Online Appendixes to "Rethinking Capital Regulation: The Case for a Dividend Prudential Target"*

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Appendix A. Data and Sources

This appendix presents the full data set employed to present some evidence on euro-area bank dividends and earnings in section 3 and to calibrate the extended model in section 6.

Gross Domestic Product: Gross domestic product at market prices, chain-linked volumes (rebased), domestic currency (may include amounts converted to the current currency at a fixed rate), seasonally and working-day adjusted. Source: Eurostat.

GDP Deflator: Gross domestic product at market prices, deflator, domestic currency, index (2010 = 100), seasonally and calendar-adjusted data—ESA 2010 national accounts. Source: Eurostat.

Final Consumption: Final consumption expenditure at market prices, chain-linked volumes (2010), seasonally and calendar-adjusted data. Source: Eurostat.

Gross Fixed Capital Formation: Gross fixed capital formation at market prices, chain-linked volumes (2010), seasonally and calendar-adjusted data. Source: Eurostat.

Households Housing Wealth: Housing wealth (net) of households and nonprofit institutions serving households sector (NPISH), current prices, euros, neither seasonally adjusted nor calendar adjusted—ESA 2010. Source: European Central Bank.

Housing Prices: Residential property prices; new and existing dwellings, residential property in good and poor condition. Neither seasonally nor working-day adjusted. Source: European Central Bank.

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Business Loans: Outstanding amounts at the end of the period (stocks) of loans from MFIs excluding ESCB reporting sector to nonfinancial corporations (S.11) sector, denominated in euros. Source: MFI Balance Sheet Items Statistics (BSI Statistics), Monetary and Financial Statistics (S/MFS), European Central Bank.

Households Loans: Outstanding amounts at the end of the period (stocks) of loans from MFIs excluding ESCB reporting sector to households and nonprofit institutions serving households (S.14 and S.15) sector, denominated in euros. Source: MFI Balance Sheet Items Statistics (BSI Statistics), Monetary and Financial Statistics (S/MFS), European Central Bank.

Dividend Payout Ratio: Fraction of net income paid to shareholders in dividends, in percentage. Calculated as Total Common Dividends * 100/Income Before Extraordinary Items Less Minority and Preferred Dividends. Capitalization-weighted sum of the SX7E members. Source: Bloomberg.

Dividends: Dividends paid to common shareholders from the profits of the company. Includes regular cash as well as special cash dividends for all classes of common shareholders. Excludes return of capital and in-specie dividends. For the cases in which dividends attributable to the period are not disclosed, dividends are estimated by multiplying the dividend per share by the number of shares outstanding. Simple sum of the SX7E members. Source: Bloomberg.

Earnings (a): Income before extraordinary items and discontinued operation but after minority interest, preferred dividend, and other adjustments. Calculated as Pretax Income – Income Tax – After Tax (Income) Loss from Affiliates – Minority Interest – Preferred Dividends – Other Adjustments. Simple sum of the SX7E members. Source: Bloomberg.

Earnings (b): Net income available to common shareholders. Calculated as Net Income – Total Cash Preferred Dividend – Other Adjustments.[1] Simple sum of the SX7E members. Source: Bloomberg.

[1] "Other adjustments" include any adjustments to bottom-line net income (except for preferred dividends) that are needed to arrive at Basic Net Income Available for Common Shareholders. Examples of other adjustments are exchangeable preferred membership interest buyback premium, earnings allocated to participating securities, interest expense for hybrid securities, accretion of preferred stock issuance cost, and net income allocated to general partners.

Retained Earnings: Cumulative undistributed earnings. Includes net unrealized gain (loss) on securities held for sale and other items included in accumulated comprehensive income (net of tax). Includes deferred compensation to officers. Retained earnings are decreased by the amount of treasury stock. Reserves resulting from revaluation of assets in many countries are included as a part of shareholders' equity and are included. Normalized by the number of shares outstanding. Simple sum of the SX7E members. Source: Bloomberg.[2]

Total Equity: Bank's total assets minus its total liabilities. Calculated as Common Equity + Minority Interest + Preferred Equity.[3] Simple sum of the SX7E members. Source: Bloomberg.[4]

Total Assets: Bank's total assets. Calculated as Cash and Bank Balances + Federal Funds Sold and Resale Agreements + Investments for Trade and Sale + Net Loans + Investments Held to Maturity + Net Fixed Assets + Other Assets + Customers' Acceptances and Liabilities. Simple sum of the SX7E members. Source: Bloomberg.

Appendix B. Equations of the Basic Model

This appendix presents the full set of equilibrium conditions of the basic model.

[2] Following investors and Bloomberg's convention, in figure 1C total retained earnings has been constructed as the capitalization-weighted sum of the SX7E members, after having normalized raw data by the number of total shares outstanding. In order to report its cyclical component in figure 2, retained earnings has been constructed as the simple sum of all SX7E members' retained earnings.

[3] "Common Equity" refers to the amount that all common shareholders have invested in a company. It is calculated as Share Capital and Additional Paid In Capital (APIC) + Retained Earnings and Other Equity.

[4] Following investors and Bloomberg's convention, in figure 1C total equity has been constructed as the capitalization-weighted sum of the SX7E members, after having normalized raw data by the number of total shares outstanding. In order to report its cyclical component in figure 2 and for calibration purposes, total equity has been constructed as the simple sum of all SX7E members' total equity.

B.1 Households

Households seek to maximize their objective function subject to the following budget constraint:

$$C_{h,t} + D_t + q_t(H_{h,t} - H_{h,t-1}) = R_{h,t-1}D_{t-1} + W_{h,t}N_{h,t}. \quad \text{(B.1)}$$

Their choice variables are $C_{h,t}$, D_t, $H_{h,t}$, and $N_{h,t}$. The optimality conditions of the problem read

$$\lambda_t^h = \frac{1}{C_{h,t}}, \quad \text{(B.2)}$$

$$\lambda_t^p = \beta_h R_{h,t} E_t \lambda_{t+1}^p, \quad \text{(B.3)}$$

$$q_t\lambda_t^p = \frac{j}{H_{h,t}} + \beta_h E_t \left(q_{t+1}\lambda_{t+1}^p\right), \quad \text{(B.4)}$$

$$\frac{W_{h,t}}{C_{h,t}} = N_{h,t}^{\phi}, \quad \text{(B.5)}$$

where λ_t^h is the Lagrange multiplier on the budget constraint of the representative patient household.

B.1.1 Entrepreneurs (Net Borrowers)

Entrepreneurs seek to maximize their objective function subject to a budget constraint, the available technology, and the corresponding borrowing limit:

$$\begin{aligned} & C_{e,t} + R_{e,t}B_{e,t-1} + q_t(H_{e,t} - H_{e,t-1}) + W_{h,t}N_t + \Phi_e(B_{e,t}) \\ & \quad = Y_t + B_{e,t}, \quad \text{(B.6)} \end{aligned}$$

$$Y_t = H_{e,t-1}^{v} N_t^{1-v}, \quad \text{(B.7)}$$

$$B_{e,t} \leq m_{e,t}^H E_t \left(\frac{q_{t+1}}{R_{e,t+1}} H_{e,t}\right) - m^N W_t N_t. \quad \text{(B.8)}$$

Their choice variables are $d_{e,t}$, $K_{e,t}$, u_t, $B_{e,t}$, and N_t. The following optimality conditions can be derived from the first-order conditions of the problem:

$$\lambda_t^e = \frac{1}{C_{e,t}}, \quad \text{(B.9)}$$

$$\lambda_t^e \left[q_t - \left(1 - \frac{\partial \Phi_e(B_{e,t})}{\partial B_{e,t}}\right) m_t^H E_t \left(\frac{q_{t+1}}{R_{e,t+1}}\right)\right]$$
$$= \beta_e E_t \left\{ \lambda_{t+1}^e \left[q_{t+1}(1 - m_t^H) + \upsilon \left(\frac{Y_{t+1}}{H_{e,t}}\right)\right]\right\}, \tag{B.10}$$

$$\lambda_t^e \left[W_{h,t} + m^N W_{h,t} \left(1 - \frac{\partial \Phi_e(B_{e,t})}{\partial B_{e,t}}\right) - (1-\upsilon)\frac{Y_t}{N_t}\right]$$
$$= \beta_e E_t \left[\lambda_{t+1}^e m^N W_{h,t} R_{e,t}\right], \tag{B.11}$$

where λ_t^e is the Lagrange multiplier on the budget constraint of the representative patient household.

The way m_t^H and m^N enter equations (B.10) and (B.11) shows that collateral constraint (B.8) introduces a wedge between the marginal productivity of each input and its price, and generates inefficiencies not only over the cycle but also in the steady state. To have a clear account of this phenomenon, the steady-state expressions of (B.10) and (B.11) are presented:

$$q = \frac{\upsilon}{\eta}\left(\frac{Y}{H_e}\right),$$
$$W_h = \frac{(1-\upsilon)}{\psi}\frac{Y}{N},$$

where $\eta = \frac{1}{\beta_e}\left[1 - \frac{m^H}{R_e} - \beta_e(1 - m^H)\right]$, and $\psi = \{1 + m^N [1 - \beta_e R_e]\}$.

B.1.2 Bankers

The representative banker chooses the trajectories of dividend payouts $d_{b,t}$, loans to entrepreneurs B_t, and deposits $D_{b,t}$ that maximize its objective function subject to a cash flow restriction and a borrowing limit (capital adequacy constraint):

$$d_{b,t} + B_t - D_{b,t} - (1-\delta_t)(B_{t-1} - D_{b,t-1})$$
$$= r_{e,t}B_{t-1} - r_{h,t-1}D_{b,t-1} - \Phi_b(B_t) - T(d_{b,t}, d_t^*), \tag{B.12}$$

$$D_{b,t} \leq \gamma_t B_t. \tag{B.13}$$

The law of motion for bank equity reads

$$K_{b,t} = J_{b,t} - d_{b,t} + (1-\delta_t)K_{b,t-1}. \tag{B.14}$$

The resulting optimality condition reads

$$\frac{(1-\gamma_t) + \dfrac{\partial \Phi_b(B_t)}{\partial B_t}}{d_{b,t}\left[1+\kappa(d_{b,t}-d_t^*)\right]} = \beta_b E_t \left\{ \frac{(R_{e,t+1}-\delta) - \gamma_t\left(R_{h,t}-\delta\right)}{d_{b,t+1}\left[1+\kappa\left(d_{b,t+1}-d_{t+1}^*\right)\right]} \right\}. \tag{B.15}$$

B.2 Macroprudential Authority

The dividend prudential target is specified as follows:

$$d_t^* = \rho_d + \rho_\chi \left(\frac{x_t}{x^{ss}} - 1\right). \tag{B.16}$$

Such policy rule is associated with a sanctions regime that penalizes deviations from the dividend prudential target. The DPT enters a penalty function of the form

$$T(d_{b,t}, d_t^*) = \frac{\kappa}{2}\left(d_{b,t} - d_t^*\right)^2. \tag{B.17}$$

The macroprudential authority has full control over the regulatory capital ratio, $(1-\gamma_t)$. The debt-to-assets ratio associated with such capital requirement reads

$$\gamma_t = \gamma + \gamma_x \left(\frac{x_t}{x^{ss}} - 1\right). \tag{B.18}$$

B.3 Aggregation and Market Clearing

Market clearing is implied by Walras's law, by aggregating all the budget constraints. The aggregate resource constraint of the economy represents the equilibrium condition for the final goods market:

$$Y_t = C_t + \delta K_{b,t-1} + Adj_t, \tag{B.19}$$

where C_t denotes the aggregate consumption of the three agent types. Formally, $C_t = C_{h,t} + C_{e,t} + d_{b,t}$ and the term Adj_t corresponds to the sum of all resources dedicated in the economy to adjust bank loans in period t. Similarly, in equilibrium, labor demand equals total labor supply,

$$N_t = N_{h,t}. \tag{B.20}$$

In equilibrium, demand for loans of entrepreneurs equals aggregate credit supply,

$$B_t = B_{e,t}. \tag{B.21}$$

The stock of bank deposits held by patient households must be equal to aggregate debt issued by bankers,

$$D_t = D_{b,t}. \tag{B.22}$$

In equilibrium, the housing market clears. The endowment of housing supply is fixed and normalized to unity,

$$\overline{H} = H_{h,t} + H_{e,t}. \tag{B.23}$$

B.4 Shocks

There is a zero-mean, AR(1) collateral shock that hits the economy in the basic model:

$$\log \varepsilon_t^{mh} = \rho_{mh} \log \varepsilon_{t-1}^{mh} + e_{mh,t}, \; e_{mh,t} \sim N(0, \sigma_{mh}). \tag{B.24}$$

Appendix C. Equations of the Extended Model

This appendix presents the full set of equilibrium equations of the extended model.

C.1 Patient Households

Patient households seek to maximize their objective function subject to the following budget constraint:

$$C_{p,t} + D_t + q_t(H_{p,t} - H_{p,t-1}) = (R_{d,t-1})D_{t-1} + W_t N_{p,t} + \omega_b d_{b,t} + \chi T_t + \omega_e d_{e,t}. \tag{C.1}$$

Their choice variables are $C_{p,t}$, D_t, $H_{p,t}$, and $N_{p,t}$. The optimality conditions of the problem read

$$\lambda_t^p = \left(C_{p,t} - \frac{N_{p,t}^{1+\phi}}{(1+\phi)} \right)^{-\sigma_h}, \tag{C.2}$$

$$\lambda_t^p = \beta_p R_{d,t} E_t \lambda_{t+1}^p, \tag{C.3}$$

$$q_t \lambda_t^p = \frac{j\varepsilon_t^h}{H_{p,t}} + \beta_p E_t \left(q_{t+1} q_t \lambda_{t+1}^p \right), \tag{C.4}$$

$$W_t = N_{p,t}^{\phi}, \tag{C.5}$$

where λ_t^p is the Lagrange multiplier on the budget constraint of the representative patient household.

C.2 Impatient Households

The representative impatient household chooses the trajectories of consumption $C_{i,t}$, housing $H_{i,t}$, demand for labor $N_{i,t}$, and bank loans $B_{i,t}$ that maximize their objective function subject to a budget constraint and a borrowing limit:

$$\begin{aligned} &C_{i,t} + R_{i,t-1} B_{i,t-1} + q_t (H_{i,t} - H_{i,t-1}) + \Phi_i(B_{i,t}) \\ &\quad = B_{i,t} + W_t N_{i,t} + (1-\omega_b) d_{b,t} + (1-\chi) T_t + (1-\omega_e) d_{e,t}, \end{aligned} \tag{C.6}$$

$$B_{i,t} \leq m_{i,t}^H E_t \left[\frac{q_{t+1}}{R_{i,t}} H_{i,t} \right]. \tag{C.7}$$

The resulting optimality conditions are

$$\lambda_t^i = \left(C_{i,t} - \frac{N_{i,t}^{1+\phi}}{(1+\phi)} \right)^{-\sigma_h}, \tag{C.8}$$

$$W_t = N_{i,t}^{\phi}, \tag{C.9}$$

$$\begin{aligned} &\lambda_t^i \left[q_t - \left(1 - \frac{\partial \Phi_i(B_{i,t})}{\partial B_{i,t}} \right) E_t \left(m_{i,t}^H \frac{q_{t+1}}{R_{i,t}} \right) \right] \\ &= \frac{j\varepsilon_t^h}{H_{i,t}} + \beta_i E_t \left[q_{t+1} \lambda_{t+1}^i \left(1 - m_{i,t}^H \right) \right], \end{aligned} \tag{C.10}$$

where λ_t^i is the Lagrange multiplier on the budget constraint of the representative impatient household.

C.3 Entrepreneurs

Entrepreneurs seek to maximize their objective function subject to a budget constraint, the available technology, and the corresponding borrowing limit:

$$\begin{aligned} d_{e,t} + R_{b,t}B_{e,t-1} + q_t^k\left[K_{e,t} - (1-\delta_t^k)K_{e,t-1}\right] + q_t(H_{e,t} - H_{e,t-1}) \\ + W_tN_t + \Phi_e(B_{e,t}) = Y_t + B_{e,t}, \end{aligned} \tag{C.11}$$

$$Y_t = A_t(u_tk_{e,t-1})^{\alpha}H_{e,t-1}^{\eta}N_t^{(1-\alpha-\eta)}, \tag{C.12}$$

$$B_{e,t} \leq m_{e,t}^H E_t\left(\frac{q_{t+1}}{R_{e,t+1}}H_{e,t}\right) - m^N W_tN_t. \tag{C.13}$$

Their choice variables are $d_{e,t}$, $K_{e,t}$, u_t, $B_{e,t}$, and N_t. The following optimality conditions can be derived from the first-order conditions of the problem:

$$\begin{aligned} d_{e,t}^{-\frac{1}{\sigma}}\left[q_t - \left(1 - \frac{\partial\Phi_e(B_{e,t})}{\partial B_{e,t}}\right)m_{e,t}^H E_t\left(\frac{q_{t+1}}{R_{e,t+1}}\right)\right] \\ = E_t\left\{\Lambda_{t,t+1}^e d_{e,t+1}^{-\frac{1}{\sigma}}\left[q_{t+1}(1-m_{e,t}^H) + \eta\left(\frac{Y_{t+1}}{H_{e,t}}\right)\right]\right\}, \end{aligned} \tag{C.14}$$

$$\begin{aligned} d_{e,t}^{-\frac{1}{\sigma}}\left[W_t + m^N W_t\left(1 - \frac{\partial\Phi_e(B_t)}{\partial B_t}\right) - (1-\alpha-\eta)\frac{Y_t}{N_t}\right] \\ = E_t\left[\Lambda_{t,t+1}^e d_{e,t+1}^{-\frac{1}{\sigma}} m^N W_t R_{e,t+1}\right], \end{aligned} \tag{C.15}$$

$$d_{e,t}^{-\frac{1}{\sigma}}q_t^k = E_t\left\{\Lambda_{t,t+1}^e d_{e,t+1}^{-\frac{1}{\sigma}}\left[q_{t+1}^k\left(1-\delta_{t+1}^k\right) + \alpha\left(\frac{Y_{t+1}}{k_{e,t}}\right)\right]\right\}, \tag{C.16}$$

$$\delta_1^k + \delta_2^k\left(u_t - 1\right) = \alpha\left(\frac{Y_t}{u_tk_{e,t-1}}\right). \tag{C.17}$$

C.4 Bank Managers

The representative banker chooses the trajectories of dividend payouts $d_{b,t}$, loans to households $B_{i,t}$, loans to entrepreneurs $B_{e,t}$, and deposits $D_{b,t}$ that maximize its objective function subject to a cash flow restriction and a borrowing limit (capital adequacy constraint):

$$
\begin{aligned}
& d_{b,t} + B_{it} + B_{e,t} - D_{b,t} - (1-\delta_t)\left(B_{i,t-1} + B_{e,t-1} - D_{b,t-1}\right) \\
& \quad = r_{e,t} B_{e,t-1} + r_{i,t-1} B_{i,t-1} - r_{d,t-1} D_{b,t-1} - \Phi_{be}(B_{e,t}) \\
& \qquad - \Phi_{bi}(B_{i,t}) - T(d_{b,t}, d_t^*),
\end{aligned}
\tag{C.18}
$$

$$
D_{b,t} \leq \gamma_{i,t} B_{i,t} + \gamma_{e,t} B_{e,t}. \tag{C.19}
$$

The law of motion for bank equity reads

$$
K_{b,t} = J_{b,t} - d_{b,t} + (1-\delta_t) K_{b,t-1}. \tag{C.20}
$$

The resulting optimality conditions read

$$
\begin{aligned}
& \frac{(1-\gamma_{i,t}) + \dfrac{\partial \Phi_{bi}(B_{i,t})}{\partial B_{i,t}}}{d_{b,t}^{\frac{1}{\sigma}}\left[1 + \kappa(d_{b,t} - d_t^*)\right]} \\
& \quad = E_t \left\{ \Lambda_{t,t+1}^b \frac{(r_{i,t} - \gamma_{i,t} r_{d,t}) + (1-\gamma_{i,t})(1-\delta_{t+1})}{d_{b,t+1}^{\frac{1}{\sigma}}\left[1 + \kappa\left(d_{b,t+1} - d_{t+1}^*\right)\right]} \right\},
\end{aligned}
\tag{C.21}
$$

$$
\begin{aligned}
& \frac{(1-\gamma_{e,t}) + \dfrac{\partial \Phi_{be}(B_{e,t})}{\partial B_{e,t}}}{d_{b,t}^{\frac{1}{\sigma}}\left[1 + \kappa(d_{b,t} - d_t^*)\right]} \\
& \quad = E_t \left\{ \Lambda_{t,t+1}^b \frac{(r_{e,t+1} - \gamma_{e,t} r_{d,t}) + (1-\gamma_{e,t})(1-\delta_{t+1})}{d_{b,t+1}^{\frac{1}{\sigma}}\left[1 + \kappa\left(d_{b,t+1} - d_{t+1}^*\right)\right]} \right\}.
\end{aligned}
\tag{C.22}
$$

C.5 Capital Goods Producers

Capital-good-producing firms seek to maximize their objective function with respect to net investment in physical capital, I_t. The resulting optimal condition is

$$1 = q_{k,t}\left[1 - \frac{\psi_I}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2 - \psi_I\left(\frac{I_t}{I_{t-1}} - 1\right)\frac{I_t}{I_{t-1}}\right] + E_t\left[\Lambda^e_{t,t+1} q_{k,t+1}\psi_I\left(\frac{I_{t+1}}{I_t} - 1\right)\left(\frac{I_{t+1}}{I_t}\right)^2\right]. \tag{C.23}$$

As is standard in the literature, the law of motion for physical capital reads

$$K_t = (1 - \delta^k_t)K_{t-1} + I_t\left[1 - \frac{\psi_I}{2}\left(\frac{I_t}{I_{t-1}} - 1\right)^2\right]. \tag{C.24}$$

C.6 Macroprudential Authority

As in the basic model, the dividend prudential target is specified as follows:

$$d^*_t = \rho_d + \rho_\chi\left(\frac{x_t}{x^{ss}} - 1\right). \tag{C.25}$$

Such policy rule is associated with a sanctions regime that penalizes deviations from the prudential target. The DPT enters a penalty function of the form

$$T(d_{b,t}, d^*_t) = \frac{\kappa}{2}\left(d_{b,t} - d^*_t\right)^2. \tag{C.26}$$

The prudential authority has full control over regulatory capital ratios, $(1 - \gamma_{i,t})$ and $(1 - \gamma_{e,t})$. The sectoral debt-to-asset ratios associated with such capital regulatory scheme read

$$\gamma_{i,t} = \gamma_i + \gamma_x\left(\frac{x_t}{x^{ss}} - 1\right), \tag{C.27}$$

$$\gamma_{e,t} = \gamma_e + \gamma_x\left(\frac{x_t}{x^{ss}} - 1\right). \tag{C.28}$$

C.7 Aggregation and Market Clearing

Market clearing is implied by Walras's law, by aggregating all the budget constraints. The aggregate resource constraint of the economy represents the equilibrium condition for the final goods market:

$$Y_t = C_{p,t} + C_{i,t} + q^k_t I_t + \delta_t K_{b,t-1} + Adj_t, \tag{C.29}$$

where the term Adj_t corresponds to the sum of all resources dedicated in the economy to adjust bank loans in period t. Similarly, in equilibrium, labor demand equals total labor supply,

$$N_t = N_{p,t} + N_{i,t}. \tag{C.30}$$

The stock of physical capital produced by capital goods producers must equal the demand for this good coming from entrepreneurs:

$$K_t = K_{e,t}. \tag{C.31}$$

Similarly, in equilibrium, demand for loans of impatient households and entrepreneurs equals aggregate credit supply:

$$B_t = B_{i,t} + B_{e,t}. \tag{C.32}$$

The stock of bank deposits held by patient households must be equal to aggregate debt issued by bankers:

$$D_t = D_{b,t}. \tag{C.33}$$

In equilibrium, the housing market clears. The endowment of housing supply is fixed and normalized to unity:

$$\overline{H} = H_{p,t} + H_{i,t} + H_{e,t}. \tag{C.34}$$

C.8 Shocks

The following zero-mean, AR(1) shocks are present in the extended model: ε_t^{mh}, ε_t^{mk}, ε_t^{kb}, ε_t^{h}, A_t. These shocks follow the processes given by

$$\log \varepsilon_t^{mh} = \rho_{mh} \log \varepsilon_{t-1}^{mh} + e_{mh,t},\ \ e_{mh,t} \sim N(0, \sigma_{mh}), \tag{C.35}$$

$$\log \varepsilon_t^{mk} = \rho_{mk} \log \varepsilon_{t-1}^{mk} + e_{mk,t},\ \ e_{mk,t} \sim N(0, \sigma_{mk}), \tag{C.36}$$

$$\log \varepsilon_t^{kb} = \rho_{mk} \log \varepsilon_{t-1}^{kb} + e_{kb,t},\ \ e_{kb,t} \sim N(0, \sigma_{kb}), \tag{C.37}$$

$$\log \varepsilon_t^{h} = \rho_{h} \log \varepsilon_{t-1}^{h} + e_{h,t},\ \ e_{h,t} \sim N(0, \sigma_{h}), \tag{C.38}$$

$$\log A_t = \rho_A \log A_{t-1} + e_{A,t},\ \ e_{A,t} \sim N(0, \sigma_A). \tag{C.39}$$

Appendix D. Policy Discussion

D.1 The DPT versus the CCyB

The wide acceptance of the CCyB as a fundamental macroprudential tool deserves the comparative analysis between such policy instrument and the countercyclical DPT to be extended without limiting to the proposed analytical framework. As presented in this paper, the countercyclical DPT is a two-sided target that gives bankers incentives to distribute earnings in a more procyclical and volatile fashion even if they are compliant with their capital requirements. By way of contrast, the CCyB operates as a dynamic one-sided restriction that gives bankers "full discretion" to distribute equity, provided that they meet their corresponding capital requirements. Interestingly, the DPT and the CCyB seem to operate in opposite directions. During the downturn (when the probability of bank default tends to be higher), the DPT encourages bank managers to cut back on dividends, whereas the CCyB calls on banks to release the capital buffer they have built up during the upturn (arguably, by restricting their dividend payouts during the credit expansion in order to retain more earnings).

In particular, and as reflected in the proposed DSGE model, both macroprudential tools smooth loans supply but operate through very different transmission channels: Under the CCyB, bank capital readjusts in the face of shocks, permitting bank debt (which now represents a larger proportion of assets) to evolve in a smoother fashion. By way of contrast, the DPT gives incentives for bank managers to optimally tolerate a higher degree of dividend volatility, thereby allowing for smoother retained earnings.

These differences have two important policy implications. First, the countercyclical DPT is more effective (than the CCyB) in smoothing the credit cycle since it directly attacks the root of the "problem" by discouraging bank dividend smoothing.[5] Second, arguably, the DPT should be more effective than the CCyB in reducing the probability of bank default over the cycle, since it discourages

[5]This is one of the findings of this paper, which is presented and discussed in section 6.

equity distributions when the likelihood of bank failure is relatively high (i.e., during the downturn).[6]

Yet, the quantitative analysis proposed in this paper suggests the DPT and the CCyB are important complements for at least two reasons. First, while households that do not own banks have a strict preference for the DPT (since they are more effective than the CCyB in smoothing bank debt and loans supply), bank owners have a stronger preference for the CCyB (as this tool favors smoother dividend payouts). Second, the complementarities of the different mechanisms through which each of these instruments operate translates into optimized DPTs reinforcing the effectiveness of the CCyB in smoothing the credit and the business cycle and the optimal DPT performing particularly better than the optimized, highly responsive, CCyB under nonfinancial shocks.

Importantly, there are other key aspects that the proposed model omits and which may reinforce the complementarities between the two instruments in practice. In reality, the CCyB plays a key role in preventing and mitigating the buildup of endogenous systemic risk during credit expansions, whereas the role of the DPT would be more focused on effectively enhancing bank soundness and sustained lending during economic downturns. In this regard, the DPT could be interpreted as a dynamic dividend restriction, in which case parameter κ could be regarded as the binding degree of the policy rule or recommendation.

D.2 The DPT and the Sanctions Regime

The proposed regulatory scheme incorporates a sanctions regime that plays an important role during the lower phase of the cycle. It gives incentives for banks to cut back on dividends and imposes a sanction to those who deviate from the DPT. For simplicity, the model assumes the collected public revenues are transferred to households within the same period. Such transfer system acts as an insurance scheme for the real economy, as it provides households with a positive payoff when they need it the most (i.e., when the marginal utility of their consumption is relatively high). A more

[6] Confirming that this is the case would require extending the proposed model by allowing for risk of bank default.

comprehensive setup in which bank default is considered would permit to set an insurance fund built on such public revenues and aimed at reducing the probability of bank failure in bad times.

Although required penalties for this regulatory scheme to give the right incentives seem to be quantitatively small, the supervisor could alternatively use the dividend prudential target as a mere indicator to give recommendations on prudent payout policies to banks.