,i}} di \right]^{\lambda_{m,i}}$$

$$X_t^m = \left[\int_0^1 (X_{i,t}^m)^{1/\lambda_{m,x}} di \right]^{\lambda_{m,x}}$$

- Importers:

$$Consumption = C_{i,t}^m, \quad Investment = I_{i,t}^m, \quad Export = X_{i,t}^m$$

$$\text{Mc}_t = \tau_t^{m,j} S_t P_t^* R_t^{\nu,*}, \qquad j = c, i, x$$

Baseline Model (III)

- Consumption, investment and export good producers:

$$C_t = \left[(1-\omega_c)^{1/\eta_c} C_t^{d\,(\eta_c-1)/\eta_c} + \omega_c^{1/\eta_c} C_t^{m\,(\eta_c-1)/\eta_c}\right]^{\eta_c/(\eta_c-1)}$$

$$I_t + a(u_t)\bar{K}_t = \Psi_t \left[(1-\omega_i)^{1/\eta_i} I_t^{d\,(\eta_i-1)/\eta_i} + \omega_i^{1/\eta_i} I_t^{m\,(\eta_i-1)/\eta_i}\right]^{\eta_i/(\eta_i-1)}$$

$$X_{i,t} = \left[(1-\omega_x)^{1/\eta_x} X_{i,t}^{d\ (\eta_x-1)/\eta_x} + \omega_x^{1/\eta_x} X_{i,t}^{m\,(\eta_x-1)/\eta_x}\right]^{\eta_x/(\eta_x-1)}$$

- Demand for domestic exports and Foreign retailers:

$$X_t = \left(\frac{P_t^x}{P_t^*}\right)^{-\eta_f} Y_t^*, \quad X_t = \left[\int_0^1 (X_{i,t})^{1/\lambda_x} di\right]^{\lambda_x}$$

Baseline Model (IV)

- NK Phillip's curve:

$$\hat{\pi}_t - \hat{\bar{\pi}}_t^c = \frac{\beta}{1+\kappa_d\beta} E_t(\hat{\pi}_{t+1} - \hat{\bar{\pi}}_{t+1}^c) + \frac{\kappa_d}{1+k_d\beta}(\hat{\pi}_{t-1} - \hat{\bar{\pi}}_t^c) - \frac{\kappa_d\beta(1-\rho_\pi)}{1+\kappa_d\beta}\hat{\bar{\pi}}_t^c$$

$$+ \frac{1}{1+\kappa_d\beta}\frac{(1-\beta\xi_d)(1-\xi_d)}{\xi_d}\widehat{mc}_t$$

- Households enjoy utility from consumption and disutility from supplying labor.
- Monetary authority:

$$log\left(\frac{R_t}{R}\right) = \rho_R log\left(\frac{R_{t-1}}{R}\right) + (1-\rho_R)\left[log\left(\frac{\bar{\pi}_t^c}{\bar{\pi}^c}\right) + r_\pi log\left(\frac{\pi_t^c}{\bar{\pi}_t^c}\right)\right.$$

$$\left. + r_y log\left(\frac{gdp_t}{gdp}\right)\right] + \varepsilon_{R_t}$$

Baseline Model (V)

- Government:

$$G_t = g_t z_t^+$$

- Adjusted UIP

$$R_t - R_t^* = E_t \, logS_{t+1} - logS_t + \mathbf{\Phi_t}$$

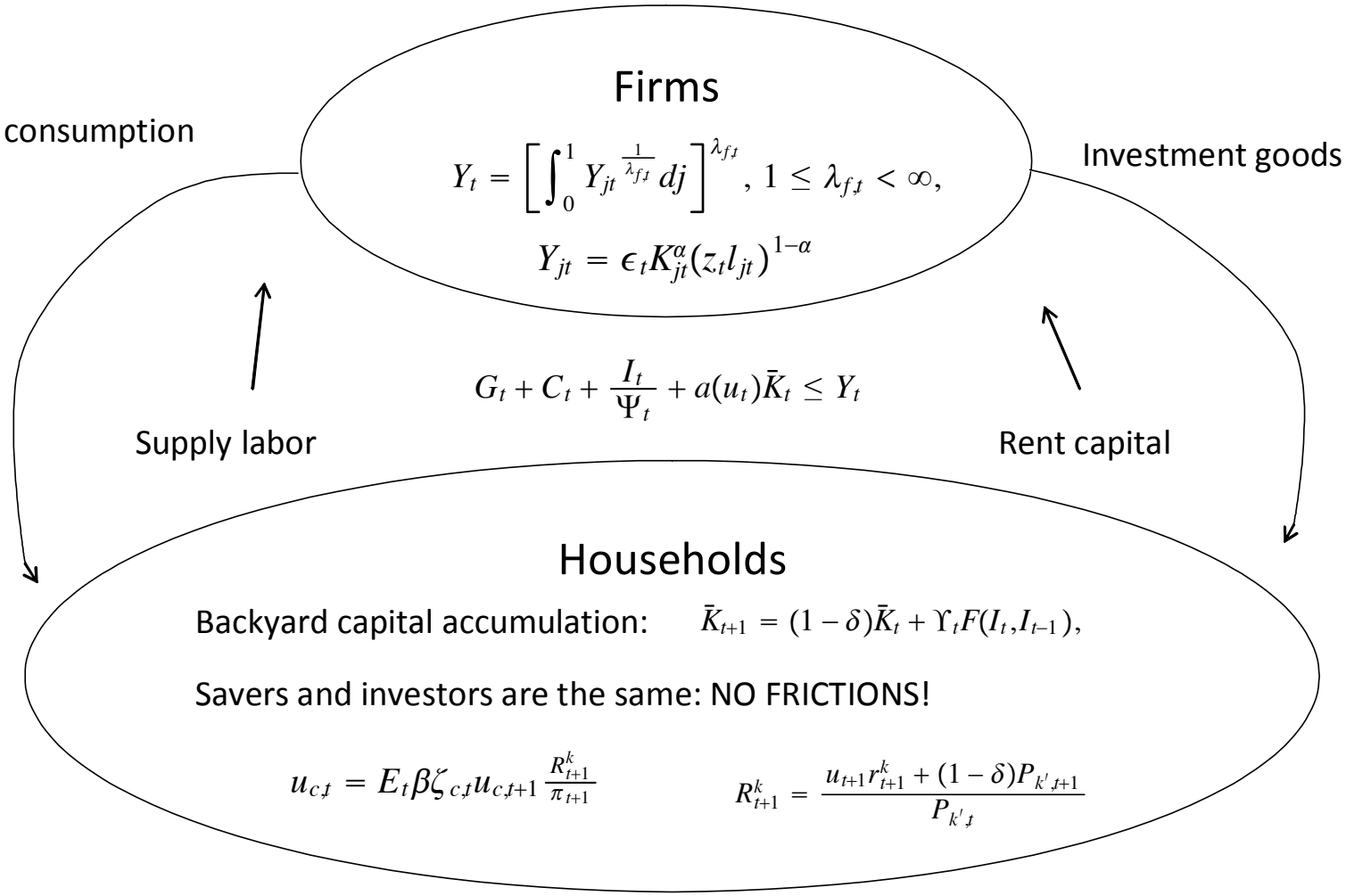
$$\mathbf{\Phi_t} = exp\{-\tilde{\phi}_a(a_t - \bar{a}) - \underbrace{\tilde{\phi}_s}_{\text{adj. param.}} (R_t^* - R_t - (R^* - R)) + \underbrace{\tilde{\phi}_t}_{\text{c. risk premium shock}}\}$$

- UIP regression

$$\beta = \frac{cov(logS_{t+1} - logS_t; R_t - R_t^*)}{var(R_t - R_t^*)} = 1 - \tilde{\phi}_s$$

- Foreign Economy (EA 17): VAR

Baseline Model VI



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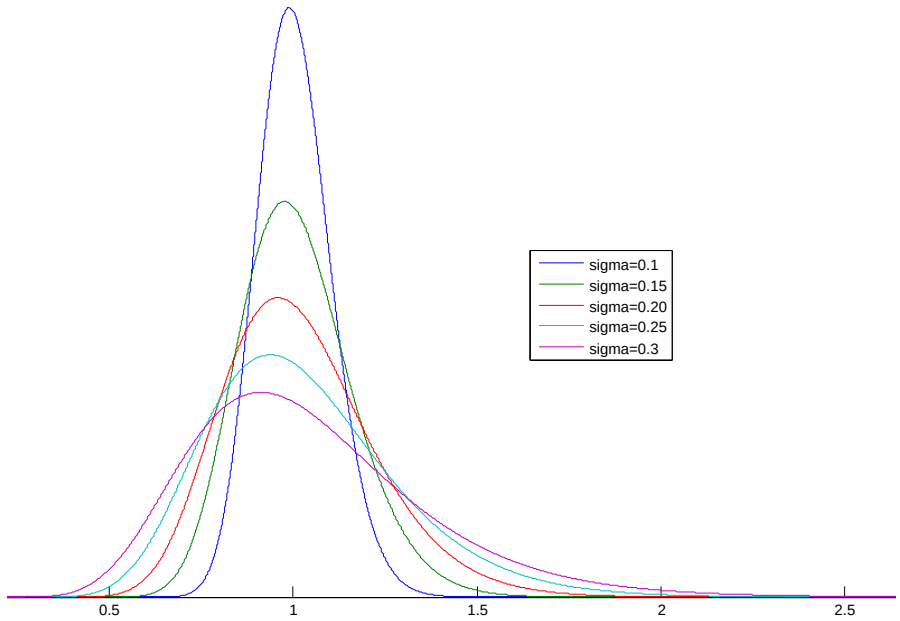
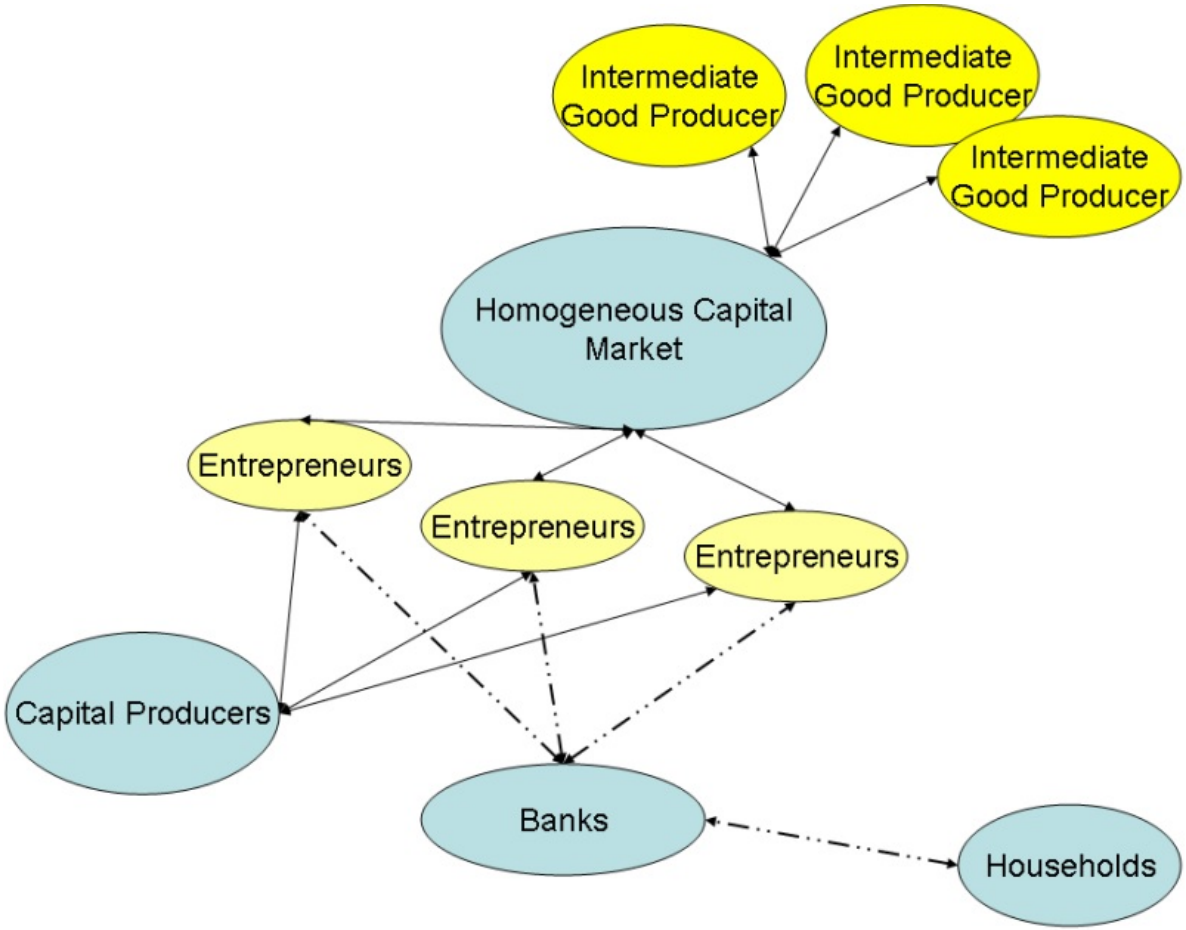


Financial Block



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- A market for contracts of type (Z fix, B fix) is needed.

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In terms of $(\bar{\omega}, L)$

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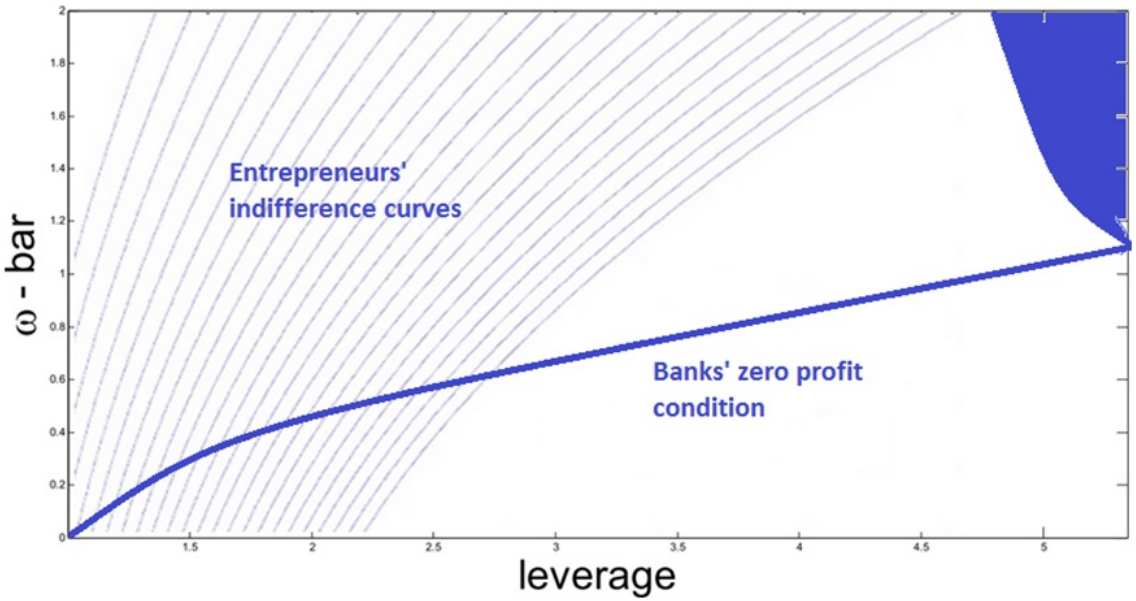
$\frac{(1+R^k)}{(1+R)} = 1.0073, \quad \mu = 0.21, \quad \sigma = 0.26$



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Financial Frictions (V)

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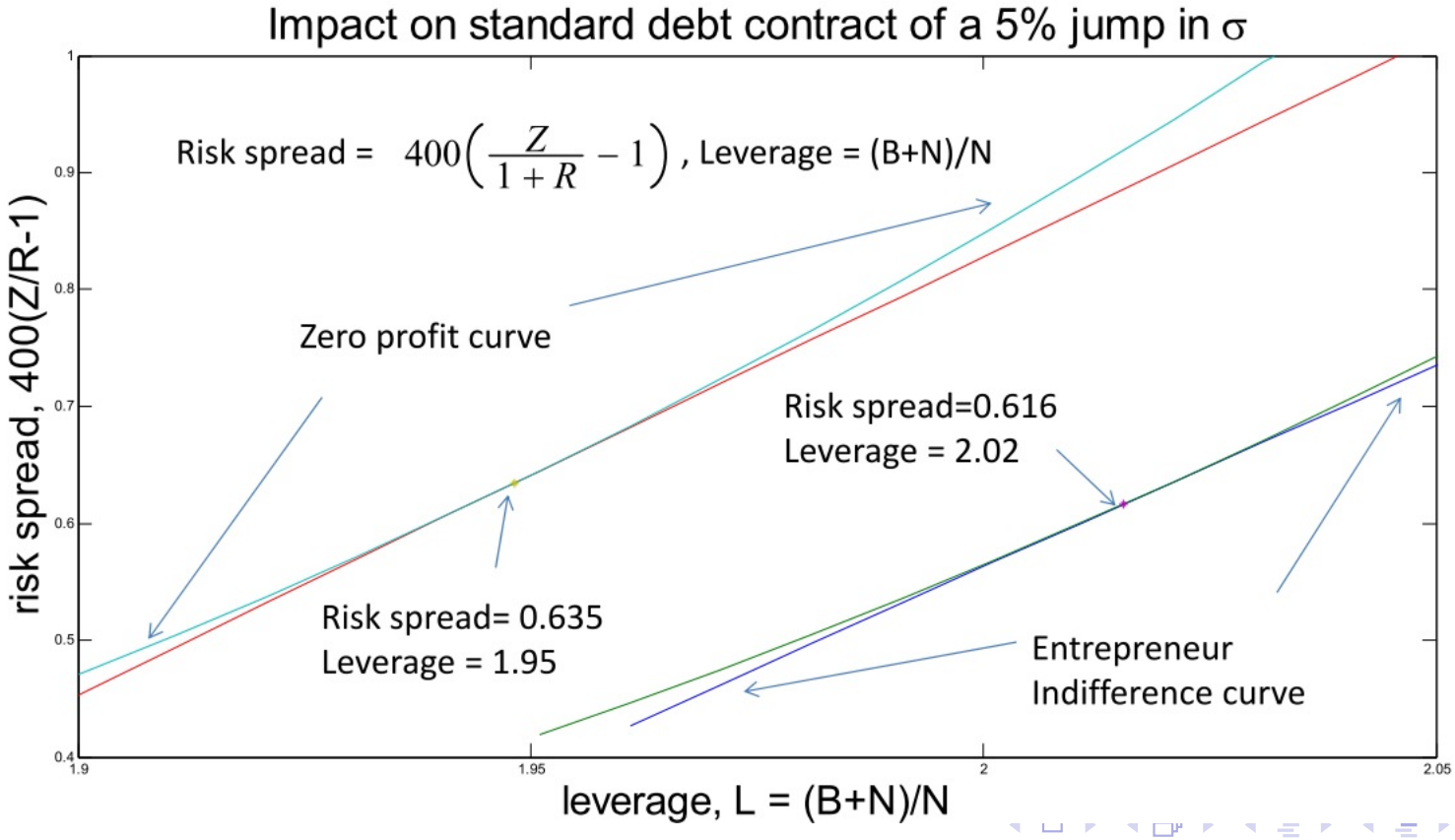

Financial Frictions (VI)

- Aggregate net worth of entrepreneurs:

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- Financial frictions brings two new shocks: σ_t and γ_t

Financial Frictions (VII)

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1. Households' F.O.C for capital is removed.

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4. The resource constraint is adjusted for monitoring costs.

Labor market block (I)

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Modeling both:

- the intensive (hours per worker) margin...

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- ...and the extensive (employment) margin of labor supply.

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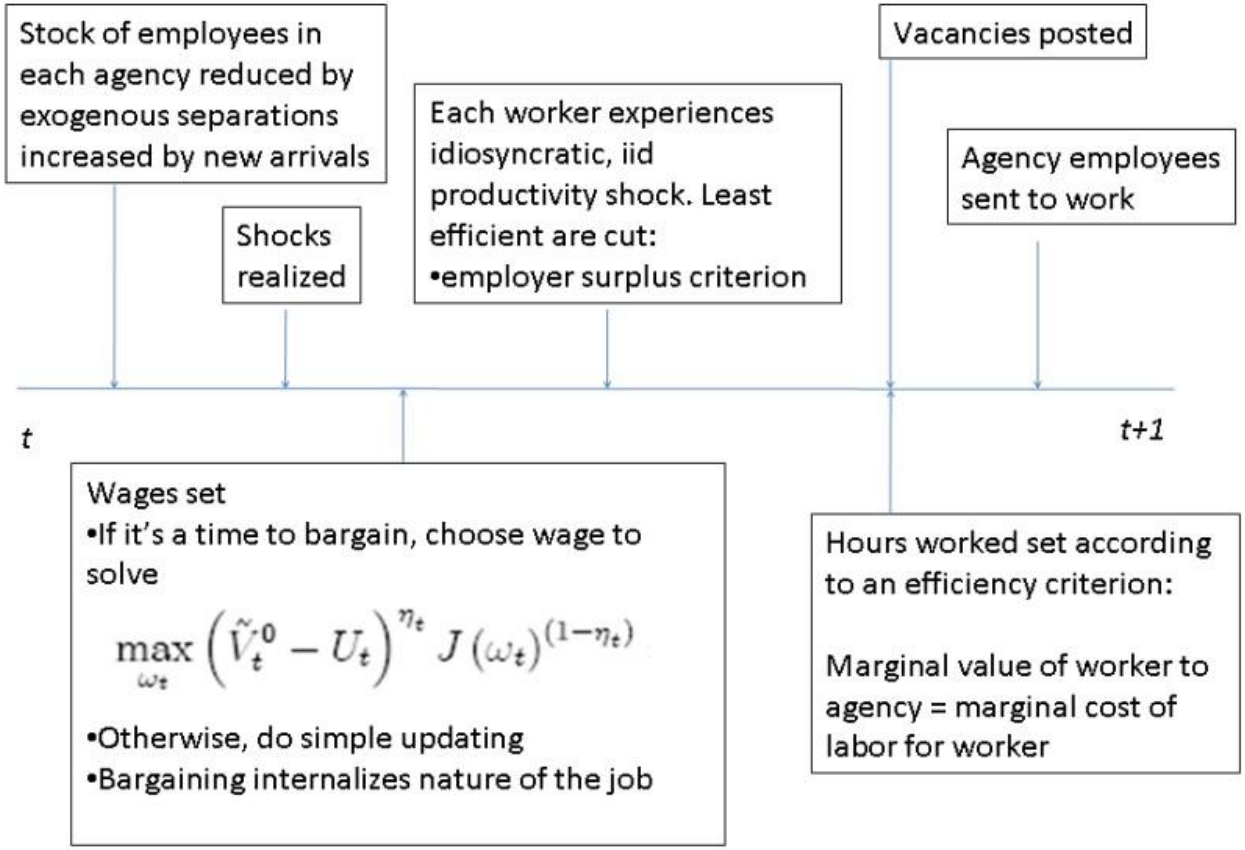


Labor marke block (II)

- Households' utility function:

Labor marke block (II)

- Households' utility function:

$$E_t \sum_{l=0}^{\infty} \beta^{l-t} \{ \zeta^c_{t+l} log(C_{t+l} - bC_{t+l-1}) -$$

$$-\zeta^h_{t+l} A_L \Big[\sum_{i=0}^{N-1} \frac{(\varsigma_{i,t+l})^{1+\sigma_L}}{1+\sigma_L} \Big[1 - F(\bar{a}^i_{t+l}; \sigma_{a,t+l}) \Big] l^i_{t+l} \Big] \}$$

Data (I)

19 time series for Romania covering 2001Q1-2012Q4

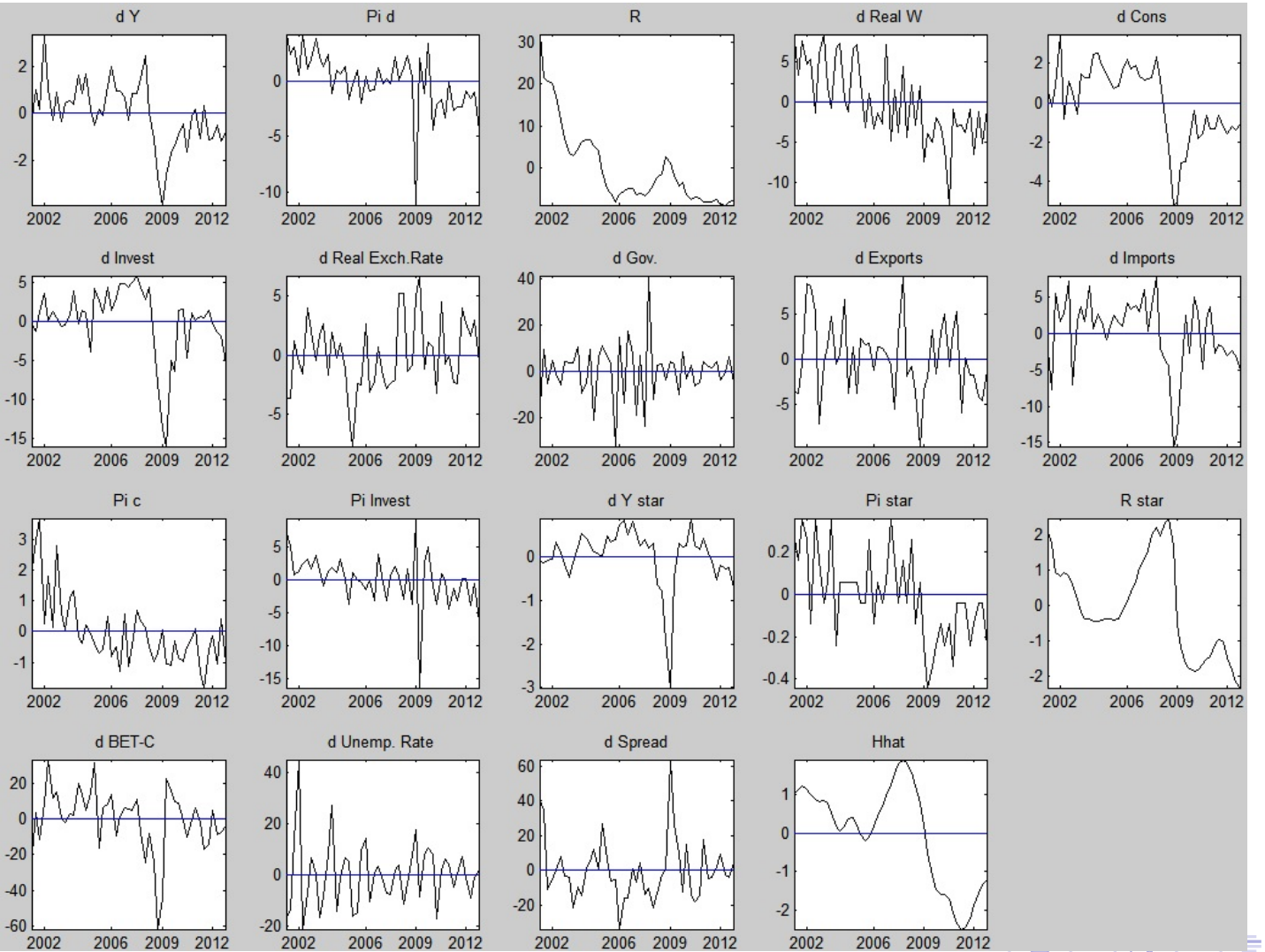
→ Log, first difference, demeaned, real, per capita:
- Domestic and foreign GDP
- Private and Government consumption
- Investment
- Exports and Imports
- Wages

→ Log, first difference, demeaned:
- BET-C
- Interest rate spread
- Unemployment rate
- Real Exchange Rate

→ In level, demeaned:
- Robor 3M and Euribor 3M
- Domestic and foreign inflation
- Domestic HCPI, investment deflator

→ Deviation from mean:
- Total hours worked

Data (II)


d Y
Pi d
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d Real W
d Cons
d Invest
d Real Exch.Rate
d Gov.
d Exports
d Imports
Pi c
Pi Invest
d Y star
Pi star
R star
d BET-C
d Unemp. Rate
d Spread
Hhat
2002
2006
2009
2012

Table of calibrated parameters (I)

Parameter	Value	Definition
α	0.402	Capital share in production
β	0.9999	Discount factor
ω_i	0.57	Share of imported investment good
ω_c	0.49	Share of imported consumption good
ω_x	0.60	Share of imported export good
$\tilde{\phi}_a$	0.15	Elasticity of country risk to net asset position
η_g	0.1717	Government spending as share of GDP
τ_k	0.16	Capital tax rate
τ_w	0.3	Payroll tax rate
τ_c	0.19	Consumption tax rate
τ_y	0.16	Labor income tax rate
τ_b	0	Bond tax rate
μ_z^+	1.0092	Steady state growth rate of aggregate technology
μ_ψ	1.0005	Steady state growth rate of investment technology
μ_z	1.0088	Steady state growth rate of neutral technology
$\bar{\pi}$	1.006875	Steady state gross inflation target
λ_j	1.2	Price markups, j=d;x;m,c;m,i;m,x;w
ϑ_w	1	Wage indexation to real growth trend
$\varkappa$	1-κ^j	Indexation to inflation target for j = d; x; m,c; m,i; m,x; w
$\breve{\pi}$	1.006875	Third indexing base
$F(\bar{\omega})$	0.01	Steady state bankruptcy rate
W_e/y	0.001	Transfers to entrepreneurs
L	1-0.07143	Steady state fraction of employment
N	4	Number of agency cohorts/length of wage contracts
φ	2	Curvature of hiring costs
ρ	0.9769	Exogenous survival rate of a match
σ	0.5	Unemployment share in matching technology
σ_m	0.57	Level parameter in matching function

Parameter	Definition	Set to match
δ	Depreciation rate of capital	Investment/output=0.257
γ	Entrepreneurial survival rate	Net worth/assets=0.67
φ	Real exchange rate	Exports share of GDP=0.346
A_L	Scaling of disutility of work	Fraction of time spent working=0.25

Data and model means

Variable	Data mean %	Model mean %
Domestic inflation	11.63	2.75
HCPI inflation	5.11	2.75
Investment inflation	10.66	0.88
Nominal interest rate	13.38	6.48
Total hours deviation	0	0
GDP growth	0.92	0.92
Real wage growth	3.73	0.92
Consumption growth	1.47	0.92
Investment growth	1.69	0.92
Real exchange rate growth	-0.5198	0
Government expenditure growth	-0.012	0.92
Export growth	1.75	0.92
Import growth	2.33	0.92
Stock market growth	3.30	0.92
Interest spread growth	-1.79	0
Unemployment growth	-0.28	0
Foreign GDP growth	0.09	0.92
Foreign inflation	1.76	2.75
Foreign nominal interest rate	2.51	6.48

Estimation procedure

- Full model using Bayesian estimation.
- Single metropolis chain with 500.000 draws, discarting 250.000.
- Acceptance rate of 0.25.

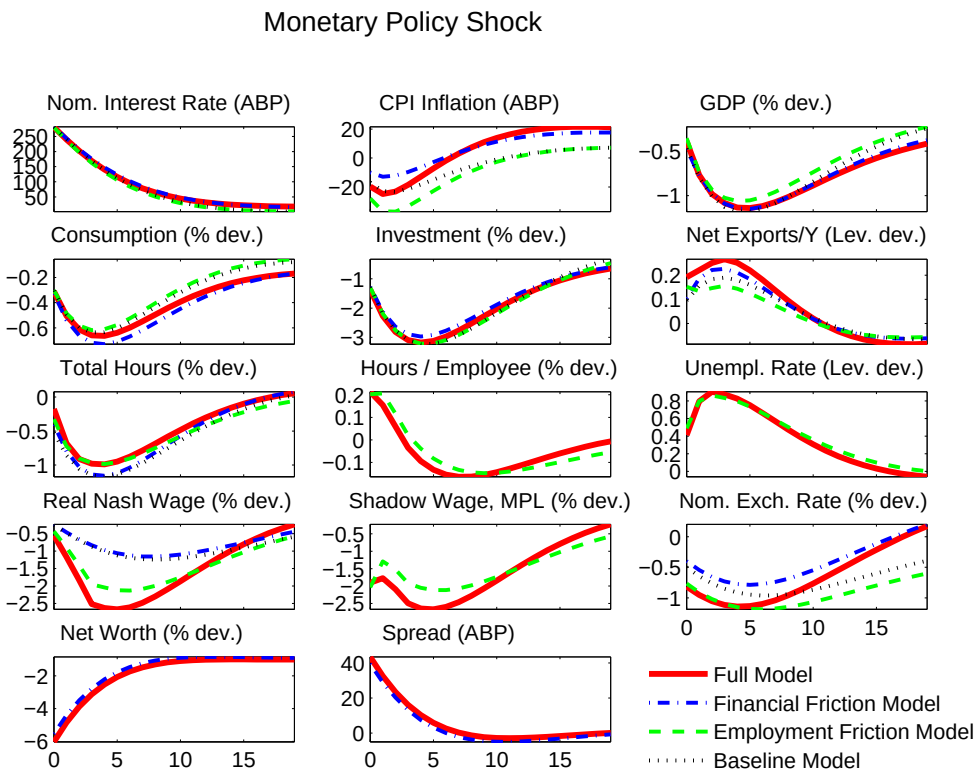
Estimated parameters

Param	Description	Prior	Post.mean
ξ_d	Calvo, domestic	$\beta(0.75; 0.075)$	0.966
ξ_x	Calvo, exports	$\beta(0.65; 0.075)$	0.689
$\xi_{m,c}$	Calvo, imported consumption	$\beta(0.65; 0.075)$	0.797
$\xi_{m,i}$	Calvo, imported investment	$\beta(0.65; 0.075)$	0.596
$\xi_{m,x}$	Calvo, imported exports	$\beta(0.60; 0.10)$	0.394
κ_d	Indexation, domestic	$\beta(0.5; 0.15)$	0.531
κ_x	Indexation, domestic	$\beta(0.5; 0.15)$	0.287
$\kappa_{m,c}$	Indexation, imported consumption	$\beta(0.5; 0.15)$	0.484
$\kappa_{m,i}$	Indexation, imported consumption	$\beta(0.5; 0.15)$	0.291
$\kappa_{m,x}$	Indexation, imported consumption	$\beta(0.5; 0.15)$	0.383
κ_w	Indexation, wages	$\beta(0.5; 0.15)$	0.532
ν^j	Working capital share	$\beta(0.5; 0.15)$	0.548
σ_L	Inverse Frisch Elasticity	$\Gamma(8; 0.12)$	9.58
b	Habbit in consumption	$\beta(0.65; 0.15)$	0.843
$S^{''}$	Investment adjustment costs	$\Gamma(0.5; 0.15)$	0.885
σ_a	Variable capital utilization	$\Gamma(0.2; 0.075)$	0.284
ρ_R	Taylor rule, lagged interest rate	$\beta(0.8; 0.1)$	0.889
r_π	Taylor rule, ination	$N(1.7; 0.15)$	1.726
r_y	Taylor rule, output	$N(0.125; 0.05)$	0.144
η_x	Elasticity of subst., exports	$\Gamma(1.5; 0.1)$	1.46
η_c	Elasticity of subst., consumption	$\Gamma(1.5; 0.05)$	1.49
η_i	Elasticity of subst., investment	$\Gamma(1.5; 0.1)$	1.57
η_f	Elasticity of subst., foreign	$\Gamma(1.5; 0.1)$	1.60
$\tilde{\phi}_s$	Country risk adjustment coefcient	$\Gamma(1.25; 0.1)$	1.12
μ	Monitoring cost	$\beta(0.3; 0.075)$	0.454
$hshare(\%)$	Hiring costs	$\Gamma(0.11; 0.075)$	0.083
$bshare$	Utility ow, unemployed	$\beta(0.65; 0.075)$	0.626
$F(\%)$	Endogenous separation rate	$\beta(0.23; 0.05)$	0.23
ρ_{shoks}	Persistence, shocks	$\beta(0.5 - 0.85; 0.05 - .075)$	0.43 - 0.98
$a_{i,j}, b_{i,j}, c_{i,j}$	Foreing VAR parameter	$N(0, 0.2)$	-0.28 - 0.99

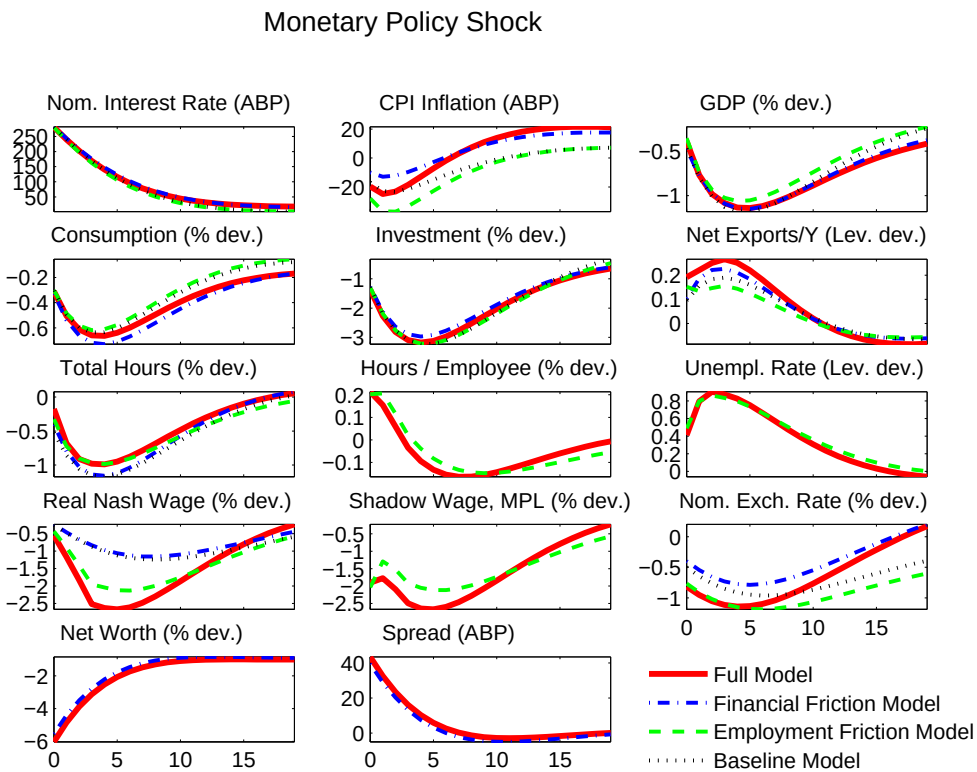
Some important shocks

- μ_z unit-root neutral technology
- ϵ stationary technology
- Υ marginal efficiency of investment (MEI)
- ζ_c, ζ_h consumption and labor preference shocks
- $\tilde{\phi}$ risk premium shock
- ε_R monetary policy shock
- g government consumption shock
- τ_i markups, i=d;x;m,c;m,i;m,x
- γ net worth financial shock
- σ idiosyncratic financial shock
- η bargaining power shock
- $\varepsilon_{R*}, \varepsilon_{\pi*}, \varepsilon_{y*}$ foreign shocks

IRF (I)


Monetary Policy Shock
Nom. Interest Rate (ABP)
CPI Inflation (ABP)
GDP (% dev.)
Consumption (% dev.)
Investment (% dev.)
Net Exports/Y (Lev. dev.)
Total Hours (% dev.)
Hours / Employee (% dev.)
Unempl. Rate (Lev. dev.)
Real Nash Wage (% dev.)
Shadow Wage, MPL (% dev.)
Nom. Exch. Rate (% dev.)
Net Worth (% dev.)
Spread (ABP)
Full Model
Financial Friction Model
Employment Friction Model
Baseline Model

IRF (I)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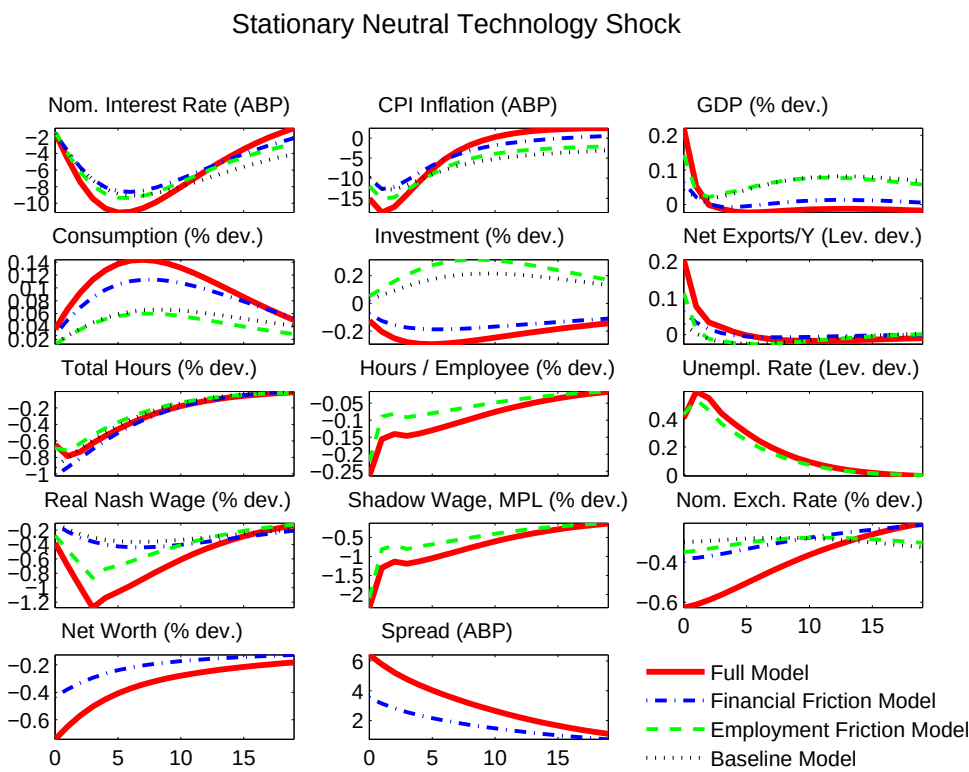
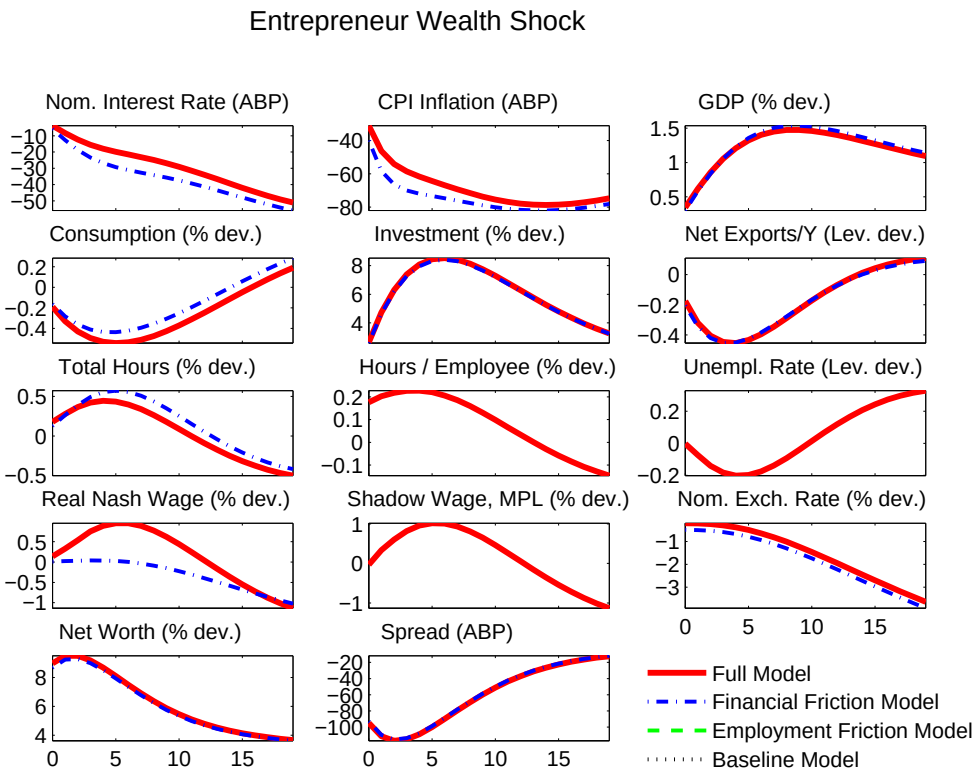

Stationary Neutral Technology Shock
Nom. Interest Rate (ABP)
CPI Inflation (ABP)
GDP (% dev.)
Consumption (% dev.)
Investment (% dev.)
Net Exports/Y (Lev. dev.)
Total Hours (% dev.)
Hours / Employee (% dev.)
Unempl. Rate (Lev. dev.)
Real Nash Wage (% dev.)
Shadow Wage, MPL (% dev.)
Nom. Exch. Rate (% dev.)
Net Worth (% dev.)
Spread (ABP)
Full Model
Financial Friction Model
Employment Friction Model
Baseline Model

IRF (II)


Entrepreneur Wealth Shock
Nom. Interest Rate (ABP)
CPI Inflation (ABP)
GDP (% dev.)
Consumption (% dev.)
Investment (% dev.)
Net Exports/Y (Lev. dev.)
Total Hours (% dev.)
Hours / Employee (% dev.)
Unempl. Rate (Lev. dev.)
Real Nash Wage (% dev.)
Shadow Wage, MPL (% dev.)
Nom. Exch. Rate (% dev.)
Net Worth (% dev.)
Spread (ABP)
Full Model
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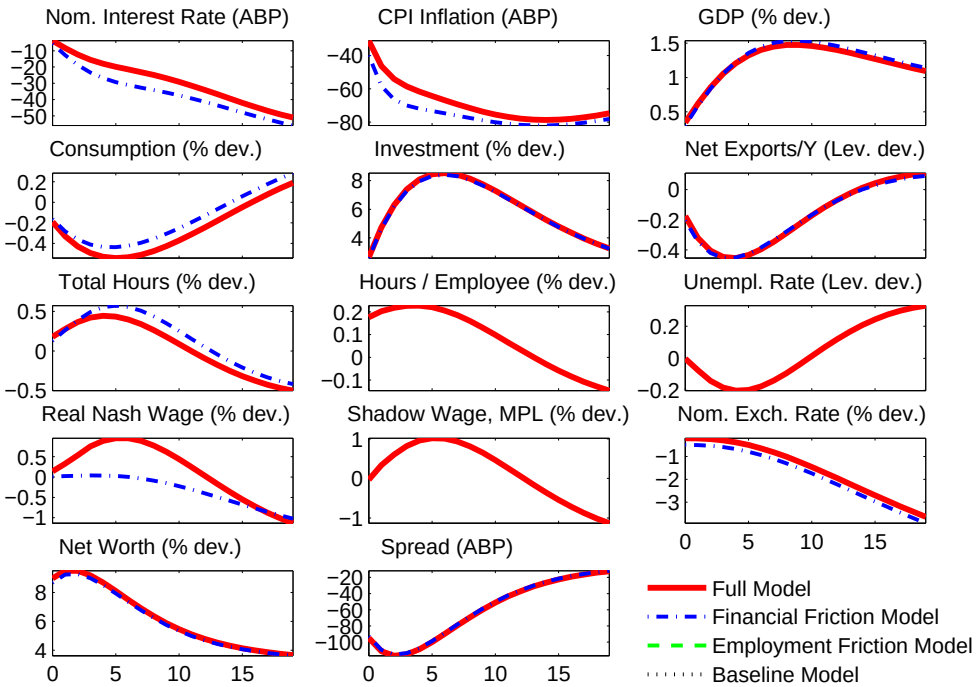
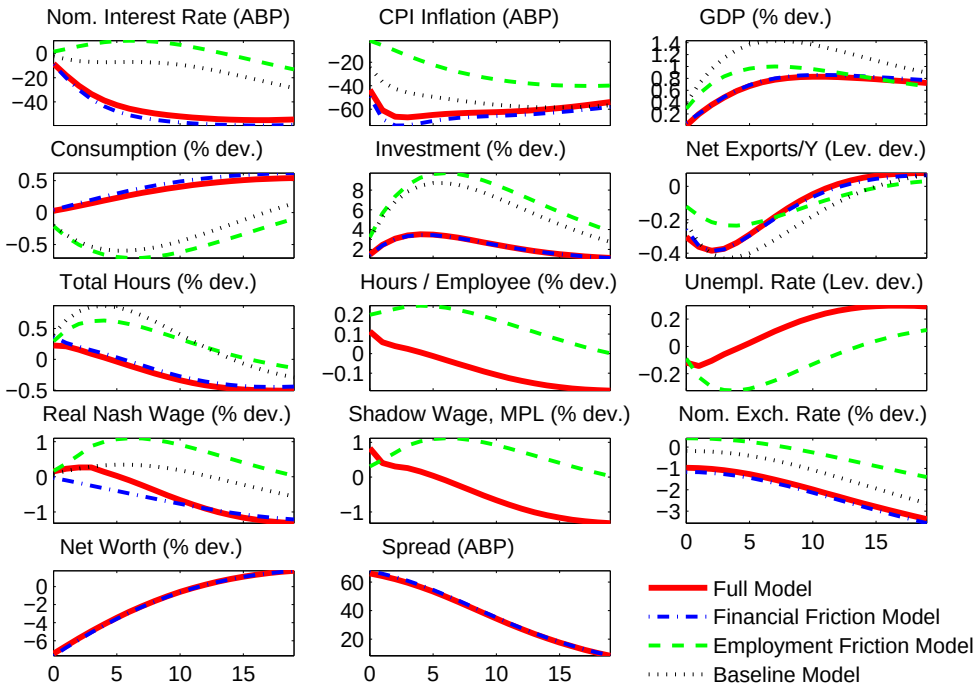
Employment Friction Model
Baseline Model

IRF (II)

Entrepreneur Wealth Shock

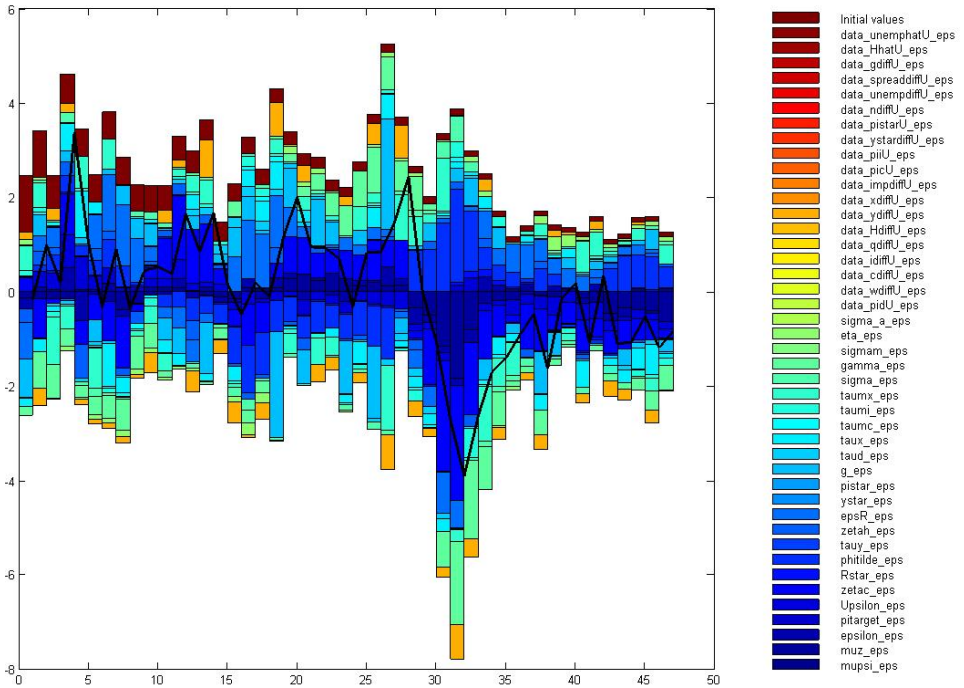


Marginal Efficiency of Investment Shock



Variance decomposition (I)

GDP decomposition



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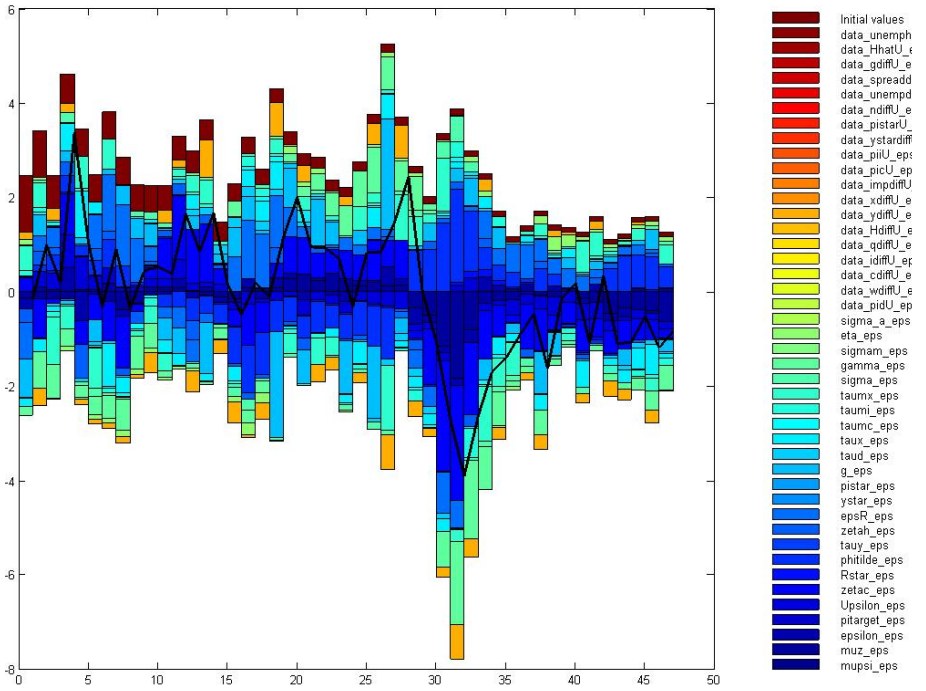
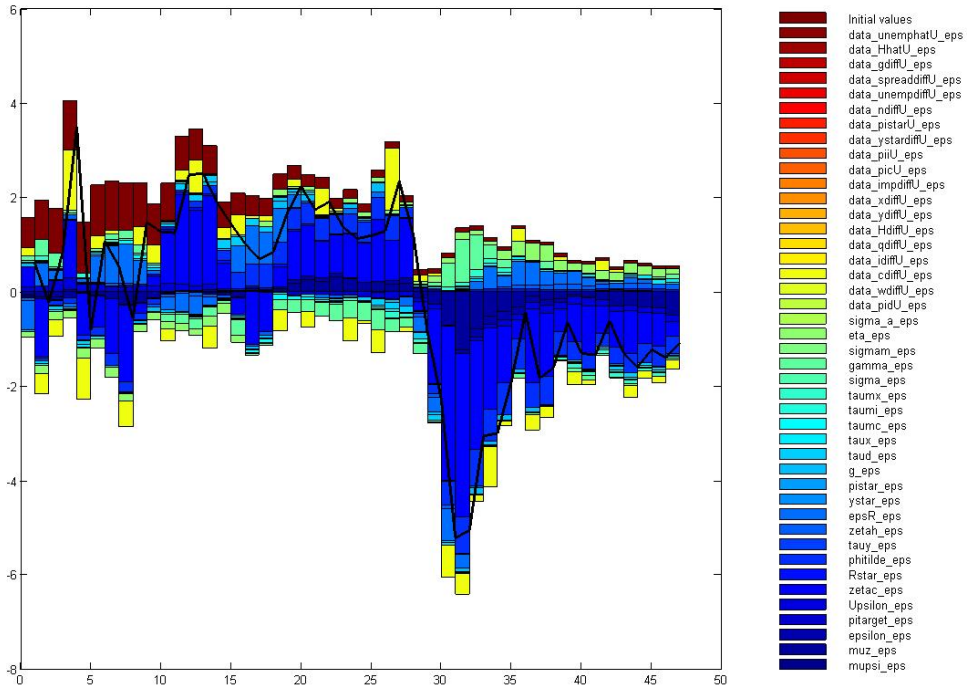
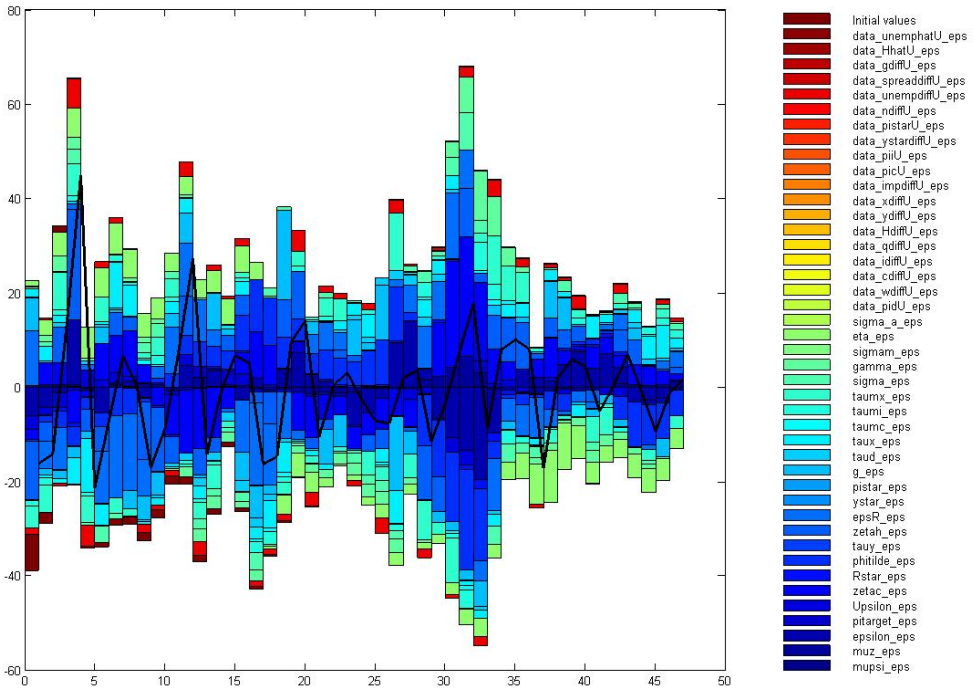


Consumption decomposition



Variance decomposition (II)

Unemp.(ext. margin) decomp.



Variance decomposition (II)

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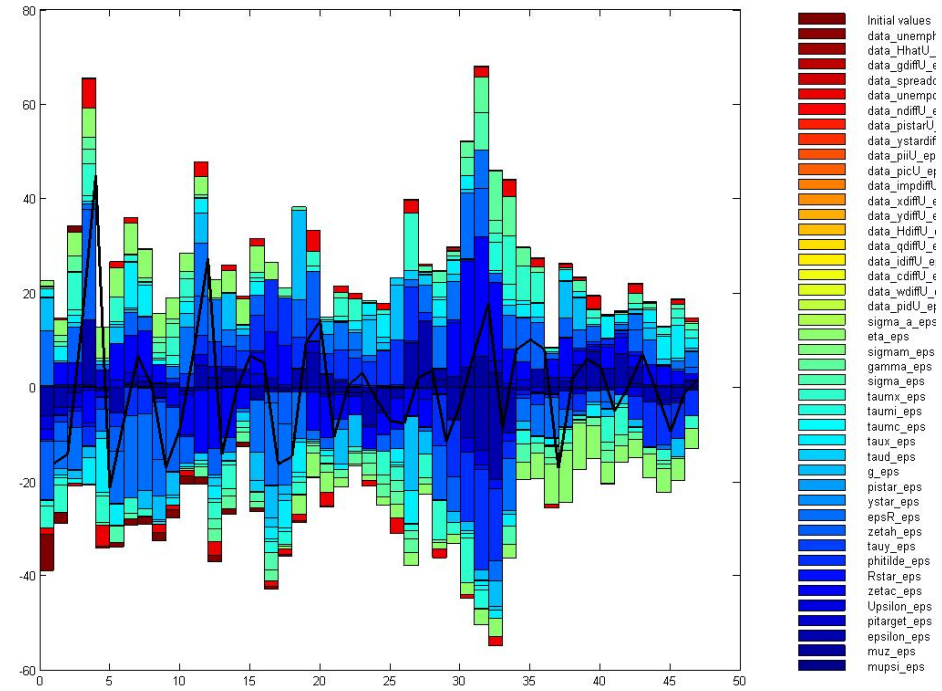
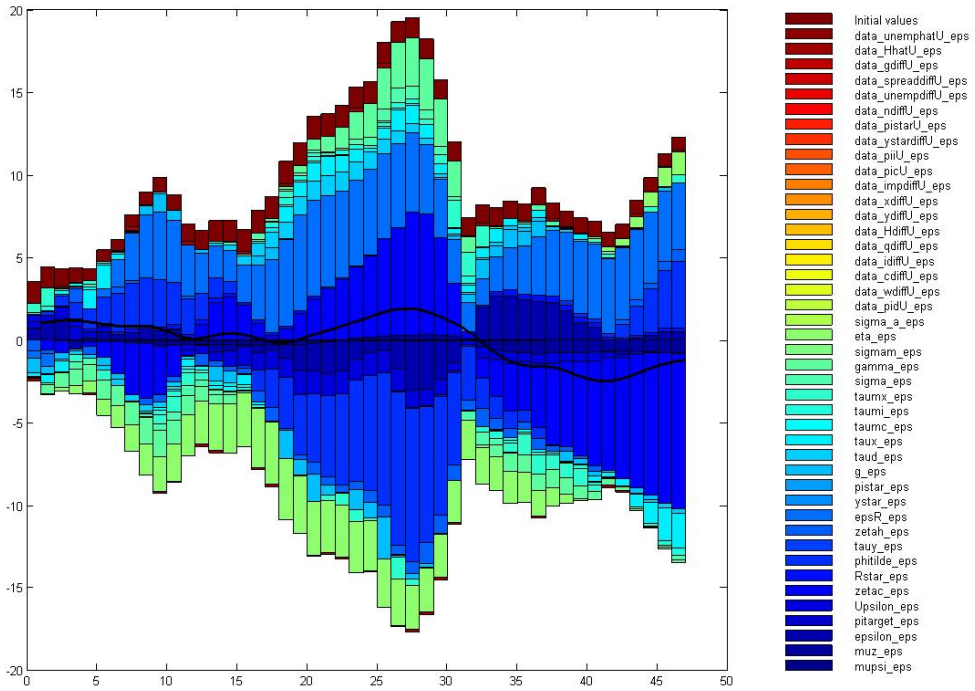
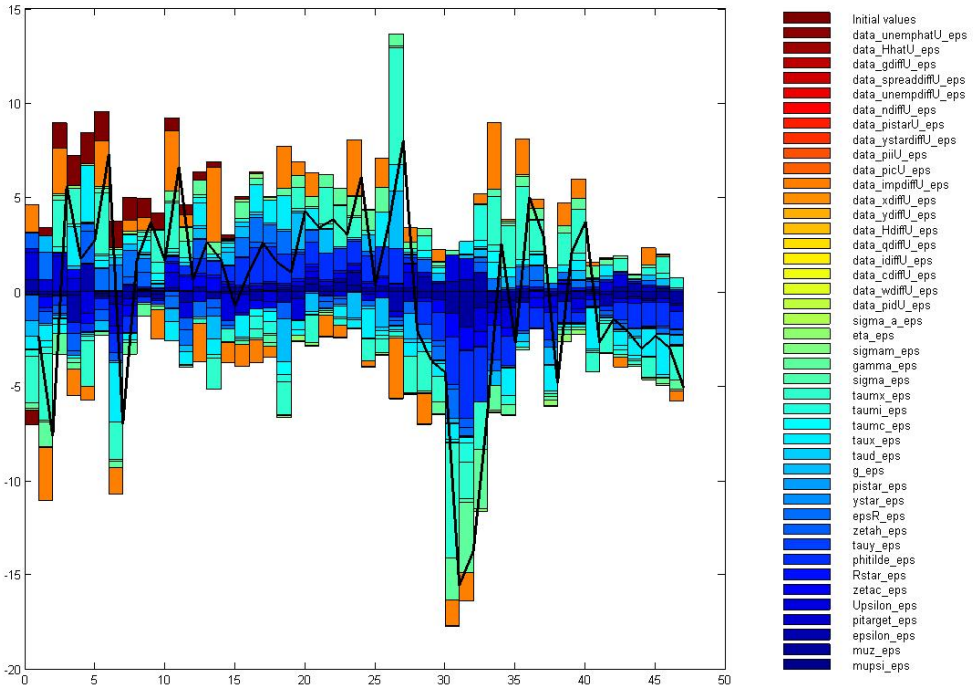


Hours worked(int. marg.) decomp.



Variance decomposition (III)

Imports decomp.



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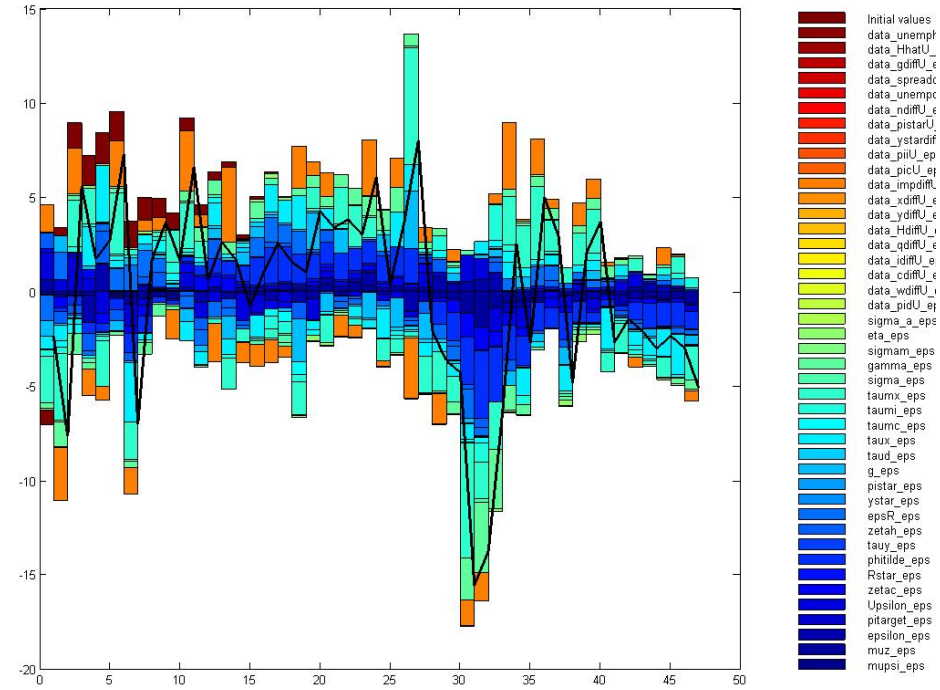
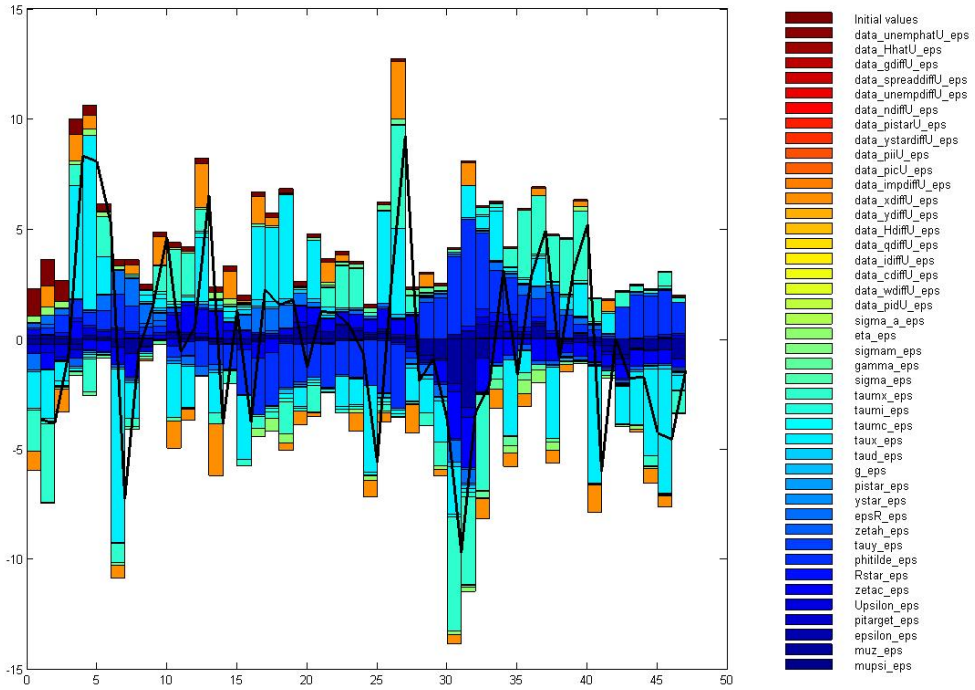
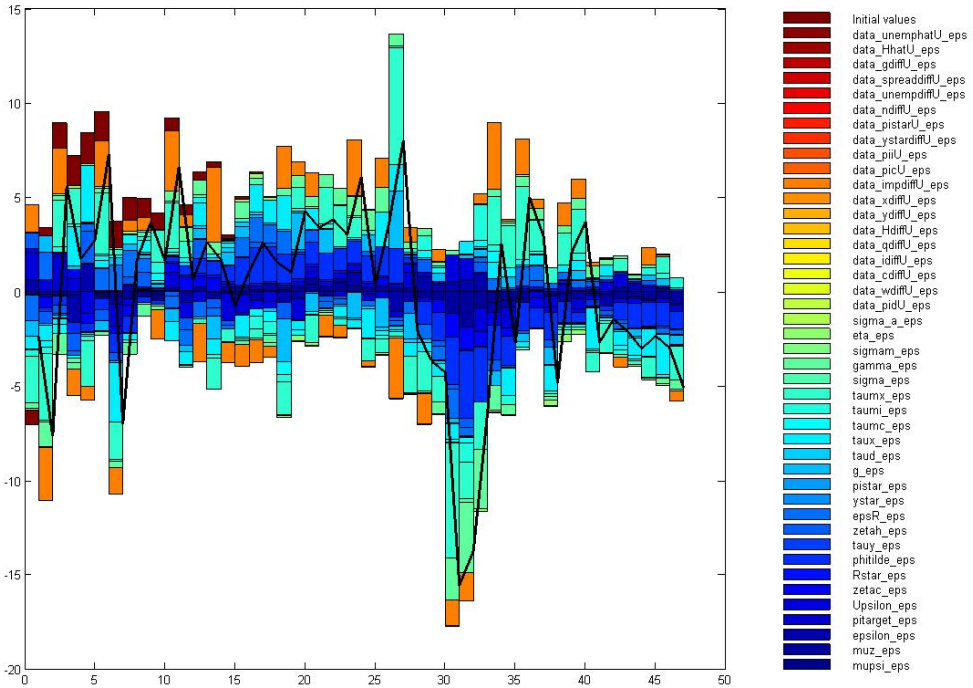


Exports decomp.



Variance decomposition (IV)

Imports decomp.



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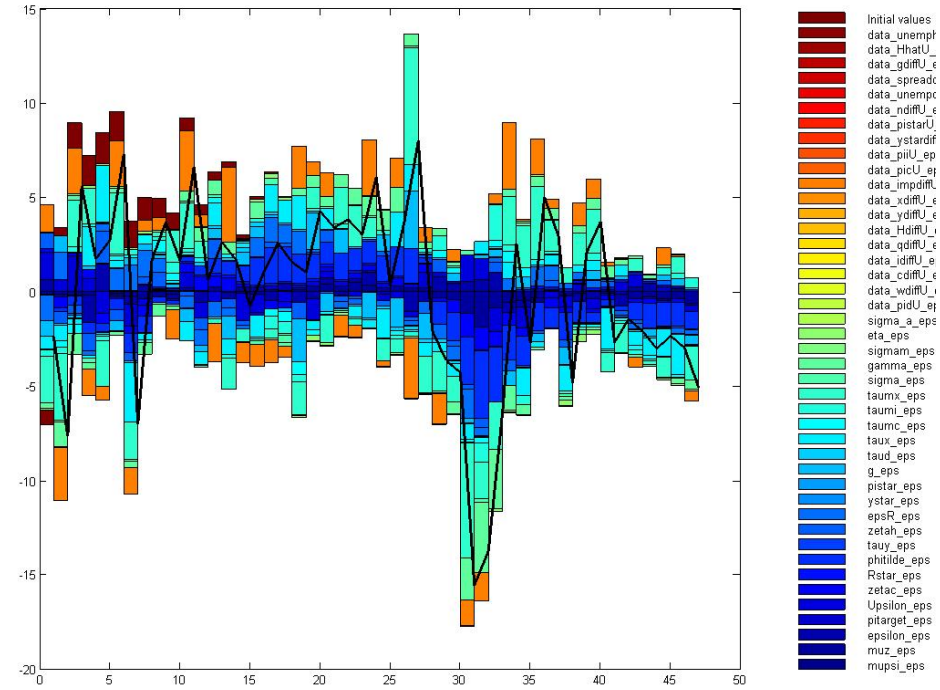
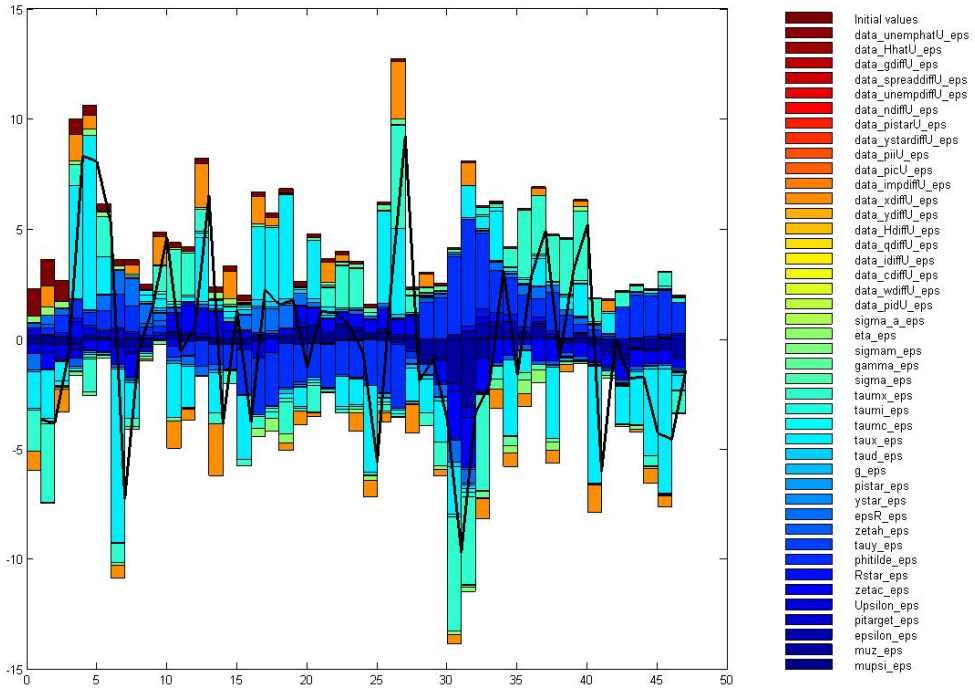
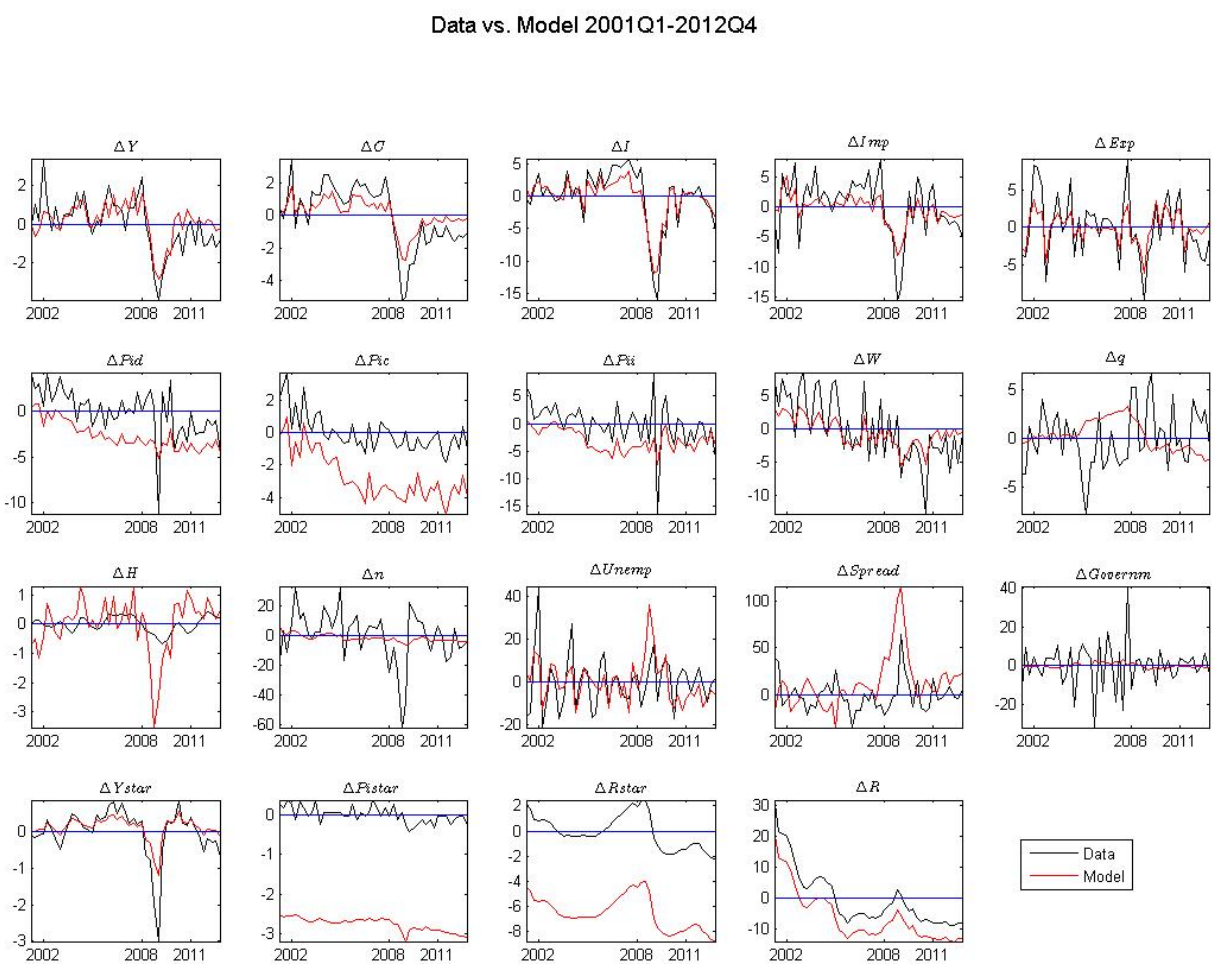


Exports decomp.



Data and simulated series



Main conclusions

- Financial factors are found as drivers for the gap of gdp, investment, imports and exports but not for consumption.
- Consumption was mainly driven by preferences.
- When financial factors are integrated, the marginal efficiency of investment reduces its importance as in Christiano et al.(2011).
- Model manages to capture the variation in main variables.

Thank You !

Review of literature

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