Misallocation and Trade Imbalance: Theory and Evidence from China

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Abstract

In the past 15 years, the trade imbalance between China and the US has remained persistently large, which leads to routine blames and ultimately the recent trade war between US and China. This paper decomposes the China-US bilateral trade imbalance and find that, on the one side, China runs huge trade surplus in the manufacturing sector; on the other side, China has large trade deficit in the service sector. The traditional wisdom may argue that the driving force of substantial divergence of trade balance in these two sectors is simply due to comparative advantage. In this paper, we provide a complementary story. We argue that, during China's economic development, the household demands for service and manufacturing goods are uneven, with the former growing much faster than the latter. However, due to policy distortion and regulation, the supply of service goods is inhibited. Consequently, the mismatch of consumption and production causes the divergence of trade balance in both sectors. To quantify the importance of our hypothesis, we build a two-country multiple-period overlapping generation model to study the China-US bilateral trade. We then calibrate the model to match Chinese trade data and show that the structural change in consumption and the resource misallocation driven by policy distortions can help to explain the rising of trade imbalance from 1998 to 2016. Furthermore, our calibration results show that removing the subsidy on SOE sector in China will speed up the economic transition and reduce the trade imbalance by 41.82%, which increase welfare by 12.04%.

Key Words: Misallocation; Trade imbalance; Economic transition
JEL Classifications: E21, E22, E23, F43, L60

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1 Introduction

Global current account imbalances have exhibited a rapid rise since 2001, as represented, for example, by a surge in China's current surplus from a modest 2% of GDP in 2001 to over 10% in 2007, and a surge in the US current account deficit from about 3% to about 6% during the same period. The current account imbalance has been less severe after financial crisis, but still routinely generated anxiety and calls for measures to "correct" the imbalances. In 2018, the trade dispute between China and the US is getting out of control and leads to a trade war. There is a growing literature that studies the global current account imbalance, especially the bilateral US-China trade. For example, Song, Storesletten and Zilibotti (2011) argue that a larger proportion of flow-out of China's domestic saving is due to the domestic financial friction between private firms and SOE firms. Wen (2011) also show that the massive foreign-reserve buildups by China are not necessarily the intend outcome of any government polices or an undervalued RMB, but instead a nature consequence of the country's rapid economic growth in conjunction with an inefficient financial system. Ju, Shi and Wei (2018) provide a theory and show that the rising of global imbalance may caused by trade liberalization after China's accession to the WTO in 2001. However, most existing literatures focus on the overall trade imbalance. If we decompose the trade imbalance between the US and China, there exist sector- level of trade imbalance. That is, as shown in Figure 1 and 2, on the one side, China runs huge trade surplus in the manufacturing sector; on the other side, China has large trade deficit in the service sector.

From the view of traditional trade theory, the substantial divergence of trade balance in these two sectors is simply due to comparative advantage or technology differentials in two countries. In this paper, we provide a complementary story. We argue that, during China's economic development, there is a mismatch between the supply and demand for both service goods and manufacture goods. During this process, demand for service and manufacturing goods by Chinese households are uneven; the former grows much faster than the latter. For example, as documented in Section 2, we find that the annual growth rate of expenditure on medical and education is about 14.77% and 32.55% respectively while the annual growth rate of expenditure on manufacturing goods is only about 4.99%. According to the recent Emerging Consumer Survey by Credit Suisse Research Institute, Chinese consumers will continue to shift their demand towards service goods or high-end manufacturing goods and away from low-end manufacturing goods and food. They will upgrade their consumption demand, on items such as education, health-care, travel and entertainment. In a market economy, firms will respond to changes of consumption pattern by shifting resource to service sector from manufacturing sector. For example, for other four BRICS countries, the average share of service sector in the economy has reached 61.4% in 2017. However, in China, the share of service sector is only about 53%. Due to policy distortion and regulation, there exist severe resource misallocation between SOE and non-SOE firms as well as upstream and downstream sectors, which inhibit the supply of service goods. First, Chinese government subsidize SOEs heavily, especially in the upstream sector. By using the data from the public listed company database (CSMAR database) of Chinese A-share market, the number of upstream SOEs accounts for less than 8%, while they receive about 36.34% of the aggregate subsidy. Due to asymmetric access to the manufacture and service sector in the downstream sector, this distort the resource allocation between manufacture and service goods. Second, in recent years, while the private sector contributes more than 50% of GDP, only less than 25% of credit from bank system are attributed to the private sector, which implies that many private firms are subject to severe credit constraint. Third, many service goods, such as financial service, utility, education, health service are produced by regulated industries and not fully open to private firms. The entry barrier to service sectors or some upstream industries for private firms lead excess competition in manufacturing sector and slow industrial upgrading. Consequently, China becomes the world factory and the major exporter of manufacturing goods, and most are low-end manufacturing products. Therefore, the structural change in demand and the misallocation in the supply side generate substantial mismatch between consumption and production both manufacture and service goods in Chinese economy, which enlarge the divergence of trade balance in both sectors.

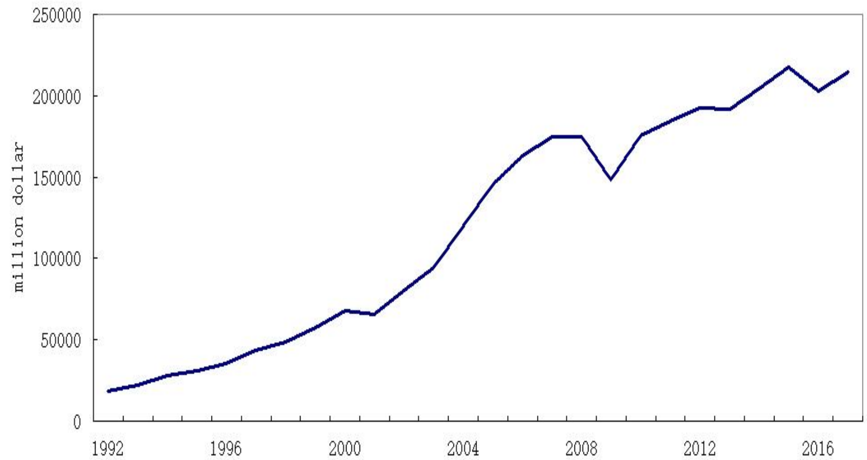

Figure 1: Bilateral manufacturing net export with U.S. from 1992 to 2016 (SITC 2-digit code, measured in constant 1992 price, million U.S. dollar)

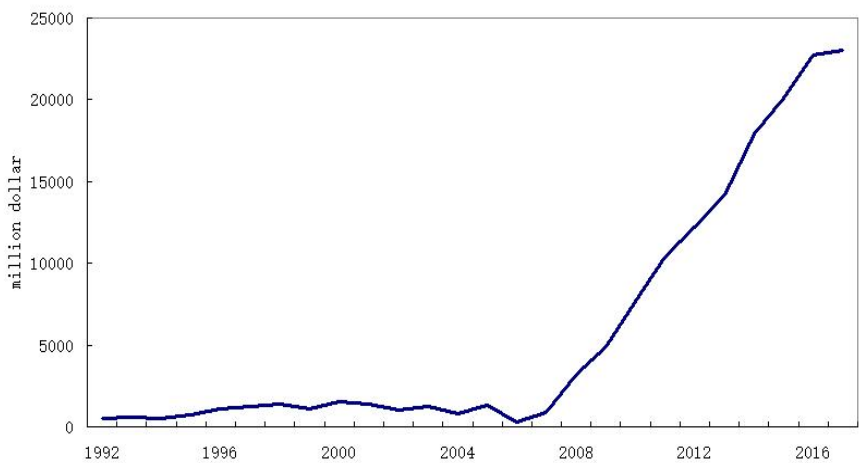

Figure 2: Bilateral service net export with U.S. from 1992 to 2016 (measured in constant 1992 price, million U.S. dollar)

Motivated by the observed fact (which will specified in more detail in Section 2) that policy distortions may lead to resource misallocation and then trade imbalance, we build a two-country, multiple-period overlapping generation model to study the transition dynamics of trade imbalance and aggregate economy. In this model, we treat China as home and the US as foreign, but focus more on China. We consider a vertical production structure in Chinese economy (see Figure 3). There is a upstream sector populated by SOE firms who produce intermediate goods to supply to the downstream manufacturing and service sector. Private firms do not have access to the upstream sector. There are two types of firms in the downstream sector : SOE and PE. However, there is asymmetric access to these two downstream sector with higher entry barrier to the service sector than that to the manufacturing sector. Three frictions are investigated in the supply side, the subsidy to upstream SOEs, the credit constraint for private firms, and the entry barrier for private firms in the downstream service sector. For the household side, we introduce subsistence of consumption on service goods so as to generate uneven demand elasticity for service goods and manufacturing goods.

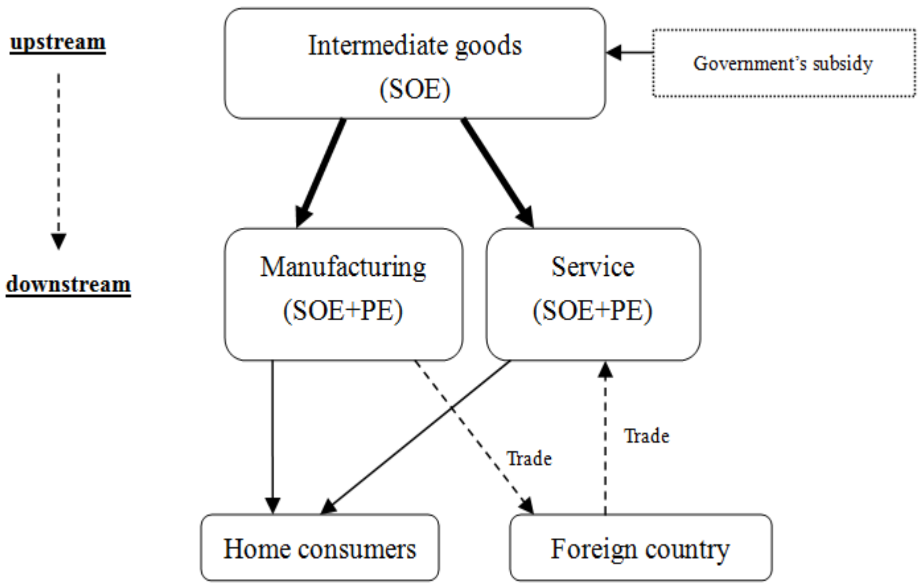

Figure 3: The flow chart of the economy

We calibrate the model to match Chinese trade data and show that the structural change in consumption and the resource misallocation driven by policy distortions can help explain the rising of trade imbalance from 1998 to 2016. Furthermore, our quantitative analysis show that removing the subsidy on SOE sector and the credit constraint on private firms in China will speed the economic transition up and reduce the trade imbalance by 41.82%, which lead to a welfare increase of 12.04%. We also show that, without dynamic structural change in consumption, the trade imbalance and welfare loss caused by policy distortion are relatively small. In other words, the structural change in consumption demand amplifies the negative effect of policy distortion on the economy.

Our paper is closely related to two strands of literature. The first one is the growing literature on resource misallocation. Restuccia and Rogerson(2008), Hsieh and Klenow (2009) show that resource misallocation can lower aggregate total factor productivity (TFP), especially by about 30%-50% in China and 40%-60% in India. By constructing a growth model, Song et al. (2011, 2014) argue that different productivity between PE and SOE and the financial imperfections are the main causes to explain the puzzle of high output growth, sustained returns on capital and a large trade surplus during China's economic transition. Chen and Wen (2017) further extend the growth model to study China's housing market, interpreting that China's housing boom is a rational bubble emerging naturally from its economic transition. Besides, misallocation also leads to investment-dependent economy and a series of structural problems in China (Brandt et al., 2010; Ju et al., 2015). Wu (2018) finds that a SOE firm on average has an MRPK 42% lower than that of a domestic private-owned firm and policy distortion and financial frictions are two leading candidates to generate capital misallocation, with the former contributes 22% and the latter contributes 20 %, respectively. There are also a number of paper in the literature that study the general research questions related to misallocation. For example, Midrigan and Xu (2014) find a large effect of credit constraint on misallocation via entry. Bilbiie et al.(2008), Epifania and Gancia (2011) study how the entire distribution of markups affects resource misallocation and welfare in a general equilibrium framework. Opp et al.(2012) shows that industry markups create labor misallocation in industries and generate aggregate welfare losses.

The second strand of literature emphasizes global current account imbalance. There are a number of influential papers in the literature. For example, see Caballero, et al. (2008) and Mendoza et al. (2009). Caballero et al. (2008) argue that the sustained rise in US current account deficits, the persistent decline in long-run world interest rate, and the rise in the US asset in the global portfolios as an equilibrium outcome when different regions of the world differ in their capacity to generate financial assets from real investments. Mendoza et. al(2009) argue that persistent global imbalance and their portfolio composition could be the result of international financial integration among countries with heterogeneous domestic financial markets. In contrast to their work, Jin (2012) integrates a factor-proportions paradigm of trade and financial capital flow and proposes an alternative view highlighting the importance of trade and specialization in explaining global imbalance. For other related literature of global imbalance, also see Gourichas and Jeanne (2007), Ju and Wei (2010) and Obstfeld and Rogoff (2005, 2008). As mentioned above, there are also several papers that focus on current account imbalance in China, such as Song, et al. (2011) , Ju et al. (2018) , and Wei and Zhang (2011). Empirically, Hoffmann (2013) assesses the relative importance of different mechanisms of China's external adjustment using a simple intertemporal model of the current account and finds that much of China's current account surplus seems to be driven by shocks that have global effects by persistently depressing the world interest rate. Chamon and Prasad (2010) use household-level data to explain why China's households are postponing consumption despite rapid income growth. Micro-data evidence show that overall saving rates have increased across all demographic groups. They argue that this can be explained by the rising private burden of expenditures on housing, education, and health care.

Compared to existing literatures, our paper makes two important contributions. First, this paper is the first paper to link the current account imbalance to structural change in consumption and resource misallocation. We show policy distortions do play an important role in generating trade imbalance. This implies that domestic reform is important for reducing trade imbalance and welfare improvement through efficient allocation of resources. Second, this paper also investigate the composition of trade imbalance at the sector level, which help to better understand the driving force and future dynamics of trade imbalance between China and the US.

The rest of the paper proceeds as follows. Section 2 document stylized facts on the mismatch between consumption and production and policy distortions in the Chinese economy. Section 3 presents a two-country model. Section 4 calibrates the model to match Chinese data from 1998-2016 and then evaluate the effect of policy distortion on the trade imbalance and social welfare quantitatively. Section 5 concludes.

2 Stylized facts

In recent decades, China experienced rapid development and consumption upgrading. The demands for service goods (i.e. medical care, higher education) are ever with increasing incomes while the demands for basic manufacturing (i.e. cloth, coal, steel and so on) are relatively constant. However, in the production side, we observe the opposite pattern, that is, the supply of service goods is slower than that of manufacturing goods. We divide the eight categories of "per capita consumption expenditure of urban residents" published by the National Bureau of Statistics from 1993 to 2016 into two type of goods/services: the low-end consumption expenditure (including food, clothing and household equipment and maintenance services) and the high-end consumption expenditure (including medical care, transportation and communications, recreational education and services and housing, and other goods and services.)[1] We argue that increases of expenditure on the former type of good/services mainly corresponds to household's low-end/survival needs; while those on the latter reflects consumers' yearning for a better life, As shown in Table 4, we find that in general there are substantial differences between growth of expenditure on low-end and high-end consumption goods. For low-end consumption goods/services, their income demand elasticity is less than 1 in the sense that their expenditure growth rate is lower than the income growth rate. The income demand elasticity for the high-end consumption expenditure goods/services (except for the other goods and services), on the contrary, is in general greater than 1.

We then report some stylized facts of structural mismatch between supply and demand of these two type of goods/services from the perspective of absolute growth rate and relative growth rate, respectively. For the demand, we just use the consumption expenditure data discussed above. For the supply data, there is no perfect match for each category of the demand data from the GDP data. So we try out best to match the two-digit industrial output data with the corresponding sub-category consumption expenditure. For each category consumption expenditure goods/services, we normalize the data by sub-categories CPI published by the National Bureau of Statistics, while the output data is adjusted by the GDP deflator index.

From Table 5 we can see that for the low-end goods/services, the absolute growth rate of demand is much slower compared to that of the high-end goods/services, especially during 2010-2016 when the increase in demand for low-end goods declined significantly. In contrast, even with the crowding-out effect of residential expenditure caused by the rapid rise of house prices, the growth rate of demand for the four categories of high-end goods has not declined significantly and maintained a steady double-digit growth.

Meanwhile, the growth rate of the supply for three categories of low-end goods/services has exceeded that of demand. In the contrary, the growth rate of supply for high-end goods/servcies are relatively slower when compared to the growth in demand. This is particularly true in the medical and health care sectors during 2004-2009 and residential sectors from 2010-2016, the gap between supply and demand growth rate is quite large. So from Table 5 we can conclude that the

[1] This classification is of course very rough. For example, demand for housing and medical care includes necessity demand for shelters and basic health care and demand for clothing and food may include demand for restaurant service and luxuries. But we are more interested in the increase of consumption expenditure on these goods.

absolute growth rates of supply and demand for low-end and high-end consumption goods exhibit very different trends.

From Tables 6 and 7, the structural mismatch of supply and demand for high-end and low-end goods/services is even more visible when we use the ratios instead of the absolute values. In summary, the supply of low-end goods/services is relatively excessive, while the supply of high-end goods/services is relatively inadequate. Although the proportion of low-end goods expenditure (especially food expenditure) in total disposable income is large, its relative importance in total expenditure is declining gradually. This is especially true in 2010-2016, during which period the growth rate of the ratio of expenditure on the three major categories of low-end goods in total disposable income all decreased. Nevertheless, there is no corresponding structural adjustment at the supply side. Measured by the ratio of sectoral industrial output to total GDP, the supply of low-end goods does not exhibit a decrease to match the change in demand structure. Although small, the ratio of production/supply of low-end goods in total output still increases in this period.

On the other hand, in terms of the ratio of expenditure to total disposable income, the demand for high-end goods is growing rapidly. Supply for these goods, however, is relatively inadequate. This can be seen from not only the relative low ratio of sectoral output to total GDP at the base year (2004 and 2010), but also the fact that the growth rate of this ratio is slower than that of the demand side. In summary, there are substantial structural change in the demand for low-end and high-end goods, but there seems to be a mismatch between the production/supply structure and the changing demand structure.

Now we will take the medical care and the education industries as examples to illustrates the pattern.

The medical care. Figure 4 indicates that the growth rate of per capita medical expenditure in China is the fastest among the US, Japan and China. Even though China's fast increasing demands for medical cares, the supply is so limited. In Figure 5, it seems that China's medical investment to GDP ratio is only one third of U.S., and the supply is not match with the growing demand in medical care industry.

The education. Figure 6 indicates that the growth rate of per capita education spending in China is faster than U.S.. However, as shown in Figure 7, the education investment to GDP ratio is lower than U.S.. This means that the overall education supply level still needs to be increased even though it converges to the U.S..

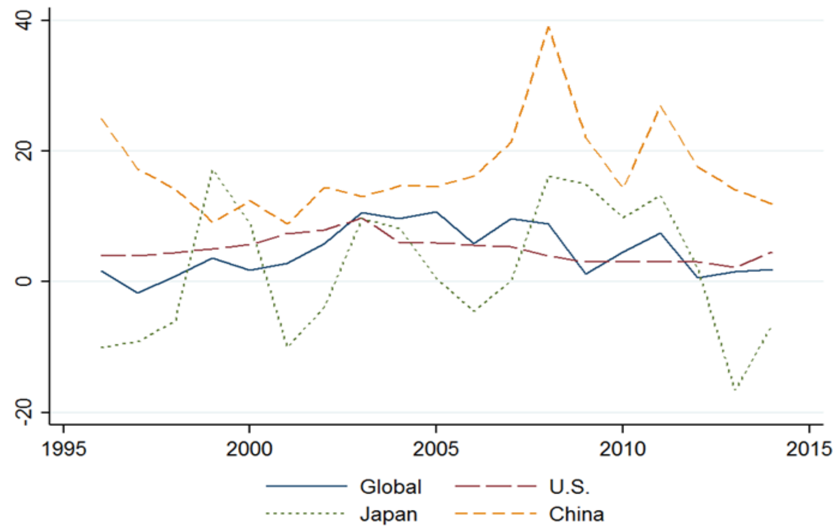

Figure 4: Growth rate of per capita Medical expenditure (%)

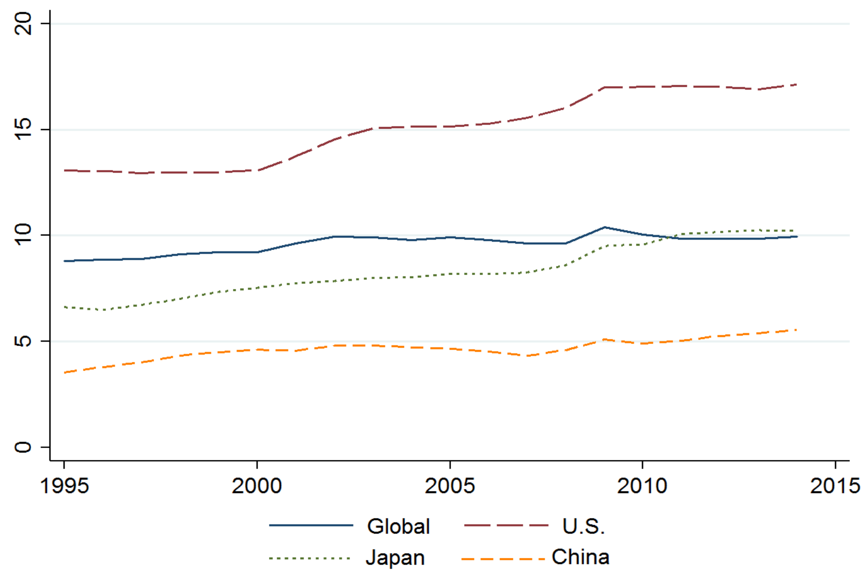

Figure 5: Medical investment/GDP (%)

Figure 6: The growth rate of per capita education expenditure (%)

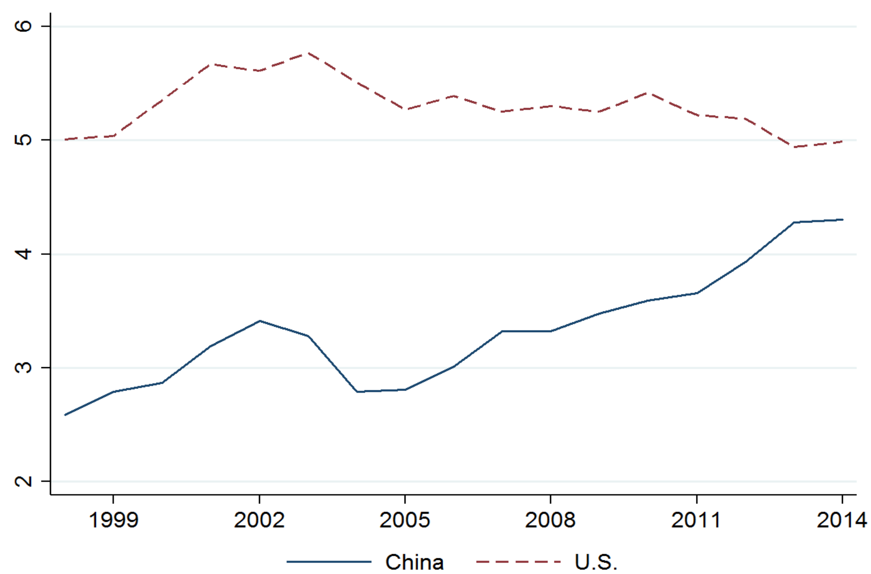

Figure 7: Education investment/GDP (%)

There are a number of policy distortions in Chinese economy. Two of them are well observed. The first one is the subsidy to the SOEs. For example, according to the Ministry of Industry and Information Technology's reports (2015), there are nineteen sectors of manufacture in the list of overcapacity. They are Electric power, Coal, Iron and steel, Ferroalloy, Coke, Calcium carbide, Aluminum, Copper smelting, Lead smelting, Cement, Plate glass, Paper, Alcohol, Monosodium glutamate, Citric acid, Tanning, Printing and dyeing, Chemical fiber, and Lead battery, among which eleven are in the upstream.[2] It is the fact that the upstream is somewhat overcapacity. In addition, these overcapacity upstream SOEs are subsidized greatly. We have shown above that the SOEs in the upstream only account for less than 8% but receive over 36% of the aggregate subsidy. The second one is the limited access of private firms to credit market. There have been extensive literature to discuss this phenomenon and its consequence. For example, Song et al. (2011) argue that financial repression is far from uniform: private firms are subject to strong discrimination in credit markets. The Chinese banks are mostly state owned, as a result SOE can finance a larger share of their investments through external financing. As shown in Figure 8, recently, the credit discrimination become more strong when the economy slowed down. The Non-state companies, including foreign-invested enterprises, account for more than half of total economic output in Chinabut according to official bank data cited by Nicholas Lardy in The State Strikes Back, his most recent book on the Chinese economy, in 2016 they received just 11 per cent of new loans issued by the official bank sector, while more than 80 per cent flowed to state-owned enterprises. In the past 10 years, private firms in China mainly survive by tapping funds from the countrys enormous shadow banking sector.

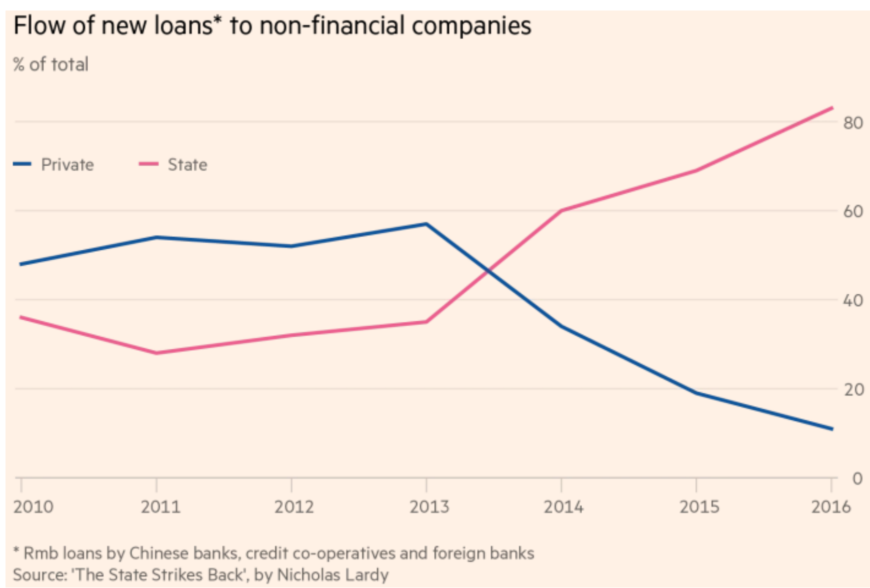

Figure 8: Flow of New Loan to Private vs State Firms

In the following section, we will build a model and investigate quantitatively how the policy distortions cause the mismatch between consumption and production, trade imbalance and then

[2]We will discuss the classification of upstream based on Li et al.(2016) in detail in the Section 4.

lead to welfare loss.

3 Model

In this section, we build a two-country, multiple-period overlapping generation model to investigate the dynamic of trade imbalance and economic dynamic transition. In this model, China and the US are considered as home and foreign countries, respectively. Following Li et al. (2015) and Song et al.(2011), we consider a vertical production structure in Chinese economy (see Figure 3). There is a upstream SOE who produce intermediate goods to the downstream manufacturing and service sector. There are two types of firms in the downstream: SOE and PE. Three frictions are investigated in the supply side, the subsidy to upstream SOEs, the credit constraint for private firms, and the entry barrier for private firms. To introduce the structure change in the consumption, we add the subsistence of consumption on service goods so as to generate uneven demand elasticity for service goods and manufacturing goods. The home (China) economy is described as below.

3.1 Upstream - Intermediate goods

There are only state-owned enterprises in the upstream, who supply the intermediate goods to downstream manufacturing and service sector. The sector is perfect competitive and the technology is given by $Y_{Ut} = A_t K_{Ut}$. where Y_{Ut} is the intermediate goods for downstream, K_{Ut} is the capital used by the upstream, and A_t is the country specific technology, which follows $A_{t+1} = A_t(1+z_t), z_t > 0$ is an exogenous TFP growth rate which we will fit the moment of China's TFP growth rate . Note that the firms in the upstream are usually capital intensive, for simplicity, we assume that capital is the only input for these firms. Furthermore, we assume that the upstream is subsidized by the government, the subsidy rate is a constant τ. Therefore, denote R_t is the gross interest rate, the profit maximization problem is given by:

$$\max_{K_{Ut}} (1+\tau) p_{It} Y_{Ut} - R_t K_{Ut}, \tag{1}$$

The first order condition yields:

$$p_{It} = \frac{R_t}{(1+\tau)A_t}. \tag{2}$$

This implies that if we do not consider the general effect of subsidy on the interest rate, the subsidy on upstream firms may reduce the intermediate goods price and is beneficial for downstream firms.

3.2 Downstream - Manufacturing industry (M)

The production functions in the downstream manufacturing industry for SOE and PE are given by:

$$Y_{FM,t} = \left(K_{FM,t}^{\phi} M_{FM,t}^{1-\phi}\right)^{\alpha} (A_t N_{FM,t})^{1-\alpha}, \tag{3}$$

$$Y_{EM,t} = \left(K_{EM,t}^{\phi} M_{EM,t}^{1-\phi}\right)^{\alpha} (\chi A_t N_{EM,t})^{1-\alpha}, \tag{4}$$

where $K_{iM,t}$, $M_{iM,t}$ and $N_{iM,t} (i \in \{E, F\})$ represents capital, intermediate goods and labor used PE and SOE, respectively. Note that F represents the SOE while E represents the PE. Parameter $\chi > 1$ implies that private enterprises have higher labor efficiency than state-owned enterprises. PE is financial constrained but SOE has easy access to bank deep pocket. We normalize the price of manufacturing goods to 1. The profit maximization problem for SOE implies that:

$$\max_{K_{FM,t}, M_{FM,t}, N_{FM,t}} Y_{FM,t} - R_t K_{FM,t} - p_{It} M_{FM,t} - w_{Mt} N_{FM,t}, \tag{5}$$

The first order conditions are:

$$\alpha\phi K_{FM,t}^{\alpha\phi-1} M_{FM,t}^{\alpha(1-\phi)} (A_t N_{FM,t})^{1-\alpha} = R_t, \tag{6}$$

$$\alpha(1-\phi) K_{FM,t}^{\alpha\phi} M_{FM,t}^{\alpha(1-\phi)-1} (A_t N_{FM,t})^{1-\alpha} = p_{It}, \tag{7}$$

$$(1-\alpha) K_{FM,t}^{\alpha\phi} M_{FM,t}^{\alpha(1-\phi)} A_t^{1-\alpha} N_{FM,t}^{-\alpha} = w_{Mt}. \tag{8}$$

And we get the wage equals to:

$$w_{Mt} = (1-\alpha)(\alpha\phi)^{\frac{\alpha\phi}{1-\alpha}} [(1+\tau)\alpha(1-\phi)]^{\frac{\alpha(1-\phi)}{1-\alpha}} A_t^{\frac{\alpha\phi-1}{\alpha-1}} R_t^{\frac{\alpha}{\alpha-1}}. \tag{9}$$

Private entrepreneurs employ their children as manager and pay $m_t = \psi Y_{EM,t}, (\psi < 1)$. Given

w_{Mt} and p_{It}, profit maximization problem implies that:

$$V\left(K_{EM,t}\right) = \max_{M_{Et},N_{EM,t}} (1-\psi)Y_{EM,t} - p_{It}M_{EM,t} - w_{Mt}N_{EM,t}, \tag{10}$$

The first order conditions are:

$$(1-\psi)\alpha(1-\phi)K_{EM,t}^{\alpha\phi}M_{EM,t}^{\alpha(1-\phi)-1}(A_t\chi N_{EM,t})^{1-\alpha} = p_{It}, \tag{11}$$

$$(1-\psi)(1-\alpha)K_{EM,t}^{\alpha\phi}M_{EM,t}^{\alpha(1-\phi)}(A_t\chi)^{1-\alpha}N_{EM,t}^{-\alpha} = w_{Mt}. \tag{12}$$

So the PE's firm value in manufacturing sector equals to:

$$V\left(K_{EM,t}\right) = (1-\psi)^{\frac{1}{\alpha\phi}}\chi^{\frac{1-\alpha}{\alpha\phi}}R_tK_{EM,t} = \rho_{EM,t}K_{EM,t}. \tag{13}$$

Following Song et al. (2011), we impose the following assumption about PE's relative productivity, such that an entrepreneur's return to capital is higher than the deposit rate R_t, during the transition: $(1-\psi)^{\frac{1}{\alpha\phi}}\chi^{\frac{1-\alpha}{\alpha\phi}} > 1$, which is necessary to start the dynamic transition. There are two stages:

∗ stage 1: both SOE and PE exist, $\frac{N_{EM,t}}{N_{EM,t}+N_{FM,t}} \leq 1$, when

$$0 \leq \frac{K_{EM,t}}{A_t\chi N_{EM,t}} \leq R_t^{\frac{1}{\alpha-1}}(1-\psi)^{\frac{-1}{\alpha\phi}}\left[\alpha(1-\phi)(1+\tau)\right]^{\frac{\alpha(1-\phi)}{1-\alpha}}(\alpha\phi)^{\frac{1-\alpha+\alpha\phi}{1-\alpha}}A_t^{\frac{\alpha(1-\phi)}{1-\alpha}}\chi^{\frac{\alpha-1-\alpha\phi}{\alpha\phi}}$$

∗ stage 2: only PE exist, $\frac{N_{EM,t}}{N_{EM,t}+N_{FM,t}} = 1$, when

$$\frac{K_{EM,t}}{A_t\chi N_{EM,t}} > R_t^{\frac{1}{\alpha-1}}(1-\psi)^{\frac{-1}{\alpha\phi}}\left[\alpha(1-\phi)(1+\tau)\right]^{\frac{\alpha(1-\phi)}{1-\alpha}}(\alpha\phi)^{\frac{1-\alpha+\alpha\phi}{1-\alpha}}A_t^{\frac{\alpha(1-\phi)}{1-\alpha}}\chi^{\frac{\alpha-1-\alpha\phi}{\alpha\phi}}$$

Due to the imperfections of the credit market, private firm's capital accumulation follows $K_{EM,t} = S_{t-1}^{EM} + L_{M,t-1}$, where the subscript EM represents the entrepreneur in manufacturing sector, S_{t-1}^{EM} denotes internal savings, $L_{M,t-1}$ denotes the external loans for manufacturing sector. Furthermore, we consider a credit constraint $R_tL_{M,t} \leq \xi\rho_{EM,t}K_{EM,t}$, where ξ is a collateral parameter.

3.3 Downstream - Service industry (S)

The production function in the service product market for SOE and PE are given by:

$$Y_{FS,t} = \left(K_{FS,t}^{\lambda} M_{FS,t}^{1-\lambda}\right)^{\omega} (A_t N_{FS,t})^{1-\omega}, \tag{14}$$

$$Y_{ES,t} = \left(K_{ES,t}^{\lambda} M_{ES,t}^{1-\lambda}\right)^{\omega} (\chi A_t N_{ES,t})^{1-\omega}, \tag{15}$$

where $K_{FS,t}, M_{FS,t}, N_{FS,t}$ and $K_{ES,t}, M_{ES,t}, N_{ES,t}$ represents capital, intermediate input and labor of state-owned enterprises and private enterprises respectively. Private firms are still financially constrained.

State-owned enterprise's profit maximization problem implies that:

$$\max_{N_{FS,t}, K_{FS,t}, M_{FS,t}} p_{St} Y_{FS,t} - w_{St} N_{FS,t} - R_t K_{FS,t} - p_{It} M_{FS,t}, \tag{16}$$

The first order conditions are

$$\omega \lambda p_{St} K_{FS,t}^{\omega\lambda-1} M_{FS,t}^{\omega(1-\lambda)} (A_t N_{FS,t})^{1-\omega} = R_t, \tag{17}$$

$$\omega(1-\lambda) p_{St} K_{FS,t}^{\omega\lambda} M_{FS,t}^{\omega(1-\lambda)-1} (A_t N_{FS,t})^{1-\omega} = p_{It}, \tag{18}$$

$$(1-\omega) p_{St} K_{FS,t}^{\omega\lambda} M_{FS,t}^{\omega(1-\lambda)} A_t^{1-\alpha} N_{FS,t}^{-\omega} = w_{St}. \tag{19}$$

The wage in the service sector equals to:

$$w_{St} = (1-\omega) p_{St}^{\frac{1}{1-\omega}} (\omega\lambda)^{\frac{\omega\lambda}{1-\omega}} \left[(1+\tau)\omega(1-\lambda)\right]^{\frac{\omega(1-\lambda)}{1-\omega}} A_t^{\frac{\omega\lambda-1}{\omega-1}} R_t^{\frac{\omega}{\omega-1}}. \tag{20}$$

The PE in service sector is independent with those in manufacturing sector. Given w_{St} and p_{It}, private-owned enterprise's profit maximization problem implies that:

$$V\left(K_{ES,t}\right) = \max_{N_{ES,t}, M_{ES,t}} (1-\psi) p_{St} Y_{ES,t} - w_{St} N_{ES,t} - p_{It} M_{ES,t}, \tag{21}$$

The first order conditions are:

$$(1-\psi)\omega(1-\lambda)p_{St}K_{ES,t}^{\omega\lambda}M_{ES,t}^{\omega(1-\lambda)-1}(A_t\chi N_{ES,t})^{1-\omega}=p_{It}, \tag{22}$$

$$(1-\psi)(1-\omega)p_{St}K_{ES,t}^{\omega\lambda}M_{ES,t}^{\omega(1-\lambda)}(A_t\chi)^{1-\omega}N_{ES,t}^{-\omega}=w_{St}. \tag{23}$$

The PE's firm value in service sector equals to:

$$V\left(K_{ES,t}\right)=(1-\psi)^{\frac{1}{\omega\lambda}}\chi^{\frac{1-\omega}{\omega\lambda}}R_tK_{ES,t}=\rho_{ES,t}K_{ES,t}. \tag{24}$$

Here we also need $(1-\psi)^{\frac{1}{\omega\lambda}}\chi^{\frac{1-\omega}{\omega\lambda}}>1$, to start the dynamic transition in service sector. There are two stages:

∗ stage 1: both SOE and PE exist, $\frac{N_{ES,t}}{N_{ES,t}+N_{FS,t}}\leq 1$, when

$$0\leq\frac{K_{ES,t}}{A_t\chi N_{ES,t}}\leq R_t^{\frac{1}{\omega-1}}p_{St}^{\frac{1}{1-\omega}}(1-\psi)^{\frac{-1}{\omega\lambda}}\left[\omega(1-\lambda)(1+\tau)\right]^{\frac{\omega(1-\lambda)}{1-\omega}}(\omega\lambda)^{\frac{1-\omega+\omega\lambda}{1-\omega}}A_t^{\frac{\omega(1-\lambda)}{1-\omega}}\chi^{\frac{\omega-1-\omega\lambda}{\omega\lambda}}$$

∗ stage 2: only PE exist, $\frac{N_{ES,t}}{N_{ES,t}+N_{FS,t}}=1$, when

$$\frac{K_{ES,t}}{A_t\chi N_{ES,t}}>R_t^{\frac{1}{\omega-1}}p_{St}^{\frac{1}{1-\omega}}(1-\psi)^{\frac{-1}{\omega\lambda}}\left[\omega(1-\lambda)(1+\tau)\right]^{\frac{\omega(1-\lambda)}{1-\omega}}(\omega\lambda)^{\frac{1-\omega+\omega\lambda}{1-\omega}}A_t^{\frac{\omega(1-\lambda)}{1-\omega}}\chi^{\frac{\omega-1-\omega\lambda}{\omega\lambda}}$$

The private firm's capital accumulation in the service sector also follows $K_{ES,t}=S_{t-1}^{ES}+L_{S,t-1}$, where S_{t-1}^{ES} denotes internal savings, $L_{S,t-1}$ denotes the external loans for manufacturing sector. The credit constraint is $R_tL_{S,t}\leq\xi\rho_{ES,t}K_{ES,t}$, where ξ is a collateral parameter.

3.4 Household

The households have heterogeneous skills. Each cohort consists of a measure N_t of agents with no entrepreneurial skills workers (W), a measure $\frac{\mu N_t}{2}$ of manufacturing (EM) and $\frac{\mu N_t}{2}$ of service agents (ES) with entrepreneurial skills (entrepreneurs) which are transmitted from parents to children. The population grows at the exogenous rate v ; $N_{t+1}=(1+v_t)N_t$. The rate v_t captures demographic trends, including migration from rural to urban areas and we will match the data of population growth rate. For simplicity it is assumed to be exogenous. The model economy is populated by overlapping generations of multi-period lived agents. Young entrepreneurs work for old entrepreneurs in the first J^E periods and consume all the firm profit in the following periods. Young workers work to earn money in the first J^W periods and live off savings after retiring. Everyone lives T years. Preferences are parameterized by the following time-separable non-homothetic utility function:

$$\sum_{t=1}^{T} \beta^{t-1} \frac{[(C^i_{St})^{\gamma}(C^i_{Mt} - \underline{C})^{1-\gamma}]^{1-\frac{1}{\theta}} - 1}{1 - \frac{1}{\theta}}, \tag{25}$$

where C^i_{Mt} and C^i_{St} represents manufacturing and service goods consumption, $i \in [W, EM, ES]$. β is the discount factor and θ is the intertemporal elasticity of substitution in consumption. The non-homothetic preference means that the income demand elasticity of household's service goods is higher than manufacturing goods, this is consist with Kongsamut et al.(2001).

In this model, we consider home goods and foreign goods are the same. However, there are two types of trade frictions. First, when China exports goods to the foreign country, there will be iceberg cost. This will leads to the manufacturing good price is higher than the domestic price, that is, $p^*_{Mt} = p_{Mt}(1 + \tau_{xt})$, where $\tau_{xt} > 0$. Second, the households will consume domestic goods first. They will consume foreign goods only when the the supply of domestic goods are enough to match domestic consumption. Furthermore, we assume the household need to pay an entry cost τ_t over domestic price if they consume import goods. For example, if the domestic consumption on service goods is larger than domestic supply $Y_{FS,t} + Y_{ES,t} < C^i_{St}$, then the price of imported service goods ($C^i_{f,St}$) will be $p_{St}(1 + \tau_{st})$.

Because we normalize p_{Mt} to 1. Each period, the representative entrepreneur maximizes (25) subject to

$$p_{St}C^i_{d,St} + p_{St}(1 + \tau_{st})C^i_{f,St} + C^i_{d,Mt} + (1 + \tau_{xt})C_{f,Mt} + S^i_t = m^i_t, \; j < J^E \tag{26}$$

$$p_{St}C^i_{d,St} + p_{St}(1 + \tau_{st})C^i_{f,St} + C^i_{d,Mt} + (1 + \tau_{xt})C_{f,Mt} + R_t L^i_t = \rho_{i,t}K_{i,t}, \; j \geq J^E \tag{27}$$

where $i \in [EM, ES]$, $C^i_{d,St}$ and $C^i_{d,Mt}$ are the demand for domestic goods, $C^i_{f,St}$ and $C^i_{f,Mt}$ are the demand for foreign goods. $C^i_{d,St} + C^i_{f,St} = C^i_{St}$ and $C^i_{d,Mt} + C^i_{f,Mt} = C^i_{Mt}$.[3] At the same time, the

[3]Given the trade pattern between China and the US, $C^i_{f,Mt} = 0$ in the model.

representative worker maximizes (25) subject to

$$p_{St}C^W_{d,St} + p_{St}(1+\tau_{st})C^W_{f,St} + C^W_{d,Mt} + (1+\tau_{xt})C^W_{f,Mt} + S^W_t + B^* = \\ w_{Mt}N_{Mt} + w_{St}N_{St} - \frac{\phi_m w_{Mt} N^2_{Mt}}{2} - \frac{\phi_s w_{St} N^2_{St}}{2} - T_t,\ j < J^W \tag{28}$$

$$p_{St}C^W_{d,St} + p_{St}(1+\tau_{st})C^W_{f,St} + C^W_{d,Mt} + (1+\tau_{xt})C^W_{f,Mt} = R_t S^W_t + R^*_t B^*,\ j \geq J^W \tag{29}$$

where S^E and S^W are the savings of entrepreneur and worker, T_t implies that the government levies income tax from workers to subsidize upstream industry, and B^* is the a foreign bond with the a foreign interest rate R^*_t. It should be noted that the time-variant price wedge between home goods and foreign goods τ_{st} and τ_{xt} is time-variant.

3.5 Bank

Banks absorb deposits from workers every period and make loans to both state-owned enterprises and private enterprises at R_t. Each period, the bank's balance sheet satisfies:

$$K_{FS,t} + K_{FM,t} + K_{Ut} + \frac{\xi[\rho_{EM,t}K_{EM,t} + \rho_{ES,t}K_{ES,t}]}{R_t} = S^W_{t-1}, \tag{30}$$

3.6 Government

Every period, the government levies lump-sum tax from workers to subsidize the upstream market, that is, the government's budget constraint equation follows:

$$T_t = \tau p_{It} Y_{Ut}, \tag{31}$$

3.7 Foreign country

In the foreign coutnry, the household maximizes the utility function:

$$\max_{C^*_{St}, C^*_{Mt}} \sum_{t=0}^{\infty} \beta^t \frac{[(C^*_{St})^{\gamma}(C^*_{Mt})^{1-\gamma}]^{1-\frac{1}{\theta}} - 1}{1-\frac{1}{\theta}}, \tag{32}$$

subject to:

$$R_t^* B_{t-1}^* + p_{Mt}^* C_{Mt}^* + p_{St}^* C_{St}^* = p_{Mt}^* Y_{Mt}^* + p_{St}^* Y_{St}^* + B_t^*, \tag{33}$$

For simplicity, we assume that the foreign output Y_{Mt}^* and Y_{St}^* are exogenously given and the houeshold can consume the domestic goods and foreing goods at the same price. If $(Y_{Mt}^* - C_{Mt}^*)$ or $(Y_{St}^* - C_{St}^*) > 0$, it means net export, otherwise < 0 means net import. In equilibrium, $p_{Mt}^* = p_{Mt}(1 + \tau_{xt})$ and $p_{St}^* = p_{St}(1 + \tau_t)$.

The first order conditions are

$$[(C_{St}^*)^{\gamma}(C_{Mt}^*)^{1-\gamma}]^{-\frac{1}{\theta}} \gamma (C_{St}^*)^{\gamma-1}(C_{Mt}^*)^{1-\gamma} = \lambda_t^* p_{St}^*, \tag{34}$$

$$[(C_{St}^*)^{\gamma}(C_{Mt}^*)^{1-\gamma}]^{-\frac{1}{\theta}} (1-\gamma)(C_{St}^*)^{\gamma}(C_{Mt}^*)^{-\gamma} = \lambda_t^* p_{Mt}^*, \tag{35}$$

$$\lambda_t^* = \beta \lambda_{t+1}^* R_{t+1}^*, \tag{36}$$

where λ_t^* is the Lagrange Multiplier of (33).

3.8 Market Clears

The manufacturing goods market clears, which implies that

$$C_{Mt}^E + C_{Mt}^W + C_{Mt}^* + (K_{t+1} - (1-\delta)K_t) + \frac{\phi_m w_{Mt}}{2p_{Mt}} N_{Mt}^2 = Y_{FM,t} + Y_{EM,t} + Y_{Mt}^*. \tag{37}$$

where

$$K_t = K_{FS,t} + K_{FM,t} + K_{Ut} + K_{ES,t} + K_{EM,t}. \tag{38}$$

The service goods market clears, which implies that

$$C_{St}^E + C_{St}^W + C_{St}^* + \frac{\phi_s w_{St}}{2p_{St}} N_{St}^2 = Y_{FS,t} + Y_{ES,t} + Y_{St}^*. \tag{39}$$

In home economy, the intermediate good market clears, which yields

$$M_{FM,t} + M_{EM,t} + M_{FS,t} + M_{ES,t} = Y_{Ut}. \tag{40}$$

The labor market clears, which yields

$$N_{M,t} + N_{S,t} = N_t. \tag{41}$$

where

$$N_{FM,t} + N_{EM,t} = N_{M,t}. \tag{42}$$

$$N_{FS,t} + N_{ES,t} = N_{S,t}. \tag{43}$$

4 Quantitative Analysis

4.1 Calibration

Following Song et al. (2011) and Chen and Wen (2017), we use data from the NBS to calibrate the model. Each period in our model corresponds to one year.

The first set of parameters are set exogenously, which are time-invariant parameters we take from the literature. The capital share is set to $\alpha = 0.5$, consistent with Bai, Hsieh and Qian (2006), and the annual depreciation rate of capital is set to $\delta = 0.1$. The intertemporal elasticity of substitution θ is set to 2. Following Leduc and Liu (2016), the wage adjustment cost in manufacturing sector and service sector ϕ_m and ϕ_s are set to 0.8, respectively. There is a large literature on the γ which determines the relative importance of service goods in the utility function. There are many estimates of this parameter to draw upon, most of them are within the range of [0.5, 0.7]. Following Markusen (2013), we set the value of γ to 2/3.

The second set of parameters are set endogenously to match certain data moments. Agents enter economy at age 24 and live an additional 50 years. This is almost consistent with an average life expectancy for males and females of 74.83 years according to the latest 2010 Chinese Population Census. Workers retire after 30 years. Using the same method with Bai and Qian (2009), the share of capital and intermediate goods in the service sector ω is set to 0.53. And the cost share of capital relative to intermediate goods ϕ and λ in manufacturing sector and service sector are set to 0.5 and 0.65 respectively, consistent with the estimates of intermediate input share by Chang, Liu and Spiegel (2015). All of these three parameters are computing by input-output data. $\beta = 0.994$

is targeted the average 45.34% aggregate savings rate between 1998 and 2016. Following Chen and Wen (2017), we calibrate the productivity parameter of PE to be 5.64 to target the following moment: the capital-to-output ratio of Chinese SOE is 2.65 times that of domestic private firms (Song et al., 2011), and the manager payment ratio $\psi = 0.53$ to target the aggregate 20% growth rate of returns to capital in 1998. $\underline{C}$ is the the subsistence consumption of manufacturing goods, we calculate it directly from the data of China's urban consumption per capita and disposable personal income. In 1993, the non-necessity expenditure per capita is 36.40% of disposable personal income, which means the necessity expenditure occupies about 3.67% of the aggregate disposable personal income.[4] Using the urban consumptionand income data, we caculate the $\underline{C} = 0.512$.

There two distortions in the benchmark model. The first one is the PE's credit constraint ξ, and the second is the subsidy to the upstream SOE τ. Song et al.(2011) have show that SOE have a more than three times larger share of investments financed through bank loans than PE. By assuming that PE firms can finance externally half their investments, they set the pledge parameter $\xi = 0.86$. Therefore, we set the same value for this parameter.

The other distortion parameter τ is calculated from the public listed company database (CS-MAR database) of Chinese A-share market. We first collect the data from 2003 to 2016 [5] which includes the firm name, the largest holder, the share of the largest holder, the actual controller's name and the government subsidy. Then we identify the SOEs by the criterion that the over 50% share is controlled by the stated-owned institutions or the actual controller is a stated-owned institution. Second, we try to pick up the SOEs in the upstream. We borrow the main results from Antràs et al. (2012) and Li et al. (2016), who calculate the stream score deliberately by using China's Input-Output table (see Li et al. (2016)'s Table A1). All the industries are sorted by scores from the highest to the lowest. They report that the upstream industries includes Coal, Petroleum and Natural Gas, Ferrous Metal Ores, Non-Ferrous Metal Ores, Other Ores, Paper and Paper Products, Petroleum, Nuclear fuel, Raw chemical materials, Smelting Ferrous Metals, Smelting and Pressing of Non-ferrous Metals, Electric Power and Heat Power and Gas (whose scores are all higher than 5). From the data we collect there are total 202 firms belong to the upstream SOE, we

[4] The NBS divides consumer spending into eight categories. By income elasticity of demand is larger than 1 or not (Chenery, 1960; Markusen,2013), we can divide these eight categories (into low-end(≤ 1) and high-end(> 1). The necessity includes food, clothes, household equipment and maintenance services, and others, while the non-necessity includes medical care, traffic and electronic communication, recreational education and service, and housing expenditure.

[5] The beginning of data in the CSMAR database is 2003.

compute the subsidy ratio of upstream SOEs is about 0.44%. Besides, in Li et al. (2016)'s study, they also report the middle stream and the downstream. We should also take care of the middle stream. Because in our benchmark model, there are only upstream and down stream, therefore we try to pick up the first three industries in Li et al. (2016)'s middle stream classification and add them to our upstream group. We select these three industries, because they rank the top three highest scores in the middle stream group (whose scores are all higher than 4), and all others in the middle stream are below 4. These three are Nonmetal Ores, Communication Equipment and Metal Products. In this case, the there are 271 firms in the data, and the subsidy ratio of upstream SOEs is about 0.48%. All the above results are summarized in Table 1.

Table 1: Values of parameters.

Parameter	Description	Value	Source
α	K and M income share in manufacturing sector	0.500	Bai, Hsieh and Qian (2006)
ω	K and M income share in service sector	0.530	by Bai and Qian (2009)'s method, input-output data
ϕ	K income share in M sector relative to M	0.500	by Bai and Qian (2009)'s method, input-output data
λ	K income share in S sector relative to M	0.650	by Bai and Qian (2009)'s method, input-output data
δ	annual depreciation rate of capital	0.100	Bai and Qian (2009)
θ	intertemporal elasticity of substitution	2	Song, Storesletten and Zilibotti (2011)
ϕ_m	wage adjustment cost in manufacturing sector	0.800	Leduc and Liu (2016)
ϕ_s	wage adjustment cost in service sector	0.800	Leduc and Liu (2016)
β	discount factor	0.994	target average 45.34% savings rate 98-16
χ	productivity parameter	5.64	target capital output ratio of SOE is 2.65 times of POE
ψ	manager payment ratio	0.53	target aggregate 20% growth rate of returns to capital in 1998
γ	service goods share in utility function	2/3	Markusen (2013)
$\underline{C}$	basic manufacturing consumption	0.512	target 1993's non-necessity expenditure is 36.40% of disposable income
ξ	PE's credit constraint	0.860	Song, Storesletten and Zilibotti (2011)
τ	the subsidy ratio to the upstream SOE	0.44	public listed firm database 03-16

Other two time-varying variables the annual urban population growth rate v_t and the technological growth rate z_t are directly fitted with China's annual data. The rest of τ_t and τ_{xt} are unobserved time-varying variables in the data. Following Reyes-Heroles (2016), we will calibrate it by relying on endogenous outcomes of the model that are observed in the data specially, bilateral trade flows and domestic consumption expenditure. This procedure implies that the disturbance provide a decomposition of the forces underlying the evolution of these data. In other words, given other fixed parameter values, we will recover a set of structural residuals that rationalizes the data as an equilibrium of the model. Using the data of bilateral trade flows, domestic consumption expenditure per capita from 1998-2016, and time-invariant parameter values, we are able to one-to-one mapping observations and the τ_t and τ_{xt} in period t given by the equilibrium conditions[6].

[6]The f.o.c of household $\frac{p_{St}C_{d,St}+p_{St}(1+\tau_{st})C_{f,St}}{C_{Mt}-\underline{C}} = \frac{\gamma}{1-\gamma}$ and foreign country $\frac{p_{St}(1+\tau_{st})C^*_{St}}{(1+\tau_{xt})C^*_{Mt}} = \frac{\gamma}{1-\gamma}$

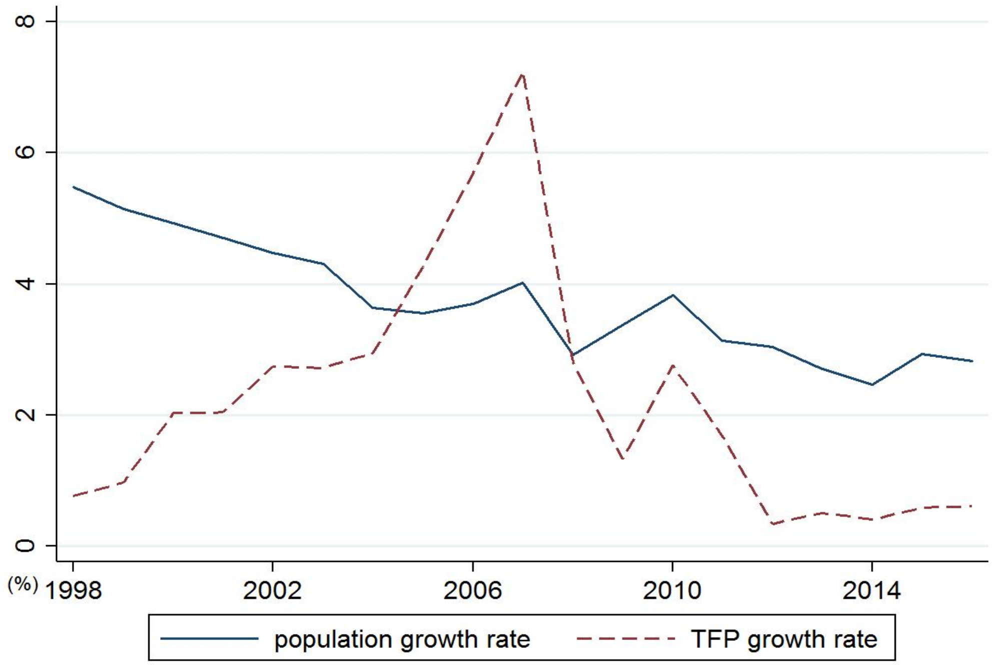

Figure 9: The growth rate of urban population and TFP from data

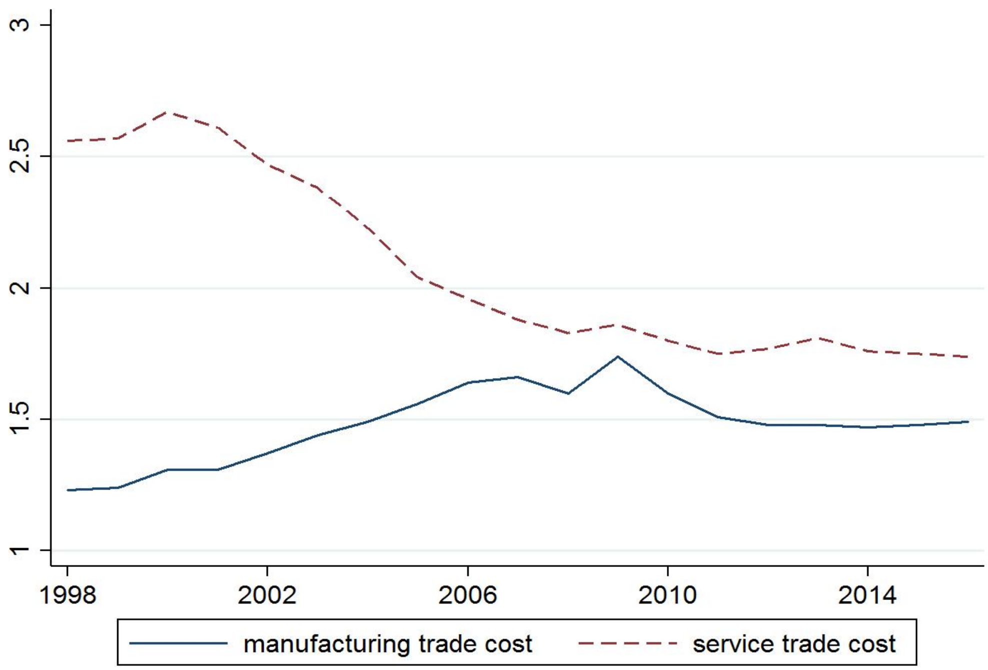

Figure 10: The estimation of trade cost

4.2 The dynamic transition

Figure 11: benchmark model

In this section, we show the evolution of key variables during transition of the calibrated economy (with both credit constraint and subsidy). The solid and dash-dotted lines refer to the simulated results from the model and the data, respectively. Panel a,c and d in Figure 11 show that the simulated private employment share, net manufacturing export-to-GDP ratio and net service import-to-GDP ratio almost can replicate the trend of the data. However, they cannot match all the detailed changes. Panel b shows that the simulated data replicates the actual data well until 2008. The under-prediction of GDP during 2008-2011 may be due to the fact that since 2008 the financial crisis hit China, and the Chinese government had adopted several policies (i.e. four trillion plan) to do the macro-control, from which our model is abstracted.

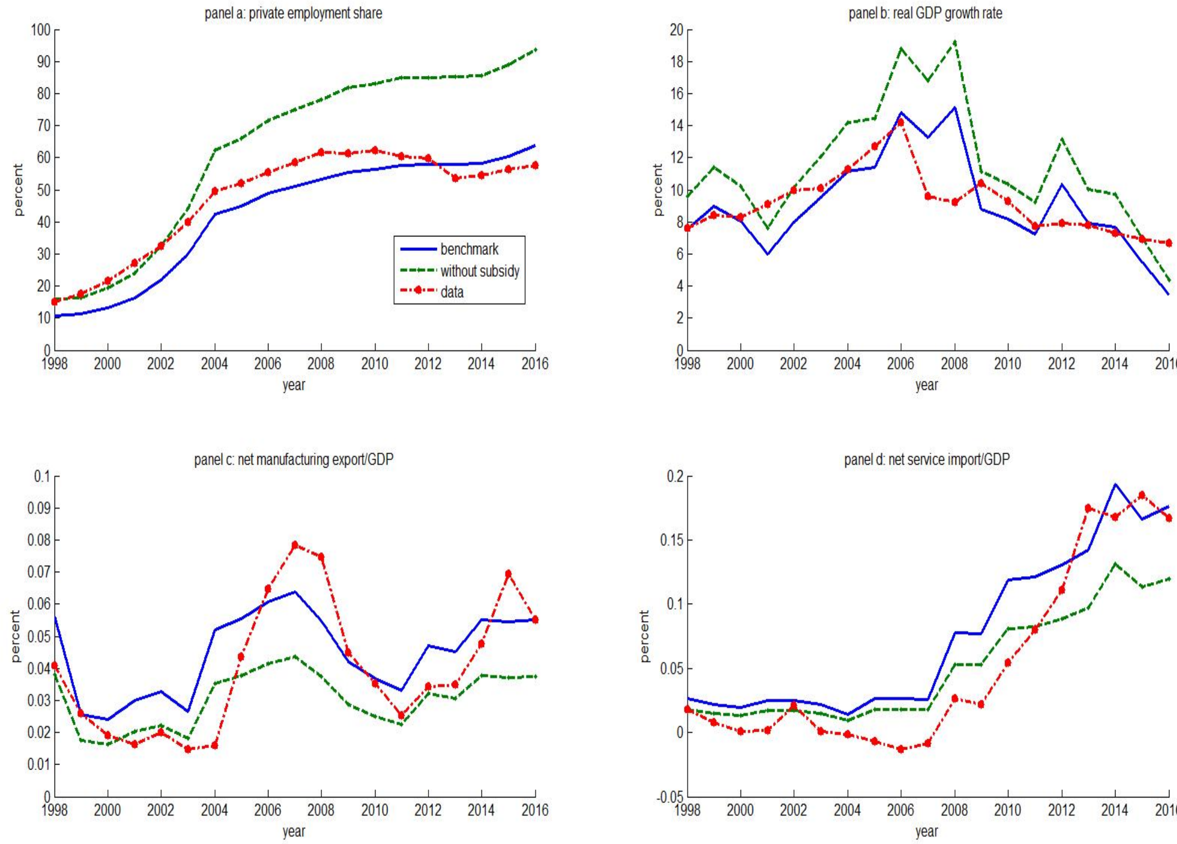

Figure 12: Model without subsidy

We now conduct several counterfactual experiments to highlight the impact of policy distortion on the economy. We exclude subsidy distortion from our model so that the counterfactual economy is essentially with only E-firms' credit constraint. In this counterfactual economy, we set $\tau = 0$ and and keep all other parameters the same as in our benchmark economy. Figure 12 shows the simulated results in this counterfactual economy, together with their counterparts in the original model. Without subsidy to upstream firms, the private employment share evolves faster. Accordingly, in this counterfactual economy, the net manufacturing export-to-GDP ratio and net service import-to-GDP ratio are essentially flatter than the benchmark model. Trade imbalance declines and GDP grows at the same time, which implies that both rations (panel c and d) decrease. Furthermore, we exclude both distortions and find that without both distortions. As shown in Figure 13, the private employment share evolves faster and even reaches 100% in 2010. Also, the net manufacturing export-to-GDP ratio and net service import-to-GDP ratio are essentially flatter than the benchmark model and the case only without subsidy.

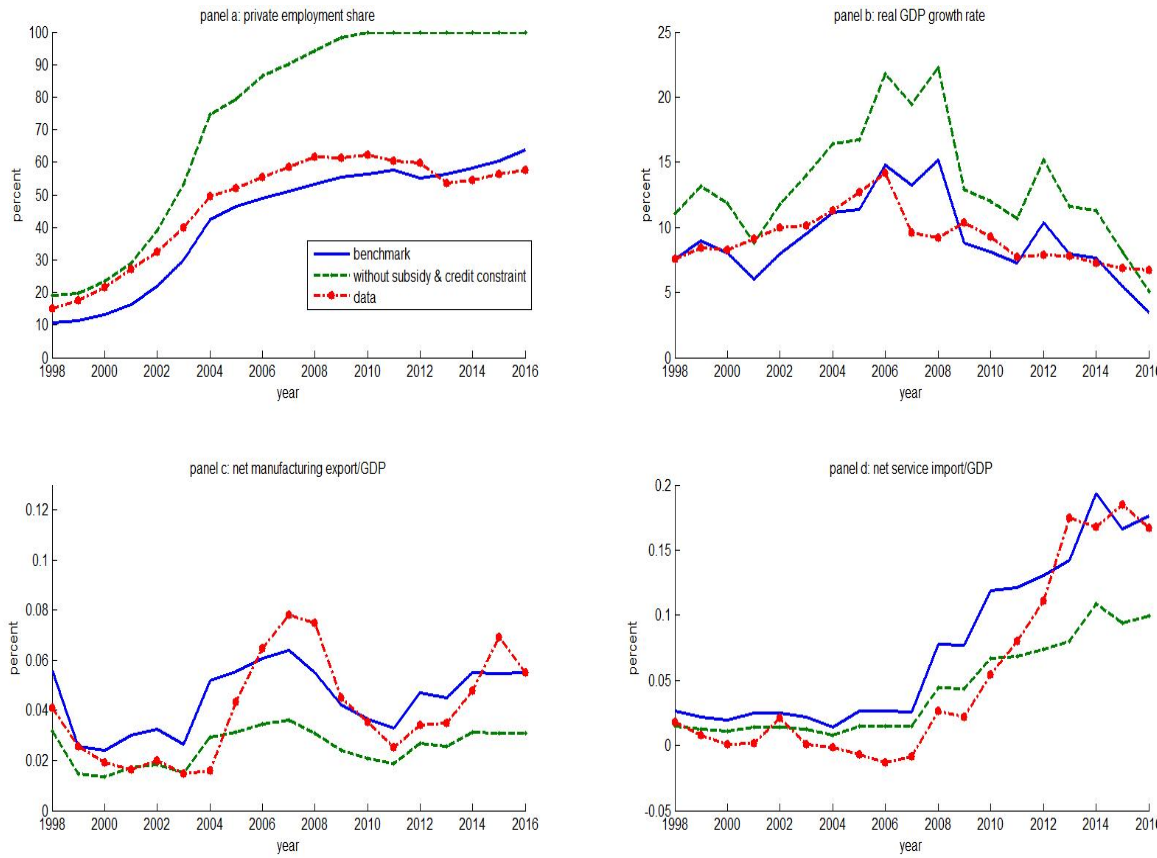

Figure 13: Model without subsidy and credit constraint

If we set the subsistence consumption=0, we find that the trade imbalance declines. Because the the income elasticity of domestic service consumption decreases, and the income elasticity of domestic manufacturing consumption increases.

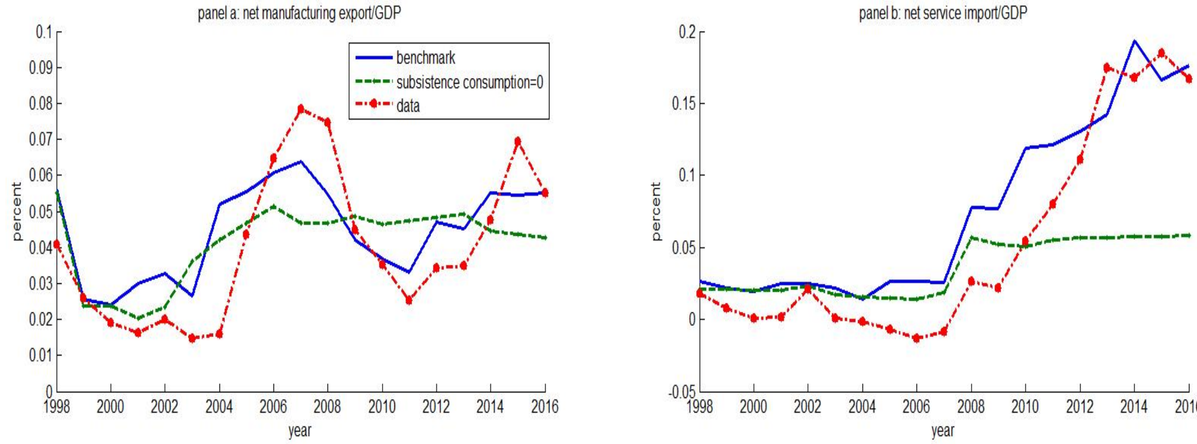

Figure 14: Model without subsistence consumption

4.3 Welfare analysis

For the welfare analysis, we take the economy with credit constraint on private firms and subsidy on SOE firm as benchmark. Welfare gains are then calculated as the percentage decrease in consumption in perpetuity under the alternative regime such that the representative agent is indifferent between living under that regime and under the benchmark regime. We find that the welfare will increase by 3.48% if we remove the subsidy distortion and by about 12.04% if we remove both subsidy and credit constraint. We also compute the average decline of trade imbalance from 1998 to 2016 and summarize the result in the following Table 2. Our results show that about 41.82% of trade imbalance can be reduced if both distortions are removed. We also report the welfare and imbalance change in the model without consumption subsistence in Table 3. Without dynamic structure change in consumption , the trade imbalance and welfare loss caused by policy distortion are relatively small. In other words, the structure change in consumption amplifies the negative effect of policy distortion on the economy. We also investigate different cases when the U.S. imposes a 10% tariff tax_t on China's manufacturing goods. We find that if U.S. imposes a 10% tariff on China's manufacturing goods, the trade imbalance in both manufacturing and service sectors will decline. However, this also leads a new distortion in the economy and reduces welfare slightly.

Table 2: Welfare and Trade imbalance changes (relative to benchmark)

	without subsidy	without both distortions	benchmark + 10% tariff
welfare	3.48%	12.04%	-1.82%
net export	-29.27%	-40.04%	-16.73%
net import	-31.55%	-42.87%	-18.52%
total imbalance	-30.70%	-41.82%	-17.35%

Table 3: Welfare and Trade imbalance changes (no subsistent consumption)

	without subsidy	without both distortions	benchmark + 10% tariff
welfare	1.67%	6.98%	-0.87%
net export	-14.03%	-23.22%	-8.02%
net import	-15.13%	-24.86%	-8.89%
total imbalance	-14.73%	-24.26%	-8.33%

5 Conclusion

There is a large literature that explain the global current account imbalance, especially on China-US bilateral trade imbalance. This paper intends to investigate this issue from the perspective of the trade imbalance within the tradable sector. We find that, on the one side, China runs huge trade surplus in the manufacturing sector; on the other side, China has large trade deficit in the service sector. Of course, the substantial divergence of trade balance might be driven by comparative advantage or technology differences. How much of the trade imbalance can be explained by policy? We argue that, during China's economic development, the household demands for service and manufacturing goods are uneven, the former one grows much faster than the latter one. However, due to policy distortion and regulation, the supply of service goods is inhibited. Consequently, the mismatch of consumption and production causes the divergence of trade balance in both sectors. In other words, the trade imbalance also represent the resource misallocation caused by policy distortions. We construct a two-country multiple-period overlapping generation model to match the data and show that removing policy distortion can reduce the trade imbalance by 41.82% and increase welfare by 12.04%.

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Table 4: Classification of residents' consumption expenditure.

Consumption expenditure	Income elasticity of demand	Growth rate of expenditure	Growth rate of income
Food	0.61	4.64%	
Clothing	0.50	4.32%	
Household equipment and maintenance services	0.80	5.61%	
Medical care	1.40	11.86%	7.87%
Traffic and communication	1.44	13.57%	
Recreational education and service	1.07	8.24%	
Residency	1.48	15.17%	
Others	0.52	5.38%	

Table 5: Supply and demand structure: absolute growth rate (%).

	Demand	Growth rate 2004-09	Growth rate 2010-16	Supply	Growth rate 2004-09	Growth rate 2010-16	Supply-demand 2004-09	Supply-demand 2010-16
Low-end goods	Food	3.93	0.64	Agriculture, forestry and animal husbandry; food and beverage	18.88	14.83	14.95	14.19
	Clothing	14.81	2.97	Textile; textile and apparel; leather fur feather; footwear industry	13.55	7.59	-1.26	4.62
	Household equipment and maintenance services	12.76	7.43	Furniture manufacturing industry	19.13	11.39	6.37	3.96
High-end goods	Traffic and communication	16.21	10.28	Transportation, warehousing(postal); information transmission, software IT services	19.8	9.83	3.59	-0.45
	Medical care	22.69	13.05	Pharmaceutical manufacturing; hygiene and social work	14.78	12.52	-12.86	-0.53
	Recreational education and service	13.00	10.39	Education; culture, sports and entertainment industry	11.37	11.11	-1.63	0.72
	Residency	7.44	26.4	Construction; residents services, repairs and other services	13.49	19.99	6.05	-6.41

Note: 1. Since 2004, the National Bureau of Statistics has published complete data of GDP added value in different industries, so we take 2004 as the starting year; 2. Since 2005, the state has fully included compulsory education in the financial security scope, so the item of "education, culture and entertainment services" is the data after considering "government public financial expenditure: education, science and technology, culture, sports and media"; 3. The item "Medical care" considers "government public financial expenditure: social security and employment, medical and health care and family planning"; 4. The classification of import and export commodities is in accordance with the International Convention on the Harmonization of Commodity Names and Codes (HS). The classification of import and export services trade comes from the China Business Yearbook; 5. The statistical caliber of residential expenditure by the National Bureau of Statistics has changed dramatically around 2014. Previous residential expenditure includes: water and electricity, fuel, housing decoration, construction materials for maintenance, rent for rent, heating, property management, maintenance service, etc. After 2014, the new calibre has increased the virtual rent converted from private housing.

Table 6: Supply and demand structure: growth rate of ratio(lower-middle-income, 04-09, %).

	Demand	$\frac{expenditure}{income}*$ in 2004	Growth rate	Supply	$\frac{industry\ output}{GDP}$ in 2004	Growth rate	Supply- demand
Low-end goods	Food	28.76	-1.91	Agriculture, forestry and animal husbandry; food and beverage	17.66	6.73	8.64
	Clothing	7.29	0.54	Textile; textile and apparel; leather fur feather; footwear industry	10.18	1.85	1.31
	Household equipment and maintenance services	4.32	1.19	Furniture manufacturing industry	0.07	6.85	5.66
High-end goods	Traffic and communication	5.61	2.00	Transportation, warehousing(postal); information transmission, software IT services	5.39	7.64	5.64
	Medical care	8.95	10.11	Pharmaceutical manufacturing; hygiene and social work	1.62	2.11	-8.00
	Recreational education and service	10.96	0.70	Education; culture, sports and entertainment industry	0.33	-0.05	-0.75
	Residency	7.79	-1.63	Construction; residents services, repairs and other services	11.97	1.84	3.47

Table 7: Supply and demand structure: growth rate of ratio(upper-middle income, 10-16 , %).

	Demand	$\frac{expenditure}{income}*$ in 2010	Growth rate	Supply	$\frac{industry\ output}{GDP}$ in 2010	Growth rate	Supply- demand
Low-end goods	Food	25.14	-3.58	Agriculture, forestry and animal husbandry; food and beverage	11.21	6.24	9.82
	Clothing	7.56	-4.87	Textile; textile and apparel; leather fur feather; footwear industry	11.58	-0.50	4.37
	Household equipment and maintenance services	4.75	-1.05	Furniture manufacturing industry	1.04	3.03	4.08
High-end goods	Traffic and communication	10.38	-0.30	Transportation, warehousing(postal); information transmission, software IT services	7.33	1.65	1.95
	Medical care	4.56	4.69	Pharmaceutical manufacturing; hygiene and social work	1.41	4.63	-0.06
	Recreational education and service	8.52	1.42	Education; culture, sports and entertainment industry	0.63	2.58	1.16
	Residency	6.97	18.42	Construction; residents services, repairs and other services	32.49	1.27	-17.15

Note: "*" per capita.