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Entrepreneurial risk shocks and financial acceleration asymmetry in a two-country DSGE model

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ABSTRACT

In a two-country DSGE model tailored to the U.S. and China, we examine the macroeconomic impacts of financial frictions and entrepreneurial risk shocks, which characterize the cross-sectional dispersion of idiosyncratic entrepreneurial productivity. We identify the transmission channels for significant financial acceleration, analyze financial acceleration asymmetry, and investigate international financial acceleration. Our main findings are as follows. The estimated monitoring cost for China is significantly larger than that for the U.S. Output, investment, and loans exhibit significant financial acceleration effects triggered by shocks to domestic entrepreneurial risk, investment, and technology. In comparison with the U.S., China's output and investment display larger financial acceleration effects induced by domestic entrepreneurial risk shocks. The financial acceleration effects of foreign entrepreneurial risk shocks on the domestic economy are insignificant. Domestic financial acceleration effects on output and investment induced by shocks to investment and technology are significantly more pronounced during the U.S.-China trade conflict periods. Domestic entrepreneurial risk shocks, which contribute substantially to economic downturns, explain about 11.2% and 12.3% of forecast error variances in output of the U.S. and China, respectively.

1. Introduction

Growth and stability have been the dual hallmark of business cycles for both the U.S. and China. Credit markets play substantial roles in propagating cyclical patterns among sectors and across countries, stimulating growth but inducing uncertainty. However, financial frictions and imperfect market mechanisms can impede macroeconomic performance and policy formation. Credit market frictions and associated costly state verification of debt contracts amplify business cycle fluctuations through the expansion and the contraction of credit, creating financial acceleration effects. Specifically, financial frictions and the time-varying entrepreneurial risk, both of which characterize credit markets, enhance financial acceleration effects by magnifying impacts of structural shocks on macroeconomic aggregates, as well as increasing amplitudes of business cycles. Information asymmetry and costly state verification

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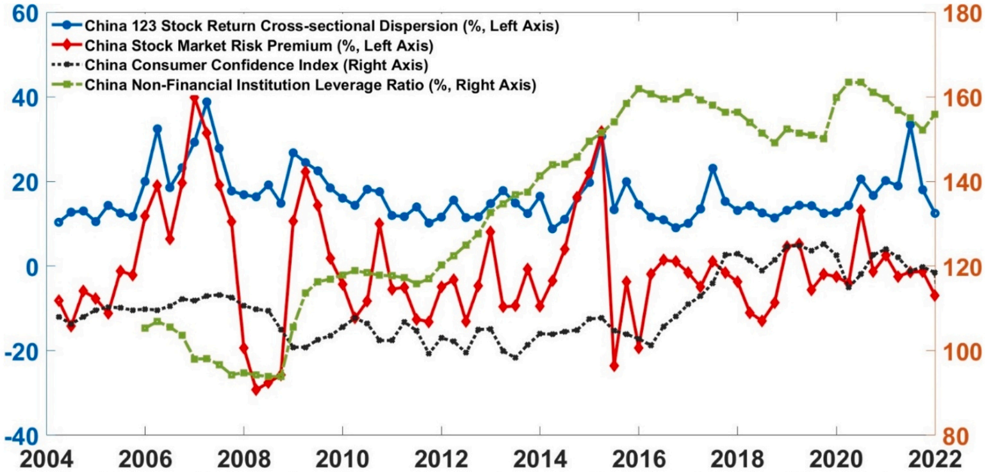
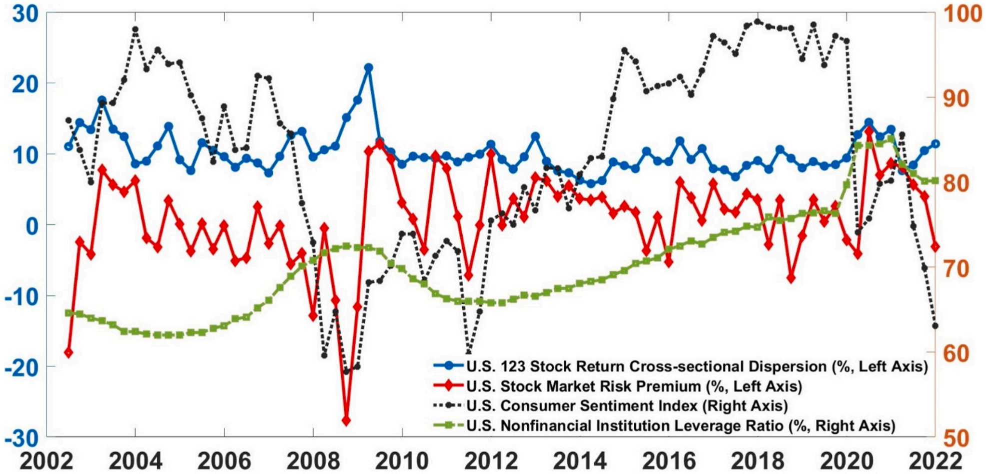
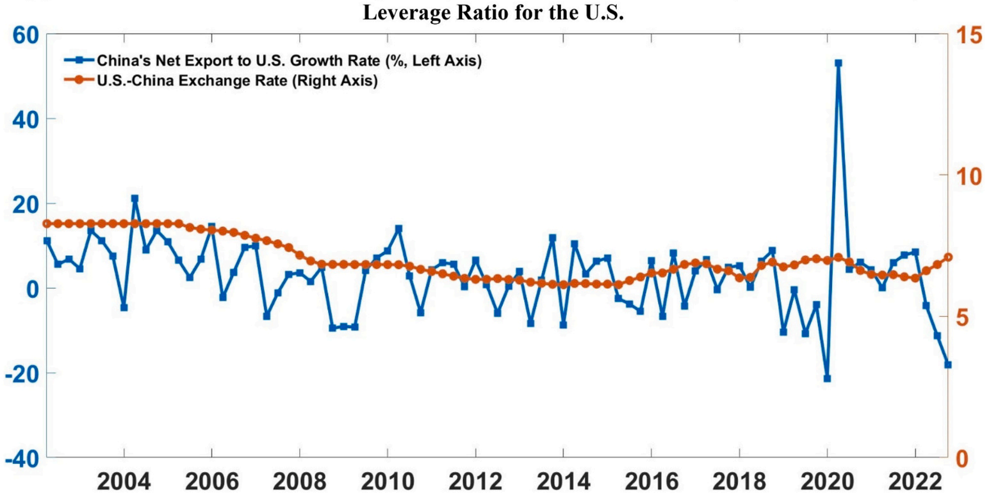


(a) Stock Return Cross-sectional Dispersion, Stock Market Risk Premium, Confidence Index, and Leverage Ratio for China



(b) Stock Return Cross-sectional Dispersion, Stock Market Risk Premium, Confidence Index, and Leverage Ratio for the U.S.



(c) The U.S.-China Trade Imbalances and Exchange Rate

Fig. 1. Macroeconomic and financial indicators of the U.S. and China. *Note:* Names of 123 U.S. firms and 123 Chinese firms are described in Appendix A. Data sources originate from Yahoo Finance, Chang et al. (2016) and Chen et al. (2016), CEIC, and Wind.

constitute the main concern of financial frictions in a globalized era. In particular, the severity of agency problems, which emerge from financial intermediation, interacts with financial cycles and macroeconomic fluctuations.

Financial frictions characterizing credit markets are the crucial channel in the propagation of uncertainty shocks. Alessandri and Mumtaz (2019) indicate that the impact of financial uncertainty on the real economy varies significantly over the cycle with asset price fluctuations and balance sheet conditions. By inspecting the time-varying effects of uncertainty shocks, Angelini, Bacchiocchi, Caggiano, and Fanelli (2019) find that recessions induce a larger micro-dispersion and a higher aggregate volatility, heightened uncertainty shrinks the real activity, and there are time-varying effects of uncertainty shocks. Benchimol (2014) proposes a New Keynesian Dynamic Stochastic General Equilibrium (DSGE) model with a risk aversion shock featuring micro-uncertainty, and confirms the counter-cyclicality of uncertainty. Benchimol and Ivashchenko (2021) estimate an open-economy nonlinear DSGE model to capture macro-uncertainty, such as drastic regime changes around a crisis. Integrating both micro- and macro-uncertainty, we assess effects of uncertainty underlying the cross-sectional dispersion of entrepreneurial productivity on financial cycles and macroeconomic fluctuations.

As Christiano, Motto, and Rostagno (2014) indicate, disturbances which alter the cross-sectional dispersion of entrepreneurial productivity trigger responses which resemble actual business cycles, and the severity of agency problems explains a substantial portion of business cycle fluctuations over the past three decades. Entrepreneurs, being endowed with either productive or unproductive venture capital, display substantial heterogeneity in idiosyncratic entrepreneurial productivity, which features the cross-sectional dispersion with the time-varying volatility. The distribution of capital productivity across entrepreneurs conveys heterogeneous exposure to financial risk. Therefore, inspired by Christiano et al. (2014), we use the cross-sectional dispersion of entrepreneurs in productivity to measure the entrepreneurial risk, which quantifies the cross-sectional productivity uncertainty and evolves dramatically during crises and pandemics. Entrepreneurial capital attached to various industry standards depends on idiosyncratic performance of entrepreneurs, and the capital return dispersion exhibits time-varying characteristics.

Differences in entrepreneurial productivity realizations are anchored to substantial heterogeneity in capital profitability, and capital returns are reflected by stock returns to a certain degree. Bloom, Bond, and Reenen (2007) document a correlation of share return volatility and firm level uncertainty, affirming share return volatility's function in proxying firm level uncertainty. Bloom (2009) identifies a large and significant correlation of the cross-sectional spread of industry productivity growth and stock-market volatility, and highlights the role of idiosyncratic firm-level productivity shocks in driving the time-varying stock market volatility. We also find such a relationship. For Panel (a) to Panel (b) in Fig. 1, in each country, we select 123 equity shares with top market capitalization and compute the quarterly cross-sectional standard deviation of these stock returns as a measure for the cross-sectional dispersion of idiosyncratic entrepreneurial productivity. The cross-sectional dispersion of stock returns, which seems to be counter-cyclical, displays a negative association with confidence, but exhibits a positive relation with the leverage ratio and stock market risk premiums.

The financial acceleration theory and literature, together with the cyclical patterns in Fig. 1, motivate the following research questions. For the U.S. and China, which macroeconomic indicators display significant financial acceleration effects triggered by domestic entrepreneurial risk shocks? And what is the size difference of financial acceleration effects between the U.S. and China? We also raise five subsequent research questions. What are the magnitudes of the estimated monitoring cost for the U.S. and China, respectively? In addition to the entrepreneurial risk shocks, what other structural shocks produce significant financial acceleration effects on macroeconomic aggregates? Are financial acceleration effects triggered by foreign entrepreneurial risk shocks significant? Given that the entrepreneurial credit spread quantifies the interest rate premium of unproductive entrepreneurial loans over that of productive entrepreneurial loans, how does the risk exposure to entrepreneurial productivity heterogeneity interact with the entrepreneurial credit spread? How do the entrepreneurial risk shocks contribute to macroeconomic dynamics and forecast error variance decompositions?.

Answers to these questions can help contribute to the alleviation of financial crises' contagion to the macroeconomy, the mitigation of information asymmetry's impacts on financial markets, and the development of policy tools to ensure financial stability. To fill in these research gaps, we build a model on a financial accelerator introduced by Bernanke, Gertler, and Gilchrist (1999), and embed the entrepreneurial risk shocks modeled by Christiano et al. (2014), but depart from their work by incorporating an international perspective, which encompasses international trade and financial transactions. Intuitively, with a rapid pace of financial market integration and technological advancement, the U.S. and China have become more economically and financially interdependent. Hence, our proposed multilateral perspective in structural modeling is crucial.

From the theoretical perspective, we develop a two-country DSGE model for the U.S. and China. We characterize a time-varying cross-sectional dispersion of idiosyncratic entrepreneurial productivity, and specify agency problems between entrepreneurs and banks in entrepreneurial loan contracts, including both domestic and international financial acceleration mechanisms. Moral hazard problems regarding entrepreneurial productivity between entrepreneurs and banks constrain entrepreneurial credit intermediation, as well as creating costly state verification of entrepreneurial debt solvency. More costly monitoring, which raises the entrepreneurial risk premium, increases entrepreneurial loan cost and impedes entrepreneurial borrowing, therefore discouraging investment, decelerating capital formation, and reducing output. In each domestic economy, a positive domestic entrepreneurial risk shock, which conveys a larger cross-sectional dispersion of idiosyncratic domestic firm productivity, creates a higher domestic credit spread by raising the entrepreneurial loan interest premium over the risk-free rate. Subsequently, banks tighten loans and extend less credit to entrepreneurs, capital goods firms decrease investment and decelerate capital formation, entrepreneurs contract the capital stock and deleverage their capital structure, generating a depreciation in corporate net worth, a shrinkage in output, and a decline in exports. By contrast, a positive foreign entrepreneurial risk shock implies a larger cross-sectional dispersion of idiosyncratic foreign firm productivity and a higher foreign credit spread. A larger foreign risk premium restrains foreign loans, discourages foreign investment, and dampens foreign exports. Consequently, foreign output decreases, domestic imports decline but domestic exports increase, generating expansionary impacts on domestic output.

From the empirical perspective, we apply Bayesian estimation to our theoretical model, and undertake impulse response analysis and other inferences, including historical decompositions and forecast error variance decompositions. We can summarize our main empirical findings as follows. The estimated monitoring cost for China is substantially larger than that of the U.S. at a 10% significance level. The growth rates of output, investment, and loans exhibit substantial financial acceleration effects triggered by shocks to domestic entrepreneurial risk, investment, and technology, at a 10% significance level. In comparison with the U.S., China's growth rates of output and investment display larger and more persistent financial acceleration effects, which are induced by domestic entrepreneurial risk shocks. The financial acceleration effects of foreign entrepreneurial risk shocks on the domestic economy are insignificant. Provoked by shocks to investment and technology, domestic financial acceleration effects on growth rates of output and investment are significantly more salient when considering the data covering the U.S.-China trade conflict periods. Domestic entrepreneurial risk shocks contribute crucially to growth fluctuations of output, consumption, investment, and China's net exports to the U.S. during recessionary periods, especially in the Global Financial Crisis and the Covid-19 pandemic. Domestic entrepreneurial risk shocks explain sizable fractions of forecast error variances in the main macroeconomic aggregates for both the U.S. and China.

The rest of this paper proceeds as follows. Section 2 presents the two-country DSGE model specification. Sections 3 to 6 conduct model estimation and inference. Section 7 concludes.

2. The two-country DSGE model

Our DSGE model captures the U.S. and China's economies, both of which are open to international trade and cross-country bond exchange. The rest of the world functions as an exogenous economy and only influences via structural shocks. Real frictions include external habit formation and investment adjustment cost. Nominal rigidities include staggered price and wage mechanisms. Financial frictions encompass information asymmetry and costly state verification. Profits, final and intermediate good prices are denominated in domestic currencies. The main structure of a foreign economy is isomorphic to that of the home economy with x denoting either 'the U.S.' or 'China'.

Households supply labor, consume domestic and foreign final goods, deposit at domestic commercial banks, and trade domestic and foreign government bonds. Labor contractors transform heterogeneous domestic labor into a homogeneous labor service, and supply the standard labor service to domestic intermediate goods firms. Capital goods firms infuse domestic investment into undepreciated capital to supply installed capital. Entrepreneurs convert installed capital into effective installed capital by attaching productivity featuring idiosyncratic uncertainty, and rent capital services to domestic intermediate goods firms. Intermediate goods firms combine domestic labor services and effective installed capital to produce intermediate goods. Final goods firms assemble intermediate goods into final goods. Commercial banks absorb domestic deposits, and extend credit to productive domestic entrepreneurs. Governments levy taxes to finance fiscal spending. The Federal Reserve manages deposit interest rate in response to the inflation gap and the output gap for the U.S. economy. The People's Bank of China pegs money supply growth to the inflation gap and the output gap, and enforces macroprudential policy via setting the reserve requirement ratio.

Details of the model are set out in the following subsections.

2.1. Final goods sector

The final goods sector contains a unit continuum of identically and infinitely-lived final goods firms. Final goods firms purchase intermediate goods from domestic intermediate goods firms, and assemble heterogeneous intermediate goods into homogenous final goods. Final goods are sold to domestic entities including capital goods firms, entrepreneurs, commercial banks, and the government, as well as domestic and foreign households. Inspired by the work of Chang, Liu, Spiegel, and Zhang (2019) and Wang, Le, Matthews, and Zhou (2020), final goods production $Y_{x,t}$ is a Dixit-Stiglitz aggregator of intermediate goods $Y_{x,j,t}$ indexed by j:

$$Y_{x,t} = \left(\int_0^1 Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}} dj \right)^{\upsilon_{x,Y,t}} \tag{1}$$

where $\frac{\upsilon_{x,Y,t}}{1-\upsilon_{x,Y,t}}$ governs the degree of substitution among intermediate goods. Similar to the specifications of Del Negro & Schorfheide (2006) and Justiniano, Primiceri, and Tambalotti (2010), the final good price markup shock $\upsilon_{x,Y,t}$, which measures the time-varying elasticity of substitution among intermediate goods, quantifies distortions in monopolistic competition, and reveals variations in firm market power. The final good price markup shock follows a first order autoregressive first order moving average ARMA(1,1) process in logs, with an independently and identically distributed normal innovation $\varepsilon_{x,Y,t} \sim i.i.d.N(0, \sigma_{x,Y}^2)$. The moving average component captures high frequency variations in inflation. A positive price markup innovation, which signals more inelastic demand for final goods, conveys more market power of intermediate goods firms and induces a higher final good price $P_{x,t}$.

The continuing investment technological progress makes the investment goods production cost decline at rate $\gamma_{x,I}^t \upsilon_{x,Q,t}$, with $\gamma_{x,I}$ being the investment technological advancement trend. The relative price of investment shock $\upsilon_{x,Q,t}$ follows a first order autoregressive AR(1) process in logs with an innovation $\varepsilon_{x,Q,t} \sim i.i.d.N(0,\sigma_{x,Q}^2)$. Perfectly competitive final goods firms obtain income from selling final goods $P_{x,t}Y_{x,t}$, and incur expenses from purchasing domestic intermediate goods $\int_0^1 P_{x,j,t}Y_{x,t}dj$. The representative final goods firm chooses optimal domestic intermediate goods $Y_{x,j,t}$ to maximize its profit $P_{x,t}PR_{x,Y,t}$. Profit maximization in Appendix B indicates that final good price $P_{x,t}$ is a Dixit-Stiglitz aggregator of the continuum of intermediate good prices $P_{x,j,t}$:

$$P_{x,t} = \left(\int_0^1 P_{x,j,t}^{\frac{1}{1-\upsilon_{x,Y,t}}} dj \right)^{1-\upsilon_{x,Y,t}} \tag{2}$$

The demand $Y_{x,j,t}$ for intermediate good j is positively associated with final good price $P_{x,t}$ and final goods production $Y_{x,t}$, but is negatively related to intermediate good j's price $P_{x,j,t}$.

$$Y_{x,j,t} = \left(\frac{P_{x,t}}{P_{x,j,t}} \right)^{\frac{\upsilon_{x,Y,t}}{\upsilon_{x,Y,t}-1}} Y_{x,t} \tag{3}$$

2.2. Intermediate goods sector

The intermediate goods sector captures the market power of intermediate goods firms and implies real effects of monetary policy. Inspired by the work of Erceg, Henderson, and Levin (2000) and Liberati (2018), monopolistically competitive intermediate goods firms produce heterogeneous intermediate goods, and sell them to domestic final goods firms. Labor and capital services are both immobile across countries but are freely mobile within domestic intermediate goods firms. Intermediate goods firm j's production $Y_{x,j,t}$, which exhibits constant returns to scale characteristics, is a Cobb–Douglas production function of technologically-augmented labor $A_{x,t}H_{x,j,t}$ and capital services $K_{x,j,t}$ net of fixed cost, which is proportional to the capital-embodied technology $A^*_{x,t}$ by a fixed cost parameter ϕ_x, and is perturbed by the temporary technology shock $TA_{x,A,t}$. The capital-embodied technology $A^*_{x,t}$ ensures the ratio $\frac{Y_{x,j,t}}{A^*_{x,t}}$ converge to a constant steady state. Building on Christiano, Motto, and Rostagno (2003), Christiano, Motto, and Rostagno (2010), and Christiano et al. (2014), intermediate goods firms continue production when income $TA_{x,A,t}K^{\alpha_x}_{x,j,t}(A_{x,t}H_{x,j,t})^{1-\alpha_x}$ outweighs a fixed cost $\phi_x A^*_{x,t}$.

$$Y_{x,j,t} = \begin{cases} TA_{x,A,t}K^{\alpha_x}_{x,j,t}\left(A_{x,t}H_{x,j,t}\right)^{1-\alpha_x} - \phi_x A^*_{x,t} & if\ TA_{x,A,t}K^{\alpha_x}_{x,j,t}\left(A_{x,t}H_{x,j,t}\right)^{1-\alpha_x} > \phi_x A^*_{x,t} \\ 0 & otherwise \end{cases} \tag{4}$$

where α_x and $(1-\alpha_x)$ denote the capital share and the technologically-augmented labor share in production, respectively. The persistent technology component $(A_{x,t} = \upsilon_{x,A,t}A_{x,t-1})$ captures the trend growth in technology and obeys a stochastic process. The persistent but stationary technology shock $\upsilon_{x,A,t}$, which measures country-specific aggregate efficiency and is assessable to all intermediate goods firms within country x, follows an AR(1) process in logs with an innovation $\varepsilon_{x,A,t} \sim i.i.d.N(0, \sigma^2_{x,A})$. A positive technological shift upgrades enterprise technology, dampens marginal cost $MC_{x,t}$, and stimulates production $Y_{x,j,t}$. Capital-embodied technological process $\left(A^*_{x,t} = A_{x,t}\gamma_{x,I}^{\frac{\alpha_x}{1-\alpha_x}t}\right)$, which couples the persistent technology component $A_{x,t}$ with the investment technological advancement trend $\gamma_{x,I}$, influences intermediate goods production growth, constitutes a fixed cost, and assures a balanced growth path. The capital-embodied persistent technology growth rate $\left(\upsilon^*_{x,A,t} = \upsilon_{x,A,t} + \frac{\alpha_x}{1-\alpha_x}\right)$ equals the sum of persistent technology growth rate $\upsilon_{x,A,t}$ and the ratio $\frac{\alpha_x}{1-\alpha_x}$ of the capital share to the technologically-augmented labor share.

Intermediate goods firms rent capital services $K_{x,j,t}$ from entrepreneurs at capital rental rate $R_{x,K,t}$, and employ standardized labor $H_{x,j,t}$ from labor contractors at wage $W_{x,t}$. Following Cristadoro, Gerali, Neri, and Pisani (2006), Breuss and Fornero (2009), and Breuss and Rabitsch (2009), intermediate goods firm j owned by households optimizes labor $H_{x,j,t}$ and capital services $K_{x,j,t}$ to minimize its cost, which is discounted by equilibrium nominal stochastic discount factor $S_{x,t,t+\iota}$, subject to the balance between intermediate good j's production and demand. Given the same demand curve, intermediate goods firms choose a common ratio $\frac{K_{x,t}}{H_{x,t}}$ of capital services to labor in perfectly competitive factor markets:

$$\frac{K_{x,j,t}}{H_{x,j,t}} = \frac{K_{x,t}}{H_{x,t}} = \frac{\alpha_x W_{x,t}}{(1-\alpha_x)R_{x,K,t}} \tag{5}$$

Following Calvo pricing of Calvo (1983) and Justiniano et al. (2010), a fraction $\gamma_{x,P}$ of intermediate goods firms cannot reset intermediate good prices due to price stickiness and inflation inertia, but partially index intermediate good prices $P_{x,j,t} = \upsilon^{\xi_{x,P}}_{x,\pi,t}\pi^{1-\xi_{x,P}}_{x,t-2,t-1}P_{x,j,t-1}$ to a geometrically weighted average of past inflation $\left(\pi_{x,t-2,t-1} = \frac{P_{x,t-1}}{P_{x,t-2}}\right)$ and the time-varying inflation target $\upsilon_{x,\pi,t}$, with weights $(1-\xi_{x,P})$ and $\xi_{x,P}$, respectively. The complementary fraction $(1-\gamma_{x,P})$ of intermediate goods firms readjust intermediate good price $P^*_{x,j,t}$ to maximize their expected profits $P_{x,t}PR_{x,j,t}$. We assume resetting domestic prices and reoptimizing foreign prices are stochastically independent events. Intermediate good j's price $P_{x,j,t}$ is a geometrically weighted average of past price $P_{x,j,t-1}$ indexed to $\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t-2,t-1}^{1-\xi_{x,P}}$ and optimal price $P^{*}_{x,j,t}$, with probabilities $\gamma_{x,P}$ and $(1-\gamma_{x,P})$, respectively. Price stickiness renders persistent but lower impacts of exchange rate changes on imported inflation:

$$P_{x,j,t}^{-\frac{1}{\upsilon_{x,Y,t}}} = \gamma_{x,P}\left(\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t-2,t-1}^{1-\xi_{x,P}}P_{x,j,t-1}\right)^{-\frac{1}{\upsilon_{x,Y,t}}} + (1-\gamma_{x,P})P_{x,j,t}^{*-\frac{1}{\upsilon_{x,Y,t}}} \tag{6}$$

Cost minimization, profit maximization, and aggregate behavior are standard and presented in Appendix C.

2.3. Capital goods firms

A unit continuum of homogenous capital goods firms populates the perfectly competitive capital goods market. Similar to Christiano et al. (2014), at the end of period t, the typical capital goods firm purchases final goods $Y_{x,t}$ from final goods firms at final good price $P_{x,t}$, converts final goods $Y_{x,t}$ into investment goods $I_{x,t}$ at investment's relative price $\frac{P_{x,t}}{\gamma_{x,I}^{t}\upsilon_{x,Q,t}}$, transforms investment goods into capital via technology $J\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right)$, and couples capital with undepreciated capital $(1-\delta_{x,K})\overline{K}_{x,t}$, which are repurchased from entrepreneurs, to accumulate installed capital $\overline{K}_{x,t+1}$.

$$\overline{K}_{x,t+1} = \left(1-\delta_{x,K}\right)\overline{K}_{x,t} + J\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right)I_{x,t} \tag{7}$$

where $\delta_{x,K}$ is capital depreciation rate. Transformation technology $\left[J\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right) = 1 - \iota_x\left(\frac{I_{x,t}}{I_{x,t-1}}-1\right)^2\upsilon_{x,I,t}\right]$ converts investment into capital at cost $\iota_x\left(\frac{I_{x,t}}{I_{x,t-1}}-1\right)^2\upsilon_{x,I,t}$, which is positively related to investment growth rate $\frac{I_{x,t}}{I_{x,t-1}}$ and adjustment speed ι_x. The investment shock $\upsilon_{x,I,t}$ follows an AR(1) process in logs with an innovation $\varepsilon_{x,I,t} \sim i.i.d.N(0,\sigma_{x,I}^2)$. A positive investment innovation stimulates investment and bolsters production. Profit maximization in Appendix D gives Tobin's Q equation linking capital price $Q_{x,t}$, investment good price $\frac{P_{x,t}}{\gamma_{x,I}^{t}\upsilon_{x,Q,t}}$, and transformation technology $J\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right)$:

$$\begin{aligned} &E_t\left\{S_{x,t,t}\left[J\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right) + J'\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right)\frac{I_{x,t}}{I_{x,t-1}}\right]Q_{x,t}\right. \\ &\left.-S_{x,t,t}\frac{P_{x,t}}{\gamma_{x,I}^{t}\upsilon_{x,Q,t}} - S_{x,t,t+1}J'\left(\frac{I_{x,t+1}}{I_{x,t}},\upsilon_{x,I,t+1}\right)\frac{I_{x,t+1}^2}{I_{x,t}^2}Q_{x,t+1}\right\} = 0 \end{aligned} \tag{8}$$

2.4. Labor contractors

Building on Erceg et al. (2000)'s specification, households exhibit heterogeneity in supplying labor to domestic labor contractors and possess wage bargaining power. Labor contractors transform heterogeneous labor $H_{x,i,t}$ into homogeneous labor $H_{x,t}$, and rent standardized labor services to intermediate goods firms at wage $W_{x,t}$, in perfectly competitive labor markets:

$$H_{x,t} = \left(\int_0^1 H_{x,i,t}^{\frac{1}{\lambda_{x,W}}}di\right)^{\lambda_{x,W}} \tag{9}$$

where labor markup $\lambda_{x,W} \in [1,+\infty)$ governs the degree of substitution among differentiated labor $H_{x,i,t}$. Labor income maximization in Appendix H stresses that standardized wage $W_{x,t}$ is a Dixit-Stiglitz aggregator of the continuum of wages $W_{x,i,t}$:

$$W_{x,t} = \left(\int_0^1 W_{x,i,t}^{\frac{1}{1-\lambda_{x,W}}}di\right)^{1-\lambda_{x,W}} \tag{10}$$

Demand $H_{x,i,t}$ for labor i is positively associated with standardized wage $W_{x,t}$ and standardized labor $H_{x,t}$, but is negatively related to labor i's wage $W_{x,i,t}$.

$$H_{x,i,t} = \left(\frac{W_{x,t}}{W_{x,i,t}}\right)^{\frac{\lambda_{x,W}}{\lambda_{x,W}-1}}H_{x,t} \tag{11}$$

A fraction $\gamma_{x,W}$ of households cannot reoptimize wages $W_{x,i,t}$ due to wage stickiness, but follow a partial indexation rule

$(\pi_{x,t-2,t-1}^{1-\xi_{x,W}}\upsilon_{x,\pi,t}^{\xi_{x,W}}\upsilon_{x,A,t}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}W_{x,i,t-1})$ tracking past inflation $\pi_{x,t-2,t-1}$, the inflation target $\upsilon_{x,\pi,t}$, the capital-embodied persistent technology growth rate $\upsilon_{x,A,t}^{*}$ and its steady state $\overline{\upsilon}_{x,A}^{*}$, with weights $(1-\xi_{x,W}), \xi_{x,W}, \vartheta_{x,A}$, and $(1-\vartheta_{x,A})$, respectively, ensuring wage-setting frictions are not distortionary along a steady state growth path. The remainder $(1-\gamma_{x,W})$ resets wage $W_{x,i,t}^{*}$ with labor contractors to maximize present discounted value of future profits. Household i's wage $W_{x,i,t}$ is a geometrically weighted average of past wage $W_{x,i,t-1}$ indexed to $\upsilon_{x,\pi,t}^{\xi_{x,W}}\pi_{x,t-2,t-1}^{1-\xi_{x,W}}\upsilon_{x,A,t}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}$ and optimal wage $W_{x,i,t}^{*}$, with weights $\gamma_{x,W}$ and $(1-\gamma_{x,W})$, respectively:

$$W_{x,i,t}^{-\frac{1}{\lambda_{x,W}}}=\gamma_{x,W}\left(\upsilon_{x,\pi,t}^{\xi_{x,W}}\pi_{x,t-2,t-1}^{1-\xi_{x,W}}\upsilon_{x,A,t}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}W_{x,i,t-1}\right)^{-\frac{1}{\lambda_{x,W}}}+\left(1-\gamma_{x,W}\right)W_{x,i,t}^{*-\frac{1}{\lambda_{x,W}}} \tag{12}$$

2.5. Entrepreneurs

Entrepreneurs represent nonfinancial business firms and risky financial firms holding non-diversifiable portfolios. A continuum of entrepreneurs, being owned by households and indexed by net worth N_x with its density $f_t(N_x)$, populates perfectly competitive entrepreneur markets, and features net worth $N_{x,t+1}=\int_0^{+\infty}N_xf_t(N_x)dN_x$ at the beginning of period $t+1$. At the end of period t, the typical entrepreneur N_x couples net worth N_x with entrepreneurial loans $L_{x,E,N,t+1}$ to acquire installed capital $\overline{K}_{x,N,t+1}$, e.g. plants and equipment, from capital goods firms, and infuses the idiosyncratic entrepreneurial productivity $\gamma_{x,E}$ into installed capital. Entrepreneurs sell capital services to intermediate goods firms, and resell undepreciated capital to capital goods firms at the end of production cycles. Net worth acts as a cushion to absorb entrepreneurial loan loss.

Idiosyncratic productivity varies substantially across entrepreneurs, inducing a dispersion across entrepreneurs in productivity. The entrepreneurial productivity $\gamma_{x,E}$, which captures the idiosyncratic productivity attached to entrepreneurial investment, follows an i.i.d. lognormal distribution across entrepreneurs with a cumulative distribution function $F_t(\gamma_{x,E})$. The standard deviation $\upsilon_{x,E,t}$ of the logarithm of the entrepreneurial productivity $ln\gamma_{x,E}$ conveys the realized time-varying entrepreneurial risk. Due to information asymmetry, the idiosyncratic entrepreneurial productivity $\gamma_{x,E}$, as private information, is perceived directly by entrepreneurs, and is observed by commercial banks at a monitoring cost μ_x.

$$ln\gamma_{x,E}\sim i.i.d.N\left(-\frac{\upsilon_{x,E,t}^2}{2},\upsilon_{x,E,t}^2\right) \tag{13}$$

where the time-varying variance $\upsilon_{x,E,t}^2$ characterizes the cross-sectional dispersion in $ln\gamma_{x,E}$. Mean $E\gamma_{x,E}=1$ when variance $\upsilon_{x,E,t}^2$ equals its steady state $\overline{\upsilon}_{x,E}^2$. The entrepreneurial risk shock $\upsilon_{x,E,t}$ follows an AR(1) process in logs with an innovation $\varepsilon_{x,E,t}\sim i.i.d.N(0,\sigma_{x,E}^2)$.

After observing entrepreneurial productivity $\gamma_{x,E}$, entrepreneur N_x bears entrepreneurial cost specified in Eq. (14), which is positively associated with final good price $P_{x,t+1}$, productive installed capital $\gamma_{x,E}\overline{K}_{x,N,t+1}$, capital utilization cost $X(CU_{x,K,t+1})$,[1] and the energy price shock $\upsilon_{x,O,t+1}$, but is negatively related to the investment technological advancement trend $\gamma_{x,I}$:

$$P_{x,t+1}\gamma_{x,I}^{-(t+1)}\upsilon_{x,O,t+1}X\left(CU_{x,K,t+1}\right)\gamma_{x,E}\overline{K}_{x,N,t+1} \tag{14}$$

The energy price shock $\upsilon_{x,O,t}$, which captures energy price uncertainty, follows an AR(1) process in logs with an innovation $\varepsilon_{x,O,t}\sim i.i.d.N(0,\sigma_{x,O}^2)$. Energy price shocks for the U.S. and China are specified to be different. Intuitively, in comparison with the U.S., China's oil suppliers rely on imports more heavily, and intervene in the domestic oil market. Besides, the energy structure for the U.S. and China are very different. Specifically, in addition to oil, coal and natural gas constitute China's major consumption of energy.

In the perfectly competitive capital market, entrepreneur N_x rents productive capital services $\gamma_{x,E}\overline{K}_{x,N,t+1}$ to intermediate goods firms at nominal rental rate $P_{x,t+1}R_{x,K,t+1}$, and adopts optimal capital utilization rate $CU_{x,K,t+1}$ to maximize rental profits. Based on first order conditions, as productive installed capital rental rate $R_{x,K,t+1}$ increases, entrepreneur N_x harvests rental profits, until capital rental rate $R_{x,K,t+1}$ coincides with the marginal cost of capital utilization $X'(CU_{x,K,t+1})$, which is adjusted by the investment technological advancement trend $\gamma_{x,I}^{-(t+1)}$ and perturbed by the energy price shock $\upsilon_{x,O,t+1}$. Optimal capital utilization rate $CU_{x,K,t+1}$ is independent of net worth N_x:

$$R_{x,K,t+1}=\gamma_{x,I}^{-(t+1)}\upsilon_{x,O,t+1}X'\left(CU_{x,K,t+1}\right) \tag{15}$$

Entrepreneur N_x self-finances a fraction of installed capital $\overline{K}_{x,N,t+1}$, and needs external financing such as entrepreneurial loans $L_{x,E,N,t+1}$ to complement net worth $\overline{N}_{x,t+1}$. The marginal cost of financing installed capital is intrinsic to financial conditions. Given that unproductive entrepreneurs are crowded out by productive entrepreneurs, commercial banks and entrepreneurs sign standard

[1] Capital utilization cost $X\left(CU_{x,K,t+1}\right)=\frac{\overline{R}_{x,K}\sigma_{x,K}}{2}CU_{x,K,t+1}^2+\overline{R}_{x,K}\left(1-\sigma_{x,K}\right)CU_{x,K,t+1}+\overline{R}_{x,K}\left(\frac{\sigma_{x,K}}{2}-1\right)$ is increasing and convex in capital utilization rate $CU_{x,K,t}$, satisfies $X(1)=0, X'(1)=\overline{R}_{x,K}$, and $X''(1)=\sigma_{x,K}\overline{R}_{x,K}$, steady-state capital rental rate $\overline{R}_{x,K}$ ensures that steady-state capital utilization rate $\overline{CU}_{x,K}$ equals 1, $\frac{X''(1)}{X'(1)}=\sigma_{x,K}$ measures entrepreneurial cost convexity.

entrepreneurial loan contracts embedding entrepreneurial productivity threshold effects. When entrepreneurial productivity $\gamma_{x,E}$ lies above an endogenously-determined cutoff value $\overline{\gamma}_{x,E,t+1}$, entrepreneur N_x repays entrepreneurial loans $L_{x,E,N,t+1}$ at entrepreneurial loan interest rate $Z_{x,t+1}$. As shown in Appendix E, the cutoff value $\overline{\gamma}_{x,E,t+1}$ defines a loan repayment ability threshold, ensuring that entrepreneurial loan payoffs $Z_{x,t+1}L_{x,E,N,t+1}$ equal capital return $\overline{R}_{x,K,t+1}Q_{x,t}\overline{\gamma}_{x,E,t+1}\overline{K}_{x,N,t+1}$, which is composed of average capital return $\overline{R}_{x,K,t+1}$, capital price $Q_{x,t}$, entrepreneurial productivity cutoff value $\overline{\gamma}_{x,E,t+1}$, and installed capital $\overline{K}_{x,N,t+1}$:

$$\overline{R}_{x,K,t+1}Q_{x,t}\overline{\gamma}_{x,E,t+1}\overline{K}_{x,N,t+1} = Z_{x,t+1}L_{x,E,N,t+1} \tag{16}$$

where optimal contractual rate $Z_{x,t+1}$ represents an entrepreneurial loan interest rate conditioning on solvency. When entrepreneurial productivity $\gamma_{x,E}$ lies below the cutoff value $\overline{\gamma}_{x,E,t+1}$, entrepreneur N_x, which is unproductive, breaches the default boundary, cannot fully repay entrepreneurial loans, and declares bankruptcy. Commercial banks settle bankrupt entrepreneur N_x's realized return of capital at state verification cost $\mu_x R_{x,K,t+1}Q_{x,t}\gamma_{x,E}\overline{K}_{x,N,t+1}$, which is proportional to entrepreneur N_x's capital assets $R_{x,K,t+1}Q_{x,t}\gamma_{x,E}\overline{K}_{x,N,t+1}$ by the monitoring cost μ_x, and retain liquidated fractional capital assets $(1-\mu_x)R_{x,K,t+1}Q_{x,t}\gamma_{x,E}\overline{K}_{x,N,t+1}$. When shutting down businesses and liquidating assets, a proportion Θ_x of net worth is consumed, and the remainder $(1-\Theta_x)$ is transferred to households. The entrepreneurial loan contract, which specifies entrepreneurial loans $L_{x,E,N,t+1}$ and contractual interest rate $Z_{x,t+1}$ jointly, alleviates information asymmetry not only by ensuring commercial banks seize entrepreneurial loan interest covering opportunity cost, but also via maximizing entrepreneur N_x's net worth $\overline{N}_{x,t+1}$ at the end of the loan contract.

Building on Christiano et al. (2003), Christiano et al. (2010), and Christiano et al. (2014), we assume that, every period, an entrepreneur with expected lifetime $\frac{1}{1-\upsilon_{x,\gamma,t}}$ survives with a probability $\upsilon_{x,\gamma,t}$, and exits with a probability $(1-\upsilon_{x,\gamma,t})$.[2] Intuitively, a random fraction $(1-\upsilon_{x,\gamma,t})$ of entrepreneurial financial wealth is destroyed exogenously, and the remaining fraction $\upsilon_{x,\gamma,t}$ is maintained. Consequently, the surviving financial wealth fraction $\upsilon_{x,\gamma,t}$ is subject to stochastic fluctuations, elucidating a resemblance between a jump in the financial wealth destruction rate and a burst of stock market bubbles. The financial wealth shock $\upsilon_{x,\gamma,t}$ influences the survival rate of entrepreneurs, whose individual net worth $\overline{N}_{x,t+1}$ is affected by the idiosyncratic entrepreneurial productivity $\gamma_{x,E}$.[3] The financial wealth shock $\upsilon_{x,\gamma,t}$, which occasionally hits entrepreneurs, conveys the instantaneous arrival probability of financial wealth movement, measures the realized financial wealth risk, and captures the unexpected innovations to aggregate equity value, generating contemporaneous impacts on net worth. The financial wealth shock $\upsilon_{x,\gamma,t}$ follows an AR(1) process in logs with an innovation $\varepsilon_{x,\gamma,t} \sim i.i.d.N(0,\sigma^2_{x,\gamma})$. At the end of period $t+1$, after the occurrence of entries and exits, all active entrepreneurs have a specific level of net worth.

The entrepreneurial productivity $\gamma_{x,E}$, which detracts from entrepreneurial profits and net worth, exerts effects on financial risk premiums. Entrepreneurial productivity's cumulative distribution function at the cutoff value $\overline{\gamma}_{x,E,t}$ is time-varying and subject to entrepreneurial productivity risk shock $\upsilon_{x,E,t}$. Entrepreneurial loans' risk premium $P_{x,E,t}$, which conveys borrowers' creditworthiness, equals the ratio of the monitoring cost $\mu_x \int_0^{\overline{\gamma}_{x,E,t}} \gamma_{x,E} dF(\gamma_{x,E})\overline{R}_{x,K,t}Q_{x,t-1}\overline{K}_{x,t}$ to entrepreneurial loans $(Q_{x,t-1}\overline{K}_{x,t}-\overline{N}_{x,t})$:

$$P_{x,E,t} = \frac{\mu_x \int_0^{\overline{\gamma}_{x,E,t}} \gamma_{x,E} dF(\gamma_{x,E})\overline{R}_{x,K,t}Q_{x,t-1}\overline{K}_{x,t}}{Q_{x,t-1}\overline{K}_{x,t}-\overline{N}_{x,t}} \tag{17}$$

2.6. Commercial banks

Financial intermediation operates via a continuum of perfectly competitive commercial banks, which absorb household deposits at the beginning of period t. Concerning possibilities of the unexpected withdrawals, China's commercial banks are precautionarily motivated to set aside a fraction of deposits as reserves, and obey the required reserve regulations set by the People's Bank of China, which intervenes when excessive credit emerges. Uncertainty in entrepreneurial project outcomes injects risk into bank balance sheets, on which liabilities involve principal and interest payments to households, and assets include entrepreneurial loans to entrepreneurs. Commercial banks monitor entrepreneurs, and diversify risk by allocating credit to a variety of entrepreneurs.

A specialized entrepreneurial loan subsidiary, being affiliated with the typical commercial bank, collects funds from the parent institution at the end of period t, grants entrepreneurial loans $L_{x,E,t+1}$ to entrepreneurs at the beginning of period $t+1$, and pays the parent institution an internal non-state-contingent nominal interest rate $R_{x,E,t+1}$ at the end of period $t+1$. The subsidiary receives a

[2] New entrepreneurs, who receive a 'start-up' transfer of net worth $W_{x,E,t}$ from households, enter in sufficient numbers so that the population of entrepreneurs remains constant. Under the assumption of a finite horizon, the coexistence of births and deaths, together with relatively small $W_{x,E,t}$, precludes that entrepreneurs ultimately accumulate sufficient wealth and fully rely on self-financing.

[3] The financial wealth shock $\upsilon_{x,\gamma,t}$ is an aggregate shock. The idiosyncratic entrepreneurial productivity $\gamma_{x,E}$ is individual and is integrated out after aggregation. They will not affect each other in identification.

proportion $\Gamma_t(\overline{\gamma}_{x,E,t+1})$, which contains a fraction $\overline{\gamma}_{x,E,t+1}[1-F_t(\overline{\gamma}_{x,E,t+1})]$ from solvent entrepreneurs and a fraction $G_t(\overline{\gamma}_{x,E,t+1})$ from bankrupt entrepreneurs, of entrepreneurial earnings $R_{x,K,t+1}\overline{K}_{x,t+1}$.[4] After deducting the monitoring cost μ_x, the subsidiary gains the proportional entrepreneurial earnings:

$$\left\{\overline{\gamma}_{x,E,t+1}\left[1-F_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]+G_t\left(\overline{\gamma}_{x,E,t+1}\right)-\mu_x G_t\left(\overline{\gamma}_{x,E,t+1}\right)\right\}R_{x,K,t+1}\overline{K}_{x,t+1} \tag{18}$$

Entrepreneurial loan contracts, which are signed collectively by entrepreneurs and commercial banks, stipulate contractual gross return $Z_{x,t+1}$ and the entrepreneurial productivity threshold $\overline{\gamma}_{x,E,t+1}$. A fraction $[1-F_t(\overline{\gamma}_{x,E,t+1})]$ of entrepreneurs, whose productivity exceeds the threshold $\overline{\gamma}_{x,E,t+1}$, pay contractual rate $Z_{x,t+1}$ to commercial banks, and the remaining fraction $F_t(\overline{\gamma}_{x,E,t+1})$, whose productivity lies below the threshold $\overline{\gamma}_{x,E,t+1}$, pay residual claims less the monitoring cost to commercial banks. Optimal entrepreneurial loans $L_{x,E,t+1}$ maximize entrepreneurs' net worth subject to zero profit condition given in Appendix F. A participation constraint requires that expected U.S. loan returns, which include loan repayment $[1-F_t(\overline{\gamma}_{U,E,t+1})]Z_{U,t+1}L_{U,E,t+1}$ from solvent entrepreneurs and foreclosure settlement $(1-\mu_U)G_t(\overline{\gamma}_{U,E,t+1})R_{U,K,t+1}Q_{U,t}\overline{K}_{U,t+1}$ from bankrupt entrepreneurs, equal commercial banks' opportunity cost $R_{U,E,t+1}L_{U,E,t+1}$, where $R_{U,E,t+1}$ represents loanable savings $L_{U,E,t+1}$'s payoff to the parent institution:

$$\begin{aligned}&\left[1-F_t\left(\overline{\gamma}_{U,E,t+1}\right)\right]Z_{U,t+1}L_{U,E,t+1}+\left(1-\mu_U\right)\\&G_t\left(\overline{\gamma}_{U,E,t+1}\right)R_{U,K,t+1}Q_{U,t}\overline{K}_{U,t+1}=R_{U,E,t+1}L_{U,E,t+1}\end{aligned} \tag{19}$$

Likewise, expected loan returns for China, which include loan repayment $[1-F_t(\overline{\gamma}_{C,E,t+1})]$

$Z_{C,t+1}L_{C,E,t+1}$ from solvent entrepreneurs and foreclosure settlement $(1-\mu_C)G_t(\overline{\gamma}_{C,E,t+1})$.

$R_{C,K,t+1}Q_{C,t}\overline{K}_{C,t+1}$ from bankrupt entrepreneurs, equal commercial banks' opportunity cost $R_{C,E,t+1}\frac{L_{C,E,t+1}}{1-\tau_t\upsilon_{C,\tau,t}}$, where $R_{C,E,t+1}$ conveys loanable savings $\frac{L_{C,E,t+1}}{1-\tau_{C,t}\upsilon_{C,\tau,t}}$'s payoff to the parent institution and $\tau_{C,t}$ is China's required reserve ratio:

$$\begin{aligned}&\left[1-F_t\left(\overline{\gamma}_{C,E,t+1}\right)\right]Z_{C,t+1}L_{C,E,t+1}+\left(1-\mu_C\right)\\&G_t\left(\overline{\gamma}_{C,E,t+1}\right)R_{C,K,t+1}Q_{C,t}\overline{K}_{C,t+1}=R_{C,E,t+1}\frac{L_{C,E,t+1}}{1-\tau_{C,t}\upsilon_{C,\tau,t}}\end{aligned} \tag{20}$$

where $F_t\left(\overline{\gamma}_{x,E,t+1}\right)=\Phi\left[\frac{ln\overline{\gamma}_{x,E,t+1}-\left(-\frac{\upsilon^2_{x,E,t}}{2}\right)}{\upsilon_{x,E,t}}\right]$ is the fraction of bankrupt entrepreneurs, $[1-F_t(\overline{\gamma}_{x,E,t+1})]$ is the fraction of solvent entrepreneurs, $G_t(\overline{\gamma}_{x,E,t+1})=\int_0^{\overline{\gamma}_{x,E,t+1}}\gamma_{x,E}dF(\gamma_{x,E})$ is unproductive entrepreneurs' cumulative productivity, $(1-\mu_x)G_t(\overline{\gamma}_{x,E,t+1})R_{x,K,t+1}Q_{x,t}\overline{K}_{x,t+1}$ is unproductive entrepreneurs' net worth less the monitoring cost.

2.7. Households

A unit continuum of households indexed by $i\in(0,1)$ populates each country. Households gain utility from consuming domestic and foreign final goods, but incur disutility from supplying distinctive labor services to domestic labor contractors monopolistically. Similar to Christiano et al. (2010), Christiano et al. (2014), Chang et al. (2019), and Benchimol and Ivashchenko (2021), the representative household i's utility $U_{x,i,t}$ is increasing and concave in real money balance $\frac{M_{x,i,t}}{P_{x,t}}$ and habit-adjusted consumption $(C_{x,i,t}-\omega_x C_{x,i,t-1})$, which equals consumption composite $C_{x,i,t}$ less habit formation $\omega_x C_{x,i,t-1}$, but is decreasing and convex in labor supply $H_{x,i,t}$. The labor supply shock $\upsilon_{x,H,t}$ and the real money holdings shock $\upsilon_{x,M,t}$ perturb household utility. We assume the U.S. and China have identical functional forms for household utility.

$$U_{x,i,t}=ln\left(C_{x,i,t}-\omega_x C_{x,i,t-1}\right)-\upsilon_{x,H,t}\frac{H_{x,i,t}^{1+\eta_{x,H}}}{1+\eta_{x,H}}+\upsilon_{x,M,t}\frac{\left(\frac{M_{x,i,t}}{P_{x,t}}\right)^{1+\eta_{x,M}}}{1+\eta_{x,M}} \tag{21}$$

where habit persistence ω_x measures habit formation intensity and introduces nonseparability of periodic preferences, the inverse of Frisch labor supply elasticity $\eta_{x,H}$ captures the curvature on disutility of labor supply, $\eta_{x,M}$ describes the curvature on utility of money holdings. The intertemporal preference shock $\upsilon_{x,P,t}$, which governs household perceptions about current utility relative to future utility, follows an AR(1) process in logs with an innovation $\varepsilon_{x,P,t}\sim i.i.d.N(0,\sigma^2_{x,P})$. The labor supply shock $\upsilon_{x,H,t}$, which quantifies perceptions

[4] $G_t(\Gamma_t(\overline{\gamma}_{x,E,t+1}))=\overline{\gamma}_{x,E,t+1}[1-F_t(\overline{\gamma}_{x,E,t+1})]+G_t(\overline{\gamma}_{x,E,t+1})$. $G_t(\overline{\gamma}_{x,E,t+1})=\int_0^{\overline{\gamma}_{x,E,t+1}}\gamma_{x,E}dF(\gamma_{x,E})$. An entrepreneur is bankrupt when its individual productivity is below the bankrupt threshold $\overline{\gamma}_{x,E,t+1}$. During crisis and recessionary periods, the cross-sectional dispersion of individual entrepreneurial productivity grows larger, and the left tail of individual entrepreneurial productivity's distribution is thickened. The proportion of bankrupt entrepreneurs rises and is crucial.

about labor supply disutility relative to consumption utility intratemporally, follows an AR(1) process in logs with an innovation $\varepsilon_{x,H,t} \sim i.i.d.N(0, \sigma^2_{x,H})$. The money holdings shock $\upsilon_{x,M,t}$, which conveys liquidity preference, follows an AR(1) process in logs with an innovation $\varepsilon_{x,M,t} \sim i.i.d.N(0, \sigma^2_{x,M})$.

Building on Lubik and Schorfheide (2005), Gertler, Gilchrist, and Natalucci (2007), Poutineau and Vermandel (2015), and Ueda (2012), we assume that tradable consumption composite $C_{x,i,t}$ includes domestically produced consumption goods $C_{x,D,i,t}$ and imported consumption goods $C_{x,F,i,t}$ perturbed by the trade shock $\upsilon_{T,t}$, which reflects the unexpected trade policies.

$$C_{x,i,t} = \left[(1-\varphi_x)^{\frac{1}{\varsigma_x}} C_{x,D,i,t}^{\frac{\varsigma_x-1}{\varsigma_x}} + \varphi_x^{\frac{1}{\varsigma_x}} \left(C_{x,F,i,t}\upsilon_{T,t}\right)^{\frac{\varsigma_x-1}{\varsigma_x}}\right]^{\frac{\varsigma_x}{\varsigma_x-1}} \tag{22}$$

where ς_x measures the intratemporal elasticity of substitution between domestically produced and imported consumption goods. $(1-\varphi_x)$ and φ_x determine demand biases towards domestically produced and imported consumption goods, respectively. Home bias quantifies the degree of international trade openness and triggers real exchange rate fluctuations. The trade shock $\upsilon_{T,t}$ follows an AR(1) process in logs with an innovation $\varepsilon_{T,t} \sim i.i.d.N(0, \sigma^2_T)$. A positive trade innovation reduces bilateral trade tariffs and dampens trade barriers, promoting international trade.

Household budget balances between expenditure and income. For the U.S., expenses comprise tax-inclusive consumption composite $(1+\tau_{U,C})C_{U,i,t}$, start-up transfer of net worth $W_{U,E,t}$ to entrepreneurs, bank deposits $\frac{D_{U,i,t+1}}{P_{U,t}}$, acquisition of domestic government bonds $\frac{B_{U,D,i,t+1}}{R_{U,D,t}}$ featuring bond yield $R_{U,D,t}$ and foreign government bonds $\frac{B_{C,F,i,t+1}RX_{U,t}}{R_{C,D,t}}$ featuring bond yield $R_{C,D,t}$, which are internationally traded foreign bonds and denominated in foreign currency, and previous money holdings $\frac{M_{U,t-1}}{P_{U,t}}$. Income includes after-tax wage income $(1-\tau_{U,H})W_{U,t}H_{U,i,t}$, net worth transfer $(1-\Theta_U)(1-\upsilon_{U,\gamma,t})\frac{\overline{N}_{U,t+1}-W_{U,E,t}}{\upsilon_{U,\gamma,t}}$ from exiting entrepreneurs, capital good profits $PR_{U,K,i,t}$, bank deposits' principal and accrued interest $R_{U,D,t}\frac{D_{U,i,t}}{P_{U,t}}$, government buyback of domestic government bonds $B_{U,D,i,t}$ and foreign government bonds $B_{C,F,i,t}RX_{U,t}$, and current money holdings $\frac{M_{U,t}}{P_{U,t}}$.

$$\begin{aligned}
&\left(1+\tau_{U,C}\right)C_{U,i,t} + \frac{D_{U,i,t+1}}{P_{U,t}} + \frac{B_{U,D,i,t+1}}{R_{U,D,t}} + \frac{B_{C,F,i,t+1}RX_{U,t}}{R_{C,D,t}} + \frac{M_{U,t-1}}{P_{U,t}} + W_{U,E,t} \\
&= \left(1-\tau_{U,H}\right)W_{U,t}H_{U,i,t} + R_{U,D,t}\frac{D_{U,i,t}}{P_{U,t}} + B_{U,D,i,t} + B_{C,F,i,t}RX_{U,t} + \frac{M_{U,t}}{P_{U,t}} \\
&+\left(1-\Theta_U\right)\left(1-\upsilon_{U,\gamma,t}\right)\frac{\overline{N}_{U,t+1}-W_{U,E,t}}{\upsilon_{U,\gamma,t}} + PR_{U,K,i,t}
\end{aligned} \tag{23}$$

where negative deposits $D_{U,i,t+1}$ reflect the credit-based consumption of U.S. household borrowers.

Analogously, for China, expenses encompass tax-inclusive consumption composite $(1+\tau_{C,C})C_{C,i,t}$, start-up transfer of net worth $W_{C,E,t}$ to entrepreneurs, bank deposits $\frac{D_{C,i,t+1}}{P_{C,t}}$, acquisition of domestic government bonds $\frac{B_{C,D,i,t+1}}{R_{C,D,t}}$ featuring bond yield $R_{C,D,t}$ and foreign government bonds $\frac{B_{U,F,i,t+1}RX_{C,t}}{R_{U,D,t}}$ featuring bond yield $R_{U,D,t}$, and previous money holdings $\frac{M_{C,t-1}}{P_{C,t}}$. Income contains after-tax wage income $(1-\tau_{C,H})W_{C,t}H_{C,i,t}$, net worth transfer $(1-\Theta_C)(1-\upsilon_{C,\gamma,t})\frac{\overline{N}_{C,t+1}-W_{C,E,t}}{\upsilon_{C,\gamma,t}}$ from exiting entrepreneurs, capital good profits $PR_{C,K,i,t}$, bank deposits' principal and accrued interest $R_{C,D,t}\frac{D_{C,i,t}}{P_{C,t}}$, government buyback of domestic government bonds $B_{C,D,i,t}$ and foreign government bonds $B_{U,F,i,t}RX_{C,t}$, and current money holdings $\frac{M_{C,t}}{P_{C,t}}$.

$$\begin{aligned}
&\left(1+\tau_{C,C}\right)C_{C,i,t} + \frac{D_{C,i,t+1}}{P_{C,t}} + \frac{B_{C,D,i,t+1}}{R_{C,D,t}} + \frac{B_{U,F,i,t+1}RX_{C,t}}{R_{U,D,t}} + \frac{M_{C,t-1}}{P_{C,t}} + W_{C,E,t} \\
&= \left(1-\tau_{C,H}\right)W_{C,t}H_{C,i,t} + R_{C,D,t}\frac{D_{C,i,t}}{P_{C,t}} + B_{C,D,i,t} + B_{U,F,i,t}RX_{C,t} + \frac{M_{C,t}}{P_{C,t}} \\
&+\left(1-\Theta_C\right)\left(1-\upsilon_{C,\gamma,t}\right)\frac{\overline{N}_{C,t+1}-W_{C,E,t}}{\upsilon_{C,\gamma,t}} + PR_{C,K,i,t}
\end{aligned} \tag{24}$$

where positive deposits $D_{C,i,t+1}$ convey the saving-backed investment of China's household depositors.

According to household utility maximization in Appendix G, the marginal cost of working in terms of consumption composite $\left(1+\tau_{x,C}\right)\frac{\upsilon_{x,P,t}\upsilon_{x,H,t}H_{x,i,t}^{\eta_{x,H}}}{\upsilon_{x,P,t}(C_{x,i,t}-\omega_x C_{x,i,t-1})^{-\eta_{x,C}}}$ equals the marginal benefit in terms of after-tax wage $(1-\tau_{x,H})W_{x,t}$:

$$\upsilon_{x,P,t}\left(C_{x,i,t}-\omega_x C_{x,i,t-1}\right)^{-\eta_{x,C}} = \left(1+\tau_{x,C}\right)\frac{\upsilon_{x,P,t}\upsilon_{x,H,t}H_{x,i,t}^{\eta_{x,H}}}{\left(1-\tau_{x,H}\right)W_{x,t}} \tag{25}$$

The marginal rate of substitution $\left[MRS_{x,i,t} = \frac{(C_{x,i,t} - \omega_x C_{x,i,t-1})^{-\eta_{x,C}}}{\upsilon_{x,H,t} H_{x,i,t}^{\eta_{x,H}}} = \frac{(1+\tau_{x,C})}{(1-\tau_{x,H})W_{x,t}}\right]$ of leisure $\Delta(1-H_{x,i,t})$ for consumption composite $\Delta C_{x,i,t}$ yields the ratio of tax-inclusive consumption price $(1+\tau_{x,C})P_{x,t}$ to tax-exclusive wage $(1-\tau_{x,H})W_{x,t}P_{x,t}$. The marginal utility of consumption composite foregone in deposits accords with nominal stochastic discount factor $\left[S_{x,t,t+1} = \frac{\beta_x \upsilon_{x,P,t+1} MU_{x,C,i,t+1}}{\upsilon_{x,P,t} MU_{x,C,i,t} \pi_{x,t,t+1}}\right]$, which equals the inversed interest rate $\frac{1}{R_{x,D,t+1}}$.

Household i decides consumption of domestic goods $\left[C_{x,D,i,t} = (1-\varphi_x)\left(\frac{P_{x,D,t}}{P_{x,t}}\right)^{-\varsigma_x} C_{x,i,t}\right]$ and foreign goods $\left[C_{x,F,i,t} = \varphi_x \left(\frac{P_{x,F,t}X_{x,t}}{P_{x,t}}\right)^{-\varsigma_x} \frac{C_{x,i,t}}{\upsilon_{T,t}}\right]$. Consumption price index $\left\{P_{x,t} = \left[(1-\varphi_x)P_{x,D,t}^{1-\varsigma_x} + \varphi_x (P_{x,F,t}X_{x,t})^{1-\varsigma_x}\right]^{\frac{1}{1-\varsigma_x}}\right\}$ is a Dixit-Stiglitz aggregator of domestic consumption good price $P_{x,D,t}$, which is charged by domestic final goods firms, and foreign consumption good price $P_{x,F,t}$, which is charged by foreign final goods firms and adjusted by nominal exchange rate $X_{x,t}$, with weights $(1-\varphi_x)$ and φ_x, respectively.

The marginal benefit of holding money $\beta_x \upsilon_{x,M,t}\left(\frac{M_{x,i,t}}{P_{x,t}}\right)^{\eta_{x,M}}$ accords with the opportunity cost of holding money $\frac{\upsilon_{x,P,t}}{(C_{x,i,t} - \omega_x C_{x,i,t-1})(1+\tau_{x,C})}$:

$$\frac{\upsilon_{x,P,t}}{C_{x,i,t} - \omega_x C_{x,i,t-1}} = \beta_x \upsilon_{x,M,t}\left(\frac{M_{x,i,t}}{P_{x,t}}\right)^{\eta_{x,M}}\left(1+\tau_{x,C}\right) \tag{26}$$

2.8. Governments

Governments mitigate market inefficiency and credit misallocation triggered by imperfections and rigidities. By imposing taxes and issuing bonds, governments finance fiscal spending $G_{x,t}$ and government bond repurchases from domestic households $B_{x,D,t}$ and foreign households $B_{x,F,t}$, respectively. Specifically, governments levy taxes on consumption of domestically produced goods $C_{x,D,t}$ and imported foreign goods $\upsilon_{T,t} C_{x,F,t} RX_{x,t}$ at tax rate $\tau_{x,C}$, as well as imposing taxes on household wage income $W_{x,t}H_{x,t}$ at tax rate $\tau_{x,H}$. Governments also issue risk-free government bonds $\frac{B_{x,D,t+1}}{R_{x,D,t}}$ and $\frac{B_{x,F,t+1}}{R_{x,D,t}}$ to domestic and foreign households, respectively. Fiscal spending, tax revenues, and government bonds constitute discretionary fiscal policy tools. By introducing fluctuations into household budget constraints, the international exchange of government bonds allows households to smooth consumption intertemporally, and enables countries to finance current account deficits, contributing to financial integration. Poutineau and Vermandel (2015) find that specifying cross-border loans strongly improves model performance. The government budget constraint is as follows:

$$\begin{aligned}&\tau_{x,C} C_{x,D,t} + \tau_{x,C} \upsilon_{T,t} C_{x,F,t} RX_{x,t} + \tau_{x,H} W_{x,t} H_{x,t} \\ &+ \frac{B_{x,D,t+1}}{R_{x,D,t}} + \frac{B_{x,F,t+1}}{R_{x,D,t}} = G_{x,t} + B_{x,D,t} + B_{x,F,t}\end{aligned} \tag{27}$$

Government spending $G_{x,t}$ contains the government spending shock $\upsilon_{x,G,t}$ and the capital-embodied technology $A^*_{x,t}$:

$$G_{x,t} = \upsilon_{x,G,t} A^*_{x,t} \tag{28}$$

The government spending shock $\upsilon_{x,G,t}$, which enters fiscal budget constraint, follows an AR(1) process in logs with an innovation $\varepsilon_{x,G,t} \sim i.i.d.N(0, \sigma^2_{x,G})$. A positive government spending innovation conveys a fiscal stimulus $G_{x,t}$ accompanied by rises in taxes.

2.9. Central banks

Assuming monetary policy independence across borders, central banking activities in the U.S. and China possess different institutional features, communicating macroeconomic conditions to policy makers. The Federal Reserve influences the short-term federal funds rate mainly via open market operations, and affects the term structure of the U.S. interest rates via the interest rate transmission mechanism. Specifically, the Federal Reserve regulates deposit interest rate $r_{U,D,t}$ in response to the inflation gap $\pi_{U,t}$ and the output gap $y_{U,t}$,[5] and is perturbed by the interest rate shock $\nu_{U,R,t}$, subject to the augmented Taylor-type rule:

$$r_{U,D,t} = \rho_{U,R} r_{U,D,t-1} + \left(1-\rho_{U,R}\right)\left(\phi_{U,\pi}\pi_{U,t} + \phi_{U,Y} y_{U,t}\right) + \nu_{U,R,t} \tag{29}$$

where $\rho_{U,R}$ measures interest rate inertia. $\phi_{U,\pi}$ and $\phi_{U,Y}$ capture the degrees of sensitivity of the interest rate to the inflation gap and the output gap, respectively. The U.S. interest rate shock, which is triggered by interest rate innovations $\varepsilon_{U,R,t} \sim i.i.d.N(0, \sigma^2_{U,R})$, captures the unexpected influence of financial crises and credit crunches on interest rates. A positive interest rate innovation signals contractionary monetary policy, curbing consumption and investment, whereas a negative interest rate shock represents expansionary monetary policy, stimulating consumption and investment. The U.S. time-varying inflation target $\upsilon_{U,\pi,t}$ follows an AR(1) process in logs

[5] Log-linearized deposit interest rate $r_{U,D,t} = R_{U,D,t} - \overline{R}_{U,D}$. The inflation gap $\pi_{U,t} = \pi_{U,t-1,t} - \upsilon_{U,\pi,t}$ measures the deviation of inflation $\pi_{U,t-1,t}$ from the inflation target $\upsilon_{U,\pi,t}$, and the output gap $y_{U,t} = lnY_{U,t} - lnY^*_U$ quantifies the deviation of output $Y_{U,t}$ from its frictionless level Y^*_U.

with an innovation $\varepsilon_{U,\pi,t} \sim i.i.d.N(0, \sigma^2_{U,\pi})$.

As discussed in Chang et al. (2019), with the intermediate target being M2 growth, China's ultimate monetary policy goals are price stability and output growth. Money supply and the required reserve ratio constitute the main constellation of China's monetary policy tools. The People's Bank of China manages money supply growth rate $g_{C,MS,t}$ in reaction to the inflation gap $\pi_{C,t}$ and the output gap $y_{C,t}$,[6] and is perturbed by the money supply shock $\varepsilon_{C,MS,t}$, subject to the augmented Taylor-type rule:

$$g_{C,MS,t} = \rho_{C,MS} g_{C,MS,t-1} + (1-\rho_{C,MS})(\phi_{C,\pi}\pi_{C,t} + \phi_{C,Y} y_{C,t}) + \nu_{C,MS,t} \tag{30}$$

where $\rho_{C,MS}$ quantifies money supply inertia. $\phi_{C,\pi}$ and $\phi_{C,Y}$ capture the degrees of sensitivity of the money supply growth to the inflation gap and the output gap, respectively. China's money supply shock, which is driven by money supply innovations $\varepsilon_{C,MS,t} \sim i.i.d.N(0, \sigma^2_{C,MS})$, reflects unforeseen impacts of financial crises and credit crunches on money supply. A money supply expansion loosens monetary policy, injects credit, and spurs demand, whereas a money supply contraction tightens monetary policy, shrinks credit, and restrains demand. The liquidity minimum requirement motivates commercial banks to keep the ratio of liquid assets to total assets above the threshold $\tau_t \upsilon_{C,\tau,t}$.

The reserve requirement at the required reserve ratio τ_t, which is perturbed by the reserve ratio shock $\upsilon_{C,\tau,t}$, drives a wedge between contractual entrepreneurial loan interest rate $R_{C,E,t}$ and the risk-free deposit interest rate $R_{C,D,t}$:

$$R_{C,E,t}(1-\tau_t \upsilon_{C,\tau,t}) = R_{C,D,t} \tag{31}$$

China's reserve ratio shock $\upsilon_{C,\tau,t}$, which controls lending margin of banks given capital requirement, follows an AR(1) process in logs with an innovation $\varepsilon_{C,\tau,t} \sim i.i.d.N(0, \sigma^2_{C,\tau})$.

Money supply $MS_{x,t}$ coincides with the sum of household money holdings $M_{x,t}$ and deposits $D_{x,t}$:

$$MS_{x,t} = M_{x,t} + D_{x,t} \tag{32}$$

2.10. International trade and financial transactions

The U.S. and China interact via international trade and financial transactions. Foreign direct investment and trade openness drive technology transfer, as well as sustaining international development. The U.S. real exchange rate $\left(RX_{U,t} = \frac{P_{U,F,t}X_{U,t}}{P_{U,D,t}}\right)$ equals the ratio of the import foreign final good price $P_{U,F,t}$, which is charged by China's final goods firms to U.S. households and adjusted by nominal exchange rate $X_{U,t}$, to the domestic final good price $P_{U,D,t}$, which is charged by U.S. final goods firms to U.S. households. The U.S. nominal exchange rate $X_{U,t}$ denotes one Chinese Yuan in terms of U.S. dollars. Likewise, China's real exchange rate $\left(RX_{C,t} = \frac{P_{C,F,t}X_{C,t}}{P_{C,D,t}}\right)$ measures the ratio of the import final good price $P_{C,F,t}$, which is charged by U.S. final goods firms to China's households and adjusted by nominal exchange rate $X_{C,t}$, to the domestic final good price $P_{C,D,t}$, which is charged by China's final goods firms to China's households. China's nominal exchange rate $X_{C,t}$ denotes one U.S. dollar in terms of Chinese Yuans. Chinese Yuans per U.S. dollar $X_{C,t}$ equals the inverse of U.S. dollars per Chinese Yuan $X_{U,t}$. An increase in the domestic exchange rate corresponds to a depreciation of domestic currency, whereas a decrease characterizes an appreciation. Following Gunter (2019), we assume that purchasing power parity and international law of one price hold for tradable consumption goods.

In a similar spirit to Albonico et al. (2019), from the U.S. perspective, the U.S. terms of trade $TT_{U,t}$ quantifies the ratio of the export consumption price index $P_{C,F,t}$, which is charged by U.S. final goods firms to China's households, to the import consumption price index $P_{U,F,t}X_{U,t}$, which is charged by China's final goods firms to U.S. households, and measures the ratio of imported foreign consumption goods $C_{U,F,t}$ to exported domestic consumption goods $C_{C,F,t}$:

$$TT_{U,t} = \frac{P_{C,F,t}}{P_{U,F,t}X_{U,t}} = \frac{C_{U,F,t}}{C_{C,F,t}} \tag{33}$$

where the export price index equals the U.S. export consumption good price $P_{C,F,t}$ to China, and the import price index equals China's export consumption good price $P_{U,F,t}$ to the U.S. adjusted by the U.S. nominal exchange rate $X_{U,t}$.

Analogously, from China's perspective, China's terms of trade $TT_{C,t}$ quantifies the ratio of the export consumption price index $P_{U,F,t}$, which is charged by China's final goods firms to U.S. households, to the import consumption price index $P_{C,F,t}X_{C,t}$, which is charged by U.S. final goods firms to China's households, and measures the ratio of imported foreign consumption goods $C_{C,F,t}$ to exported domestic consumption goods $C_{U,F,t}$:

[6] Log-linearized money supply growth rate $g_{C,MS,t} = log\left(\frac{MS_{C,t}}{\overline{MS}_C}\right) - log\left(\frac{MS_{C,t-1}}{\overline{MS}_C}\right)$. Analogous to the U.S. case, the inflation gap $\pi_{C,t} = \pi_{C,t-1,t} - \upsilon_{C,\pi,t}$ quantifies the deviation of inflation $\pi_{C,t-1,t}$ from the inflation target $\upsilon_{C,\pi,t}$, and the output gap $y_{C,t} = lnY_{C,t} - lnY^*_C$ measures the deviation of output $Y_{C,t}$ from its frictionless level Y^*_C.

$$TT_{C,t} = \frac{P_{U,F,t}}{P_{C,F,t}X_{C,t}} = \frac{C_{C,F,t}}{C_{U,F,t}} \tag{34}$$

where the export price index equals China's export consumption good price $P_{U,F,t}$ to the U.S., and the import price index equals the U.S. export consumption good price $P_{C,F,t}$ to China adjusted by China's nominal exchange rate $X_{C,t}$.

The U.S. net exports $NX_{U,t}$ to China equal the U.S. exported consumption goods $C_{C,F,t}$ to China minus the U.S. imported consumption goods $C_{U,F,t}$ from China adjusted by the U.S. real exchange rate $RX_{U,t}$.

$$NX_{U,t} = C_{C,F,t} - C_{U,F,t}RX_{U,t} \tag{35}$$

China's net exports $NX_{C,t}$ to the U.S. equal China's exported consumption goods $C_{U,F,t}$ to the U.S. minus China's imported consumption goods $C_{C,F,t}$ from the U.S. adjusted by China's real exchange rate $RX_{C,t}$.

$$NX_{C,t} = C_{U,F,t} - C_{C,F,t}RX_{C,t} \tag{36}$$

The U.S. net foreign assets quantify the wedge between the U.S. holdings of China's government bonds $\left(\frac{B_{C,F,t+1}RX_{C,t}}{R_{C,D,t}} - B_{C,F,t}RX_{C,t}\right)$, which equal China's government bonds $\frac{B_{C,F,t+1}RX_{C,t}}{R_{C,D,t}}$ sold to the U.S. minus China's buyback of government bonds $B_{C,F,t}RX_{C,t}$ from the U.S., and China's holdings of the U.S. government bonds $\left(\frac{B_{U,F,t+1}}{R_{U,D,t}} - B_{U,F,t}\right)$, which equal the U.S. government bonds $\frac{B_{U,F,t+1}}{R_{U,D,t}}$ sold to China minus the U.S. buyback of government bonds $B_{U,F,t}$ from China. The U.S. net exports $NX_{U,t}$ to China accord with the U.S. net foreign assets:

$$NX_{U,t} = \frac{B_{C,F,t+1}RX_{C,t}}{R_{C,D,t}} - B_{C,F,t}RX_{C,t} - \left(\frac{B_{U,F,t+1}}{R_{U,D,t}} - B_{U,F,t}\right) \tag{37}$$

Likewise, China's net foreign assets quantify the wedge between China's holdings of the U.S. government bonds $\left(\frac{B_{U,F,t+1}RX_{U,t}}{R_{U,D,t}} - B_{U,F,t}RX_{U,t}\right)$, which equal the U.S. government bonds $\frac{B_{U,F,t+1}RX_{U,t}}{R_{U,D,t}}$ sold to China minus the U.S. buyback of government bonds $B_{U,F,t}RX_{U,t}$ from China, and the U.S. holdings of China's government bonds $\left(\frac{B_{C,F,t+1}}{R_{C,D,t}} - B_{C,F,t}\right)$, which equal China's government bonds $\frac{B_{C,F,t+1}}{R_{C,D,t}}$ sold to the U.S. minus China's buyback of government bonds $B_{C,F,t}$ from the U.S. China's net exports $NX_{C,t}$ to the U.S. accord with China's net foreign assets:

$$NX_{C,t} = \frac{B_{U,F,t+1}RX_{U,t}}{R_{U,D,t}} - B_{U,F,t}RX_{U,t} - \left(\frac{B_{C,F,t+1}}{R_{C,D,t}} - B_{C,F,t}\right) \tag{38}$$

Along the lines of Fama (1984), Gupta and Steinbach (2013), Alpanda and Aysun (2014), Engle (2016), and Chinn and Zhang (2018), uncovered interest rate parity, which ensures no arbitrage between domestic and foreign government bonds, postulates that the wedge between expected future exchange rate $E_tRX_{C,t+1}$ and current exchange rate $RX_{C,t}$ equals the sum of the real interest rate spread, which quantifies the gap between China's real interest rate $(R_{C,D,t} - E_t\pi_{C,t,t+1})$ and the U.S. real interest rate $(R_{U,D,t} - E_t\pi_{U,t,t+1})$, and the international risk premium shock $\upsilon_{RP,t}$. The international risk premium shock, which follows an AR(1) process in logs with an innovation $\varepsilon_{RP,t} \sim i.i.d.N(0, \sigma_{RP}^2)$, captures a time-varying exchange rate premium underlying international assets and conveys capital flow controls, reflecting exogenous variation in international financial market conditions.

$$E_tRX_{C,t+1} = RX_{C,t} + \left(R_{C,D,t} - E_t\pi_{C,t,t+1}\right) - \left(R_{U,D,t} - E_t\pi_{U,t,t+1}\right) + \upsilon_{RP,t} \tag{39}$$

2.11. Market clearance

Final goods market equilibrium balances between final goods production $Y_{x,t}$ and final goods demand, which includes the monitoring cost $\mu_x G_t\left(\overline{\gamma}_{x,E,t}\right)R_{x,K,t}\frac{Q_{x,t-1}\overline{K}_{x,t}}{P_{x,t}}$, investment adjustment cost $\frac{\upsilon_{x,O,t}X(CU_{x,K,t})\overline{K}_{x,t}}{\gamma_{x,I}^t}$, entrepreneur bankrupt cost $\Theta_x\left(1 - \upsilon_{x,\gamma,t}\right)\frac{\overline{N}_{x,t+1} - W_{x,E,t}}{\upsilon_{x,\gamma,t}P_{x,t}}$, domestic household consumption of domestic goods $C_{x,D,t}$, government expenditure $G_{x,t}$, capital good investment $\frac{1}{\gamma_{x,I}^t\upsilon_{x,Q,t}}I_{x,t}$, and net exports $NX_{x,t}$:

$$\begin{aligned} Y_{x,t} &= \mu_x G_t\left(\overline{\gamma}_{x,E,t}\right)R_{x,K,t}\frac{Q_{x,t-1}\overline{K}_{x,t}}{P_{x,t}} + \frac{\upsilon_{x,O,t}X\left(CU_{x,K,t}\right)\overline{K}_{x,t}}{\gamma_{x,I}^t} \\ &+ \Theta_x\left(1 - \upsilon_{x,\gamma,t}\right)\frac{\overline{N}_{x,t+1} - W_{x,E,t}}{\upsilon_{x,\gamma,t}P_{x,t}} + C_{x,D,t} + G_{x,t} + \frac{1}{\gamma_{x,I}^t\upsilon_{x,Q,t}}I_{x,t} + NX_{x,t} \end{aligned} \tag{40}$$

where Θ_x is the fraction of net worth used by bankrupt entrepreneurs, $\frac{1}{\gamma_{x,I}^t\upsilon_{x,Q,t}}$ is the relative price of investment goods.

Labor market equilibrium requires that labor $\int_0^1 H_{x,i,t}di$ supplied by households equals labor $\int_0^1 H_{x,j,t}dj$ demanded by domestic intermediate goods firms:

$$\int_0^1 H_{x,i,t}di = \int_0^1 H_{x,j,t}dj \tag{41}$$

Capital market equilibrium requires that capital services $K_{x,t}$provided by entrepreneurs accord with capital services $\int_0^1 K_{x,j,t}dj$ demanded by intermediate goods firms:

$$K_{x,t} = \int_0^1 K_{x,j,t}dj \tag{42}$$

Bond market equilibrium ensures the U.S. net foreign asset holdings $\left[\frac{B_{C,F,t+1}RX_{C,t}}{R_{C,D,t}} - B_{C,F,t}RX_{C,t} - \left(\frac{B_{U,F,t+1}}{R_{U,D,t}} - B_{U,F,t}\right)\right]$ and China's net foreign asset holdings $\left[\frac{B_{U,F,t+1}RX_{U,t}}{R_{U,D,t}} - B_{U,F,t}RX_{U,t} - \left(\frac{B_{C,F,t+1}}{R_{C,D,t}} - B_{C,F,t}\right)\right]$ sum up to zero:

$$\begin{aligned}&\frac{B_{C,F,t+1}RX_{C,t}}{R_{C,D,t}} - B_{C,F,t}RX_{C,t} - \left(\frac{B_{U,F,t+1}}{R_{U,D,t}} - B_{U,F,t}\right)\\&+\frac{B_{U,F,t+1}RX_{U,t}}{R_{U,D,t}} - B_{U,F,t}RX_{U,t} - \left(\frac{B_{C,F,t+1}}{R_{C,D,t}} - B_{C,F,t}\right) = 0\end{aligned} \tag{43}$$

The first order conditions and clearance of all markets lead to a general equilibrium, and the non-linear system is log-linearized around its steady state.

3. Calibration and prior distributions of parameters

We calibrate a subset of parameters for a quarterly frequency based on the literature, microeconomic data, and long-term averages of macroeconomic aggregates in Table 1. Fixed cost parameters ϕ_U and ϕ_C are calibrated so that the U.S. and China's equilibrium intermediate good profits are zero, making sure fixed cost do not vanish along balanced growth paths. Prior distributions of the remaining parameters are given in Tables 2 and 3 when reporting results below. Due to different industrial structures and policy implementations, we distinguish between the U.S. and China's economies mainly via calibrating parameters, in particular, capital shares of intermediate goods production, capital depreciation rates, investment adjustment speed, the steady-state ratios of government spending to final goods production, the steady-state gross inflation targets, labor income tax rates, consumption tax rates, and capital tax rates. We also capture different monetary policy tools through model specification.

4. Data structure

To prevent stochastic singularity and utilize data information, we select observed variables to identify the DSGE structural shocks in Appendix I. We concentrate on the U.S. and China's quarterly data ranging from 1998Q1 to 2022Q2.[7] For the U.S., observed variables include GDP growth rate $\Delta lnY_{U,t}$, personal consumption expenditure growth rate $\Delta lnC_{U,t}$, gross private domestic investment growth rate $\Delta lnI_{U,t}$, employment growth rate $\Delta lnH_{U,t}$, wage growth rate $\Delta lnW_{U,t}$, the S&P 500 Index growth rate $\Delta ln\overline{N}_{U,t}$, total bank loan growth rate $\Delta lnL_{U,t}$, capital price growth rate $\Delta lnQ_{U,t}$, government consumption expenditure and investment growth rate $\Delta lnG_{U,t}$, M2 monetary aggregate growth rate $\Delta lnM_{U,t}$, capacity utilization $U_{U,t}$, inflation $\Pi_{U,t}$, and effective federal funds rate $R_{U,t}$.[8] For China, observed variables include GDP growth rate $\Delta lnY_{C,t}$, household consumption growth rate $\Delta lnC_{C,t}$, business investment growth rate $\Delta lnI_{C,t}$, employment growth rate $\Delta lnH_{C,t}$, wage growth rate $\Delta lnW_{C,t}$, the SSE Composite Index growth rate $\Delta ln\overline{N}_{C,t}$, total bank loan growth rate $\Delta lnL_{C,t}$, capital price growth rate $\Delta lnQ_{C,t}$, government consumption expenditure and investment growth rate $\Delta lnG_{C,t}$, M2 monetary aggregate growth rate $\Delta lnM_{C,t}$, production capacity utilization $U_{C,t}$, required reserve ratio RR_t, Repo 7-day rate $R_{C,t}$, and inflation $\Pi_{C,t}$. Capacity utilization, inflation, reserve ratio, and interest rates are stationary. Growth rates of output, consumption, investment, employment, wages, stock prices, loans, capital prices, money, and government spending are anchored to the capital-embodied persistent technology growth rate $\upsilon^*_{x,A,t}$.

Data for GDP, consumption, investment, employment, wages, stock market indices, bank loans, capital prices, government expenditure, inflation, money supply, and capacity utilization identify structural shocks to technology $\upsilon_{x,A,t}$, intertemporal preferences $\upsilon_{x,P,t}$, marginal efficiency of investment $\upsilon_{x,I,t}$, labor supply $\upsilon_{x,H,t}$, price markups $\upsilon_{x,Y,t}$, financial wealth $\upsilon_{x,\gamma,t}$, entrepreneurial risk $\upsilon_{x,E,t}$, capital prices $\upsilon_{x,Q,t}$, government spending $\upsilon_{x,G,t}$, the inflation target $\upsilon_{x,\pi,t}$, money holdings $\upsilon_{x,M,t}$, and energy prices $\upsilon_{x,O,t}$, respectively.

[7] The U.S. data stems from Federal Reserve Bank of St. Louis, CEIC, and Wind databases. China's data includes updated data from Chang, Chen, Waggoner, and Zha (2016), Chen, Higgins, Waggoner, and Zha (2016), CEIC and Wind databases. To obtain per capita real values, nominal GDP, nominal consumption, nominal investment, nominal wage, and M2 are deflated by GDP Deflator and population, total bank loans are adjusted by population. All data series are seasonally adjusted. All variables except interest rates, capacity utilization, reserve ratio, and inflation are transformed into log-differences to ensure stationarity. All data are not percentualized.

[8] Inflation is measured as the log-difference of the GDP Implicit Price Deflator.

CNY/USD exchange rate growth rate $\Delta lnX_{C,t}$ identifies the risk premium shock $\upsilon_{RP,t}$. Effective federal funds rate $R_{U,t}$ identifies the U.S. interest rate shock $\upsilon_{U,R,t}$. China's net exports to the U.S. growth rate ΔlnT_t identifies the trade shock $\upsilon_{T,t}$. China's required reserve ratio RR_t and Repo 7-day rate $R_{C,t}$ identify China's reserve ratio shock $\upsilon_{C,\tau,t}$ and money supply shock $\upsilon_{C,MS,t}$, respectively. Given major differences between the economies of the U.S. and China, we assume independent common trends for the U.S. and China, but that the U.S.-China trade balance growth rate is stationary. Observed series are connected with state variables of the log-linearized DSGE model via the matrix of linearized measurement equations:

$$
\begin{bmatrix} \Delta lnY_{U,t} \\ \Delta lnY_{C,t} \\ \Delta lnC_{U,t} \\ \Delta lnC_{C,t} \\ \Delta lnI_{U,t} \\ \Delta lnI_{C,t} \\ \Delta lnH_{U,t} \\ \Delta lnH_{C,t} \\ \Delta lnW_{U,t} \\ \Delta lnW_{C,t} \\ \Delta ln\overline{N}_{U,t} \\ \Delta ln\overline{N}_{C,t} \\ \Delta lnL_{U,t} \\ \Delta lnL_{C,t} \\ \Delta lnQ_{U,t} \\ \Delta lnQ_{C,t} \\ \Delta lnG_{U,t} \\ \Delta lnG_{C,t} \\ \Delta lnM_{U,t} \\ \Delta lnM_{C,t} \\ U_{U,t} \\ U_{C,t} \\ \Pi_{U,t} \\ \Pi_{C,t} \\ R_{U,t} \\ R_{C,t} \\ RR_t \\ \Delta lnX_{C,t} \\ \Delta lnT_t \end{bmatrix} = \begin{bmatrix} \Delta ln\overline{Y}_U \\ \Delta ln\overline{Y}_C \\ \Delta ln\overline{C}_U \\ \Delta ln\overline{C}_C \\ \Delta ln\overline{I}_U \\ \Delta ln\overline{I}_C \\ \Delta ln\overline{H}_U \\ \Delta ln\overline{H}_C \\ \Delta ln\overline{W}_U \\ \Delta ln\overline{W}_C \\ \Delta ln\overline{\overline{N}}_U \\ \Delta ln\overline{\overline{N}}_C \\ \Delta ln\overline{L}_U \\ \Delta ln\overline{L}_C \\ \Delta ln\overline{Q}_U \\ \Delta ln\overline{Q}_C \\ \Delta ln\overline{G}_U \\ \Delta ln\overline{G}_C \\ \Delta ln\overline{M}_U \\ \Delta ln\overline{M}_C \\ \overline{U}_U \\ \overline{U}_C \\ \overline{\Pi}_U \\ \overline{\Pi}_C \\ \overline{R}_U \\ \overline{R}_C \\ \overline{RR} \\ \Delta ln\overline{X}_C \\ \Delta ln\overline{T} \end{bmatrix} + \begin{bmatrix} y_{U,t} - y_{U,t-1} \\ y_{C,t} - y_{C,t-1} \\ c_{U,t} - c_{U,t-1} \\ c_{C,t} - c_{C,t-1} \\ i_{U,t} - i_{U,t-1} \\ i_{C,t} - i_{C,t-1} \\ h_{U,t} - h_{U,t-1} \\ h_{C,t} - h_{C,t-1} \\ w_{U,t} - w_{U,t-1} \\ w_{C,t} - w_{C,t-1} \\ \overline{n}_{U,t} - \overline{n}_{U,t-1} \\ \overline{n}_{C,t} - \overline{n}_{C,t-1} \\ l_{U,E,t} - l_{U,E,t-1} \\ l_{C,E,t} - l_{C,E,t-1} \\ q_{U,t} - q_{U,t-1} \\ q_{C,t} - q_{C,t-1} \\ g_{U,t} - g_{U,t-1} \\ g_{C,t} - g_{C,t-1} \\ ms_{U,t} - ms_{U,t-1} \\ ms_{C,t} - ms_{C,t-1} \\ cu_{U,K,t} \\ cu_{C,K,t} \\ \pi_{U,t} \\ \pi_{C,t} \\ r_{U,E,t} \\ r_{C,E,t} \\ \tau\tau_t \\ x_{C,t} - x_{C,t-1} \\ nx_{C,t} - nx_{C,t-1} \end{bmatrix} + \begin{bmatrix} \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ \nu^*_{U,A,t} \\ \nu^*_{C,A,t} \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{bmatrix} \tag{44}
$$

where observed variables with bars are sample means. For the U.S., log-linearized series $\nu^*_{U,A,t}, y_{U,t}, c_{U,t}, i_{U,t}, h_{U,t}, w_{U,t}, \overline{n}_{U,t}, l_{U,E,t}, q_{U,t}, g_{U,t}$, and $ms_{U,t}$ refer, respectively, to log deviations of the capital-embodied persistent technology growth rate $\upsilon^*_{U,A,t}$, final goods production $Y_{U,t}$, consumption $C_{U,t}$, investment $I_{U,t}$, labor $H_{U,t}$, wages $W_{U,t}$, net worth $\overline{N}_{U,t}$, entrepreneurial loans $L_{U,E,t}$, capital prices $Q_{U,t}$, government spending $G_{U,t}$, and money supply $MS_{U,t}$ from steady state values $\overline{\upsilon}^*_{U,A}, \overline{Y}_U, \overline{C}_U, \overline{I}_{U,t}, \overline{H}_U, \overline{W}_U, \overline{\overline{N}}_U, \overline{L}_{U,E}, \overline{Q}_U, \overline{G}_U$, and $\overline{MS}_U$, respectively, $cu_{U,K,t}$ is deviation of capacity utilization $CU_{U,K,t}$ from steady state value $\overline{CU}_{U,K}$, $\pi_{U,t}$ is deviation of inflation $\pi_{U,t-1,t}$ from target $\overline{\upsilon}_{U,\pi}$, $r_{U,D,t}$ is deviation of deposit interest rate $R_{U,D,t}$ from steady state value $\overline{R}_{U,D}$. For China, log-linearized series $\nu^*_{C,A,t}, y_{C,t}, c_{C,t}, i_{C,t}, h_{C,t}, w_{C,t}, \overline{n}_{C,t}, l_{C,E,t}$, $q_{C,t}, g_{C,t}$, and $ms_{C,t}$ refer, respectively, to log deviations of the capital-embodied persistent technology growth rate $\upsilon^*_{C,A,t}$, final goods production $Y_{C,t}$, consumption $C_{C,t}$, investment $I_{C,t}$, employment $H_{C,t}$, wages $W_{C,t}$, net worth $\overline{N}_{C,t}$, entrepreneurial loans $L_{C,E,t}$, capital prices $Q_{C,t}$, government spending $G_{C,t}$, and money supply $MS_{C,t}$ from steady state values $\overline{\upsilon}^*_{C,A}, \overline{Y}_C, \overline{C}_C, \overline{I}_{C,t}, \overline{H}_C, \overline{W}_C, \overline{\overline{N}}_C, \overline{L}_{C,E}, \overline{Q}_C, \overline{G}_C$, and $\overline{MS}_C$, respectively, $cu_{C,K,t}$ is deviation of capacity utilization $CU_{C,K,t}$ from steady state value $\overline{CU}_{C,K}$, $\pi_{C,t}$ is deviation of inflation $\pi_{C,t-1,t}$ from target $\overline{\upsilon}_{C,\pi}$, $r_{C,D,t}$ is deviation of deposit interest rate $R_{C,D,t}$ from steady state value $\overline{R}_{C,D}$. Log-linearized series $x_{C,t}$ is log deviation of China's exchange rate $X_{C,t}$ from steady state value $\overline{X}_C$. Log-linearized series $nx_{C,t}$ is log deviation of China's net exports $NX_{C,t}$ to the U.S. from steady state value $\overline{NX}_C$.

Table 1
Calibration of parameters.

Structural Parameter Description	The U.S.		China	
	Symbol	Value	Symbol	Value
Intertemporal discount factor	β_U	0.9987	β_C	0.995
Capital share of intermediate goods production	α_U	0.3	α_C	0.5
Capital depreciation rate	$\delta_{U,K}$	0.025	$\delta_{C,K}$	0.035
Fixed cost of intermediate goods production	ϕ_U	0.07	ϕ_C	0.07
The trend of investment technological advancement	$\gamma_{U,I}$	1.0035	$\gamma_{C,I}$	1.0035
Steady-state 'start-up' transfer of net worth	$\overline{W}_{U,E}$	0.005	$\overline{W}_{C,E}$	0.005
Investment adjustment speed	ι_U	2	ι_C	2
Steady-state capital utilization rate	$\overline{U}_{U,K}$	1	$\overline{U}_{C,K}$	1
Fraction of entrepreneurs' total net worth consumed when exiting	Θ_U	0.1	Θ_C	0.1
Steady-state ratio of government spending to final goods production	$\frac{\overline{G}_U}{\overline{Y}_U}$	0.2	$\frac{\overline{G}_C}{\overline{Y}_C}$	0.15
Steady-state aggregate price index	$\overline{P}^*_U$	1	$\overline{P}^*_C$	1
Steady-state aggregate wage index	$\overline{W}^*_U$	1	$\overline{W}^*_C$	1
Steady-state price mark-up shock	$\overline{\upsilon}_{U,Y}$	1.2	$\overline{\upsilon}_{C,Y}$	1.2
Steady-state wage mark-up	$\lambda_{U,W}$	1.05	$\lambda_{C,W}$	1.05
Steady-state quarterly gross inflation target	$\overline{\upsilon}_{U,\pi}$	1.005	$\overline{\upsilon}_{C,\pi}$	1.0074
Labor income tax rate	$\tau_{U,H}$	0.24	$\tau_{C,H}$	0.2
Consumption tax rate	$\tau_{U,C}$	0.05	$\tau_{C,C}$	0.05
Capital tax rate	$\tau_{U,K}$	0.28	$\tau_{C,K}$	0.2

Note: The U.S. steady-state annual gross inflation target $1.02=\overline{\upsilon}^4_{U,\pi}$, steady-state quarterly gross inflation target $\overline{\upsilon}_{U,\pi} = 1.005$. China's steady-state annual gross inflation target $1.03=\overline{\upsilon}^4_{C,\pi}$, quarterly gross inflation target $\overline{\upsilon}_{C,\pi} = 1.0074$.

5. Prior and posterior distributions for parameters

The Bayesian DSGE model is estimated using Dynare in MatLab. We evaluate the likelihood using the Kalman filter, combine the likelihood and prior distributions to calculate posterior distributions, and simulate from the posterior kernel using an MCMC sampling algorithm. Based on trace plots and multivariate MCMC diagnostics, Markov chains converge to ergodic distributions. Following Ivashchenko and Mutschler (2020), we apply the Random-Walk Metropolis–Hastings sampling algorithm based on four Markov chains each with 100000000000 draws, half of which are discarded as burn-in draws in each chain. Following Iskrev (2010), Komunjer and Ng (2011), and Qu and Tkachenko (2012), we have calculated the rank of the Hessian and the rank of the Jacobian of the steady-state and reduced-form solution matrices for our DSGE model using Dynare, and the identification analysis suggests that all estimated parameters are identified.

Tables 2 and 3 present prior means, prior standard deviations, posterior means, and 90% highest probability density intervals for the estimated U.S. and China's parameters, respectively. The priors for Calvo price probability $\gamma_{x,P}$ and Calvo wage probability $\gamma_{x,W}$ are assumed to follow beta distributions with means 0.5 and 0.75, respectively, implying that prices and wages are reoptimized on average once every 2 and 4 quarters, respectively. In comparison between Tables 2 and 3, the estimated monitoring cost $\widehat{\mu}_C$ for China is 0.077, whose 90% posterior interval is [0.056, 0.099], and it is significantly larger than the estimated U.S. monitoring cost $\widehat{\mu}_U$ of 0.047, whose 90% posterior interval is [0.031, 0.064], at a 10% significance level.[9] The estimated entrepreneurial risk shock's standard deviation $\widehat{\sigma}_{C,E}$ for China is 0.131, whose 90% posterior interval is [0.109, 0.152], and it is significantly larger than the estimated U.S. entrepreneurial risk shock's standard deviation $\widehat{\sigma}_{U,E}$ of 0.091, whose 90% posterior interval is [0.078, 0.102].

6. Impulse response analysis

Impulse response analysis traces out percentage divergences of endogenous variables from steady state values in response to structural shocks. In Figs. 2 and 3, the impulse responses illustrate expected future paths of endogenous variables for specific sizes of structural shocks over a 20-quarter horizon, and are elucidated with parameters estimated at posterior means. The thick black solid lines are the mean impulse responses of the baseline DSGE model, with Bayesian 90% posterior bands captured by the grey regions surrounding them. To examine the influence of monitoring cost μ_x on financial acceleration, we simulate impulse responses of the main macroeconomic aggregates to key structural shocks based on two different versions of the DSGE model, which are specified with positive monitoring cost and zero monitoring cost, respectively. The thick black solid and red dash lines represent impulse responses with positive monitoring cost and zero monitoring cost, respectively. Since 2018 Q2, additional tariffs and investment restrictions have been imposed on the U.S.-China trade, provoking trade frictions, expectation changes, and macroeconomic fluctuations. To assess impacts of the U.S.-China trade conflict upon financial acceleration, we simulate impulse responses of the main macroeconomic

[9] Christiano et al. (2010)'s calibrated monitoring cost is 0.06.

Table 2
Prior and posterior distributions for the U.S. structural parameters.

Sector	Parameter Description	Symbol	Prior Distribution	Posterior Mean	Posterior Bands [5*th*, 95*th*]
Households	Habit persistence	ω_U	B(0.5,0.2)	0.473	$[0.460, 0.487]$
	Inverse of Frisch labor supply elasticity	$\eta_{U,H}$	N(1,1)	1.391	$[1.366, 1.420]$
	Curvature on utility of money holdings	$\eta_{U,M}$	N(1,1)	0.475	$[0.445, 0.505]$
	Bias towards foreign consumption goods	φ_U	B(0.3,0.2)	0.320	$[0.308, 0.342]$
	Elasticity of intratemporal consumption substitution	ς_U	IG(2,1)	1.679	$[1.649, 1.710]$
Labor Contractors	Calvo wage probability	$\gamma_{U,W}$	B(0.75,0.05)	0.733	$[0.721, 0.746]$
	Wage indexation	$\xi_{U,W}$	B(0.5,0.15)	0.538	$[0.526, 0.549]$
	Weight on the capital-embodied technology growth	$\vartheta_{U,A}$	B(0.5,0.2)	0.480	$[0.458, 0.502]$
Firms	Calvo price probability	$\gamma_{U,P}$	B(0.5,0.2)	0.535	$[0.501, 0.576]$
	Price indexation	$\xi_{U,P}$	B(0.5,0.15)	0.517	$[0.499, 0.537]$
Central Bank	Monetary policy inertia	$\rho_{U,R}$	B(0.75,0.15)	0.638	$[0.626, 0.649]$
	Response to inflation gap	$\phi_{U,\pi}$	G(1.5,0.25)	1.484	$[1.471, 1.496]$
	Response to output gap	$\phi_{U,Y}$	G(0.25,0.2)	0.279	$[0.263, 0.296]$
Commercial Banks	Monitoring cost rate	μ_U	B(0.06,0.05)	0.047	$[0.031, 0.064]$
Central Bank	Monetary policy inertia	$\rho_{U,R}$	B(0.75,0.15)	0.691	$[0.658, 0.723]$
	Response to inflation gap	$\phi_{U,\pi}$	G(1.5,0.25)	1.477	$[1.455, 1.499]$
	Response to output gap	$\phi_{U,Y}$	G(0.25,0.2)	0.296	$[0.274, 0.317]$
AR(1) Coefficients of Shocks	Intertemporal preference	$\rho_{U,P}$	B(0.5,0.2)	0.497	$[0.474, 0.519]$
	Persistent technology	$\rho_{U,A}$	B(0.5,0.2)	0.358	$[0.335, 0.381]$
	Final good price markup	$\rho_{U,Y}$	B(0.5,0.2)	0.484	$[0.462, 0.506]$
	Labor supply	$\rho_{U,H}$	B(0.5,0.2)	0.607	$[0.584, 0.629]$
	Money holdings	$\rho_{U,M}$	B(0.5,0.2)	0.427	$[0.405, 0.449]$
	Investment	$\rho_{U,I}$	B(0.5,0.2)	0.636	$[0.614, 0.658]$
	Entrepreneurial risk	$\rho_{U,E}$	B(0.5,0.2)	0.373	$[0.350, 0.396]$
	Energy price	$\rho_{U,O}$	B(0.5,0.2)	0.366	$[0.343, 0.388]$
	Financial wealth	$\rho_{U,\gamma}$	B(0.5,0.2)	0.651	$[0.629, 0.674]$
	Capital price	$\rho_{U,Q}$	B(0.5,0.2)	0.341	$[0.319, 0.364]$
	Government spending	$\rho_{U,G}$	B(0.5,0.2)	0.623	$[0.602, 0.645]$
	Inflation target	$\rho_{U,\pi}$	B(0.9,0.05)	0.810	$[0.790, 0.831]$
	Trade	ρ_T	B(0.5,0.1)	0.608	$[0.585, 0.632]$
MA(1) Coefficient of Shock	Final good price markup	$\Psi_{U,Y}$	B(0.5,0.2)	0.619	$[0.495, 0.743]$
	Intertemporal preference	$\sigma_{U,P}$	IG(0.01,2)	0.072	$[0.057, 0.088]$
	Persistent technology	$\sigma_{U,A}$	IG(0.01,2)	0.043	$[0.029, 0.057]$
	Final good price markup	$\sigma_{U,Y}$	IG(0.01,2)	0.066	$[0.052, 0.082]$
	Labor supply	$\sigma_{U,H}$	IG(0.01,2)	0.034	$[0.022, 0.046]$
	Money holdings	$\sigma_{U,M}$	IG(0.01,2)	0.045	$[0.030, 0.058]$
	Investment	$\sigma_{U,I}$	IG(0.01,2)	0.079	$[0.059, 0.098]$
	Entrepreneurial risk	$\sigma_{U,E}$	IG(0.01,2)	0.091	$[0.078, 0.102]$
	Energy price	$\sigma_{U,O}$	IG(0.01,2)	0.084	$[0.068, 0.104]$
	Financial wealth	$\sigma_{U,\gamma}$	IG(0.01,2)	0.032	$[0.020, 0.044]$
	Capital price	$\sigma_{U,Q}$	IG(0.01,2)	0.098	$[0.079, 0.119]$
	Government spending	$\sigma_{U,G}$	IG(0.01,2)	0.061	$[0.045, 0.079]$
	Inflation target	$\sigma_{U,\pi}$	IG(0.01,2)	0.051	$[0.037, 0.064]$
	Monetary policy	$\sigma_{U,R}$	IG(0.01,2)	0.095	$[0.072, 0.118]$
	Trade	σ_T	IG(0.01,2)	0.067	$[0.042, 0.093]$

Note: Symbols B, U, N, G, and IG refer, respectively, to beta, uniform, normal, gamma, and inverse gamma distributions. Prior means and prior standard deviations are in brackets. ∞ denotes infinity. [5th,95th] posterior percentiles are 90% highest probability densities. In sensitivity analysis, posterior distributions are robust to changes in prior distributions.

Table 3
Prior and posterior distributions for China's structural parameters.

Sector	Parameter Description	Symbol	Prior Distribution	Posterior Mean	Posterior Bands[5*th*, 95*th*]
Households	Habit persistence	ω_C	B(0.5,0.2)	0.642	[0.631, 0.654]
	Inverse of Frisch labor supply elasticity	$\eta_{C,H}$	N(1,1)	1.324	[1.298, 1.349]
	Curvature on utility of money holdings	$\eta_{C,M}$	N(1,1)	0.665	[0.640, 0.691]
	Bias towards foreign consumption goods	φ_C	B(0.3,0.2)	0.401	[0.380, 0.423]
	Elasticity of intratemporal consumption substitution	ς_C	IG(2,1)	1.836	[1.803, 1.870]
Labor Contractors	Calvo wage probability	$\gamma_{C,W}$	B(0.75,0.05)	0.760	[0.747, 0.774]
	Wage indexation	$\xi_{C,W}$	B(0.5,0.15)	0.447	[0.435, 0.458]
	Weight on the capital-embodied technology growth	$\vartheta_{C,A}$	B(0.5,0.2)	0.603	[0.580, 0.625]
Firms	Calvo price probability	$\gamma_{C,P}$	B(0.5,0.2)	0.604	[0.573, 0.637]
	Price indexation	$\xi_{C,P}$	B(0.5,0.15)	0.558	[0.541, 0.572]
Commercial Banks	Monitoring cost rate	μ_C	B(0.06,0.05)	0.077	[0.056, 0.099]
Central Bank	Money supply growth inertia	$\rho_{C,MS}$	B(0.75,0.15)	0.802	[0.758, 0.841]
	Response to inflation gap	$\phi_{C,\pi}$	G(1.5,0.25)	1.468	[1.445, 1.491]
	Response to output gap	$\phi_{C,Y}$	G(0.5,0.25)	0.386	[0.364, 0.408]
AR(1) Coefficients of Shocks	Intertemporal preference	$\rho_{C,P}$	B(0.5,0.2)	0.628	[0.605, 0.652]
	Persistent technology	$\rho_{C,A}$	B(0.5,0.2)	0.425	[0.404, 0.446]
	Final good price markup	$\rho_{C,Y}$	B(0.5,0.2)	0.614	[0.457, 0.473]
	Labor supply	$\rho_{C,H}$	B(0.5,0.2)	0.643	[0.592, 0.635]
	Money holdings	$\rho_{C,M}$	B(0.5,0.2)	0.442	[0.419, 0.465]
	Investment	$\rho_{C,I}$	B(0.5,0.2)	0.677	[0.653, 0.699]
	Entrepreneurial risk	$\rho_{C,E}$	B(0.5,0.2)	0.396	[0.375, 0.418]
	Energy price	$\rho_{C,O}$	B(0.5,0.2)	0.468	[0.445, 0.492]
	Financial wealth	$\rho_{C,\gamma}$	B(0.5,0.2)	0.656	[0.632, 0.679]
	Capital price	$\rho_{C,Q}$	B(0.5,0.2)	0.365	[0.343, 0.387]
	Government spending	$\rho_{C,G}$	B(0.5,0.2)	0.636	[0.615, 0.657]
	Inflation target	$\rho_{C,\pi}$	B(0.9,0.05)	0.933	[0.912, 0.954]
	Reserve Ratio	$\rho_{C,\tau}$	B(0.5,0.2)	0.868	[0.846, 0.890]
	Risk premium	ρ_{RP}	B(0.5,0.2)	0.632	[0.607, 0.656]
MA(1) Coefficient of Shock	Final good price markup	$\Psi_{C,Y}$	B(0.5,0.2)	0.452	[0.310, 0.594]
Standard Deviation of Innovations	Intertemporal preference	$\sigma_{C,P}$	IG(0.01,2)	0.104	[0.083, 0.129]
	Persistent technology	$\sigma_{C,A}$	IG(0.01,2)	0.035	[0.023, 0.048]
	Final good price markup	$\sigma_{C,Y}$	IG(0.01,2)	0.047	[0.035, 0.060]
	Labor supply	$\sigma_{C,H}$	IG(0.01,2)	0.059	[0.045, 0.073]
	Money holdings	$\sigma_{C,M}$	IG(0.01,2)	0.064	[0.046, 0.081]
	Investment	$\sigma_{C,I}$	IG(0.01,2)	0.107	[0.076, 0.108]
	Entrepreneurial risk	$\sigma_{C,E}$	IG(0.01,2)	0.131	[0.109, 0.152]
	Energy price	$\sigma_{C,O}$	IG(0.01,2)	0.072	[0.050, 0.098]
	Financial wealth	$\sigma_{C,\gamma}$	IG(0.01,2)	0.023	[0.012, 0.033]
	Capital price	$\sigma_{C,Q}$	IG(0.01,2)	0.092	[0.060, 0.125]
	Government spending	$\sigma_{C,G}$	IG(0.01,2)	0.113	[0.095, 0.133]
	Inflation target	$\sigma_{C,\pi}$	IG(0.01,2)	0.034	[0.012, 0.057]
	Reserve Ratio	$\sigma_{C,\tau}$	IG(0.01,2)	0.094	[0.070, 0.118]
	Monetary policy	$\sigma_{C,MS}$	IG(0.01,2)	0.112	[0.099, 0.124]
	Risk premium	σ_{RP}	IG(0.01,2)	0.064	[0.046, 0.081]

Note: Symbols B, U, N, G, and IG refer, respectively, to beta, uniform, normal, gamma, and inverse gamma distributions. Prior means and prior standard deviations are in brackets. ∞ denotes infinity. [5th,95th] posterior percentiles are 90% highest probability densities. In sensitivity analysis, posterior distributions are robust to changes in prior distributions.

aggregates to key structural shocks based on two subsamples: 1998Q1 to 2018Q1 excluding the trade conflict periods, and 1998Q1 to 2022Q2 including the trade conflict periods. The thick black solid and blue dotted lines denote impulse responses affiliated with subsamples 1998Q1-2022Q2 and 1998Q1-2018Q1, respectively.

Figs. 2 and 3 portray impulse responses of the U.S. and China, respectively. In Panel (a) of both figures, response variables include growth rates of output, investment, net worth, and loans in the first to fourth columns. In Panel (b) of both figures, response variables encompass inflation, exchange rate, export growth, and import growth in the first to fourth columns. In each panel, the first to seventh rows depict simulated macroeconomic reaction to 1% increments in shocks to monetary policy, domestic entrepreneurial risk, foreign entrepreneurial risk, investment, technology, preferences, and price markups, respectively. In the first row of both panels in Fig. 2, a positive interest rate shock dampens the U.S. output growth, investment growth, net worth growth, loan growth, inflation, exchange rate, and export growth significantly, although it improves import growth significantly. In the first row of both panels in Fig. 3, a positive money supply shock spurs China's output growth, investment growth, net worth growth, loan growth, inflation, exchange rate, and export growth significantly, although it deteriorates import growth significantly.

The existence of monitoring cost not only magnifies the negative influence of positive domestic entrepreneurial risk shock on macroeconomic fluctuations, but it also amplifies the positive impacts of positive domestic investment and technology shocks on macroeconomic aggregates, strengthening domestic financial acceleration mechanism. Intuitively, in the domestic economy, a higher monitoring cost μ_x raises the entrepreneurial risk premium in Eq. (17), increases entrepreneurial loan cost, and impedes entrepreneurial borrowing, resulting in a decline in investment, a deceleration in capital formation, and a reduction in output. When the impulse response (the red dashed line) affiliated with the DSGE model featuring zero monitoring cost is outside the 90% posterior interval (the grey region) of the mean impulse response associated with the DSGE model characterized by positive monitoring cost, the financial acceleration effect is significant, at a 10% significance level. The estimated size of the financial wealth effect is measured by the gap between the mean impulse response of the DSGE model characterized by positive monitoring cost and the impulse response of the DSGE model featuring zero monitoring cost.

In a similar spirit to Christiano et al. (2014), a positive domestic entrepreneurial risk shock, which conveys a larger cross-sectional dispersion of idiosyncratic domestic firm productivity, creates a higher domestic credit spread by raising the entrepreneurial loan interest premium over the risk-free rate, according to entrepreneurial productivity's log-normal distribution in Eq. (13) and the entrepreneurial risk premium defined in Eq. (17). Banks tighten loans and extend less credit to entrepreneurs, capital goods firms decrease investment and decelerate capital formation, entrepreneurs contract capital stock and deleverage capital structure. These reactions depreciate corporate net worth, shrink output, and discourage exports. Given positive domestic entrepreneurial risk shocks in the second rows of Panel (a) and Panel (b), growth rates of output, investment, net worth, loans, and exports respond negatively and significantly, but import growth reacts positively and significantly. Observing that the red dashed lines are outside the grey regions, at a 10% significance level, U.S. growth rates of output, investment, and loans exhibit significant financial acceleration effects triggered by shocks to domestic entrepreneurial risk, investment, and technology, whereas for China, growth rates of output, investment, and loans display significant financial acceleration effects induced by shocks to domestic entrepreneurial risk, investment, and technology. In particular, growth rates of China's exports and imports show significant financial acceleration effects in response to domestic entrepreneurial risk shocks.

To consider the immediate reaction of each macroeconomic aggregate to a positive structural shock, we estimated the instantaneous gap between the thick black solid line, which represents the DSGE model characterized by positive monitoring cost, and the red line, which signifies the DSGE model featuring zero monitoring cost. The estimated instantaneous gap for the U.S. output response to a domestic entrepreneurial risk shock is 0.16%, whereas the estimated instantaneous gap for China's output response to a domestic entrepreneurial risk shock is 0.2%, implying that the financial acceleration effect of China's entrepreneurial risk shock on output growth is larger than that of the U.S. by 0.04 percentage points. The estimated instantaneous gap for the U.S. output response to an investment shock is 0.19%, whereas the estimated instantaneous gap for China's output response to an investment shock is 0.31%, implying that the financial acceleration effect of China's investment shock on output exceeds that of the U.S. by 0.12 percentage points. The estimated instantaneous gap for the U.S. output response to a technology shock is 0.27%, whereas the estimated instantaneous gap for China's output response to a technology shock is 0.33%, implying that the financial acceleration effect of China's technology shock on output outweighs that of the U.S. by 0.06 percentage points.

Analogously, the estimated instantaneous gap for the U.S. investment response to a domestic entrepreneurial risk shock is 0.12%, whereas the estimated instantaneous gap for China's investment response to a domestic entrepreneurial risk shock is 0.26%, implying that the financial acceleration effect of China's entrepreneurial risk shock on investment is larger than that of the U.S. by 0.14 percentage points. The estimated instantaneous gap for the U.S. investment response to an investment shock is 0.15%, whereas the estimated instantaneous gap for China's investment response to an investment shock is 0.27%, implying that the financial acceleration effect of China's investment shock on investment is larger than that of the U.S. by 0.12 percentage points. The estimated instantaneous gap for the U.S. investment response to a technology shock is 0.18%, whereas the estimated instantaneous gap for China's investment response to a technology shock is 0.3%, implying that the financial acceleration effect of China's technology shock on investment is greater than that of the U.S. by 0.12 percentage points.

To summarize, in comparison with the U.S., China's output and investment growth display larger and more persistent domestic financial acceleration effects triggered by shocks to domestic entrepreneurial risk, investment, and technology. These findings are consistent with Carrière-Swallow and Céspedes (2013)'s conclusions that following an uncertainty shock, emerging economies suffer much more severe falls in investment and consumption, take significantly longer time to recover, and escape experiencing a subsequent overshoot in activity, in comparison with the U.S. and other developed countries. The asymmetric financial acceleration effects can be attributed to asymmetries in the underlying U.S.-China macro-financial relationships, which are described by the two-country specification, captured by the data, calibrated in Table 1, and estimated in Tables 2 and 3. The estimated monitoring cost $\widehat{\mu}_C$ for China is 0.077 and exceeds the estimated U.S. monitoring cost $\widehat{\mu}_U$ of 0.047. The calibrated China's capital share α_C is 0.5 and is higher than the calibrated U.S. capital share α_U of 0.3. The calibrated China's capital depreciation rate δ_C is 0.035 and is also higher than the calibrated U.S. capital depreciation rate δ_U of 0.025.

Comparing between the third rows of both panels in Figs. 2 and 3, a positive foreign entrepreneurial risk shock can be seen to imply a larger cross-sectional dispersion of idiosyncratic foreign firm productivity and a higher foreign credit spread. A larger foreign risk premium restrains foreign loans, discourages foreign investment, and dampens foreign exports. These reactions reduce foreign output, decrease domestic imports, and increase domestic exports, generating expansionary impacts on domestic output. Hence, a positive foreign entrepreneurial risk shock's influence on domestic output growth is positive although insignificant. The insignificance of foreign entrepreneurial risk shock's influence on domestic economy mirrors De Walque, Jeanfils, Lejeune, Rychalovska, and Wouters (2017)'s finding that cross-border spillover effects from foreign shocks are weak in explaining domestic macroeconomic fluctuations.

When a macroeconomic indicator's impulse response (the blue dotted line), which is affiliated with the subsample excluding the U.S.-China trade conflict periods, is outside the 90% posterior interval (the grey region) of the mean impulse response, which is associated with the subsample covering the U.S.-China trade conflict periods, we can interpret that the financial acceleration effect on this macroeconomic indicator is more severe based on the data covering the U.S.-China trade conflict periods, at a 10% significance level. Looking at Figs. 2 and 3, the domestic financial acceleration effects on growth rates of output, investment, and net worth, all of which are triggered by shocks to investment and technology, are significant and more pronounced based on the data covering the U.S.-China trade conflict periods. Intuitively, the U.S.-China trade conflict magnifies entrepreneurial uncertainty and raises domestic monitoring cost, amplifying domestic financial acceleration effects.

7. Historical decompositions

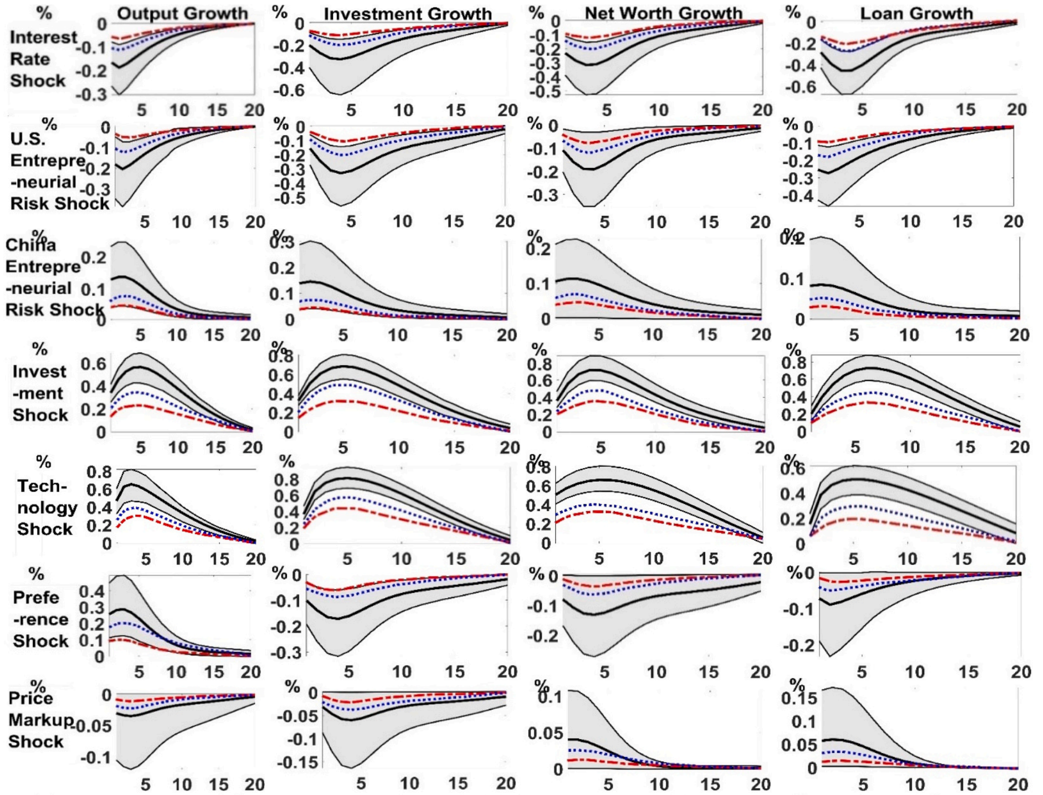
By applying the Kalman smoother to the state space form, we can calculate historical decompositions to provide a structural interpretation of smoothed observed dynamics, which are linear amalgamations of smoothed initial states and estimated structural shocks. In Figs. 4–10, black lines depict percentage deviations of observed variables from steady state values, color bars and grey bars, which are added vertically to yield black lines, capture observed variability attributable to structural shocks and initial states, respectively. Domestic entrepreneurial risk shocks contribute substantially to growth fluctuations of output, consumption, investment, and China's net exports to the U.S. during the Global Financial Crisis and Covid-19 pandemic. Intuitively, entrepreneurial risk shocks are relatively inconsequential in normal times, but their effects on credit markets and economic activities are greatly amplified during episodes of financial stress and economic crisis, when borrowing constraints bind more severely.

In Fig. 4, the U.S. output growth fluctuations are mainly explained by shocks to the U.S. technology, investment efficiency, preferences, entrepreneurial risk, capital prices, and energy prices. The U.S. output growth depresses during the 2008 Global Financial Crisis and falls during the 2020 COVID-19 Pandemic. These downtrends are primarily attributable to domestic entrepreneurial uncertainty, real forces, entrepreneurial survival risk, price risk, and policy uncertainty. Domestic entrepreneurial uncertainty is represented by the U.S. entrepreneurial risk shock. Real forces include shocks to investment efficiency, preferences, and technology. Entrepreneurial survival risk is captured by the financial wealth shock. Price risk contains shocks to capital prices and energy prices. Policy uncertainty encompasses shocks to interest rates and government spending. Impacts of the U.S. entrepreneurial risk shock magnify in financial turmoil and economic crisis.

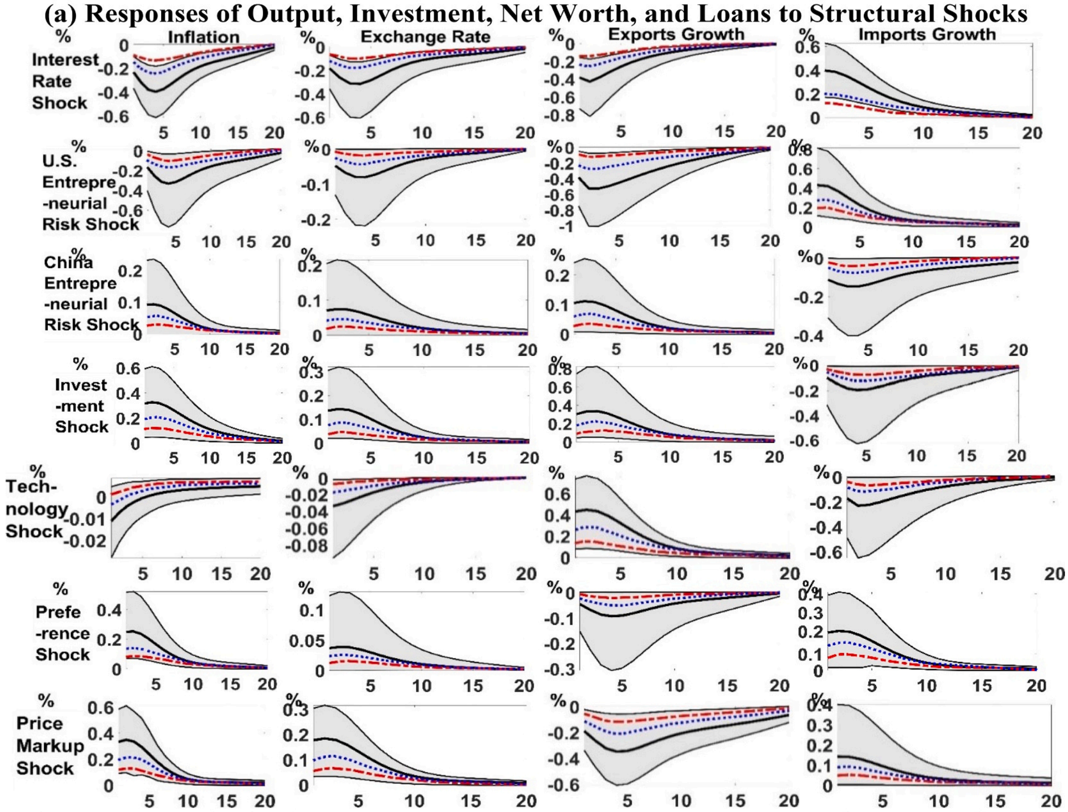
In Fig. 5, China's output growth fluctuations are mainly explained by shocks to China's technology, investment efficiency, preferences, entrepreneurial risk, capital prices, and energy prices. China's output growth depresses during the 2008 Global Financial Crisis and falls during the 2020 COVID-19 Pandemic. These downtrends are primarily attributable to domestic entrepreneurial uncertainty, real forces, entrepreneurial survival risk, price risk, and policy uncertainty. Domestic entrepreneurial uncertainty is signified by China's entrepreneurial risk shock. Real forces incorporate shocks to investment efficiency, preferences, and technology. Entrepreneurial survival risk is reflected by the financial wealth shock. Price risk covers shocks to capital prices and energy prices. Policy uncertainty comprises shocks to money supply, reserve ratio, and government spending. The influence of China's entrepreneurial risk shock amplifies in financial turmoil and economic crisis.

In Fig. 6, the U.S. consumption growth fluctuations are mostly driven by shocks to the U.S. technology, preferences, entrepreneurial risk, price markups, money holdings, labor supply, interest rates, and the inflation target. The U.S. consumption growth decreases during the 2008 Global Financial Crisis and declines during the 2020 COVID-19 Pandemic. These downturns are primarily attributable to domestic entrepreneurial uncertainty, real forces, price risk, and policy uncertainty. Domestic entrepreneurial uncertainty is represented by the U.S. entrepreneurial risk shock. Real forces include shocks to preferences, labor supply, money holdings, and technology. Price risk contains the price markup shock. Policy uncertainty encompasses shocks to interest rates and the inflation target. The U.S. entrepreneurial risk shock contributes moderately to financial turmoil and economic crisis.

In Fig. 7, China's consumption growth fluctuations are mostly driven by shocks to China's preferences, entrepreneurial risk, technology, price markups, money holdings, labor supply, money supply, and the inflation target. China's consumption growth decreases during the 2008 Global Financial Crisis and declines during the 2020 COVID-19 Pandemic. These downturns are primarily attributable to domestic entrepreneurial uncertainty, real forces, price risk, and policy uncertainty. Domestic entrepreneurial

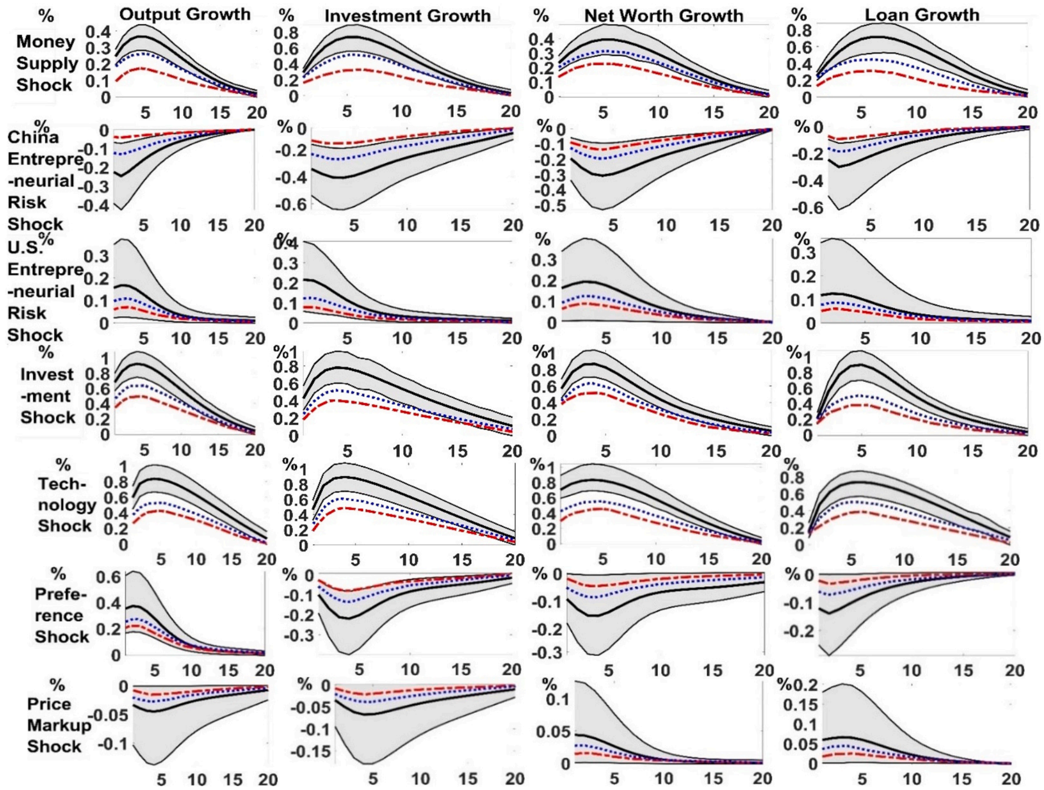


(a) Responses of Output, Investment, Net Worth, and Loans to Structural Shocks

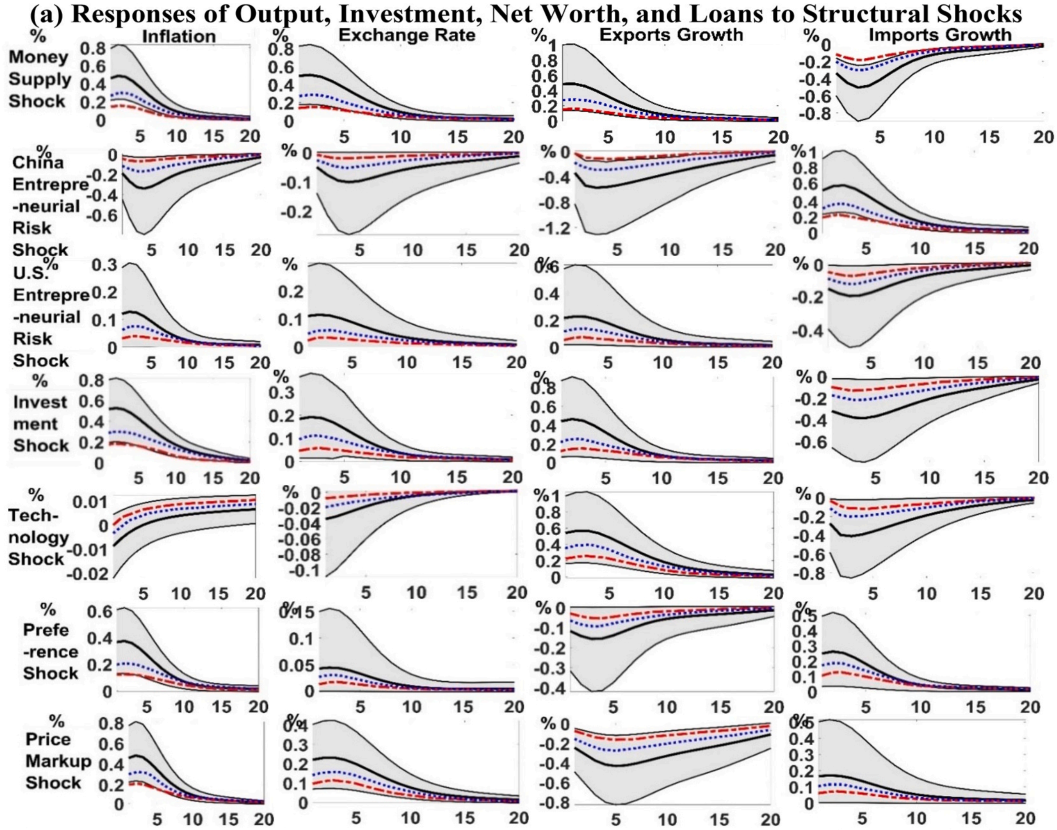


(b) Responses of Inflation, Exchange Rate, Exports, and Imports to Structural Shocks

Fig. 2. The U.S. impulse response.



(a) Responses of Output, Investment, Net Worth, and Loans to Structural Shocks



(b) Responses of Inflation, Exchange Rate, Exports, and Imports to Structural Shocks

Fig. 3. China's impulse response.

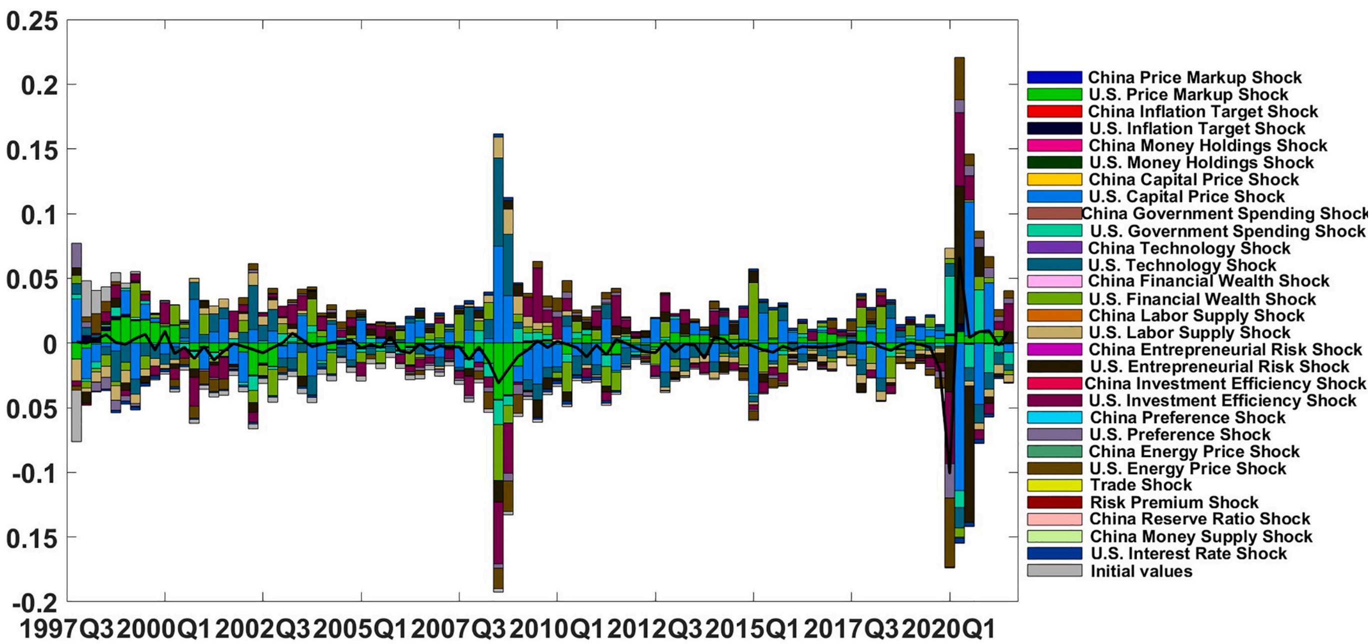


Fig. 4. Historical decomposition of the U.S. output growth.

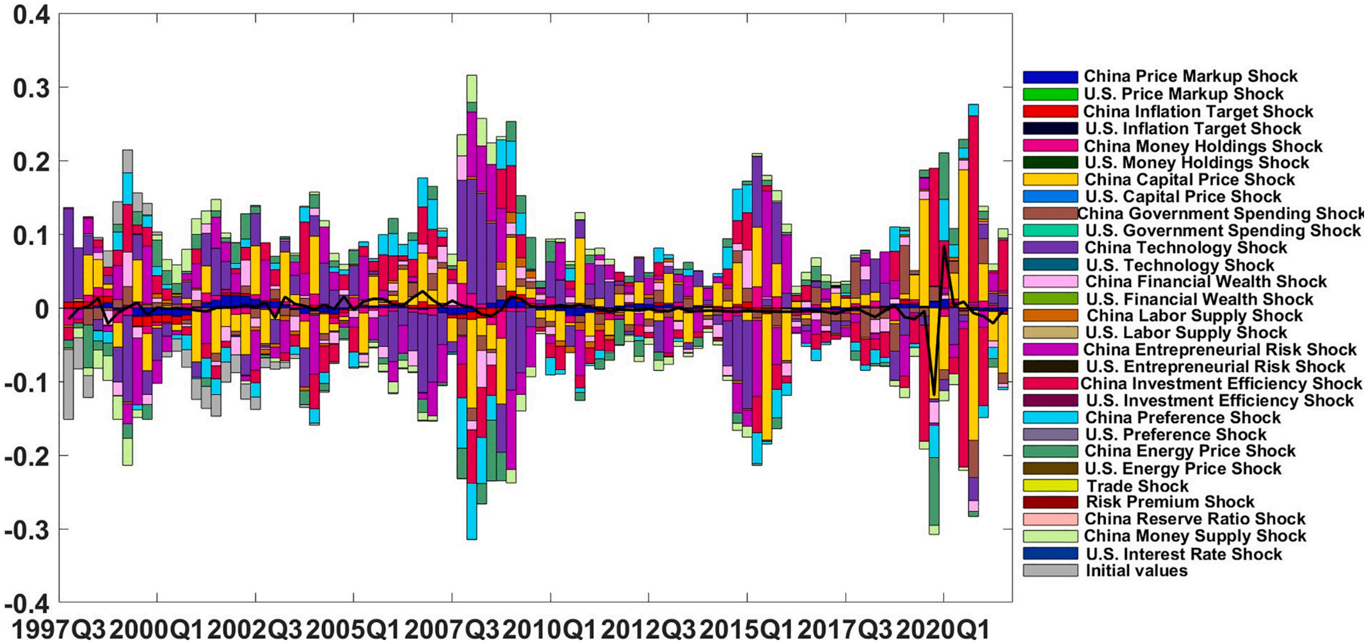


Fig. 5. Historical decomposition of China's output growth.

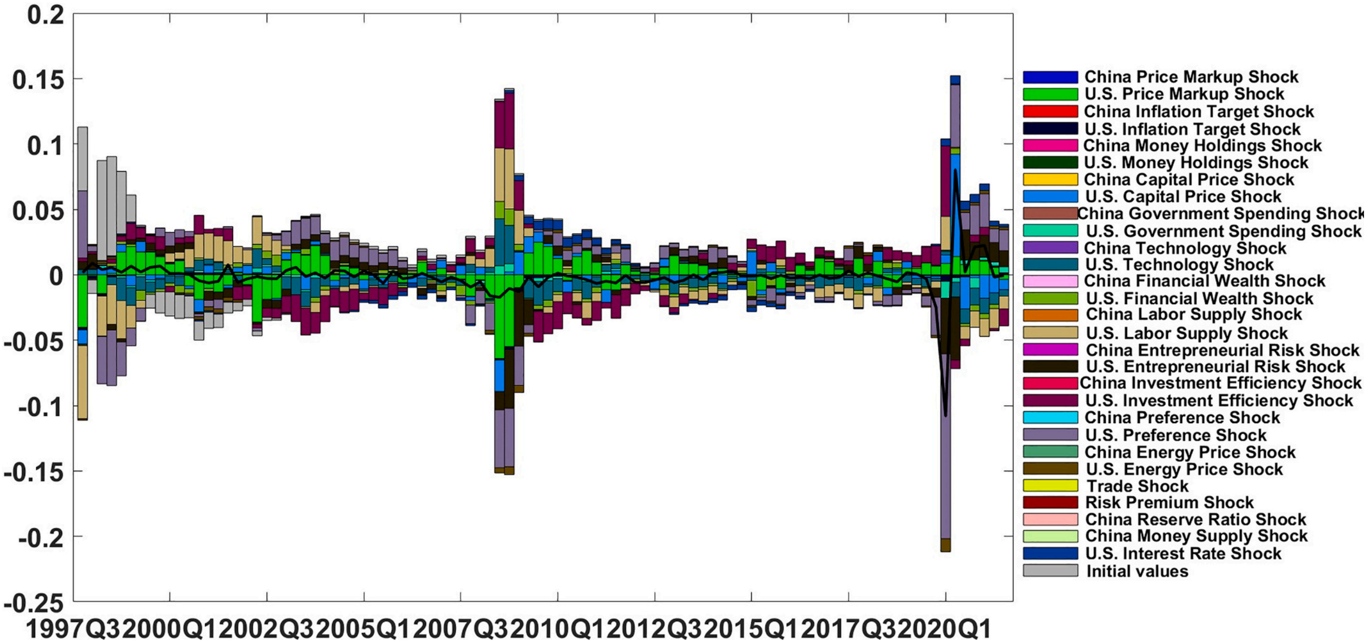


Fig. 6. Historical decomposition of the U.S. consumption growth.

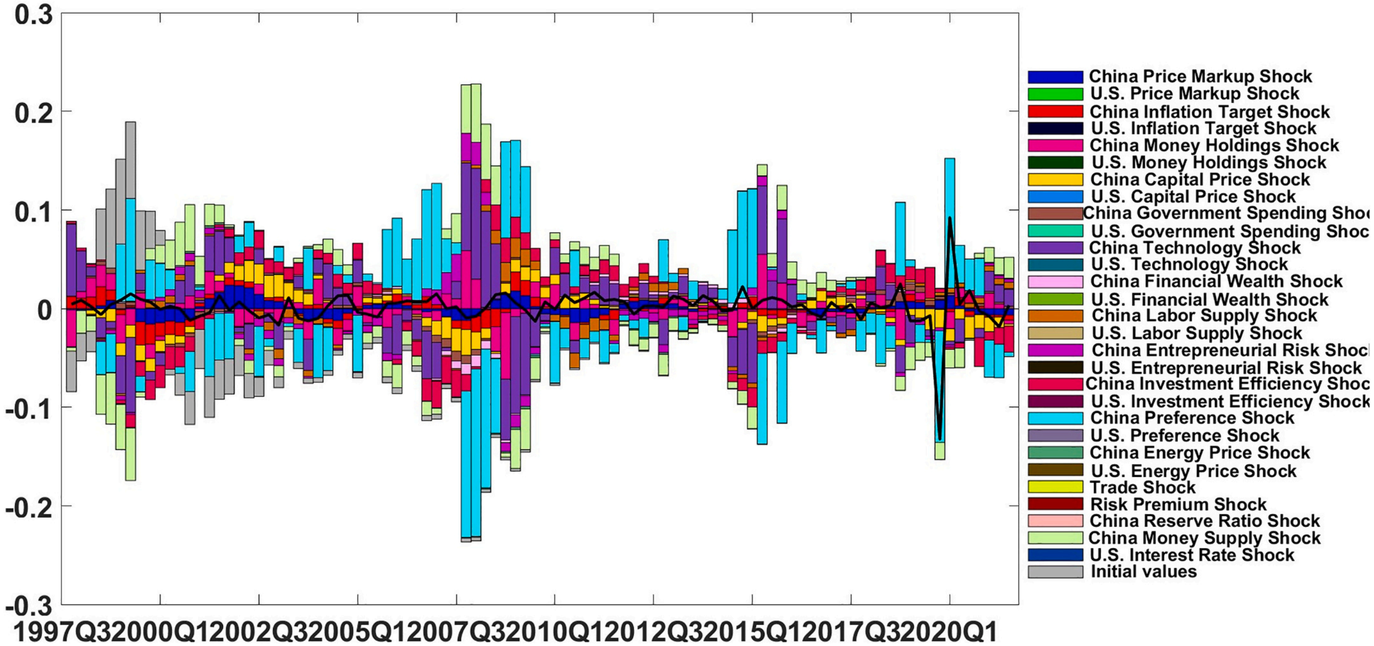


Fig. 7. Historical decomposition of China's consumption growth.

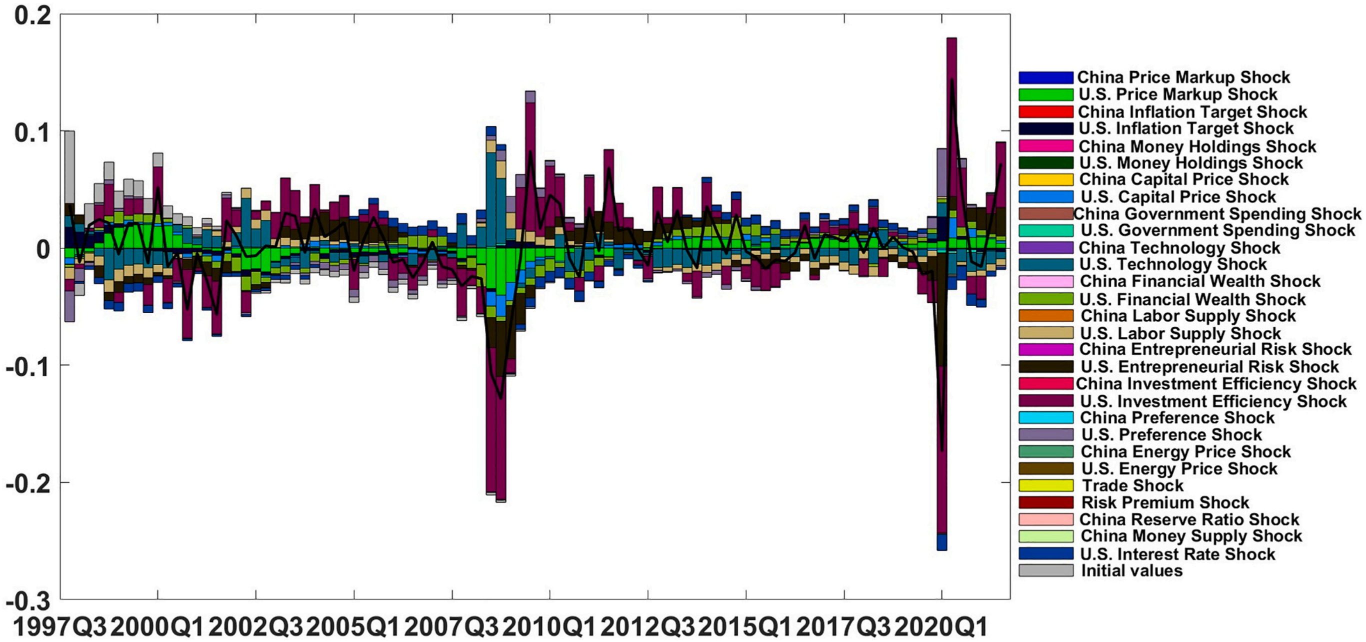


Fig. 8. Historical decomposition of the U.S. investment growth.

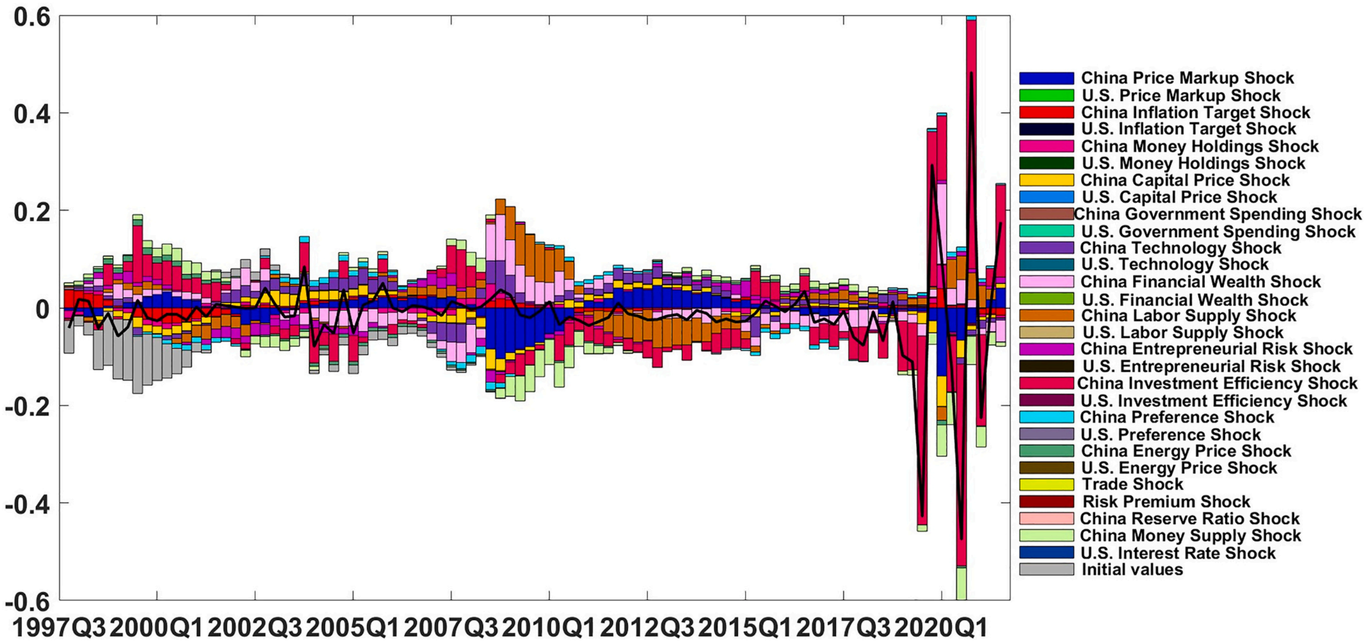


Fig. 9. Historical decomposition of China's investment growth.

uncertainty is signified by China's entrepreneurial risk shock. Real forces incorporate shocks to preferences, labor supply, money holdings, and technology. Price risk covers the price markup shock. Policy uncertainty comprises shocks to money supply and the inflation target. China's entrepreneurial risk shock contributes moderately to financial turmoil and economic crisis.

In Fig. 8, the U.S. investment growth fluctuations are substantially illuminated by shocks to the U.S. interest rate, investment efficiency, entrepreneurial risk, technology, financial wealth, labor supply, capital prices, and price markups. The U.S. investment growth exhibits massive slumps during the 2008 Global Financial Crisis and plunges during the 2020 COVID-19 Pandemic. These downswings are primarily attributable to domestic entrepreneurial uncertainty, real forces, entrepreneurial survival risk, price risk, and the U.S. interest rate shock. Domestic entrepreneurial uncertainty is represented by the U.S. entrepreneurial risk shock. Real forces include shocks to investment efficiency, technology, and labor supply. Entrepreneurial survival risk is captured by the financial wealth shock. Price risk contains shocks to capital prices and price markups. The U.S. entrepreneurial risk shock contributes moderately to financial turmoil and economic crisis.

In Fig. 9, China's investment growth fluctuations are substantially illuminated by shocks to China's money supply, investment efficiency, entrepreneurial risk, technology, financial wealth, labor supply, capital prices, and price markups. China's investment growth displays massive slumps during the 2008 Global Financial Crisis and plunges during the 2020 COVID-19 Pandemic. These downswings are primarily attributable to domestic entrepreneurial uncertainty, real forces, entrepreneurial survival risk, price risk, and China's money supply shock. Domestic entrepreneurial uncertainty is signified by China's entrepreneurial risk shock. Real forces incorporate shocks to investment efficiency, technology, and labor supply. Entrepreneurial survival risk is reflected by the financial wealth shock. Price risk covers shocks to capital prices and price markups. China's entrepreneurial risk shock contributes moderately to financial turmoil and economic crisis.

In Fig. 10, during the 2008 Global Financial Crisis, the 2020 COVID-19 Pandemic, and the U.S.-China trade conflict since early 2018, China's net exports to the U.S. growth fluctuations are mainly explained by shocks to trade, risk premiums, the U.S. entrepreneurial risk, China's entrepreneurial risk, U.S. preferences, China's preferences, U.S. investment efficiency, China's investment efficiency, the U.S. interest rate, and China's money supply, among which the U.S. and China's entrepreneurial risk shocks make moderate contributions.

7.1. Forecast error variance decompositions

Based on posterior means, the DSGE forecasts describe the evolution of observed variables from initial conditions absent structural shocks, and observed deviations from forecasts are attributable to the realized amalgamations of structural shocks. Table 4 elucidates unconditional forecast error variance decompositions of key observed variables in terms of 29 structural shocks for the infinite time horizon. Unconditional forecast error variance decompositions capture fractions of observed variables' variances attributable to structural shocks in the long-term, as well as evaluating relative contributions of structural shocks.

The U.S. entrepreneurial risk shocks explain around 11.2%, 9.4%, 15.2%, 15.1%, 19.2%, and 6.7% of forecast error variances in growth rates of U.S. GDP, U.S. personal consumption expenditure, U.S. gross private domestic investment, the S&P 500 Index, U.S.

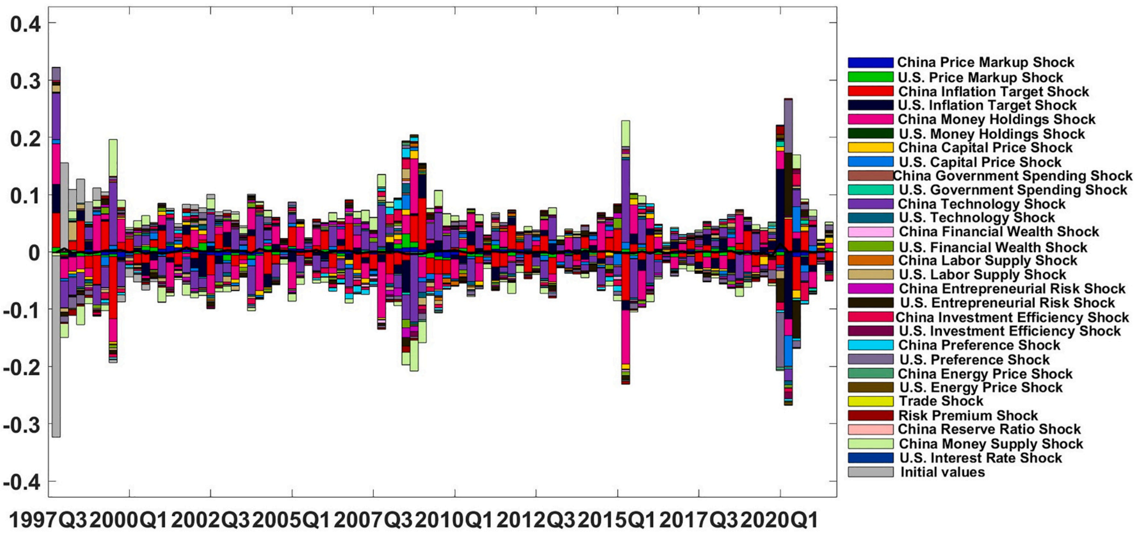


Fig. 10. Historical decomposition of China's net exports to the U.S. growth.

Table 4
Forecast error variance decompositions.

%	ΔlnY_U	ΔlnC_U	ΔlnI_U	$\Delta ln\overline{N}_U$	ΔlnL_U	ΔlnY_C	ΔlnC_C	ΔlnI_C	$\Delta ln\overline{N}_C$	ΔlnL_C	ΔlnT
$\upsilon_{U,A}$	8.81	7.62	8.07	12.06	10.18	1.56	0.99	0.18	0.42	0.56	2.32
$\upsilon_{U,P}$	18.21	36.9	13.5	9.34	4.38	1.32	1.05	0.91	0.21	0.18	7.32
$\upsilon_{U,I}$	19.55	16.33	25.76	17.19	18.25	1.18	0.91	0.81	0.35	0.42	9.44
$\upsilon_{U,H}$	4.14	3.42	4.03	5.29	3.03	0.12	0.11	0.87	0.09	0.13	1.08
$\upsilon_{U,Y}$	0.82	0.91	0.67	0.32	0.29	0	0	0.05	0.07	0.08	0.82
$\upsilon_{U,\gamma}$	6.52	4.25	5.16	16.57	15.17	0.85	0.66	0.22	0.05	0.06	1.62
$\upsilon_{U,E}$	11.17	9.38	15.18	15.06	19.15	4.19	2.45	2.05	1.91	1.95	6.67
$\upsilon_{U,Q}$	1.02	1.56	3.24	9.38	5.12	0.05	0.04	0.07	0.33	0.42	1.02
$\upsilon_{U,O}$	3.17	2.14	3.17	0.85	1.05	0.13	0.11	0.09	0.18	0.23	0.89
$\upsilon_{U,G}$	3.58	1.32	1.14	1.26	0.98	0.06	0.08	0.67	0.08	0.12	1.62
$\upsilon_{U,\pi}$	0.38	0.69	0.68	1.03	1.11	0	0	0	0	0	0.38
$\upsilon_{U,M}$	0.61	1.17	1.06	1.09	0.86	0	0	0	0	0	0.61
$\upsilon_{U,R}$	6.79	5.61	10.56	6.18	11.87	0.38	0.21	0.86	1.46	1.54	3.11
$\upsilon_{C,A}$	1.65	0.46	0.96	0.82	0.67	9.2	7.12	7.96	9.18	9.61	1.78
$\upsilon_{C,P}$	2.06	2.13	0.52	0.22	0.08	16.16	22.41	9.57	8.72	4.35	6.38
$\upsilon_{C,I}$	2.13	1.09	0.75	0.31	0.22	18.2	17.64	24.06	10.62	13.09	10.38
$\upsilon_{C,H}$	0.78	0.54	0.85	0.05	0.03	7.13	6.89	7.13	8.89	3.25	0.93
$\upsilon_{C,Y}$	0	0.03	0.02	0.04	0.01	0.32	0.57	0.78	0.92	1.07	0
$\upsilon_{C,\gamma}$	0.94	0.28	0.11	0.08	0.02	5.18	4.14	6.89	14.18	16.02	1.32
$\upsilon_{C,E}$	1.16	1.06	0.95	0.1	0.09	12.32	11.67	12.64	12.27	19.31	6.29
$\upsilon_{C,Q}$	0.16	0.11	0.03	0.06	0.07	0.99	0.85	0.03	7.88	4.32	0.94
$\upsilon_{C,O}$	0.14	0.08	0.07	0.05	0.08	1.63	1.16	3.19	1.87	2.51	0.96
$\upsilon_{C,G}$	0.13	0.09	0.08	0.01	0.01	4.19	4.78	2.11	2.32	2.17	1.98
$\upsilon_{C,\pi}$	0	0	0	0	0	0.42	0.79	1.89	2.02	2.01	0
$\upsilon_{C,M}$	0	0	0	0	0	1.31	1.87	1.22	1.39	1.15	0
$\upsilon_{C,MS}$	0.12	0.07	0.09	0.17	0.3	6.21	7.24	8.38	8.05	9.17	2.09
$\upsilon_{C,\tau}$	0.09	0.02	0.03	0.07	0.24	3.41	2.34	4.05	2.08	2.01	0.35
υ_{RP}	2.69	1.59	2.04	1.35	5.18	1.31	1.56	2.04	3.15	2.21	11.44
υ_{T}	3.18	1.15	1.28	1.05	1.56	2.18	2.36	1.28	1.31	2.06	18.26

Note: Observed variables $\Delta lnY_U, \Delta lnC_U, \Delta lnI_{U,t}, \Delta ln\overline{N}_U$, and ΔlnL_U refer, respectively, to U.S. growth rates of GDP, personal consumption expenditure, gross private domestic investment, the S&P 500 Index, and total bank loans. Observed variables ΔlnY_C, ΔlnC_C, ΔlnI_C, $\Delta ln\overline{N}_C$, and ΔlnL_C refer, respectively, to China's growth rates of GDP, household consumption, business investment, the SSE Composite Index, and total bank loans. Observed variable ΔlnTrefers to China's exports to U.S. growth rate. Structural shocks $\upsilon_{U,A}, \upsilon_{U,P}, \upsilon_{U,I}, \upsilon_{U,H}, \upsilon_{U,Y}, \upsilon_{U,\gamma}, \upsilon_{U,E}, \upsilon_{U,Q}, \upsilon_{U,O}, \upsilon_{U,G}, \upsilon_{U,\pi}, \upsilon_{U,M}$, and $\upsilon_{U,R}$ refer, respectively, to the U.S. shocks to technology, intertemporal preferences, marginal efficiency of investment, labor supply, price markups, financial wealth, entrepreneurial risk, capital prices, energy prices, government spending, the inflation target, money holdings, and interest rates. Structural shocks $\upsilon_{C,A}, \upsilon_{C,P}, \upsilon_{C,I}, \upsilon_{C,H}, \upsilon_{C,Y}, \upsilon_{C,\gamma}, \upsilon_{C,E}, \upsilon_{C,Q}, \upsilon_{C,O}, \upsilon_{C,G}, \upsilon_{C,\pi}, \upsilon_{C,M}, \upsilon_{C,MS}$, and $\upsilon_{C,\tau}$ refer, respectively, to China's shocks to technology, intertemporal preferences, marginal efficiency of investment, labor supply, price markups, financial wealth, entrepreneurial risk, capital prices, energy prices, government spending, the inflation target, money holdings, money supply, and reserve ratio. Structural shock υ_{RP} refers to the risk premium shock. Structural shock υ_T refers to the trade shock.

total bank loans, and China's net exports to the U.S., respectively. China's entrepreneurial risk shocks explain about 12.3%, 11.7%, 12.6%, 12.3%, 19.3%, and 6.3% of forecast error variances in growth rates of China's GDP, China's household consumption, China's business investment, the SSE Composite Index, China's total bank loans, and China's net exports to the U.S., respectively. The U.S. entrepreneurial risk shocks explain approximately 4.2%, 2.5%, and 2.1% of forecast error variances in growth rates of China's GDP, China's household consumption, and China's business investment, respectively.

8. Conclusions

Extending the work of Bernanke et al. (1999) and Christiano et al. (2014), we have specified a two-country DSGE model linking the U.S. and China. Based on Bayesian estimation and inferences, our analysis proceeds as follows. First, we have investigated the interconnections between the cross-sectional dispersion of idiosyncratic entrepreneurial productivity and macroeconomic fluctuations. Second, we have identified significant financial acceleration effects triggered by key structural shocks. Third, we have examined the financial acceleration asymmetry between the U.S. and China. Fourth, we have elucidated transmission channels of domestic and foreign entrepreneurial risk shocks. Finally, we have investigated international financial acceleration triggered by foreign entrepreneurial risk shocks.

Our main findings are as follows. Domestic entrepreneurial risk shocks exhibit negative and significant impacts on domestic macroeconomic aggregates, whereas foreign entrepreneurial risk shocks exert insignificant influence on the domestic economy. The extent of financial acceleration hinges on the size of costly monitoring. In the domestic economy, a positive domestic entrepreneurial risk shock conveys a larger cross-sectional dispersion of idiosyncratic domestic entrepreneurial productivity and a higher domestic credit spread, consequently, a larger risk premium tightens loans, discourages investment, and squeezes consumption. The existence of monitoring cost magnifies the adverse influence of a positive entrepreneurial risk shock on investment and consumption, leading to financial acceleration effects. By contrast, a positive foreign entrepreneurial risk shock implies a larger cross-sectional dispersion of idiosyncratic foreign firm productivity and a higher foreign credit spread, a larger foreign risk premium restrains foreign loans, discourages foreign investment, and dampens foreign exports, as a result, foreign output decreases, domestic imports decline but domestic exports increase, generating expansionary impacts on domestic output. The cross-border channel functions as a mechanism in the diffusion of foreign entrepreneurial risk shocks.

Other key findings based on Bayesian estimation and impulse response analysis are as follows. First, the estimated monitoring cost for China (0.077) is significantly larger than the estimated monitoring cost for the U.S. (0.047), at a 10% significance level, because 0.077 is outside the 90% posterior interval [0.031, 0.064] of the estimated U.S. monitoring cost. Second, for the U.S., growth rates of output, investment, and loans exhibit significant financial acceleration effects triggered by shocks to domestic entrepreneurial risk, investment, and technology, whereas for China, growth rates of output, investment, and loans display significant financial acceleration effects induced by shocks to domestic entrepreneurial risk, investment, and technology, in particular, growth rates of China's exports and imports show significant financial acceleration effects given domestic entrepreneurial risk shocks. Third, China's growth rates of output and investment display larger and more persistent financial acceleration effects triggered by shocks to domestic entrepreneurial risk, investment, and technology, in comparison with those of the U.S., echoing Carrière-Swallow and Céspedes (2013)'s finding that developing countries suffer more severe falls in investment and consumption following an uncertainty shock, in comparison with developed countries. Fourth, the financial acceleration effects of foreign entrepreneurial risk shocks on the domestic economy are insignificant. Finally, domestic financial acceleration effects on growths rates of output, investment, and net worth triggered by shocks to investment and technology are significant and more pronounced when including the data covering the U.S.-China trade conflict periods.

Other key findings based on historical decompositions and forecaste error variance decompositions are as follows. First, domestic entrepreneurial risk shocks contribute substantially to growth fluctuations of output, consumption, investment, and China's net exports to the U.S. during recessionary periods, in particular, the Global Financial Crisis and the Covid-19 pandemic. Second, the U.S. entrepreneurial risk shocks explain around 11.2%, 9.4%, 15.2%, 15.1%, and 19.2% of forecast error variances in the U.S. growth rates of output, consumption, investment, the S&P 500 Index, and loans, respectively. China's entrepreneurial risk shocks explain about 12.3%, 11.7%, 12.6%, 12.3%, and 19.3% of forecast error variances in China's growth rates of output, consumption, investment, the SSE Composite Index, and loans, respectively.

Our research contributes to identifying transmission channels via which agency problems influence financial contracts, examining propagation mechanisms through which financial frictions affect the real economy, and gauging entrepreneurial uncertainty shocks with which credit frictions interact in amplifying real impacts. Our research sheds light on moderating macroeconomic fluctuations, navigating financial cycles, curbing excess volatility, and combatting financial instability. Although domestic entrepreneurial shocks cause significant macro-financial fluctuations, policymakers could limit their propagation by preserving the resilience of the financial sector through appropriate macroprudential policy interventions. Policy implications involve alleviating the contagion of financial crises to the macroeconomy, mitigating the impacts of information asymmetry on financial markets, and developing policy tools to ensure financial stability.

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Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

I have shared the link to my data at the Attach File step

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Appendix A. Names of firms in the U.S. and China

123 U.S. firms in alphabetical order: Abbott Laboratories, Accenture Plc Class A, Adobe Inc., Advanced Micro Devices Inc., Air Products and Chemicals Inc., Albermarle Corp., Altria Group Inc., Amazon.com Inc., American Express Company, Amgen Inc., American Tower Corporation, Analog Devices Inc., ANSYS Inc., Apple, Applied Materials Inc., AT&T Inc., Automatic Data Processing Inc., Autodesk Inc., Bank of America Corporation, Becton Dickinson and Company, Berkshire Hathaway, BlackRock Inc., Booking Holdings Inc., Boston Scientific Corporation, Bristol-Myers Squibb Company, Capital One Financial Corporation, Caterpillar Inc., Chevron Corporation, Chubb Limited, Cigna Corporation, Cisco Systems Inc., Citigroup Inc., CSX Corporation, Colgate-Palmolive Company, Comcast Corporation, ConocoPhillips, Costco Wholesale Corporation, Crown Castle International Corp., CVS Health Corporation, Danaher Corp., Deere & Company, Dominion Energy Inc., Duke Energy Corporation, Eaton Corporation plc, Ecolab Inc., Edwards Lifesciences Corporation, Elevance Health Inc., Eli Lilly and Company, United Parcel Service Inc., Emerson Electric Co., Exxon Mobil Corporation, FedEx Corporation, Fidelity National Information Services Inc., Fiserv Inc., Ford Motor Company, Freeport-McMoRan Inc., General Electric Company, Gilead Sciences Inc., Global Payments Inc., Honeywell International Inc., Humana Inc., Intel Corp., Illinois Tool Works Inc., International Business Machines Corporation, Intuit Inc., Intuitive Surgical Inc., Johnson Controls International plc, Johnson & Johnson, JPMorgan Chase & Co., KLA Corporation, Lam Research Corporation, Linde plc, Lockheed Martin Corporation, Lowe's Companies Inc., McDonald's Corp., Medtronic Plc, Merck & Co. Inc., Micron Technology Inc., Microsoft Corporation, Marsh & McLennan Companies Inc., Moody's Corporation, Morgan Stanley, Netflix Inc., NextEra Energy Inc., NIKE Inc., Norfolk Southern Corporation, Northrop Grumman Corporation, NVIDIA Corp., Oracle Corp., PepsiCo Inc., Pfizer Inc., Procter & Gamble Company, Prologis Inc., Public Storage, Qualcomm Inc., Raytheon Technologies Corporation, Regeneron Pharmaceuticals Inc., Starbucks Corporation, Stryker Corporation, TARGET Corporation, Texas Instruments Inc., The Boeing Company, The Charles Schwab Corporation, The Coca-Cola Company, The Goldman Sachs Group Inc., The Home Depot Inc., The Southern Company, The PNC Financial Services Group Inc., The Progressive Corporation, The Sherwin-Williams Company, The TJX Companies Inc., The Walt Disney Company, Thermo Fisher Scientific Inc., Truist Financial Corporation, UnitedHealth Group Incorporated, Union Pacific Corporation, The U.S. Bancorp, Verizon Communications Inc., Walmart Inc., Waste Management Inc., Wells Fargo & Company, Xerox Holdings Corporation, 3 M Company.

123 Chinese firms in alphabetical order: Aluminum Corporation of China Limited, Angel Yeast Co. Ltd, Anhui Conch Cement Company Limited, AVIC Xi'an Aircraft Industry Group Company Ltd., Baoshan Iron & Steel Co. Ltd., Beijing Capital Development Co. Ltd., Beijing Shunxin Agriculture Co. Ltd., Beijing Tiantan Biological Products Co. Ltd., Beijing Tong Ren Tang Chinese Medicine Company Limited, BOE Technology Group, Changchun Gas Co. Ltd, Chang Jiang Shipping Group Phoenix Co. Ltd., China Aerospace Times Electronics CO. Ltd., China Avionics Systems Co. Ltd., China CSSC Holdings Limited, China Fortune Land Development Co. Ltd., China Gold International Resources Corp. Ltd., China Hi-Tech Group Co. Ltd., China Jushi Co. Ltd., China Life Insurance Company Limited, China Mobile Limited, China Northern Rare Earth (Group) High-Tech Co. Ltd, China Petroleum & Chemical Corporation, China Security Co. Ltd., China Shipbuilding Industry Group Power Co. Ltd., China Southern Airlines, China United Network Communications Limited, Chongqing Changan Automobile Company Limited, Chongqing Zongshen Power Machinery Co. Ltd, CITIC Securities Company Limited, Citic Pacific Special Steel Group Co. Ltd., Dashang Co. Ltd., Datang International Power Generation Co. Ltd., FangDa Carbon New Material Co. Ltd, Fangda Special Steel Technology Co. Ltd., FAW Jiefang Group Co. Ltd., FuJian YanJing HuiQuan Brewery Co. Ltd, Fuyao Glass Industry Group Co. Ltd., Gree Electric Appliances Inc. of Zhuhai, Greenland Holdings Corporation Limited, Guanghui Energy Co. Ltd., Guangzhou Automobile Group Co. Ltd., Guangzhou Baiyunshan Pharmaceutical Holdings Company Limited, Haier Smart Home Co. Ltd., Hangzhou Silan Microelectronics Co. Ltd, Harbin Electric Company Limited, Henan Shuanghui Investment & Development Co. Ltd., Hengan International Group Company Limited, Hengli Petrochemical Co. Ltd., Hengtong Optic-Electric Co. Ltd., Hua Xia Bank Co. Limited, HUAYU Automotive Systems Company Limited, Huadong Medicine Co. Ltd, Inner Mongolia Yili Industrial Group Co. Ltd., Jiangsu Eastern Shenghong Co. Ltd., Jiangsu Hengrui Medicine Co. Ltd., Jiangsu Hongdou Industrial Co. Ltd., Jiangsu Sanfame Polyester Material Co. Ltd., Jiangsu Yangnong Chemical Co. Ltd., Jiangsu Zhongnan Construction Group Co. Ltd., Jiangsu Zhongtian Technology Co. Ltd., Jonjee Hi-tech Industrial & Commercial Holding Co. Ltd., Kangmei Pharmaceutical Co. Ltd., Keda Industrial Group Co. Ltd., Kweichow Moutai Co. Ltd., Lao Feng Xiang Co. Ltd., Lenovo Group Limited, Liaoning Cheng Da Co. Ltd., Maanshan Iron & Steel Company Limited, Minmetals Capital Company Limited, Nanjing Panda Electronics Company Limited, Nanjing Red Sun Co. Ltd., NetEase Inc., New Hope Liuhe Co. Ltd., Ningbo Joyson Electronic Corp., Offshore Oil Engineering Co. Ltd., Orient Group Incorporation, Pacific Construction Co. Ltd, PetroChina Company Limited, Poly Property Group Co. Limited, SAIC Motor Corporation Limited, Sanan Optoelectronics Co. Ltd, Sany Heavy Industry Co. Ltd, Shandong

Gold Mining Co. Ltd., Shandong Huatai Paper Industry Shareholding Co. Ltd, Shanghai Fosun Pharmaceutical (Group) Co. Ltd., Shanghai Jin Jiang International Hotels Co. Ltd., Shanghai International Airport Co. Ltd., Shanghai International Port (Group) Co. Ltd., Shanghai Oriental Pearl Group Co. Ltd., Shanghai Pudong Development Bank Co. Ltd., Shanghai Shimao Co. Ltd., Shanxi Taigang Stainless Steel Co. Ltd., Shengyi Technology Co. Ltd., Shuangliang Eco-Energy Systems Co. Ltd, Sinolink Securities Co. Ltd., Sinopec Shanghai Petrochemical Company Limited, Skyworth Group Limited, State Grid Information & Communication Co. Ltd., Sunyard Technology Co. Ltd., Tasly Pharmaceutical Group Co. Ltd, TBEA Co. Ltd., Tengda Construction Group Co. Ltd., Tiandi Science & Technology Co. Ltd., Tongda Group Holdings Limited, Tonghua Dongbao Pharmaceutical Co. Ltd., Topchoice Medical Co. Inc., Tsinghua Tongfang Co. Ltd., Tsingtao Brewery Company Limited, Qinghai Salt Lake Industry Co. Ltd, Wanhua Chemical Group Co. Ltd., Weiqiao Textile Company Limited, Wingtech Technology Co. Ltd, Wolong Electric Drive Group Co. Ltd., Xinyu Iron & Steel Co. Ltd, XCMG Construction Machinery Co. Ltd., Yanzhou Coal Mining Company Limited, Youngor Group Co. Ltd., Yutong Bus Co. Ltd., Zhejiang Huahai Pharmaceutical Co. Ltd., Zhejiang Longsheng Group Co. Ltd, Zijin Mining Group Company Limited, Zhongtian Financial Group Company Limited.

Appendix B. Final goods firms' optimal behavior

Country x's representative final goods firm chooses the optimal continuum of domestic intermediate goods $Y_{x,j,t}$ to maximize its nominal profit $P_{x,t}PR_{x,Y,t}$:

$$\begin{aligned} max_{\{Y_{x,j,t}\}}P_{x,t}PR_{x,Y,t} &= max_{\{Y_{x,j,t}\}}\left[P_{x,t}Y_{x,t} - \int_0^1 P_{x,j,t}Y_{x,j,t}dj\right] \\ &= max_{\{Y_{x,j,t}\}}\left[P_{x,t}\left(\int_0^1 Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}}dj\right)^{\upsilon_{x,Y,t}} - \int_0^1 P_{x,j,t}Y_{x,j,t}dj\right] \end{aligned} \tag{45}$$

subject to final good technological constraint in Eq. (1). Taking the partial derivative of the representative final goods firm's nominal profits $P_{x,t}PR_{x,Y,t}$ with respect to intermediate good j's production $Y_{x,j,t}$ yields:

$$\begin{aligned} &\frac{\partial(P_{x,t}PR_{x,Y,t})}{\partial Y_{x,j,t}} = P_{x,t}\upsilon_{x,Y,t}\left(\int_0^1 Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}}dj\right)^{\upsilon_{x,Y,t}-1}\frac{1}{\upsilon_{x,Y,t}}Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}-1} - P_{x,j,t} = 0 \\ &\rightarrow P_{x,t}\left(\int_0^1 Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}}dj\right)^{\upsilon_{x,Y,t}-1}Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}-1} = P_{x,j,t} \\ &\rightarrow P_{x,t}Y_{x,t}Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}-1} = P_{x,j,t}\left(\int_0^1 Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}}dj\right) \\ &\rightarrow P_{x,t}^{\upsilon_{x,Y,t}}Y_{x,t}^{\upsilon_{x,Y,t}}Y_{x,j,t}^{1-\upsilon_{x,Y,t}} = P_{x,j,t}^{\upsilon_{x,Y,t}}\left(\int_0^1 Y_{x,j,t}^{\frac{1}{\upsilon_{x,Y,t}}}dj\right)^{\upsilon_{x,Y,t}} = P_{x,j,t}^{\upsilon_{x,Y,t}}Y_{x,t} \\ &\rightarrow P_{x,t}^{\upsilon_{x,Y,t}}Y_{x,t}^{\upsilon_{x,Y,t}-1}Y_{x,j,t}^{1-\upsilon_{x,Y,t}} = P_{x,j,t}^{\upsilon_{x,Y,t}} \rightarrow Y_{x,j,t} = \left(\frac{P_{x,j,t}}{P_{x,t}}\right)^{\frac{\upsilon_{x,Y,t}}{1-\upsilon_{x,Y,t}}}Y_{x,t} \end{aligned} \tag{46}$$

Appendix C. Intermediate goods firms' optimal behavior

In the first stage, intermediate goods firm j's cost includes wage bills $W_{x,t}H_{x,j,t}$ to labor contractors and capital rental expenses $R_{x,K,t}K_{x,j,t}$ to entrepreneurs. Intermediate goods firms rent capital services $K_{x,j,t}$ at capital rental rate $R_{x,K,t}$ and employ standardized labor $H_{x,j,t}$ at wage $W_{x,t}$. The Lagrange multiplier $\lambda_{x,j,t}$ measures intermediate good j's nominal marginal cost. Following Cristadoro et al. (2006), Breuss and Fornero (2009), and Breuss and Rabitsch (2009), given intermediate goods production $M_{x,j,t}$, intermediate good price $P_{x,j,t}$, final good price $P_{x,t}$, wage $W_{x,t}$, and capital rental rate $R_{x,K,t}$, intermediate goods firm j, being owned by households, chooses optimal labor $H_{x,j,t}$ and capital services $K_{x,j,t}$intratemporally to minimize cost $CO_{x,j,t}$ discounted by equilibrium nominal stochastic discount factor $S_{x,t,t+\iota}$:

$$CO_{x,j,t} = E_t \sum_{\iota=0}^{+\infty} S_{x,t,t+\iota} \left(W_{x,t+\iota} H_{x,j,t+\iota} + R_{x,K,t+\iota} K_{x,j,t+\iota} \right) \tag{47}$$

subject to the constraint that intermediate good j's production $Y_{x,j,t} = TA_{x,A,t} K_{x,j,t}^{\alpha_x} (A_{x,t} H_{x,j,t})^{1-\alpha_x} - \phi_x A_{x,t}^{*}$ equals its demand $Y_{x,j,t}^{D} = \left(\frac{P_{x,j,t}}{P_{x,t}}\right)^{\frac{\upsilon_{x,Y,t}}{1-\upsilon_{x,Y,t}}} Y_{x,t}$.

Intermediate goods firm j's cost minimization leads to the Lagrangian function $Ł_{x,j,t}$:

$$Ł_{x,j,t} = W_{x,t} H_{x,j,t} + R_{x,K,t} K_{x,j,t} + \lambda_{x,j,t} \left[\left(\frac{P_{x,j,t}}{P_{x,t}} \right)^{\frac{\upsilon_{x,Y,t}}{1-\upsilon_{x,Y,t}}} Y_{x,j,t} - TA_{x,A,t} K_{x,j,t}^{\alpha_x} \left(A_{x,t} H_{x,j,t} \right)^{1-\alpha_x} + \phi_x A_{x,t}^{*} \right] \tag{48}$$

where Lagrange multiplier $\lambda_{x,j,t}$ measures intermediate good j's nominal marginal cost.

Taking the partial derivative of intermediate goods firm j's Lagrangian function $Ł_{x,j,t}$ with respect to capital services $K_{x,j,t}$yields:

$$\begin{aligned} \frac{\partial Ł_{x,j,t}}{\partial K_{x,j,t}} &= R_{x,K,t} - \lambda_{x,j,t} TA_{x,A,t} \alpha_x K_{x,j,t}^{\alpha_x - 1} \left(A_{x,t} H_{x,j,t} \right)^{1-\alpha_x} \\ &= R_{x,K,t} - \lambda_{x,j,t} \alpha_x \frac{Y_{x,j,t} + \phi_x A_{x,t}^{*}}{K_{x,j,t}} = 0 \end{aligned} \tag{49}$$

Capital rental rate $R_{x,K,t}$ equals nominal marginal cost $\lambda_{x,j,t}$ times the marginal production $\alpha_x \frac{Y_{x,j,t} + \phi_x A_{x,t}^{*}}{K_{x,j,t}}$ of capital services:

$$R_{x,K,t} = \lambda_{x,j,t} \alpha_x \frac{Y_{x,j,t} + \phi_x A_{x,t}^{*}}{K_{x,j,t}} \tag{50}$$

Taking the partial derivative of intermediate goods firm j's Lagrangian function $Ł_{x,j,t}$ with respect to real labor supply $H_{x,j,t}$ yields:

$$\begin{aligned} \frac{\partial Ł_{x,j,t}}{\partial H_{x,j,t}} &= W_{x,t} - \lambda_{x,j,t} TA_{x,A,t} \left(1 - \alpha_x \right) K_{x,j,t}^{\alpha_x} A_{x,t}^{1-\alpha_x} H_{x,j,t}^{-\alpha_x} \\ &= W_{x,t} - \lambda_{x,j,t} \left(1 - \alpha_x \right) \frac{Y_{x,j,t} + \phi_x A_{x,t}^{*}}{H_{x,j,t}} = 0 \end{aligned} \tag{51}$$

Wage $W_{x,t}$ equals nominal marginal cost $\lambda_{x,j,t}$ times the marginal production $(1 - \alpha_x) \frac{Y_{x,j,t} + \phi_x A_{x,t}^{*}}{H_{x,j,t}}$ of labor:

$$W_{x,t} = \lambda_{x,j,t} \left(1 - \alpha_x \right) \frac{Y_{x,j,t} + \phi_x A_{x,t}^{*}}{H_{x,j,t}} \tag{52}$$

Combining Eqs. (50) and (52) generates the ratio $\frac{K_{x,j,t}}{H_{x,j,t}}$ of capital services to labor:

$$\frac{K_{x,j,t}}{H_{x,j,t}} = \frac{\alpha_x W_{x,t}}{(1 - \alpha_x) P_{x,t} R_{x,K,t}} \tag{53}$$

In equilibrium, real marginal cost of capital $R_{x,K,t}$ equals the cost of renting one unit of capital services divided by the marginal production of capital:

$$R_{x,K,t} = \frac{\alpha_x H_{x,j,t} \frac{W_{x,t}}{P_{x,t}}}{\left(1 - \alpha_x\right) K_{x,j,t}} \tag{54}$$

Intermediate goods firms not only rent capital services at capital rental rate $R_{x,K,t}$ in perfectly competitive capital markets, but also employ labor at wage $W_{x,t}$ in perfectly competitive labor markets. We substitute Eq. (52) into Eq. (53) to obtain nominal marginal cost $\lambda_{x,j,t}$, which is independent of intermediate goods firm index j:

$$\lambda_{x,j,t} = \frac{R_{x,K,t}}{\alpha_x TA_{x,A,t} A_{x,t}^{1-\alpha_x}} \frac{\alpha_x^{1-\alpha_x} W_{x,t}^{1-\alpha_x}}{\left(1 - \alpha_x\right)^{1-\alpha_x} P_{x,t}^{1-\alpha_x} R_{x,K,t}^{1-\alpha_x}} = \frac{R_{x,K,t}^{\alpha_x} \left(\frac{W_{x,t}}{P_{x,t}} \right)^{1-\alpha_x}}{\alpha_x^{\alpha_x} \left(1 - \alpha_x\right)^{1-\alpha_x} TA_{x,A,t} A_{x,t}^{1-\alpha_x}} \tag{55}$$

Substituting Eq. (54) into Eq. (55) reformulates real marginal cost $\lambda_{x,j,t}$:

$$\lambda_{x,j,t} = \frac{R_{x,K,t}^{\alpha_x}\left[R_{x,K,t}(1-\alpha_x)K_{x,j,t}\right]^{1-\alpha_x}}{(1-\alpha_x)^{1-\alpha_x}\alpha_x^{\alpha_x}TA_{x,A,t}A_{x,t}^{1-\alpha_x}\left(\alpha_x H_{x,j,t}\right)^{1-\alpha_x}} = \frac{R_{x,K,t}}{\alpha_x TA_{x,A,t}\left(\frac{A_{x,t}H_{x,j,t}}{K_{x,j,t}}\right)^{1-\alpha_x}} \tag{56}$$

Every period, only a proportion $(1-\gamma_{x,P})$ of intermediate goods firms receives signals to reset intermediate good prices $P_{x,j,t}$. In period t, facing the same demand curve, firm j chooses optimal intermediate good price $P^*_{x,j,t}$ to maximize expected profits $P_{x,t}PR_{x,j,t}$ and maintain optimal price until period $t+\iota$, by which no price reoptimization but partially indexing optimal price to $\prod_{\kappa=0}^{\iota}\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t+\kappa-2,t+\kappa-1}^{1-\xi_{x,P}}$ is allowed:

$$P_{x,t}PR_{x,j,t} = E_t\sum_{\iota=0}^{+\infty}\gamma_{x,P}^{\iota}S_{x,t,t+\iota}\left[Y_{x,j,t+\iota}\left(P^*_{x,j,t}\prod_{\kappa=0}^{\iota}\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t+\kappa-2,t+\kappa-1}^{1-\xi_{x,P}} - P_{x,t+\iota}\lambda_{x,t+\iota}\right)\right] \tag{57}$$

subject to intermediate good j's demand $Y_{x,j,t} = \left(\frac{P^*_{x,j,t}}{P_{x,t}}\right)^{-\frac{1+\upsilon_{x,Y,t}}{\upsilon_{x,Y,t}}}Y_{x,t}$. Profit maximization generates a common optimal intermediate good price $P^*_{x,j,t}$, which is independent of firm index j:

$$P^*_{x,t} = \frac{E_t\sum_{\iota=0}^{+\infty}\gamma_{x,P}^{\iota}S_{x,t,t+\iota}Y_{x,t+\iota}P_{x,t+\iota}\frac{1+\upsilon_{x,Y,t+\iota}}{\upsilon_{x,Y,t+\iota}}\lambda_{x,j,t+\iota}}{E_t\sum_{\iota=0}^{+\infty}\gamma_{x,P}^{\iota}S_{x,t,t+\iota}Y_{x,t+\iota}\frac{1}{\upsilon_{x,Y,t+\iota}}\left(\prod_{\kappa=0}^{\iota}\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t+\kappa-2,t+\kappa-1}^{1-\xi_{x,P}}\right)} \tag{58}$$

Integrating $\left(\frac{P_{x,j,t}}{P_{x,t}}\right)^{\frac{\upsilon_{x,Y,t}}{\upsilon_{x,Y,t}-1}}$ in Eq. (58) over the unit continuum and indexing it to $\frac{\upsilon_{x,Y,t}-1}{\upsilon_{x,Y,t}}$ yield:

$$P^*_{x,t} = \frac{\left(\int_0^1 P_{x,j,t}^{\frac{\upsilon_{x,Y,t}}{\upsilon_{x,Y,t}-1}}dj\right)^{\frac{\upsilon_{x,Y,t}-1}{\upsilon_{x,Y,t}}}}{P_{x,t}} \tag{59}$$

Aggregate price index $P^*_{x,t}$ is a geometrically weighted average of past aggregate price index $P^*_{x,t-1}$ indexed to $\frac{\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t-2,t-1}^{1-\xi_{x,P}}}{\pi_{x,t-1,t}}P^*_{x,t-1}$ with a probability $\gamma_{x,P}$ and optimal aggregate price index $\left[\frac{1-\gamma_{x,P}\left(\frac{\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t-2,t-1}^{1-\xi_{x,P}}}{\pi_{x,t-1,t}}\right)^{\frac{1}{1-\upsilon_{x,Y,t}}}}{1-\gamma_{x,P}}\right]^{1-\upsilon_{x,Y,t}}$ with a probability $(1-\gamma_{x,P})$:

$$P^*_{x,t} = \left\{\left(1-\gamma_{x,P}\right)\left[\frac{1-\gamma_{x,P}\left(\frac{\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t-2,t-1}^{1-\xi_{x,P}}}{\pi_{x,t-1,t}}\right)^{\frac{1}{1-\upsilon_{x,Y,t}}}}{1-\gamma_{x,P}}\right]^{1-\upsilon_{x,Y,t}} + \gamma_{x,P}\left(\frac{\upsilon_{x,\pi,t}^{\xi_{x,P}}\pi_{x,t-2,t-1}^{1-\xi_{x,P}}}{\pi_{x,t-1,t}}P^*_{x,t-1}\right)^{\frac{\upsilon_{x,Y,t}}{1-\upsilon_{x,Y,t}}}\right\}^{\frac{1-\upsilon_{x,Y,t}}{\upsilon_{x,Y,t}}} \tag{60}$$

Appendix D. Capital goods firms' optimal behavior

Capital goods firms' instantaneous profits $PR_{x,K,t}$ are new installed capital $\left[\left(1-\delta_{x,K}\right)\overline{K}_{x,t} + J\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right)I_{x,t}\right]$ multiplied by capital price $Q_{x,t}$ net of repurchase cost of undepreciated capital $Q_{x,t}(1-\delta_{x,K})\overline{K}_{x,t}$ and installation cost $\frac{P_{x,t}}{\gamma_{x,I}^{t}\upsilon_{x,\gamma,t}}I_{x,t}$:

$$PR_{x,K,t} = Q_{x,t}\left[\left(1-\delta_{x,K}\right)\overline{K}_{x,t} + J\left(\frac{I_{x,t}}{I_{x,t-1}},\upsilon_{x,I,t}\right)I_{x,t}\right] - Q_{x,t}\left(1-\delta_{x,K}\right)\overline{K}_{x,t} - \frac{P_{x,t}I_{x,t}}{\gamma_{x,I}^{t}\upsilon_{x,\gamma,t}} \tag{61}$$

Capital goods firms choose optimal consumption of investment goods $I_{x,t}$ to maximize present discounted value of expected future profits $PR_{x,K,t+\iota}$:

$$E_t\sum_{\iota=0}^{+\infty}S_{x,t,t+\iota}PR_{x,K,t+\iota} \tag{62}$$

where stochastic discount factor $S_{x,t,t+\iota}$ acts as a Lagrange multiplier on constraint in period $t+\iota$.

Appendix E. Entrepreneurs' optimal behavior

Entrepreneur N_x chooses optimal capital utilization rate $CU_{x,K,t+1}$ to maximize net rental profits, which contain capital rental income $R_{x,K,t+1}CU_{x,K,t+1}P_{x,t+1}\gamma_{x,E}\overline{K}_{x,N,t+1}$ and undepreciated productive capital resale value $(1-\delta_{x,K})Q_{x,t+1}\gamma_{x,E}\overline{K}_{x,N,t+1}$ net of entrepreneurial cost $\gamma_{x,I}^{-(t+1)}\upsilon_{x,O,t+1}X(CU_{x,K,t+1})P_{x,t+1}\gamma_{x,E}\overline{K}_{x,N,t+1}$:

$$max_{CU_{x,K,t+1}}\left\{\left[R_{x,K,t+1}CU_{x,K,t+1}-\gamma_{x,I}^{-(t+1)}\upsilon_{x,O,t+1}X\left(CU_{x,K,t+1}\right)\right]P_{x,t+1}+\left(1-\delta_{x,K}\right)Q_{x,t+1}\right\}\gamma_{x,E}\overline{K}_{x,N,t+1} \tag{63}$$

Entrepreneurs' demand for installed capital strikes a balance between average marginal return on productive installed capital and the marginal cost of financing installed capital. In period $t+1$, average marginal return of capital is $\overline{R}_{x,K,t+1}$, which is composed of productive installed capital's return $\frac{[R_{x,K,t+1}CU_{x,K,t+1}-\gamma_{x,I}^{-(t+1)}\upsilon_{x,O,t+1}X(CU_{x,K,t+1})]P_{x,t+1}}{Q_{x,t}}$, undepreciated productive installed capital's return $\frac{(1-\delta_{x,K})Q_{x,t+1}}{Q_{x,t}}$, and tax shield $\tau_{x,K}\delta_{x,K}$.

$$\overline{R}_{x,K,t+1}=\frac{\left[R_{x,K,t+1}CU_{x,K,t+1}-\gamma_{x,I}^{-(t+1)}\upsilon_{x,O,t+1}X\left(CU_{x,K,t+1}\right)\right]P_{x,t+1}+\left(1-\delta_{x,K}\right)Q_{x,t+1}}{Q_{x,t}}+\tau_{x,K}\delta_{x,K} \tag{64}$$

where $\tau_{x,K}$ is capital tax rate. $\delta_{x,K}$ is capital depreciation rate.

Averaging individual net worth N_x across entire entrepreneurs N_x yields aggregate net worth $\overline{N}_{x,t+1}$:

$$\overline{N}_{x,t+1}=\int_0^{+\infty}N_xf_t\left(N_x\right)dN_x \tag{65}$$

Averaging individual installed capital $\overline{K}_{x,N,t+1}$ across all entrepreneurs N_x yields aggregate installed capital $\overline{K}_{x,t+1}$:

$$\overline{K}_{x,t+1}=\int_0^{+\infty}\overline{K}_{x,N,t+1}f_t\left(N_x\right)dN_x \tag{66}$$

Averaging productive installed capital $\gamma_{x,E}\overline{K}_{x,N,t}$ across all entrepreneurs N_x over entire idiosyncratic productivity $\gamma_{x,E}$ yields aggregate productive installed capital $\overline{K}_{x,t}$, then adjusting it by utilization rate $CU_{x,K,t}$ yields capital services $K_{x,t}$:

$$K_{x,t}=\int_0^{+\infty}\int_0^{+\infty}CU_{x,K,t}\gamma_{x,E}\overline{K}_{x,N,t}f_{t-1}\left(N_x\right)dF\left(\gamma_{x,E}\right)dN_x=CU_{x,K,t}\overline{K}_{x,t} \tag{67}$$

Conditional on survival probability $\upsilon_{x,\gamma,t}$, net worth averaged across all entrepreneurs $\overline{N}_{x,t+1}$ is the sum of capital asset returns $\overline{R}_{x,K,t}Q_{x,t-1}\overline{K}_{x,t}$ and 'start-up' transfer of net worth $W_{x,E,t}$ net of payoffs to commercial banks $Z_{x,t}(Q_{x,t-1}\overline{K}_{x,t}-\overline{N}_{x,t})$ and the monitoring cost $\mu_xG_t(\overline{\gamma}_{x,E,t})\overline{R}_{x,K,t}Q_{x,t-1}\overline{K}_{x,t}$:

$$\begin{aligned}&\overline{N}_{x,t+1}=\upsilon_{x,\gamma,t}\{\overline{R}_{x,K,t}Q_{x,t-1}\overline{K}_{x,N,t}-\\&\left[Z_{x,t}+\mu_x\frac{G_t(\overline{\gamma}_{x,E,t})\overline{R}_{x,K,t}Q_{x,t-1}\overline{K}_{x,t}}{Q_{x,t-1}\overline{K}_{x,t}-\overline{N}_{x,t}}\right]\left(Q_{x,t-1}\overline{K}_{x,t}-\overline{N}_{x,t}\right)\right\}+W_{x,E,t}\end{aligned} \tag{68}$$

where entrepreneurial loans $(L_{x,E,t}=Q_{x,t-1}\overline{K}_{x,t}-\overline{N}_{x,t})$ equal average market value of capital $Q_{x,t-1}\overline{K}_{x,t}$ net of average net worth of entrepreneur $\overline{N}_{x,t}$.

Appendix F. Commercial banks' optimal behavior

Entrepreneur loans $L_{x,E,t+1}$ supplied to entrepreneurs, internal entrepreneurial loan interest rate $R_{x,E,t+1}$, and contractual entrepreneurial loan interest rate $Z_{x,t+1}$ are jointly determined to maximize entrepreneurs' expected net worth $N_{x,t+1}$ at the end of entrepreneurial loan contracts, subject to zero profit condition of the representative commercial bank's entrepreneurial loan subsidiary:

$$\begin{aligned}&max_{\left\{L_{x,E,t+1},\overline{\gamma}_{x,E,t+1}\right\}}E_t\left\{\left[1-\Gamma_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\frac{R_{x,K,t+1}}{R_{x,E,t+1}}\left(\overline{N}_{x,t+1}+L_{x,E,t+1}\right)+\lambda_{x,B,t+1}\right.\\&\left.\left\{\left[\Gamma_t\left(\overline{\gamma}_{x,E,t+1}\right)-\mu_xG_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\frac{R_{x,K,t+1}}{R_{x,E,t+1}}\left(\overline{N}_{x,t+1}+L_{x,E,t+1}\right)-L_{x,E,t+1}\right\}\right\}\end{aligned} \tag{69}$$

where $\lambda_{x,B,t+1}$ is Lagrange multiplier for zero profit constraint, $[1-\Gamma_t(\overline{\gamma}_{x,E,t+1})]$ is entrepreneurial retained earnings, $R_{x,K,t+1}$ is entrepreneurs' capital return. Substituting entrepreneurial loans $(L_{x,E,t+1}=Q_{x,t}\overline{K}_{x,t+1}-\overline{N}_{x,t+1})$ and dividing by net worth $N_{x,t+1}$ yield entrepreneurs' optimal installed capital $\overline{K}_{x,t+1}$ and productivity threshold $\overline{\gamma}_{x,E,t+1}$:

$$\begin{aligned}&max_{\{\overline{K}_{x,t+1},\overline{\gamma}_{x,E,t+1}\}}E_t\Bigg\{\left[1-\Gamma_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\frac{R_{x,K,t+1}}{R_{x,E,t+1}}\frac{Q_{x,t}\overline{K}_{x,t+1}}{N_{x,t+1}}\\&+\lambda_{x,B,t+1}\left\{\left[\Gamma_t\left(\overline{\gamma}_{x,E,t+1}\right)-\mu_xG_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\frac{R_{x,K,t+1}}{R_{x,E,t+1}}\frac{Q_{x,t}\overline{K}_{x,t+1}}{N_{x,t+1}}-\frac{Q_{x,t}\overline{K}_{x,t+1}}{N_{x,t+1}}+1\right\}\Bigg\}\end{aligned}\tag{70}$$

The first order condition of optimal installed capital $\overline{K}_{x,t+1}$:

$$\begin{aligned}&E_t\Bigg\{\left[1-\Gamma_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\frac{R_{x,K,t+1}}{R_{x,E,t+1}}\\&+\lambda_{x,B,t+1}\left\{\left[\Gamma_t\left(\overline{\gamma}_{x,E,t+1}\right)-\mu_xG_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\frac{R_{x,K,t+1}}{R_{x,E,t+1}}-1\right\}\Bigg\}=0\end{aligned}\tag{71}$$

The first order condition of optimal entrepreneurial loan threshold $\overline{\gamma}_{x,E,t+1}$:

$$E_t\left[\lambda_{x,B,t+1}-\frac{\Gamma_t^{'}(\overline{\gamma}_{x,E,t+1})}{\Gamma_t^{'}(\overline{\gamma}_{x,E,t+1})-\mu_xG_t^{'}(\overline{\gamma}_{x,E,t+1})}\right]=0\tag{72}$$

When Lagrange multiplier $\lambda_{x,B,t+1}$ exceeds zero, complementary slackness condition:

$$E_t\left\{\frac{Q_{x,t}\overline{K}_{x,t+1}}{N_{x,t+1}}\left\{\left[\Gamma_t\left(\overline{\gamma}_{x,E,t+1}\right)-\mu_xG_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\frac{R_{x,K,t+1}}{R_{x,E,t+1}}-1\right\}+1\right\}=0\tag{73}$$

Substituting Eq. (72) into Eq. (71) yields:

$$\left\{\left[1-F_t\left(\overline{\gamma}_{x,E,t+1}\right)\right]\overline{\gamma}_{x,E,t+1}+\left(1-\mu_x\right)\right\}\frac{R_{x,K,t+1}}{R_{x,E,t+1}}Q_{x,t}\overline{K}_{x,t+1}=L_{x,E,t+1}\tag{74}$$

Substituting Eq. (73) into Eq. (74) yields:

$$\begin{aligned}&\left\{\left[1-F_t(\overline{\gamma}_{x,E,t+1})\right]\overline{\gamma}_{x,E,t+1}+G_t(\overline{\gamma}_{x,E,t+1})-\mu_xG_t(\overline{\gamma}_{x,E,t+1})\right\}\\&\frac{R_{x,K,t+1}}{R_{x,E,t+1}}\left(\overline{N}_{x,t+1}+\overline{L}_{x,E,t+1}\right)=L_{x,E,t+1}\end{aligned}\tag{75}$$

where $\{[1-F_t(\overline{\gamma}_{x,E,t+1})]\overline{\gamma}_{x,E,t+1}+G_t(\overline{\gamma}_{x,E,t+1})\}$ is the aggregate share of entrepreneurial earnings received by commercial banks before deducting the monitoring cost. As entrepreneurial productivity threshold $\overline{\gamma}_{x,E,t+1}$ rises, productive entrepreneurs' payoffs $[1-F_t(\overline{\gamma}_{x,E,t+1})]\overline{\gamma}_{x,E,t+1}$ increase, although inducing a higher default probability $G_t(\overline{\gamma}_{x,E,t+1})$ of entrepreneurs.

Appendix G. Household optimization behavior

The typical household i chooses optimal consumption composite $C_{x,i,t}$, labor supply $H_{x,i,t}$, new bank deposits $D_{x,i,t+1}$, new domestic government bonds $B_{x,D,i,t+1}$ and foreign government bonds $B_{x,F,i,t+1}$ to maximize expected future utility, subject to flow budgets and borrowing constraints:

$$max_{\{C_{x,i,t},H_{x,i,t},M_{x,i,t},D_{x,D,i,t+1},B_{x,D,i,t+1},B_{x,F,i,t+1}\}}E_0\sum_{t=0}^{+\infty}\beta_x^t\upsilon_{x,P,t}CU_{x,i,t}\tag{76}$$

where discount factor β_x captures consumption impatience. Due to utility function's additive time separability, household value function $V(D_{x,i,t},B_{x,D,i,t},B_{x,F,i,t},\upsilon_{x,P,t},\upsilon_{x,H,t})$:

$$\begin{aligned}&V\left(D_{x,i,t},B_{x,D,i,t},B_{x,F,i,t},\upsilon_{x,P,t},\upsilon_{x,H,t}\right)=max_{\{C_{x,i,t},H_{x,i,t},M_{x,i,t}\}_{t=0}^{+\infty}}\\&\upsilon_{x,P,t}U\left(C_{x,i,t},H_{x,i,t},M_{x,i,t}\right)+\beta_xV\left(D_{x,i,t+1},B_{x,D,i,t+1},B_{x,F,i,t+1},\upsilon_{x,P,t+1},\upsilon_{x,H,t+1}\right)\end{aligned}\tag{77}$$

Setting up household i's Lagrangian function $Ł_{x,H,i}$:

$$\begin{aligned}&Ł_{x,H,i}=\upsilon_{x,P,t}U\left(C_{x,i,t},H_{x,i,t},M_{x,i,t}\right)+\beta_xV\big(D_{x,i,t+1},B_{x,D,i,t+1},B_{x,F,i,t+1},\\&\upsilon_{x,P,t+1},\upsilon_{x,H,t+1}\big)+\lambda_{x,H}\Bigg[\left(1-\tau_{x,H}\right)W_{x,t}H_{x,i,t}+R_{x,D,t}\frac{D_{x,i,t}}{P_{x,t}}+B_{x,D,i,t}+B_{x,F,i,t}RX_{x,t}\\&+\frac{M_{x,i,t}}{P_{x,t}}+\left(1-\Theta_x\right)\left(1-\upsilon_{x,\gamma,t}\right)\frac{\overline{N}_{x,t+1}-W_{x,E,t}}{\upsilon_{x,\gamma,t}}+PR_{x,K,i,t}-\left(1+\tau_{x,C}\right)C_{x,i,t}\\&-\frac{B_{x,D,i,t+1}}{R_{x,D,t}}-\frac{B_{x,F,i,t+1}RX_{x,t}}{R_{x,F,t}}-\frac{M_{x,i,t-1}}{P_{x,t}}-\frac{D_{x,i,t+1}}{P_{x,t}}-W_{x,E,t}\Bigg]\end{aligned}\tag{78}$$

where household Lagrange multiplier $\lambda_{x,H}$ is identical across households and over time, and households have access to a complete set of state-contingent securities. Taking the partial derivative of Lagrangian function $Ł_{x,H,i}$ with respect to consumption composite $C_{x,i,t}$:

$$\begin{aligned}&\frac{\partial Ł_{x,H,i}}{\partial C_{x,i,t}} = \upsilon_{x,P,t}\left(C_{x,i,t} - \omega_x C_{x,i,t-1}\right)^{-\eta_{x,C}} - \lambda_{x,H}\left(1+\tau_{x,C}\right) = \upsilon_{x,P,t}MU_{x,C,i,t}\\&-\lambda_{x,H}\left(1+\tau_{x,C}\right) = 0 \rightarrow \upsilon_{x,P,t}\left(C_{x,i,t} - \omega_x C_{x,i,t-1}\right)^{-\eta_{x,C}} = \lambda_{x,H}\left(1+\tau_{x,C}\right)\end{aligned} \tag{79}$$

Taking the partial derivative of Lagrangian function $Ł_{x,H,i}$ with respect to labor supply $H_{x,i,t}$:

$$\begin{aligned}&\frac{\partial Ł_{x,H,i}}{\partial H_{x,i,t}} = -\upsilon_{x,P,t}\left(1+\eta_{x,H}\right)\frac{\upsilon_{x,H,t}}{1+\eta_{x,H}}H_{x,i,t}^{\eta_{x,H}} + \lambda_{x,H}\left(1-\tau_{x,H}\right)W_{x,t} = \upsilon_{x,P,t}\\&MU_{x,H,i,t} + \lambda_{x,H}\left(1-\tau_{x,H}\right)W_{x,t} = 0 \rightarrow \upsilon_{x,P,t}\upsilon_{x,H,t}H_{x,i,t}^{\eta_{x,H}} = \lambda_{x,H}\left(1-\tau_{x,H}\right)W_{x,t}\end{aligned} \tag{80}$$

Taking the partial derivative of Lagrangian function $Ł_{x,H,i}$ with respect to deposits $D_{x,i,t+1}$:

$$\begin{aligned}&\frac{\partial Ł_{x,H,i}}{\partial D_{x,i,t+1}} = \beta_x V'_{x,D}\left(D_{x,i,t+1}, \upsilon_{x,P,t+1}, \upsilon_{x,H,t+1}\right) - \frac{\lambda_{x,H}}{P_{x,t}} = 0\\&\rightarrow \beta_x V'_{x,D}\left(D_{x,i,t+1}, \upsilon_{x,P,t+1}, \upsilon_{x,H,t+1}\right) = \frac{\lambda_{x,H}}{P_{x,t}}\end{aligned} \tag{81}$$

The marginal cost of working in terms of consumption composite $\frac{\upsilon_{x,P,t}\upsilon_{x,H,t}H_{x,i,t}^{\eta_{x,H}}(1+\tau_{x,C})}{\upsilon_{x,P,t}(C_{x,i,t}-\omega_x C_{x,i,t-1})^{-\eta_{x,C}}}$ equals the marginal benefit in terms of after-tax real wage $(1-\tau_{x,H})W_{x,t}$, combining Eqs. (79) and (80):

$$\upsilon_{x,P,t}\left(C_{x,i,t} - \omega_x C_{x,i,t-1}\right)^{-\eta_{x,C}} = \left(1+\tau_{x,C}\right)\frac{\upsilon_{x,P,t}\upsilon_{x,H,t}H_{x,i,t}^{\eta_{x,H}}}{\left(1-\tau_{x,H}\right)W_{x,t}} \tag{82}$$

The marginal rate of substitution $MRS_{x,i,t}$ of leisure $\Delta(1-H_{x,i,t})$ for consumption composite $\Delta C_{x,i,t}$:

$$MRS_{x,i,t} = \frac{\frac{\partial CU_{x,i,t}}{\partial C_{x,i,t}}}{\frac{\partial CU_{x,i,t}}{\partial H_{x,i,t}}\frac{dH_{x,i,t}}{d\left(1-H_{x,i,t}\right)}} = \frac{\left(C_{x,i,t} - \omega_x C_{x,i,t-1}\right)^{-\eta_{x,C}}}{\upsilon_{x,H,t}H_{x,i,t}^{\eta_{x,H}}} = \frac{\left(1+\tau_{x,C}\right)}{\left(1-\tau_{x,H}\right)W_{x,t}} \tag{83}$$

Rearranging budget constraint in Eq. (23) and leading forward for one period:

$$\begin{aligned}&\left(1+\tau_{x,C}\right)C_{x,i,t+1} + \frac{D_{x,i,t+2}}{P_{x,t+1}} + W_{x,E,t} = \left(1-\tau_{x,H}\right)W_{x,t+1}H_{x,i,t+1}\\&+R_{x,D,t+1}\frac{D_{x,i,t+1}}{P_{x,t+1}} + \left(1-\Theta_x\right)\left(1-\upsilon_{x,\gamma,t+1}\right)\frac{\overline{N}_{x,t+2} - W_{x,E,t}}{\upsilon_{x,\gamma,t+1}} + PR_{x,K,i,t+1}\end{aligned} \tag{84}$$

Leading value function in Eq. (77) forward for one period, substituting Eqs. (84) and (2) into it, and taking the partial derivative of value function $V(D_{x,i,t+1}, \upsilon_{x,P,t+1}, \upsilon_{x,H,t+1})$ with respect to new deposits $D_{x,i,t+1}$:

$$\begin{aligned}&V'_D\left(D_{x,i,t+1}, \upsilon_{x,P,t+1}, \upsilon_{x,H,t+1}\right) = \frac{\upsilon_{x,P,t+1}R_{x,D,t+1}MU_{x,C,i,t+1}}{\left(1+\tau_{x,C}\right)}\\&= \frac{\upsilon_{x,P,t+1}\left(C_{x,i,t+1} - \omega_x C_{x,i,t}\right)^{-\eta_{x,C}}R_{x,D,t+1}}{\left(1+\tau_{x,C}\right)}\end{aligned} \tag{85}$$

Substituting Eq. (85) into Eq. (81):

$$\frac{\beta_x \upsilon_{x,P,t+1}R_{x,D,t+1}MU_{x,C,i,t+1}}{\left(1+\tau_{x,C}\right)} = \lambda_{x,H}\pi_{x,t,t+1} \tag{86}$$

The marginal utility of consumption composite foregone in depositing equals the interest, substituting Eq. (81) into Eq. (86) yields nominal stochastic discount factor $S_{x,t,t+1}$:

$$S_{x,t,t+1} = \frac{1}{R_{x,D,t+1}} = \frac{\beta_x \upsilon_{x,P,t+1}MU_{x,C,i,t+1}}{\upsilon_{x,P,t}MU_{x,C,i,t}\pi_{x,t,t+1}} \tag{87}$$

In each period t, given consumption composite $C_{x,i,t}$, consumption composite price $P_{x,t}$, domestic good price $P_{x,D,t}$ and foreign good price $P_{x,F,t}$, the representative household chooses consumption of domestic goods $C_{x,D,i,t}$ and foreign goods $C_{x,F,i,t}$ to maximize consumption composite value $P_{x,t}C_{x,i,t}$ net of cost $(P_{x,D,t}C_{x,D,i,t} + \upsilon_{T,t}P_{x,F,t}X_{x,t}C_{x,F,i,t})$:

$$\begin{aligned} & max_{\{C_{x,D,i,t},C_{x,F,i,t}\}}P_{x,t}C_{x,i,t} - \left(P_{x,D,t}C_{x,D,i,t} + \upsilon_{T,t}P_{x,F,t}X_{x,t}C_{x,F,i,t}\right) \\ & = max_{\{C_{x,D,i,t},C_{x,F,i,t}\}}P_{x,t}\left[(1-\varphi_x)^{\frac{1}{\varsigma_x}}C_{x,D,i,t}^{\frac{\varsigma_x-1}{\varsigma_x}}\right. \\ & \left. + \varphi_x^{\frac{1}{\varsigma_x}}\left(C_{x,F,i,t}\upsilon_{T,t}\right)^{\frac{\varsigma_x-1}{\varsigma_x}}\right]^{\frac{\varsigma_x}{\varsigma_x-1}} - \left(P_{x,D,t}C_{x,D,i,t} + \upsilon_{T,t}P_{x,F,t}X_{x,t}C_{x,F,i,t}\right) \end{aligned} \tag{88}$$

Taking the partial derivative with respect to consumption of domestic final goods $C_{x,D,i,t}$:

$$\begin{aligned} & P_{x,t}\left[(1-\varphi_x)^{\frac{1}{\varsigma_x}}C_{x,D,i,t}^{\frac{\varsigma_x-1}{\varsigma_x}} + \varphi_x^{\frac{1}{\varsigma_x}}\left(C_{x,F,i,t}\upsilon_{T,t}\right)^{\frac{\varsigma_x-1}{\varsigma_x}}\right]^{\frac{1}{\varsigma_x-1}}(1-\varphi_x)^{\frac{1}{\varsigma_x}}C_{x,D,i,t}^{\frac{-1}{\varsigma_x}} - P_{x,D,t} \\ & = P_{x,t}C_{x,i,t}^{\frac{1}{\varsigma_x}}(1-\varphi_x)^{\frac{1}{\varsigma_x}}C_{x,D,i,t}^{\frac{-1}{\varsigma_x}} - P_{x,D,t} = 0 \rightarrow C_{x,D,i,t} = \left(1-\varphi_x\right)\left(\frac{P_{x,D,t}}{P_{x,t}}\right)^{-\varsigma_x}C_{x,i,t} \end{aligned} \tag{89}$$

Taking the partial derivative with respect to consumption of foreign final goods $C_{x,F,i,t}$:

$$\begin{aligned} & P_{x,t}\left[(1-\varphi_x)^{\frac{1}{\varsigma_x}}C_{x,D,i,t}^{\frac{\varsigma_x-1}{\varsigma_x}} + \varphi_x^{\frac{1}{\varsigma_x}}\left(C_{x,F,i,t}\upsilon_{T,t}\right)^{\frac{\varsigma_x-1}{\varsigma_x}}\right]^{\frac{1}{\varsigma_x-1}}\varphi_x^{\frac{1}{\varsigma_x}}\frac{\upsilon_{T,t}}{\left(C_{x,F,i,t}\upsilon_{T,t}\right)^{\frac{1}{\varsigma_x}}} \\ & -\upsilon_{T,t}P_{x,F,t}X_{x,t} = P_{x,t}C_{x,i,t}^{\frac{1}{\varsigma_x}}\varphi_x^{\frac{1}{\varsigma_x}}\left(C_{x,F,i,t}\upsilon_{T,t}\right)^{\frac{-1}{\varsigma_x}}\upsilon_{T,t} \\ & -\upsilon_{T,t}P_{x,F,t}X_{x,t} = 0 \rightarrow C_{x,F,i,t} = \varphi_x\left(\frac{P_{x,F,t}X_{x,t}}{P_{x,t}}\right)^{-\varsigma_x}\frac{C_{x,i,t}}{\upsilon_{T,t}} \end{aligned} \tag{90}$$

Substituting consumption of domestic final goods $C_{x,D,i,t}$ and foreign final goods $C_{x,F,i,t}$ into consumption composite $C_{x,i,t}$:

$$P_{x,t} = \left[\left(1-\varphi_x\right)P_{x,D,t}^{1-\varsigma_x} + \varphi_x\left(P_{x,F,t}X_{x,t}\right)^{1-\varsigma_x}\right]^{\frac{1}{1-\varsigma_x}} \tag{91}$$

Appendix H. Household labor income maximization behavior

In period $t+\iota$, household i faces a probability $\gamma_{x,W}^{\iota}$ to adjust wage $W_{x,i,t}^{*}$ indexed by $\prod_{\zeta=0}^{\iota}\upsilon_{x,\pi,t+\iota}^{\xi_{x,W}}\pi_{x,t+\zeta-2,t+\zeta-1}^{1-\xi_{x,W}}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}$, and incurs a probability $\left(1-\gamma_{x,W}\right)$ to reset wage $W_{x,i,t}^{*}$ by maximizing expected income in monopolistic competitive labor markets:

$$\begin{aligned} & max_{\{W_{x,i,t}^{*}\}}E_t\sum_{\iota=0}^{+\infty}\gamma_{x,W}^{\iota}S_{x,t,t+\iota}H_{x,i,t+\iota} \\ & \left(W_{x,i,t}^{*}\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-2,t+\zeta-1}^{1-\xi_{x,W}}\upsilon_{x,\pi,t+\iota}^{\xi_{x,W}}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}} - W_{x,t+\iota}MRS_{x,i,t+\iota}\right) \end{aligned} \tag{92}$$

subject to the demand for household i's labor $H_{x,i,t+\iota} = \left(\frac{W_{x,i,t+\iota}^{*}}{W_{x,t+\iota}}\right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}H_{x,t+\iota}$.

Substituting the demand for household i's labor into Eq. (92):

$$\begin{aligned} & max_{\{W_{x,i,t}^{*}\}}E_t\sum_{\iota=0}^{+\infty}\gamma_{x,W}^{\iota}S_{x,t,t+\iota}\left(\frac{W_{x,i,t+\iota}^{*}}{W_{x,t+\iota}}\right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}H_{x,t+\iota} \\ & \left(W_{x,i,t}^{*}\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-2,t+\zeta-1}^{1-\xi_{x,W}}\upsilon_{x,\pi,t+\iota}^{\xi_{x,W}}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}} - W_{x,t+\iota}MRS_{x,i,t+\iota}\right) \end{aligned} \tag{93}$$

Substituting $\left(W_{x,i,t+\iota}^{*} = \prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}W_{x,i,t}^{*}\right)$ into Eq. (93):

$$max_{\{W^*_{x,i,t}\}} E_t \sum_{\iota=0}^{+\infty} \gamma^{\iota}_W S_{x,t,t+\iota} \left(\frac{\prod_{\zeta=0}^{\iota} \pi_{x,t+\zeta-1,t+\zeta} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} W^*_{x,t}}{W_{x,i,t+\iota}} \right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}$$
$$H_{x,i,t+\iota} \left(W^*_{x,i,t} \prod_{\zeta=0}^{\iota} \pi^{1-\xi_{x,W}}_{x,t+\zeta-2,t+\zeta-1} \upsilon^{\xi_{x,W}}_{x,\pi,t+\iota} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} - W_{x,t+\iota} MRS_{x,i,t+\iota} \right) \tag{94}$$

Rearranging Eq. (94) yields:

$$max_{\{W^*_{x,i,t}\}} E_t \left[\sum_{\iota=0}^{+\infty} \gamma^{\iota}_{x,W} S_{x,t,t+\iota} \left(\frac{\prod_{\zeta=0}^{\iota} \pi_{x,t+\zeta-1,t+\zeta} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A}}{W_{x,t+\iota}} \right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}} \right.$$
$$W^{*\frac{1}{1-\lambda_{x,W}}}_{x,i,t} H_{x,t+\iota} \prod_{\zeta=0}^{\iota} \pi^{1-\xi_{x,W}}_{x,t+\zeta-2,t+\zeta-1} \upsilon^{\xi_{x,W}}_{x,\pi,t+\iota} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} - \sum_{\iota=0}^{+\infty} \gamma^{\iota}_{x,W} S_{x,t,t+\iota}$$
$$\left. \left(\frac{\prod_{\zeta=0}^{\iota} \pi_{x,t+\zeta-1,t+\zeta} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A}}{W_{x,t+\iota}} \right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}} W^{*\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}_{x,t} H_{x,i,t+\iota} W_{x,t+\iota} MRS_{x,i,t+\iota} \right] \tag{95}$$

Taking the derivative of Eq. (95) with respect to household i labor's optimal wage $W^*_{x,i,t}$:

$$E_t \left[\sum_{\iota=0}^{+\infty} \gamma^{\iota}_{x,W} S_{x,t,t+\iota} W^{-\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}_{x,t+\iota} \frac{W^{*\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}_{x,i,t}}{1-\lambda_{x,W}} \left(\prod_{\zeta=0}^{\iota} \pi_{x,t+\zeta-1,t+\zeta} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} \right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}} \right.$$
$$H_{x,t+\iota} \prod_{\zeta=0}^{\iota} \pi^{\xi_{x,W}}_{x,t+\zeta-2,t+\zeta-1} \upsilon^{\left(1-\xi_{x,W}\right)}_{x,\pi,t+\iota} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} - \sum_{\iota=0}^{+\infty} \gamma^{\iota}_{x,W} S_{x,t,t+\iota} W^{\frac{1-2\lambda_{x,W}}{1-\lambda_{x,W}}}_{x,t+\iota}$$
$$\left. \frac{\lambda_{x,W}}{1-\lambda_{x,W}} W^{*\frac{2\lambda_{x,W}-1}{1-\lambda_{x,W}}}_{x,i,t} H_{x,t+\iota} \left(\prod_{\zeta=0}^{\iota} \pi_{x,t+\zeta-1,t+\zeta} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} \right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}} MRS_{x,t+\iota} \right] = 0 \tag{96}$$

Rearranging Eq. (96) and multiplying it by $W^{*2}_{x,i,t}$ yield:

$$E_t \sum_{\iota=0}^{+\infty} \left[\gamma^{\iota}_{x,W} S_{x,t,t+\iota} W^{-\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}_{x,t+\iota} \frac{W^{*\frac{1}{1-\lambda_{x,W}}}_{x,i,t}}{1-\lambda_{x,W}} \left(\prod_{\zeta=0}^{\iota} \pi_{x,t+\zeta-1,t+\zeta} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} \right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}} \right.$$
$$H_{x,t+\iota} W^*_{x,i,t} \prod_{\zeta=0}^{\iota} \pi^{\xi_{x,W}}_{x,t+\zeta-2,t+\zeta-1} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} \upsilon^{\left(1-\xi_{x,W}\right)}_{x,\pi,t+\iota} - \gamma^{\iota}_{x,W} S_{x,t,t+\iota} W^{\frac{1-2\lambda_{x,W}}{1-\lambda_{x,W}}}_{x,t+\iota}$$
$$\left. \frac{\lambda_{x,i}}{1-\lambda_{x,i}} W^{*\frac{1}{1-\lambda_{x,W}}}_{x,i,t} H_{x,t+\iota} \left(\prod_{\zeta=0}^{\iota} \pi_{x,t+\zeta-1,t+\zeta} \right)^{\frac{\lambda_{x,W}}{1-\lambda_{x,W}}} \upsilon^{*\vartheta_{x,A}}_{x,A,t+\iota} \overline{\upsilon}^{*1-\vartheta_{x,A}}_{x,A} MRS_{x,i,t+\iota} \right] = 0 \tag{97}$$

Rearranging Eq. (97) yields:

$$E_t\sum_{\iota=0}^{+\infty}\left[\gamma_{x,W}^{\iota}S_{x,t,t+\iota}W_{x,Y,t+\iota}^{-\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}\frac{1}{1-\lambda_{x,W}}W_{x,i,t+\iota}^{*\frac{1}{1-\lambda_{x,W}}}\left(\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}\right)^{-1}\right.$$

$$H_{x,t+\iota}W_{x,i,t}^{*}\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-2,t+\zeta-1}^{\xi_{x,W}}\upsilon_{x,\pi,t+\iota}^{\left(1-\xi_{x,W}\right)}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}-\gamma_{x,W}^{\iota}S_{x,t,t+\iota}W_{x,t+\iota}^{\frac{1-2\lambda_{x,W}}{1-\lambda_{x,W}}} \tag{98}$$

$$\left.\frac{\lambda_{x,W}}{1-\lambda_{x,W}}W_{x,i,t+\iota}^{*\frac{1}{1-\lambda_{x,W}}}H_{x,t+\iota}\left(\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}\right)^{-1}MRS_{x,i,t+\iota}\right]=0$$

Since the marginal rate of substitution of leisure for consumption $MRS_{x,i,t}$ is independent of household index i, and households set the marginal labor remuneration equal to the marginal rate of substitution of leisure for consumption in monopolistic competitive labor markets, optimal wage $W_{x,i,t}^{*}$ is also independent of household index i. Replacing $W_{x,i,t}$with $W_{x,t}^{*}$and integrating over the continuum of households yield:

$$E_t\sum_{\iota=0}^{+\infty}\left[\gamma_{x,W}^{\iota}S_{x,t,t+\iota}W_{x,t+\iota}^{-\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}\frac{1}{1-\lambda_{x,W}}\left(\int_0^1 W_{x,i,t+\iota}^{*\frac{1}{1-\lambda_{x,W}}}di\right)^{\left(1-\lambda_{x,W}\right)\frac{1}{1-\lambda_{x,W}}}\right.$$

$$\left(\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}\right)^{-1}H_{x,t+\iota}W_{x,t}^{*}\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-2,t+\zeta-1}^{\xi_{x,W}}\upsilon_{x,\pi,t+\iota}^{\left(1-\xi_{x,W}\right)} \tag{99}$$

$$\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}-\gamma_{x,W}^{\iota}S_{x,t,t+\iota}W_{x,t+\iota}^{\frac{1-2\lambda_{x,W}}{1-\lambda_{x,W}}}\frac{\lambda_{x,W}}{1-\lambda_{x,W}}\left(\int_0^1 W_{x,i,t+\iota}^{*\frac{1}{1-\lambda_{x,W}}}di\right)^{\frac{1-\lambda_{x,W}}{1-\lambda_{x,W}}}$$

$$\left.H_{x,t+\iota}\left(\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}\right)^{-1}MRS_{x,j,t+\iota}\right]=0$$

Substituting $W_{x,t+\iota}=\left(\int_0^1 W_{x,i,t+\iota}^{*\frac{1}{1-\lambda_{x,W}}}di\right)^{1-\lambda_{x,W}}$ into Eq. (99) yields:

$$E_t\sum_{\iota=0}^{+\infty}\left[\gamma_{x,W}^{\iota}S_{x,t,t+\iota}W_{x,t+\iota}^{-\frac{\lambda_{x,W}}{1-\lambda_{x,W}}}\frac{1}{1-\lambda_{x,W}}W_{x,t+\iota}^{\frac{1}{1-\lambda_{x,W}}}\left(\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}\right)^{-1}\right.$$

$$H_{x,t+\iota}W_{x,t}^{*}\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-2,t+\zeta-1}^{\xi_{x,W}}\upsilon_{x,\pi,t+\iota}^{1-\xi_{x,W}}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}-\gamma_{x,W}^{\iota}S_{x,t,t+\iota}W_{x,t+\iota}^{\frac{1-2\lambda_{x,W}}{1-\lambda_{x,W}}} \tag{100}$$

$$\left.\frac{\lambda_{x,W}}{1-\lambda_{x,W}}W_{x,t+\iota}^{\frac{1}{1-\lambda_{x,W}}}H_{x,t+\iota}\left(\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}\right)^{-1}MRS_{x,i,t+\iota}\right]=0$$

Households face the same demand curve, optimal wage $W_{x,i,t}^{*}$ generated by leisure utility maximization is independent of household index i. The proportion $\left(1-\gamma_{x,W}\right)$ of households that adjust wages in period t chooses a common optimal wage $W_{x,t}^{*}$:

$$W_{x,t}^{*}=\frac{E_t\sum_{\iota=0}^{+\infty}\gamma_{x,W}^{\iota}S_{x,t,t+\iota}W_{x,t+\iota}^{2}\frac{\lambda_{x,W}}{1-\lambda_{x,W}}H_{x,t+\iota}\frac{MRS_{x,j,t+\iota}}{\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}}}{E_t\sum_{\iota=0}^{+\infty}\gamma_{x,W}^{\iota}S_{x,t,t+\iota}\frac{W_{x,t+\iota}H_{x,t+\iota}}{1-\lambda_{x,W}}\frac{\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-2,t+\zeta-1}^{\xi_{x,W}}\upsilon_{x,\pi,t+\iota}^{1-\xi_{x,W}}\upsilon_{x,A,t+\iota}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}}{\prod_{\zeta=0}^{\iota}\pi_{x,t+\zeta-1,t+\zeta}}} \tag{101}$$

where $S_{x,t,t+\iota}$ is equilibrium nominal stochastic discount factor. $W_{x,t+\iota}$ is wage. $\lambda_{x,W}$ is wage markup. $MRS_{x,i,t+\iota}$ is the marginal rate of substitution of leisure for consumption. $\pi_{x,t+\zeta-2,t+\zeta-1}$ is past gross inflation. $\upsilon_{x,\pi,t}$ is the time-varying inflation target. $\xi_{x,W}$ is wage indexation. Rearranging aggregate wage index in terms of wage $W_{x,t}$:

$$1=\int_0^1\left(\frac{W_{x,i,t}}{W_{x,t}}\right)^{\frac{1}{1-\lambda_{x,W}}}di \tag{102}$$

Based on Calvo wage-setting mechanism and the law of large numbers, a proportion $\gamma_{x,W}$ of households indexes wages to $\pi_{x,t-2,t-1}^{\xi_{x,W}}\upsilon_{x,\pi,t}^{1-\xi_{x,W}}\upsilon_{x,A,t}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}$, while the remainder $(1-\gamma_{x,W})$ of households reoptimizes wage $W_{x,t}^{*}$, Eq. (102) is approximately:

$$1=\gamma_{x,W}\int_0^1\left(\frac{\pi_{x,t-2,t-1}^{\xi_{x,W}}\upsilon_{x,\pi,t}^{1-\xi_{x,W}}\upsilon_{x,A,t}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}W_{x,i,t-1}}{W_{x,t}}\right)^{\frac{1}{1-\lambda_{x,W}}}di+\left(1-\gamma_{x,W}\right)\int_0^1\left(\frac{W_{x,i,t}^{*}}{W_{x,t}}\right)^{\frac{1}{1-\lambda_{x,W}}}di \tag{103}$$

Defining optimal wage $W_{x,t}^{*}$ as a Dixit-Stiglitz aggregator of optimal wages $W_{x,i,t}^{*}$:

$$W_{x,t}^{*}=\left(\int_0^1 W^{*\frac{1}{1-\lambda_{x,W}}}_{x,i,t}di\right)^{1-\lambda_{x,W}} \tag{104}$$

Substituting Eq. (104) into Eq. (103) and rearranging it:

$$1=\gamma_{x,W}\left[\frac{\pi_{x,t-2,t-1}^{\xi_{x,W}}\upsilon_{x,\pi,t}^{*1-\xi_{x,W}}\upsilon_{x,A,t}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}}{\pi_{x,t-1,t}}\right]^{\frac{1}{1-\lambda_{x,W}}}+\left(1-\gamma_{x,W}\right)\left(\frac{W_{x,t}^{*}}{W_{x,t}}\right)^{\frac{1}{1-\lambda_{x,W}}} \tag{105}$$

Plugging indexed inflation $\left(\widetilde{\pi}_{x,t-1,t}=\frac{\pi_{x,t-1,t}}{\pi_{x,t-2,t-1}^{\xi_{x,W}}\upsilon_{x,\pi,t}^{1-\xi_{x,W}}\upsilon_{x,A,t}^{*\vartheta_{x,A}}\overline{\upsilon}_{x,A}^{*1-\vartheta_{x,A}}}\right)$ into Eq. (105):

$$\gamma_{x,W}\widetilde{\pi}_{x,t-1,t}^{\frac{1}{1-\xi_{x,W}}}+\left(1-\gamma_{x,W}\right)\left(\frac{W_{x,t}^{*}}{W_{x,t}}\right)^{\frac{1}{1-\lambda_{x,W}}}=1 \tag{106}$$

Appendix I. Structural shocks and associated innovations

The U.S. price markup shock $\upsilon_{U,Y,t}$ follows a first order autoregressive first order moving average ARMA(1,1) process in logs driven by an innovation $\varepsilon_{U,Y,t}$:

$$\upsilon_{U,Y,t}=\rho_{U,Y}\left(\upsilon_{U,Y,t-1}-\overline{\upsilon}_{U,Y}\right)+\overline{\upsilon}_{U,Y}\left(1+\varepsilon_{U,Y,t}-\Psi_{U,Y}\varepsilon_{U,Y,t-1}\right) \tag{107}$$

with persistence parameter $\rho_{U,Y}\in(0,1)$, moving average parameter $\Psi_{U,Y}\in(0,1)$, and $\overline{\varepsilon}_{U,Y}$being its steady-state.

China's price markup shock $\upsilon_{C,Y,t}$ follows a first order autoregressive first order moving average ARMA(1,1) process in logs driven by an innovation $\varepsilon_{C,Y,t}$:

$$\upsilon_{C,Y,t}=\rho_{C,Y}\left(\upsilon_{C,Y,t-1}-\overline{\upsilon}_{C,Y}\right)+\overline{\upsilon}_{C,Y}\left(1+\varepsilon_{C,Y,t}-\Psi_{C,Y}\varepsilon_{C,Y,t-1}\right) \tag{108}$$

with persistence parameter $\rho_{C,Y}\in(0,1)$, moving average parameter $\Psi_{C,Y}\in(0,1)$, and $\overline{\varepsilon}_{C,Y}$being its steady-state.

The U.S. relative price of investment shock $\upsilon_{U,Q,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,Q,t}$:

$$\upsilon_{U,Q,t}=\rho_{U,Q}\left(\upsilon_{U,Q,t-1}-\overline{\upsilon}_{U,Q}\right)+\overline{\upsilon}_{U,Q}\left(1+\varepsilon_{U,Q,t}\right) \tag{109}$$

with persistence parameter $\rho_{U,Q}\in(0,1)$ and $\overline{\upsilon}_{U,Q}$ being its steady-state.

China's relative price of investment shock $\upsilon_{C,Q,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,Q,t}$:

$$\upsilon_{C,Q,t}=\rho_{C,Q}\left(\upsilon_{C,Q,t-1}-\overline{\upsilon}_{C,Q}\right)+\overline{\upsilon}_{C,Q}\left(1+\varepsilon_{C,Q,t}\right) \tag{110}$$

with persistence parameter $\rho_{C,Q}\in(0,1)$ and $\overline{\upsilon}_{C,Q}$ being its steady-state.

The U.S. technology shock $\upsilon_{U,A,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,A,t}$:

$$\upsilon_{U,A,t}=\rho_{U,A}\left(\upsilon_{U,A,t-1}-\overline{\upsilon}_{U,A}\right)+\overline{\upsilon}_{U,A}\left(1+\varepsilon_{U,A,t}\right) \tag{111}$$

with persistence parameter $\rho_{U,A}\in(0,1)$ and $\overline{\upsilon}_{U,A}$ being its steady-state.

China's technology shock $\upsilon_{C,A,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,A,t}$:

$$\upsilon_{C,A,t}=\rho_{C,A}\left(\upsilon_{C,A,t-1}-\overline{\upsilon}_{C,A}\right)+\overline{\upsilon}_{C,A}\left(1+\varepsilon_{C,A,t}\right) \tag{112}$$

with persistence parameter $\rho_{C,A}\in(0,1)$ and $\overline{\upsilon}_{C,A}$ being its steady-state.

The U.S. investment efficiency shock $\upsilon_{U,I,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,I,t}$:

$$\upsilon_{U,I,t} = \rho_{U,I}\left(\upsilon_{U,I,t-1} - \overline{\upsilon}_{U,I}\right) + \overline{\upsilon}_{U,I}\left(1 + \varepsilon_{U,I,t}\right) \tag{113}$$

with persistence parameter $\rho_{U,I} \in (0,1)$ and $\overline{\upsilon}_{U,I}$ being its steady-state.

China's investment efficiency shock $\upsilon_{C,I,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,I,t}$:

$$\upsilon_{C,I,t} = \rho_{C,I}\left(\upsilon_{C,I,t-1} - \overline{\upsilon}_{C,I}\right) + \overline{\upsilon}_{C,I}\left(1 + \varepsilon_{C,I,t}\right) \tag{114}$$

with persistence parameter $\rho_{C,I} \in (0,1)$ and $\overline{\upsilon}_{C,I}$ being its steady-state.

The U.S. entrepreneurial risk shock $\upsilon_{U,E,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,E,t}$:

$$\upsilon_{U,E,t} = \rho_{U,E}\left(\upsilon_{U,E,t-1} - \overline{\upsilon}_{U,E}\right) + \overline{\upsilon}_{U,E}\left(1 + \varepsilon_{U,E,t}\right) \tag{115}$$

with persistence parameter $\rho_{U,E} \in (0,1)$ and $\overline{\upsilon}_{U,E}$ being its steady-state.

China's entrepreneurial risk shock $\upsilon_{C,E,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,E,t}$:

$$\upsilon_{C,E,t} = \rho_{C,E}\left(\upsilon_{C,E,t-1} - \overline{\upsilon}_{C,E}\right) + \overline{\upsilon}_{C,E}\left(1 + \varepsilon_{C,E,t}\right) \tag{116}$$

with persistence parameter $\rho_{C,E} \in (0,1)$ and $\overline{\upsilon}_{C,E}$ being its steady-state.

The U.S. energy price shock $\upsilon_{U,O,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,O,t}$:

$$\upsilon_{U,O,t} = \rho_{U,O}\left(\upsilon_{U,O,t-1} - \overline{\upsilon}_{U,O}\right) + \overline{\upsilon}_{U,O}\left(1 + \varepsilon_{U,O,t}\right) \tag{117}$$

with persistence parameter $\rho_{U,O} \in (0,1)$ and $\overline{\upsilon}_{U,O}$ being its steady-state.

China's energy price shock $\upsilon_{C,O,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,O,t}$:

$$\upsilon_{C,O,t} = \rho_{C,O}\left(\upsilon_{C,O,t-1} - \overline{\upsilon}_{C,O}\right) + \overline{\upsilon}_{C,O}\left(1 + \varepsilon_{C,O,t}\right) \tag{118}$$

with persistence parameter $\rho_{C,O} \in (0,1)$ and $\overline{\upsilon}_{C,O}$ being its steady-state.

The U.S. intertemporal preference shock $\upsilon_{U,P,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,P,t}$:

$$\upsilon_{U,P,t} = \rho_{U,P}\left(\upsilon_{U,P,t-1} - \overline{\upsilon}_{U,P}\right) + \overline{\upsilon}_{U,P}\left(1 + \varepsilon_{U,P,t}\right) \tag{119}$$

with persistence parameter $\rho_{U,P} \in (0,1)$ and $\overline{\upsilon}_{U,P}$ being its steady-state.

China's intertemporal preference shock $\upsilon_{C,P,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,P,t}$:

$$\upsilon_{C,P,t} = \rho_{C,P}\left(\upsilon_{C,P,t-1} - \overline{\upsilon}_{C,P}\right) + \overline{\upsilon}_{C,P}\left(1 + \varepsilon_{C,P,t}\right) \tag{120}$$

with persistence parameter $\rho_{C,P} \in (0,1)$ and $\overline{\upsilon}_{C,P}$ being its steady-state.

The U.S. money holdings shock $\upsilon_{U,M,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,M,t}$:

$$\upsilon_{U,M,t} = \rho_{U,M}\left(\upsilon_{U,M,t-1} - \overline{\upsilon}_{U,M}\right) + \overline{\upsilon}_{U,M}\left(1 + \varepsilon_{U,M,t}\right) \tag{121}$$

with persistence parameter $\rho_{U,M} \in (0,1)$ and $\overline{\upsilon}_{U,M}$ being its steady-state.

China's money holdings shock $\upsilon_{C,M,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,M,t}$:

$$\upsilon_{C,M,t} = \rho_{C,M}\left(\upsilon_{C,M,t-1} - \overline{\upsilon}_{C,M}\right) + \overline{\upsilon}_{C,M}\left(1 + \varepsilon_{C,M,t}\right) \tag{122}$$

with persistence parameter $\rho_{C,M} \in (0,1)$ and $\overline{\upsilon}_{C,M}$ being its steady-state.

The U.S. labor supply shock $\upsilon_{U,H,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,H,t}$:

$$\upsilon_{U,H,t} = \rho_{U,H}\left(\upsilon_{U,H,t-1} - \overline{\upsilon}_{U,H}\right) + \overline{\upsilon}_{U,H}\left(1 + \varepsilon_{U,H,t}\right) \tag{123}$$

with persistence parameter $\rho_{U,H} \in (0,1)$ and $\overline{\upsilon}_{U,H}$ being its steady-state.

China's labor supply shock $\upsilon_{C,H,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,H,t}$:

$$\upsilon_{C,H,t} = \rho_{C,H}\left(\upsilon_{C,H,t-1} - \overline{\upsilon}_{C,H}\right) + \overline{\upsilon}_{C,H}\left(1 + \varepsilon_{C,H,t}\right) \tag{124}$$

with persistence parameter $\rho_{C,H} \in (0,1)$ and $\overline{\upsilon}_{C,H}$ being its steady-state.

The U.S. financial wealth shock $\varepsilon_{U,F,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,F,t}$:

$$\upsilon_{U,F,t} = \rho_{U,F}\left(\upsilon_{U,F,t-1} - \overline{\upsilon}_{U,F}\right) + \overline{\upsilon}_{U,F}\left(1 + \varepsilon_{U,F,t}\right) \tag{125}$$

with persistence parameter $\rho_{U,F} \in (0,1)$ and $\overline{\upsilon}_{U,F}$ being its steady-state.

China's financial wealth shock $\varepsilon_{C,F,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,F,t}$:

$$\upsilon_{C,F,t} = \rho_{C,F}\left(\upsilon_{C,F,t-1} - \overline{\upsilon}_{C,F}\right) + \overline{\upsilon}_{C,F}\left(1 + \varepsilon_{C,F,t}\right) \tag{126}$$

with persistence parameter $\rho_{C,F} \in (0,1)$ and $\overline{\upsilon}_{C,F}$ being its steady-state.

The U.S. time-varying inflation target $\upsilon_{U,\pi,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,\pi,t}$:

$$\upsilon_{U,\pi,t} = \rho_{U,\pi}\left(\upsilon_{U,\pi,t-1} - \overline{\upsilon}_{U,\pi}\right) + \overline{\upsilon}_{U,\pi}\left(1 + \varepsilon_{U,\pi,t}\right) \tag{127}$$

with persistence parameter $\rho_{U,\pi} \in (0,1)$ and $\overline{\upsilon}_{U,\pi}$being its steady-state.

China's time-varying inflation target $\upsilon_{C,\pi,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,\pi,t}$:

$$\upsilon_{C,\pi,t} = \rho_{C,\pi}\left(\upsilon_{C,\pi,t-1} - \overline{\upsilon}_{C,\pi}\right) + \overline{\upsilon}_{C,\pi}\left(1 + \varepsilon_{C,\pi,t}\right) \tag{128}$$

with persistence parameter $\rho_{C,\pi} \in (0,1)$ and $\overline{\upsilon}_{C,\pi}$being its steady-state.

The U.S. interest rate shock $\varepsilon_{U,R,t}$ corresponds to an innovation $\varepsilon_{U,R,t} \sim i.i.d.N(0,\sigma^2_{U,R})$.

China's money supply shock $\varepsilon_{C,MS,t}$ corresponds to an innovation $\varepsilon_{C,MS,t} \sim i.i.d.N(0,\sigma^2_{C,MS})$.

China's reserve ratio shock $\upsilon_{C,\tau,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,\tau,t}$:

$$\upsilon_{C,\tau,t} = \rho_{C,\tau}\left(\upsilon_{C,\tau,t-1} - \overline{\upsilon}_{C,\tau}\right) + \overline{\upsilon}_{C,\tau}\left(1 + \varepsilon_{C,\tau,t}\right) \tag{129}$$

with persistence parameter $\rho_{C,\tau} \in (0,1)$ and $\overline{\upsilon}_{C,\tau}$being its steady-state.

The U.S. government spending shock $\upsilon_{U,G,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{U,G,t}$:

$$\upsilon_{U,G,t} = \rho_{U,G}\left(\upsilon_{U,G,t-1} - \overline{\upsilon}_{U,G}\right) + \overline{\upsilon}_{U,G}\left(1 + \varepsilon_{U,G,t}\right) \tag{130}$$

with government spending inertia parameter $\rho_{U,G} \in (0,1)$ and $\overline{\upsilon}_{U,G}$being its steady-state.

China's government spending shock $\upsilon_{C,G,t}$ follows an AR(1) process in logs driven by an innovation $\varepsilon_{C,G,t}$:

$$\upsilon_{C,G,t} = \rho_{C,G}\left(\upsilon_{C,G,t-1} - \overline{\upsilon}_{C,G}\right) + \overline{\upsilon}_{C,G}\left(1 + \varepsilon_{C,G,t}\right) \tag{131}$$

with government spending inertia parameter $\rho_{C,G} \in (0,1)$ and $\overline{\upsilon}_{C,G}$being its steady-state.

The trade shock $\upsilon_{T,t}$ follows an AR(1) process in logs with an innovation $\varepsilon_{T,t}$:

$$\upsilon_{T,t} = \rho_{T}\left(\upsilon_{T,t-1} - \overline{\upsilon}_{T}\right) + \overline{\upsilon}_{T}\left(1 + \varepsilon_{T,t}\right) \tag{132}$$

with persistence parameter $\rho_T \in (0,1)$ and $\overline{\upsilon}_T$ being its steady-state.

The risk premium shock $\upsilon_{RP,t}$ follows an AR(1) process in logs with an innovation $\varepsilon_{RP,t}$:

$$\upsilon_{RP,t} = \rho_{RP}\left(\upsilon_{RP,t-1} - \overline{\upsilon}_{RP}\right) + \overline{\upsilon}_{RP}\left(1 + \varepsilon_{RP,t}\right) \tag{133}$$

with persistence parameter $\rho_{RP} \in (0,1)$ and $\overline{\upsilon}_{RP}$ being its steady-state.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.chieco.2023.102006.

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