An Empirical Ecological Stock Flow Consistent Model of China

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Abstract

This paper develops an empirical ecological stock-flow consistent model for China. It embeds the Chinese balance sheet and transaction flow matrix and describes institutions' behaviours to mimic the Chinese economy. By including the material and energy balance, the model can link the economy to its effect on the environment. We use the in-sample prediction to validate the model and find that the fitness of the data is fairly good. We run a baseline scenario under a promised green transition, giving a reference to future predictions. Then, we compare a working hour reduction shock to a wage increase policy and income redistribution policy. All three policies reduce real GDP and emissions, showing a trade-off between economy and environmental quality. A working hour reduction reduces income equality and unemployment more significantly but may trigger long-run inflation.

1 Introduction

Stock-flow consistent (SFC) models, as a branch of macroeconomic models, are tools to answer macroeconomic research questions. Theoretical models are clean and tight to explain a specific economic phenomenon. When it comes to a national economy, an empirical model has the advantage of capturing some specific features of the economy Zezza and Zezza (2019). Theoretical models assume the economy starts with a balanced growth path or an initial steady state to avoid spikes in the beginning periods of the simulation and focus on the second moment fitness to the data, i.e. variance and covariance. It requires some parameters to be chosen to calibrated to guarantee this assumption, losing some degree of freedom. When the system is small, it is very likely that the calibrated parameters have bizarre values because it ignores many channels of the real world. Empirical models, unlike theoretical models that are built from simple to more complex, start directly from the complete system and attempt to simplify without breaking the completeness of the system; for example, if we drop the deposits held by the rest of the world, then we need to assume the same amount of money appear somewhere in the assets side or cancelled out in the liability side so that the foreign net worth does not change; moreover, the interest generated by these deposits also has to be dropped and appear somewhere in the current account. Empirical models do not require an initial steady state assumption since they describe the full system and the system never has a balanced growth path. It allows the model to directly validate the first moment of the data, e.g., the level and the long-term trend, and it does not require calibration to distort the value of the parameters and the initial value of the variables.

Recently, studies employing an empirical SFC framework for some economies have been emerging: the Argentina model (Valdecantos, 2022), the Denmark model (Byrialsen and Raza, 2021), the French model (Mazier and Reyes, 2022), the Italian model (F. Zezza and Zezza, 2022), the Netherlands model (Meijers and Muysken, 2022), the UK model (George and Dafermos, 2023), and a few to name. Most of the studies are on developed countries because of data availability. Very few of them have integrated the ecological side, which has become one of the biggest trends in the theoretical framework (Jacques et al., 2023). SFC models, as a type of demand-driven model of economic growth, have the advantage of studying social transformation to achieve sustainable growth, such as sustainable consumption, reduced working time, and the rebound effect (Rezai et al., 2013).

This paper presents an empirical ecological SFC model of China. It develops the first existing empirical SFC model of the Chinese economy and is one of the few that attempt to integrate the ecological side with the country's material and energy balance. Over the past decades, China has shown incredible economic growth. The tremendous economic performance of China, however, accompanies some costs.

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China has become the largest carbon emitter in the world. The income gap in China has risen and remains high between the working class and the capitalists. In this paper, we attempt to give a near-future prediction of China and policy advice to solve these issues.

The National Bureau of Statistics has reported that the average working hour per week has reached 48.6 in the first half of 2024, which has peaked in the past two decades. The "996" work regime has become a hot word in China in recent years, which means working from 9 am to 9 pm daily and six working days weekly. While, according to the *Labor Law of the People's Republic of China* issued on 07/05/1994, the State shall practice a working hour system wherein labourers shall work for no more than eight hours a day and no more than 44 hours a week on the average.

Long working hours are considered one of the major risk factors for workplace accidents and workers' health (Lee & Lee, 2016). Reducing working hours, in traditional belief, is considered a policy for increasing employment since firms have to hire additional workers, i.e. work sharing. While, it may also increase wage pressure, causing more unemployment (Skans, 2001). In this paper, we investigate the effect of a working hour reduction shock on unemployment, income equality and material emissions. In comparison, we also test a wage increase policy and an income redistribution policy.

The following section describes the model. Section 3 discusses the data management and parameters estimations. Section 4 discusses the model validation. Section 5 shows the model forecast for the near future and policy scenarios. And, last, we conclude and remark.

2 The Model

The economy comprises five sectors: households, firms, banks, governments, and the rest of the world (RoW). Households and governments consume the final good according to their consumption functions. Investments are made by households (mainly real estate acquisition), firms and governments (final good production) through their investment decisions. Banks receive deposits and issue bonds and loans to fulfil money demand (endogenous money). The Central Bank, which is included in the banking sector, runs an inflation-biased Taylor rule by adjusting the policy rate. Accounting equations such as changes in loans and bonds and the accumulation of assets and liabilities are modelled to guarantee stock-flow consistency. Behaviour equations, e.g., consumption and investment decisions and financial instruments saving/borrowings, follow Post-Keynesian economic theory and adjust to the econometric regression results. Prices are endogenous and depend on production costs.

The ecological block includes the material balance and energy balance of China (see Table 1). They account for material and energy inflows and outflows, which are linked to economic activities.

Table 1: Physical flow matrix

	Material balance	Energy balance
Inflows		
Biomass extraction	$+DE_b$	
Fossil energy material extraction	$+DE_f$	$+EN$
Metal ores extraction	$+DE_m$	
Non-metallic material extraction	$+DE_{nm}$	
Renewable energy		$+ER$
Biomass import	$+MIM_b$	
Fossil energy material import	$+MIM_f$	$+EIM$
Metal ores import	$+MIM_m$	
Non-metallic material import	$+MIM_{nm}$	
Other products import	$+MIM_o$	
Balancing items	$+BI_{in}$	
Recovery of energy		$+RoE$
Outflows		
Biomass consumption	$-DMC_b$	
Fossil energy material consumption	$-DMC_f$	
Metal ores consumption	$-DMC_m$	
Non-metallic ores consumption	$-DMC_{nm}$	
Other products consumption	$-DMC_o$	
Energy consumption		$-EC$
Biomass export	$-MEX_b$	
Fossil energy material export	$-MEX_f$	$-EEX$
Metal ores export	$-MEX_m$	
Non-metallic material export	$-MEX_{nm}$	
Other products export	$-MEX_o$	
Emissions to air	$-DPO_a$	
Dissipative use of products	$-DPO_{dup}$	
Emissions to water	$-DPO_w$	
Balancing items	$-BI_{out}$	$-EB$
Change in stock	$-NAS$	$+ESC$
Total	0	0

Note: + denotes inflows, - denotes outflows. Other product consumption is a mismatched item. Energy stock change is recorded as an inflow.

2.1 Energy

According to the energy balance sheet from the National Bureau of Statistics of China (NBSC), energy consumption, EC_t, follows,

$$EC_t = EP_t - EEX_t + EIM_t + RoE_t + ESC_t - EB_t, \tag{1}$$

where EP_t denotes primary energy production, EEX_t denotes energy exports, EIM_t denotes energy imports, RoE_t denotes recovery of energy, ESC_t denotes energy stock change, and EB_t is a balancing item. The last three terms are assumed to be exogenous because their level is negligible from the data.

Primary energy production is driven by energy intensity and aggregate demand,

$$EP_t = \varepsilon_t y_t, \tag{2}$$

where y_t denotes real GDP and ε_t denotes energy intensity. Jun et al. (2011) show there is a negative relationship between income distribution and environmental quality in China. We assume that a larger income distribution gap would cause people to consume more energy-intensive goods to capture this relationship,

$$\Delta \ln \varepsilon_t = \varepsilon_0 + \varepsilon_1 \left[\ln \varepsilon_{t-1} - \varepsilon_2 - \varepsilon_3 (t-1) - \varepsilon_4 \ln gini_{t-1} \right], \tag{3}$$

where $\varepsilon_0 < 0$ denotes the short-run exogenous energy efficiency improvement, $-1 < \varepsilon_1 < 0$ is the long-run correction parameter of energy intensity, ε_2 is the initial level of energy intensity in logarithm, $\varepsilon_3 < 0$ denotes the long-run exogenous energy efficiency improvement, and $\varepsilon_4 > 0$ is the elasticity of energy intensity to the Gini coefficient.

Primary energy production consists of fossil energy production and renewable energy production. Renewable energy production is determined by the green share,

$$ER_t = \theta_t EP_t, \tag{4}$$

where θ_t denotes the share of renewable energy production, which is exogenous.

Fossil energy production fulfils the remaining energy production needs,

$$EN_t = EP_t - ER_t. \tag{5}$$

Energy exports depend on exports in volume,

$$EEX_t = \varepsilon_{ex} x_t, \tag{6}$$

where ε_{ex} is the energy intensity of exports, which is exogenous, and x_t is exports in volume.

Similarly, energy imports depend on imports in volume,

$$EIM_t = \varepsilon_{im} m_t, \tag{7}$$

where ε_{im} is the energy intensity of imports, also exogenous, and m_t is imports in volume.

2.2 Materials

The accounting structure of material flows follows Chen et al. (2022). We separate materials into five categories: biomass, fossil energy materials, metal ores, non-metallic materials, and other products.

Aggregate domestic material input consists of aggregate domestic extraction and aggregate material import,

$$DMI_t = DE_t + MIM_t, \tag{8}$$

where DE_t denotes aggregate domestic extraction and MIM_t denotes aggregate material import.

Similarly, domestic biomass input, domestic fossil energy materials input, domestic metal ores input, and domestic non-metallic input are the sum of their domestic extraction and imports,

$$DMI_{i,t} = DE_{i,t} + MIM_{i,t},\ i = b, f, m, nm, \tag{9}$$

where the subscript $i = b, f, m, nm$ represents biomass, fossil energy materials, metal ores, and non-metallic materials, respectively.

Other product inputs, specifically, are only imported,

$$DMI_{o,t} = MIM_{o,t}, \tag{10}$$

where the subscript o represents other products.[1]

Aggregate domestic extraction equals the sum of biomass extraction, fossil energy materials extraction, metal ores extraction, and non-metallic extraction,

$$DE_t = DE_{b,t} + DE_{f,t} + DE_{m,t} + DE_{nm,t}. \tag{11}$$

Domestic extractions, except fossil energy materials, are demanded directly from economic activities,

$$DE_{i,t} = \mu_i y_t,\ \forall i \neq f, \tag{12}$$

where μ_i denotes the respective material intensity, which is exogenous.

Domestic fossil energy material extraction is driven by fossil energy production,

$$DE_{f,t} = \frac{EN_t}{car}, \tag{13}$$

[1] Other products are balancing instruments for the physical trade balance, which are only recorded in material exports and imports.

where car is the coverage ratio of fossil energy production, which is exogenous.

Aggregate material imports contain all five types of material imports,

$$MIM_t = MIM_{b,t} + MIM_{f,t} + MIM_{m,t} + MIM_{nm,t} + MIM_{o,t}. \tag{14}$$

Material imports, except fossil energy materials, are driven by imports in volume,

$$MIM_{i,t} = \mu_{i,im} m_t, \ \forall i \neq f, \tag{15}$$

where $\mu_{i,im}$ denotes the respective import material intensity.

Fossil energy material import is determined by the imported energy,

$$MIM_{f,t} = \frac{EIM_t}{car_{im}}, \tag{16}$$

where car_{im} is the coverage ratio of energy imports.

Aggregate domestic material consumption equals aggregate domestic material input subtracts aggregate material export,

$$DMC_t = DMI_t - MEX_t, \tag{17}$$

where MEX_t denotes aggregate material export. The same for all types of materials,

$$DMC_{i,t} = DMI_{i,t} - MEX_{i,t}, \ \forall i. \tag{18}$$

Aggregate material exports contain all five types of material exports,

$$MEX_t = MEX_{b,t} + MEX_{f,t} + MEX_{m,t} + MEX_{nm,t} + MEX_{o,t}. \tag{19}$$

Material exports, except fossil energy materials, are driven by exports in volume,

$$MEX_{i,t} = \mu_{i,ex} x_t, \ \forall i \neq f, \tag{20}$$

where $\mu_{i,ex}$ denotes the respective export material intensity.

Fossil energy material export is determined by the exported energy,

$$MEX_{f,t} = \frac{EEX_t}{car_{ex}}, \tag{21}$$

where car_{ex} is the coverage ratio of energy exports.

Aggregate material stock follows,

$$MS_t = MS_{t-1} + NAS_t + OCS_t, \tag{22}$$

where NAS_t denotes net additions to material stock, and OCS_t denotes other changes in material stock, which is a discrepancy item assumed to be exogenous.

Net additions to material stock follow,

$$NAS_t = DMC_t + BI_{in,t} - DPO_t - BI_{out,t}, \tag{23}$$

where $BI_{in,t}$ denotes material inflows balancing items, DPO_t denotes aggregate domestic processed output, and $BI_{out,t}$ denotes material outflows balancing items.

Material inflow balancing items are mainly oxygen required in the combustion process of fossil energy,

$$BI_{in,t} = comb_{in} DMC_{f,t}, \tag{24}$$

where $comb_{in}$ denotes the combustion inflow coefficient.

The aggregate domestic processed output follows,

$$DPO_t = DPO_{a,t} + DPO_{dup_t} + DPO_{w,t}, \tag{25}$$

where $DPO_{a,t}$ denotes emissions to air, $DPO_{dup,t}$ denotes dissipative use of products, and $DPO_{w,t}$ denotes emission to water.

Emissions to air are mainly CO_2, SO_2, etc released from the fossil energy combustion process,

$$DPO_{a,t} = \nu_a DMC_{f,t}, \tag{26}$$

where ν_a is the coefficient of emission to air, which is exogenous.

The dissipative use of products mainly consists of materials dissipated by fertilizer use. It is driven by biomass extraction,

$$DPO_{dup,t} = \nu_{dup,t} DE_{b,t}, \tag{27}$$

where $\nu_{dup,t}$ is the coefficient of dissipative use of products. We assume a larger income distribution gap would cause more dissipative use of products under the same level of biomass extraction to capture the negative relationship between income distribution and environmental quality (Jun et al., 2011),

$$\Delta \ln \nu_{dup,t} = dup_0 + dup_1 \Delta \ln gini_t + dup_2 \left[\ln \nu_{dup,t-1} - dup_3 - dup_4(t-1) - dup_5 \ln gini_{t-1}\right], \tag{28}$$

where $dup_0 < 0$ denotes the short-run exogenous reduction of dissipative use of products to biomass extraction, $dup_1 > 0$ is the short-run elasticity of the coefficient of dissipative use of products to the Gini coefficient, $-1 < dup_2 < 0$ is the long-run correction parameter of the coefficient of dissipative use of products, dup_3 is the initial level of the coefficient of dissipative use of products in logarithm, $dup_4 < 0$ is the long-run exogenous reduction of dissipative use of products to biomass extraction, and $dup_5 > 0$ is the long-run elasticity of the coefficient of dissipative use of products to the Gini coefficient.

Emissions to water are mainly materials released in industrial and municipal wastewater. They are driven by economic activities,

$$DPO_{w,t} = \nu_{w,t} y_t, \tag{29}$$

where $\nu_{w,t}$ is the emissions to water intensity. Similar to energy intensity and the coefficient of dissipative use of products, we assume a larger income distribution gap would cause more wastewater to real GDP,

$$\Delta \ln \nu_{w,t} = \nu_{w0} + \nu_{w1} \left[\ln \nu_{w,t-1} - \nu_{w2} - \nu_{w3}(t-1) - \nu_{w4} \ln gini_{t-1}\right], \tag{30}$$

where $\nu_{w0} < 0$ denotes the short-run exogenous reduction of emissions to water intensity, $-1 < \nu_{w1} < 0$ is the long-run correction parameter of emissions to water intensity, ν_{w2} is the initial level of emissions to water intensity in logarithm, $\nu_{w3} < 0$ is the long-run exogenous reduction of emission to water intensity, and $\nu_{w4} > 0$ is the elasticity of emissions to water intensity to the Gini coefficient.

Material outflow balancing items are mainly water vapour from the combustion process of fossil energy,

$$BI_{out,t} = comb_{out} DMC_{f,t}, \tag{31}$$

where $comb_{out}$ denotes the combustion outflow coefficient, which is exogenous.

2.3 Macroeconomy

The economy comprises five sectors: firms, banks, governments, households, and the rest of the world (RoW) (see Table 3). Firms, banks, governments, and households hold fixed capital, K_{1f}, K_{1b}, K_{1g} and K_{1h}, respectively. Firms and governments hold inventories, K_{2f} and K_{2g}, which include both output and input inventories. Firms, banks, and governments hold other non-financial assets (NFA), K_{3f}, K_{3b}, and K_{3g}, respectively, which include patents and nationally owned construction land, etc. Banks hold international reserves, G. Households hold currencies issued by the central bank, H. Banks issue deposits, D. Sectors borrow money from each other through bonds or loans, B and L. Firms' and banks' equity on the liability side account for both equity issued and net assets, so their net worth is 0 (*China's National Balance Sheet 2018*). In this case, the net worth of firms and banks is transferred to their owners (the other sectors) through equities holding, E. Investing banks issue investment fund shares to investors, IFS. Firms and households buy insurance from banks, A_f and A_h, respectively. Other accounts payable/receivables, Z, capture the statistic misallocation and net position of all the other instruments by sectors that are not included in the model.[2] Net worth represents the net asset position of the sectors, in other words, wealth. The economy's total wealth should equal total physical capital, aggregate fixed capitals, inventories, and other NFA, $V_g + V_h + V_r = K = K_1 + K_2 + K_3$.

The transaction flow matrix shows the transaction received and paid between sectors (see Table 4). Each column has to sum up to zero to satisfy the vertical consistency, meaning that transactions received and paid have to even out in every sector (see equation 54 for the example of households). Each row also has to sum up to zero for horizontal consistency. It guarantees that there is no black hole; any transaction received/paid by a sector has to be paid/received by another sector.

[2]For simplicity, we drop net positions of the instruments held by sectors that are negligible in their size, for example, currencies held by sectors other than households and foreign bonds held and issued.

Table 3: The national balance sheet

	Firms	Banks	Governments	Households	RoW	Total
Fixed capitals	$+K_{1f}$	$+K_{1b}$	$+K_{1g}$	$+K_h$		$+K_1$
Inventories	$+K_{2f}$		$+K_{2g}$			$+K_2$
Other NFA	$+K_{3f}$	$+K_{3b}$	$+K_{3g}$			$+K_3$
International reserves		$+G$			$-G$	0
Currencies		$-H$		$+H$		0
Deposits	$+D_f$	$+D_b - D$	$+D_g$	$+D_h$		0
Bonds	$-B_f$	$+B_{ab} - B_{lb}$	$-B_g$	$+B_h$		0
Loans	$-L_f$	$+L_b$		$-L_h$	$+L_{ar} - L_{lr}$	0
Equities	$+E_{af} - E_{lf}$	$+E_{ab} - E_{lb}$	$+E_g$	$+E_h$	$+E_r$	0
Investment funds shares		$+IFS_{ab} - IFS_{lb}$	$+IFS_g$	$+IFS_h$		0
FDI	$+FDI_{out} - FDI_{in}$				$+FDI_{in} - FDI_{out}$	0
Insurance	$+A_f$	$-A$		$+A_h$		0
Other accounts payable/receivable (+/-)	$+Z_f$	$+Z_b$	$+Z_g$	$+Z_h$	$+Zr$	0
Networth	0	0	V_g	V_h	V_r	$+K$

Note: + denotes assets, - denotes liabilities.

Table 4: Transaction flow matrix

	Production	Firms	Banks	Governments	Households	RoW	Total
GDP	$-Y$ $+Y_{adj}$	$+Y_f$	$+Y_b$	$+Y_g$	$+Y_h$		0
Consumption	$+C$			$-C_g$	$-C_h$		0
Fixed capital formation	$+I_1$	$-I_{1f}$	$-I_{1b}$	$-I_{1g}$	$-I_h$		0
Change in inventories	$+I_2$	$-I_{2f}$		$-I_{2g}$			0
Acquisition less disposals of other NFA		$-I_3$		$+I_3$			0
Export	$+X$					$-X$	0
Import	$-M$					$+M$	0
Net export adjustment	$+NX_{adj}$					$-NX_{adj}$	0
Wages		$-W_f$	$-W_b$	$-W_g$	$+W - W_h$	$-W_r$	0
Net taxes on production		$-TL_f$	$-TL_b$	$+TL$	$-TL_h$		0
Interest on deposits		$+INT_{df}$	$+INT_{db} - INT_d$	$+INT_{dg}$	$+INT_{dh}$		0
Interest on bonds		$-INT_{bf}$	$+INT_{brb} - INT_{bpb}$	$-INT_{bg}$	$+INT_{bh}$		0
Interest on loans		$-INT_{lf}$	$+INT_{lb}$		$-INT_{lh}$	$+INT_{rr} - INT_{pr}$	0
Distributed income of Corporations		$+DIV_{rf}$ $-DIV_{pf}$	$+DIV_{rb} - DIV_{pb}$	$+DIV_g$	$+DIV_h$	$+DIV_{rr}$	0
Other income from properties		$+OIP_f$	$-OIP_b$	$+OIP_g$	$+OIP_h$	$-OIP_r$	0
Taxes on income and wealth		$-T_f$	$-T_b$	$+T$	$-T_h$		0
Social contributions				$+SC$	$-SC$		0
Social benefits				$-SB$	$+SB$		0
Other current transfers		$-O_f$	$+O_b$	$+O_g$	$-O_h$	$-O_r$	0
Capital transfers		$+TRK$		$-TRK$			0
Errors and omissions	$-EO$	$+EO_f$	$+EO_b$	$+EO_g$	$+EO_h$	$+EO_r$	0
International reserves			$-\Delta G$			$+\Delta G$	0
Currencies			$+\Delta H$		$-\Delta H$		0
Deposits		$-\Delta D_f$	$-\Delta D_b + \Delta D$	$-\Delta D_g$	$-\Delta D_h$		0
Bonds		$+\Delta B_f$	$-\Delta B_{ab} + \Delta B_{lb}$	$+\Delta B_g$	$-\Delta B_h$		0
Loans		$+\Delta L_f$	$-\Delta L_b$		$+\Delta L_h$	$-\Delta L_{ar} + \Delta L_{lr}$	0
Investment fund shares			$-\Delta IFS_{ab} + \Delta IFS_{lb}$	$-\Delta IFS_g$	$-\Delta IFS_h$		0
FDI inward		$+\Delta FDI_{in}$				$-\Delta FDI_{in}$	0
FDI outward		$-\Delta FDI_{out}$				$+\Delta FDI_{out}$	0
Insurance		$-\Delta A_f$	$+\Delta A$		$-\Delta A_h$		0
Other account payable /receivables (+/-)		$-\Delta Z_f$	$-\Delta Z_b$	$-\Delta Z_g$	$-\Delta Z_h$	$-\Delta Z_r$	0
Total	0	0	0	0	0	0	0

Note: + denotes transactions received, - denotes transactions paid. According to the National Bureau of Statistics of China, acquisition less disposals of other NFA are mainly transfers from firms to governments, and there are no data for banks, which are inconsistent with the balance sheet. Adjustment variables and errors and omissions are included to solve the data mismatch because of different sources and statistical methods.

Notice that firms' and banks' equity on the liability side account for both equity issued and net assets, so their net worth is 0 (*China's National Balance Sheet 2018*, see Table 3). Equity flows reported by *National Bureau of Statistics* of China are 0 (see Table 4). Therefore, we have the following treatment for equity liabilities of firms and banks, i) the value of firms' and banks' equity on the liability side of the balance sheet satisfied the following conditions to guarantee their net worth is zero,

$$E_{lf,t} = K_{1f,t}+K_{2f,t}+K_{3f,t}+D_{f,t}-B_{f,t}-L_{f,t}+E_{af,t}+FDI_{out,t}-FDI_{in,t}+A_{f,t}+Z_{f,t}\,(V_{f,t}=0), \quad (32)$$

$$E_{lb,t} = K_{1b,t}+K_{3b,t}+G_t-H_t+D_{b,t}-D_t+B_{ab,t}-B_{lb,t}+L_{b,t}+E_{ab,t}+IFS_{ab,t}-IFS_{lb,t}-A_t+Z_{b,t}\,(V_b=0), \quad (33)$$

ii) since there are no equity flows, the revaluation effect accounts for all the changes in value,

$$REV_{e_{lj},t} = E_{lj,t} - E_{lj,t-1},\ j=b,f, \quad (34)$$

iii) we derive the implicit equity price indices,[3]

$$P_{e_{lj},t} = P_{e_{lj},t-1}\frac{REV_{e_{lj},t}}{E_{lj,t-1}},\ j=b,f. \quad (35)$$

[3]We have tried using the stock market price index to estimate equity flows, but it would increase the mismatch of net financial investment between the real account and financial account in the transaction-flow matrix.

The following subsections present the main equations of the sectors. Behaviour equations follow the Post-Keynesian macroeconomic theory (e.g. Godley and Lavoie, 2006) and are pragmatically verified by econometrics employing historical annual data from 2000 to 2019 (National Bureau of Statistics of China, China's National Balance Sheet and World Bank).[4] Other simplified behaviour equations and accounting equations are shown in detail in the Appendix.

2.3.1 Final good equilibrium

Final good production, Y_t, fulfills the aggregate demand, which consists of households consumption, $C_{h,t}$, government consumption, $C_{g,t}$, fixed capital formation by firms, banks, and governments, $I_{1f,t}$, $I_{1b,t}$ and $I_{1g,t}$, respectively, fixed capital formation by households (mainly dwelling acquisition), $I_{h,t}$, change in inventories by firms and governments, $I_{2f,t}$ and $I_{2g,t}$, net exports, $X_t - M_t$, net exports adjustment, $NX_{adj,t}$, errors and omissions, EO_t, and GDP adjustment, $Y_{adj,t}$,

$$Y_t = C_{h,t} + C_{g,t} + I_{1f,t} + I_{1b,t} + I_{1g,t} + I_{h,t} + I_{2f,t} + I_{2g,t} + X_t - M_t + NX_{adj,t} - EO_t + Y_{adj,t}. \quad (36)$$

Aggregate demand in real term (in volume),

$$y_t = c_{h,t} + c_{g,t} + i_{1f,t} + i_{1b,t} + i_{1g,t} + i_{h,t} + i_{2f,t} + i_{2g,t} + x_t - m_t + nx_{adj,t} - eo_t + y_{adj,t}, \quad (37)$$

where $c_{h,t} = \frac{C_{h,t}}{P_{c,t}}$, $c_{g,t} = \frac{C_{g,t}}{P_{c,t}}$, $i_{f,t} = \frac{I_{1f,t}}{P_{k_1,t}}$, $i_{1b,t} = \frac{I_{1b,t}}{P_{k_1,t}}$, $i_{1g,t} = \frac{I_{1g,t}}{P_{k_1,t}}$, $i_{h,t} = \frac{I_{h,t}}{P_{k_h,t}}$, $i_{2f,t} = \frac{I_{2f,t}}{P_{k_{2f},t}}$, $i_{2g,t} = \frac{I_{2g,t}}{P_{k_{2g},t}}$, $x_t = \frac{X_t}{P_{x,t}}$, $m_t = \frac{M_t}{P_{m,t}}$, $nx_{adj,t} = \frac{NX_{adj,t}}{P_{x,t}}$, $eo_t = \frac{EO_t}{P_{eo,t}}$ and $y_{adj,t} = \frac{Y_{adj,t}}{P_{y,t}}$ are the aggregate demand components in volume.[5] $P_{c,t}$ is the consumer price index (CPI). $P_{k_1,t}$ is the general capital price index. $P_{k_h,t}$ is the capital price index of households. $P_{k_{2f},t}$ and $P_{k_{2g},t}$ are the price of inventories held by firms and governments, respectively. $P_{x,t}$ and $P_{m,t}$ are the export and import price index, respectively. We assume net export adjustment is deflated by export price. $P_{eo,t}$, price of errors and omissions is calculated to make sure equation (36) and (37) are consistent. By definition, then, GDP deflator is $P_{y,t} = \frac{Y_t}{y_t}$.

2.3.2 Labour market

Following Keynes (1937), the employment level is determined by aggregate demand. Then, employment in our model, N_t, is simply real GDP over labour productivity times working hours,

$$N_t = \eta \frac{y_t}{y_{N,t}}, \quad (38)$$

where η is working hours normalized to 1 in the in-sample prediction and baseline scenario, and $y_{N,t}$ is labour productivity, measured in real GDP per labour, referring to Reati (2001). Labour productivity follows the Kaldor-Verdoorn Law,

$$\Delta \ln y_{N,t} = y_{n_1} \Delta \ln y_{N,t-1} + y_{n_2} \Delta \ln y_t + y_{n_3} [\ln y_{N,t-1} - y_{n_4} - y_{n_5} \ln y_{N,t-2} - y_{n_6} \ln y_{t-1}], \quad (39)$$

where $0 < y_{n1} < 1$ is the short-run persistence of labour productivity, $y_{n2} > 0$ captures the short-run Kaldor-Verdoorn effect, $-1 < y_{n3} < 0$ is the parameter of labour productivity long-run correction, y_{n4} is the initial labour productivity level in logarithm, $y_{n5} > 0$ is the long-run persistence of on labour productivity and $y_{n6} > 0$ captures captures the long-run Kaldor-Verdoorn effect.[6]

The unemployment rate, by definition, is unemployment over the labour force,

$$u_t = \frac{LF_t - N_t}{LF_t}, \quad (40)$$

where $LF_t = \gamma_{LF} POP_t$ denotes labour force, assumed to be proportional to the total population, POP_t.

Real wage, w_t, is determined by labour productivity and unemployment,

$$\Delta \ln w_t = w_0 + w_1 \Delta \ln \frac{y_t}{N_t} + w_2 \left(\ln w_{t-1} - w_3 - w_4 u_{t-2} - w_5 \ln \frac{y_{t-1}}{N_{t-1}} \right), \quad (41)$$

[4] Our method is pragmatic in the sense that we try to follow economic theories as closely as possible but drop the determinants in the behaviour equations that are not statistically significant.

[5] Capital letters denote variables in value (nominal term), and small letters denote variables in volume (real term).

[6] We introduce the Kaldor-Verdoorn Law in labour productivity to offset the fluctuation of real GDP to employment and, as a consequence, to stabilize the unemployment rate in the model.

where w_0 is the autonomous real wage growth, $w_1 > 1$ denotes the elasticity of real wage growth to labour productivity growth, $-1 < w_2 < 0$ is the long-run correction parameter of real wage, w_3 is the real wage level in logarithm with full employment in the last period and $\frac{y_t}{N_{t-1}} = 1$, $w_4 < 0$ denotes the sensitivity of real wage to unemployment, and $w_5 > 0$ denotes the elasticity of real wage to labour productivity.[7] The unemployment rate has a negative effect on real wages because it decreases the searching probability of finding new jobs for workers and reduces the value of their outside options consequently. Conversely, firms have a higher searching probability to fill their vacancy under a higher unemployment labour market. In summary, workers are worse off, and firms are better off in the wage bargaining process as the unemployment rate increases (Pissarides, 2000).

The total wage bill, W_t, equals the nominal wage times labour,

$$W_t = P_{y,t} w_t N_t, \tag{42}$$

where $P_{y,t} w_t$ is the nominal wage.

Unit labour cost, by definition, is the total wage bill divided by real GDP,

$$ULC_t = \frac{W_t}{y_t}. \tag{43}$$

2.3.3 Inequality

Income inequality can be caused by three aspects, i. inequality driven by unemployment, ii. wage inequality, iii. distributional income inequality (Checchi & García-Peñalosa, 2008). This model does not study wage inequality between skilled and unskilled workers. We focus on the two other aspects.

Income inequality, measured by the Gini coefficient, is a function of the wage share times the employment share (Bowles & Halliday, 2022), and the ratio of social benefits to nominal GDP,

$$gini_t = \omega_0 + \omega_1 \frac{N_t W_t}{POP_t Y_t} + \omega_2 \frac{SB_t}{Y_t}, \tag{44}$$

where ω_0 is the exogenous inequality factor, $\omega_1 \approx -1$ by definition, $\omega_2 < 0$ is the sensitivity of the Gini coefficient to the ratio of social benefits to nominal GDP. We introduce the ratio of social benefits to nominal GDP in order to capture the effect of income redistribution on income inequality.[8]

2.3.4 Prices

Producers fulfil aggregate demand but set their prices based on their cost of production. The consumer price index (CPI) is determined by import price and unit labour cost,

$$\Delta \ln P_{c,t} = p_{c1} \Delta \ln P_{m,t} + p_{c2} \Delta \ln ULC_t + p_{c3}(\ln P_{c,t-1} - p_{c4} - p_{c5} \ln P_{m,t-1} - p_{c6} \ln ULC_{t-1}), \tag{45}$$

where $p_{c1} > 1$ is the short-run elasticity of CPI to import price, $p_{c2} > 0$ is the short-run elasticity of CPI to unit labour cost, $-1 < p_{c3} < 0$ is the parameter of long-run correction, p_{c4} is the long-run mark-up of CPI, $p_{c5} > 0$ is the long-run elasticity of CPI to import price, and $p_{c6} > 0$ is the long-run elasticity of CPI to unit labour cost.

Similarly, the price of productive fixed capital depends on import price and unit labour cost,

$$\Delta \ln P_{k1,t} = \alpha_1 \Delta \ln P_{m,t} + \alpha_2 \Delta \ln ULC_t + \alpha_3(\ln P_{k1,t-1} - \alpha_4 - \alpha_5 \ln P_{m,t-1} - \alpha_6 \ln ULC_{t-1}), \tag{46}$$

where $\alpha_1 > 0$ is the short-run elasticity of the price of fixed capital to import price, $\alpha_2 > 0$ is the short-run elasticity of the price of fixed capital to unit labour cost, $-1 < \alpha_3 < 0$ is the long-run correction parameter, α_4 is the mark-up of the price of fixed capital, $\alpha_5 > 0$ is the long-run elasticity of the price of fixed capital to import price, and $\alpha_6 > 0$ is the long-run elasticity of the price of fixed capital to unit labour cost.

Real housing price, $\frac{P_{k_h,t}}{P_{y,t}}$, is driven by housing demand, $i_{h,t}$,

$$\Delta \ln \frac{P_{k_h,t}}{P_{y,t}} = p_{kh0} + p_{kh1} \left(\ln \frac{P_{k_h,t-1}}{P_{y,t-1}} - p_{kh2} - p_{kh3} \ln i_{h,t-1} \right), \tag{47}$$

[7] In equation (41) we have $\frac{y_t}{N_t}$ rather than $y_{N,t}$ for the working hour reduction scenario shown in section 5.2 because our real wage, w_t, is measured by annually per workers rather than hourly per workers.

[8] This is a simplified form of the equation from the textbook, Bowsles and Halliday (2022), by assuming the income share of the unemployed and the population share of the capitalists are negligible.

where $p_{kh0} > 0$ denotes the autonomous real housing price growth, $-1 < p_{kh1} < 0$ is the long-run correction parameter of real housing price, p_{kh2} denotes the real housing price level in logarithm when housing acquisition equals 100 million rmb, and $p_{kh3} > 0$ is the elasticity of real housing price to housing demand.

The price of firm inventories depends on unit labour cost,

$$\Delta \ln P_{k_{2f},t} = p_{k2f0} + p_{k2f1} \Delta \ln ULC_t, \tag{48}$$

where p_{k2f0} denotes the exogenous growth rate of the price of firm inventories, $p_{k2f1} > 0$ is the short-run elasticity of the price of firm inventories to unit labour cost.

Export price is determined by import price and unit labour cost,

$$\Delta \ln P_{x,t} = p_{x1} \Delta \ln P_{m,tt} + p_{x2} \Delta \ln ULC_t, \tag{49}$$

where p_{x1} denotes the short-run elasticity of export price to import price and $p_{x2} > 0$ denotes the elasticity of export price to unit labour cost.

Import price is foreign price, $P_{r,t}$, converted into domestic currencies,

$$P_{m,t} = \frac{P_{r,t}}{XR_t}, \tag{50}$$

where $P_{r,t}$ is exogenous, and XR_t is the nominal effective exchange rate (rise = appreciation).

For simplicity, we assume the price of government inventories and other non-financial assets are exogenous.

2.3.5 Households

Households earn revenues, wages, interest from deposits, dividends, other income from properties and social benefits. They pay taxes, interest on loans and social contributions.

Households' consumption depends on their consumption level in the past (habit formation), their disposable income deflated by consumption price, $\frac{YD_{t-1}}{P_{c,t-1}}$ (income effect),

$$\Delta \ln c_{h,t} = c_0 + c_1 \Delta \ln \frac{YD_{t-1}}{P_{c,t-1}} + c_2 \left(\ln c_{h,t-1} - c_3 \ln c_{h,t-2} - c_4 \ln \frac{YD_{t-1}}{P_{c,t-1}} \right), \tag{51}$$

where c_0 denotes the short-run autonomous consumption, $c_1 > 0$ is the short-run income effect, c_2 is the long-run correction parameter, $c_3 > 0$ captures consumption habit formation and $c_4 > 0$ is the long-run income effect.

Housing demand depends on the population. We introduce a lag for housing demand to capture speculation behaviour in the housing market with equation (47),

$$\Delta \ln k_{h,t} = k_{h1} \Delta \ln k_{h,t-1} + k_{h2} \Delta \ln POP_t + k_{h3} (\ln k_{h,t-1} - k_{h4} - k_{h5} \ln k_{h,t-2} - k_{h6} \ln POP_{t-1}), \tag{52}$$

where $k_{h1} > 0$ captures the short-run speculation behaviour, $k_{h2} > 0$ denotes the short-run elasticity of housing demand to population, $-1 < k_{h3} < 0$ is the long-run correction parameter, k_{h4} is the intercept of the long-run correction equation, $k_{h5} > 0$ captures the long-run speculation behaviour, $k_{h6} > 0$ is the long-run elasticity of housing demand to population.

Financial assets and liabilities follow Tobin's portfolio theory (Tobin, 1982) as in Godley and Lavoie, 2006. Households have liquidity preferences on currencies. They keep a proportion of their net worth as cash in hand and hold more when income increases,

$$\frac{H_t}{V_{h,t}} = h_0 + h_1 \frac{YD_t}{V_{h,t}}, \tag{53}$$

where $h_0 > 0$ is the liquidity preference for currencies and $h_1 > 0$ captures the income effect.

Households' deposit savings close their budget constraint,

$$\Delta D_{h,t} = NFI_{h,t} - \Delta H_t - \Delta B_{h,t} + \Delta L_{h,t} - \Delta A_{h,t} - Z_{h,t}. \tag{54}$$

Households invest in bonds to earn interest, $r_{rh,t} - \pi_{y,t}$, but bear the opportunity cost of not repaying loans, $r_{ph,t} - \pi_{y,t}$. They would invest more with more disposable income.

$$\frac{B_{h,t}}{V_{h,t}} = b_{h0} + b_{h1}(r_{rh,t} - \pi_{y,t}) + b_{h2}(r_{ph,t} - \pi_{y,t}) + b_{h3} \frac{YD_t}{V_{h,t}}, \tag{55}$$

where b_{h0} is the preference for bonds, $b_{h1} > 0$ is the sensitivity of households' bonds to real interest received, $b_{h2} < 0$ is the sensitivity of households' bonds to real interest paid and $b_{h3} > 0$ captures the income effect.

Households borrow loans, mainly mortgages, to buy houses. On the demand side, they borrow more when the rate of interest received from other savings increases and less when the borrowing cost increases. On the supply side, banks issue mortgages based on households' disposable income. The more cash flow they receive, the less default risk, and banks allow them to borrow with a higher mortgage ratio (credit rationing),

$$\frac{\Delta L_{h,t}}{I_{h,t}} = l_{h1}(r_{rh,t} - \pi_{y,t}) + l_{h_2}(r_{ph,t} - \pi_{y,t}) + l_{h3}\frac{YD_t}{I_{h,t}}, \tag{56}$$

where $l_{h1} > 1$ denotes the sensitivity of household loans borrowing ratio to the real rate of interest received, $l_{h2} < 0$ denotes the sensitivity of household loans borrowing ratio to the real rate of interest paid, and $l_{h3} > 0$ captures the effect of credit rationing of mortgages.

2.3.6 Firms

Firms earn revenue from production, interest from deposits, and dividends from equity ownership. They also pay taxes, wages, and interest on debt and distribute profit through dividends.

Firms fixed capital formation rate, $\frac{\Delta k_{1f,t}}{k_{1f,t-1}}$, is driven by the gross profit rate, $\frac{\Pi_{f,t-1} - INT_{pf,t-1}}{P_{k1,t-1}k_{1f,t-2}}$ (*Kaleckian*),

$$\frac{\Delta k_{1f,t}}{k_{1f,t-1}} = i_{f1}\frac{\Pi_{f,t-1} - INT_{pf,t-1}}{P_{k_1,t-1}k_{1f,t-2}}, \tag{57}$$

where $i_{f1} > 0$ is the sensitivity to the net profit rate.

Firms hold deposits as a proportion of their net worth, i.e. $E_{lf,t}$, in need of operation expenditure. They increase savings in deposits as the real interest they receive increases, $r_{rf,t} - \pi_{y,t}$, and their net cash flow increases, $\frac{FP_t}{E_{lf,t}}$.

$$\frac{D_{f,t}}{E_{lf,t}} = d_{f0} + d_{f1}(r_{rf,t} - \pi_{y,t}) + d_{f2}\frac{FP_t}{E_{lf,t}}, \tag{58}$$

where $d_{f0} > 0$ denotes the liquidity preference of firms, $d_{f1} > 0$ is the sensitivity of firms' deposits to the real rate of interest received, and $d_{f2} > 0$ is the sensitivity of firms' deposits to net disposable income.

Firms issue bonds to finance and less when they have sufficient cash flow,

$$\frac{B_{f,t}}{E_{lf,t}} = b_{f0} + b_{f1}\frac{FP_t}{E_{lf,t}}, \tag{59}$$

where $b_{f0} > 0$ is the preference for issuing bonds and $b_{f1} < 0$ is the sensitivity of firms' bonds to net disposable income.

Firms would invest abroad in the form of outward foreign direct investment (FDI) when domestic investment is less profitable,

$$\frac{FDI_{out,t}}{E_{lf,t}} = fdi_{out0} + fdi_{out1}\frac{\Pi_{f,t} - INT_{pf,t}}{P_{k1,t}k_{1f,t-1}}, \tag{60}$$

where $fdi_{out0} > 0$ is the preference for outward FDI and $fid_{out1} < 0$ is the sensitivity of outward FDI to the net profit rate of domestic investment.

2.3.7 Banks

Banks earn revenue and interest from lending. They also pay wages, taxes, interest on deposits and inter-banks lending, dividends, and insurance indemnity. As the closing sector of the model, the vertical consistency of the banks' transaction flows, i.e., budget constraint, is inherently fulfilled.

The central bank is included in the banking sector and runs an inflation-biased Taylor rule by adjusting the policy rate,

$$r_{\delta,t} = r_{\delta 0} + r_{\delta 1}r_{\delta,t-1} + r_{\delta 2}\pi_t, \tag{61}$$

where $r_{\delta 0} > 0$ is the lower bound of the policy rate, $0 < r_{\delta 1} < 1$ denotes the persistence of the policy rate, and $r_{\delta 2} > 0$ is the sensitivity of the policy rate to CPI inflation.

Domestic interest rates, except the government's rate of interest paid, positively correlate to the policy rate (see Appendix).

Banks' fixed capital formation rate, $\frac{\Delta k_{1b,t}}{k_{1b,t-1}}$, depends on banks' net profit rate, $\frac{BP_{g,t}+DIV_{pb,t}}{P_{k_1,t}k_{1b,t-1}}$,

$$\frac{\Delta k_{1b,t}}{k_{1b,t-1}} = i_{b0} + i_{b1}\frac{BP_{g,t} + DIV_{pb,t}}{P_{k_1,t}k_{1b,t-1}}, \tag{62}$$

where i_{b0} is banks' autonomous fixed capital formation rate and $i_{b1} > 0$ is the sensitivity of banks' fixed capital formation rate to net profit rate.

Banks have liquidity preference for holding deposits and increase their holding if the real rate of interest received increases, $r_{rb,t} - \pi_{y,t}$,

$$\frac{D_{b,t}}{E_{lb,t}} = d_{b0} + d_{b1}(r_{rb,t} - \pi_{y,t}), \tag{63}$$

where $d_{b0} > 0$ is banks' liquidity preference for holding deposits and $d_{b1} > 0$ is the sensitivity of banks' deposits to the real rate of interest received.

Banks issue bonds in case of shortage of funds because banks face liquidity risk by holding long-term assets, e.g. firm loans, and short-term debts, e.g. household deposits, and would issue less if the real rate of interest paid rises, $r_{pb,t} - \pi_{y,t}$,

$$\frac{B_{lb,t}}{E_{lb,t}} = b_{lb0} + b_{lb1}(r_{pb,t} - \pi_{y,t}), \tag{64}$$

where $b_{lb0} > 0$ is banks' liquidity demand for issuing bonds and $b_{lb1} < 0$ is the sensitivity of banks' bonds issued to the real rate of interest paid.

2.3.8 Governments

Governments receive taxes, interest from deposits, dividends, and social contributions. They pay wages, interest for bonds, social benefits to households and capital transfers to firms.

Governments' consumption consists of goods and services provided to society. It is pro-cyclical because demand for public goods and services increases when economic activity increases. For simplicity, we assume it is proportional to real output,

$$c_{g,t} = \gamma_{c_g} y_t. \tag{65}$$

Similarly, we also assume government investments are proportional to real output,

$$i_{g,t} = \gamma_{i_{1g}} y_t. \tag{66}$$

The Chinese commercial banks are mainly state-owned. The price of government equities held depends largely on the price of banks' equities issued,

$$\Delta \ln P_{e_g,t} = p_{eg0} + p_{eg1}(\ln P_{e_g,t-1} - p_{eg2} - p_{eg3} \ln P_{e_{lb},t-1}), \tag{67}$$

where $p_{eg0} > 0$ is the return premium of government equities, $0 < p_{eg1} < 1$ is the long-term correction of the price of government equities, p_{eg2} is the price premium of government equities in logarithm, $p_{eg3} > 0$ is the elasticity of the price of governments' equities held to the price of banks' equities issued.

2.3.9 The rest of the world

The rest of the world demands export goods, supplies import goods, and other current transfers and financial transfers between the domestic sectors.

The nominal effective exchange rate (rise = appreciation) follows the uncovered interest parity, which depends on the policy rate of the central bank, $r_{\delta,t}$ and federal funds rate, ffr_t,

$$\Delta \ln XR_t = xr_1 \ln\left(\frac{1 + r_{\delta,t}}{1 + ffr_t},\right) \tag{68}$$

where $0 < xr_1 < 1$ is the imperfection of interest parity caused by currency hierarchy and capital controls.

The federal funds rate, ffr_t and foreign GDP (nominated in US dollar), $Y_{r,t}$, are exogenous in the model.

Due to the conversion of currencies, the rate of interest paid by the foreign sector includes the change in exchange rate within the maturity,

$$r_{pr,t} = r_{pr0} + (1 - r_{pr1} - r_{pr2}) r_{pr,t-1} + r_{pr1} \Delta \ln XR_t + r_{pr2} ffr_t, \tag{69}$$

where $r_{pr0} > 0$ is the interest rate premium, $r_{pr1} < 0$ is the sensitivity of the interest rate paid by the foreign sector to nominal effective exchange rate growth, $r_{pr2} > 0$ is the sensitivity to federal funds rate. Whereas, the rate of interest received by the foreign sector, $r_{rr,t}$ is assumed to be exogenous.[9]

Exports depend on foreign demand converted into domestic currencies and deflated by export price, $\frac{Y_{r,t}}{P_{x,t} XR_t}$,

$$\Delta \ln x_t = x_1 \Delta \ln \frac{Y_{r,t}}{P_{x,t} XR_t} + x_2 \left(\ln x_{t-1} - x_3 - x_4 \ln \frac{Y_{r,t-1}}{P_{x,t-1} XR_{t-1}} \right), \tag{70}$$

where $x_1 > 0$ is the short-run elasticity of export to foreign demand, $-1 < x_2 < 0$ is the export long-run correction parameter, $x_3 > 0$ is the long-run autonomous export demand in logarithm, and $x_4 > 0$ is the long-run export demand elasticity.

For simplicity, imports are proportional to real GDP,

$$m_t = \gamma_m y_t, \tag{71}$$

where $\gamma_m > 0$ is the share of import in volume.

The foreign sectors lend loans to the domestic sectors depending on the rate of interest received, the higher the return, the more they supply,

$$\frac{\Delta L_{ar,t}}{L_{ar,t-1}} = l_{ar1} r_{rr,t}, \tag{72}$$

where $l_{ar1} > 0$ is the sensitivity of foreign loan lending to the rate of interest received by the foreign sector.

Inward FDI depends on the domestic firms' gross profit, $\frac{\Pi_{f,t}}{P_{k_1,t} k_{1f,t-1}}$, with more domestic economic growth, cheaper labour, lower taxes, and cheaper fixed asset prices, the domestic sector will attract more inward FDI,

$$\frac{\Delta FDI_{in,t}}{FDI_{in,t}} = fdi_{in0} + fdi_{in1} \frac{\Pi_{f,t}}{P_{k_1,t} k_{1f,t-1}}, \tag{73}$$

where fdi_{in0} is the autonomous inward FDI accumulation rate and $fdi_{in1} > 0$ is the sensitivity of inward FDI to domestic firms' gross profit rate.

3 Data and parameters

Table 6 and 7 in the Appendix give an overall description of the variables and parameters.

Our data covers the years 2000 to 2019. Material flows are obtained from Chen et al. (2022), and material stocks are obtained from Song et al. (2021). The energy balance is obtained from the National Bureau of Statistics of China (NBSC). The economy balance sheets, e.g., non-financial assets and financial assets and liabilities, are obtained from China's National Balance. Transaction data are obtained from NBSC.

The GDP deflator is obtained from World Development Indicators. Other price variables are obtained or estimated from NBSC. The nominal effective exchange rate is obtained from the European Central Bank. Fiscal tax rates and interest rates are estimated using the transaction data and stock data, dividing the flows by the stocks. Employment data are obtained from the World Bank. The real wage is calculated by the wage bill payment over employment deflated by the GDP deflator. Equity price indices are calculated by the revaluation effect over the lagged stock in value. The revaluation effect of equities is calculated by the equity accumulation equation. Adjustment variables and errors and omissions are calculated based on the accounting equations to solve the mismatch in the data. Other changes in values are calculated based on the stock accumulation equations to ensure stock-flow consistency.

Parameters in the behaviour equations are estimated by running simple OLS regressions with Durbin-Watson to ensure they do not reject the homoskedasticity hypothesis. Moreover, we run Augmented Dickey-Fuller (ADF) tests on the residuals to ensure co-integrations between the variables. Other parameters, such as ratios and shares, are calculated based on the data.

[9] We did not find any statistical explanation for the rate of interest received by the foreign sector.

4 Model validation

We run an in-sample prediction to check the model performance. Specifically, we run a dynamic simulation of the model from 2002 to 2023 and compare it with the data.[10] Endogenous variables only employ the 2002 values as the initial values. Exogenous variables employ the data. Ratios and shares become moving parameters and employ the data.

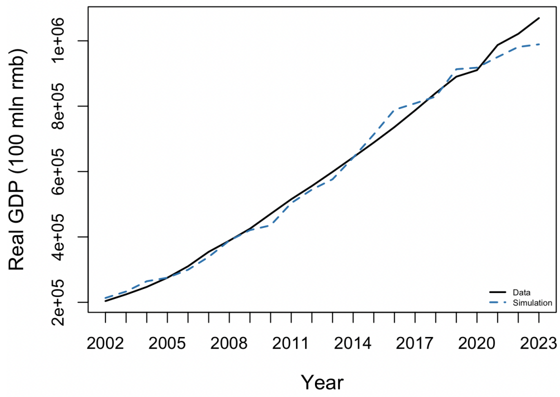
Figure 1 shows the in-sample prediction results. Real GDP from the dynamic simulation performs more fluctuation than the data, mainly due to firms' investment and households' investment. (Figure 1a, 1c and 1d). The prediction of households' consumption fits relatively well with the data, though it does not capture the drop in 2020 because of COVID-19 (Figure 1b). The fluctuation of firms' investment is because firms are highly sensitive to the gross profit ($i_{1f1} = 1.085$ in equation (57), Figure 1c).[11] Households' investment fit relatively well before 2019 but shows a huge peak in 2019 and drop after that (Figure 1d).[12] Exports are more stable than the data because of the exchange rate but under-predicted after 2019 (Figure 1e and 1g). GDP deflator is more volatile than the data but follows closely to the trend (Figure 1f). The simulation of income inequality is a bit over-estimated (Figure 1h). Regarding the ecological part, the fluctuation of energy consumption follows real GDP (Figure 1a and 1i). Emissions to air and emissions water fit relatively well with the data, but dissipative use of products is more unstable (Figure 1j, 1k and 1l).

Overall, the model is capable of mimicking the Chinese economy and its side effects on the ecology fairly well. After many trials and errors, we are confident in the validation.

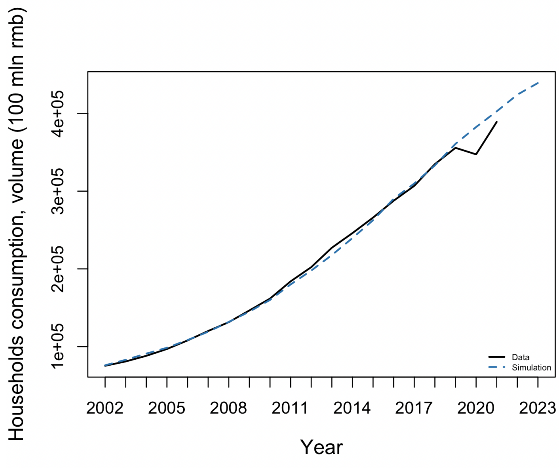
[10]A dynamic simulation accumulates model errors over time. we could also run a static simulation, which will have a better performance but only show model errors of each year because it employs the data for the lagged variables. This model is built for the purpose of scenario prediction in the future. It would be reasonable to check the model validation in a dynamic way.

[11]Firms' investment in China has been exploding the past two decades, which makes the coefficient estimation difficult to get a value that guarantees the stability of the model.

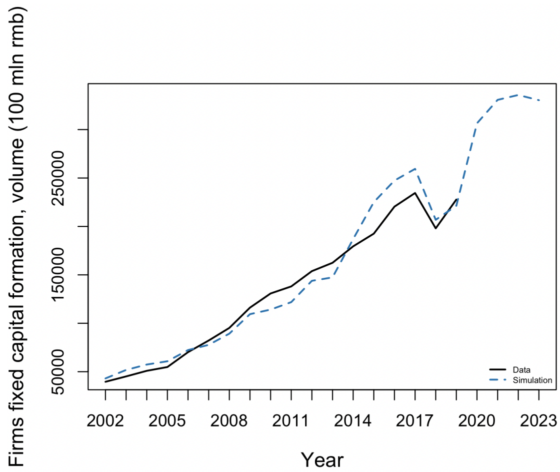
[12]We have to insert many dummies to fit households' investment because it is extremely difficult to explain.



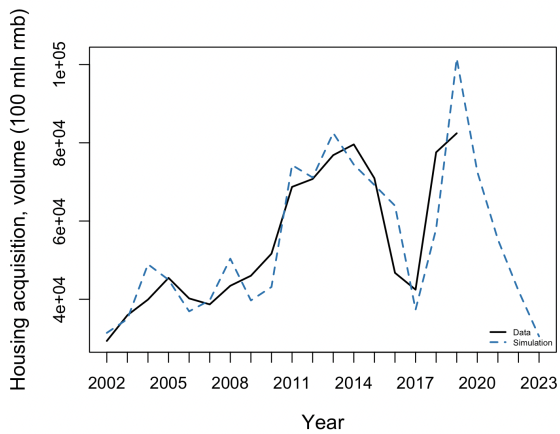
(a) Real GDP



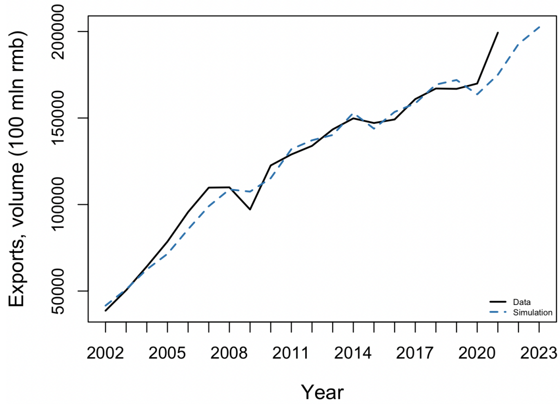
(b) Households consumption, volume



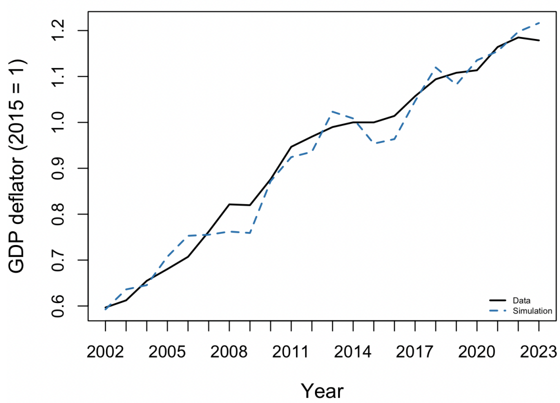
(c) Firms investment, volume



(d) Households investment, volume



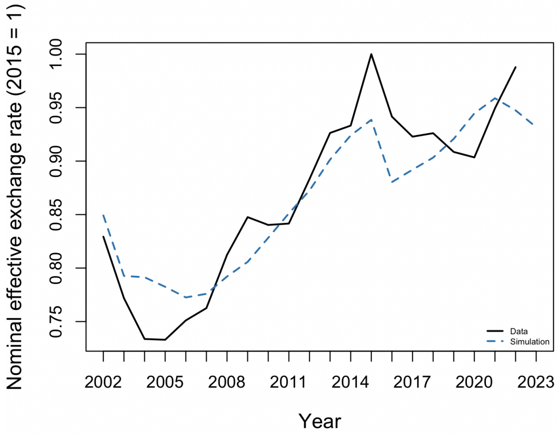
(e) Exports, volume



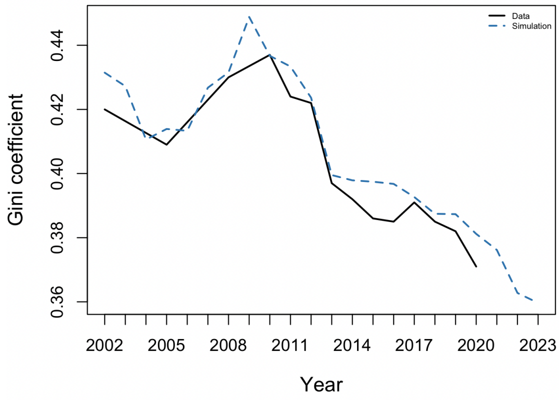
(f) GDP deflator

Figure 1: In-sample prediction

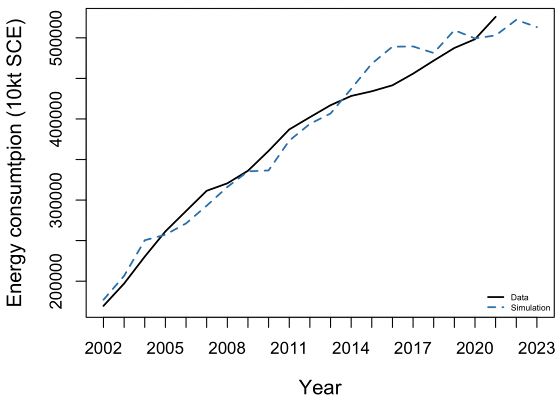
Note: The black solid line is the data. The blue dashed line is the dynamic simulation starting from 2002.



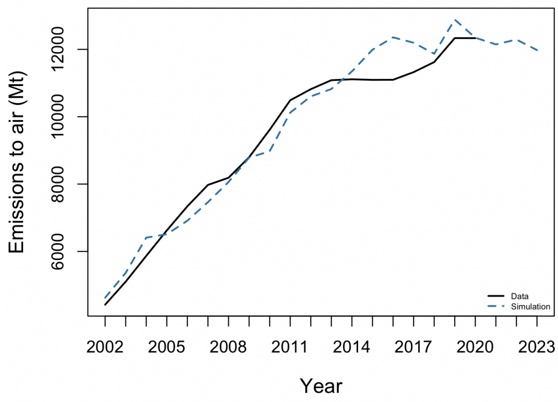
(g) Nominal effective exchange rate



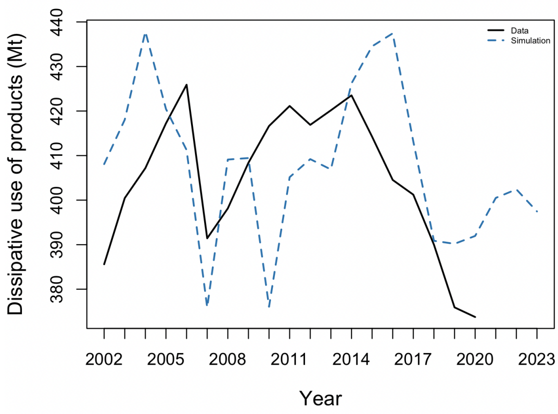
(h) Gini coefficient



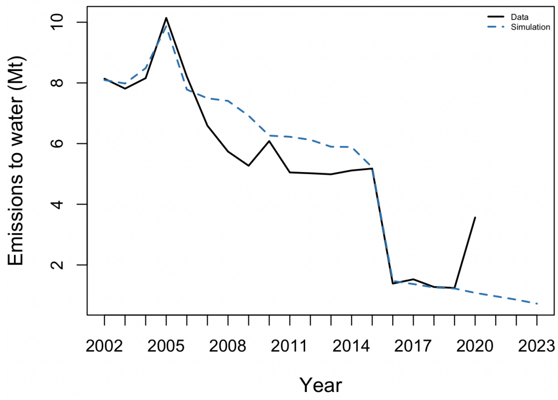
(i) Energy consumption



(j) Emissions to air



(k) Dissipative use of products



(l) Emissions to water

Figure 1: In-sample prediction

Note: The black solid line is the data. The blue dashed line is the dynamic simulation starting from 2002.

5 Forecast

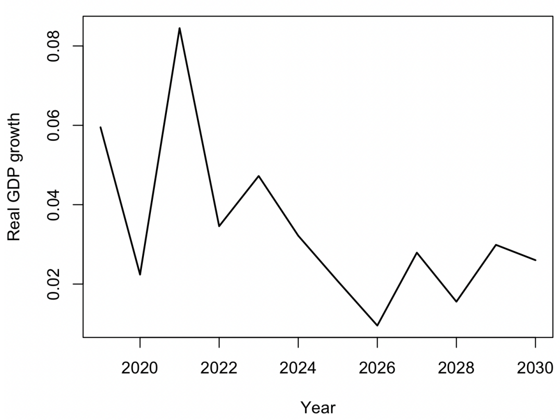
After validating the model, we run a baseline scenario of the model from 2019 to 2030 as a forecast reference. Then, we run a working hour reduction scenario, a wage policy scenario, and an income redistribution scenario. We compare the three scenarios, namely, working hour, wage policy, and fiscal policy, with the baseline to check their impulse response.

Before doing that, we employ the latest available data for the variables and extrapolate the exogenous variables under certain assumptions. We assume all adjustment variables, errors and omissions, and other changes in values are 0. For exogenous domestic prices, we use the last eight years 4-year mean growth rate to extrapolate them, i.e. $\left[\frac{Mean(Variable_{t-8}, Variable_{t-7}, Variable_{t-6}, Variable_{t-5})}{Mean(Variable_{t-4}, Variable_{t-3}, Variable_{t-2}, Variable_{t-1})}\right]^{\frac{1}{4}} - 1$. We assume foreign nominal GDP grows at a rate of 5% and foreign price grows at a rate of 3%. The share of renewable energy is assumed to grow at a rate of 2.57% to reach 25% in 2030, which is one of the policy targets of China (14th Five-Year Plan). Other shares and ratios are assumed to be constant.

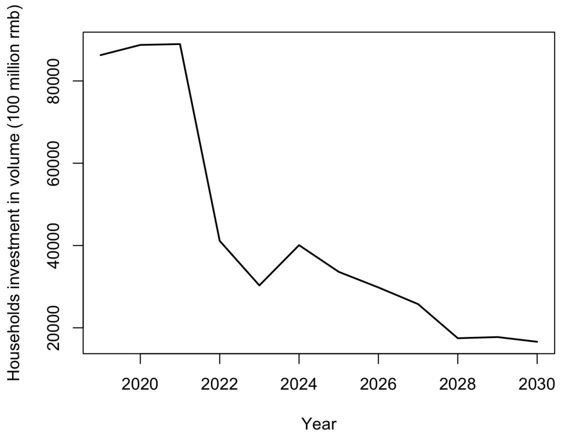
5.1 Baseline

The baseline scenario gives a blurry vision of the Chinese economy in the future, which we consider as a reference. However, we do not claim that the baseline is a precise forecast for the future since it relies on many assumptions on exogenous variables, ratios, and shares and does not consider any structural change.

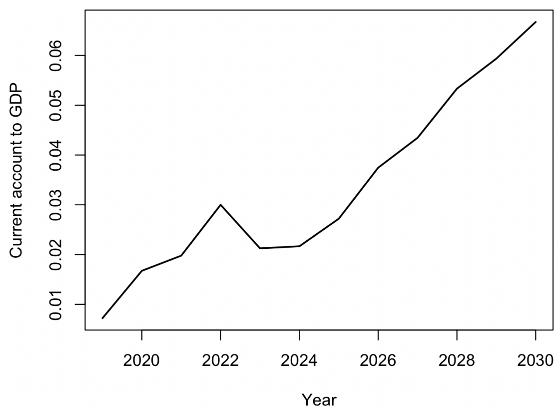
Figure 2 shows the forecast simulation results. The Chinese economy stepped into a low-growth regime after COVID mainly because of the recession of the housing market, which is driven by population, which is decreasing according to the World Bank's prediction (Figure 2a and 2b). Current account to GDP increases over time because domestic prices fall and the domestic currency depreciates after 2022 (Figure 2c, 2d and 2e). Inflation falls to negative in 2024 because the recession of the housing market decreases the nominal wage bills through housing prices in the GDP deflator and recovers back around 2% in the long run as GDP growth increases and unemployment falls (Figure 2d and 2g). The nominal effective exchange rate decreases over time after 2022 because the domestic interest rate is lower than the federal funds rate since inflation is low (Figure 2e). Income inequality peaks in 2021 and decreases over time, mainly driven by wage shares since unemployment remains relatively stable except it drops after 2029. The wage share increases over time after 2021 because unemployment remains stable due to the fact that the population is decreasing and so does the labour force, as a consequence, real wage increases with labour productivity (Figure 2f, 2g and 2h). Energy intensity decreases over time because of an exogenous technology improvement and decreasing income inequality. With the commitment to green transition, as a consequence, emissions to air remain stable after 2024 under low real GDP growth (2j and 2i). Similarly, the dissipative use of products remains stable after 2024 and emissions to water decrease over time(Figure 2k and 2l).



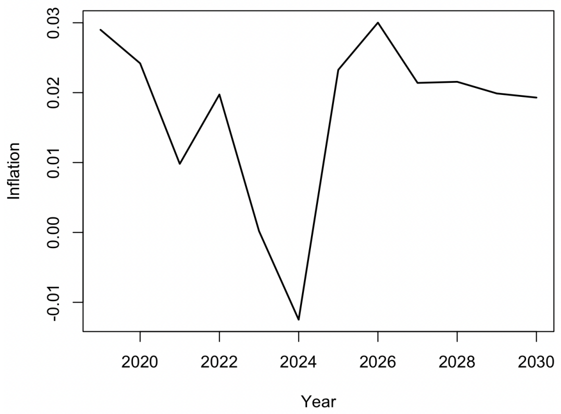
(a) Real GDP growth



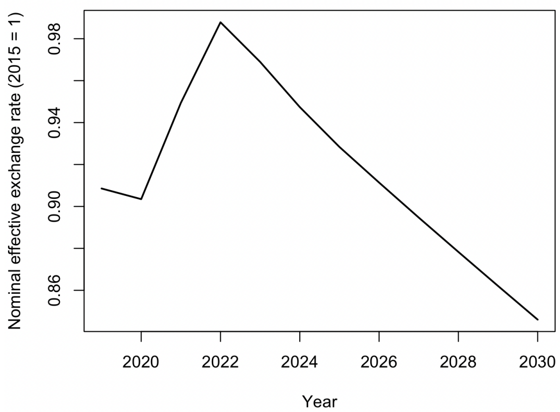
(b) Households investment, volume



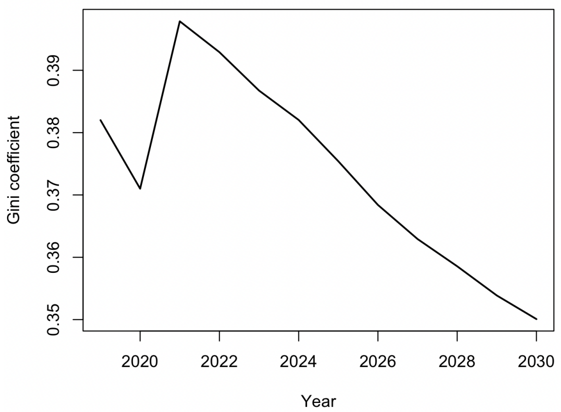
(c) Current account to GDP



(d) Inflation

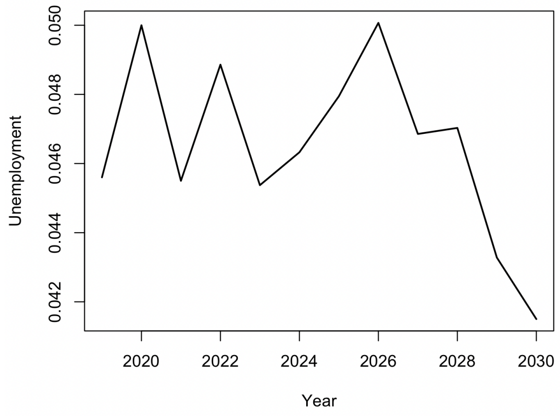


(e) Nominal effective exchange rate

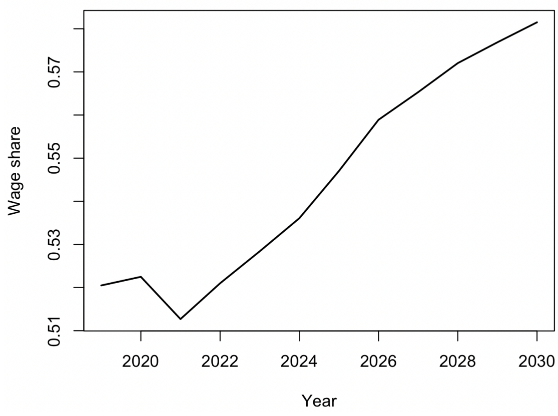


(f) Gini coefficient

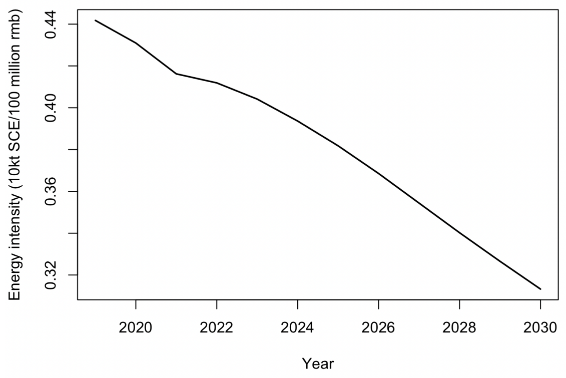
Figure 2: Baseline scenario



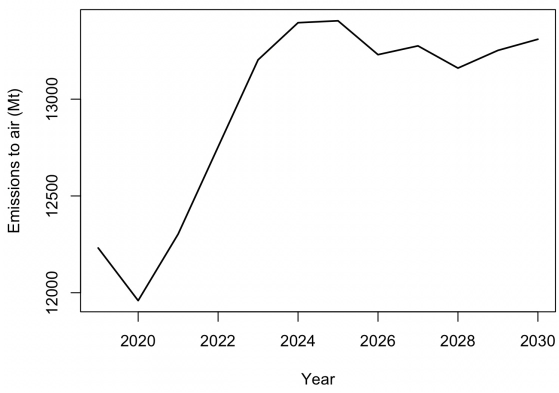
(g) Unemployment rate



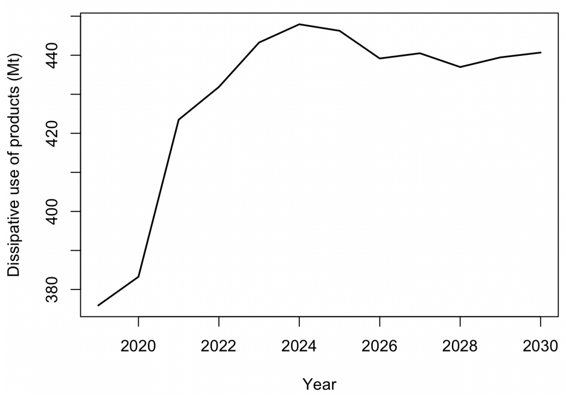
(h) Wage share



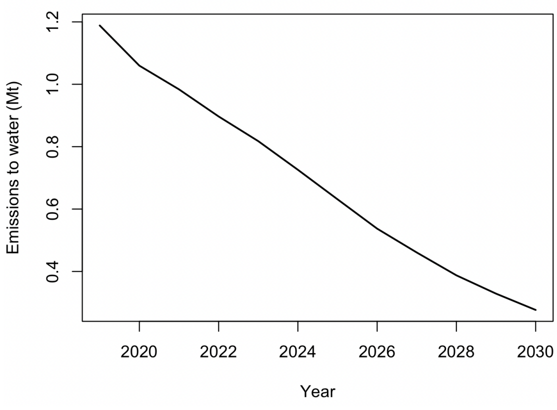
(i) Energy intensity



(j) Emissions to air



(k) Dissipative use of products



(l) Emissions to water

Figure 2: Baseline scenario

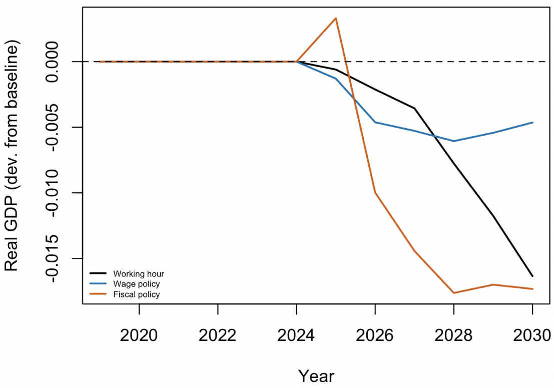
5.2 Working hours reduction, wage increase and social benefits

In this section, we study the impulse response of three permanent shocks from 2025 separately: a 1% reduction in working hours, a 1% increase in the real wage, and a 1% increase in social benefit to GDP to households (γ_{SB}) financed by firms' production tax. We would like to compare the effect of a working hour regulation policy to a wage increase policy and an income redistribution policy.

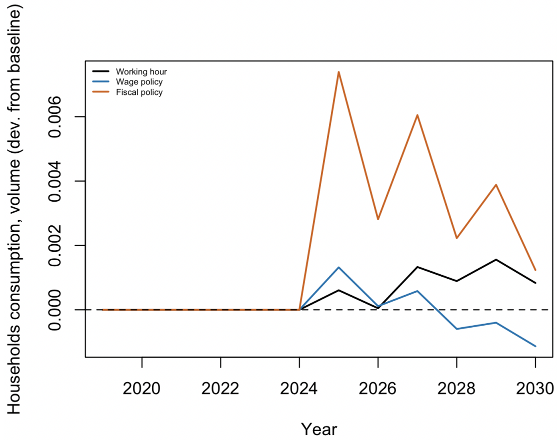
Figure 3 shows the impulse response functions of the shocks, which are the deviations from the baseline scenario, $\frac{Shock_t}{Baseline_t} - 1$ for variables in level and $Shock_t - Baseline_t$ for variables in rate. The black line is the working hour reduction scenario (Working hour). The blue line is the wage increase scenario (Wage policy). The orange line represents the income redistribution scenario (Fiscal policy). All three shocks harm real GDP as expected, mainly because firms' investment decreases. The fiscal policy scenario increases real GDP in 2025 because firms react to the profit rate in one lag (Figure 3a). Household consumption increases under the fiscal scenario because households receive more social benefits. Under the wage policy scenario, household consumption increases in the short run with more wage income. Still, it decreases in the long run because the real wage decreases because of higher unemployment. Similarly, household consumption increases under the working hour reduction scenario but also in the long run due to lower unemployment (Figure 3b and 3g).[13] Firms' investment decreases in all three scenarios because the cost of production increases, firms are paying more wages under working hour reduction and wage policy scenario, paying more taxes under the fiscal scenario (Figure 3c). Exports decrease under a working hour reduction and a real wage shock because prices increase. The working hour reduction shock has a long-run negative impact on exports because it causes long-run inflation (Figure 3d and 3e). Firms raise prices under higher real wages and shorter working hours because they face a higher unit labour cost. A working hour reduction results in long-run inflation. (Figure 3e). Income inequality decreases under the working hour scenario mainly because employment increases. Increasing the real wage decreases income inequality by increasing the wage share. The fiscal policy scenario also decreases income inequality because of the income redistribution effect (Figure 3f, 3g and 3h). Unemployment rises under the wage policy scenario and fiscal policy scenario because of the reduction of real GDP. Although real GDP decreases under the working hour reduction scenario, unemployment decreases because its direct effect on labour demand dominates (Figure 3g). Real wage measured by the annual wage bill per worker decreases in the short run under the working hour reduction scenario because workers work fewer hours. Still, it increases in the long run because of lower unemployment, and the workers can ask for higher wages through bargaining (Figure 3h). Energy intensity decreases in all scenarios because of lower income inequality (Figure 3i). Emissions of all types are reduced in the three scenarios because of less production and less emissions intensity (Figure 3j, 3k and 3l).

To summarize, there is always a trade-off between economic activities and the environment. Reducing working hours and increasing wages will trigger inflation to rise. Working hour reduction and income redistribution are effective in reducing income inequality. Working hour reduction decreases unemployment, while a rise in wage and an income redistribution financed through corporate tax cause more unemployment (see Table 5).

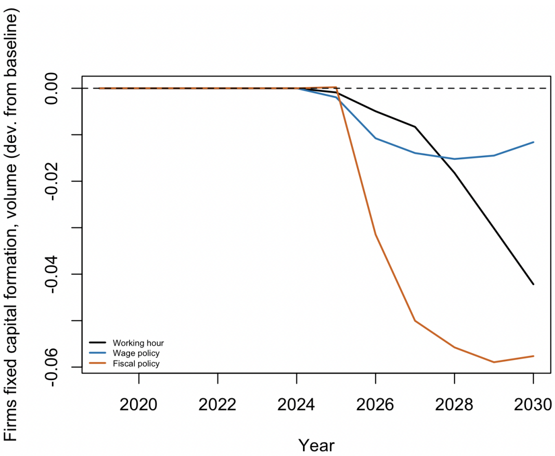
[13]The spikes of household consumption are because of the habit formation in equation (51).



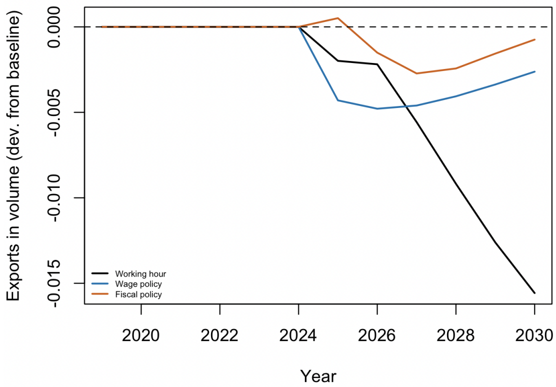
(a) Real GDP



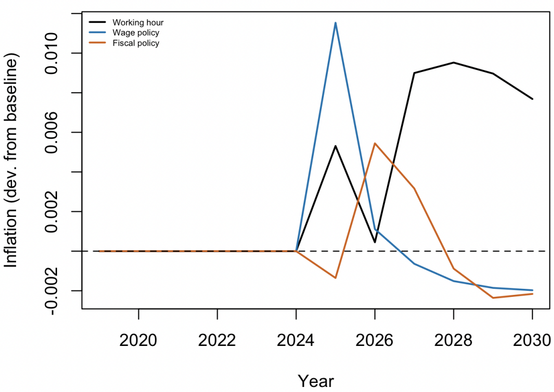
(b) Households consumption, volume



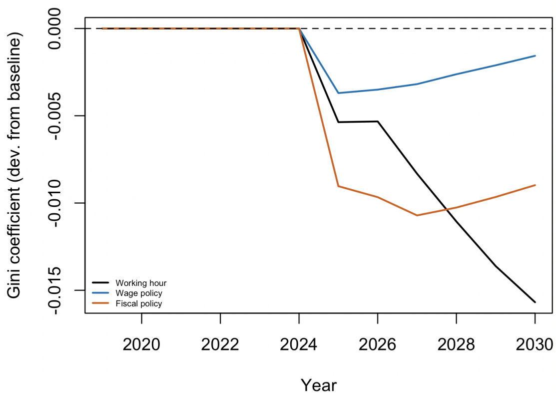
(c) Firms investment, volume



(d) Exports, volume



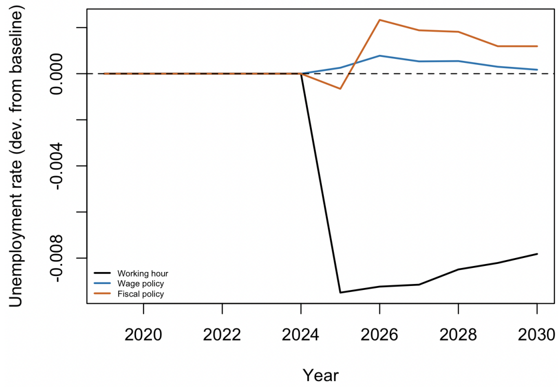
(e) Inflation



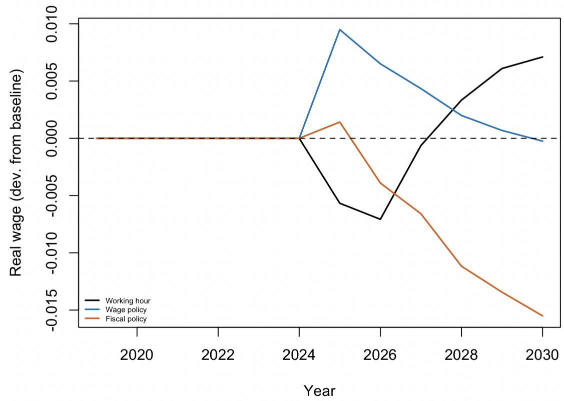
(f) Gini coefficient

Figure 3: Policy shocks

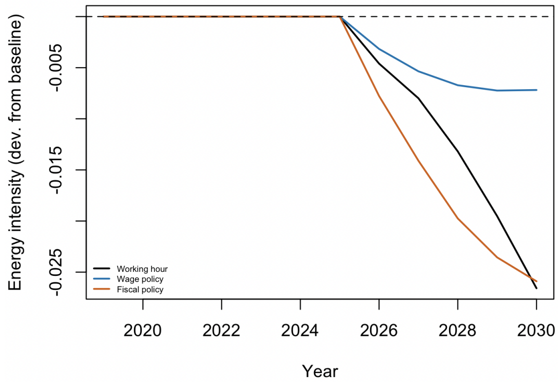
Note: The black line is the impulse response to a 1% permanent reduction in working hours. The blue line is the impulse response to a 1% increase in the real wage. The orange line is the impulse response to a 1% permanent increase in social benefits to households financed by the production tax for firms.



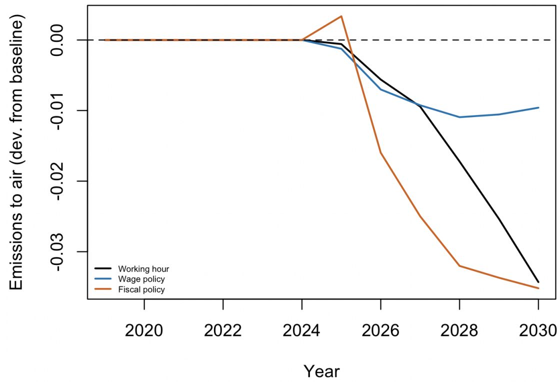
(g) Unemployment rate



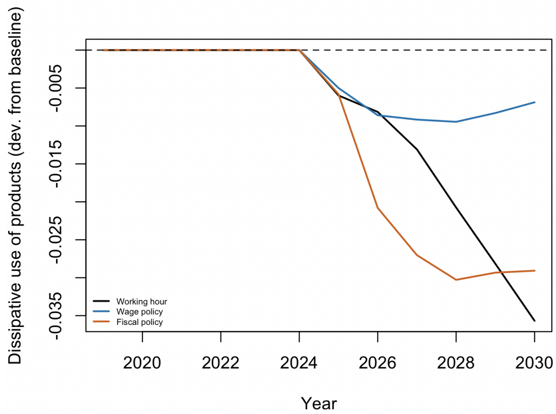
(h) Real wage



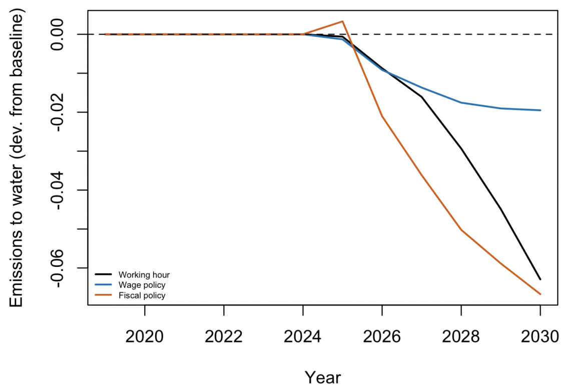
(i) Energy intensity



(j) Emissions to air



(k) Dissipative use of products



(l) Emissions to water

Figure 3: Policy shock

Note: The black line is the impulse response to a 1% permanent reduction in working hours. The blue line is the impulse response to a 1% increase in the real wage. The orange line is the impulse response to a 1% permanent increase in social benefits to households financed by the production tax for firms.

Table 5: The effect of policy shocks

	Real GDP	Inflation	Income equality	Unemployment	Emissions to air
Working hour	long-run -1.5%	long-run +1%	long-run -1.5%	-0.8%	long-run -3%
Wage policy	short-run -0.5%	short-run +1%	short-run -0.3%	+0.1%	short-run -1%
Income redistribution	long-run -1.5%	+/-	short-run -1%	+0.2%	long-run -3%

6 Conclusion and Remark

This paper develops an empirical ecological stock-flow consistent model for China. It embeds the Chinese balance sheet and transaction flow matrix and describes institutions' behaviours to mimic the Chinese economy. By including the material and energy balance, the model can link the economy to its effect on the environment. We use the in-sample prediction to validate the model and find that the fitness of the data is fairly good. We run a baseline scenario under a promised green transition, giving a reference to future predictions. Then, we compare a working hour reduction shock to a wage increase policy and income redistribution policy. All three policies reduce real GDP and emissions, showing a trade-off between economy and environmental quality. A working hour reduction reduces income equality and unemployment more significantly but may trigger long-run inflation.

The model can be improved in some directions. The model does not capture any feedback from the environment to the economy. We could evaluate the damage function of emission; however, within an empirical framework, sufficient detailed data is required. Another perspective is to study the link between material intensity and prices. The cost of production will increase if a type of material is over-demanded. This would happen in a technology change, e.g., batteries for storing renewable energy are made with raw materials.

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Appendix

The price of aggregate energy: Production:

Final goods or services are produced by domestic sectors given a fixed proportion,

$$Y_{j,t} = \gamma_j Y_t, \sum_j \gamma_j = 1, \tag{74}$$

where $j = f, b, g, h$ denotes firms, banks, governments, and households.

Households:

The gross operating surplus of households is defined as,

$$\Pi_{h,t} = Y_{h,t} + W_{h,t} - TL_{h,t}, \tag{75}$$

where $W_{h,t} = \gamma_{W_h} W_t$ is the wage paid by households with γ_{W_h}, the share of wage paid by households, and $TL_{h,t} = \tau_{L_h} Y_{h,t}$, the net production tax paid by households with τ_{L_h} is the net production tax rate paid by households.

The gross disposable income of households is,

$$YD_{g,t} = \Pi_{h,t} + W_t + INT_{rh,t} - INT_{lh,t} + DIV_{h,t} + OIP_{h,t}, \tag{76}$$

where $INT_{rh,t} = INT_{dh,t} + INT_{bh,t}$ is the total interest received by households, which is the sum of households' deposit interest, $INT_{dh,t} = r_{rh,t} D_{h,t-1}$, and households' bond interest, $INT_{bh,t} = r_{rh,t} B_{h,t-1}$, $INT_{lh,t} = r_{ph,t} L_{h,t-1}$ is households' loans interest paid, $DIV_{h,t} = \gamma_{DIV_h}(E_{h,t-1} + IFS_{h,t-1})$ is the dividend received by households with γ_{DIV_h} the dividend rate received by households, and $OIP_{h,t} = \gamma_{OIP_h} YD_{g,t}$ is households other income form properties received, which is a fixed proportion of households' gross disposable income for simplicity, γ_{OIP}.

The net disposable income of households is,

$$YD_t = YD_{g,t} - T_{h,t} - SC_t + SB_t - O_{h,t}, \tag{77}$$

where $T_{h,t}$ is the income tax paid by households, $T_{h,t} = \tau_{h,t} YD_{g,t}$, SC_t is the social contribution paid by households to the governments, proportional to total wages, $SC_t = \tau_{sc} W_t$, SB_t is the social benefits received from the governments, and $O_{h,t} = \gamma_{O_h} YD_t$ is households other current transfers paid, proportional to net disposable income for simplicity.

Household savings are disposable income minus consumption, and errors and omissions,

$$S_{h,t} = YD_t - C_{h,t}. \tag{78}$$

Households' fixed capital in value equals housing price times the volume,

$$K_{h,t} = P_{k_h,t} k_{h,t}. \tag{79}$$

Households' fixed capital formation in value,

$$I_{h,t} = K_{h,t} - K_{h,t-1}(1 - \delta_h) - REV_{k_h,t} - OCV_{k_h,t}, \tag{80}$$

where δ_h denotes the depreciation rate of households' fixed capital, $REV_{k_h,t}$ is the revaluation effect, and $OCV_{k_h,t}$ is the other changes in value, which is exogenous.

Households' fixed capital formation in volume,

$$i_{h,t} = \frac{I_{h,t}}{P_{k_h,t}}. \tag{81}$$

Households fixed capital revaluation equals the price change times the stock in volume in the previous period,

$$REV_{k_h,t} = \Delta P_{k_h,t} k_{h,t-1}. \tag{82}$$

Households' net financial investment equals households' savings minus fixed capital formation and plus errors and omissions,

$$NFI_{h,t} = S_{h,t} - I_{h,t} + EO_{h,t}, \tag{83}$$

where $EO_{h,t}$ is errors and omissions of households, which is the mismatch between the household's real account and financial account, assumed to be exogenous.

Households' currencies savings equal to the change in stock subtracts other changes in value,

$$\Delta H_t = H_t - H_{t-1} - OCV_{h,t}, \tag{84}$$

where $OCV_{h,t}$ are the other changes in value of households' currencies, which are exogenous.

Households' deposit,

$$D_{h,t} = D_{h,t-1} + \Delta D_{h,t} + OCV_{d_h,t}, \tag{85}$$

where $OCV_{d_h,t}$ is the other changes in value of households' deposits, which is exogenous.

Household bonds held in volume equal to bonds held in value over the bond price,

$$b_{h,t} = \frac{B_{h,t}}{P_{b_h,t}}. \tag{86}$$

Household bonds savings equal to the change in stock value minus the revaluation effect of bonds and other changes in value,

$$\Delta B_{h,t} = B_{h,t} - B_{h,t-1} - REV_{b_h,t} - OCV_{b_h,t}, \tag{87}$$

where $REV_{b_h,t}$ is the revaluation effect of households' bonds held, and $OCV_{b_h,t}$ is the other changes in value of households' bonds held, which is exogenous.

Households' bonds held revaluation equal to the price change times the stock in volume in the previous period,

$$REV_{b_h,t} = \Delta P_{b_h,t} b_{h,t}. \tag{88}$$

The price of households' bonds held is approximated as the inverse of its interest rate as in Godley and Lavoie, 2006,

$$P_{b_h,t} = \frac{1}{r_{rh,t}}. \tag{89}$$

The accumulation of households' loans is

$$L_{h,t} = L_{h,t-1} + \Delta L_{h,t} + OCV_{l_h,t}, \tag{90}$$

where $OCV_{l_h,t}$ are the other changes in value of households' loan issued, which are exogenous.

Households' equity held in value equals the stock in value in the previous period plus the revaluation effect,

$$E_{h,t} = E_{h,t-1} + REV_{e_h,t}, \tag{91}$$

where $REV_{e_h,t}$ is the revaluation effect of households equity held.

Households' equity held revaluation is the residual revaluation effect of equities held and issued by the other sector,

$$REV_{e_h,t} = REV_{e_{lf},t} + REV_{e_{lb},t} - REV_{e_{af},t} - REV_{e_{ab},t} - REV_{e_g,t} - REV_{e_r,t}. \tag{92}$$

Households invest a proportion of their net worth in investment fund shares,

$$IFS_{h,t} = \gamma_{IFS_h} V_{h,t}. \tag{93}$$

Households' investment fund shares held in volume,

$$ifs_{h,t} = \frac{IFS_{h,t}}{P_{ifs,t}}, \tag{94}$$

where $P_{ifs,t}$ is the price of investment fund shares, which is exogenous.[14]

Households' investment fund shares savings equal to the change in stock value subtracts the revaluation effect and other changes in value,

$$\Delta IFS_{h,t} = IFS_{h,t} - IFS_{h,t-1} - REV_{ifs_h,t} - OCV_{ifs_h,t}, \tag{95}$$

where $REV_{ifs_h,t}$ is the revaluation effect of households' investment fund shares held, $OCV_{ifs_h,t}$ is the other changes in value of households' investment fund shares held, which is exogenous.

Households' investment fund shares held revaluation,

$$REV_{ifs_h,t} = DeltaP_{ifs,t} ifs_{h,t-1}. \tag{96}$$

We assume households' insurance is proportional to households' net worth for simplicity,

$$A_{h,t} = \gamma_{A_h} V_{h,t}, \tag{97}$$

where γ_{A_h} is households' insurance held to net worth ratio.

Households' insurance savings equal the change in stock value minus other changes in value,

$$\Delta A_t = A_t - A_{t-1} - OCV_{a_h,t}, \tag{98}$$

where $OCV_{a_h,t}$ is the other changes in value of households' insurance held, which is exogenous.

We assume other accounts payable/receivables are proportional to households' net worth for simplicity,

$$Z_{h,t} = \gamma_{Z_h} V_{h,t-1}. \tag{99}$$

Households' change in other accounts payable/receivables is

$$\Delta Z_{h,t} = Z_{h,t} - Z_{h,t-1} + OCV_{z_h,t}, \tag{100}$$

where $OCV_{z_h,t}$ is the other changes in value of households' other accounts payable/receivables, which is exogenous.

Households' net worth is

$$V_{h,t} = K_{h,t} + H_t + D_{h,t} + B_{h,t} - L_{h,t} + E_{h,t} + A_{h,t} + Z_{h,t}. \tag{101}$$

Firms:

The gross operation surplus of firms is

$$\Pi_{f,t} = Y_{f,t} - TL_{f,t} - W_{f,t}, \tag{102}$$

where $TL_{f,t} = \tau_{L,f} Y_{f,t}$ is the net production tax paid by firms. $W_{f,t}$ denotes wages paid by firms, assumed to be a proportion of the total wage bill, $W_{f,t} = \gamma_{W_f} W_t$.

The gross disposable income of firms is

$$FP_{g,t} = \Pi_{f,t} + INT_{df,t} - INT_{pf,t} + DIV_{rf,t} - DIV_{pf,t} - OIP_{f,t}, \tag{103}$$

where $INT_{df,t} = r_{rf,t} D_{f,t-1}$ is the deposit interest received by firms, $INT_{pf,t} = INT_{bf,t} + INT_{lf,t}$ is the total interest paid by firms, which is the sum of bonds interest paid, $INT_{bf,t} = r_{pf,t} B_{f,t-1}$ and loans interest paid, $INT_{lf,t} = r_{pf,t} L_{f,t-1}$, $DIV_{rf,t} = \gamma_{DIV_{rf}}(E_{af,t-1} + FDI_{out,t-1})$ is the dividend received by firms with $\gamma_{DIV_{rf}}$ the dividend rate received by firms, $DIV_{pf,t}$ is dividend paid by firms, and $OIP_{f,t} = \gamma_{OIP_f} FP_{g,t}$ is firms other income from properties paid, which is a fixed proportion of firms' gross disposable income for simplicity.

Firms' dividend paid is the sum of dividends received by all sectors minus dividends paid by banks,

$$DIV_{pf,t} = DIV_{rf,t} + DIV_{rb,t} + DIV_{g,t} + DIV_{h,t} + DIV_{rr,t} - DIV_{pb,t}. \tag{104}$$

Firms' net disposable income is

$$FP_t = FP_{g,t} - T_{f,t} - O_{f,t}, \tag{105}$$

[14] Including it as an endogenous variable would break the model simulation convergence.

where $T_{f,t} = \tau_{f,t}$ is the income tax paid by firms and $O_{f,t} = \gamma_{O_f} FP_t$ is firms' other current transfers paid, assumed as fixed a proportion of firms' net disposable income.

Firms fixed capital held in value is

$$K_{1f,t} = K_{1f,t-1}(1 - \delta_{f,t}) + I_{1f,t} + REV_{k_{1f},t} + OCV_{k_{1f},t}, \tag{106}$$

where δ_f denotes the depreciation rate of firms' fixed capital, $REV_{k_{1f},t}$ is the revaluation effect, and $OCV_{k_{1f},t}$ are the other changes in value of firms' fixed capital.

Firms' fixed capital in volume is

$$k_{1f,t} = \frac{K_{1f,t}}{P_{k_1,t}}. \tag{107}$$

Firms' fixed capital formation in volume,

$$i_{1f,t} = \Delta k_{1f,t} + \frac{\delta_f K_{1f,t-1}}{P_{k_1,t}}. \tag{108}$$

Firms' fixed capital revaluation,

$$REV_{k_{1f},t} = \Delta P_{k_1,t} k_{1f,t-1}. \tag{109}$$

Firms' inventories in value,

$$K_{2f,t} = K_{2f,t-1} + I_{2f,t} + REV_{k_{2f},t}, \tag{110}$$

where $REV_{k_{2f},t}$ is the revaluation effect.

Firms' inventories in volume,

$$k_{2f,t} = \frac{K_{2f,t}}{P_{k_{2f},t}}. \tag{111}$$

We assume firms' changes in inventories as a fixed share of real GDP for simplicity,

$$i_{2f,t} = \gamma_{i_{2f}} y_{t-1}. \tag{112}$$

Firms' inventories revaluation,

$$REV_{k_{2f},t} = \Delta P_{k_{2f},t} k_{2f,t-1}. \tag{113}$$

Firms' other non-financial assets in value,

$$K_{3f,t} = P_{k_3} k_{3f,t}. \tag{114}$$

Firms' other non-financial assets in volume is proportional to real GDP (accelerator effect),

$$k_{3f,t} = \gamma_{k_{3f}} y_t, \tag{115}$$

where $\gamma_{k_{3f}}$ is the accelerator effect parameter of firms' other non-financial assets.

Firms' acquisition less disposal of other non-financial assets in value,

$$I_{3f,t} = K_{3f,t} - K_{3f,t-1} - REV_{k_{3f},t} - OCV_{k_{3f},t}, \tag{116}$$

where $REV_{k_{3f},t}$ is the revaluation effect and $OCV_{k_{3f},t}$ is the other changes in value of firms' other non-financial assets, which is exogenous.

Firms' acquisition less disposal of other non-financial assets in volume,

$$i_{3f,t} = \frac{I_{3f,t}}{P_{k_3,t}}. \tag{117}$$

Firms' other non-financial assets revaluation,

$$REV_{k_{3f},t} = \Delta P_{k_3,t} k_{3f,t-1}. \tag{118}$$

Firms' net financial investment,

$$NFI_{f,t} = FP_t + TRK_t - I_{1f,t} - I_{2f,t} - I_{3f,t} + EO_{f,t}, \tag{119}$$

where TRK_t is the capital transfers received by firms, and $EO_{f,t}$ is the errors and omissions of firms, which is exogenous.

The firms' deposit savings are the change in deposit stock value,

$$\Delta D_{f,t} = D_{f,t} - D_{f,t-1} - OCV_{d_f,t}, \tag{120}$$

where $OCV_{d_f,t}$ is the other changes in value of firms' deposit, which is exogenous.

Firms' bond borrowing,

$$\Delta B_{f,t} = B_{f,t} - B_{f,t-1} - REV_{b_f,t} - OCV_{b_f,t}, \tag{121}$$

where $REV_{b_f,t}$ is firms' bond issued revaluation, and $OCV_{b_f,t}$ is the other changes in value of firms' bond, which is exogenous.

Firms' bonds issued in volume,

$$b_{f,t} = \frac{B_{f,t}}{P_{b_f,t}}, \tag{122}$$

where $P_{b_f,t} = \frac{1}{r_{pf,t}}$ is the price of firms' bond.

Firms' bond revaluation,

$$REV_{b_f,t} = \Delta P_{b_f,t} b_{f,t-1}. \tag{123}$$

Firms' equity held in value is the stock value in the previous period plus the revaluation effect,

$$E_{af,t} = E_{af,t-1} + REV_{e_af,t}. \tag{124}$$

Firms' equity held in volume,

$$e_{af,t} = \frac{E_{af,t}}{P_{e_{af},t}}, \tag{125}$$

where $P_{e_{af},t}$ is the price of firms' equity held, assumed to be exogenous.[15]

Firms' equity held revaluation,

$$REV_{e_{af},t} = \Delta P_{e_{af},t} e_{af,t-1}. \tag{126}$$

For simplicity, we assume the price of FDIs is constant. Outward FDI flow equals the change in stock value,

$$\Delta FDI_{out,t} = FDI_{out,t} - FDI_{out,t-1}. \tag{127}$$

Firms' insurance held is proportional to its net worth,

$$A_{f,t} = \gamma_{Af} E_{lf,t}, \tag{128}$$

where γ_{Af} is the share of firms insurance held.

Firms' insurance savings,

$$\Delta A_{f,t} = A_{f,t} - A_{f,t-1} - OCV_{a_f,t}, \tag{129}$$

where $OCV_{a_f,t}$ is the other changes in value of firms' insurance held.

We assume other accounts payable/receivables are proportional to the firm's net worth for simplicity,

$$Z_{f,t} = \gamma_{Z_f} E_{lf,t-1}. \tag{130}$$

Firms' change in other accounts payable/receivables is

$$\Delta Z_{f,t} = Z_{f,t} - Z_{f,t-1} - OCV_{z_f,t}, \tag{131}$$

where $OCV_{z_f,t}$ is the other changes in value of firms' other accounts payable/receivables.

Firm loans issued,

$$L_{f,t} = L_{f,t-1} + \Delta L_{f,t} + OCV_{l_f,t}, \tag{132}$$

where $OCV_{l_f,t}$ is the other changes in value of firms' loans issued.

Firms' loan borrowing closes the financial constraint,

$$\Delta L_{f,t} = \Delta D_{f,t} - \Delta B_{f,t} + \Delta FDI_{out,t} - \Delta FDI_{in,t} + \Delta A_{f,t} + \Delta Z_{f,t} - NFI_{f,t}. \tag{133}$$

[15]Including the price of firms' equity held as an endogenous variable would break the model simulation convergence.

Banks:

Domestic interest rates, except the government's rate of interest paid, are correlated to the policy rate,

$$r_{j,t} = r_{j0} + (1 - r_{j1})r_{j,t-1} + r_{j1}r_{\delta,t}, \tag{134}$$

where $j = \{pb, pf, ph, rb, rf, rg, rh\}$ denotes paid by banks, paid by firms, paid by households, received by banks, received by firms, received by governments and received by households, respectively, $r_{j0} > 0$ is the interest rate premium, and $r_{j1} > 0$ is the sensitivity to the policy rate. The government's rate of interest paid, $r_{pg,t}$ is assumed to be exogenous.[16]

Banks' gross operating surplus is

$$\Pi_{b,t} = Y_{b,t} - W_{b,t} - TL_{b,t}, \tag{135}$$

where $W_{b,t} = \gamma_{W_b} W_t$ is the wage paid by banks, proportional to the total wage bill, and $TL_{b,t} = \tau_{L_b} Y_{b,t}$ is the net production tax paid by banks.

Banks' gross disposable income is

$$BP_{g,t} = \Pi_{b,t} + INT_{rb,t} - INT_{pb,t} + DIV_{rb,t} - DIV_{pb,t} - OIP_{b,t}, \tag{136}$$

where $INT_{rb,t} = INT_{db,t} + INT_{brb,t} + INT_{lb,t}$ is banks' interest received, which is the sum of banks' deposit interest received, $INT_{db,t} = r_{rb,t}D_{b,t-1}$, banks' bond interest received, $INT_{brb,t}$, and banks' loans interest received, $INT_{lb,t}$, $INT_{pb,t} = INT_{d,t} + INT_{bpb,t}$ is banks' interest paid, which is the sum of banks' deposit interest paid, $INT_{d,t}$ and banks' bond interest paid, $INT_{bpb,t} = r_{pb,t}B_{lb,t-1}$, $DIV_{rb,t} = \gamma_{DIV_{rb}}(E_{ab,t-1} + IFS_{ab,t-1})$ is banks' dividend received, $DIV_{pb,t} = \gamma_{DIV_{pb}}(E_{lb,t-1} + IFS_{lb,t-1})$ is banks' dividend paid, and $OIP_{b,t} = \gamma_{OIP_b} BP_{g,t}$ is banks' other income from properties, assumed to be fixed proportion of banks' gross disposable income.

Banks' bond interest received is the sum of all sectors' bond interest paid minus households' bond interest received,

$$INT_{brb,t} = INT_{bf,t} + INT_{bg,t} + INT_{brb,t} - INT_{bh,t}. \tag{137}$$

Similarly, banks' loan interest received is the sum of all sectors' loan interest paid minus the RoW loan interest received,

$$INT_{lb,t} = INT_{lf,t} + INT_{lh,t} + INT_{pr,t} - INT_{rr,t}. \tag{138}$$

Banks' deposit interest paid is the sum of all sectors' deposit interest received,

$$INT_{d,t} = INT_{db,t} + INT_{df,t} + INT_{dg,t} + INT_{dh,t}. \tag{139}$$

Banks' net disposable income is

$$BP_t = BP_{g,t} - T_{b,t} + O_{b,t}, \tag{140}$$

where $T_{b,t} = \tau_{b,t} BP_{g,t}$ denotes banks' income tax paid and $O_{b,t} = \gamma_{O_b} BP_t$ is banks' other current transfer received, assumed to be a fixed proportion of banks' disposable income.

Banks' fixed capital held in value,

$$K_{1b,t} = K_{1b,t-1}(1 - \delta_b) + I_{1b,t} + REV_{k_{1b},t} + OCV_{k_{1b},t}, \tag{141}$$

where δ_b is the depreciation rate of banks' fixed capital, $REV_{k_{1b},t}$ is the revaluation effect of banks' fixed capital, and $OCV_{k_{1b},t}$ is the other changes in value of banks' fixed capital.

Banks' fixed capital held in volume,

$$k_{1b,t} = \frac{K_{1b,t}}{P_{k_1,t}}. \tag{142}$$

Banks' fixed capital formation in volume,

$$i_{1b,t} = \Delta k_{1b,t} + \frac{\delta_b K_{1b,t-1}}{P_{k_1,t}}. \tag{143}$$

Banks' fixed capital revaluation,

$$REV_{k_{1b},t} = \Delta P_{k_1,t} k_{1b,t-1}. \tag{144}$$

[16] Including the government's rate of interest paid endogenous would break the model simulation convergence.

Banks' other non-financial assets in value,

$$K_{3b,t} = P_{k_{3b},t} k_{3b,t}, \tag{145}$$

where $P_{k_{3b},t}$ is the price of other non-financial assets, which is exogenous for simplicity.

Since there is no banks' acquisition less disposal of other non-financial assets, banks' other non-financial assets in volume, $k_{3b,t}$, is constant. And we assume the change in stock value is caused by the revaluation effect,

$$REV_{k_{3b},t} = K_{3b,t} - K_{3b,t-1}. \tag{146}$$

Banks' net financial investment,

$$NFI_{b,t} = BP_t - I_{1b,t} + EO_{b,t}, \tag{147}$$

where $EO_{b,t}$ is the banks' errors and omissions, which is the mismatch between the real account and financial account, assumed to be exogenous.

Banks' deposit savings,

$$\Delta D_{b,t} = D_{b,t} - D_{b,t-1} - OCV_{d_b,t}, \tag{148}$$

where $OCV_{d_b,t}$ is the other changes in value of banks' deposit held, which is exogenous.

Banks' deposit issued

$$D_t = D_{t-1} + \Delta D_t + OCV_{d,t}, \tag{149}$$

where $OCV_{d,t}$ is the other changes in value of banks' deposit issued.

Banks receive deposit savings from all sectors,

$$\Delta D_t = \Delta D_{b,t} + \Delta D_{f,t} + \Delta D_{g,t} + \Delta D_{h,t}. \tag{150}$$

Banks' deposits issued other changes in value is the sum of all deposits' other changes in value,

$$OCV_{d,t} = OCV_{d_b,t} + OCV_{d_f,t} + OCV_{d_g,t} + OCV_{d_h,t}. \tag{151}$$

Banks' bonds held in value,

$$B_{ab,t} = B_{ab,t} + \Delta B_{ab,t} + REV_{b_{ab},t} + OCV_{b_{ab},t}, \tag{152}$$

where $REV_{b_{ab},t}$ is the revaluation effect of banks' bonds held, and $OCV_{b_{ab},t}$ is the other changes in value of banks' bonds held.

Banks' bonds savings equal the sum of bonds issued by all sectors minus households' bonds savings,

$$\Delta B_{ab,t} = \Delta B_{f,t} + \Delta B_{g,t} + \Delta B_{lb,t} - \Delta B_{h,t}. \tag{153}$$

Similarly, banks' bonds held revaluation equals the sum of the revaluation of bonds issued by all sectors minus the revaluation of households' bonds held,

$$REV_{b_{ab},t} = REV_{b_f,t} + REV_{b_g,t} + REV_{b_{lb},t} - REV_{b_h,t}. \tag{154}$$

Equivalently, banks' bonds held other changes in value,

$$OCV_{b_{ab},t} = OCV_{b_f,t} + OCV_{b_g,t} + OCV_{b_{lb},t} - OCV_{b_h,t}. \tag{155}$$

Banks' bonds issued in volume,

$$b_{lb,t} = \frac{B_{lb,t}}{P_{b_{lb},t}}, \tag{156}$$

where $P_{b_{lb},t} = \frac{1}{r_{pb,t}}$ is the price of banks' bonds issued.

Banks' bonds borrowing,

$$\Delta B_{lb,t} = B_{lb,t} - B_{lb,t-1} - REV_{b_{lb},t} - OCV_{b_lb,t}, \tag{157}$$

where $REV_{b_{lb},t}$ is the revaluation effect of banks' bonds issued, and $OCV_{b_{lb},t}$ is the other changes in value of banks' bonds issued, which is exogenous.

Banks' bonds issued revaluation,

$$REV_{b_{lb},t} = \Delta P_{b_{lb},t} b_{lb,t-1}. \tag{158}$$

Banks' loans issued,

$$L_{b,t} = L_{b,t-1} + \Delta L_{b,t} + OCV_{l_b,t}, \tag{159}$$

where $OCV_{l_b,t}$ is the other changes in value of banks' loans issued.

Banks fulfill the demand for domestic loan borrowing, that is, total loan demand minus foreign loan supply,

$$\Delta L_{b,t} = \Delta L_{f,t} + \Delta L_{h,t} + \Delta L_{lr,t} - \Delta L_{ar,t}. \tag{160}$$

Similarly, banks' loans issued other changes in value,

$$OCV_{l_b,t} = OCV_{l_f,t} + OCV_{l_h,t} + OCV_{l_{lr},t} - OCV_{l_{ar},t}. \tag{161}$$

Banks' equity held in value,

$$E_{ab,t} = E_{ab,t-1} + REV_{e_{ab},t}, \tag{162}$$

where $REV_{e_{ab},t}$ is the revaluation effect of banks' equity held.

Banks' equity held in volume,

$$e_{ab,t} = \frac{E_{ab,t}}{P_{e_{ab},t}}, \tag{163}$$

where $P_{e_{ab},t}$ is the price of banks' equity held, which is exogenous.[17]

Banks' equity held revaluation,

$$REV_{e_{ab},t} = \Delta P_{e_{ab},t} e_{ab,t-1}. \tag{164}$$

Banks' investment fund shares held in value is proportional to banks' net worth,

$$IFS_{ab,t} = \gamma_{IFS_{ab}} E_{lb,t}. \tag{165}$$

Banks' investment fund shares held in volume,

$$ifs_{ab,t} = \frac{IFS_{ab,t}}{P_{ifs,t}}. \tag{166}$$

Banks' investment fund shares investing,

$$\Delta IFS_{ab,t} = IFS_{ab,t} - IFS_{ab,t-1}. \tag{167}$$

Banks' investment fund shares issued,

$$IFS_{lb,t} = IFS_{lb,t-1} + \Delta IFS_{lb,t} + REV_{ifs_{lb},t} + OCV_{ifs_{lb},t}, \tag{168}$$

where $REV_{ifs_{lb},t}$ is the revaluation effect of banks' investment fund shares issued, and $OCV_{ifs_{lb},t}$ is the other changes in value of banks' investment fund shares issued.

Banks supply investment fund shares to the investment demand,

$$\Delta IFS_{lb,t} = \Delta IFS_{ab,t} + \Delta IFS_{g,t} + \Delta IFS_{h,t}. \tag{169}$$

Same for banks' investment fund shares issued revaluation and other changes in value,

$$REV_{ifs_{lb},t} = REV_{ifs_{ab},t} + REV_{ifs_g,t} + REV_{ifs_h,t}, \tag{170}$$

$$OCV_{ifs_{lb},t} = OCV_{ifs_{ab},t} + OCV_{ifs_g,t} + OCV_{ifs_h,t}. \tag{171}$$

Banks' insurance issued,

$$A_t = A_{t-1} + \Delta A_t + OCV_{a,t}, \tag{172}$$

where $OCV_{a,t}$ is the other changes in value of banks' insurance issued.

Banks fulfill insurance demand,

$$\Delta A_t = \Delta A_{f,t} + \Delta A_{h,t}. \tag{173}$$

Banks' insurance issued other changes in value,

$$OCV_{a,t} = OCV_{a_f,t} + OCV_{a_h,t}. \tag{174}$$

[17] Including it as an endogenous variable would break the model simulation convergence.

Banks' other accounts payable/receivables are assumed to be proportional to their net worth,

$$Z_{b,t} = \gamma_{Z_b} E_{lb,t}. \tag{175}$$

Changes in banks' other accounts payable/receivables,

$$\Delta Z_{b,t} = Z_{b,t} - Z_{b,t-1} - OCV_{z_b,t}, \tag{176}$$

where $OCV_{z_b,t}$ is the other changes in value of banks' other accounts payable/receivables.[18]

Banks' other accounts payable/receivables other changes in value,

$$OCV_{z_b,t} = -OCV_{z_f,t} - OCV_{z_g,t} - OCV_{z_h,t} - OCV_{z_r,t}. \tag{177}$$

Governments:

Governments' gross operating surplus is

$$\Pi_{g,t} = Y_{g,t} - W_{g,t}, \tag{178}$$

where $W_{g,t} = \gamma_{W_g})W_t$ is the wage paid by governments, proportional to the total wage bill.

Governments' gross disposable income is

$$GP_{g,t} = \Pi g, t + TL_t + CT_{g,t} + INT_{dg,t} - INT_{bg,t} + DIV_{g,t} + OIP_{g,t}, \tag{179}$$

where $TL_t = TL_{f,t} + TL_{h,t} + TL_{b,t}$ is the net production tax received by governments, $INT_{dg,t} = r_{rg,t} D_{g,t-1}$ is government deposit interest received, $INT_{bg,t} = r_{pg,t} B_{g,t-1}$ is government bond interest paid, $DIV_{g,t} = \gamma_{DIV_g}(E_{g,t-1} + IFS_{g,t-1})$ is government dividend received with a fixed dividend rate γ_{DIV_g}, and $OIP_{g,t}$ is government other income from properties received.

Governments receive other income from properties from other sectors minus households' other income from properties,

$$OIP_{g,t} = OIP_{f,t} + OIP_{b,t} + OIP_{r,t} - OIP_{h,t}. \tag{180}$$

Governments' net disposable income is

$$GP_t = GP_{g,t} + T_t + SC_t - SB_t + O_{g,t}, \tag{181}$$

where $T_t = T_{f,t} + T_{b,t} + T_{h,t}$ is the total income tax received by governments, $SB_t = \gamma_{SB} Y_t$ is the social benefits paid to households, proportional to nominal GDP, and $O_{g,t}$ is other current transfers.

Government receive other current transfers from other sectors minus banks' other current transfers received,

$$O_{g,t} = O_{f,t} + O_{h,t} + O_{r,t} - O_{b,t}. \tag{182}$$

Government savings equal net disposable income minus government consumption,

$$S_{g,t} = GP_t - C_{g,t}. \tag{183}$$

Governments' fixed capital depreciates at a fixed rate, δ_g. Government fixed capital in value,

$$K_{1g,t} = K_{1g,t-1}(1 - \delta_g) + I_{1g,t} + REV_{k_{1g},t} + OCV_{k_{1g},t}, \tag{184}$$

where $REV_{k_{1g},t}$ is the revaluation effect of government fixed capital, $OCV_{k_{1g},t}$ is the other changes in value of government fixed capital, which is exogenous.

Governments' fixed capital in volume,

$$k_{1g,t} = \frac{K_{1g,t}}{P_{k_1,t}}. \tag{185}$$

Governments' fixed capital revaluation,

$$REV_{k_{1g},t} = \Delta P_{k_1,t} k_{1g,t-1}. \tag{186}$$

Governments' inventories in value,

$$K_{2g,t} = P_{k_{2g},t} k_{2g,t}. \tag{187}$$

[18]We do not let changes in banks' other accounts payable/receivables close the instrument account because it would make the model fragile.

Governments target their inventories to production (Godley & Lavoie, 2006),

$$k_{2g,t} = \gamma_{k_{2g}} y_t, \tag{188}$$

where $k_{2g0} > 0$ is the accelerator effect parameter.

Government changes in inventories in volume, by definition,

$$i_{2g,t} = \Delta k_{2g,t}. \tag{189}$$

Government other non-financial assets in value,

$$K_{3g,t} = K_{3g,t-1}(1 - 0.1) + I_{3g,t} + REV_{k_{3g},t} + OCV_{k_{3g},t}, \tag{190}$$

where 0.1 is the depreciation rate of the government's other non-financial assets (*China's National Balance Sheet 2018*), $REV_{k_{3g},t}$ is the revaluation effect, and $OCV_{k_{3g},t}$ is the other changes in value, which is exogenous.

Government other non-financial assets in volume are proportional to real GDP,

$$k_{3g,t} = \gamma_{k_{3g}} y_t. \tag{191}$$

Governments sell other non-financial assets to firms,[19]

$$I_{3g,t} = -I_{3f,t}. \tag{192}$$

Governments' other non-financial assets' revaluation effect,

$$REV_{k_{3g},t} = \Delta P_{k_3,t} k_{3g,t-1}. \tag{193}$$

Governments' net financial investment,

$$NFI_{g,t} = S_{g,t} - TRK_t - I_{1g,t} - I_{2g,t} - I_{3g,t} + EO_{g,t}, \tag{194}$$

where $TRK_t = \gamma_{TRK} Y_t$ is capital transfers to firms, which is a fixed proportion of nominal GDP, and $EO_{g,t}$ is governments' errors and omissions, which is exogenous.

Governments save part of their net worth as deposits,

$$D_{g,t} = \gamma_{D_g} V_{g,t}. \tag{195}$$

Governments' deposit savings,

$$\Delta D_{g,t} = D_{g,t} - D_{g,t-1} - OCV_{d_g,t}, \tag{196}$$

where $OCV_{d_g,t}$ is the other changes in value of governments' deposits held.

Governments' equities held in value,

$$E_{g,t} = E_{g,t-1} + REV_{e_g,t}, \tag{197}$$

where $REV_{e_g,t}$ is the revaluation effect of government equities held.

Governments' equities held in volume,

$$e_{g,t} = \frac{E_{g,t}}{P_{e_g,t}}. \tag{198}$$

Governments' equities held revaluation,

$$REV_{e_g,t} = \Delta P_{e_g,t} e_{g,t-1}. \tag{199}$$

Governments invest a proportion of net worth in investment fund shares,

$$IFS_{g,t} = \gamma_{IFS_g} V_{g,t-1}. \tag{200}$$

[19]This accounting equation is based on the transaction flow matrix. There is a mismatch between the national balance sheet and the transaction flow matrix from the data, governments' other non-financial assets are increasing over time with negative funds paid (positive funds received). The classification of governments' other non-financial assets includes state-owned construction land (*China's National Balance Sheet 2018*), which mainly comes from legislation.

Governments' investment fund shares savings,

$$\Delta IFS_{g,t} = IFS_{g,t} - IFS_{g,t-1} - REV_{ifs_g,t} - OCV_{ifs_g,t}, \tag{201}$$

where $REV_{ifs_g,t}$ is the revaluation effect and $OCV_{ifs_g,t}$ is the other changes in value of governments' investment fund shares held, which is exogenous.

Governments' investment fund shares held in volume,

$$ifs_{g,t} = \frac{IFS_{g,t}}{P_{ifs,t}}. \tag{202}$$

Governments' investment fund shares held revaluation,

$$REV_{ifs_g,t} = \Delta P_{ifs,t} ifs_{g,t}. \tag{203}$$

Governments' other accounts payable/receivables are proportional to net worth,

$$Z_{g,t} = \gamma_{Z_g} V_{g,t-1}. \tag{204}$$

Governments' changes in other accounts payable/receivables,

$$\Delta Z_{g,t} = Z_{g,t} - Z_{g,t-1} - OCV_{z_g,t}, \tag{205}$$

where $OCV_{z_g,t}$ is the other changes in value of governments' other accounts payables/receivables, which is exogenous.

Governments' bonds close the fiscal constraint,

$$\Delta B_{g,t} = \Delta D_{g,t} + \Delta IFS_{g,t} + \Delta Z_{g,t} - NFI_{g,t}. \tag{206}$$

Governments' bonds issued in value,

$$B_{g,t} = B_{g,t-1} + \Delta B_{g,t} + REV_{b_g,t} + OCV_{b_g,t}, \tag{207}$$

where $REV_{b_g,t}$ is the revaluation of government bonds, and $OCV_{b_g,t}$ is the other changes in value of government bonds, which is exogenous.

Governments' bonds issued in volume,

$$b_{g,t} = \frac{B_{g,t}}{P_{b_g,t}}, \tag{208}$$

where $P_{b_g,t}$ is the price of government bonds.

Governments' bonds revaluation,

$$REV_{b_g,t} = \Delta P_{b_g,t} b_{g,t-1} \tag{209}$$

Assuming each unit of government bonds pays 1 rmb after one year, then the price of government bonds can be derived by the inverse of its interest rate (Godley and Lavoie, 2006),

$$P_{B_g,t} = \frac{1}{r_{pg,t}}. \tag{210}$$

Government net worth,

$$V_{g,t} = K_{1g,t} + K_{2g,t} + K_{3g,t} + D_{g,t} - B_{g,t} + E_{g,t} + IFS_{g,t} + Z_{g,t}. \tag{211}$$

The rest of the world:

Net exports, by definition, equal exports minus imports plus net export adjustment,

$$NX_t = X_t - M_t + NX_{adj,t}. \tag{212}$$

Foreign savings is the net current transfers received by the rest of the world,

$$S_{r,t} = -NX_t - W_{r,t} + INT_{rr,t} - INT_{pr,t} + DIV_{rr,t} - OIP_{r,t} - O_{r,t}, \tag{213}$$

where $W_{r,t}$ is the foreign wage paid, $INT_{rr,t} = r_{rr,t}L_{ar,t-1}$ is the rest of the world interest received, $INT_{pr,t} = r_{pr,t}L_{lr,t-1}$ is the rest of the world interest paid, $DIV_{rr,t} = \gamma_{DIV_{rr}}(E_{r,t-1} + FDI_{in,t-1})$ is the dividend received by the rest of the world, $OIP_{r,t} = \gamma_{OIP_r}S_{r,t}$ is the other income from properties paid by the rest of the world, assumed to be proportional to foreign savings, and $O_{r,t} = \gamma_{O_r}S_{r,t}$ are the other current transfers paid by the rest of the world, also assumed to by proportional to foreign savings for simplicity.

Foreign wages paid close row of wage payments,

$$W_{r,t} = W_t - W_{b,t} - W_{f,t} - W_{g,t} - W_{h,t}. \tag{214}$$

The current account,

$$CA_t = -S_{r,t}. \tag{215}$$

Foreign net financial investment,

$$NFI_{r,t} = S_{r,t} + EO_{r,t}, \tag{216}$$

where $EO_{r,t}$ is the errors and omissions of the rest of the world, which is exogenous.

The rest of the world loans held,

$$L_{ar,t} = L_{ar,t-1} + \Delta L_{ar,t} + OCV_{l_{ar},t}, \tag{217}$$

where $OCV_{l_{ar},t}$ is the other changes in value of the rest of the world loans held, which is exogenous.

We assume the rest of the world loans borrowing stands for a fixed share of the capital account, i.e. $NFI_{r,t}$,

$$\Delta L_{lr,t} = \gamma_{\Delta L_{lr}} NFI_{r,t}. \tag{218}$$

The rest of the world's loans issued,

$$L_{lr,t} = L_{lr,t} + \Delta L_{lr,t} + OCV_{l_{lr},t}, \tag{219}$$

where $OCV_{l_{lr},t}$ is the other changes in value of the rest of the world's loans issued.

The rest of the world's equities held in value,

$$E_{r,t} = E_{r,t-1} + REV_{e_r,t}, \tag{220}$$

where $REV_{e_r,t}$ is the rest of the world equities' revaluation effect.

The rest of the world's equities held in volume,

$$e_{r,t} = \frac{E_{r,t}}{P_{e_r,t}}. \tag{221}$$

The rest of the world's equities held revaluation,

$$REV_{e_r,t} = \Delta P_{e_r,t} e_{r,t-1}. \tag{222}$$

Inward FDI stock in value,

$$FDI_{in,t} = FDI_{in,t-1} + \Delta FDI_{in,t} + REV_{fdi_{in},t}, \tag{223}$$

Inward FDI stock in volume,

$$fdi_{in,t} = \frac{FDI_{in,t}}{P_{fdi_{in},t}}, \tag{224}$$

where $P_{fdi_{in},t}$ is the price of inward FDI, which is exogenous by assumption.[20]

Inward FDI revaluation,

$$REV_{fdi_{in},t} = \Delta P_{fdi_{in},t} fdi_{in,t-1}. \tag{225}$$

The rest of the world's changes in other accounts payable/receivables close the horizontal line,

$$\Delta Z_{r,t} = -\Delta Z_{f,t} - \Delta Z_{b,t} - \Delta Z_{g,t} - \Delta Z_{h,t}. \tag{226}$$

[20] We failed to find any statistical explanation for the price of inward FDI.

The rest of the world's other accounts payable/receivables,

$$Z_{r,t} = Z_{r,t-1} + \Delta Z_{r,t} + OCV_{z_r,t}, \tag{227}$$

where $OCV_{z_r,t}$ is the other changes in value of the rest of the world's other accounts receivables/payables, which is exogenous.

Changes in international reserves close the balance of payment,

$$\Delta G_t = \Delta L_{ar,t} - \Delta L_{lr,t} + \Delta FDI_{in,t} - \Delta FDI_{out,t} + \Delta Z_{r,t} - NFI_{r,t}. \tag{228}$$

International reserves in value,

$$G_t = G_{t-1} + \Delta G_t + REV_{g,t}, \tag{229}$$

where $REV_{g,t}$ is the revaluation effect of international reserves.

International reserves in volume,

$$g_t = \frac{G_t}{P_{g,t}}, \tag{230}$$

where $P_{g,t}$ is the price of international reserves, which is exogenous by assumption.[21]

The rest of the world's net worth,

$$V_{r,t} = -G_t + L_{ar,t} - L_{lr,t} + E_{r,t} + FDI_{in,t} - FDI_{out,t} + Z_{r,t}. \tag{231}$$

Table 6: Variables and their values in 2019 (to be updated)

Symbol	Description	Value	Remark/sources
A	Banks' insurance issued (100 million rmb)	185272	Based on China's National Balance Sheet
A_f	Firms' insurance held (100 million rmb)	55582	Based on China's National Balance Sheet
A_h	Households' insurance held (100 million rmb)	129690	Based on China's National Balance Sheet
B_{ab}	Banks' bonds held in value (100 million rmb)	827160	Based on China's National Balance Sheet
B_f	Firms' bonds in value (100 million rmb)	220142	Based on China's National Balance Sheet
B_g	Government bonds in value (100 million rmb)	352935	Based on China's National Balance Sheet
B_{lb}	Banks' bonds issued in value (100 million rmb)	281419	Based on China's National Balance Sheet
B_h	Households' bonds in value (100 million rmb)	27336	Based on China's National Balance Sheet
BI_{in}	Material inflow balancing items (Mt)	11402	Based on Chen et al. 2022
BI_{out}	Material outflow balancing items (Mt)	7734	Based on Chen et al. (2022)
BP	Banks' net disposable income (100 million rmb)	-3196	Calculated from equation (147)
BPg	Banks' gross disposable income (100 million rmb)	34833	Based on National Bureau of Statistics of China
b_f	Firms' bonds in volume (100 million rmb)	5339	Calculated from equation (122)
b_g	Governments' bonds in volume (100 million rmb)	9141	Calculated from equation (208)
b_h	Households' bonds in volume (100 million rmb)	920	Calculated from equation (86)
b_{lb}	Banks' bonds issued in volume (100 million rmb)	7077	Calculated from equation (156)
C_g	Governments consumption (100 million rmb)	149600	Based on National Bureau of Statistic of China
C_h	Households consumption (100 million rmb)	387188	Based on National Bureau of Statistic of China
CA	Current account surplus/deficit (100 million rmb)	9501	Calculated from equation (215)
c_h	Households consumption in volume (100 million rmb)	355735	Based on the assumption that initial prices are 1
c_g	Governments consumption in volume (100 million rmb)	149600	Based on the assumption that initial prices are 1
D	Total deposits (100 million rmb)	2279930	Calculated from equation (149)
D_b	Banks' deposits held (100 million rmb)	198935	Based on China's National Balance Sheet
D_f	Firms' deposits (100 million rmb)	621147	Based on China's National Balance Sheet

[21] We did not find any statistical explanation for the price of international reserves.

D_g	Governments' deposits (100 million rmb)	339179	Based on China's National Balance Sheet
D_h	Households' deposits (100 million rmb)	1120669	Based on China's National Balance Sheet
DE	Aggregate domestic extraction (Mt)	12423	Based on Chen et al. (2022)
DE_b	Domestic biomass extraction (Mt)	2047	Based on Chen et al. (2022)
DE_f	Domestic fossil energy materials extraction (Mt)	4181	Based on Chen et al. (2022)
DE_m	Domestic metal ores extraction (Mt)	1321	Based on Chen et al. (2022)
DE_{nm}	Domestic non-metallic materials extraction (Mt)	4874	Based on Chen et al. (2022)
DIV_g	Governments' dividend received (100 million rmb)	11257	Based on National Bureau of Statistics of China
DIV_h	Households' dividend received (100 million rmb)	3467	Based on National Bureau of Statistics of China
DIV_{pb}	Banks' dividend paid (100 million rmb)	7175	Based on National Bureau of Statistics of China
DIV_{pf}	Firms' dividend paid (100 million rmb)	43895	Based on National Bureau of Statistics of China
DIV_{rb}	Banks' dividend received (100 million rmb)	1229	Based on National Bureau of Statistics of China
DIV_{rf}	Firms' dividend received (100 million rmb)	26165	Based on National Bureau of Statistics of China
DIV_{rr}	The rest of the world's dividend received (100 million rmb)	8951	Based on National Bureau of Statistics of China
DMC	Aggregate domestic material consumption (Mt)	14504	Based on Chen et al. (2022)
DMC_b	Domestic biomass consumption (Mt)	2295	Based on Chen et al. (2022)
DMC_f	Domestic fossil energy material consumption (Mt)	5051	Based on Chen et al. (2022)
DMC_m	Domestic metal ores consumption (Mt)	2457	Based on Chen et al. (2022)
DMC_{nm}	Domestic non-metallic material consumption (Mt)	4820	Based on Chen et al. (2022)
DMC_o	Domestic other products consumption (Mt)	-119	Based on Chen et al. (2022)
DMI	Aggregate domestic material input (Mt)	15202	Based on Chen et al. (2022)
DMI_b	Domestic biomass input (Mt)	2359	Based on Chen et al. (2022)
DMI_f	Domestic fossil energy materials input (Mt)	5182	Based on Chen et al. (2022)
DMI_m	Domestic metal ores input (Mt)	2680	Based on Chen et al. (2022)
DMI_{nm}	Domestic non-metallic materials input (Mt)	4962	Based on Chen et al. (2022)
DMI_o	Domestic other products input (Mt)	19.77	Based on Chen et al. (2022)
DPO	Aggregate domestic processed output (Mt)	12712	Based on Chen et al. (2022)
DPO_a	Emissions to air (Mt)	12334	Based on Chen et al. (2022)
DPO_{dup}	Dissipative use of products (Mt)	376	Based on Chen et al. (2022)
DPO_w	Emissions to water (Mt)	1.24	Based on Chen et al. (2022)
ΔA	Banks' insurance borrowing (100 million rmb)	10405	Calculated from equation (173)
ΔA_f	Firms' insurance savings (100 million rmb)	3122	Calibrated from equation (129) for initial steady state
ΔA_h	Households' insurance savings (100 million rmb)	7284	Calibrated from equation (98) for initial steady state
ΔB_{ab}	Banks' bonds savings (100 million rmb)	46456	Calculated from equation (153)
ΔB_f	Firms' bonds borrowing (100 million rmb)	12364	Calibrated from equation (121) for initial steady state
ΔB_g	Governments' bonds borrowing (100 million rmb)	19822	Calibrated from equation (207) for initial steady state
ΔB_h	Households' bonds savings (100 million rmb)	1535	Calibrated from equation (87) for initial steady state
ΔB_{lb}	Banks' bonds borrowing (100 million rmb)	15805	Calibrated from equation (157) for initial steady state
ΔD	Total deposits saving (100 million rmb)	128048	Calculated from equation (150)
ΔD_b	Banks' deposits saving (100 million rmb)	11173	Calibrated from equation (148) for initial steady state
ΔD_f	Firms' deposits saving (100 million rmb)	34886	Calibrated from equation (120) for initial steady state
ΔD_g	Governments' deposits saving (100 million rmb)	19049	Calibrated from equation (196) for initial steady state
ΔD_h	Households deposits saving (100 million rmb)	62940	Calibrated from equation (54) for initial steady state
ΔFDI_{out}	FDI outward flow (100 million rmb)	8250	Calibrated from equation (127) for initial steady state
ΔFDI_{in}	FDI inward flow (100 million rmb)	11533	Calibrated from equation (73) for initial steady state
ΔG	Change in international reserves (100 million rmb)	12232	Calibrated from equation (229) for initial steady state
ΔH	Currencies savings (100 million rmb)	3585	Calibrated from equation (84) for initial steady state
ΔIFS_{ab}	Banks' investment fund shares savings (100 million rmb)	27428	Calibrated from equation (167) for initial steady state
ΔIFS_g	Governments' investment fund shares savings	5422	Calibrated from equation (201) for

	(100 million rmb)		initial steady state
ΔIFS_h	Households' investment fund shares savings (100 million rmb)	10807	Calibrated from equation (95) for initial steady state
ΔIFS_{lb}	Banks' investment fund shares borrowing	27428	Calculated from equation (169)
ΔL_{ar}	The rest of the world's loans savings (100 million rmb)	3249	Calculated from equation (217)
ΔL_b	Banks' loans savings (100 million rmb)	102220	Calculated from equation (160)
ΔL_f	Firms' loans borrowing (100 million rmb)	66306	Calculated from equation (133)
ΔL_h	Households loans borrowing (100 million rmb)	34213	Based on National Bureau of Statistics of China
ΔL_{lr}	The rest of the world's loans borrowing (100 million rmb)	4950	Calculated from equation (218)
ΔZ_b	Banks other payable/receivables flows (100 million rmb)	8637	Calibrated from equation (**??**)
ΔZ_f	Firms' change in other accounts payable/receivables (100 million rmb)	-336	Calibrated from equation (131) for initial steady state
ΔZ_g	Governments change in other accounts payable/receivables (100 million rmb)	1661	Calibrated from equation (205) for initial steady state
ΔZ_h	Households' change in other accounts payable/receivables (100 million rmb)	0.1685	Calibrated from equation (100) for initial steady state
ΔZ_r	The rest of the world's change in other accounts payable/receivables (100 million rmb)	1149	Calibrated from equation (226) for initial steady state
E_{ab}	Banks' equities held in value (100 million rmb)	333067	Based on China's National Balance Sheet
E_{af}	Firms' equities held in value (100 million rmb)	61154	Based on China's National Balance Sheet
E_g	Governments' equities held in value (100 million rmb)	850000	Based on China's National Balance Sheet
E_h	Households' equities held in value (100 million rmb)	1702111	Based on China's National Balance Sheet
E_{lb}	Banks' equities issued in value (100 million rmb)	287758	Based on China's National Balance Sheet
E_{lf}	Firms' equities issued in value (100 million rmb)	2692202	Based on China's National Balance Sheet
E_r	The rest of the world's equities held in value (100 million rmb)	33628	Based on China's National Balance Sheet
EB	Energy balancing items (10kt SCE)	5690	Based on National Bureau of Statistics of China
EC	Energy consumption (10 kt SCE)	487488	Based on National Bureau of Statistics of China
EEX	Energy exports (10 kt SCE)	14151	Based on National Bureau of Statistics of China
EIM	Energy imports (10 kt SCE)	119064	Based on National Bureau of Statistics of China
EN	Fossil energy production (10 kt SCE)	321827	Based on National Bureau of Statistics of China
EP	Primary energy production (10 kt SCE)	397317	Based National Bureau of Statistics of China
ER	Renewable energy production (10 kt SCE)	75490	Based National Bureau of Statistics of China
ESC	Energy stock change (10 kt SCE)	-9052	Based on National Bureau of Statistics of China
e_{ab}	Banks' equities held in volume (100 million rmb)	333067	Based on the assumption that initial prices are 1
e_{af}	Firms' equities held in volume (100 million rmb)	61154	Based on the assumption that initial prices are 1
e_g	Governments' equities held in volume (100 million rmb)	850000	Based on the assumption that initial prices are 1
e_r	The rest of the world's equities held in volume (100 million rmb)	33628	Based on the assumption that initial prices are 1
FDI_{out}	FDI outward stock (100 million rmb)	146886	Based on China's National Balance Sheet
FDI_{in}	FDI inward stock (100 million rmb)	205340	Based on China's National Balance Sheet
FFR	Federal funds rate	0.005	Based on Federal Reserves Economic Data
FP	Firms' net disposable income (100 million rmb)	205563	Calculated from equation (119)
FP_g	Firms' gross disposable income (100 million rmb)	219249	Calculated from equation (103)
G	International reserves (100 million rmb)	217797	Based on China's National Balance Sheet
GP	Governments' net disposable income (100 million rmb)	159352	Calculated from equation (181)
GP_g	Governments' gross disposable income	124985	Calculated from equation (179)

	(100 million rmb)		
g_y	Real GDP growth	0.0595	Calculated from the series of y
H	Currencies (100 million rmb)	63840	Based on China's National Balance Sheet
I_{1b}	Banks' fixed capital formation in value (100 million rmb)	1270	Calibrated from equation (141) for initial steady state
I_{1f}	Firms' fixed capital formation in value (100 million rmb)	169038	Calibrated from equation (106) for initial steady state
I_{1g}	Governments' fixed capital formation in value (100 million rmb)	16697	Calibrated from equation (184) for initial steady state
I_h	Households' fixed capital formation in value(100 million rmb)	185997	Calibrated from equation (??) for initial steady state
I_{2f}	Firms' changes in inventories in value (100 million rmb)	67027	Calibrated from equation (110) for initial steady state
I_{2g}	Governments' changes in inventories in value (100 million rmb)	524.28	Calibrated from equation (189) for initial steady state
I_{3f}	Firms' acquisition less disposal of other non-financial assets in value (100 million rmb)	26669	Calculated from equation (192)
I_{3g}	Governments' acquisition less disposal of other non-financial assets in value (100 million rmb)	-26669	Calibrated from equation (114) for initial steady state
IFS_{ab}	Banks investment fund shares held (100 million rmb)	488365	Based on China's National Balance Sheet
IFS_g	Governments' investment fund shares held (100 million rmb)	96545	Based on China's National Balance Sheet
IFS_h	Households' investment fund shares held (100 million rmb)	192424	Based on China's National Balance Sheet
IFS_{lb}	Banks' investment fund shares issued (100 million rmb)	777334	Based on China's National Balance Sheet
INT_{bf}	Firms' bonds interest paid (100 million rmb)	5040	Calculated from $INT_{bf} = \frac{r_{pf}B_f}{1+g_y}$
INT_{bg}	Governments' bonds interest paid (100 million rmb)	8631	Calculated from $INT_{bg} = \frac{r_{pg}B_g}{1+g_y}$
INT_{bh}	Households' bonds interest received (100 million rmb)	868.41	Calculated from $INT_{bh} = \frac{r_{rh}B_h}{1+g_y}$
INT_{brb}	Banks' bonds interest received (100 million rmb)	19483	Calculated from equation (137)
INT_{bpb}	Banks' bonds interest paid (100 million rmb)	6680	Calculated from $INT_{bpb} = \frac{r_{pb}B_{lb}}{1+g_y}$
INT_d	Banks' deposits interest paid (100 million rmb)	66995	Calculated from equation (139)
INT_{db}	Banks' deposits interest received (100 million rmb)	4177	Calculated from $INT_{db} = \frac{r_{rb}D_b}{1+g_y}$
INT_{df}	Firms' deposits interest received (100 million rmb)	19921	Calculated from $INT_{df} = \frac{r_{rf}D_f}{1+g_y}$
INT_{dg}	Governments' deposits interest received (100 million rmb)	7296	Calculated from $INT_{dg} = \frac{r_{rg}D_g}{1+g_y}$
INT_{dh}	Households' deposits interest received (100 million rmb)	35601	Calculated from $INT_{dh} = \frac{r_{rh}D_h}{1+g_y}$
INT_{lb}	Banks' loans interest received (100 million rmb)	44892	Calculated from equation (138)
INT_{lf}	Firms' loans interest paid (100 million rmb)	27027	Calculated from $INT_{lf} = \frac{r_{pf}L_f}{1+g_y}$
INT_{lh}	Households' loans interest paid (100 million rmb)	13610	Calculated from $INT_{lh} = \frac{r_{ph}L_h}{1+g_y}$
INT_{pb}	Banks' interest paid (100 million rmb)	73674	Calculated from $INT_{pb} = INT_d + INT_{bpb}$
INT_{pf}	Firms' interest paid (100 million rmb)	32066	Calculated from $INT_{pf} = INT_{bf} + INT_{lf}$
INT_{pr}	The rest of the world's interest paid (100 million rmb)	5830	Calculated from $IN_{pr} = \frac{r_{pr}L_{lr}}{1+g_y}$
INT_{rb}	Banks' interest received (100 million rmb)	68552	Calculated from $INT_{rb} = INT_{db} + INT_{brb} + INT_{lb}$
INT_{rh}	Households' interest received (100 million rmb)	36470	Calculated from $INT_{rh} = INT_{dh} + INT_{bh}$
INT_{rr}	The rest of the world's interest received (100 million rmb)	1574	Calculated from $INT_{rr} = \frac{r_{rr}L_{ar}}{1+g_y}$
i_{1b}	Banks' fixed capital formation in volume (100 million rmb)	1270	Based on the assumption that initial prices are 1
i_{1f}	Firms' fixed capital formation in volume (100 million rmb)	169038	Based on the assumption that initial prices are 1
i_{1g}	Governments' fixed capital formation in volume	16697	Based on the assumption that initial

	(100 million rmb)		prices are 1
i_h	Households' fixed capital formation in volume (100 million rmb)	185898	Based on the assumption that initial prices are 1
i_{2f}	Firms' changes in inventories in volume (100 million rmb)	67027	Based on the assumption that initial prices are 1
i_{2g}	Governments' changes in inventories in volume (100 million rmb)	524.28	Based on the assumption that initial prices are 1
i_{3f}	Firms' acquisition less disposal of other non-financial assets in volume (100 million rmb)	26669	Based on the assumption that initial prices are 1
K_{1b}	Banks' fixed capital in value (100 million rmb)	15928	Based on China's National Balance Sheet
K_{1f}	Firms' fixed capital in value (100 million rmb)	1751211	Based on China's National Balance Sheet
K_{1g}	Governments' fixed capital in value (100 million rmb)	209337	Based on China's National Balance Sheet
K_{2g}	Governments' fixed capital in value (100 million rmb)	9335	Based on China's National Balance Sheet
K_h	Households' fixed capital in value (100 million rmb)	2499331	Based on China's National Balance Sheet
K_{2f}	Firms' inventories in value (100 million rmb)	1193439	Based on China's National Balance Sheet
K_{3b}	Banks' other non-financial assets in value (100 million rmb)	18282	Based on China's National Balance Sheet
K_{3f}	Firms' other non-financial assets in value (100 million rmb)	474852	Based on China's National Balance Sheet
K_{3g}	Governments' other non-financial assets in value (100 million rmb)	447314	Based on China's National Balance Sheet
k_{1b}	Banks' fixed capital in volume (100 million rmb)	15928	Based on the assumption that initial prices are 1
k_{1f}	Firms' fixed capital in volume (100 million rmb)	1751211	Based on the assumption that initial prices are 1
k_{1g}	Governments' fixed capital in volume (100 million rmb)	209337	Based on the assumption that initial prices are 1
k_h	Households' fixed capital in volume (100 million rmb)	2499331	Based on the assumption that initial prices are 1
k_{2f}	Firms' inventories in volume (100 million rmb)	1193439	Based on the assumption that initial prices are 1
k_{2g}	Governments' inventories in volume (100 million rmb)	9335	Based on the assumption that initial prices are 1
k_{3f}	Firms' other non-financial assets in volume (100 million rmb)	474852	Based on the assumption that initial prices are 1
k_{3g}	Governments' other non-financial assets in volume (100 million rmb)	447314	Based on the assumption that initial prices are 1
L_{ar}	The rest of the world's loans held (100 million rmb)	57843	Based on China's National Balance Sheet
L_b	Banks loans held (100 million rmb)	1820063	Based on China's National Balance Sheet
L_f	Firms' loans (100 million rmb)	1180596	Based on China's National Balance Sheet
L_h	Households loans (100 million rmb)	609179	Based on China's National Balance Sheet
L_{lr}	The rest of the world's loans issued (100 million rmb)	88131	Based on China's National Balance Sheet
LF	Labour force (100 million)	7.7532	Based on World Bank
M	Imports in value (100 million rmb)	172444	Based on World Bank
MEX	Aggregate material export (Mt)	698	Based on Chen et al. (2022)
MEX_b	Biomass export (Mt)	64.06	Based on Chen et al. (2022)
MEX_f	Fossil energy materials export (Mt)	131	Based on Chen et al. (2022)
MEX_m	Metal ores export (Mt)	222	Based on Chen et al. (2022)
MEX_{nm}	Non-metallic materials export (Mt)	142	Based on Chen et al. (2022)
MEX_o	Other products export (Mt)	139	Based on Chen et al. (2022)
MIM	Aggregate material import (Mt)	2779	Based on Chen et al. (2022)
MIM_b	Biomass import (Mt)	311	Based on Chen et al. (2022)
MIM_f	Fossil energy materials import (Mt)	1001	Based on Chen et al. (2022)
MIM_m	Metal ores import (Mt)	1359	Based on Chen et al. (2022)
MIM_{nm}	Non-metallic materials import (Mt)	87.68	Based on Chen et al. (2022)
MIM_o	Non-metallic materials import (Mt)	19.77	Based on Chen et al. (2022)
MS	Aggregate material stock (Mt)	187670	Based on Chen et al. (2022)
m	Imports in volume (100 million rmb)	149380	Calculated from $\frac{M}{P_m}$
N	Employment (100 million)	7.3997	Based on World Bank
NAS	Net additions to material stock (Mt)	5460	Based on Chen et al. 2022
NFI_b	Banks' net financial investment (100 million rmb)	-4466	Calibrated from $NFI_b = \Delta G - \Delta H$ $+ \Delta Db - \Delta D + \Delta B_{ab} - \Delta B_{lb} + \Delta L_b$

			$+\Delta IFS_{ab} - \Delta IFS_{lb} - \Delta A + \Delta Zb$ for initial steady state
NFI_f	Firms' net financial investment (100 million rmb)	51939	Calculated from equation (133)
NFI_g	Governments' net financial investment (100 million rmb)	6311	Calculated from equation (194)
NFI_h	Households' net financial investment (100 million rmb)	-44281.96	Calculated from equation (83)
NFI_r	The rest of the world's net financial investment (100 million rmb)	-9501	Calculated from equation (216)
NX	Net exports (100 million rmb)	9174	Based on National Bureau of Statistics of China
ν_{dup}	Coefficient of dissipative use of products	0.18	Calculated from equation (27)
O_b	Banks' other current transfers paid (100 million rmb)	-29153	Calculated from equation (140)
ν_w	Emissions to water intensity (Mt/100 million rmb)	1.39e-06	Calculated from equation (29)
O_f	Firms' other current transfers paid (100 million rmb)	-14742	Calculated from equation (105)
O_g	Governments' other current transfers received (100 million rmb)	-7145	Calculated from equation (182)
O_h	Households' other current transfers paid (100 million rmb)	-25092	Calculated from $O_h = \gamma_{O_h} YD_g$
O_r	The rest of the world's other current transfers paid (100 million rmb)	3535	Calculated from equation (213)
OCS	Other change in material stock (Mt)	0	Based on Chen et al. (2022)
OIP_b	Banks' other income from properties paid (100 million rmb)	1931	Calculated from equation (136)
OIP_f	Firms' other income from properties paid (100 million rmb)	7847	Based on National Bureau of Statistics of China
OIP_g	Governments' other income from properties received (100 million rmb)	5896	Calculated from equation (180)
OIP_h	Households other income from properties received (100 million rmb)	5159	Based on National Bureau of Statistics of China
OIP_r	The rest of the world's other income from properties paid (100 million rmb)	1276	Based on National Bureau of Statistics of China
P_{b_f}	Price of firms' bonds	41.23	Calculated from $P_{b_f} = \frac{1}{r_{pf}}$
P_{b_g}	Price of government bonds	38.59	Calculated from equation (210)
P_{b_h}	Price of households bonds	29.71	Calculated from equation (89)
$P_{b_{lb}}$	Price of banks bonds issued	39.76	Calculated from $P_{b_{lb}} = \frac{1}{r_{pb}}$
P_c	CPI (2019 = 1)	1	Assumed
$P_{e_{ab}}$	Price of banks equity held	1	Assumed
$P_{e_{af}}$	Price of firms equity held	1	Assumed
P_{e_g}	Price of governments equity held	1	Assumed
$P_{e_{lb}}$	Price of banks equity issued	1	Assumed
$P_{e_{lf}}$	Price of firms equity issued	1	Assumed
P_{e_r}	Price of the rest of the world equity held	1	Assumed
P_{k_1}	Fixed capital price index (2019 = 1)	1	Assumed
P_{k_h}	Housing price index (2019 = 1)	1	Assumed
$P_{k_{2f}}$	Price of firms inventories (2019 = 1)	1	Assumed
$P_{k_{2g}}$	Price of government inventories (2019 = 1)	1	Assumed
P_{k_3}	Price of other non-financial assets (2019 = 1)	1	Assumed
P_m	Import price index (2019 = 1)	1	Assumed
P_x	Export price index (2019 = 1)	1	Assumed
P_y	GDP deflator (2019 = 1)	1	Assumed
Π_b	Banks' gross operating surplus (100 million rmb)	47833	Calculated from equation (135)
Π_f	Firms' gross operating surplus (100 million rmb)	256972	Calculated from equation (102)
Π_g	Governments' gross operating surplus (100 million rmb)	11535	Calculated from equation (178)
Π_h	Households' gross operating surplus (100 million rmb)	59284	Calculated from equation (75)
π	CPI inflation	0	Assumed for initial steady state
$REV_{b_{ab}}$	Banks' bonds held revaluation (100 million rmb)	0	Assumed for initial steady state
REV_{b_f}	Firms' bonds revaluation (100 million rmb)	0	Assumed for initial steady state
REV_{b_g}	Governments' bonds revaluation (100 million rmb)	0	Assumed for initial steady state
REV_{b_h}	Households' bonds revaluation (100 million rmb)	0	Assumed for initial steady state
$REV_{b_{lb}}$	Banks' bonds issued revaluation (100 million rmb)	0	Assumed for initial steady state

$REV_{e_{ab}}$	Banks' equity held revaluation (100 million rmb)	18706	Calibrated from equation (162) for initial steady state
$REV_{e_{af}}$	Firms' equity held revaluation (100 million rmb)	3435	Calibrated from equation (124) for initial steady state
REV_{e_g}	Governments' equity held revaluation (100 million rmb)	47739	Calibrated from equation (197) for initial steady state
REV_{e_h}	Households' equity held revaluation (100 million rmb)	95596	Calibrated from equation (91) for initial steady state
$REV_{e_{lb}}$	Banks' equity issued revaluation (100 million rmb)	16161	Calibrated from equation (34) for initial steady state
$REV_{e_{lf}}$	Firms' equity issued revaluation (100 million rmb)	151202	Calibrated from equation (34) for initial steady state
REV_{e_r}	The rest of the world's equity held revaluation (100 million rmb)	1889	Calibrated from equation (220) for initial steady state
$REV_{k_{1b}}$	Banks' fixed capital revaluation (100 million rmb)	0	Assumed for initial steady state
$REV_{k_{1f}}$	Firms' fixed capital revaluation (100 million rmb)	0	Assumed for initial steady state
$REV_{k_{1g}}$	Governments' fixed capital revaluation (100 million rmb)	0	Assumed for initial steady state
REV_{k_h}	Households' fixed capital revaluation (100 million rmb)	0	Assumed for initial steady state
$REV_{k_{2f}}$	Firms' inventories revaluation (100 million rmb)	0	Assumed for initial steady state
$REV_{k_{3b}}$	Banks' other non-financial assets revaluation	1027	Calibrated from equation (146)
$REV_{k_{3f}}$	Firms' other non-financial assets revaluation (100 million rmb)	0	Assumed for initial steady state
RoE	Recovery of energy (10 kt SCE)	0	Based on National Bureau of Statistics of China
r_{pb}	Banks rate of interest paid	0.0251	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{pf}	Firms rate of interest paid	0.0243	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{pg}	Governments rate of interest paid	0.0259	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{ph}	Households rate of interest paid	0.0237	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{pr}	The rest of the world rate of interest paid	0.0701	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{rb}	Banks rate of interest received	0.0222	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{rf}	Firms' rate of interest received	0.034	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{rg}	Governments' rate of interest received	0.0228	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{rh}	Households' rate of interest received	0.0337	Based on National Bureau of Statistics of China and China's National Balance Sheet
r_{rr}	The rest of the world's rate of interest received	0.0288	Based on National Bureau of Statistics of China and China's National Balance Sheet
S_g	Governments' savings (100 million rmb)	9752	Calculated from equation (183)
S_h	Households' savings (100 million rmb)	237936	Calculated from equation (78)
S_r	The rest of the world's savings and (228) (100 million rmb)	-9501	Calibrated from equation (216) for initial steady state
SB	Social benefits (100 million rmb)	70238	Based on National Bureau of Statistics of China
SC	Social contributions (100 million rmb)	64049	Based on National Bureau of Statistics of China
T	Income tax received by governments (100 million rmb)	47702	Based on National Bureau of Statistics of China
T_b	Income tax paid by banks (100 million rmb)	8876	Based on National Bureau of Statistics of China
T_f	Income tax paid by firms (100 million rmb)	28428	Based on National Bureau of Statistics of China

T_h	Income tax paid by households (100 million rmb)	10399	Based on National Bureau of Statistics of China
TL	Net production tax received by governments (100 million rmb)	97632	Based on National Bureau of Statistics of China
TL_b	Net production tax paid by banks (100 million rmb)	7595	Based on National Bureau of Statistics of China
TL_f	Net production tax paid by firms (100 million rmb)	88546	Based on National Bureau of Statistics of China
TL_h	Net production tax paid by households (100 million rmb)	1493	Based on National Bureau of Statistics of China
θ	Share of renewable energy production	0.19	Based on National Bureau of Statistics of China
ULC	Unit labour cost	0.5205	Calculated from equation (43)
u	Unemployment rate	0.0456	Based on World Bank
ε	Energy intensity	0.4509	Calculated from equation (2)
V_h	Households' net worth (100 million rmb)	5126225	Calculated from equation (101)
V_g	Governments' net worth (100 million rmb)	1628347	Calculated from equation (211)
V_r	The rest of the world's net worth (100 million rmb)	-135543	Calculated from equation (211)
W	Total wage bill (100 million rmb)	513472	Based on National Bureau of Statistics of China
W_b	Wage paid by banks (100 million rmb)	20824	Based on National Bureau of Statistics of China
W_f	Wage paid by firms (100 million rmb)	266647	Based on National Bureau of Statistics of China
W_g	Wage paid by governments (100 million rmb)	89253	Based on National Bureau of Statistics of China
W_h	Wage paid by households (100 million rmb)	136534	Based on National Bureau of Statistics of China
W_r	Wage paid by the rest of the world (100 million rmb)	213.73	Based on National Bureau of Statistics of China
w	Real wage (100 million rmb)	0.0005	Calculated from equation (42)
X	Exports in value (100 million rmb)	181617	Based on World Bank
XR	Nominal effective exchange rate	1	Assumed
x	Exports in volume (100 million rmb)	166830	Calculated from $\frac{X}{P_x}$
Y	Nominal GDP (100 million rmb)	986515	Based on National Bureau of Statistics of China
Y_b	Banks' output (100 million rmb)	76251	Based on National Bureau of Statistics of China
Y_f	Firms' output (100 million rmb)	612165	Based on National Bureau of Statistics of China
Y_g	Governments' output (100 million rmb)	100788	Based on National Bureau of Statistics of China
Y_h	Households' output (100 million rmb) (100 million rmb)	197312	Based on National Bureau of Statistics of China
Y_r	Nominal GDP of the rest of the world (100 million US dollar)	5074080	Based on World Bank
YD	Households' net disposable income (100 million rmb)	625124	Calculated from equation (77)
YD_g	Households' gross disposable income (100 million rmb)	604242	Based on National Bureau of Statistics of China
y	Real GDP (100 million rmb)	890305	Calculated from $\frac{Y}{P_y}$
$y_{N,t}$	Labor productivity	133318	Real GDP per labour
Z_b	Banks' other accounts payable/receivables (100 million rmb)	-44044	Based on China's National Balance Sheet
Z_f	Firms' other accounts payable/receivables (100 million rmb)	-5991	Based on China's National Balance Sheet
Z_g	Governments' other accounts payable/receivables (100 million rmb)	29572	Based on China's National Balance Sheet
Z_h	Households other accounts payable/receivable (100 million rmb)	3	Based on China's National Balance Sheet
Z_r	The rest of the world other accounts payable/receivables (100 million rmb)	20460	Based on China's National Balance Sheet

Table 7: Values for parameters (to be updated)

Symbol	Description	Value	Remark/sources
α_0	Price mark-up of fixed assets (short-run)	-0.0135	Calibrated from equation (46) for initial steady state

α_1	Elasticity of price of fixed assets to CPI (short run)	1.1134	Estimated from OLS regression
α_2	Price of fixed assets long run correction	-0.3091	Estimated from OLS regression
α_2	Elasticity of price of fixed assets to unit labour cost (long run)	0.6729	Estimated from OLS regression
α_4	Elasticity of price of fixed assets to capacity utilization (long run)	0.6431	Estimated from OLS regression
b_{f0}	Firms bond issued preference	0.1919	Calibrated from equation (59) for initial steady state
b_{f1}	Sensitivity of firms bonds to net disposable income	-1.3786	Estimated from OLS regression
b_{h0}	Households bond held preference	0.004	Calibrated from equation (55) for initial steady state
b_{h1}	Sensitivity of households bonds to real interest received	0.2856	Estimated from OLS regression
b_{h2}	Sensitivity of households bonds to real interest paid	-0.3161	Estimated from OLS regression
b_{h3}	Sensitivity of households bonds to real equity and investment fund shares return	-0.0101	Estimated from OLS regression
b_{lb0}	Banks liquidity demand for issuing bonds	1.252	Calibrated from equation (64) for initial steady state
b_{lb1}	Sensitivity of banks bonds issued to real rate of interest paid	-8.5838	Estimated from OLS regression
c_0	Autonomous consumption growth	-0.102	Calibrated from equation (51) for initial steady state
c_1	Households consumption income effect (short run)	0.9299	Estimated from OLS regression
c_2	Households consumption long run correction income	-0.7253	Estimated from OLS regression
c_3	Households consumption habit formation	0.6199	Estimated from OLS regression
c_4	Households consumption income effect (short run)	0.3801	Calibrated from $c_4 = 1 - c_3$ for initial steady state
car	Coverage ratio of fossil energy production	76.97	Calculated from equation (13)
car_{ex}	Coverage ratio of energy exports	107.86	Calculated from equation (21)
car_{im}	Coverage ratio of energy imports	118.92	Calculated from equation (16)
$comb_{in}$	Combustion inflow coefficient	2.257	Calculated from equation (24)
$comb_{out}$	Combustion outflow coefficient	1.531	Calculated from equation (31)
d_{b0}	Banks deposit held preference	0.7325	Calibrated from equation (63) for initial steady state
d_{b1}	Sensitivity of banks deposits held to real rate of interest received	5.7436	Estimated from OLS regression
d_{f0}	Liquidity preference of firms	0.1226	Calibrated from equation (58) for initial steady state
d_{f1}	Sensitivity of firms deposits to real rate of interest received	0.5008	Estimated from OLS regression
d_{f2}	Sensitivity of firms deposits to net disposable income	1.595	Estimated from OLS regression
d_{g0}	Governments' deposits per net worth	0.2207	Calibrated from equation (195) for initial steady state
d_{h0}	Households liquidity preference to deposits	0.215	Calibrated from equation (85) for initial steady state
d_{h1}	Sensitivity of households deposits to real interest received	1.2286	Estimated from OLS regression
d_{h2}	Sensitivity of households deposits to real interest paid	-1.0466	Estimated from OLS regression
dup_0	Short-run exogenous reduction of dissipative use of products to biomass extraction	-0.0169	Estimated from OLS regression
dup_1	Short-run elasticity of the coefficient of dissipative use of products to the Gini coefficient	0.5068	Estimated from OLS regression
dup_2	Long-run correction parameter of the coefficient of dissipative use of products	-0.3381	Estimated from OLS regression
dup_3	Initial level of the coefficient of dissipative use of products in logarithm	34.62	Estimated from OLS regression
dup_4	Long-run exogenous reduction of dissipative use of products to biomass extraction	-0.0177	Estimated from OLS regression
dup_5	Long-run elasticity of the coefficient of dissipative use of products to the Gini coefficient	0.459	Estimated from OLS regression
δ_b	Banks' fixed capital depreciation rate	0.025	Based on China's National Balance Sheet
δ_f	Firms' fixed capital depreciation rate	0.0428	Based on China's National Balance Sheet
δ_g	Governments' fixed capital depreciation rate	0.025	Based on the China's National Balance Sheet
δ_h	Households' fixed capital depreciation rate	0.0193	Based on the China's National Balance Sheet

fdi_{out0}	Firms outward FDI preference	0.0904	Calibrated from equation (60) for initial steady state
fdi_{out1}	Sensitivity of FDI outward to firms gross profit rate	-0.2539	Estimated from OLS regression
fdi_{in0}	Autonomous FDI inward accumulation rate	-0.0815	Calibrated from equation (73) for initial steady state
fdi_{in1}	Sensitivity of FDI inward to firms gross profit rate	0.9612	Estimated from OLS regression
γ_{DIV_g}	Governments rate of dividend received	0.0126	Calibrated from $\gamma_{DIV_g} = \frac{DIV_g(1+g_y)}{E_g+IFS_g}$ for initial steady state
γ_{DIV_h}	Households rate of dividend received	0.1333	Calibrated from $\gamma_{DIV_h} = \frac{DIV_h(1+g_y)}{E_h+IFS_h}$ for initial steady state
$\gamma_{DIV_{pb}}$	Banks rate of dividend paid	0.0071	Calibrated from $\gamma_{DIV_{pb}} = \frac{DIV_{pb}(1+g_y)}{E_{lb}+IFS_{lb}}$ for initial steady state
$\gamma_{DIV_{rb}}$	Banks rate of dividend received	0.0016	Calibrated from $\gamma_{DIV_{rb}} = \frac{DIV_{rb}(1+g_y)}{E_{ab}+IFS_{ab}}$ for initial steady state
$\gamma_{DIV_{rf}}$	Firms rate of dividend received	0.0019	Calibrated from $\gamma_{DIV_{rf}} = \frac{DIV_{rf}(1+g_y)}{E_{af}+FDI_{out}}$ for initial steady state
$\gamma_{DIV_{rr}}$	The rest of the world rate of dividend received	0.0397	Calibrated from $\gamma_{DIV_{rr}} = \frac{DIV_{rr}(1+g_y)}{E_r+FDI_{in}}$ for initial steady state
γ_{O_b}	Share of banks other current transfers received	-0.8369	Calculated from $\gamma_{O_b} = \frac{O_b}{BP_g}$
γ_{O_h}	Share of households other current transfers paid	-0.0415	Calibrated from equation (77), (78), (83) and (**??**) for initial steady state
γ_{O_f}	Share of firms other current transfers paid	-0.0672	Calculated from $\gamma_{O_f} = \frac{O_f}{FP_g}$
γ_{O_r}	Share of the rest of the world other current transfers paid	-0.3941	Calibrated from $\gamma_{O_r} = \frac{O_r(1+g_y)}{Sr}$ for initial steady state
γ_{OIP_b}	Share of banks other income from properties paid	0.0587	Calibrated from $\gamma_{OIP_b} = \frac{OIP_b(1+g_y)}{BP_g}$ for initial steady state
γ_{OIP_f}	Share of firms other income from properties received	0.0379	Calibrated from $\gamma_{OIP_f} = \frac{OIP_f(1+g_y)}{FP_g}$ for initial steady state
γ_{OIP_h}	Share of households other income from properties received	0.009	Calibrated from $\gamma_{OIP_h} = \frac{OIP_h(1+g_y)}{YD_g}$ for initial steady state
γ_{OIP_r}	Share of the rest of the world other income from properties paid	-0.1423	Calibrated from $\gamma_{OIP_r} = \frac{OIP_r(1+g_y)}{S_r}$ for initial steady state
γ_{SB}	Social benefit per GDP	0.0712	Calculated from $\gamma_{SB} = \frac{SB}{Y}$
γ_{TRK}	Capital transfers per GDP	0.0131	Calculated from $\gamma_{TRK} = \frac{TRK}{Y}$
γ_{W_b}	Share of banks' wage paid	0.0406	Calculated from $\gamma_{W_b} = \frac{W_b}{W}$
γ_{W_f}	Share of firms' wage paid	0.5193	Calculated from $\gamma_{W_f} = \frac{W_f}{W}$
γ_{W_g}	Share of governments wage paid	0.1738	Calculated from $\gamma_{W_g} = \frac{W_g}{W}$
γ_{W_h}	Share of households wage paid	0.2659	Calculated from $\gamma_{W_h} = \frac{W_h}{W}$
γ_{W_r}	Share of the rest of the world wage paid	0.0004	Calculated from $\gamma_{W_h} = \frac{W_r}{W}$
γ_{Y_b}	Share of banks' output	0.0773	Calculated from equation (74)
γ_{Y_f}	Share of firms' output	0.6205	Calculated from equation (74)
γ_{Y_g}	Share of governments' output	0.1022	Calculated from equation (74)
h_0	Households liquidity preference for currencies	-0.0231	Calibrated from equation (53) for initial steady state
h_1	Households' propensity to hold currencies	0.2981	Estimated from OLS regression
i_{b0}	Banks autonomous fixed capital accumulation rate	0.0207	Calibrated from equation (62) for initial steady state
i_{b1}	Sensitivity of banks fixed capital accumulation rate to profit rate	0.0147	Estimated from OLS regression
i_{f0}	Autonomous firms' capital accumulation rate	-0.7653	Calibrated from equation (57) for initial steady state
i_{f1}	Sensitivity of firms' capital accumulation rate to net profit rate	0.6249	Estimated from OLS regression
l_{ar0}	The rest of world loans held autonomous accumulation	0.0388	Calibrated from equation (72) for initial steady state
l_{ar1}	Sensitivity of RoW loan held to rate of interest received by the RoW	0.7170	Estimated from OLS regression
l_{lr0}	Share of the rest of the world loans issued	-0.6888	Calibrated from equation (219) for initial steady state
μ_b	Biomass intensity	0.0023	Calculated from equation (12)
$\mu_{b,ex}$	Biomass export intensity	0.0004	Calculated from equation (20)
$\mu_{b,im}$	Biomass import intensity	0.0021	Calculated from equation (15)
μ_m	Metal ores intensity	0.0015	Calculated from equation (12)
$\mu_{m,ex}$	Metal ores export intensity	0.0013	Calculated from equation (20)
$\mu_{m,im}$	Metal ores import intensity	0.0091	Calculated from equation (15)
μ_{nm}	Non-metallic materials intensity	0.0055	Calculated from equation (12)

$\mu_{nm,ex}$	Non-metallic materials export intensity	0.0009	Calculated from equation (20)
$\mu_{nm,im}$	Non-metallic materials import intensity	0.0006	Calculated from equation (15)
$\mu_{o,ex}$	Other products export intensity	0.0008	Calculated from equation (20)
$\mu_{o,im}$	Other products import intensity	0.0001	Calculated from equation (15)
ν_{w0}	Short-run exogenous reduction of emissions to water intensity	-0.1189	Estimated from OLS regression
ν_{w1}	Long-run correction parameter of emissions to water intensity	-0.4393	Estimated from OLS regression
ν_{w2}	Initial level of emissions to water intensity in logarithm	364.2	Estimated from OLS regression
ν_{w3}	Long-run exogenous reduction of emission to water intensity	-0.185	Estimated from OLS regression
ν_{w4}	Elasticity of emissions to water intensity to the Gini coefficient	4.291	Estimated from OLS regression
p_{c0}	Mark-up of CPI, growth	0.6912	Calibrated from equation (45) for initial steady state
p_{c1}	Elasticity of CPI to unit labour cost (short run)	0.5753	Estimated from OLS regression
p_{c2}	CPI long run correction	-.3359	Estimated from OLS regression
p_{c3}	Elasticity of CPI to unit labour cost (long run)	0.6245	Estimated from OLS regression
p_{c4}	Elasticity of CPI to energy price (long run)	0.2144	Estimated from OLS regression
p_{eg0}	Return premium of government equity held	0.037	Calibrated from equation (67) for initial steady state
p_{eg1}	Price of government equity held long-run correction	-0.2749	Estimated from OLS regression
p_{eg2}	Price premium of government equity held	0.0757	Estimated from OLS regression
p_{eg3}	Elasticity of price of government equity held to price of banks equity issued	1	Calibrated for initial steady state
p_{k0}	Mark-up of capital price	1.349	Calibrated from equation (46) for initial steady state
p_{kh1}	Elasticity of housing price growth to inflation	1.3932	Estimated from OLS regression
p_{x0}	Mark-up of export price	1.2502	Calibrated from equation (49) for initial steady state
p_{x1}	Elasticity of export price growth to unit labour cost growth	0.3297	Estimated from OLS regression
r_{pb0}	Banks rate of interest paid premium	-0.0022	Calibrated from equation (134) for initial steady state
r_{pb1}	Sensitivity of banks rate of interest paid to 10-year government bond yield	0.3241	Estimated from OLS regression
r_{pg0}	Governments rate of interest paid premium	-0.0015	Calibrated from equation (134) for initial steady state
r_{pg1}	Sensitivity of governments rate of interest paid to 10-year government bond yield	0.2432	Estimated from OLS regression
r_{ph0}	Households rate of interest paid premium	-0.0014	Calibrated from equation (134) for initial steady state
r_{ph1}	Sensitivity of Households rate of interest paid to 10-year government bond yield	0.1621	Estimated from OLS regression
r_{pr0}	The rest of the world rate of interest paid premium	-0.0014	Calibrated from equation (69) for initial steady state
r_{pr1}	Sensitivity of the rest of the world rate of interest paid to NEER growth	-0.2143	Estimated from OLS regression
r_{pr2}	Sensitivity of the rest of the world rate of interest paid to federal funds rate	0.2455	Estimated from OLS regression
r_{rb0}	Banks rate of interest received lower bound, log	-8.0814	Calibrated from equation (**??**) for initial steady state
r_{rb1}	Semi-elasticity of banks rate of interest received to capacity utilization	5.6927	Estimated from OLS regression
r_{rf0}	Firms rate of interest received premium	0.0005	Calibrated from equation (134) for initial steady state
r_{rf1}	Sensitivity of firms rate of interest received to 10-year government bond yield	0.2793	Estimated from OLS regression
r_{rg0}	Governments rate of interest received premium	-0.0015	Calibrated from equation (134) for initial steady state
r_{rg1}	Sensitivity of governments rate of interest received to 10-year government bond yield	0.1663	Estimated from OLS regression
r_{rh0}	Households rate of interest received premium	0.0006	Calibrated from equation (134) for initial steady state
r_{rh1}	Sensitivity of households rate of interest received to 10-year government bond yield	0.3832	Estimated from OLS regression
τ_b	Income tax rate paid by banks	0.2548	Calculated from $\tau_b = \frac{T_b}{BP_g}$
τ_f	Income tax rate paid by firms	0.1297	Calculated from $\tau_f = \frac{T_f}{FP_g}$
τ_h	Income tax rate paid by households	0.0172	Calculated from $\tau_h = \frac{T_h}{YD_g}$
τ_{L_b}	Net production tax rate paid by banks	0.0996	Calculated from $\tau_{L_b} = \frac{TL_b}{Y_b}$

τ_{L_f}	Net production tax rate paid by firms	0.1446	Calculated from $\tau_{L_f} = \frac{TL_f}{Y_f}$
τ_{L_h}	Net production tax rate paid by households	0.0076	Calculated from $\tau_{L_h} = \frac{TL_h}{Y_h}$
τ_{sc}	Social contribution ratio over wage bill	0.1247	Calculated from $\tau_{sc} = \frac{SC}{W}$
ε_{ex}	Energy intensity of exports	0.0798	Calculated from equation (6)
ε_{im}	Energy intensity of imports	0.7398	Calculated from equation (7)
ε_0	Short-run exogenous energy efficiency improvement	-0.0327	Estimated from OLS regression
ε_1	Long-run correction parameter of energy intensity	-0.38	Estimated from OLS regression
ε_2	Initial level of energy intensity in logarithm	55.59	Estimated from OLS regression
ε_3	Long-run exogenous energy efficiency improvement	-0.0274	Estimated from OLS regression
ε_4	Elasticity of energy intensity to the Gini coefficient	1.1819	Estimated from OLS regression
w_0	Exogenous real wage growth	0.0309	Calibrated from equation (41) for initial steady state
w_1	Sensitivity of real wage growth to labour productivity growth	-0.0009	Estimated from OLS regression
x_0	Autonomous export demand growth	0.2784	Calibrated from equation (70) for initial steady state
x_1	Elasticity of export to foreign demand (short run)	0.9844	Estimated from OLS regression
x_2	Exports long-run correction	-0.769	Estimated from OLS regression
x_3	Minimum exports demand, log	-8.2468	Estimated from OLS regression
x_3	Elasticity of exports to foreign demand (long run)	1.2962	Estimated from OLS regression
xr_1	Elasticity of NEER to interest rate parity	0.5714	Estimated from OLS regression
y_{n0}	Initial labour productivity, log	28.01	Calibrated from equation (39) for initial steady state
y_{n1}	Elasticity of labour productivity to FDI inward (short run)	0.1872	Estimated from OLS regression
y_{n2}	Labour productivity long run correction	-0.3688	Estimated from OLS regression
y_{n3}	Minimum labour productivity, log	-68.83	Estimated from OLS regression
y_{n4}	Elasticity of labour productivity to FDI inward (long run)	0.392	Estimated from OLS regression
y_{n5}	Labour productivity exogenous improvement	0.0375	Estimated from OLS regression