# Notes on the implementation of the Christiano, Motto and Rostagno (2010) model in Dynare

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**Abstract**

In this paper I briefly describe two versions of the DSGE model presented in Christiano, Motto and Rostagno (2010) – the *baseline model* and the *financial accelerator model* – and provide the codes to simulate both versions of the model in Dynare (see Adjemian et al., 2011 and http://www.dynare.org). Overall, with few exceptions, the replication results closely track the ones reported in Christiano, Motto and Rostagno (2010). I also provide the codes for running these models in the Macroeconomic Model Data Base (see Cwik et al., 2012 and http://www.macromodelbase.com/), which is an on-line database containing monetary models used at policy institutions – central banks (ECB, Fed, Riksbank and others) and IMF – as well as in academia.

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# 1 The *baseline model*

## 1.1 Brief description of the model

The *baseline model* presented in Christiano, Motto and Rostagno (2010) (hereafter CMR) builds on the basic structure of Smets and Wouters (2003) and Christiano et al. (2005) enlarged with a) the neoclassical banking model of Chari et al. (1995) and b) the financial accelerator mechanism developed by Bernanke et al. (1999).

The model is composed of households, firms, capital producers, entrepreneurs, a representative retail bank and the government sector. Figures 1 and 2 sketch the structure of the *baseline model* and of its banking sector in more details, respectively.

Households consume, supply labor services monopolistically (to intermediate good firms and bank), and allocate saving across assets with different degrees of liquidity. In particular, they divide their high-powered money into currency, which pays no interest and is held for the transactions services it generates, and bank deposits, which pay interest and generate liquidity services.

On the production side, monopolistically competitive intermediate good firms use labor and capital to produce a continuum of differentiated goods. They borrow from the bank the funds they need to pay their wage bills and capital rental costs in advance of production. Perfectly competitive final good firms buy intermediate goods and produce the final output, which is then converted into consumption, investment and government goods, as well as goods used in capital utilization and in bank monitoring.

Capital producers combine investment goods with undepreciated capital purchased from entrepreneurs to produce new capital, which is then sold back to entrepreneurs.

Capital services (to intermediate good firms and bank) are supplied by entrepreneurs, who own the stock of physical capital. Entrepreneurs purchase capital using their own resources as well as external finance. In particular, the bank issues time and savings deposits (held by households) to provide the credit necessary to finance the part of the entrepreneurs' purchases of capital that cannot be financed with their net worth. As in Bernanke et al. (1999), lending to entrepreneurs involves an agency problem, because they costlessly observe their idiosyncratic shocks, whereas the bank must pay a monitoring cost to observe those shocks. To deal with the asymmetric information

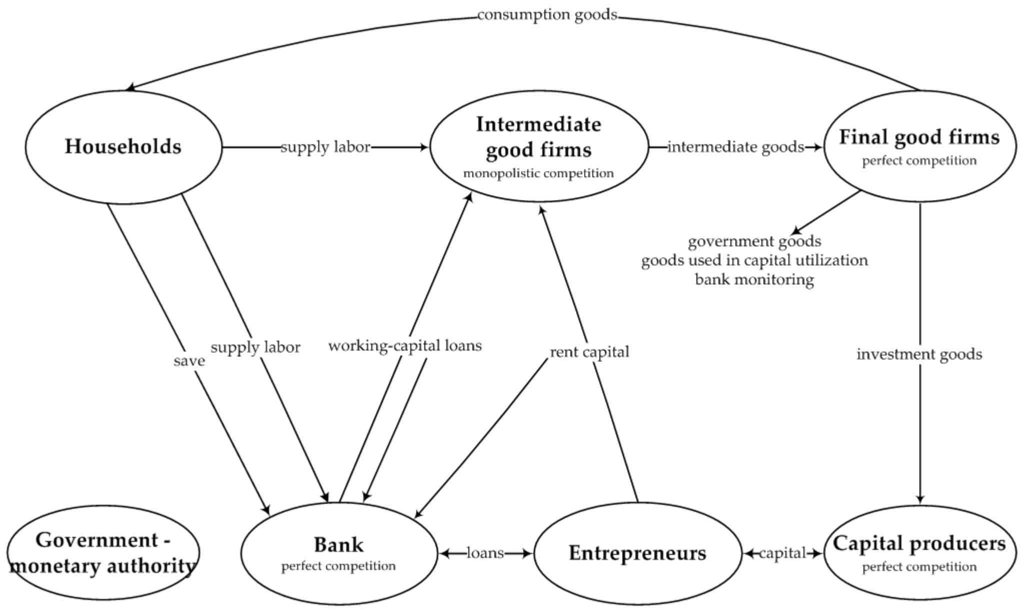


Figure 1: structure of the *baseline model*

problem, entrepreneurs and bank sign a debt contract, according to which the entrepreneur commits to pay back the loan principal and a non-default interest rate, unless he declares default, in which case the bank verifies the residual value of the entrepreneur's assets and takes in all of the entrepreneur's net worth, net of monitoring costs.[1]

As in Chari et al. (1995), the bank uses labor, capital and reserves to produce liquidity services. It issues demand deposits to loan firms (and bank itself) the funds they need to pay for working capital in advance of production. Moreover, it also holds a minimum of cash reserves against households' deposits of base money and Central Bank liquidity injections.

Government expenditures represent a fraction of final output and are financed by lump-sum taxes imposed to households, with the government budget systematically balanced. The Central Bank sets the nominal interest rate according to a Taylor-type interest rate rule.

[1] CMR also modify the Bernanke et al. (1999) financial accelerator mechanism to allow for the Fisher (1933) debt deflation effect. In particular, CMR assume that the return received by households on their deposits is nominally non-state contingent, while loans to entrepreneurs are state-contingent. As a consequence, unexpected movements in the price level change the ex-post real burden of entrepreneurial debt and, hence, the entrepreneur's net worth. For example, after an unexpected increase in inflation, the real resources transferred from the entrepreneur to households fall and consequently the entrepreneur's net worth increases.

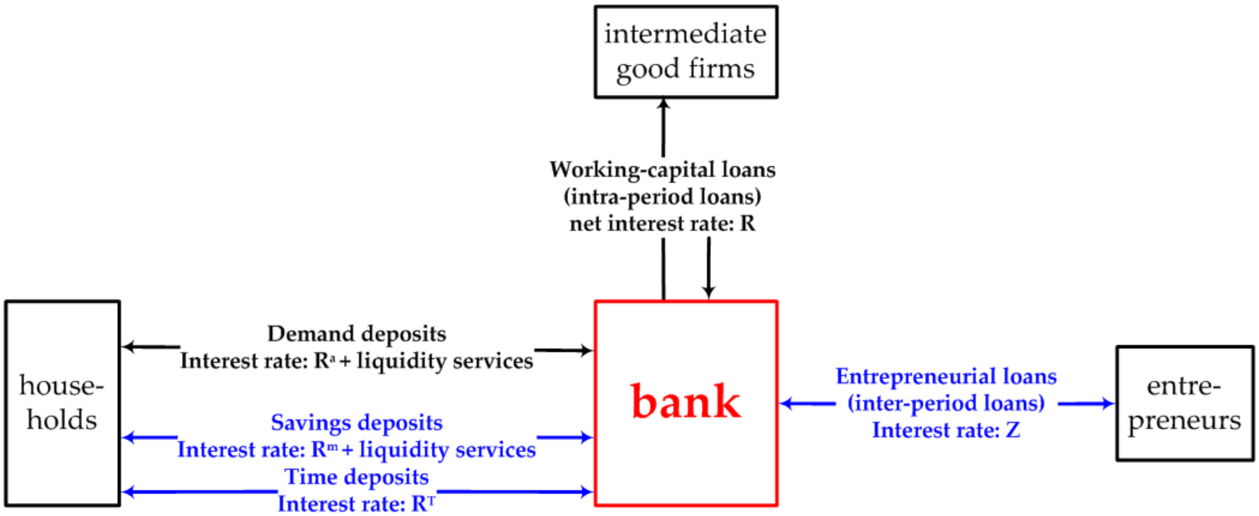


Figure 2: banking sector of the *baseline model*

## 1.2 Equilibrium conditions

The equilibrium conditions of the *baseline model* are:

1. A measure of marginal cost:

$$s_t = \left(\frac{1}{1-\alpha}\right)^{1-\alpha} \left(\frac{1}{\alpha}\right)^{\alpha} \frac{\left(r_t^k \left[1+\psi_k R_t\right]\right)^{\alpha} \left(\tilde{w}_t \left[1+\psi_l R_t\right]\right)^{1-\alpha}}{\epsilon_t} \tag{1.1}$$

2. Another measure of marginal cost:

$$s_t = \frac{r_t^k \left[1+\psi_k R_t\right]}{\alpha \epsilon_t \left(\Upsilon \frac{\mu_{z,t}^* l_t}{u_t \bar{k}_t}\right)^{1-\alpha}} \tag{1.2}$$

3. Definition of $p^*$:

$$p_t^* = \left\{ (1-\xi_p) \left[ \frac{1-\xi_p \left(\frac{\tilde{\pi}_t}{\pi_t}\right)^{\frac{1}{1-\lambda_{f,t}}}}{1-\xi_p} \right]^{\lambda_{f,t}} + \xi_p \left( \frac{\tilde{\pi}_t}{\pi_t} p_{t-1}^* \right)^{\frac{\lambda_{f,t}}{1-\lambda_{f,t}}} \right\}^{\frac{1-\lambda_{f,t}}{\lambda_{f,t}}} \tag{1.3}$$

4. Conditions associated with Calvo sticky prices:[2]

$$E_t \left\{ \lambda_{z,t} Y_{z,t} + \beta \xi_p \left( \frac{\tilde{\pi}_{t+1}}{\pi_{t+1}} \right)^{\frac{1}{1-\lambda_{f,t+1}}} F_{p,t+1} - F_{p,t} \right\} = 0 \tag{1.4}$$

5. Conditions associated with Calvo sticky prices:[3]

$$E_t \left\{ \lambda_{z,t} Y_{z,t} \lambda_{f,t} s_t + \beta \xi_p \left( \frac{\tilde{\pi}_{t+1}}{\pi_{t+1}} \right)^{-\frac{\lambda_{f,t+1}}{\lambda_{f,t+1}-1}} K_{p,t+1} - K_{p,t} \right\} = 0 \tag{1.5}$$

where: $\tilde{\pi}_t = \left(\pi_t^{target}\right)^{\iota} (\pi_{t-1})^{1-\iota}$ and $K_{p,t} = F_{p,t} \left[ \frac{1-\xi_p \left(\frac{\tilde{\pi}_t}{\pi_t}\right)^{\frac{1}{1-\lambda_{f,t}}}}{1-\xi_p} \right]^{1-\lambda_{f,t}}$

6. Production function:[4]

$$Y_{z,t} = (p_t^*)^{\frac{\lambda_{f,t}}{\lambda_{f,t}-1}} \left\{ \epsilon_t \nu_t^l \left( u_t \frac{\bar{k}_t}{\Upsilon \mu_{z,t}^*} \right)^{\alpha} \left[ l_t \left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w - 1}} \right]^{1-\alpha} - \phi \right\} \tag{1.6}$$

7. Supply of capital:[5]

$$E_t \left[ \lambda_{z,t} q_t F_{1,t} - \frac{\lambda_{z,t}}{\mu_{\Upsilon,t}} + \beta \frac{\lambda_{z,t+1} q_{t+1}}{\mu_{z,t+1}^* \Upsilon} F_{2,t+1} \right] = 0 \tag{1.7}$$

8. Capital accumulation:[6]

$$\bar{k}_{t+1} = \frac{1-\delta}{\mu_{z,t}^* \Upsilon} \bar{k}_t + i_t \left[ 1 - S\left( \frac{\zeta_{i,t} i_t \mu_{z,t}^* \Upsilon}{i_{t-1}} \right) \right] \tag{1.8}$$

[2] In equation A.4. in CMR, $\lambda_{f,t}$ should be $\lambda_{f,t+1}$.

[3] Equation A.5. in CMR should read as (1.5).

[4] In equation A.6. in CMR, $\lambda_f$ should be $\lambda_{f,t}$.

[5] $F(\cdot) = [1 - S(\cdot)]\, i_t$ , where $S(\cdot)$ is defined in footnote 6, $F_{1,t} = \frac{\partial F(i_t, i_{t-1})}{\partial i_t}$ and $F_{2,t+1} = \frac{\partial F(i_{t+1}, i_t)}{\partial i_t}$.

[6] I assume $S\left(\frac{\zeta_{i,t} i_t \mu_{z,t}^* \Upsilon}{i_{t-1}}\right) = \exp\left[\sqrt{\frac{S''}{2}} \left( \frac{\zeta_{i,t} i_t \mu_{z,t}^* \Upsilon}{i_{t-1}} - \Upsilon \mu_{z^*} \right)\right] + \exp\left[-\sqrt{\frac{S''}{2}} \left( \frac{\zeta_{i,t} i_t \mu_{z,t}^* \Upsilon}{i_{t-1}} - \Upsilon \mu_{z^*} \right)\right] - 2$, so that $S = S' = 0$ and $S'' > 0$ in steady state.

9. Capital utilization:[7]

$$r_t^k = \tau_t^{oil} a^{'}(u_t) \tag{1.9}$$

10. Rate of return on capital:[8]

$$R_t^k = \frac{\left(1-\tau^k\right)\left[u_t r_t^k - \tau_t^{oil} a(u_t)\right] + (1-\delta) q_t}{\Upsilon q_{t-1}} \pi_t + \tau^k \delta - 1 \tag{1.10}$$

11. Standard debt contract:

$$E_t \left\{ \left[1-\Gamma_t(\bar{\omega}_{t+1})\right] \frac{1+R_{t+1}^k}{1+R_{t+1}^e} + \frac{\Gamma_t^{'}(\bar{\omega}_{t+1})}{\Gamma_t^{'}(\bar{\omega}_{t+1}) - \mu G_t^{'}(\bar{\omega}_{t+1})} \left[ \frac{1+R_{t+1}^k}{1+R_{t+1}^e} \left(\Gamma_t(\bar{\omega}_{t+1}) - \mu G_t(\bar{\omega}_{t+1})\right) - 1 \right] \right\} = 0 \tag{1.11}$$

12. Zero profit condition:[9]

$$\left[\Gamma_t(\bar{\omega}_{t+1}) - \mu G_t(\bar{\omega}_{t+1})\right] = \frac{1+R_{t+1}^e}{1+R_{t+1}^k} \frac{q_t \bar{k}_{t+1} - n_{t+1}}{q_t \bar{k}_{t+1}} \tag{1.12}$$

13. Law of motion for net worth:

$$n_{t+1} = \frac{\gamma_t}{\pi_t \mu_{z,t}^*} \left\{ q_{t-1} \bar{k}_t \left[R_t^k - R_t^e - \mu G_{t-1}(\bar{\omega}_t)\left(1+R_t^k\right)\right] + n_t\left(1+R_t^e\right) \right\} + w^e \tag{1.13}$$

14. Banking service production function:

$$x_t^b (e_{v,t})^{-\xi_t} e_t^r = \frac{m_t^b (1 - m_t + \varsigma d_t^m)}{\pi_t \mu_{z,t}^*} + \psi_l \tilde{w}_t l_t + \frac{\psi_k r_t^k}{\mu_{z,t}^* \Upsilon} u_t \bar{k}_t \tag{1.14}$$

where $e_t^r = \frac{m_t^b}{\pi_t \mu_{z,t}^*}(1-\tau)(1-m_t) - \tau\left(\psi_l \tilde{w}_t l_t + \frac{\psi_k r_t^k}{\mu_{z,t}^* \Upsilon} u_t \bar{k}_t\right)$

15. Ratio of bank excess reserves to their value-added:

$$e_{v,t} = \frac{e_t^r}{\left(1-\nu_t^l\right)\left(\frac{u_t \bar{k}_t}{\mu_{z,t}^* \Upsilon}\right)^{\alpha} (l_t)^{1-\alpha}} \tag{1.15}$$

[7] I assume $a(u_t) = \frac{r^k}{\sigma_a}\{\exp[\sigma_a(u_t-1)]-1\}$, so $a^{'}(u_t) = r^k\{\exp[\sigma_a(u_t-1)]\}$.
[8] The term $\left(1-\tau^k\right)$ is omitted in CMR, equation A.10.
[9] Equation A.12. in CMR should read as (1.12).

16. Banking efficiency condition:

$$R_t^a = \frac{(1-\tau)\, h_{e^r,t} - 1}{1 + \tau h_{e^r,t}} R_t \tag{1.16}$$

where $h_{e^r,t} = \frac{\partial h(\cdot)}{\partial e_t^r} = (1-\xi_t)\, x_t^b \left(e_{v,t}\right)^{-\xi_t}$

17. Another banking efficiency condition

$$E_t \left\{ \frac{\lambda_{z,t+1}}{\pi_{t+1}\mu_{z,t+1}^*} \left( R_{t+1}^e - R_{t+1}^m - \frac{\varsigma R_{t+1}}{1+\tau h_{e^r,t+1}} \right) \right\} = 0 \tag{1.17}$$

18. Choice of labor:

$$\tilde{w}_t = \frac{R_t}{(1+\psi_l R_t)} \frac{(1-\alpha)\, \xi_t x_t^b \left(e_{v,t}\right)^{1-\xi_t} \left( \frac{u_t \bar{k}_t}{\mu_{z,t}^* \Upsilon l_t} \right)^{\alpha}}{1 + \tau h_{e^r,t}} \tag{1.18}$$

19. Marginal utility of consumption:

$$E_t \left[ u_{c,t}^z - \frac{\mu_{z,t}^* \zeta_{c,t}}{c_t \mu_{z,t}^* - b c_{t-1}} + \beta b \frac{\zeta_{c,t+1}}{c_{t+1}\mu_{z,t+1}^* - b c_t} \right] = 0 \tag{1.19}$$

20. Consumption decision:

$$E_t \left\{ u_{c,t}^z - \zeta_{c,t} \upsilon c_t^{-\sigma_q} \left[ (1+\tau^c) \left( \frac{1}{m_t} \right)^{(1-\chi_t)\theta} \left( \frac{1}{1-m_t} \right)^{(1-\chi_t)(1-\theta)} \left( \frac{1}{d_t^m} \right)^{\chi_t} \right]^{1-\sigma_q} \left( \frac{\pi_t \mu_{z,t}^*}{m_t^b} \right)^{1-\sigma_q} - (1+\tau^c)\, \lambda_{z,t} \right\} = 0 \tag{1.20}$$

21. Definition of $w^*$:

$$w_t^* = \left\{ (1-\xi_w) \left[ \frac{1 - \xi_w \left( \frac{\tilde{\pi}_{w,t}}{\pi_{w,t}} \left(\mu_z^*\right)^{1-\vartheta} \left(\mu_{z,t}^*\right)^{\vartheta} \right)^{\frac{1}{1-\lambda_w}}}{1-\xi_w} \right]^{\lambda_w} + \xi_w \left( \frac{\tilde{\pi}_{w,t}}{\pi_{w,t}} \left(\mu_z^*\right)^{1-\vartheta} \left(\mu_{z,t}^*\right)^{\vartheta} w_{t-1}^* \right)^{\frac{\lambda_w}{1-\lambda_w}} \right\}^{\frac{1-\lambda_w}{\lambda_w}} \tag{1.21}$$

22. Conditions associated with Calvo sticky wages:

$$E_t \left\{ \left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w - 1}} l_t \frac{\left(1-\tau^l\right) \lambda_{z,t}}{\lambda_w} + \beta \xi_w \left(\mu_z^*\right)^{\frac{1-\vartheta}{1-\lambda_w}} \left(\mu_{z,t+1}^*\right)^{\frac{\vartheta}{1-\lambda_w} - 1} \left( \frac{1}{\pi_{w,t+1}} \right)^{\frac{\lambda_w}{1-\lambda_w}} \frac{\left(\tilde{\pi}_{w,t+1}\right)^{\frac{1}{1-\lambda_w}}}{\pi_{t+1}} F_{w,t+1} - F_{w,t} \right\} = 0 \tag{1.22}$$

23. Conditions associated with Calvo sticky wages:

$$E_t\left\{\zeta_{c,t}\left[\left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w-1}}l_t\right]^{1+\sigma_L}+\beta\xi_w\left[\frac{\tilde{\pi}_{w,t+1}}{\pi_{w,t+1}}\left(\mu_z^*\right)^{1-\vartheta}\left(\mu_{z,t+1}^*\right)^{\vartheta}\right]^{\frac{\lambda_w(1+\sigma_L)}{1-\lambda_w}}K_{w,t+1}-K_{w,t}\right\}=0 \tag{1.23}$$

where $\tilde{\pi}_{w,t}=\left(\pi_t^{target}\right)^{\iota_w}\left(\pi_{t-1}\right)^{1-\iota_w}$, $\pi_{w,t}=\frac{W_t}{W_{t-1}}=\frac{\tilde{w}_t}{\tilde{w}_{t-1}}\pi_t\mu_{z,t}^*$ and

$$K_{w,t}=F_{w,t}\frac{\tilde{w}_t}{\psi_L}\left\{\frac{1-\xi_w\left[\frac{\tilde{\pi}_{w,t}}{\pi_{w,t}}\left(\mu_z^*\right)^{1-\vartheta}\left(\mu_{z,t}^*\right)^{\vartheta}\right]^{\frac{1}{1-\lambda_w}}}{1-\xi_w}\right\}^{1-\lambda_w(1+\sigma_L)}$$

24. Choice of $T_t$:

$$E_t\left[-\lambda_{z,t}+\frac{\beta}{\pi_{t+1}\mu_{z,t+1}^*}\lambda_{z,t+1}\left(1+R_{t+1}^e\right)\right]=0 \tag{1.24}$$

25. Choice of $M_t$:[10]

$$\begin{gathered}E_t\left\{\zeta_{c,t}v\left[\left(1+\tau^c\right)c_t\left(\tfrac{1}{m_t}\right)^{(1-\chi_t)\theta}\left(\tfrac{1}{1-m_t}\right)^{(1-\chi_t)(1-\theta)}\left(\tfrac{1}{d_t^m}\right)^{\chi_t}\right]^{1-\sigma_q}\left(\tfrac{\pi_t\mu_{z,t}^*}{m_t^b}\right)^{2-\sigma_q}\right. \\ \left[\tfrac{(1-\chi_t)\theta}{m_t}-\tfrac{(1-\chi_t)(1-\theta)}{1-m_t}\right]-\zeta_{c,t}H'\left(\tfrac{m_tm_t^b\pi_{t-1}\mu_{z,t-1}^*}{m_{t-1}m_{t-1}^b}\right)\tfrac{\pi_t\mu_{z,t}^*\pi_{t-1}\mu_{z,t-1}^*}{m_{t-1}m_{t-1}^b}+ \\ \left.\beta\zeta_{c,t+1}H'\left(\tfrac{m_{t+1}m_{t+1}^b\pi_t\mu_{z,t}^*}{m_tm_t^b}\right)\tfrac{m_{t+1}m_{t+1}^b\left(\pi_t\mu_{z,t}^*\right)^2}{\left(m_tm_t^b\right)^2}-\lambda_{z,t}R_t^a\right\}=0\end{gathered} \tag{1.25}$$

26. Choice of $D_{t+1}^m$:[11]

$$\begin{gathered}E_t\left\{\beta\zeta_{c,t+1}v\chi_{t+1}\left[\left(1+\tau^c\right)c_{t+1}\left(\tfrac{1}{m_{t+1}}\right)^{(1-\chi_{t+1})\theta}\left(\tfrac{1}{1-m_{t+1}}\right)^{(1-\chi_{t+1})(1-\theta)}\left(\tfrac{1}{d_{t+1}^m}\right)^{\chi_{t+1}}\right]^{1-\sigma_q}\right. \\ \left.\tfrac{1}{d_{t+1}^m}\left(m_{t+1}^b\right)^{\sigma_q-2}\left(\pi_{t+1}\mu_{z,t+1}^*\right)^{1-\sigma_q}+\beta\tfrac{\lambda_{z,t+1}}{\pi_{t+1}\mu_{z,t+1}^*}\left(1+R_{t+1}^m\right)-\lambda_{z,t}\right\}=0\end{gathered} \tag{1.26}$$

[10] I assume $H\left(\frac{m_tm_t^b\pi_{t-1}\mu_{z,t-1}^*}{m_{t-1}m_{t-1}^b}\right)=\exp\left[\sqrt{\frac{H''}{2}}\left(\frac{m_tm_t^b\pi_{t-1}\mu_{z,t-1}^*}{m_{t-1}m_{t-1}^b}-\mu_{z^*}\pi\right)\right]+\exp\left[-\sqrt{\frac{H''}{2}}\left(\frac{m_tm_t^b\pi_{t-1}\mu_{z,t-1}^*}{m_{t-1}m_{t-1}^b}-\mu_{z^*}\pi\right)\right]-2$.

[11] In equation A.26. in CMR, $v_t$ and $\theta_t$ should be $v$ and $\theta$, respectively.

27. Choice of $M_{t+1}^b$:[12]

$$E_t \left\{ \beta\zeta_{c,t+1} v (1-\theta)(1-\chi_{t+1}) \left[ (1+\tau^c) c_{t+1} \left(\frac{1}{m_{t+1}}\right)^{(1-\chi_{t+1})\theta} \left(\frac{1}{1-m_{t+1}}\right)^{(1-\chi_{t+1})(1-\theta)} \left(\frac{1}{d_{t+1}^m}\right)^{\chi_{t+1}} \right]^{1-\sigma_q} \right. \tag{1.27}$$
$$\left. \left(m_{t+1}^b\right)^{\sigma_q-2} \left(\pi_{t+1}\mu_{z,t+1}^*\right)^{1-\sigma_q} \frac{1}{1-m_{t+1}} + \beta \frac{\lambda_{z,t+1}}{\pi_{t+1}\mu_{z,t+1}^*} \left(1+R_{t+1}^a\right) - \lambda_{z,t} \right\} = 0$$

28. Monetary policy:[13]

$$R_t^e = \tilde{\rho} R_{t-1}^e + (1-\tilde{\rho}) \left[ R^e + \alpha_\pi \left(E_t \pi_{t+1} - \bar{\pi}\right) + \alpha_y \left(Y_t - \bar{Y}\right) \right] + \varepsilon_t^{MP}$$

29. Law of motion of the monetary base:

$$m_{t+1}^b = \frac{1+x_t}{\pi_t \mu_{z,t}^*} m_t^b \tag{1.28}$$

30. Resource constraint:

$$\frac{\mu G_t(\bar{\omega}_t)\left(1+R_t^k\right) q_{t-1} \bar{k}_t}{\pi_t \mu_{z,t}^*} + \tau_t^{oil} a(u_t) \frac{\bar{k}_t}{\Upsilon \mu_{z,t}^*} + g_t + c_t + \frac{i_t}{\mu_{\Upsilon,t}} + \Theta \frac{1-\gamma_t}{\gamma_t} \left(n_{t+1} - w^e\right)$$
$$= \tag{1.29}$$
$$(p_t^*)^{\frac{\lambda_{f,t}}{\lambda_{f,t}-1}} \left\{ \epsilon_t \nu_t^l \left(u_t \frac{\bar{k}_t}{\Upsilon \mu_{z,t}^*}\right)^\alpha \left[ l_t \left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w - 1}} \right]^{1-\alpha} - \phi \right\}$$

where $g_t = \eta_g Y_{z,t}$

31. Definition of (scaled) broad money, $M_t^{Broad}$:

$$m_t^{Broad} = m_{t+1}^b \left(1 + d_{t+1}^m\right) + \psi_l \tilde{w}_t l_t + \frac{\psi_k r_t^k}{\mu_{z,t}^* \Upsilon} u_t \bar{k}_t \tag{1.30}$$

32. Definition of (scaled) total bank loans:[14]

$$b_t^{Tot} = \psi_l \tilde{w}_t l_t + \frac{\psi_k r_t^k}{\mu_{z,t}^* \Upsilon} u_t \bar{k}_t + \frac{q_t \bar{k}_{t+1} - n_{t+1}}{\pi_t \mu_{z,t}^*} \tag{1.31}$$

[12] In equation A.27. in CMR, $v_t$ and $\theta_t$ should be $v$ and $\theta$, respectively.
[13] The Taylor rule used by CMR is slightly different from the one used here.
[14] In equation A.32. in CMR, the term $\left(q_t \bar{k}_{t+1} - n_{t+1}\right)$ should be divided by $\left(\pi_t \mu_{z,t}^*\right)$.

33. Definition of average credit spread:

$$P_t^e = \frac{\mu \int_0^{\bar{\omega}_t} \omega dF_t(\omega_t) \left(1 + R_t^k\right) q_{t-1}\bar{k}_t}{q_{t-1}\bar{k}_t - n_t} \tag{1.32}$$

34. Definition of (scaled) narrow money, $M_t^{Narrow}$:

$$m_t^{Narrow} = m_{t+1}^b + \psi_l \tilde{w}_t l_t + \frac{\psi_k r_t^k}{\mu_{z,t}^* \Upsilon} u_t \bar{k}_t \tag{1.33}$$

35. Definition of (scaled) reserves, $Res_t$:

$$res_t = \frac{m_t^b}{\pi_t}(1 - m_t + x_t) \tag{1.34}$$

## 1.3 Calibration and strategy to compute the steady state

The model is calibrated for the US economy assuming the quarter as the time unit. The numerical values of the steady-state parameters are reported in table 1. I would like to point out that four parameter values are not reported by CMR, while other two parameters are misspecified. Table 2 presents the values of the estimated parameters.

The strategy for computing the steady state of the model follows the approach used by Christiano et al. (2003). They set three (or four) of the endogenous variables to a value that seems empirically reasonable, making these variables exogenous in the steady-state calculation. They then move three (or four) model parameters into the list of variables that are endogenous in the steady-state calculation. This approach allows them to simplify the problem of computing the steady state.

From tables 2 and 3 in CMR, it seems that they a) choose a value for the steady-state rental rate of capital, $r^k$, the percent of aggregate labor and capital in goods production, $\nu^l$, and the currency to base ratio, $m$, and b) consider parameters $\psi_L$, $x^b$ and $\xi$ as endogenous variables. The set of endogenous variables (34) thus is:

$$\pi_t\,,\ s_t\,,\ i_t\,,\ \bar{\omega}_t\,,\ R_t^k\,,\ \bar{k}_t\,,\ n_t\,,\ q_t\,,\ \lambda_{z,t}\,,\ c_t\,,\ \tilde{w}_t\,,\ l_t\,,\ R_t^e\,,\ F_{p,t}\,,\ F_{w,t}\,,\ Y_{z,t}\,,\ u_t\,,\ u_{c,t}^z\,,\ e_{v,t}\,,$$
$$p_t^*\,,\ w_t^*\,,\ R_t\,,\ R_t^a\,,\ R_t^m\,,\ d_t^m\,,\ m_t^b\,,\ m_t^{Broad}\,,\ b_t^{Tot}\,,\ P_t^e\,,\ m_t^{Narrow}\,,\ res_t\,,\ \psi_L\,,\ x_t^b\,,\ \xi_t\,,$$

and the equations available for computing the steady-state values are (1.1)-(1.34). I proceed as follows.

Solve for $\pi$, $q$ and $u$ using (1.28), (1.7) and (1.9), respectively. Use (1.24), (1.3) and (1.21) to get the steady-state value for $R^e$, $p^*$ and $w^*$. Take the ratio of (1.4) and (1.5) to obtain the value for $s$. Solve for $R^k$ using (1.10). Then solve the non-linear system composed by equations (1.11)-(1.13) to obtain the values for $n$, $\bar{\omega}$ and $\bar{k}$. Use (1.8) to get the value for $i$, and the ratio of (1.25) and (1.27) gives the value for $R^a$.

Now the algorithm involves finding the value of $R$ that solves (1.18). So, for a given $R$, solve (1.1), (1.2), (1.29), (1.19) and (1.6) for $\tilde{w}$, $l$, $c$, $u_c^z$ and $Y_z$, respectively. Then solve the non-linear system composed by equations (1.14)-(1.17), (1.20), (1.26) and (1.27) to get the values for $x^b$, $e_v$, $m^b$, $\xi$, $R^m$, $d^m$ and $\lambda_z$. Finally, equations (1.4), (1.22) and (1.23) can be used to obtain $F_p$, $F_w$ and $\psi_L$. Iterate over $R$ until (1.18) is satisfied. The remaining variables are trivial functions of the structural parameters and other steady-state values and are computed using equations (1.30)-(1.34). In these calculations, all variables must be positive, $\bar{k} > n > 0$ and $0 \leq \xi \leq 1$.

Tables 3 and 4 report the steady-state implications of the *baseline model* and their empirical counterparts. These tables show that the *baseline model* reproduces most of the salient features of the US economy, and that my results are very similar to those reported by CMR (recall that my calibration is different because CMR do not report the values of four parameters).

# 2 The *financial accelerator model*

## 2.1 Brief description of the model

The *financial accelerator model* in Christiano et al. (2010) removes the neoclassical banking model of Chari et al. (1995) from the *baseline model*. It essentially corresponds to the models in Smets and Wouters (2003) and Christiano et al. (2005) enlarged with the financial accelerator mechanism developed by Bernanke et al. (1999). Figures 3 and 4 sketch the structure of the *financial accelerator model* and of its banking sector in more details, respectively.

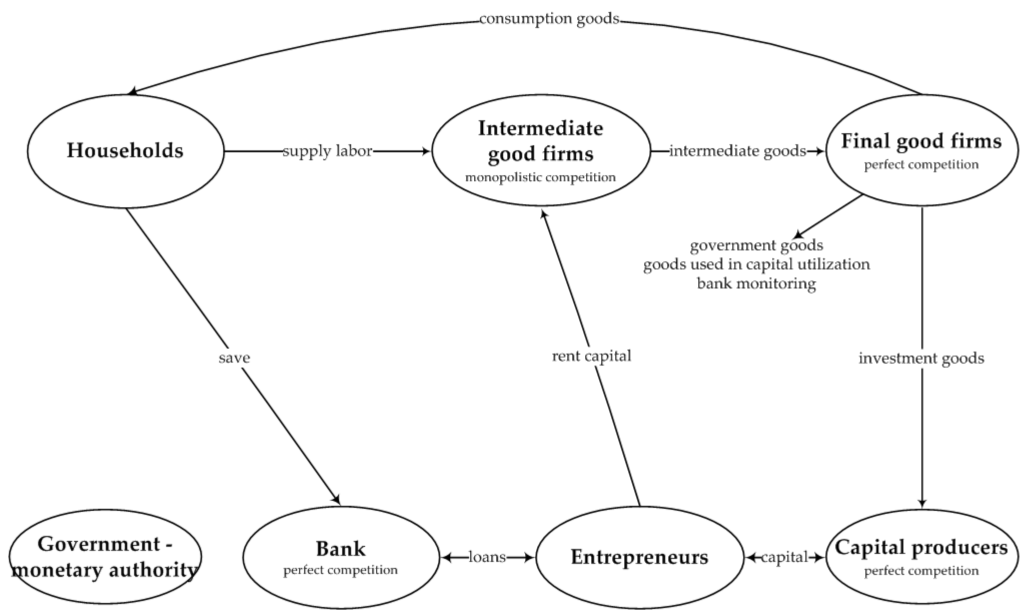


Figure 3: structure of the *financial accelerator model*

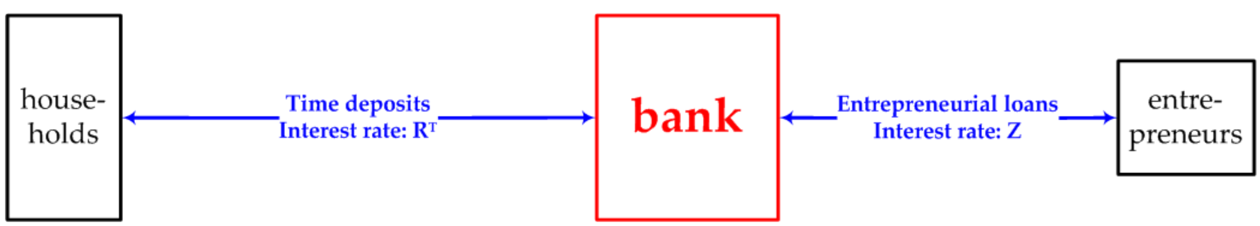


Figure 4: banking sector of the *financial accelerator model*

## 2.2 Equilibrium conditions

The equilibrium conditions of the *financial accelerator model* are:

1. A measure of marginal cost:
$$s_t = \left(\frac{1}{1-\alpha}\right)^{1-\alpha}\left(\frac{1}{\alpha}\right)^{\alpha}\frac{\left(r_t^k\right)^{\alpha}\left(\tilde{w}_t\right)^{1-\alpha}}{\epsilon_t} \tag{2.1}$$

2. Another measure of marginal cost:
$$s_t = \frac{r_t^k}{\alpha\epsilon_t\left(\Upsilon\frac{\mu_{z,t}^* l_t}{u_t\bar{k}_t}\right)^{1-\alpha}} \tag{2.2}$$

3. Definition of $p^*$:
$$p_t^* = \left\{(1-\xi_p)\left[\frac{1-\xi_p\left(\frac{\tilde{\pi}_t}{\pi_t}\right)^{\frac{1}{1-\lambda_{f,t}}}}{1-\xi_p}\right]^{\lambda_{f,t}} + \xi_p\left(\frac{\tilde{\pi}_t}{\pi_t}p_{t-1}^*\right)^{\frac{\lambda_{f,t}}{1-\lambda_{f,t}}}\right\}^{\frac{1-\lambda_{f,t}}{\lambda_{f,t}}} \tag{2.3}$$

4. Conditions associated with Calvo sticky prices:
$$E_t\left\{\lambda_{z,t}Y_{z,t} + \beta\xi_p\left(\frac{\tilde{\pi}_{t+1}}{\pi_{t+1}}\right)^{\frac{1}{1-\lambda_{f,t+1}}}F_{p,t+1} - F_{p,t}\right\} = 0 \tag{2.4}$$

5. Conditions associated with Calvo sticky prices:
$$E_t\left\{\lambda_{z,t}Y_{z,t}\lambda_{f,t}s_t + \beta\xi_p\left(\frac{\tilde{\pi}_{t+1}}{\pi_{t+1}}\right)^{-\frac{\lambda_{f,t+1}}{\lambda_{f,t+1}-1}}K_{p,t+1} - K_{p,t}\right\} = 0 \tag{2.5}$$

   where: $\tilde{\pi}_t = \left(\pi_t^{target}\right)^{\iota}\left(\pi_{t-1}\right)^{1-\iota}$ and $K_{p,t} = F_{p,t}\left[\frac{1-\xi_p\left(\frac{\tilde{\pi}_t}{\pi_t}\right)^{\frac{1}{1-\lambda_{f,t}}}}{1-\xi_p}\right]^{1-\lambda_{f,t}}$

6. Production function:
$$Y_{z,t} = \left(p_t^*\right)^{\frac{\lambda_{f,t}}{\lambda_{f,t}-1}}\left\{\epsilon_t\left(u_t\frac{\bar{k}_t}{\Upsilon\mu_{z,t}^*}\right)^{\alpha}\left[l_t\left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w-1}}\right]^{1-\alpha} - \phi\right\} \tag{2.6}$$

7. Supply of capital:

$$E_t\left[\lambda_{z,t}q_tF_{1,t}-\frac{\lambda_{z,t}}{\mu_{\Upsilon,t}}+\beta\frac{\lambda_{z,t+1}q_{t+1}}{\mu^*_{z,t+1}\Upsilon}F_{2,t+1}\right]=0 \tag{2.7}$$

8. Capital accumulation:

$$\bar{k}_{t+1}=\frac{1-\delta}{\mu^*_{z,t}\Upsilon}\bar{k}_t+i_t\left[1-S\left(\frac{\zeta_{i,t}i_t\mu^*_{z,t}\Upsilon}{i_{t-1}}\right)\right] \tag{2.8}$$

9. Capital utilization:

$$r^k_t=\tau^{oil}_t a'\left(u_t\right) \tag{2.9}$$

10. Rate of return on capital:

$$R^k_t=\frac{\left(1-\tau^k\right)\left[u_tr^k_t-\tau^{oil}_t a\left(u_t\right)\right]+\left(1-\delta\right)q_t}{\Upsilon q_{t-1}}\pi_t+\tau^k\delta-1 \tag{2.10}$$

11. Standard debt contract:

$$E_t\left\{\left[1-\Gamma_t\left(\bar{\omega}_{t+1}\right)\right]\frac{1+R^k_{t+1}}{1+R^e_{t+1}}+\frac{\Gamma'_t\left(\bar{\omega}_{t+1}\right)}{\Gamma'_t\left(\bar{\omega}_{t+1}\right)-\mu G'_t\left(\bar{\omega}_{t+1}\right)}\left[\frac{1+R^k_{t+1}}{1+R^e_{t+1}}\left(\Gamma_t\left(\bar{\omega}_{t+1}\right)-\mu G_t\left(\bar{\omega}_{t+1}\right)\right)-1\right]\right\}=0 \tag{2.11}$$

12. Zero profit condition:

$$\frac{q_t\bar{k}_{t+1}}{n_{t+1}}\frac{1+R^k_{t+1}}{1+R^e_{t+1}}\left[\Gamma_t\left(\bar{\omega}_{t+1}\right)-\mu G_t\left(\bar{\omega}_{t+1}\right)\right]+1=\frac{q_t\bar{k}_{t+1}}{n_{t+1}} \tag{2.12}$$

13. Law of motion for net worth:

$$n_{t+1}=\frac{\gamma_t}{\pi_t\mu^*_{z,t}}\left\{q_{t-1}\bar{k}_t\left[R^k_t-R^e_t-\mu G_{t-1}\left(\bar{\omega}_t\right)\left(1+R^k_t\right)\right]+n_t\left(1+R^e_t\right)\right\}+w^e \tag{2.13}$$

14. Marginal utility of consumption:

$$E_t\left[\left(1+\tau^c\right)\lambda_{z,t}-\frac{\mu^*_{z,t}\zeta_{c,t}}{c_t\mu^*_{z,t}-bc_{t-1}}+\beta b\frac{\zeta_{c,t+1}}{c_{t+1}\mu^*_{z,t+1}-bc_t}\right]=0 \tag{2.14}$$

15. Definition of $w^*$:

$$w_t^* = \left\{ (1-\xi_w) \left[ \frac{1-\xi_w \left( \frac{\tilde{\pi}_{w,t}}{\pi_{w,t}} \left(\mu_z^*\right)^{1-\vartheta} \left(\mu_{z,t}^*\right)^{\vartheta} \right)^{\frac{1}{1-\lambda_w}}}{1-\xi_w} \right]^{\lambda_w} + \xi_w \left( \frac{\tilde{\pi}_{w,t}}{\pi_{w,t}} \left(\mu_z^*\right)^{1-\vartheta} \left(\mu_{z,t}^*\right)^{\vartheta} w_{t-1}^* \right)^{\frac{\lambda_w}{1-\lambda_w}} \right\}^{\frac{1-\lambda_w}{\lambda_w}} \tag{2.15}$$

16. Conditions associated with Calvo sticky wages:

$$E_t \left\{ \left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w - 1}} l_t \frac{\left(1-\tau^l\right) \lambda_{z,t}}{\lambda_w} + \beta \xi_w \left(\mu_z^*\right)^{\frac{1-\vartheta}{1-\lambda_w}} \left(\mu_{z,t+1}^*\right)^{\frac{\vartheta}{1-\lambda_w}-1} \left( \frac{1}{\pi_{w,t+1}} \right)^{\frac{\lambda_w}{1-\lambda_w}} \frac{\left(\tilde{\pi}_{w,t+1}\right)^{\frac{1}{1-\lambda_w}}}{\pi_{t+1}} F_{w,t+1} - F_{w,t} \right\} = 0 \tag{2.16}$$

17. Conditions associated with Calvo sticky wages:

$$E_t \left\{ \zeta_{c,t} \left[ \left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w - 1}} l_t \right]^{1+\sigma_L} + \beta \xi_w \left[ \frac{\tilde{\pi}_{w,t+1}}{\pi_{w,t+1}} \left(\mu_z^*\right)^{1-\vartheta} \left(\mu_{z,t+1}^*\right)^{\vartheta} \right]^{\frac{\lambda_w(1+\sigma_L)}{1-\lambda_w}} K_{w,t+1} - K_{w,t} \right\} = 0 \tag{2.17}$$

where $\tilde{\pi}_{w,t} = \left(\pi_t^{target}\right)^{\iota_w} \left(\pi_{t-1}\right)^{1-\iota_w}$, $\pi_{w,t} = \frac{W_t}{W_{t-1}} = \frac{\tilde{w}_t}{\tilde{w}_{t-1}} \pi_t \mu_{z,t}^*$ and

$$K_{w,t} = F_{w,t} \frac{\tilde{w}_t}{\psi_L} \left\{ \frac{1-\xi_w \left[ \frac{\tilde{\pi}_{w,t}}{\pi_{w,t}} \left(\mu_z^*\right)^{1-\vartheta} \left(\mu_{z,t}^*\right)^{\vartheta} \right]^{\frac{1}{1-\lambda_w}}}{1-\xi_w} \right\}^{1-\lambda_w(1+\sigma_L)}$$

18. Choice of $T_t$:

$$E_t \left[ -\lambda_{z,t} + \frac{\beta}{\pi_{t+1} \mu_{z,t+1}^*} \lambda_{z,t+1} \left(1 + R_{t+1}^e\right) \right] = 0 \tag{2.18}$$

19. Monetary policy:

$$R_t^e = \tilde{\rho} R_{t-1}^e + (1-\tilde{\rho}) \left[ R^e + \alpha_\pi \left(E_t \pi_{t+1} - \bar{\pi}\right) + \alpha_y \left(Y_t - \bar{Y}\right) \right] + \varepsilon_t^{MP} \tag{2.19}$$

20. Resource constraint:

$$\frac{\mu G_t(\bar{\omega}_t)\left(1+R_t^k\right)q_{t-1}\bar{k}_t}{\pi_t \mu_{z,t}^*} + \tau_t^{oil} a(u_t)\frac{\bar{k}_t}{\Upsilon \mu_{z,t}^*} + g_t + c_t + \frac{i_t}{\mu_{\Upsilon,t}} + \Theta\frac{1-\gamma_t}{\gamma_t}(n_{t+1} - w^e) = (p_t^*)^{\frac{\lambda_{f,t}}{\lambda_{f,t}-1}}\left\{\epsilon_t\left(u_t\frac{\bar{k}_t}{\Upsilon\mu_{z,t}^*}\right)^{\alpha}\left[l_t\left(w_t^*\right)^{\frac{\lambda_w}{\lambda_w-1}}\right]^{1-\alpha} - \phi\right\} \tag{2.20}$$

where $g_t = \eta_g Y_{z,t}$

21. Definition of (scaled) total bank loans:

$$b_t^{Tot} = \frac{q_t\bar{k}_{t+1} - n_{t+1}}{\pi_t \mu_{z,t}^*} \tag{2.21}$$

## 2.3 Calibration and steady state

The numerical values of the steady-state parameters are reported in table 5, and table 6 presents the values of the estimated parameters.

To compute the steady state of the *financial accelerator model*, I choose the value for the steady-state rental rate of capital, $r^k$, and consider parameter $\psi_L$ as endogenous variable. The set of endogenous variables (21) thus is:

$$\pi_t\,,\; s_t\,,\; i_t\,,\; \bar{\omega}_t\,,\; R_t^k\,,\; \bar{k}_t\,,\; n_t\,,\; q_t\,,\; \lambda_{z,t}\,,\; c_t\,,\; \tilde{w}_t\,,\; l_t\,,$$
$$R_t^e\,,\; F_{p,t}\,,\; F_{w,t}\,,\; Y_{z,t}\,,\; u_t\,,\; p_t^*\,,\; w_t^*\,,\; b_t^{Tot}\,,\; \psi_L\,,$$

and the equations available for computing the steady-state values are (2.1)-(2.21). The steady-state value of the inflation rate is assumed to be the same as that of the *baseline model*. Then I proceed as follows.

Solve for $q$ and $u$ using (2.7) and (2.9), respectively. Use (2.18), (2.3) and (2.15) to get the steady-state value for $R^e$, $p^*$ and $w^*$. Take the ratio of (2.4) and (2.5) to obtain the value for $s$. Solve for $R^k$ using (2.10). Then solve the non-linear system composed by equations (2.11)-(2.13) to obtain the values for $n$, $\bar{\omega}$ and $\bar{k}$. Use (2.8) to get the value for $i$. Solve (2.1), (2.2) and (2.6) for $\tilde{w}$, $l$ and $Y_z$, respectively. Use (2.20) and (2.14) to get the value for $c$ and $\lambda_z$, respectively. Finally, equations (2.4), (2.16), (2.17) and (2.21) can be used to obtain $F_p$, $F_w$, $\psi_L$ and

$b^{Tot}$, respectively. In these calculations, all variables must be positive, and $\bar{k} > n > 0$. Tables 7 and 8 report the steady-state implications of the *financial accelerator model* and their empirical counterparts.

## 3 List of Dynare and Matlab files

This section lists the Dynare and Matlab files used to simulate the models described in sections 1 and 2. All files are contained in the *ReplicationFilesCMR.zip* file available on the website where this paper is posted. To researchers interested in conducting model comparison, I also provides the codes for running these models in the Macroeconomic Model Data Base (for further information, see Cwik et al., 2012 and http://www.macromodelbase.com/).

The impulse response functions (IRFs) to a one standard deviation monetary policy shock ($\varepsilon_t^{MP}$), transitory productivity shock ($\epsilon_t$), financial wealth shock ($\gamma_t$) and marginal efficiency of investment shock ($\zeta_{i,t}$) are automatically plotted at the end of the simulation (run ***CMR_ baseline.mod*** or ***CMR_ FA.mod***). For the sake of comparison, the scale of each subplot is restricted to match that of the figure in CMR. Overall, with few exceptions, the replication results closely track the ones obtained by CMR.

**Folder "BaselineModel"**

- ***CMR_ baseline.mod*** – Dynare code to simulate the *baseline model* in Dynare
- ***US_ CMRba.mod*** – Dynare code to simulate the *baseline model* in the Macro Model Data Base (note: set modelbase.variabledim=2 in MMB.m)
- ***plots_ CMR_ baseline.m*** – plots the IRFs
- ***ss_ CMR_ baseline_ US.mat*** – has the steady-state values for the *baseline model*, which are computed using the codes available in the
  - **subfolder "sstate"**
    - Master file: ***SS_ CMR_ baseline.m*** - at the beginning there is the calibration and then it computes the steady state for the endogenous variables by calling the functions ***funcontractCMR.m***, ***funcontract2CMR.m*** and ***funbigsysCMR.m***

        * ***check_ss_CMR_baseline.m*** - checks whether the steady state previously computed is the steady state

**Folder "FAmodel"**

- ***CMR_FA.mod*** – Dynare code to simulate the *financial accelerator model* in Dynare
- ***US_CMRfa.mod*** – Dynare code to simulate the *financial accelerator model* in the Macro Model Data Base (note: set modelbase.variabledim=2 in MMB.m)
- ***plots_CMR_FA.m*** – plots the IRFs
- ***ss_CMR_FA_US.mat*** – has the steady-state values for the *financial accelerator model*, which are computed using the codes available in the
    - **subfolder "sstate"**
        * Master file: ***SS_CMR_FA.m*** - at the beginning there is the calibration and then it computes the steady state for the endogenous variables by calling the functions ***funcontractCMR.m*** and ***funcontract2CMR.m***
        * ***check_ss_CMR_FA.m*** - checks whether the steady state previously computed is the steady state

Table 1: *Baseline Model* Parameters, US (time unit of model: quarterly)

| | | |
|---|---|---|
| **Panel A: household sector** | | |
| $\beta$ | Discount rate | 0.9966 |
| $\psi_L$ | Weight on disutility of labor | (endogenous) |
| $\sigma_L$ | Curvature on disutility of labor | 1 |
| $\upsilon$ | Weight on utility of money | 0.002 |
| $\sigma_q$ | Curvature on utility of money | $-7$ |
| $\theta$ | Power on currency in utility of money | 0.87 |
| $\chi$ | Power on Saving Deposit in Utility | 0.40 |
| $b$ | Habit persistence parameter | 0.63 |
| $\lambda_w$ | Steady-state markup, suppliers of labor | 1.05 |
| **Panel B: goods producing sector** | | |
| $\mu_z$ | Growth rate of technology (APR) | 1.0036 § |
| $\psi_k$ | Fraction of capital rental costs that must be financed | 0.75 |
| $\psi_l$ | Fraction of wage bill that must be financed | 0.75 |
| $\delta$ | Depreciation rate on capital | 0.025 |
| $\alpha$ | Power on capital in production function | 0.40 |
| $\lambda_f$ | Steady-state markup, intermediate good firms | 1.20 |
| $\Phi$ | Fixed cost, intermediate goods | 0.07 |
| **Panel C: entrepreneurs** | | |
| $\gamma$ | Percent of entrepreneurs who survive from one quarter to the next | 0.9762 |
| $\mu$ | Fraction of realized profits lost in bankruptcy | 0.94 |
| $var\,(\log \omega)$ | Variance of (normally distributed) log of idiosyncratic productivity | 0.24 |
| $\Theta$ | Fraction of net worth consumed when they exit the economy | 0.1 # |
| $\omega^e$ | Transfer from households | 0.009 # |
| **Panel D: banking sector** | | |
| $\xi$ | Power on excess reserves in deposit services technology | (endogenous) |
| $x^b$ | Constant in front of deposit services technology | (endogenous) |
| $\varsigma$ | Constant in banking services production function | 0.088 # |
| **Panel E: Policy** | | |
| $\tau$ | Bank reserve requirement | 0.01 |
| $\tau^c$ | Tax rate on consumption | 0.05 |
| $\tau^k$ | Tax rate on capital income | 0.32 |
| $\tau^l$ | Tax rate on labor income | 0.24 |
| $x$ | Growth rate of Monetary Base (APR) | 3.71/400 * |
| $\eta_g$ | Share of government consumption to GDP | 0.20 |
| **Panel F: Others** | | |
| $\Upsilon$ | trend rate of investment-specific technical change (APR) | 1.0035 # |

Note. When not specified, the values are the ones reported in CMR, Table 1.§ The value reported by CMR is 1.36. To have a reasonable value for the Annual Percentage Rate (APR) of technology, it should be $\mu_z = 1.0036$. # My calibration. The value is not reported in CMR. * The value in CMR is 3.71, while the corresponding APR value should be 3.71/400.

Table 2: Parameter Estimates, *Baseline Model*, US

| | | |
|---|---|---|
| $\xi_p$ | Calvo prices | 0.693 |
| $\xi_w$ | Calvo wages | 0.699 |
| $H''$ | Curvature on currency demand | 0 |
| $\iota$ | Weight on steady-state inflation | 0.362 |
| $\iota_w$ | Weight on steady-state inflation | 0.641 |
| $\vartheta$ | Weight on technology growth | 0.930 |

| | | |
|---|---|---|
| $S''$ | Investment adjustment cost | 26.64 |
| $\sigma_a$ | Capacity utilization | 19.718 |
| $\alpha_\pi$ | Weight on inflation in Taylor rule | 1.849 |
| $\alpha_y$ | Weight on output gap in Taylor rule | 0.321 § |
| $\tilde{\rho}$ | Coefficient on lagged interest rate | 0.880 |

Note. When not specified, the values are the ones reported in CMR, Table 4. For the shock processes, I also use the results reported in CMR, Table 4. § My calibration.

Table 3: Steady-State Properties, *Baseline Model* versus Data, US

| **Variable** | **US data** | ***Baseline Model*** my calibration | ***Baseline Model*** CMR |
|---|---|---|---|
| $K/Y$ | 10.7 | 6.97 | 6.98 |
| $I/Y$ | 0.25 | 0.22 | 0.22 |
| $C/Y$ | 0.56 | 0.56 | 0.58 |
| $G/Y$ | 0.20 | 0.20 | 0.20 |
| $r^k$ | | 0.059 | 0.059 |
| $\frac{N}{K-N}$ ('Equity to debt') | $1.3 - 4.7$ | 3.4 | 3.4 |
| Percent of Aggregate Labor and Capital in Banking $(1-\nu^l)$ | 5.9 | 0.01 | 0.01§ |
| Inflation (APR) | 2.32 | 2.26 | 2.32 |

Note. The source for US data is CMR and the sample period is 1998Q1-2003Q4. § The value reported in CMR, table 2 is 0.95, which represents the percent of aggregate labor and capital in *goods production* $(\nu^l)$, while the percent of aggregate labor and capital in *banking* is $1-\nu^l$. In page 80, the authors state that "around one percent of labor and capital resources are in the banking sector in our EA and US models". Accordingly, here I choose $1-\nu^l = 0.01$ (recall from subsection 1.3 that the value of $\nu^l$ is calibrated).

Table 4: Money and Interest Rates, *Baseline Model* versus Data, US

| | **US data** | ***Baseline Model*** my calibration | ***Baseline Model*** CMR |
|---|---|---|---|
| Currency/Base | 0.86 | 0.86 | 0.86 |
| Deposits, $R^a$ | | 0.42 | 0.41 |
| Rate of Return on Capital, $R^k$ | 10.32 | 10.51 | 10.52 |
| Cost of External Finance, $Z$ | $7.1 - 8.1$ | 6.21 | 6.16 |
| Gross rate on Working Capital Loans | 7.07 | 4.35 | 4.18 |
| Other Financial Securities, $R^e$ | 5.12 | 5.19 | 5.12 |

Note. The source for U.S. data is CMR and the sample period is 1987Q1-2003Q4.

Table 5: *Financial Accelerator Model* Parameters, US (time unit of model: quarterly)

| | | |
|---|---|---|
| **Panel A: household sector** | | |
| $\beta$ | Discount rate | 0.9966 |
| $\psi_L$ | Weight on disutility of labor | (endogenous) |
| $\sigma_L$ | Curvature on disutility of labor | 1 |
| $b$ | Habit persistence parameter | 0.63 |
| $\lambda_w$ | Steady-state markup, suppliers of labor | 1.05 |
| **Panel B: goods producing sector** | | |
| $\mu_z$ | Growth rate of technology (APR) | 1.0036 $^{\S}$ |
| $\delta$ | Depreciation rate on capital | 0.025 |
| $\alpha$ | Power on capital in production function | 0.40 |
| $\lambda_f$ | Steady-state markup, intermediate good firms | 1.20 |
| $\Phi$ | Fixed cost, intermediate goods | 0.07 |
| **Panel C: entrepreneurs** | | |
| $\gamma$ | Percent of entrepreneurs who survive from one quarter to the next | 0.9762 |
| $\mu$ | Fraction of realized profits lost in bankruptcy | 0.94 |
| $var\,(\log\omega)$ | Variance of (normally distributed) log of idiosyncratic productivity | 0.24 |
| $\Theta$ | Fraction of net worth consumed when they exit the economy | 0.1 $^{\#}$ |
| $\omega^e$ | Transfer from households | 0.009 $^{\#}$ |
| **Panel D: Policy** | | |
| $\tau$ | Bank reserve requirement | 0.01 |
| $\tau^c$ | Tax rate on consumption | 0.05 |
| $\tau^k$ | Tax rate on capital income | 0.32 |
| $\tau^l$ | Tax rate on labor income | 0.24 |
| $x$ | Growth rate of Monetary Base (APR) | 3.71/400 $^{*}$ |
| $\eta_g$ | Share of government consumption to GDP | 0.20 |
| **Panel E: Others** | | |
| $\Upsilon$ | trend rate of investment-specific technical change (APR) | 1.0035 $^{\#}$ |

Note. When not specified, the values are the ones reported in CMR, Table 1.$^{\S}$ The value reported by CMR is 1.36. To have a reasonable value for the Annual Percentage Rate (APR) of technology, it should be $\mu_z = 1.0036$. $^{\#}$ My calibration. The value is not reported in CMR. $^{*}$ The value in CMR is 3.71, while the corresponding APR value should be 3.71/400.

Table 6: Parameter Estimates, *Financial Accelerator Model*, US

| | | |
|---|---|---|
| $\xi_p$ | Calvo prices | 0.702 |
| $\xi_w$ | Calvo wages | 0.771 |
| $H''$ | Curvature on currency demand | 0 |
| $\iota$ | Weight on steady-state inflation | 0.159 |
| $\iota_w$ | Weight on steady-state inflation | 0.285 |
| $\vartheta$ | Weight on technology growth | 0.917 |

| | | |
|---|---|---|
| $S''$ | Investment adjustment cost | 29.31 |
| $\sigma_a$ | Capacity utilization | 18.85 |
| $\alpha_\pi$ | Weight on inflation in Taylor rule | 1.817 |
| $\alpha_y$ | Weight on output gap in Taylor rule | 0.310 $^{\S}$ |
| $\tilde{\rho}$ | Coefficient on lagged interest rate | 0.877 |

Note. When not specified, the values are the ones reported in CMR, Table A.2. For the shock processes, I also use the results reported in CMR, Table A.2. $^{\S}$ My calibration.

Table 7: Steady-State Properties, *Financial Accelerator Model* versus Data, US

| **Variable** | **US data** | ***Financial Accelerator Model* my calibration** |
|---|---|---|
| $K/Y$ | 10.7 | 6.96 |
| $I/Y$ | 0.25 | 0.22 |
| $C/Y$ | 0.56 | 0.56 |
| $G/Y$ | 0.20 | 0.20 |
| $r^k$ | | 0.059 |
| $\frac{N}{K-N}$ ('Equity to debt') | $1.3-4.7$ | 3.4 |
| Inflation (APR) | 2.32 | 2.26 |

Note. The source for US data is CMR and the sample period is 1998Q1-2003Q4. CMR do not report the steady-state properties of the *financial accelerator model*.

Table 8: Money and Interest Rates, *Financial Accelerator Model* versus Data, US

| | **US data** | ***Financial Accelerator Model* my calibration** |
|---|---|---|
| Rate of Return on Capital, $R^k$ | 10.32 | 10.51 |
| Cost of External Finance, $Z$ | $7.1-8.1$ | 6.21 |
| Other Financial Securities, $R^e$ | 5.12 | 5.19 |

Note. The source for U.S. data is CMR and the sample period is 1987Q1-2003Q4. CMR do not report the steady-state properties of the *financial accelerator model*.

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