Factoral and Sectoral Characteristics of China's Growth since the Reform

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Content

Summary

From both factoral and sectoral angles, this paper examines China's economic growth since the Reform in 1978 in order to derive some growth patterns explaining the economic logic behind the great China Miracle. Our objective also lies in summarizing different views in literature of China's growth and trying to mitigate some conflicts among the scholars, debates over the role of TFP and capital, the contribution of agriculture, etc.. Through out the paper, we examine the extent to which this paper is connected with and differentiated from previous studies

We first review the history of China's reform and we divide it into four periods with three divisive time points, South Talk in 1992, China joining WTO in 2001, and Global Crisis in 2008.

Our analysis is mainly based on China statistical yearbook data, and we use Penn World Table 9.1 and data structured by Hsueh and Li (1999) to complement and justify the yearbook source. Specifically, we apply a two-step extension method to extend the data on investment to 1986, and we also calculate the income share of labor, the alpha parameter in Cobb-Douglas production function, by referring to the two ancillary data sources.

For factoral analysis, we apply Zhu's (2012) growth accounting approach at both aggregate and sectoral levels. We discover some change of role of the growth of two factors, TFP and capital, since although TFP's contribution to total growth dominates during the entire history, it drops sharply from 77% to 57% after 2001 in company with the rise of capital growth whose explanatory power rise from less than 10% to 35%. We further show that this change during the early 2000s should be completely attributed to the factoral role interchange happening in non-agricultural sector, as TFP growth accounted for 75% of non-agricultural growth before 2001, while capital growth has explained half of it after 2001. However, the agricultural growth has been constantly driven by powerful TFP growth. Another phenomenon we disclose is that labor force has been escaping from agriculture to other industries implying an inter-sectoral structural transformation.

The labor migration pattern above makes sectoral analysis necessary. To illustrate the economic incentives driving the migration, we develop a useful notion, Model Price Ratio (MPR), defined as the theoretical wage of one sector to that of agricultural department deduced from standard Cobb-Douglas production function. The gap between the realized MPR and its theoretical value 1 demonstrates the deviation of reality from the theory that ideal labor market yields the same wages in different markets. Through three ways, we justify that this deviation is an adequate proxy for migration restriction. MPR has been obviously higher than 1 since the 1950s, and this confirms the existence of both demand and friction of China's structural transformation. We also define the counterpart notion for capital, Model Price Ratio of Capital (MPRC), which stays close to 1 after 2001, but also has been steadily increasing since reform.

Literature shows consistency with our findings. We discuss factoral contribution and structural transformation separately in which we first present the causes discussed in literature for factoral changes, like the rise of capital's role in non-primary sector and the powerful agricultural TFP growth; further, we delve into the demand and friction of sectoral transformation, and we point out that it is the rapid agricultural TFP growth that pushes labor out of primary industry, and that the transformation friction is ascribed to both coercive regulations and the growing discrepancy between urban and rural economies.

Finally, we draw some prospects on China's future development. MPR's rebound in 2016 shows that there will still be great demand for structural transformation, and that MPRC has increased sharply since 2013 implies that capital's role will continue to rise. We make the suggestion that Chinese government should stick to serious reforms, and we list some policy examples.

1.Introduction

The China Miracle happening during the past 40 years is marked by its unprecedented speed and massive scale of economic growth. This must be closely related to China's history of active reform. Chinese government has carefully implemented a series of reforms with Chinese characteristics, which is necessitated by the uncertainty and difficulty involved in dealing with the residuals left by China's planned economy period and this country's political and cultural systems, both of which are peculiar in comparison with any peer economy. Hence, the role of the government is far from a dictator, and right on the contrary, Xu (2011) contended that economic reforms took a gradual, experimental, and decentralized form. This learning-in-trial method guarantees the government to make many correct choices; however, this also sheds fog of mystery over China's reform, for we cannot access the intrinsic logic of China's growth by merely looking into policy documents.

To understand China Miracle, one of the efficient paths lies in growth accounting at different levels and for different scales. Among numerous scholars analyzing China in this manner, we notice that some have emphasized two most pronounced phenomena during China's progress of development: factoral and sectoral shifts. Specifically, economists delve into the relative significance of capital accumulation and total factor productivity (TFP), and also the structural transformation in labor market from agriculture to non-agricultural department. The debate has been heated, and therefore we find it necessary to utilize data from multiple sources to characterize some patterns related to this two angles, and by comparing our results with those of previous studies, we intend to depict a more clear picture of China's growth. We divide China's post-reform period into four segments for analysis and find several surprising outcomes.

The first interesting finding lies in the roles of growth factors. Young (2003) held the belief that China's development should mainly be attributed to labor deepening during 1978-1998 and to capital deepening after the early 1990s. This conclusion has been backed by later works, for example, Kuijs and Wang (2005). However, Brandt and Zhu (2010) and Zhu (2012) argued that the key factor pushing development is the high growth rate of TFP, and that capital accumulation only had served a modest role.

Our result, not similar to neither of views above, suggests that the relative importance of TFP

and investment is not dichotomy. We find that TFP growth accounts for in average 77% of total output growth in aggregate level before the early 2000s; however, the contribution made by growth of capital/output rose drastically to around 35%, while TFP growth's share dropped to 57%. After investigating into sectoral growth, we further identify that this shift of role happened only in non-primary industry where the contribution of TFP growth has fallen from 75% before 2001 to 25% after 2001, whereas that of capital growth has risen from almost 0% before 2001 to 50% after 2001. On the other hand, TFP growth in primary sector has always been dominant. Clearly, a serious change of growth pattern in the secondary and tertiary industries happened around 2001.

This asymmetry in capital growth patterns between sectors is supported and explained by literature. This change of role has been verified by Chen, Jefferson, and Zhang (2011) where they identified the shifting year also to be 2001, and we confirm that this trend has remained steady after the year of their publication. They ascribed this phenomenon to reforms in factor markets and industrial structure which explain the sectoral heterogeneity. Besides, Kuijs and Wang (2005) showed that China's non-agricultural growth manifests a more capital-dependent growth pattern than agriculture, and Brandt and Zhu (2012) maintained that the distortion in China's capital market has made state-owned enterprises to accumulate capital faster and the capital-labor ratio of state sector has been rising rapidly since 1997.

The second pattern we recognize is the labor migration from primary sector to non-primary sector. The labor share of agriculture was 70.5% at the beginning of the reform but it now only takes up 27%, and the labor scales in the other two sectors have been constantly increasing. Another view of this trend is urbanization in which the population growth rate of cities has been higher than that of countrysides since 1971, and because of the higher natural growth rate in rural areas, migration must cover most of the population change.

To form an analyzable view of structural transformation, we create Model Price Ratio (MPR) derived from standard Cobb-Douglas production function. MPR of one sector is defined as the ratio of the theoretical labor wage of this sector to that of primary sector. This variable is an adequate indicator of both the demand and friction of labor migration, because its value has remained conspicuously higher than the theoretical price ratio, 1, and lingered between 2-4 since 1950. Also, the behavior of MPR fits some historical events, and this makes it more reliable. To view the capital counterpart, we likewise construct Model Price Ratio of Capital (MPRC) and find

this variable, on the one hand, staying closer to the theoretical value than MPR, and on the other, constantly increasing since reform and transcending 1 during the late 2000s. MPRC's steadily increasing pattern predicts a continuous growth of non-agricultural capital.

The reason for this labor force transformation is multidimensional. Similar to Brandt, Hsieh, and Zhu's (2008) finding, we point out that the increasingly powerful role of agricultural TFP growth, whose contribution to total sectoral growth has risen from 59.5% during 1986-1991 to 118.9% during 2008-2017, makes the labor force needed to meet with food demand shrink and reallocates the redundant to other industries. The literature attributes the cause for agricultural TFP growth mainly to institutional factors, like land reforms. Finally, we attribute the friction of transformation to demographic regulation forcing the migration to be incomplete, and also to the high cost of living and getting education in cities and urban-rural income inequality.

Both factoral and sectoral changes during China's growth and reform are critical, for they not only disclose the panorama of China's economic development, but also give clues on the underlying logic behind this miracle. To sum up, we identify firstly the interchange of roles in explaining national development of TFP growth and capital accumulation around 2001. Besides, alongside many institutional factors, rapid agricultural TFP growth has pushed the labor migration from primary sector to non-primary sector. Eventually, we suggest that Chinese government should further loosen the urban-rural migration restrictions preventing the labor flow caused by the powerful engine, agricultural productivity; and also that they investigate the possible reasons behind the fall of TFP growth rate in non-agricultural industry and the dependence of investment.

We organize this paper as bellow. The rest two parts of this section firstly retrospect the history of China's reform, and then show how our work is connected with and differentiated from related literature. Section 2 demonstrates three data sources we utilize, and the methods applied to process and complement the data sets of aggregate and sectoral investment volume and labor's income share. Section 3 shows our method of carrying out the growth accounting at aggregate and sectoral levels, and also that of defining and justifying MPR. Besides, we exhibit and describe our main findings in section 3. Section 4 discusses the presentations of factoral and sectoral changes, and then we delve into their causes and their inter-causal relationship by using evidence shown in section 3 and literature's points. Section 5 concludes and provides policy enlightenment.

1.1 Reform History

After the 1978 economic reforms China has experienced very rapid economic growth, and thus its economy could begin to exploit both the advantages of relative economic backwardness and some aspects of the "Fordist model of growth". The period of 1978-2017, combined with the relevant political policy background, can be divided into four stages with three divisive events: South Talk in 1992, China joining WTO in 2001, and Global Crisis in 2008. Each of the four periods involves peculiar form of reform and economic performance.

Stage 1: 1978-1991, Political and Tentative Economic Trials

Since China had experienced recurring food crises before 1978, it is not surprising that its economic reform started in the agricultural sector. There were two important reforms. First, the government increased prices for agricultural goods. Second, the previous Collective Farming System was shifted to the Household Responsibility System (HRS). Under the new system, each farm household was assigned a fixed quota of grains that the household had to sell to the government at official prices. However, any extra grain the household produced could be sold at market prices. The reforms were implemented gradually and completed in 1984.Between 1978 and 1984, total factor productivity in the agricultural sector grew 5.62 percent per year. Several studies argue that most of the productivity growth during this period can be attributed to the price and institutional reforms that generated strong positive incentive effects on farmers' efforts and input choices(for example, McMillan, Walley, and Zhu 1989; Lin 1992).

As a result of the productivity growth, China's agricultural output increased by 47 percent during this period. The increase in food availability alleviated China's subsistence food constraint and started a structural transformation that reallocated a large amount of labor from agriculture to industry. From 1978 to 1984, agriculture's share of total employment fell from 69 percent to 50 percent: that is, in just six years, 19 percent of China's labor force—more than 49 million workers—reallocated out of the agricultural sector. Most of the 49 million reallocated workers did not move to urban centers. Instead, they went to work in the rural industrial enterprises set up by township and village-level governments that are called "township and village enterprises" (TVEs).

Stage 2: 1992-2001, Economic Reforms

This reform stage started with Deng's South Talk. In the 1990s the second wave of reforms mainly involved industry, the services, property rights and institutions. 1990s in China there was

the addition of microelectronics, telecommunication and energy. Finally, since the 2000s, there also has been a rapid growth in the production of industrial vehicles, motorcycles and automobiles. For the first few years, the price and institutional reforms increased agricultural output mainly by improving incentives without much change in the production technologies being used. However, by about 1984 these static efficiency gains, from workers using the same technology with a much more rewarding set of incentives, were largely exhausted. Both agricultural productivity and structural transformation stagnated in the second half of the 1980s. Starting around 1990, or more in detail, 1992, markets for agricultural inputs and outputs were gradually liberalized and government interventions were significantly reduced (Zhu, Xiaodong, 2012). Huang, Otsuka, and Rozelle (2008) documented extensive market liberalization in China's agricultural sector and state: "aside from restrictions on land ownership, China today may have one of the least distorted domestic agricultural economies in the World." As this market liberalization provided farmers with strong incentives to adopt new technologies, the average annual growth rate of total factor productivity in agriculture reached 5.10 percent between 1988 and 1998, and remained at 4.13 percent between 1998 and 2007. Most of agriculture's growth in total factor productivity after 1990 came from technological progress (Jin, Ma, Huang, Hu, and Rozelle 2010). Structural transformation also resumed after 1990, and the rural-to-non-rural policy implemented gradually during 1998-2003 breached the strict restrictions preventing urban-rural labor migration.

Stage 3: 2002-2008, WTO and Open

The third wave of reforms in the late 1990s and in the 2000s mainly regarded banking, finance and above all the rapid enlarging of international economic relations. mainly based on rapid accumulation and on the growth of the internal market, while since the late 1990s and especially after the entrance in WTO, from 2001 up to the 2008-2009 global crisis, they were violently spurred by the rapid rise of exports and the great inflow of foreign direct investment. In the last six years the acceleration of exports brought about a recovery of the employment share of industry and a slowing down in the rise of the share of the tertiary sector. This was partly due to the rate of growth of some traditional industrial sectors such as textiles, cloth and leather articles, which could find a growing and easier access into the world markets; and partly to an entrance in new sectors such as ICT and later in automobiles, facilitated by several large joint ventures with foreign enterprises. A substantial part of the increase of exports in middle and high technical

products was made by joint-ventures and foreign companies operating in China (OECD, 2005). However, in the last four to five years there were also growing outward FDI with a number of acquisitions of foreign firms and foreign natural resources by Chinese corporations (Saccone, Donatella, and Vittorio Valli, 2009).

Stage 4: 2009-2017, Global Crisis and "One Belt, One Road"

While China had been accumulating large external surpluses since 2004, following the global shock triggered by the Lehman bankruptcy in September 2008 the current account surplus started to shrink. By 2011, the current account surplus was 2.7 % of GDP, well below the peak of 10.3 % reached in 2007. The Chinese authorities have welcomed this development, claiming that China has made a substantial contribution to more balanced and sustainable growth in the global economy.

Taking the perspective of the savings-investment balance, data available up to 2010 indicate that the current account surplus has been reduced via an increase in investment rather than a drop in savings. The increase in the investment ratio reflects in turn the impact of the major policy stimulus enacted in 2008-09. This set of measures was needed because China is always at risk from the materialisation of excess capacity, and the impact of the "Lehman shock", coupled with the burst of a domestic housing bubble, was so big that in the absence of strongly countercyclical macroeconomic measures a significant output gap would have materialised. The lack of adjustment in the savings ratio points, conversely, to the limited success of the authorities' policy efforts to increase the share of domestic consumption over GDP. With the withdrawal of the policy stimulus and in the absence of major changes in the savings pattern of domestic agents, China's current account surplus would likely re-emerge in the coming years (Dorrucci, Ettore, Gabor Pula, and Daniel Santabárbara, 2013).

There is another important background. During Chinese President Xi Jinping's visit to Kazakhstan and Indonesia in September and October of 2013, he proposed the initiative of building the Silk Road Economic Belt (hereafter referred to as "One Belt") and the 21st Century Maritime Silk Road (hereafter referred to as "One Road"), which links China with South-east and South Asia, Eurasia, Africa and Brazil through trade, investments, transport and energy infrastructure projects, tourism, education, culture and other areas of cooperation (Mitrovic 2016:76). The "One Belt, One Road" (OBOR) initiative was included as the focus of the year's

work in the Chinese “Government Work Report” in 2015. It is of great strategic significance for China to comprehensively improve its open economy level, and to explore deeply the current situation and challenges of its security cooperation, which is of great practical significance to ensure the realization of the strategic interests of OBOR (Liu.2017).

1.3 Related literature

During the past 40 years, rapid and sustained economic development has occurred in China. To understand China Miracle, numerous scholars analyzing the question that *What are the main reasons for China’s remarkable growth?* Rajan (2006) pointed out that China’s growth was widely attributed to its unique development model, the principal element of which had been an incremental and experimental approach to reforms, but shortcomings might be exposed with shifts in the structure of China's economy. Long (2018) held that social progress, industrialization, and the agrarian question were the deep drivers of economic development in China, and also found that the economic growth trajectory of China, exceptional in both strength and scale, had not been smooth through the examination of the strong growth of China’s GDP and industrial profit rates. Meeta (2011) compared the growth of India and China and found that China’s development led by its manufacturing sector differed from India’s growth driven by its service sector, and the economy of China was featured by a high saving and investment rate along with large exports.

Though there were different opinions about the main sources of China’s growth, two most pronounced phenomena has been emphasized: factoral and sectoral shifts. That is to say, economists delve into the relative significance of capital accumulation and total factor productivity (TFP), and also the structural transformation in labor market from agriculture to non-agricultural department. Both are frequently mentioned in literature.

The research on total factor productivity (TFP) in China mainly focuses on the following aspects: firstly, The macro-level study of the national economy, which uses the macro-time series data of the industry to measure and analyze the overall TFP performance of the Chinese economy. For example, Some economists believe that the key driving force behind the economic miracle is the soaring input use and the contribution of productivity growth is very limited (Young, 2003). However, some drew the opposite conclusion, Zhu (2012) argued that China's rapid growth over the last three decades had been driven by productivity growth rather than by capital investment. Zheng (2008) believed that China’s reform measures often resulted in one-time level effects on

TFP. Islam (2006) used the dual approach to growth accounting to examine the role of total factor productivity (TFP) in recent Chinese growth, and found that the TFP growth rate for mainland China computed using the dual approach also proves high. Ze and Jian (2014) investigated the effects on firm-TFP of the import competition intensified after access to WTO, and concluded that import competition promoted the growth of TFP of domestic firms on average and it hindered the growth of TFP of firms with low TFP, but pushes the growth of TFP of firms with high TFP. Secondly, the study at the specific industry level. For instance, with the progress of capital deepening in the service sector, the role of factor inputs for the services growth was quite obvious, while the contribution of TFP growth was gradually reduced (Liu, 2009). Our research mainly focus on the macro-level study, and the role of TFP played in China's growth had been wildly recognized. However, some recent research noticed a change that the contribution of productivity to output growth declined(Chen, Jefferson, and Zhang, 2011).

The other key sources of China's growth is the structural transformation in labor market from agriculture to non-agricultural department. MicMillan and Rodric (2014) emphasized that labor flows from low-productivity activities to high-productivity activities are a key driver of development. In China, Cai, Fang, and Wang (2010) clarified officially published statistics on labor market, explained how its structure diversifies, urban unemployment alleviates and number of rural surplus laborers reduces with economic development. And other empirical results in China also showed that structural change had contributed to growth significantly by reallocating resources from low-productivity sectors to high-productivity sectors (Fan, Zhang, and Robinson, 2003; Valli, Saccone, 2015). In addition to recognizing the positively impact on economic growth, economists also researched the the Lewis turning point: Fukao, kyoji, and Yuan (2012) showed that in an economy like China, where there are strong barriers to the movement of labor to the manufacturing sector and where the ratio of net exports of goods and services to GDP is high, the economy will not reach the turning point until GDP per worker reaches a relatively high level.

Through the numerous scholars, we can know the important role to TFP and Structural Change in China's growth, so in this paper, we will use statistics to demonstrate their contact and interaction. Similar to Zhu's paper, we examined some common variables such as TFP. However, instead of emphasizing the importance of TFP growth, we mainly focus on that how TFP and Structural transformation differently impact on China's growth and their interaction.

2.Data

We first investigate the relative contribution of total factor productivity (TFP), labor force, physical capital accumulation, and human capital on output growth at aggregate level and for both primary and non-agricultural sectors. Additionally, the inter-sectoral structural transformation is measured by the ratio of model price of non-primary sector to that of primary sector where the calculation requires data on income share of labor. We also present demographic shift between urban and rural areas. Three data sources are used including two official utilities, Penn World Table 9.1 (PWT) structured by Feenstra, Inklaar, and Timmer (2015) and China Statistical Yearbooks (CSY), along with a China's income accounting record by Hsueh and Li (1999). In this section, we introduce the three data sources and describe and comment on our estimation of investment volume and labor income share, the two sets of data requiring specified calculations.

2.1 Sources

Penn World Table 9.1 provides the latest description on countries' overall economic performance and focuses mainly on aggregate level data. Because of its descriptive nature and the fact that most of the variables are calculated and scaled based on the United States standard and the US dollar, we regard this source only as a reference for justifying processing operations over other data sources. Our validation of the estimation of labor income share and factor contribution to output growth is partly based on PWT data.

We manually collect yearbook data, the main source we use, from the website of National Bureau of statistics of China (Yearbook, 1999-2018) where there are yearbooks of 1999-2018 published versions recording detailed macro-level descriptions. From this source we construct a data set covering productive and demographic economic variables with an adequate time span from before 1978 to the present time 2017. However, this database suffers from inconsistency in some parts between yearbooks published in different years, since perhaps some statistical standards were changed by NBC during 2000s and 2010s; and to solve this, we test the continuity of the same kind of data from distinct years and find that this inconsistency is basically trivial so that we simply use older version data as an extension to complete the later version. But the data on investment and fixed capital is an exception which manifests severe inconsistency between years,

and this makes it impossible to structure capital data with time span long enough for study.

Fortunately, Hsueh and Li's (1999) book, codified mainly based on NBC's publications, provides detailed and coherent data on aggregate investment, but the sectoral investment still remains a mystery, the estimation of which is introduced later in this paper. Also, their book shows output and labor remuneration at aggregate level and primary, secondary and tertiary partitions allowing us to calculate labor income share overall and in each sector.

2.2 Investment

The previous sub-section shows that the investment data at all levels is incomplete, as in yearbooks the earliest aggregate investment is that of 1997 and the sectoral data can only date back to 2003. We use Hsueh and Li's (1999) record of aggregate investment from 1952 to 1995 and fill in the 1996 blank by averaging the numbers of year 1995 and 1997. The two data sets are essentially from the same base, and to show this we depict the total capital in Figure 1 where the splice, marked by the vertical line, links both sides smoothly.

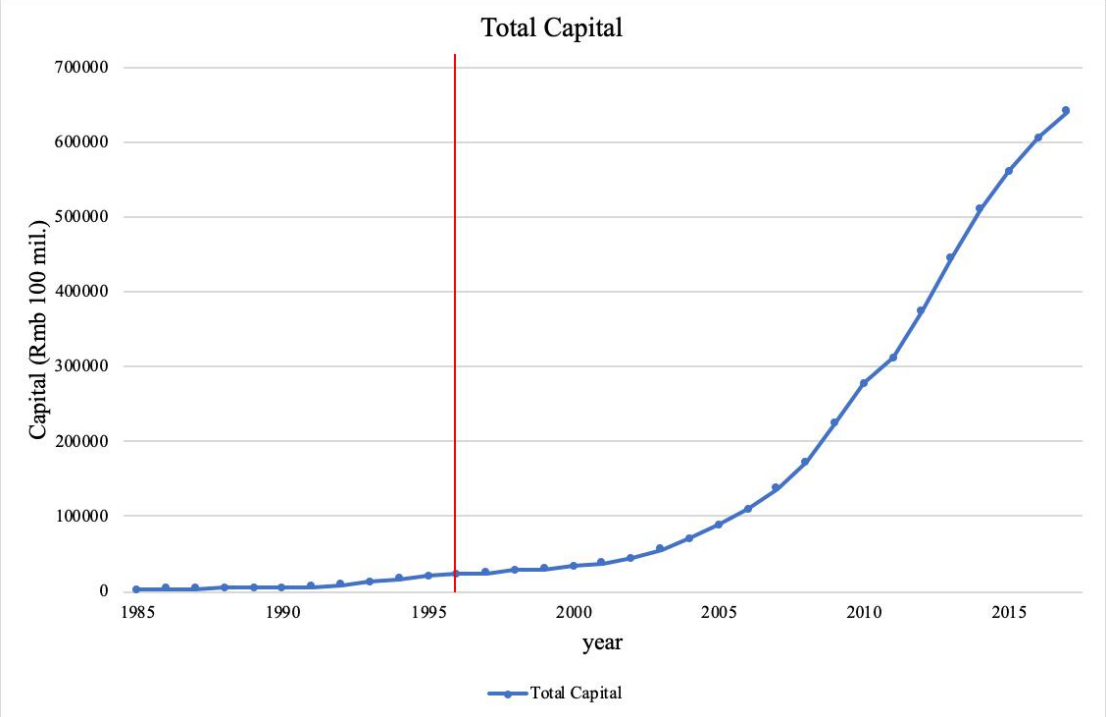

Figure 1

As for the sectoral data, we manage to extend it to 1981 with a two-step method. In the first step,

we find some related data, peasants' total investment and non-peasants' investment on agriculture, forestry, animal husbandry and fishery (AFHF) from 1995-2017. We employ the method, the first part of which is also used by Brandt and Zhu (2010) that, by assuming that investment decision is proportional to income or output, we calculate peasants' investment in primary industry; and the second part lies in that nearly all kinds of data on AFHF is proportional to the same kinds on primary sector, because of their similarity. Formally, we denote peasants' investment on primary sector by k_{pea-p}, non-peasants' counterpart by k_{npea-p}, peasants' total investment by k_{pea}, non-peasants' investment on AFHF by $k_{npea-p+}$, overall output by y, output in primary sector by y_p, and output in fields of AFHF by y_{p+}. And we have:

$$k_{pea-p} \approx k_{pea} y_p / y, \quad k_{npea-p} \approx k_{npea-p+} y_p / y_{p+}, \quad k_p = k_{pea-p} + k_{npea-p}$$

Here k_p is the primary investment, the variable we want. In this way, we get the first extension. Nonetheless, the data predating 1995 is still missing, and we figure out the second step, a cursory but intuitive method, that if two categories of capital are linearly correlated with each other in some time period, then this proportional characteristics is likely to hold during other time span, since expenditures on investment is usually planned beforehand by individuals according to some stable arrangement: for example, the investment on fishing boats and fishing nets is often planned proportionally. Therefore, we collect all kinds of data related to primary investment and select several from them identified as categories most linearly correlated with the extended k_p during 1995-. We then use these *similar* categories to further extend k_p to 1981. Questionable as this method may sound, its justification is shown clearly in Figure 2.

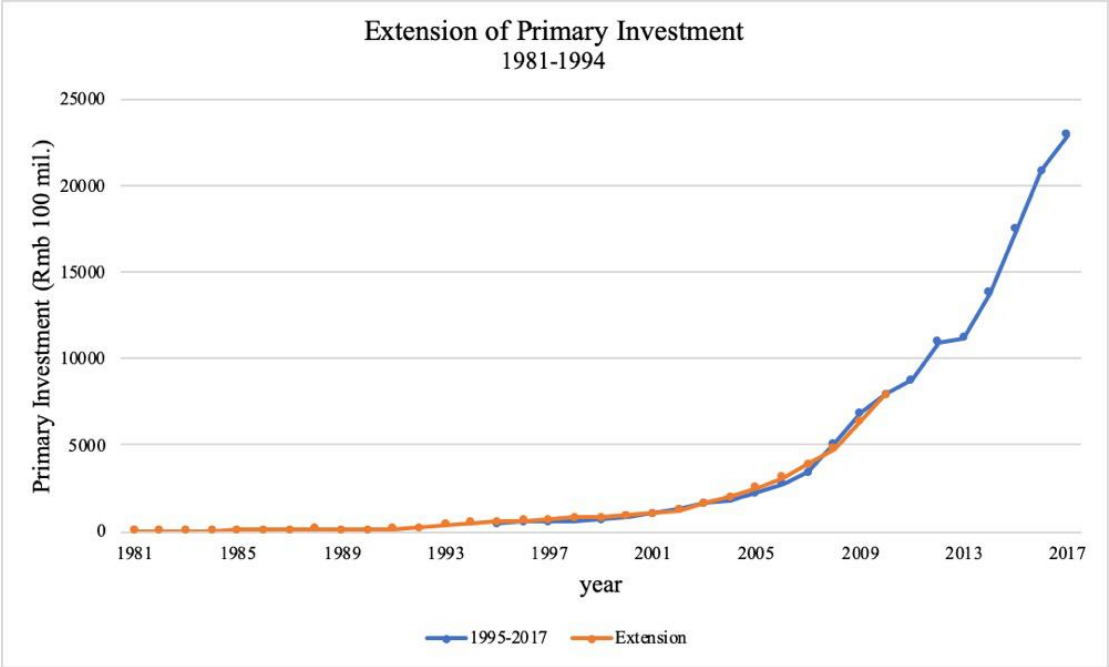

Figure 2

From the figure above, we can easily observe that, during the overlapping period (1995-2010) of two curves, they perfectly coincide. This outcome suggests that our second data extension is acceptable, and it also corroborates the first extension because it is included in the overlap.

This two-step extension method of sector investment is also justified by later calculation in that this extended data yields reasonable and consistent outcome.

2.3 Labor Income Share

In Penn World Table 9.0, we find the variable *labsh* representing the labor compensation share in GDP which in average is 0.586, but its calculation cannot be plausible since it takes the same value from 1952 to 1992 indicating an arbitrary extension. Instead, we apply Hsueh and Li's (1999) more detailed and thus reliable record on GDP and labor remuneration of each Chinese province at both aggregate and sectoral levels. This calculation yields that the aggregate labor share ratio is approximately 0.542 with standard deviation 0.005, the primary sector 0.850 with sd. 0.004, the secondary sector 0.389 with sd. 0.004, and the tertiary sector 0.470 with sd. 0.004. It is obvious that each of four labor share ratios remains stable and can be seen as immutable even in a long period. The stability is more vividly shown in Figure 3.

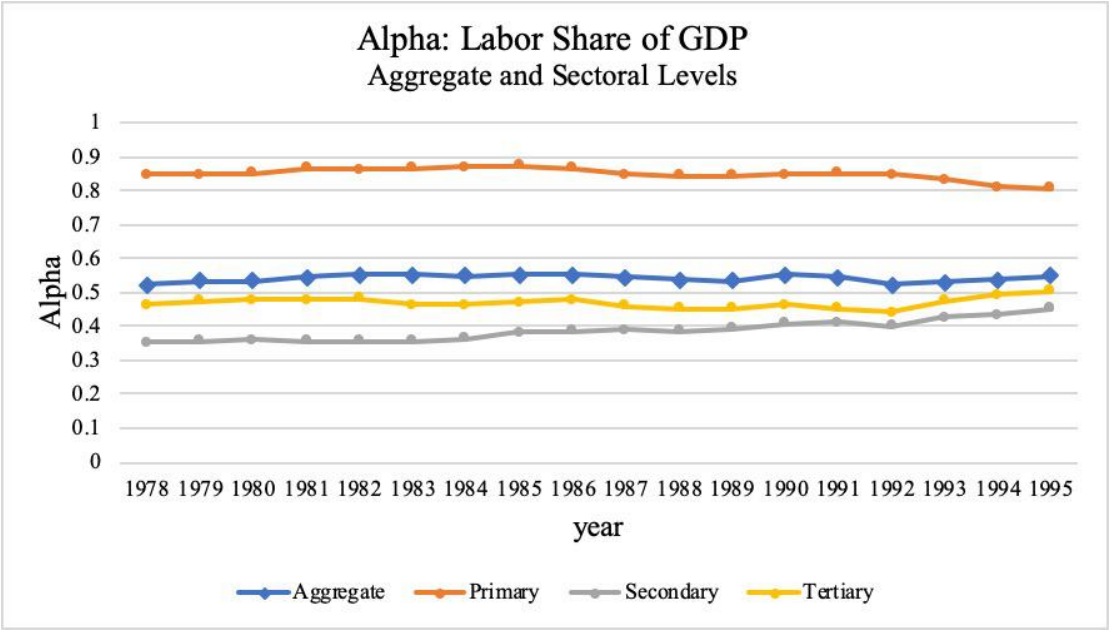

Figure 3

Labor share ratios, also named as the $1-\alpha$ parameter in the standard Cobb-Douglas production function $Y = AK^{\alpha}(hL)^{1-\alpha}$ which we will mention later, of different levels and sectors take the four values demonstrated above respectively, and we assume that the $1-\alpha$ parameter of non-primary sector is the average of those of both secondary and tertiary sectors, namely 0.429.

3.Main Results

This section presents our methodology and calculation outcomes demonstrating several main characteristics of China's growth at aggregate, factoral, and sectoral levels. We first use the data from Penn World Table9.1 (PWT) to capture some basic traits, including average growth rates of aggregate and factoral economic variables during four well-divided periods, and decomposition of factoral contribution to per capita GDP growth. Then we introduce the growth accounting method that we employ in calculating, with yearbook data, the factoral contribution to output growth at both aggregate and sectoral levels, and we derive some trends underlying the numbers. Last, we define Model Price Ratio (MPR) as the ratio of theoretical price of one sector to that of primary sector deduced from standard Cobb-Douglas production function, and we further justify this

variable as an adequate measure of transformation liquidity.

3.1 Basic Description: PWT Data

In order to have a preliminary understanding of China's overall growth and to compare the results of the following yearbook data, we first use the Penn World Table data to make a preliminary presentation. Here, the method of decomposition follows Zhu (2012), which will be introduced later.

Decomposition of Aggregate Growth (PWT): 1978-2017

Period	*Average annual growth rate (%)*				
	GDP per capita	*Labor participation rate*	*Capital-output ration*	*Average human capital*	*TFP*
1978-1991	4.76	1.47	1.02	1.21	0.66
1992-2001	6.47	0.10	2.31	1.57	1.55
2002-2008	9.31	0.01	0.93	0.68	4.25
2009-2017	6.22	-0.21	4.12	1.14	0.98
Period	*Contributions to per capita GDP growth (%)*				
	GDP per capita	*Labor participation rate*	*Capital-output ration*	*Average human capital*	*TFP*
1978-1991	100	30.83	21.44	25.47	22.26
1992-2001	100	1.47	35.73	24.32	38.48
2002-2008	100	0.13	10.00	7.29	82.58
2009-2017	100	-3.30	66.17	18.31	18.82

Table 1: Penn World Table 9.1

It can be seen from Table 1 that between 1978 and 2008, China has a significant increase in GDP per capita, Capital output ration, Average human capital, and TFP. Even GDP per capita and TFP have growth rates in these three stages. They are growing. Among them, GDP per capita growth rate is close to 40% or more per stage, and TFP is more than 50%. In the period 1992-2001 to 2002-2008, the annual growth rate jumped from 1.55% to 4.25%. Significantly different from these, the annual growth rate of Labor participation rate has been declining in four stages, from 1.47% in 1978-1991 to 0.01% in 2002-2008, and even turned into a negative growth rate in 2009-2017, -0.21%. After entering 2009-2017, affected by the global financial turmoil, the annual growth rate of most indicators has decreased compared with the previous stage, including GDP per capita, TFP and Labor participation rate. The annual growth rate of Average human capital and

Capital output ration has increased significantly in 2009-2017. The annual growth rates of the two in 2002-2008 were 0.68% and 0.93% respectively, and the growth rate in 2009-2017 was 1.14 % and 4.12%. In terms of the peak annual growth rate of indicators, the annual growth rate of TFP and GDP per capita reached the maximum in 2002-2008, and the maximum annual growth rate of Average human capital reached the maximum in 1992-2001. Besides the annual growth rate of Capital output ration peaked in 2009-2017. In terms of Contributions to per capita GDP growth, the proportion of each indicator is basically consistent with the above-mentioned rules. The specific contribution ratio is discussed below. Among them, from 1978 to 1991, Labor participation rate accounted for the most, but it was not much different from Capital output ration, Average human capital and TFP. In 1992-2001, Capital output ration and TFP contributed the most, accounting for 35.73% and 38.48%, respectively. By the end of 2002-2008, there was a very obvious focus. The contribution of TFP was the largest, reaching 82.58%, which was more than 8 times that of the second indicator Capital output ration. In 2008-2017, the most important contribution indicator was Capital output ration, which was 66.17%. It is worth mentioning that the contribution rate of Labor participation rate was negative.

Especially，PWT data is somewhat different from the literature because its statistical standards and units are different from official Chinese data and data sources in the literature. Another weakness of PWT data is that no data is given for the sectoral. We will use processed yearbook data to compare with PWT data and do sectoral analysis.

3.2 Factoral Decomposition

Factoral decomposition refers to the relative contributions to the growth of total output made by different economic factors, for example, income share of labor and capital, scale and distribution of labor, volume of physical and human investment, and total factor productivity (TFP). The data on labor and physical capital is processed and structured from yearbook data. The labor income share can be regarded as constant in the long run, having been justified in the previous section, and this value at aggregate level is 0.542, whereas it for primary industry is 0.850, and for secondary and tertiary is respectively 0.389 and 0.470. We assign 0.429 to the labor income share of non-primary sector as the mean value of those of secondary and tertiary sectors. Clearly, this gives an intuitive result that primary sector is more labor-intensive than non-primary sector, since

the share value of the former is almost twice as much as that of the latter. Besides, we measure human capital with the data from PWT calculated based on years of schooling and returns to education. Although this data comes from a different source constructed by different standard, it shows that human capital has been growing slowly and smoothly and only takes a small proportion in total growth, so the distortion should be very limited.

We follow Zhu's (2012) growth accounting method in which he derived the decomposition formula by utilizing standard Cobb-Douglas production function:

$$Y = AK^{\alpha}(hL)^{1-\alpha}$$

Here the output or GDP is denoted by Y, capital income share or one minus labor income share by α, physical capital volume by K, human capital volume by h, labor force by L, and total factor productivity by A. They followed Hall and Jones' (1999) formulation, and by shifting the function above to a more analyzable form and dividing both sides with total population, they gave:

$$Y / Pop = L / Pop \times \left(K / Y\right)^{\alpha/(1-\alpha)} \times hA^{1/(1-\alpha)}$$

Here Pop refers to total population. Further, differentiating this expression above yields the decomposition method that our growth accounting at all levels is based on:

$$\begin{aligned} Growth\ rate\ of\ per\ capita\ GDP = {} & growth\ rate\ of\ labor\ participation\ rate \\ & +\alpha/(1-\alpha)\,growth\ rate\ of\ the\ capital/output\ ratio \\ & +growth\ rate\ of\ average\ human\ capital \\ & +1/(1-\alpha)\,growth\ rate\ of\ total\ \ factor\ productivity \end{aligned}$$

Notably, the two coefficients in front of the growth rate of the capital/output ratio and that of total factor productivity illustrate how relatively important are these two factors. This comparative significance varies with level and sector, for in primary sector, the weight assigned to capital growth, $\alpha/(1-\alpha)$, is approximately 0.176 which is only one sixth as much as that assigned to TFP growth, $1/(1-\alpha)$=1.176; and this discrepancy between factors is reversed when it comes to non-primary sector, as capital growth's weight is 1.331 only around half the TFP growth's weight, 2.331. This can partly explain why TFP growth takes a higher proportion of contribution to total growth than capital growth in agricultural sector.

We first present growth decomposition at aggregate level in Table 2. Similar to the method used

in the previous sub-section, we consider growth accounting spanning from 1986 to 2017, and this span is divided into four periods with three divisive events, South Talk in 1992, China Joining WTO in 2001, and Financial Crisis in 2008.

Decomposition of Aggregate Growth: 1986-2017

Period	*Average annual growth rate (%)*			
	Labor participation rate	*Capital-output ration*	*Average human capital*	*TFP*
1986-1991	3.05	-0.87	1.05	5.79
1992-2001	0.09	2.48	1.57	7.08
2002-2008	-0.00	7.10	0.68	4.93
2009-2017	-0.21	4.32	1.14	3.29
Period	*Contributions to per capita GDP growth (%)*			
	Labor participation rate	*Capital-output ration*	*Average human capital*	*TFP*
1986-1991	21.7	-5.3	7.5	76.1
1992-2001	0.5	12.5	9.3	77.7
2002-2008	-0.2	38.2	4.3	57.8
2009-2017	-1.9	34.3	10.7	57.0

Table 2

Compared with the decomposition accounting done with PWT data in the previous sub-section, we notice similarity in the trend of change of role between TFP growth and capital growth. PWT data tells that China has been equally driven by TFP and capital growth before 2001, while after that the former dominated during 2002-2008 and the latter dominated during 2009-2017. Whereas the labor growth has been modest since 1992, the growth of human capital has contributed to total growth in a considerable proportion comparable to that of TFP except for the period 2002-2008.

Yearbook data, having been processed and complemented, holds similar as PWT data in three aspects. First, our work yields as well that growth of TFP and capital volume have remained as the main engines of China's aggregate growth, and second, that 2001 indeed serves as a critical line marking the change of role of these two factors. And third, our result on the role of labor growth coincides with PWT, as during 1986-1991, right after the implementation of the Household Responsibility System (HRS) policy, the potential labor force chained by the planned economy was released into economic practice and thus made up a big share of growth, but after 1991, labor

has contributed little or even negatively. However, the two data set give different outcomes in that yearbook data indicates the consistent domination of TFP growth's contribution to total growth nonetheless deadened from 77% before 2001 to 57% after 2001, while the explanatory power of capital accumulation rose from less than 10% to 36% as time crossing 2001. Besides, yearbook data shows that human capital only takes a small share throughout the entire span, as its contribution never deviates from around 1 percent.

We choose data from yearbooks for further analysis for two reasons. The absolutely dominant status of TFP increase and capital accumulation given by yearbook data is more consistent with the fact that literature mainly focuses on these two factors, and this makes human capital's great contribution given by PWT curious. Additionally, our later results on sectoral decomposition make sense when linked to reform policies and compared with literature.

Now we present growth accounting for primary and non-primary sectors in Table 3 and Table 4.

Decomposition of Primary Sector Growth: 1986-2017

Period	*Average annual growth rate (%)*			
	Labor participation rate	*Capital-output ration*	*Average human capital*	*TFP*
1986-1991	2.05	7.96	1.05	5.61
1992-2001	-1.65	10.37	1.57	7.75
2002-2008	-3.30	12.80	0.68	9.57
2009-2017	-4.36	10.17	1.14	7.64
Period	*Contributions to per capita GDP growth (%)*			
	Labor participation rate	*Capital-output ration*	*Average human capital*	*TFP*
1986-1991	18.4	12.7	9.4	59.5
1992-2001	-15.2	16.8	14.5	83.9
2002-2008	-30.2	20.7	6.2	103.3
2009-2017	-57.7	23.7	15.1	118.9

Table 3

Decomposition of Non-Primary Sector Growth: 1986-2017

Period	*Average annual growth rate (%)*			
	Labor participation rate	*Capital-output ration*	*Average human capital*	*TFP*
1986-1991	4.74	-1.78	1.05	5.23
1992-2001	2.29	1.12	1.57	5.55

2002-2008	2.71	6.44	0.68	1.93
2009-2017	1.93	3.95	1.14	1.14

Period	*Contributions to per capita GDP growth (%)*			
	Labor participation rate	*Capital-output ration*	*Average human capital*	*TFP*
1986-1991	30.4	-15.2	6.7	78.1
1992-2001	12.5	8.2	8.6	70.7
2002-2008	16.5	52.1	4.1	27.3
2009-2017	17.5	47.8	10.4	24.3

Table 4

The structural discrepancy between sectors is pronounced. In agriculture, although during 1986-1991 labor force increased due to institutional impacts like HRS policy, labor force volume has been falling after that and the velocity of labor escaping from primary sector has been increasing. Accordingly, in non-agricultural industry, labor volume spiked shortly after 1986, and has held a considerable and stable share of contribution to total growth since 1992. These reverse trends of labor growth in two sectors indicates a steady structural transformation since 1992. Human capital growth only has taken a modest role in both sectors' growth.

The main engine of agricultural growth, as shown by yearbook data, is the fast growth of TFP. The contribution of TFP growth dominates and takes up nearly fifth to sixth as much as the contribution made by capital growth during the entire reform. The absolute values of TFP and capital growth rates, however, are rather stationary, as TFP has grown at in average around 7% annually while capital at around 10%. This suggests that these two factors have been accumulating in a stable speed, and the reason for their increasing share of contribution lies in the labor force crowd-out which has kept accelerating after South Talk.

Non-agricultural decomposition tells a quite different story. There is clearly a divisive year, 2001, that partitions the reform into two periods, the earlier one of which manifests itself as TFP-driven while the later one capital-deepening. Before China joining WTO in 2001, TFP growth accounted for more than 70% of the total growth in non-primary sector, while capital accumulation in average made approximately no contribution during this period. Nonetheless, from 2001 to the present time, non-primary sector has kept growing mostly credit to capital growth explaining around half of the total output growth, while TFP growth's explanatory power has dropped to approximate 25%. This shift of role of TFP growth an capital growth must have

something to do with events happened during the early 2000s.

The sectoral decomposition separates two trends appearing in aggregate growth accounting. The first trend refers to the breakpoint-like change of relative importance of TFP and capital during the early 2000s. The fall of TFP growth's contribution and the rise of that of capital accumulation perfectly coincides with the interchange of role of these two factors in non-primary sector, the change that capital growth has taken the lead instead of TFP growth.

We find the results of this sectoral dissection interesting, for it must imply some underlying distinction in the patterns of agricultural and non-agricultural development in China, for example, the structural transformation in labor market across sectors, the driving forces behind rapid agricultural TFP growth, and the economic logic explaining capital's overriding TFP in non-agricultural industry. We will revisit these issues in detail later.

3.3 Sectoral Transformation

The factoral analysis has shown that the labor migration from agricultural department to non-agricultural department has been phenomenal and steady since the 1990s. The topic of structural transformation is a distinct angle of viewing China's growth apart from factoral growth, but it has always been intertwining with the latter.

To form a overall view of this transformation, we draw three sectors' shares of labor market from the 1950s to 2017 in Figure 5 where the declining share of agricultural labor force with the increasing trend in the other two industries is manifest.

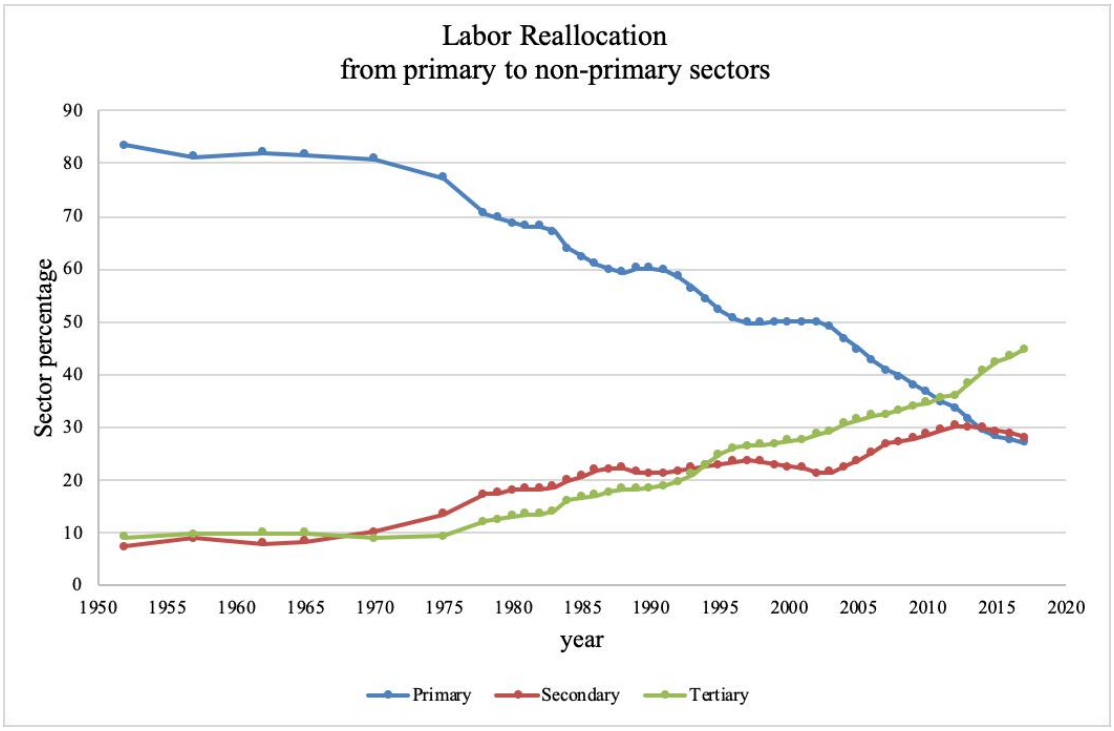

Figure 5

Another demographic presentation is also relevant that the urbanization process pushing population out of rural to urban household demonstrates the main part of this labor migration. We illustrate urban and rural population growth rate respectively in Figure 6 where we notice that since the 1970s the population growth in cities has been higher than that of countrysides, and because of the higher natural growth rate in rural region, the migrant population takes more than the discrepancy in rate shown on the figure.

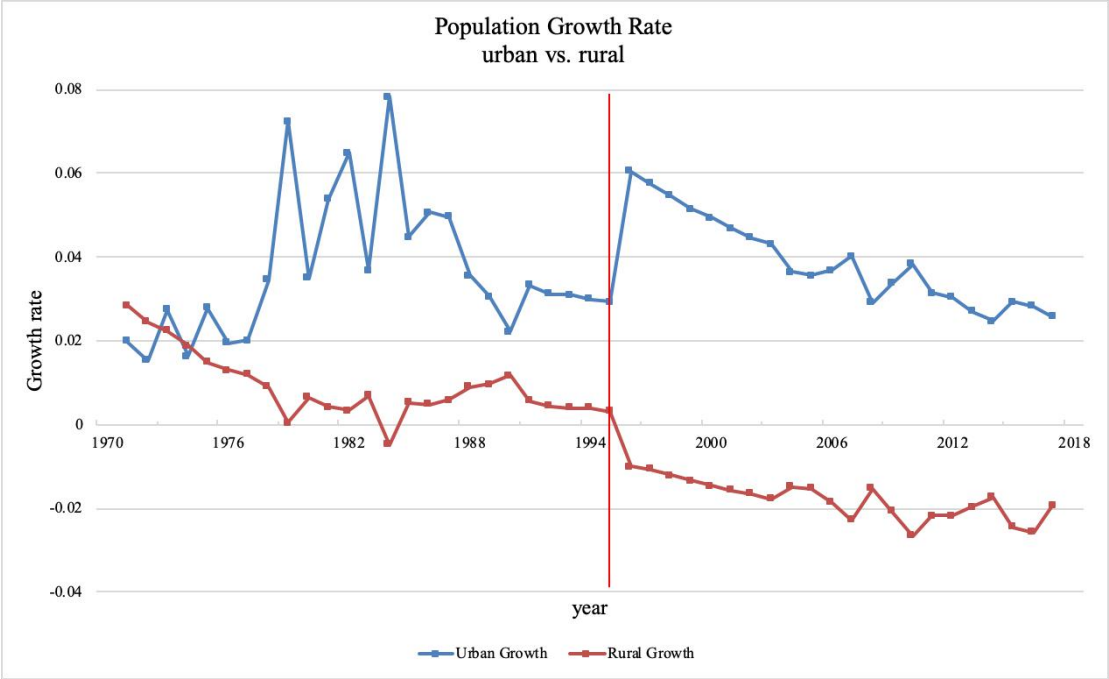

Figure 6

However, population shift only represents the facade of structural transformation, and a more analytical way lies in investigating the incentives driving the individuals in migration decisions. A straightforward measure of economic incentives here is the wages that labor faces in different sector. In principle, an ideal economy, where labor markets in each of the sectors all reach equilibrium state and the liquidity between sectors is unlimited, will gives that wages of different sectors should be equal if the discrepancy in human capital among individuals is not manifest. Based on this theoretical scenario, we can evaluate China's deviation from an ideal economy, the deviation that may incorporate the friction imposed on labor migration, by comparing the wages in agricultural sector and non-agricultural one. What is mentionable, the notion wage here is a general concept in that it measures not only the income of workers, but also revenue earned by peasants, managers, entrepreneurs, etc. whoever devote to economic growth somehow with its labor, so it is more appropriate to construe wage here as income or price.

Similar to our factoral decomposition, we assume that China's economy can be described by standard Cobb-Douglas production functions at aggregate and sectoral levels, which is also widely applied in literature. The production functions of the two sectors can be written as:

$$Y_p = A_p K_p^{\alpha_p} L_p^{1-\alpha_p}$$

$$Y_i = A_i K_i^{\alpha_i} L_i^{1-\alpha_i}$$

Here variables with subscription p refers to those in primary industry, and those with i to the i th sector. The capital income shares of two sectors are denoted by α_p and α_i, respectively. By further assuming that each of the sectors reaches equilibrium, we acquire the Model Price Ratio (MPR) defined as ratio of the wage of the i th sector to that of primary sector:

$$Wage_p = (1-\alpha_p) Y_p / L_p$$

$$Wage_i = (1-\alpha_i) Y_i / L_i$$

$$MPR_i = Wage_i / Wage_p$$

The expression of wage is acquired by dividing the labor share of output with labor volume.

For analysis based on this new notion, if one sector's MPR value is greater than 1, this sector should in principle expect more labor immigration from primary industry, which means that the demand of structural transformation is present. On the other hand, the presence of gap between MPR and its theoretical reference value implies some restrictions preventing labor migration from deepening to the equilibrium level. And if MPR is less than 1, the direction of demand and friction of structural transformation is reversed.

However, one may question the validity of MPR as an adequate measure, since this is based on two assumptions: that each sector reaches equilibrium, and that endowments like human capital are not pivotal determinant between positions in different sectors.

Now we start to justify MPR's meaningfulness and demonstrate its economic representation by showing evidence and elucidating theoretical notions. First, human capital along with other heterogeneity between two sectors' labor is indeed incorporated in MPR and is almost impossible to be separated. But in the sense of long-term transformation, these discrepancies can also be seen as part of migration restriction. The incentives contained in the notion *wage* is far richer than its common version, since it encompasses all concerns over cost and benefit of working in a sector, for example, the cost of accumulating human capital to be qualified for positions in another industry. These costs are actually similar to some migration barriers in the long run, like the loss one must take before acquiring an urban household registration which is necessary in working in urban industries.

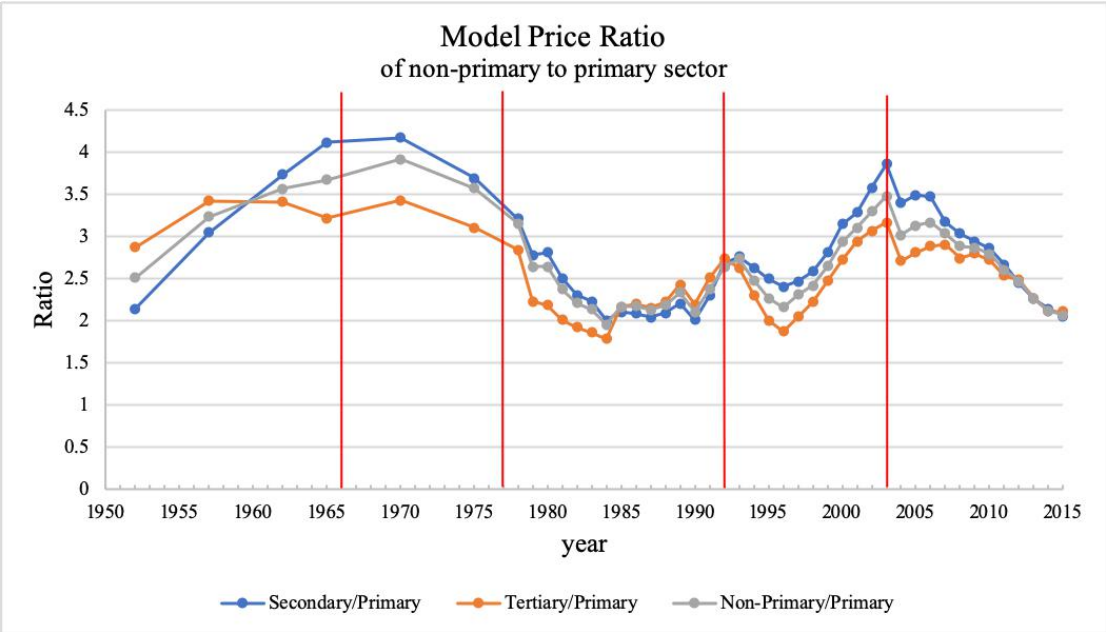

Figure 7

Our second justification of MPR lies in its perfect fit with historical events. In Figure 7, we presents the MPR values of secondary, tertiary, and the whole non-primary sectors. Notice, on the one hand, that these three sectoral MPRs have shared the same trend since the 1950s, and that they have stayed constantly greater than 1 and dwelt between 2-4. And on the other hand, there are three conspicuous time points after which MPR started to fall for some time: that is, 1977 when the Great Culture Revolution (GCR) ended, 1992 when Deng traveled south to address speeches and instructions for official economic reform and open, and 2003 when the gradual implementation of the rural-to-non-rural policy was finished. These three time points are marked by red vertical lines in Figure 7. After the trauma of GCR, China soon stepped into reform and the reallocation of labor from rural to urban areas was expedite. Likewise, South Talk triggered a nationwide mobilization from countrysides to cities and from west inland to east coast. The most phenomenal decrease of MPR is the one lasting from 2003 to the present time, and this must result from the new urban-rural migration policy spread all over China during 1998-2003, the policy that broke the strict migration restriction on peasants and allowed qualified rural individuals to seek for urban household registrations. Corresponding to the three events, MPR dropped right after them, or equivalently, it approached the theoretical value 1. This characteristics makes MPR a sensitive indicator of transformation restrictions responsive to relevant policies.

The last justification for MPR is to corroborate the assumption that markets all reach equilibrium, and therefore MPR presents mainly the effect of migration restriction. Unlike labor, capital usually suffers less from inter-sectoral liquidity barriers so that we should expect Model Price Ratio of Capital (MPRC) to be more stationary and near to 1. Similar to the definition of MPR, we write MPRC as below:

$$R_p = \alpha_p Y_p / K_p$$

$$R_i = \alpha_i Y_i / K_i$$

$$MPRC_i = R_i / R_p$$

Here we denote the income or price of capital, rent, as R . We depict MPRC of non-primary sector in Figure 8.

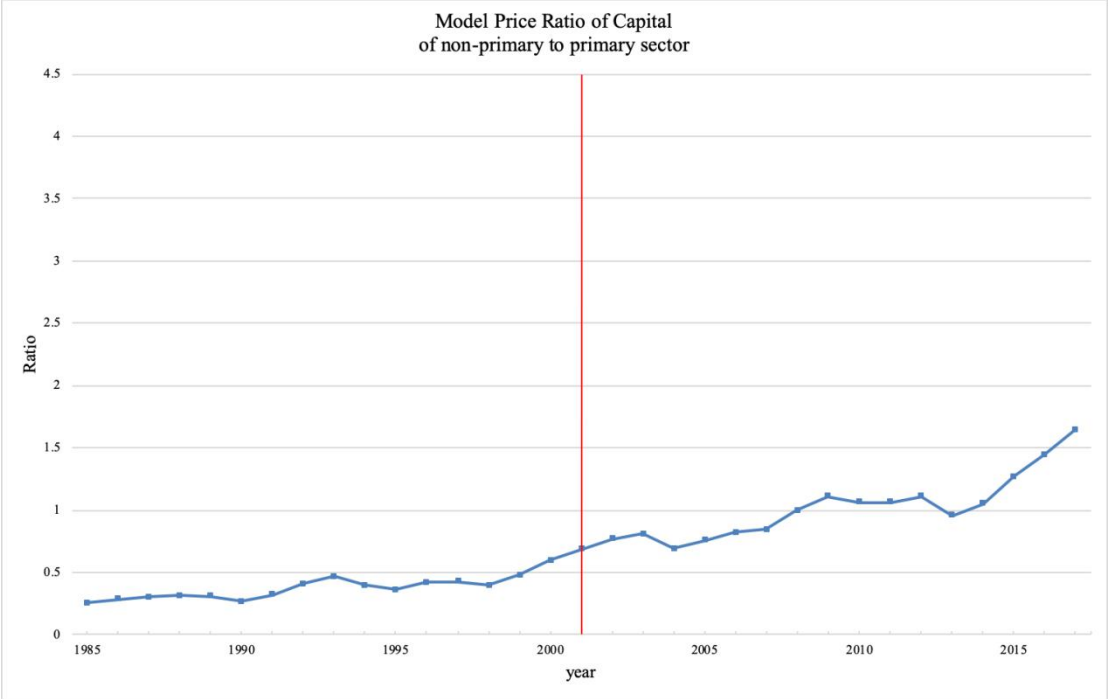

Figure 8

As expected, MPRC of non-agricultural department has been maintained around value 1 since the early 2000s by which China's capital market reform had achieved great progress, and although before that MPRC lied farther from 1, its rapid converging trend was remarkably consistent with China's gradual liberalization of capital flow. Along with the assumption that capital can be viewed as with higher inter-sectoral liquidity, the fact that the rents in primary and non-primary

industries float at similar level confirms that the capital markets within each of the sectors are actually at equilibrium. However, we still need to answer the last question that if the liquidity within each labor market is comparable to that of the corresponding capital market. We only state this issue intuitively that labor market's in-sectoral friction should be far less severe than the inter-sectoral friction, which makes MPR only a noisy proxy of migration restriction, instead of a confounding one.

For more comments on MPRC defined above, we notice this value has been generally increasing and surpassed 1 in the late 2000s. While the increase before MPRC reaching 1 presents a converging pattern, the trend after the late 2000s started to diverge from equilibrium level, especially the sharp rise after 2013. This trait may imply unusual growth pattern of capital, which we will discuss later.

Therefore, by incorporating human capital discrepancy into the notion of transformation restriction, linking MPR's three drops perfectly to three important historical events, and comparing MPR with MPRC to demonstrate that equilibrium is reached within labor market, we justify MPR's validity for being an measure of migration barriers. As a result, Figure 7 shows a huge gap between the realized MPR and its theoretical value 1, and this implies the existence of two driving forces shaping MPR which we will discuss in the next section.

4.Discussions

Two angles illustrating the underlying force driving the growth of China, factoral contribution and structural transformation, are presented in the previous section. Many studies have laid eyes on the causes for China's rapid development after 1978 and these two perspectives are most frequently discussed. They separately demonstrate the phenomenal growth patterns of China's economy in the past 40 years, while their effects are always intertwined with each other. This section presents previous views in literature and our economic interpretation over these two points.

4.1 Factoral Contribution

Confronted with the fact that China has become the second largest economy, scholars have heatedly debated about which factor plays a larger role. For example, after comparing capital

investment and TFP's effect on output growth, Sun and Ren (2005) pointed out the former is the primary cause of China's success. Coincidentally, Li, Dong and Wang (2008) induced institution into the endogenous growth model, discovering that physical capital, human capital and property institution are three main determinants of China's economic growth. Their work also implied that as the development of institution is more perfect in the future, economic growth will rely on human capital and technical progress to a greater extent.

However, others like Young (2003) saw the country's unprecedented developing speed from a different perspective. He held the belief that China's prosperity should be interpreted in two stages, with labor deepening being the main reason during 1978-1998 and capital deepening after the early 1990s. This conclusion was challenged by Zhu (2012) later on, who argued that it was the high growth rate of TFP rather than capital accumulation that keeps pushing economic growth.

As another view of this phenomenon, Chen, Jefferson and Zhang (2011) maintained that structural change is the most important source of development. And by analyzing data during the entire 1978-2008 period, they found that TFP growth has exceeded the quantitative growth of inputs since 1992, but the contribution of productivity to output growth declines after 2001. Moreover, structural change has contributed to TFP and output growth substantially but also decreasingly overtime.

Similar to the literature reviewed above, our work also examined the contribution of various factors to China's development. In consideration of different stages of structural reform in Chinese Industry, we decomposed its economic growth between 1978-2017 in four time spans separately, with the South Talks in 1992, China's entering the WTO in 2001 and Global Financial Crisis in 2008 as time divisions. When we focus on the non-primary sector, the results in last section have suggest that before 2001, TFP remained being the dominant driving force behind its GDP growth, whereas quickly shaded into relatively insignificance afterwards. On the contrary, capital growth seemed to gain momentum and dramatically improved its contribution rate since 2001.

According to Zhu (2012), the rapid TFP growth in non-primary sector before 2001 could be mainly explained by a series of State-owned Enterprise Reform (SER) and the subsequent rise of non-state sector. To be specific, encouraged by the success of rural reforms in the early 1980s, the Chinese government started two market reforms in the non-agricultural sector. Firstly, the non-state-owned enterprises were allowed to enter previously forbidden industries, selling and

buying their inputs or outputs at market prices. In addition to that, economic decision-making powers were also devolved to lower-level governments, providing them with fiscal incentives. As a consequence, the non-state sector gained access to capital and raw materials from the markets, flourished and greatly promoted employment. And on top of that, the expansion of employment was accompanied by rapid total factor productivity (TFP) growth, averaging 5.87 percent a year during this period.

As for the accelerating growth pace of capital accumulation, Kuijs and Wang (2005) have verified that China's non-agricultural sector has a capital growth trend far exceeding that of agriculture. This finding was also supported by our results. It is exactly this superiority that makes capital growth in non-agricultural sector gradually become the center and finally surpass TFP growth's contribution in 2001.

But unlike Young (2003) or Kuijs and Wang (2005), we don't think this is bound to be an unsustainable economic growth pattern. Just as Figure 8 shows in last section, MPRC is still on the rise, implying that even though capital accumulation is so rapid, the growth rate of non-agricultural capital is actually insufficient. Hence, we suppose that the capital growth at present only indicates a balance between more rapid growth in capital demand and the friction imposed on capital flow.

Such urgent needs for capital growth may come from the driving forces of open capital markets and China's opening to the outside world (since joining WTO in 2001). Or, as shown in Figure 9 below, Brandt and Zhu (2010) maintained that the capital market's distortion made the state-owned sector's capital share accelerate since 1997, and a government-led accumulation of capital may be one of the drivers.

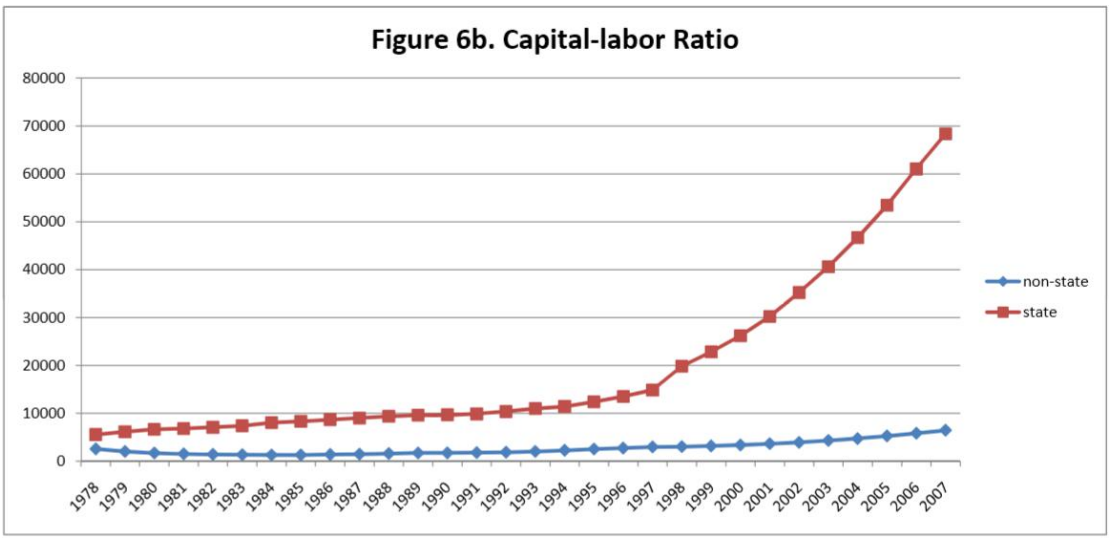

Figure 9: Figure 6b, Brandt and Zhu (2010)

4.2 Structural Transformation

Beside productivity growth, reallocation of labor force from agricultural to secondary and tertiary industries is also attached with great importance in depicting China's growth. Dekle and Vandenbroucke (2012) showed that the transformation from agricultural to non-agricultural department accounts for one third of total GDP growth during 1978-2003.

To analyze the economic logic behind such transformation, we have introduced Model Price Ratio (MPR) in our main findings. MPR has been justified with careful analysis earlier as being an adequate measure of transformation restrictions. However, the cause shaping MPR needs further dissection because this superficial *restrictions* shown in MPR is an equilibrium outcome involving numerous factors, and it contains at least two main countervailing forces: the *demand* and the *friction*, that is, the strength pushing agricultural employment to non-agricultural department, and the institutional barriers suppressing this liquidity of transformation. Based on this framework, the fact that MPR is consistently greater than 1 as shown in Figure 7 makes us believe that both the demand and friction exist. We elaborate on China's structural transformation by discussing the form and cause of these two aspects.

The *demand* of transformation refers to unbalanced sectoral labor demands caused by different intrinsic changes within primary and non-primary sectors, and many studies narrow the changes to two categories: TFP growth and capital accumulation. Both of these factors can affect the

productivity of labor in a specific industry and thus indirectly shape the incentives of individuals differently. While some (for example, Zhu 2012) argue that China's economic growth is persistent because it mainly results from the growth of TFP, as Solow (1956) taught us, others (for example, Wolf 2011) contend that China has been merely *chasing* by accumulating capital volume. The pushing forces of both can be measured respectively by the contributions of sectoral TFP growth and investment growth to sectoral total growth.

In the last section, we have shown their factoral contributions at every levels. In primary sector, growth of TFP remains a dominating factor for it takes up nearly fifth to sixth as much as the proportion taken up by investment/output during the entire 1986-2017 period; and in non-primary sector, the power of TFP growth has been falling while capital growth becoming more and more important, since before 2001 TFP growth took up approximately 75 percent of total contribution and investment/output only around 0, but after the year when China joined WTO the trend has been reversed and investment on physical capital explains half of the total growth in secondary and tertiary sectors. The explanation suitable for this result is that the comparatively higher increase of TFP in agricultural sector allows food demand, which is less elastic and growing slower than aggregate economy, to be met with fewer farmers and workers, and consequently this lowers the demand for labor in primary sector and reallocates employment to non-primary parts. Brandt, Hsieh, and Zhu (2008) have verified this numerical trait that TFP growth in agricultural field is more phenomenal in other sectors, and argued that the indirect function of agricultural TFP increase lies in labor reallocation.

And on the other hand, capital accumulation indirectly rises the productivity of labor and thus the rising wage can engender an inter-sectoral shift. Brandt and Zhu (2010) scrutinized this channel by modelling a three-sector model to test causes for structural reallocation, including the increase in investment rate, and they found that during 1978-2007 while TFP growth accounts for 39 percentage points of total transformation from agricultural to non-agricultural sectors, investment increase only explains 6 percentage points. Moreover, in our findings the absolute value of investment growth rate in primary industry is even higher than that of non-primary industry. As a result, all reasons above suggest that higher TFP growth in agricultural sector is the major cause responsible for the structural transformation from primary industry to non-primary industry.

The reason for rapid TFP growth in agricultural department is debatable. The strong incentives elicited by the Household Responsibility System along with other institutional and price reforms during the 1980s must take an important role. The gradual detachment of planned economy allowed individuals to efficiently respond to market, and therefore the TFP increasing during this period reflects an institutional improvement. Lin (1987) blamed the team-based system before HRS for its lack of efficiency in monitoring agricultural production, and argued that HRS shaped monitoring to an appropriate degree forming a Pareto improvement. And other institutional factors have been mentioned later, for example, by Deininger and Jin (2005) that the development of land rental market in both theory and practice matters in enhancing productivity, and by Deininger, Jin, and Xia (2012) that micro-level data shows the importance of land tenure security in facilitating the incentives for labor migration. Besides, the open of market has allowed peasants to access and develop agricultural technologies, and some scholars (for example, Jin, Ma, Huang, Hu, and Rozelle 2010) believe that this was the main force driving TFP after 1990.

The *friction* of transformation, however, seems less easy to identify. Back to the notion of MPR, while the demand tends to expand the fission between MPR and the theoretical value 1, micro-level economic selection, namely the process of individuals reaching their rationality and yielding an equilibrium, is aimed at narrowing it by balancing wages in different sectors, and the existence of this fission must represent some inadequacy of the latter force, the inadequacy which we call friction. In the 1980s and 1990s, the demographic liquidity between rural and urban areas was poor, for strict restrictions had been set since planned economy period, and the structural transformation might be mainly attributed to local development of non-primary industry. Further, even from the application of the rural-to-non-rural policy around the early 2000s to the present, the restrictions have still been rigid and one with rural household registration cannot change its identity before meticulous scrutinization.

Besides, friction refers to not only forbidding rules out of the need of demographic regulation, but also a result of separation between rural and urban economies: prohibitively high cost of living and education in cities and income inequality between the two societies may destructively quench peasants' fervor of seeking for new identity and thus of leaving for new industrial sectors. This corresponds to our analysis in the previous section that different endowments like human capital are actually migration friction in a long-term sense. Brown and Park (2002) used family-level data

to verify that lack of wealth tends to reduce education years of children from rural households. For more costly urban-rural barriers, Garriga, Hedlund, Tang, and Wang (2017) concluded that structural transformation shapes nearly 80% of urban house price rise, which in turn suppresses the transformation itself. Also, Chen and Lu (2004) identified the rising problem of urban-rural inequality, and they ascribed this to some urban-biased local governmental policies.

To sum up, the existence of both demand and friction of structural transformation is verified by our demonstration of MPR. Curiously, mutable as MPR seems in a long run, it remains contained in the interval 2-4, and even the value today is at a comparable level to that of 1949 and 1985. This may be an indication of the somehow balancing dynamic change of the demand and friction. Specifically, the increase in demand out of TFP growth should in this sense implies the reduction in friction out of loosened restrictions, for they have been dragging MPR line in a rivaling manner; and the phenomenon of structural transformation can be implicitly inferred.

4.3 Why These Two Angles?

The question *What is economic growth?* is different from another *How to measure economic growth?* What economists do about these two questions lies in the strategy of testing the former by first delving into the latter. Their stylized routine begins with manifest phenomena showing the patterns of growth, and then however the underlying causes for each phenomenon may intertwine, researchers hypothesize and test these causes, and later they compare these factors to exogenous inputs like policies and impacts in order to provide better understanding of the extent to which they can shape the society in success or failure.

The phenomena we are interested in when analyzing China's growth are factoral and sectoral transformations. Their concurrence suggests multiple logic strands explaining the *bases* of the 40-year growth, including institutional refinement implied by great TFP increase, chasing effect by capital accumulation, distinct sector productivity by structural shift, labor market friction by oddly high MPR, etc.. And of course they are essentially interacting, for on the one hand, different factoral changes create the need of structural shift, while on the other, labor reallocation marks a better economic layout directly enhancing aggregate TFP which helps with capital accumulation. By investigating these two perspectives, we, similar to literature, manage to breach the surface.

Even further, we shall derive from the elemental pieces of logic behind factoral and sectoral

growth a compelling story on China Miracle. And some prospects over China's future economic performance and several policy implications narrowing this future in an optimistic direction can be given. We present this in the following section.

5.Conclusion

The explanations of China Miracle, heatedly debated in scholarship and mysteriously mutable under different angles and updating data sets, offer the chance of analyzing the economic, political, and social factors driving the world's second largest economy. Scattering and marginal as the factors may appear in most of literature, a real and unique story must have been buried underneath the facts and data characterizing them. Our story, trying to refer to the conclusions of and to mitigate the conflicts among previous studies by utilizing data from different sources and constructing useful notion under careful scrutinization, is based on analysis of China's factoral and sectoral growth spanning from the 1980s to the present time.

Despite of the company of many impacts of reform, China's agricultural growth has manifested two phenomenal and stationary patterns: that the powerful engine, TFP growth, along with the more modest capital accumulation has been the main driving force of agricultural development since reform; and that labor force, albeit being shortly increasing right after HRS policy, has escaped from agriculture at accelerating speed since the early 1990s. Non-agricultural growth, consistent in the role of labor growth that has made steady contribution since reform, involves time-contingent presentations on TFP and capital growth. Before 2001, growth of TFP was considerable while capital accumulation almost stagnant; but after the early 2000s, the role of TFP has been overridden by investment.

Factoral changes within each sector result mainly from institutional factors. Technological accessibility plus land reforms like HRS policy and those on land rental market and land tenure security contributes to the steady growth of agricultural TFP growth. Before the late 1990s, the rapid TFP growth in non-state sector explains most of TFP growth in non-agricultural industry, and this mainly results from a series of State-owned Enterprise Reform (SER). The accelerating growth pace of capital accumulation in non-primary sector marks a distinct pattern of non-agricultural development, and we predict that this capital-dependence will continue in the

future evidenced by the rise of MPRC. However, we do not know for sure whether this trend of capital accumulation is a result of open and liberalization or that of state-leading growth pattern.

Sectoral labor transformation follows the inter-sectoral discrepancy in factoral growth. While MPRC shows that capital balancing between sectors has fitted with theory, especially since the early 2000s, the labor migration from primary to non-primary department has been both pushed by the demand of transformation and also stymied by the friction. The demand is attributed to the powerful growth of agricultural TFP which spares workers from meeting with food demand and frees them to be reallocated to other sectors. On the other hand, both the remaining formal restriction on urban-rural migration and the high cost of settling and working in cities contribute to the friction suppressing structural transformation.

For prospect, MPR, which has been converging to 1 since 2003, indicates a continuous trend of labor migration from agriculture to other sectors. Although this indicator underwent some rebound in 2016, we believe the agricultural productivity driven by institutional and technological factors will go on pumping population out of primary industry, unless further studies discover some unsustainability in it, for example, resurrection of universal governmental control. Besides, the emerging capital-dependent growth pattern in non-primary industries evokes more worries. The mounting MPRC demonstrates an increasing demand of capital accumulation, especially the rapid spiking since 2013, and we expect this trend to continue and that capital will take greater proportion in total growth if TFP growth further shrinks. However, the fact that MPRC has been greater than and therefore diverging from theoretical value 1 may imply that this capital growth cannot be completely ascribed to development of markets, and unhealthy growth pattern like state-leading may take some role.

We suggest Chinese government find cure from the deep root. China should continue to conduct institutional change, however different the form and area will be, and also should preventing expedient measures like state-driving growth, which may shortly prettify the aggregate growth accounting report but in the long run will go marginal and distorting, from taking the lead. Solow (1956) stressed the importance of TFP growth in sustaining long-term growth, and behind this blackbox-like notion lie institutions determining the efficiency of organization and mobilization, and technologies shaping the cost structures of markets. Only the self-perpetuating growth pattern under merely necessary regulation can secure healthy development. However, for developing

countries, this ideal equilibrium must be the eventual outcome of a series of governmental interventions, for which Chinese government has set an excellent example in the past 40 years with its success secret of focusing on active reform lighting the economic vigor once deadened. And this country should go on doing so, for example, further freeing land markets, deregulating labor migration restrictions, stimulating peasants to come to cities by accurate subsidy, undercutting the privilege of state-owned enterprises in capital market, etc..

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