

Financial frictions in a DSGE framework

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Aims of the thesis

- Estimating the model developed by Gertler and Karadi (2011) for the Romanian economy
- Using Bayesian techniques to recover the posterior mode and distribution for the non steady state parameters
- Analyzing the capability of the model to mimic the path of financial variables
- Assessing the significance of financial frictions in explaining the data generating process with the help of marginal likelihood density

Literature review

- Financial frictions on non financial firms, whose seminal paper is Bernanke et al. (1999);
- Literature on the role of bank capital : Gertler and Kiyotaki (2010)
- Standard DSGE modeling with frictionless capital markets: Christiano et al. (2005) and Smets and Wouters (2007)

Model features

- The model developed by Gertler and Karadi (2011) incorporates new keynesian features like:
 - Nominal frictions: price stickiness, price indexation
 - Real frictions: investment adjustment, capital utilization
 - Financial frictions
- The main novelties of the model regard the set-up of financial intermediaries.

Agents

- Households
- Financial Intermediaries
- Intermediate good firms
- Capital producers
- Retail firms
- Policymaker

Households Setup

- Each household consumes, saves by lending funds to the banks and supplies labor;
- Within each household there are two types of members at any point in time : the fraction f of the household members are workers and the fraction $(1-f)$ are bankers;
- The turnover between bankers and workers is as follows: every bankers stays banker next period with probability θ , which is independent of history; the relative proportion of each type is constant;
- The family provides its new banker with a start-up transfer, a small fraction of total assets.

Households Objective

- Utility function:

$$\max E_t \sum_{i=0}^{\infty} \beta^i \left[\ln(C_{t+i} - hC_{t+i-1}) - \frac{\chi}{1+\varphi} L_{t+i}^{1+\varphi} \right] \quad (1)$$

It is separable in consumption and labor and exhibits internal habit formation

- Budget constraint:

$$C_t = W_t L_t + \Pi_t + TR_t + R_t B_t - B_{t+1} \quad (2)$$

Financial Intermediaries Setup

- Financial intermediaries obtain funds from households at the non contingent real rate R and they lend them to firms at the market lending rate R_k

The intermediary balance sheet :

$$Q_t S_{jt} = N_{jt} + B_{jt+1} \quad (3)$$

- Law of motion of bank's net worth

$$N_{jt+1} = (R_{kt+1} - R_{t+1}) Q_t S_{jt} + R_{t+1} N_{jt} \quad (4)$$

- Financial intermediary's objective:

$$V_{jt} = \max_{S_{jt}} E_t \sum_{i=0}^{\infty} (1-\theta) \theta^i \beta^{i+1} \Lambda_{t,t+1+i} (N_{jt+1+i}) \quad (5)$$

Financial Intermediaries : the agency problem

- There is perfect information between financial intermediaries and firms and asymmetric information between financial intermediaries and households
- Agency problem: the financial intermediary can divert a fraction of the total assets and transfer them to its family. The incentive constraint for the lenders to supply funds to the financial intermediary is:

$$V_{jt} \geq \lambda Q_t S_{jt} \quad (6)$$

- When the constraint binds:

$$V_{jt} = v_t Q_t S_{jt} + \eta_t N_{jt} \quad (7)$$

$$Q_t S_{jt} = \frac{\eta_t}{\lambda - v_t} N_{jt} = \phi_t N_{jt} \quad (8)$$

Financial Intermediaries Net Worth

- Equation of motion for total net worth : it is the sum of net worth of existing bankers and the net worth of new entering bankers;

$$N_t = N_{et} + N_{nt} \quad (9)$$

- The fraction θ of the financial intermediaries at time t will survive until $t+1$, their net worth is given by:

$$N_{et} = \theta \left[(R_{kt} - R_t) \phi_{t-1} + R_t \right] N_{t-1} \quad (10)$$

- The household transfers ω of the total bank capital, the capital for the new bankers is:

$$N_{nt} = \omega Q_t S_{t-1} \quad (11)$$

Intermediate good firms

- Acquire capital at the end of period t to produce the final output in the next period and to sell it to the retail firms
- In order to finance their capital expenditures, the firm issues equities in each period and sell them to financial intermediaries.
- The value of capital acquired is equal to the value of financial claims :

$$Q_t K_{t+1} = Q_t S_t \quad (12)$$

Intermediate good firms

- The firm produces output Y_t , using capital and labor and by varying the utilization rate of capital (Z_t). The production technology is described by the constant returns to scale function:

$$Y_t = A_t (Z_t \xi_t K_t)^\alpha L_t^{1-\alpha} \quad (13)$$

- Derivative with respect to K_{t+1} yields:

$$R_{kt+1} = \frac{\left[P_{mt+1} \alpha \frac{Y_{t+1}}{\xi_{t+1} K_{t+1}} + Q_{t+1} - \delta(Z_{t+1}) \right] \xi_{t+1}}{Q_t} \quad (14)$$

where ξ_{t+1} , the valuation shock provides a source of variation in the return to capital

Capital producing firms – Real rigidities

- Competitive capital producing firms buy capital from intermediate goods producing firms and then repair depreciated capital and build new capital
- As in Christiano et al. (2005), there are introduced investment adjustment costs, but restricted to depend on the net investment flow

$$\max_{I_{nt}} E_t \sum_{\tau=t}^{\infty} \beta^{\tau-t} \Lambda_{t,\tau} \left\{ (Q_{\tau} - 1) I_{n\tau} - f \left(\frac{I_{n\tau} + I_{ss}}{I_{n\tau-1} + I_{ss}} \right) (I_{n\tau} + I_{ss}) \right\} \quad (15)$$

where $I_{nt} \equiv I_t - \delta(Z_t) \zeta_t K_t$ is the net capital created

Retail firms

- Retail firms are incorporated in order to introduce the nominal rigidities as in Christiano et al.(2005);
- Retailers buy goods from intermediate goods firms , differentiate them and sell them in a monopolistically competitive market .
- Final output is a composite of intermediate goods differentiated by retailers :

$$Y_t = \left[\int_0^1 Y_{ft}^{\frac{\varepsilon-1}{\varepsilon}} df \right]^{\frac{\varepsilon}{\varepsilon-1}} \quad (16)$$

- Retailers set nominal prices according to the staggered fashion according to Calvo(1983). Each retailer resets its price with probability $(1-\gamma)$. For the fraction of retailers that cannot adjust , the price is automatically increased at the lagged inflation rate following the dynamic price updating scheme, as in Christiano et al. (2005).

Data

Observable variables:

- real GDP
- real investment
- Inflation
- lending to private non financial corporations
- Interest rate spread

The sample period is 2000Q1 : 2012Q4

Calibrated parameters

Parameter	Value
Capital income share	0.33
Discount factor	0.99
Depreciation rate	0.025
Price elasticity of demand	6
Inverse of Frisch elasticity of labor supply	0.33
Relative utility weight of labor	4.01
Habit persistence parameter	0.815
Fraction of assets given to the new bankers	0.004
Survival rate	0.94
Fraction of assets given to the new bankers	0.319

Estimated parameters: Priors and Posteriors

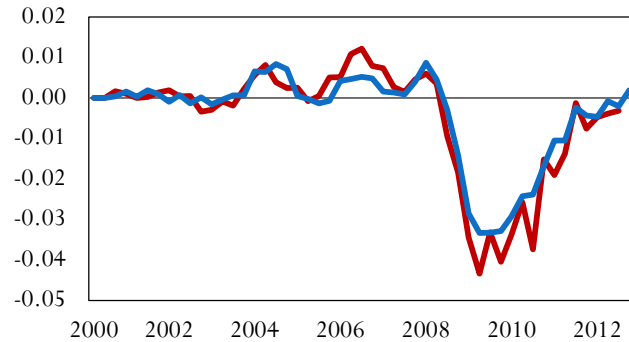
Parameters	Prior distribution		Posterior	
	Distribution	Mean	Mean	Mode
Calvo parameter	Beta	0.75	0.3047	0.3331
Price indexation	Beta	0.5	0.2353	0.0708
Investment adjustment costs	Gamma	5.5	5.3962	5.8020
Elasticity of marginal depreciation	Gamma	1	2.6360	1.9626
Taylor inflation	Normal	1.5	1.9048	2.2786
Taylor output gap	Normal	0.12	0.1170	0.1195
Taylor interest rate smoothing	Normal	0.87	0.5319	0.6200
AR persistence of tech. shock	Beta	0.85	0.9419	0.9464
AR persistence of capital shock	Beta	0.5	0.2596	0.3292
AR persistence of gov shock	Beta	0.5	0.8644	0.8474
Std of tech shock	IG	0.1	0.0180	0.0192
Std of capital shock	IG	0.1	0.0206	0.0201
Std of monetary shock	IG	0.1	0.0180	0.0167
Std of FI capital shock	IG	0.1	0.1295	0.1418
Std of gov shock	IG	0.1	0.0475	0.0461

Results

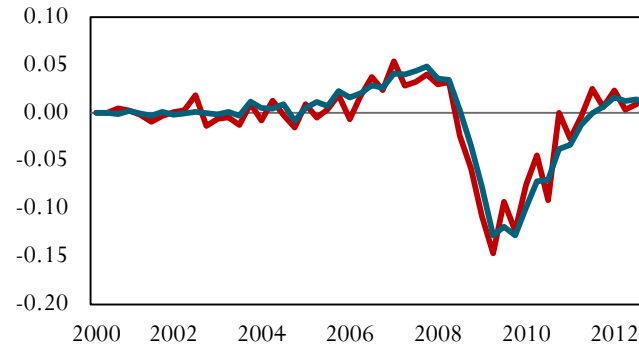
- The estimated Calvo parameter implies that firms adjust the prices almost every two quarters, similar to the findings in Copaciu et al. (2010)
- The degree of price indexation is lower than its prior mean, similarly to the results obtained by Smets and Wouters(2003)
- The elasticity of the cost of changing investment is estimated to be lower than the prior, suggesting a slightly faster response of investment to the changes in the value of capital
- The elasticity of marginal depreciation with respect to capital utilization rate is higher , suggesting a small response of capital utilization to the shocks
- Concerning the monetary policy, the mean of the reaction coefficient to inflation is estimated to be higher than its prior distribution., with an estimated value greater than one, There is a lower degree of interest rate smoothing than what it is assumed apriori.
- The technological and government shock are quite persistent and the shock to the quality of capital is lower than the prior mean
- The shock to the bank capital is the most volatile, the second one is to government which might also capture trade movements

Model fit

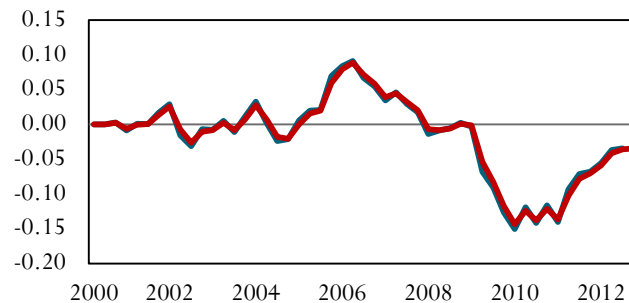
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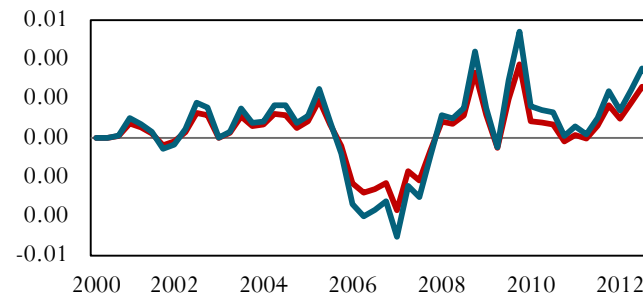
investment



lending



spread



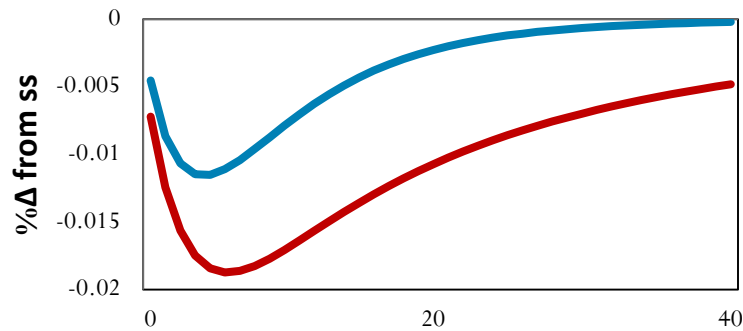
— data
— model

Importance of financial frictions

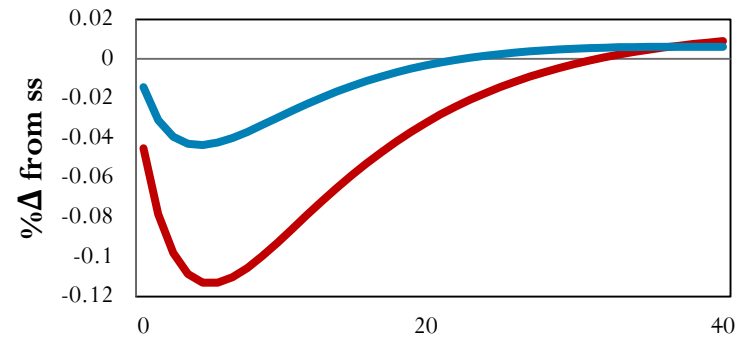
	Base	No FF
<i>Marginal likelihood</i>	672.52	562.125
<i>Mean of estimated parameters</i>		
Calvo parameter	0.3047	0.4621
Price indexation	0.2353	0.1732
Investment adj. costs	5.3962	5.5249
Elasticity of marginal deprec.	2.6360	3.2263
Taylor inflation	1.9048	1.9489
Taylor output gap	0.1170	0.0962
Taylor interest rate smoothing	0.5319	0.5717
persistence of tech. shock	0.9419	0.7922
persistence of capital shock	0.2596	0.3960
persistence of gov shock	0.8644	0.8555
Std of tech shock	0.0180	0.0180
Std of capital shock	0.0206	0.0207
Std of monetary shock	0.0180	0.0196
Std of FI capital shock	0.1295	-
Std of gov shock	0.0475	0.0453

Impulse response functions Technological shock

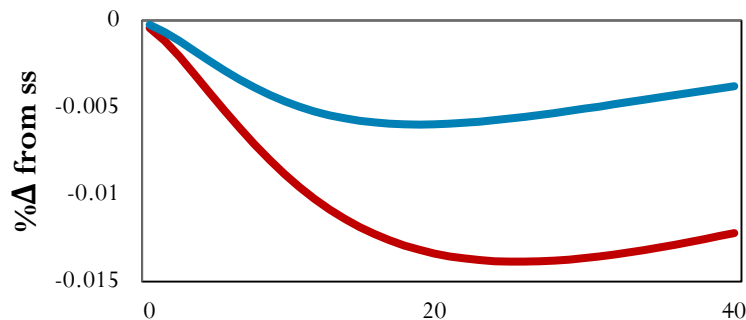
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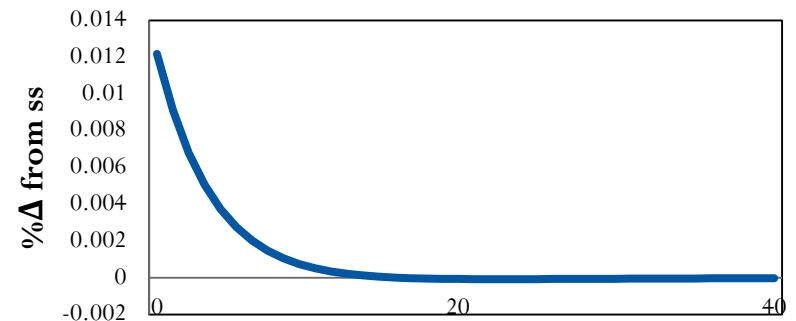
investment



lending



spread

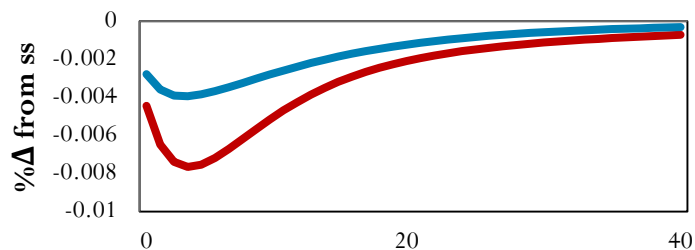


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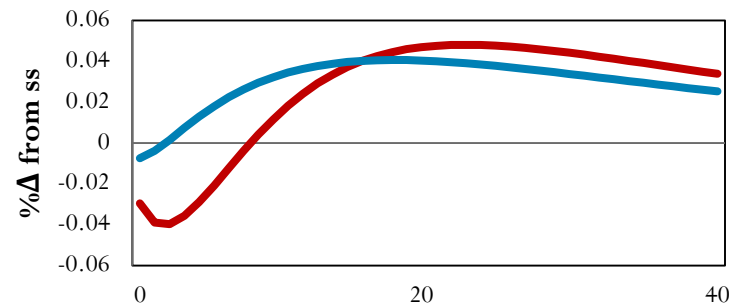
Impulse response functions

Capital quality shock

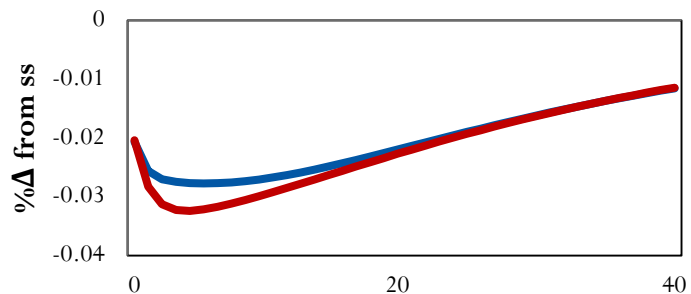
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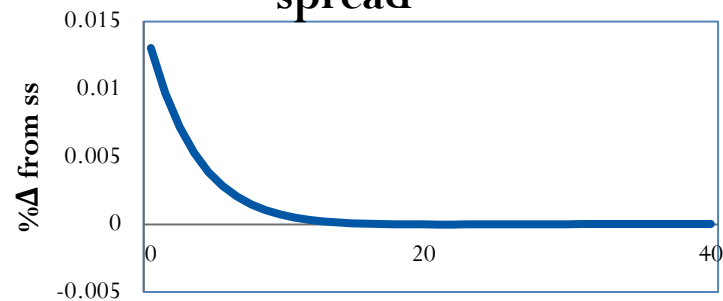
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lending



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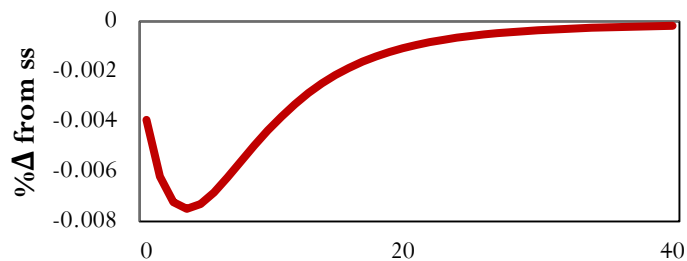


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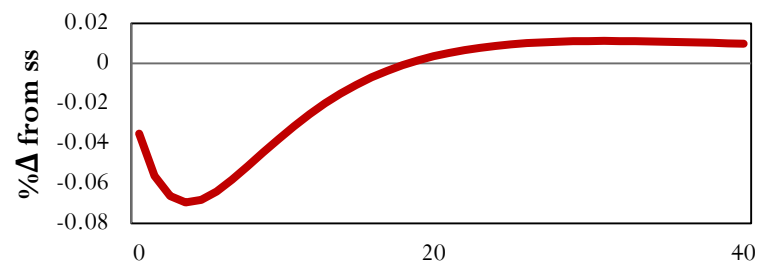
Impulse response functions

Bank capital shock

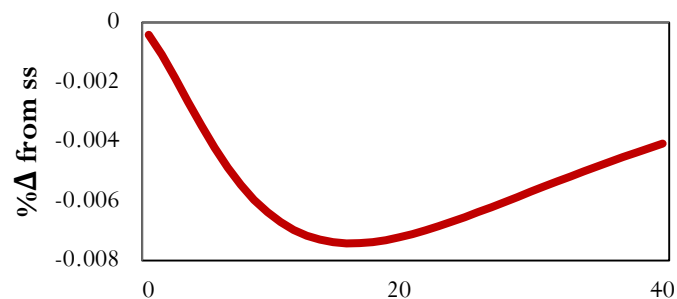
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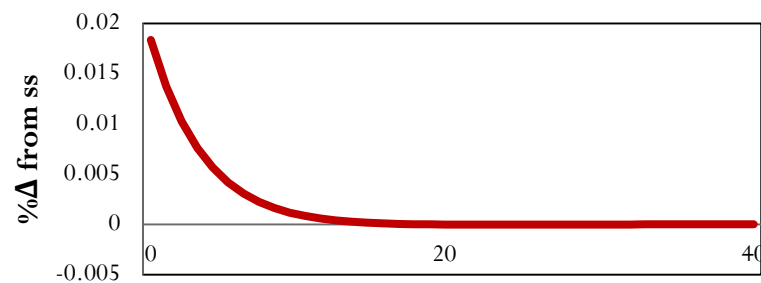
investment



lending



spread



— FF

Conclusions

- Price stickiness suggests that prices adjust almost every two quarters in line with Copaciu et al. (2010)
- Analysis of the filtered variables reveals an acceptable “in-sample” fit.
- The data favor a model with financial frictions
- The impulse response functions explain the financial accelerator mechanism



Thank you!

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