HONG KONG INSTITUTE FOR MONETARY RESEARCH

# Sectoral Shifts and Growth Patterns in China

*Juan Carlos Martinez Oliva*

HKIMR Occasional Paper No.10

*July 2018*

HKIMR®

# Sectoral Shifts and Growth Patterns in China

Juan Carlos Martinez Oliva*

Former Senior Director
Directorate General for Economics, Statistics, and Research
Bank of Italy

Hong Kong Institute for Monetary Research

July 2018

**Table of Contents**



* I wish to thank Gemma B. Estrada, Jesus Felipe, Yasuyuki Sawada, and other participants in a seminar at Asian Development Bank where this work was first presented on June 26, 2017, for helpful remarks. All errors are my own.

## Annex

### Charts and tables

# 1. Abstract

This paper analyses the sectoral shifts that occurred in the Chinese economy in the period 1980-2015. This is done by highlighting the main patterns of growth and productivity using Chinese official statistics. The analysis points to a transition that is still under way, from an era of deep industrialisation towards an economy driven by growth in the services sector. It is argued that this transition might be completed sooner than expected in view of the broad scope for expansion in financial services, and of China's extraordinary track record as a fast reformer.

**Keywords:** China; growth; productivity; sectoral analysis.

## 2. Introduction

The reform process started in 1978 by China's leader Deng Xiaoping paved the way to a broad structural transformation in the Chinese economy. Rural liberalization initially encouraged the establishment of local entrepreneurship activities and the beginning of migration towards the new "special economic zones", and state-owned enterprises. Growing flows of mostly young workers from the countryside to the cities started from the early 1990s. The transformation of China into a market economy, and its progressive integration with the world economy demanded larger and larger proportions of workers engaged in industrial activity. That unprecedented mass migration of workers from less productive to more productive activities contributed to the rise of aggregate growth and productivity[1].

As a result of labour reallocation China's economic transition was a striking success. In 1978 China represented 2.2 per cent of the world's GDP. That figure leapt eightfold to more than 16 per cent in 2016, a performance never previously achieved by a rising economic power.

China's transition from an emerging economy to a developed economy is still in progress. This paper aims to assess the situation in the light of the most recent trends, and in view of the task, reiterated by authorities in recent years, to make the services sector the main driver, led by consumption, of the economy. This is performed by analysing the sectoral shifts that occurred in China in the period 1980-2015, with the help of a number of tools aimed at highlighting the main features in the patterns of growth and productivity of the economy. The narrative that can be drawn from the official statistics points to the fact that China is already transitioning from the era of heavy industrialisation and manufacturing activity towards a growth model led by the services sector. The data suggest that there is still a long way to go to a services-led pattern of growth; but if one looks at the broad scope for expansion in financial services, and to the policies undertaken in China to enlarge the opening of the economy, broaden the financial and currency markets, foster global communication, finance world infrastructures, then the transition might occur faster than expected.

1 The positive net contribution to China's growth coming from the reallocation of workers from agriculture to non-agriculture has been estimated to be around 1.4 percent per year. (Ercolani and Wei, 2011)

# 3. GDP Decomposition in Supply Side Components

We start the analysis by decomposing GDP according to the following identity:

$$Y = \frac{Y}{L} \times \frac{L}{F} \times \frac{F}{P} \times P$$

Where $Y$ is GDP; $L$ is the number of workers (employment); $F$ is the labour force; and $P$ is population.

If we apply logarithms on both hands of the above expression, and differentiate we get:

$$\Delta Y / Y = \Delta \frac{Y}{L} / \frac{Y}{L} + \Delta \frac{L}{F} / \frac{L}{F} + \Delta \frac{F}{P} / \frac{F}{P} + \Delta P / P$$

The expression above represents the percentage change of GDP as the sum of the percentage changes of: productivity; the employment rate; labour participation; population.

Table 1a shows that labour productivity has been the main driver of GDP growth in 1980-2015. Being a cyclical component, the employment rate can be disregarded. Participation rates, which grew at very high rates during the 1980s, have stabilised in the 2000s. The rate of growth of population has reduced from yearly rates close to 1.5 per cent, to 0.5 per cent, as an effect of the one-child-policy introduced in 1980 and scrapped in 2015.

# 4. Decomposition of Aggregate Labour Productivity

The category of productivity considered here is labour productivity, i.e. output per worker. For this paper, output per worker represents a simpler and more visible indicator than total factor productivity (TFP) to measure the consequences of inter-sectoral shifts. Indeed, TFP calculation heavily depends on how capital stock is measured and assessed. The range of TFP estimates for China is so wide that the necessity has arisen to categorise them under the two broad groups of "optimistic" and "pessimistic" views. The choice between the two views clearly relies more on individual judgement than on objective evaluation[2]. Furthermore, recent research persuasively argues that the results from TFP calculations for East Asia are affected by methodological choices that reduce the relevance of such exercises, and therefore their use for analytical or policy purposes[3].

The approach utilised in this paper is widespread in literature. It takes different names and formulations, but it is fundamentally based on the economic interpretation that can be given to the expression obtained from applying the difference operator to the product of two variables in mathematics (see Annex). This kind of decomposition, commonly named shift-share analysis (such as in Molnar and Chalaux, 2015), proves helpful to the task of decomposing aggregate labour productivity in various effects[4]. In the literature of labour productivity decomposition it follows the observation that a simple weighted sum of sectoral productivities fails to provide a complete explanation for aggregate productivity in one national economy (Denison, 1962). In this light, shifts in labour allocation across sectors may contribute to a more thorough explanation of aggregate labour productivity change.

The working assumption in the following decomposition is that real sectoral components are additive, i.e. their sum amounts to the aggregate output of the economy[5]. Accordingly, country's GDP can be decomposed as follows:

$$Y = \sum_{i=1}^{n} Y_i$$

where the aggregate output $Y$ is equal to the sum of the output of all $n$ sectors.

---

2 For an extensive survey of the debate see Xu (2014).

3 See Felipe and McCombie (2017). Felipe (1999), had previously criticised the neoclassical framework as a tool for evaluating TFP in East Asia, suggesting that the theoretical problems underlying the notion of TFP are so significant that the whole concept should be seriously questioned.

4 In the context of the analysis of international trade, it is called, constant market share analysis, and it is used to describe if the allocation of a country's exports across its trading partners is optimal.

5 This property descends from the fact that real output is calculated at constant prices using fixed base Laspeyres quantity and Paasche price indexes at both the aggregate and sectoral levels.

Given the property of additivity, the difference of Y from time 0 to time t can be defined as:

$$Y_t - Y_0 = \Delta Y = \sum_{i=1}^{n} \Delta Y_i$$

Dividing the above by $Y$, we can define the percentage change of $Y$ as a weighted sum of all sectors' rates of percentage change:

$$\frac{\Delta Y}{Y} = \sum_{i=1}^{n} w_i \frac{\Delta Y_i}{Y_i}$$

Where the weights $w_i = Y_i / Y$ represent the relative size of each sector $i$ on aggregate GDP (Table 1b).

It now follows the decomposition of the growth rate of labour productivity.

According to the above, aggregate productivity, defined as aggregate real output per worker, can be expressed as:

$$\frac{Y}{L} = \frac{\sum_{i=1}^{n} Y_i}{\sum_{i=1}^{n} L_i}$$

If we assume that $k_i = L_i / L$ (the share of sectoral employment over total employment) and $y_i = Y_i / L_i$ (sectoral productivity) we obtain the following expression:

$$y_t = \sum_{i=1}^{n} k_{t,i} y_{t,i}$$

If we take the difference of $y$

$$y_t - y_{t-1} = \sum_{i=1}^{n} \left( k_{i,t} y_{i,t} - k_{i,t-1} y_{i,t-1} \right)$$

and use the following[6]:

$$k_{i,t} y_{i,t} - k_{i,t-1} y_{i,t-1} = y_{i,t-1} \left( k_{i,t} - k_{i,t-1} \right) + k_{t,i-1} \left( y_{i,t} - y_{i,t-1} \right) + \left( k_{i,t} - k_{i,t-1} \right) \left( y_{i,t} - y_{i,t-1} \right)$$

6 This property is expressed geometrically in the Annex.

by dividing by $y_{t-1}$, we get:

$$\frac{y_t - y_{t-1}}{y_{t-1}} = \frac{1}{y_{t-1}} \sum_{i=1}^{n} \left( y_{i,t-1} \left( k_{i,t} - k_{i,t-1} \right) + k_{i,t-1} \left( y_{i,t} - y_{i,t-1} \right) + \left( k_{i,t} - k_{i,t-1} \right) \left( y_{i,t} - y_{i,t-1} \right) \right)$$

that is, rearranging for convenience:

$$\frac{y_t - y_{t-1}}{y_{t-1}} = \sum_{i=1}^{n} \left( \frac{k_{i,t-1}}{y_{t-1}} \left( y_{i,t} - y_{i,t-1} \right) + \frac{y_{i,t-1}}{y_{t-1}} \left( k_{i,t} - k_{i,t-1} \right) + \frac{1}{y_{t-1}} \left( k_{i,t} - k_{i,t-1} \right) \left( y_{i,t} - y_{i,t-1} \right) \right)$$

The expression above represents the decomposition of total productivity percentage change in three separated effects.

Following Nordhaus (2001), performing the above decomposition highlights that aggregate labour output per worker can be split into three components: (a) a pure, fixed-weight productivity term which uses fixed base-year output weights (“pure productivity effect”); (b) a term that reflects the difference between current weights and base-year weights; (c) a term which reflects the interaction between changing weights and relative productivity levels in different sectors.

The definition of the three effects in this paper follows the mainstream naming convention in the literature of labour productivity decomposition[7].

Accordingly, Nordhaus’ “pure productivity effect” will be defined as a “within-sector productivity growth effect”, henceforth WSPGE. It represents the direct effect descending from changes in productivity in individual sectors.

The second term, Nordhaus’ “Denison effect”, consistent with Denison (1962), will be named “static structural reallocation effect” (SSRE). It shows that aggregate output per worker can increase even when sectoral labour productivities remain constant, provided that labour moves from sectors with lower output per worker towards sectors with higher output per worker.

The third term, the so-called “Baumol effect” in Nordhaus’ classification, after Baumol (1967), will be referred to as the “dynamic structural reallocation effect” (DSRE). This definition highlights the changes in productivity associated with the reallocation of employment across sectors with different productivity growth rates. The sign of this effect is positive (negative) when labour moves towards (away from) a sector with higher (lower) labour productivity growth.

---

7 Such as, among others, Felipe et al. (2007), Usui (2011), De Avillez (2012), Dumagan (2013).

To better understand the features of WSPGE, DSRE, and SSRE it is helpful to note that:

(1) When sectoral productivity is constant (i.e. $y_{i,t} = y_{i,t-1}$) WSPGE and DSRE collapse to zero, and aggregate productivity is entirely explained by $SSRE = \sum_{i=1}^{n} \frac{y_{i,t-1}}{y_{t-1}} \left(k_{i,t} - k_{i,t-1}\right)$ that is the change in sectoral employment share. The implication is that the net sign and size of SSRE will be determined by the way labour force moves toward the sector(s) with higher-than-average productivity.

(2) When sectoral labour shares are constant (i.e. $k_{i,t} = k_{i,t-1}$), SSRE and DSRE collapse to zero (there is no sectoral shift). The aggregate productivity is only explained by:

$$WSPGE = \sum_{i=1}^{n} \frac{k_{i,t-1}}{y_{t-1}} \left(y_{i,t} - y_{i,t-1}\right)$$

that is the sum of sectoral productivity changes, weighted by quotas of sectoral output, over total output.

# 5. The Data

Since China's fast economic expansion triggered a growing interest by analysts and academic scholars in the last two decades, its official GDP figures have been subjected to close scrutiny and heavy criticism[8]. These ranged from the suspicion that official statistics might be inconsistent with the evidence emerging from alternative indicators of economic activity to the concern that the figures might be hardly comparable with the equivalent statistics of other countries that follow uniform international standards[9].

In spite of the above, recent research suggests that recently reported Chinese GDP figures are no less reliable than is commonly observed elsewhere (Fernald et al., 2013). Official GDP data are found to display only few and acceptable statistical anomalies, supporting the view that the National Bureau of Statistics of China is fully reliable (Holz, 2014). In summary, China's official GDP data can be viewed as similar, in quality, to those of other countries[10].

With these considerations in mind, the data in this paper were collected from the 2016 issue of the National Bureau of Statistics of China's Statistical Yearbook. Although not exempt from some problems, which will be considered in the following sections, such data are trusted in this paper as providing a true and realistic representation of the Chinese economy.

When computing sectoral output in real terms for China, one is faced with a serious difficulty. In the National Bureau of Statistics of China's Statistical Yearbook for 2016, there are six base years in the National Accounts Series, namely 1970, 1980, 1990, 2000, 2005, and 2010. For the period relevant to the present analysis, 1980-2015, constant price data are based on five different benchmark years, as linking of GDP has not been undertaken so far. If one follows the procedure to link the time series of GDP at constant prices, in every rebasing year[11], the results are inconsistent, because they lose the additivity property. Moreover there are breaks in sectoral quotas when moving across different base periods. For this reason, the following procedure has been used in this paper. Sectoral quotas from current prices series have been computed and applied to the aggregate real GDP series at 2010 constant prices to derive the equivalent real output for the three sectors. This procedure implicitly assumes that relative prices in the three sectors are constant over time, which might prove a disadvantage. On the positive side, it makes the series smooth and consistent, and keeps the additive properties.

Another problem with the data used for productivity calculations involves the labour force series. This is a well-known anomaly in the aggregate employment series (Maddison and Wu, 2008; Wu, 2015), consisting in a 17.3 per cent increase in the number of employed between 1989 and 1990 (from

---

8 A detailed review of the debate on the reliability of Chinese GDP figures started by the "wind of falsification and embellishment" found in 1998 is contained in Holz, 2014.

9 The interest in thoroughly analysing the Chinese economic structure, and an evident dissatisfaction or mistrust in what concerns official statistics, has induced some authors to recalculate specific subsets of Chinese macroeconomic data, so as to be compliant with a priori assumptions or models (see, inter alia, Maddison and Wu, 2008; Wu, 2014; Cheremukhin et alii, 2015; Chang et alii, 2015).

10 This might not be necessarily reassuring if one considers the early warnings of pioneers like Kuznets and Morgenstern against the reliability of national accounts statistics for quantitative analysis purposes.

11 This procedure is consistent with the suggestion of the National Bureau of Statistics of China to "link the time series of GDP at constant prices, in every time of rebasing, not only by the new base year constant prices, but also by the previous base year constant prices". See United Nations Statistics Division, p. 9.

55,707 to 65,323), the causes of which are still unclear[12] today. In this paper no attempt is made at smoothing the above discontinuity. Since the analysis is based on annual rates of change the jump in employment series is restricted to a single year in year-by-year analysis and is almost negligible in cumulative analysis.

12 It has been suggested that this problem might be caused by a clash between population census-based estimates and annual estimates through a long-established data reporting system, but it is also claimed that the problem deserves further investigation. See Wu (2014); Maddison and Wu (2008).

## 6. Labor Productivity Decomposition

Calculations have been performed by using Speakeasy, a numerical computing interactive environment also featuring a powerful interpreted programming language[13]. Formulas are computed in cumulative terms, which means using the initial and final observation of each period, or sub-period, considered, so as to have that $t_0 = initial$ and $t_n = final$[14].

To start with the object of the decomposition, in the period 1980-2015 aggregate labour productivity has increased from 5,224 yuan to 77,883 yuan per worker, at constant 2010 prices (roughly from US$765 to US$11,450 at the average exchange rate of that year), with an average yearly rate of growth of 7.58 per cent (Figure 1, Table 1c). This makes China an exceptional performer vis-à-vis most other economies in the world[15]. Industrial output per worker has been consistently higher than services output, with agriculture lagging behind the two throughout the whole period.

As a result, the sectoral share of industry has been the largest until 2012 (Figure 2). Afterwards services have gained a consistent advantage, with a share nearing 50 per cent, as against 42 per cent in industry, and 8 per cent in agriculture.

Sectoral labour shares show that in the early 1980s agriculture absorbed almost 70 per cent of total employment, and progressively fell below 30 per cent in 2015 (Figure 3). Likewise in output shares, labour shares in industry remained roughly stable from 1980 to early 2000s. Afterwards, industry labour share has increased by 10 percentage points to almost 30 per cent. However, labour share in services sector has steadily increased throughout the whole period, from around 13 per cent to around 42 per cent.

Table 2 shows the decomposition of aggregate China's output per worker into sectors and effects, calculated on the basis of the framework illustrated in the previous section. The increase in aggregate output per worker between 1980 and 2015 amounts to 13.91, or almost 14 times, consistent with a yearly growth rate of 7.58 per cent. For the whole period 1980-2015 the largest contribution comes from services sector, followed by industry. The contribution from agricultural sector appears only marginal.

If one looks at the decomposition of aggregate productivity increase throughout the whole period, the WSPGE, or pure productivity effect, prevails over the other effects – a result commonly found in literature. As already noted before, WSPGE represents the overall productivity change when sectoral labour shares are constant.

However, this is not the case in the period under examination, because the strong reallocation in sectoral labour shares yields sizeable dynamic structural reallocation effects (DSRE). Its amount is particularly large for services, as one would in principle expect, for the combined effect of the sector's productivity dynamics, and its fast growing labour share. A similar pattern, but on a smaller scale, is found in industry, where productivity dynamics is slightly faster, but labour share

---

[13] A long-lasting numerical package, Speakeasy was initially developed for internal use at the Physics Division of Argonne National Laboratory by the theoretical physicist Stanley Cohen.

[14] It can be easily checked that, given the peculiar features of the disaggregation formula, the single terms cannot be summed or averaged, because the additivity property would get lost, and the analysis would thus yield inconsistent results.

[15] For a comparison see United Nations Statistics – Millennium Development Goal Indicators; growth rate of GDP per person employed, indicator 1.4 on web: *https://unstats.un.org/unsd/mdg/SeriesDetail.aspx?srid=757*

dynamics is slower than in services. In agriculture, a declining labour share combined with slow productivity produces a strong negative DSRE, as expected.

Finally, the contribution of SSRE is quite small. This is consistent with the pattern of fast productivity dynamics recorded throughout the period under observation, which makes DSRE the main source of overall productivity change.

Comparing different decades adds helpful complexity to the narrative provided by the aggregate dynamic patterns so far described. Indeed, agriculture records negative SSREs and DSREs, due to an ongoing process of reduction in the number of agricultural workers. As a consequence its contribution to aggregate productivity shrinks over time. At the opposite side, industry and services record fast productivity growth, and both contribute to the dynamics of aggregate productivity recorded by the Chinese economy during the different sub-periods. However, since 2000 to 2010, a decade of particularly fast productivity growth, the contribution of services sector starts catching up with that of industry sector. In 2010-2015, the contribution of services ends up becoming larger, both in terms of overall productivity growth, and in terms of static and dynamic sectoral reallocation, thus confirming the leading role of services sector in China's growth in the past few years.

The above is confirmed if one looks at Figures 4-8 which represent the sectoral contribution to aggregate productivity growth in cumulative terms (Figure 4); the contribution of the three effects (SSRE, WSPGE, and DSRE) to aggregate productivity growth (Figure 5); and the contribution of each of the three effects decomposed by sector (Figures 6-8). The graphical analysis highlights a number of interesting features, such as a declining contribution to productivity by industry in recent years (Figure 4); a persistently high dynamic reallocation, particularly in the 2000s, as noted before; a strong divergence, starting from early 2000s, in the dynamic allocation effects from industry and services. The latter displays an impressive boost, mirrored by the reduction in agriculture, in the presence of a slowing down in industry. Such patterns appear in line with the observed dynamic trends in immigration flows from the rural to the urban areas. Since this has still some way to go, the potential for fast GDP and productivity dynamics is viewed as very positive in the coming years (OECD, 2015). As a final remark, it is worth noting that, looking at cumulative dynamic effects, the industry sector appears the most strongly synchronized with the cyclical profile of GDP (Figure 9).

# 7. Sectoral Shifts and Economic Stages

Previous discussion has highlighted an ongoing sectoral shift towards the services sector in the Chinese economy. This is not surprising though; the behaviour of the services sector share in an economy has been long observed by economists, starting from the seminal contributions of Fisher (1935), Clark (1940), Fourastier (1949), and Chenery (1960). This relevant thread of economic literature that focuses on the structural transformation associated to the reallocation of economic activity across the three broad sectors, suggests that sectoral quotas of employment and output across sectors follow a predetermined sequence that helps in identifying the state of development of an economy.

In this vein, following an initial stage where agriculture absorbs the largest share of labor force, with low productivity levels, workers gradually move towards industrial activity, characterised by higher productivity and higher salaries. A new shift will occur when labor force flows towards tertiary activities, thus bringing about a gradual deindustrialization, in favour of an enlargement of services sector.

In order to analyse the features of the above trends in China, this section draws upon the pioneering econometric approach of Chenery (1960 and 1982), and Chenery and Syrquin (1975), which paved the way to a broad number of following contributions. In their analysis they assumed that sectoral quotas of economic activity basically depended on per-capita income, a variable that simultaneously embodies those supply and demand factors which represent the foundations of development process[16]. This analysis has become the workhorse of modern studies on the patterns of structural shift in development literature.

The specification adopted in this paper is based on the authors' suggestion that development dynamics should be viewed as a "multidimensional transition from one structure to another with lower and upper bounds for the analysed variables".

Since a logistic function seems to best match the above description[17], the following econometric specification has been here adopted for its convenient analytic properties:

$$Ln\left(\frac{\alpha_i}{100-\alpha_i}\right)=a+bY+c\ln Y$$

where $\alpha_i$ is the share of output or employment of sector $i$ and $Y$ is aggregate per-capita income. The above logistic transformation forces calculated values of $\alpha_i$ to stay in a boundary of zero to 100 for any value of independent variables.

The equation above has been estimated for the period 1980-2015 both for output sectoral data and per-capita GDP. Tables 3.1 through 4.3 report the details of the estimation tests, and figures 10 and 11 plot the calculated values for employment and output shares in the three sectors.

Employment and output share for agriculture dramatically decreases, as per capita income increases. The relative positions of the corresponding curves for output and employment in agriculture also confirm the low productivity in the sector, as already shown in Figure 1 and in the

16 A thorough discussion of demand- and supply-side factors in explaining the interdependence between growth and structural change is found in Syrquin (1988).

17 As suggested also by Garrido (2014).

analysis of previous sections. The opposite occurs in industry and services sectors. Services, in particular, display a marked tendency to increase their output and labour share across the period considered. The higher per capita income, the stronger the reallocation of labour towards services, particularly from agriculture; correspondingly, the output share of services increases mostly at the expenses of industry sector.

Projecting current sectoral patterns of output and labour shares across sectors would probably suggest that the services sector is likely to further reinforce its role as a leading source of growth and productivity in China. Indeed, for its still unexploited potential, the services sector is very likely to represent the main engine of growth and productivity in the future.

This finding appears to be in line with previous research. Herrendorf et al. (2014) have regressed sectoral shares for a number of countries in different periods, and using different databases. *Mutatis mutandis*, the sectoral pattern followed in the countries considered in that study appear broadly similar to that found for China. Looking at the industrial countries in the period 1800-2000[18], at earlier stages, with lower per capita income, the agricultural sector absorbs the largest labour share, and produces the largest (albeit relatively smaller) output share; the two approximately range from 60-80 per cent and from 50-70 per cent, respectively, to move lower than 10 per cent. At the centre stage of development most countries approach 50 per cent on both employment and industry shares, to decline to around 20 per cent in most cases. Services sector displays a steep upward trend starting in a range of 10-20 per cent to reach 80 per cent or more for employment shares. For the output shares, the start is at a range of approximately 20-40 per cent to end at around 80 per cent.

The above describes a common narrative for many countries in East Asia and South-East Asia, consistent with the classical view of reallocation patterns across sectors in the path to higher stages of development[19]. If China were to match the described trends, the services sector would still have a broad scope for growth from the current share of 40-50 per cent. The way to go might be shorter than expected if one considers that discontinuities sometimes occur in the path of services sector takeoff, due to an observable decline in the threshold per capita income for a takeoff of services, a behaviour that presumably reflects the diffusion and increased applicability of information technology (Noland, Park, and Estrada, 2012).

---

18 These are: Belgium, Spain, Finland, France, Japan, Korea, the Netherlands, Sweden, United Kingdom, and the United States.

19 See Park and Shin (2012), Estrada et al. (2013).

# 8. Conclusions

The evidence coming from advanced economies suggests that deep industrialization is only transitional, as it is invariably followed by a fast rise of the services sector share at the expense of industry. In the most advanced stages of development process services eventually become the most relevant economic activity. This begs the question of when this will happen for China.

Previous studies (Noland, Park, and Estrada, 2012) have suggested that the industrial sector has already come to maturity in many Asian countries, with the implication that industry is now displaying a reduced ability to maintain a fast pace of productivity and to absorb labour. Service sector, for its being labor intensive and highly dynamic, is the answer to the question of how to increase employment and living standards in the Asian region in the coming years.

The objectives stated in 2011 and again in 2016 in China's Five-Year Plan points to services sector and to consumption demand as the main drivers of the Chinese economy in the future. Evidence on the changing attitudes of Chinese consumers suggests that people are now spending larger amounts of their earnings on health care and education, as well as for travel and entertainment. Yet, shifting demand components from investment and net exports to private consumption is a complex task, requiring careful policy planning. Keeping the pace of structural reform will be crucial to ensure a smooth and painless transition to the "new normal"[20].

Compared with other Asian economies, China's services sector's share of output and employment appears still small but seems to be fast heading in the right direction. This paper has tried to analyse past trends of structural shifts in China, and derive insights for the future.

In this light, the first *caveat* that comes to mind is that conventional wisdom, policy blueprints, and the historical experience of other countries seem of little or no use when analysing China.

For its ability to successfully pursue hard-to-reach goals and to challenge conventional wisdom, China has often surprised analysts and practitioners. For example, the process of renminbi internationalization which has brought the yuan into the SDR basket of currencies has challenged the opinions of those who thought that a "dual track reform" was doomed to failure.

China has also displayed an extraordinary vitality and activism in creating visionary projects, such as the One Belt One Road initiative, or the AIIB, which are poised to promote growth and prosperity and improve lives in the regions affected. The growing use of RMB in trade and investment in Asia is fostering joint ventures and activities in Hong Kong, the largest offshore RMB Centre, meant to finance infrastructure projects in the Asian region. There is a clear mutually reinforcing interaction between the spread of RMB across the world markets and offshore issuances of RMB bonds aimed at financing infrastructural projects.

In spite of a relatively high share of economic activity compared to lower income Asian economies (Estrada et al., 2013), financial services are in China still smaller than in the largest advanced economies, and therefore with a broad potential for expansion. This suggests that the contribution of financial services to growth in China is likely to become very relevant in the years to come.

---

[20] OECD, 2015.

# References

Baumol, William J. (1967), "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis," *American Economic Review* 57, 415-26.

Chang, C. et alii, 2015. "Trends and Cycles in China's Macroeconomy". NBER Working Paper Series 21244, June.

Clark, C. (1940), The Conditions of Economic Progress. London: MacMillan & Co. Ltd. (reprinted in 1951)

Chenery, H.B., 1960. "Patterns of Industrial Growth", *American Economic Review*, Vol. 50, n. 4.

Chenery, H.B., 1982. Industrialization and growth: the experience of large countries. Staff working paper; no. SWP 539. Washington, D.C.: The World Bank.

Chenery H. and M. Syrquin, 1975, "Patterns of Development 1950-1970", Published for The World Bank by Oxford University Press.

Cheremukhin, A. et alii, 2015. "The Economy of People's Republic of China from 1953", NBER Working Paper No. 21397, July.

De Avillez R., 2012. Sectoral Contributions to Labor Productivity Growth in Canada: Does the Choice of Decomposition Formula Matter? CSLS Research Report 2012-09, December.

Dumagan, J. C., 2013, A Generalized Exactly Additive Decomposition of Aggregate Labor Productivity Growth. *Review of Income and Wealth*, 59: 157-168.

Denison, E.F., 1962, "The Sources of Economic Growth in The United States and the Alternatives Before Us". Supplementary Paper No. 13. New York: Committee for Economic Development.

Ercolani, M.G., and Z. Wei, 2011. "An Empirical Analysis of China's Dualistic Economic Development: 1965-2009", Asian Economic Papers 10:3, The Earth Institute at Columbia University and the Massachusetts Institute of Technology.

Estrada, G. et al., 2013. "The Service Sector in Lower-Income Asian Economies", ADB Economics Working Paper Series No. 347, Asian Development Bank, Manila, April.

Felipe, J., 1999, "Total Factor Productivity Growth in East Asia: A Critical Survey", *Journal of Development Studies* 35 (4), pp.1-41.

Felipe, J. and J. McCombie, 2017. "The Debate about the Sources of Growth in East Asia after a Quarter of a Century: *much ado about nothing*", ADB Economics Working Paper Series, No. 512. Asian Development Bank, Manila, May.

Felipe, J. et al., "Sectoral Engines of Growth in Developing Asia: Stylized Facts and Implications", ERD Working Paper Series no. 107, Asian Development Bank, Manila, November.

Fernald, J., Malkin, I., and M. Spiegel, 2013. "On the Reliability of Chinese Output Figures", FRBSF Economic Letter 2013-08. March.

Fisher, A.G.B., 1935. "The Clash of Progress and Security". London: MacMillan & Co. Ltd.

Fourastié, J., 1949. “Le Grand Espoir du XXe Siècle”, Paris: Presses Universitaires de France.

Garrido, L., 2014. “Patterns of Development. A Review of the Literature for an Empirical Update”. Paper presented at the 17th Annual Conference on Global Economic Analysis, Dakar, Senegal. https://www.gtap.agecon.purdue.edu/resources/download/ /7030.pdf

Herrendorf, B. et al., 2014, “Growth and Structural Transformation”, in: Handbook of Economic Growth, Edited by Philippe Aghion and Steven N. Durlauf, Elsevier. Downloadable at: http://www.sciencedirect.com/science/handbooks/15740684

Holz, C.A., 2014. “The quality of China’s GDP statistics”, *China Economic Review* 30: 309-338.

Maddison A., and H.X. Wu, 2008. “Measuring China’s Economic Performance”. World Economics, Vol. 9, n. 2, April-June.

Molnar, M. and T. Chalaux, 2015. “Recent trends in productivity in China: shift-share analysis of labour productivity growth and the evolution of the productivity gap”, OECD Economics Department Working Papers, No. 1221, OECD Publishing, Paris. http://dx.doi.org/10.1787/5js1j15rj5zt-en

Noland, M., D. Park, and G.B. Estrada, 2012. “Developing the Service Sector as Engine of Growth for Asia: An Overview”, ADB Economics Working Paper Series, No. 320, November.

Nordhaus, W.D., 2001. “Productivity Growth and the New Economy”. National Bureau of Economic Research Working Paper 8096. Cambridge, MA. January.

OECD, 2015. “Economic Survey on China”. OECD, Paris, March.

Park, D. and K. Shin, 2012. “The Service Sector in Asia: Is It an Engine of Growth?”, ADB Economics Working Paper Series, No. 322, December.

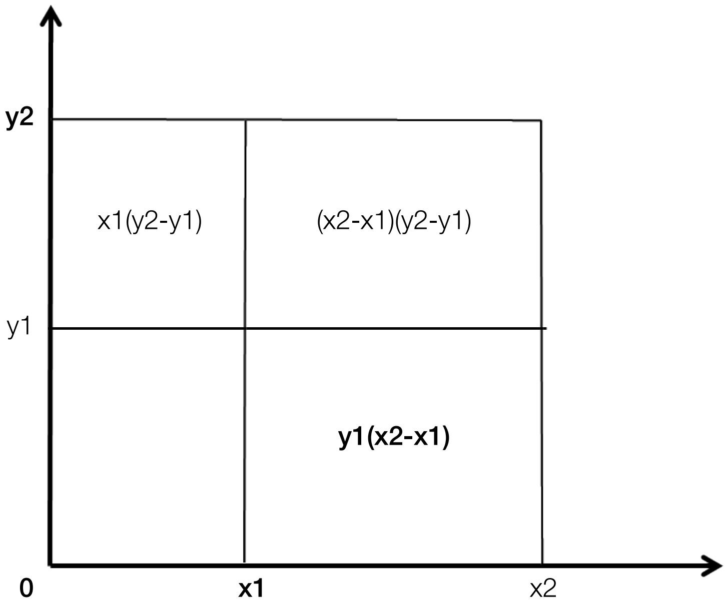
Syrquin, M., (1988), “Patterns of Structural Change”, in H. B. Chenery and T. N. Srinivasan, ed., Handbook of Development Economics, 2 vols., North Holland, vol. I, pp. 197-273.

Usui, N., 2011. “Transforming the Philippine economy: ‘walking on two legs’.”, ADB Economics Working Paper Series - No. 252, March

United Nations Statistics Division, “Review of Country Practices on Rebasing and Linking National Account Series”. Available via the internet: https://unstats.un.org/unsd/DA-SEA-Asia/Documents%20-%20Lao%20WS/Lao%20WS-Country%20practices%20on%20 rebasing%20and%20linking%20NA.pdf

Wu, H.X., 2014. “China’s Growth and Productivity Performance Debate Revisited – Accounting for China’s Sources of Growth with a New Data Set”, The Conference Board Economics Program Working Paper Series, EPWP n.14-01

# Annex

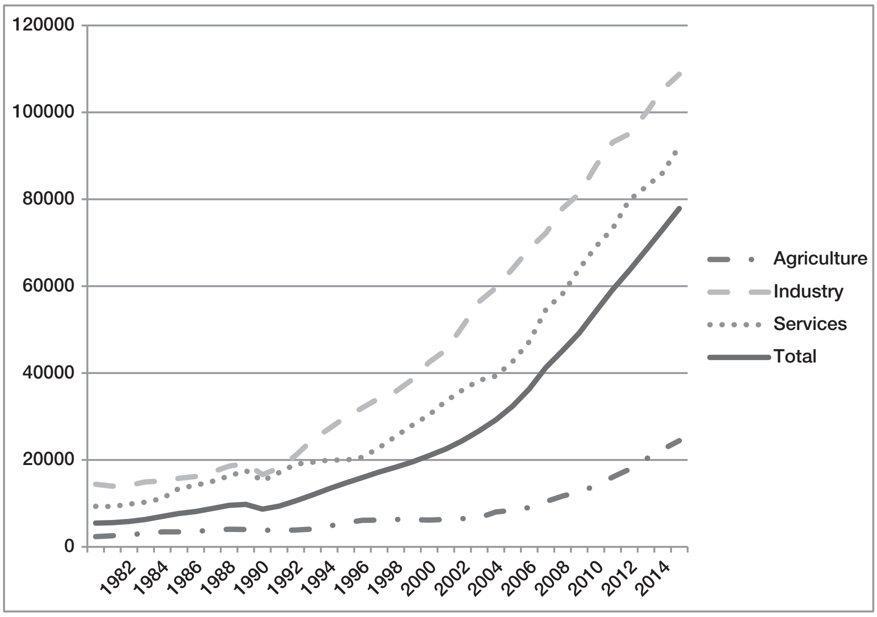



**$z1=x1y1$ ; $z2=x2y2$**

$z2-z1=x1(y2-y1)+y1(x2-x1)+(x2-x1)(y2-y1)$

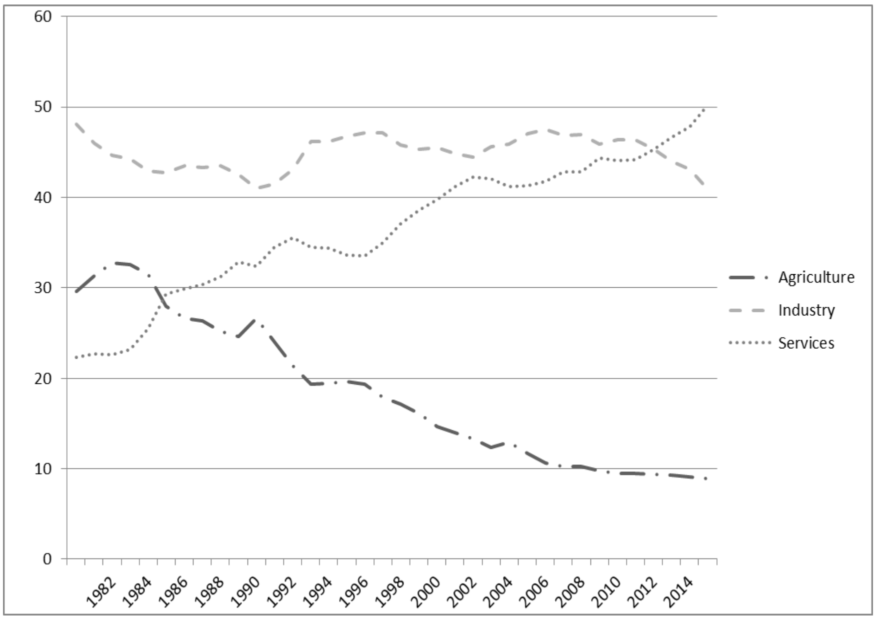
# Charts and Tables

**Figure 1 Labour Productivity (Real Output Per Worker) in China (Yuan at 2010 Prices)**




Source: National Bureau of Statistics of China and Author's calculations.

**Figure 2 Sectoral Quotas of GDP in China 1980-2015 (Percentage Values)**

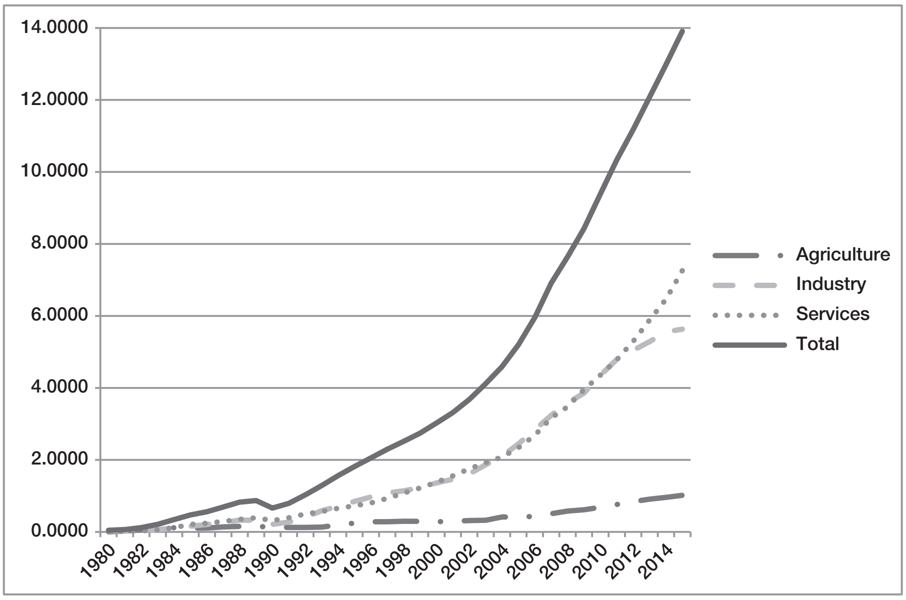



Source: China's National Bureau of Statistics and Author's calculations.

**Figure 3 Sectoral Quotas of Employment in China 1980-2015 (Percentage Values)**

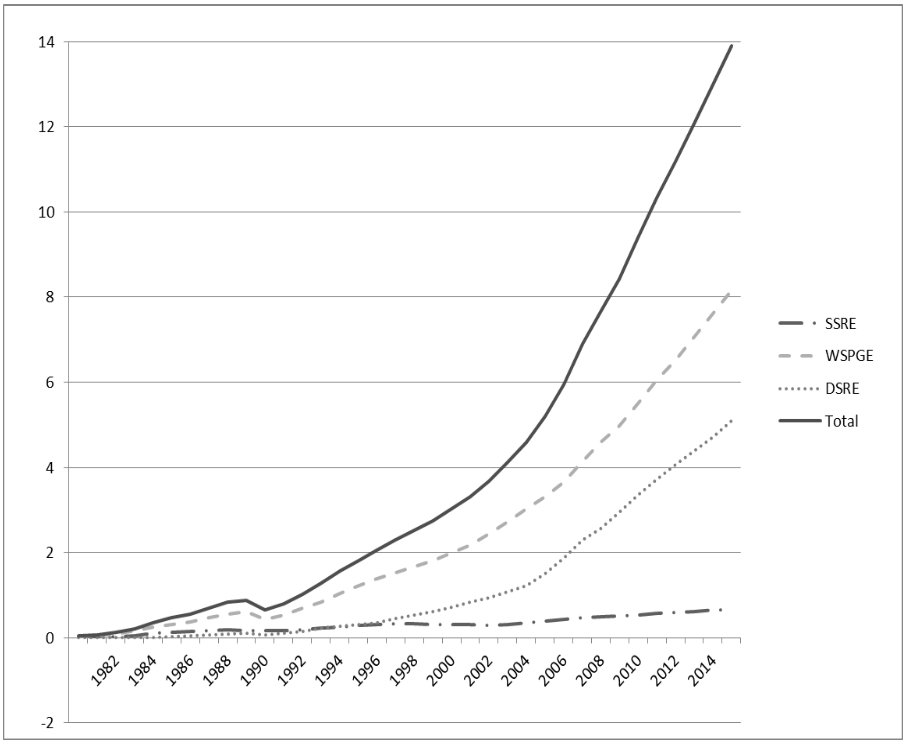

Source: National Bureau of Statistics of China and Author's calculations.

**Figure 4 Cumulative Sectoral Contribution to Productivity Growth (Output Per Worker) in China 1980-2015**



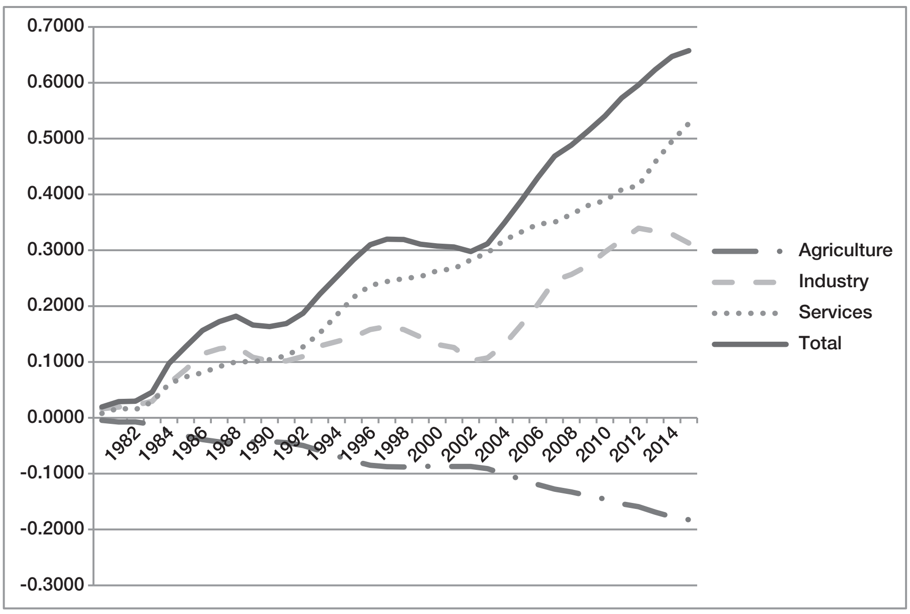

Source: National Bureau of Statistics of China and Author's calculations.

**Figure 5　Decomposition of Cumulative Productivity Growth (Output Per Worker) in China 1980-2015**



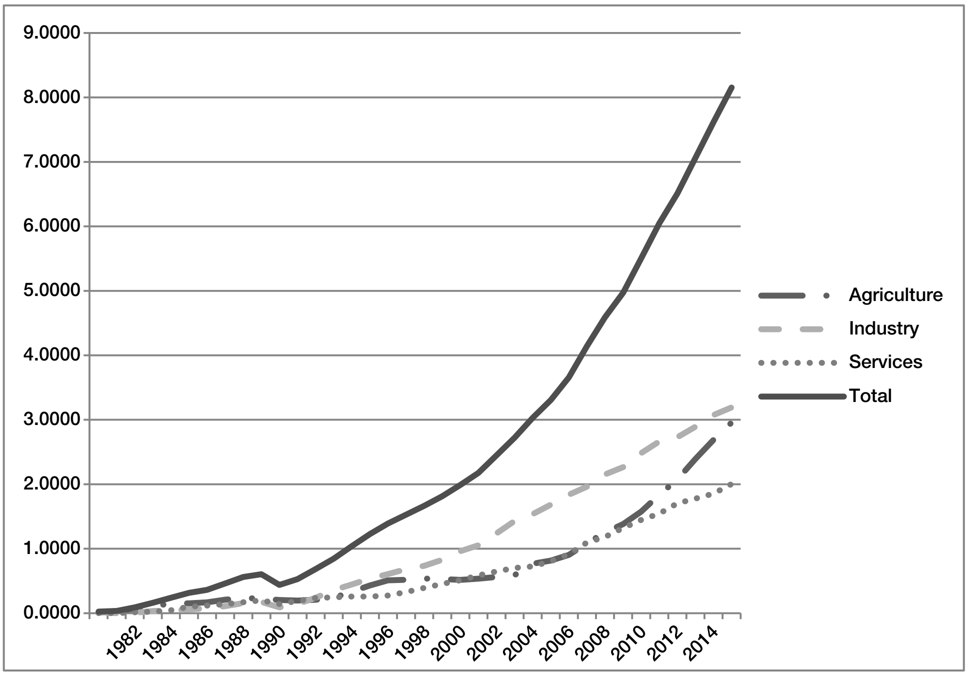

Source: National Bureau of Statistics of China and Author's calculations.

**Figure 6　Cumulative Dynamic Structural Reallocation Effect (SSRE) on Productivity Growth (Output Per Worker) by Sector in China 1980-2015**



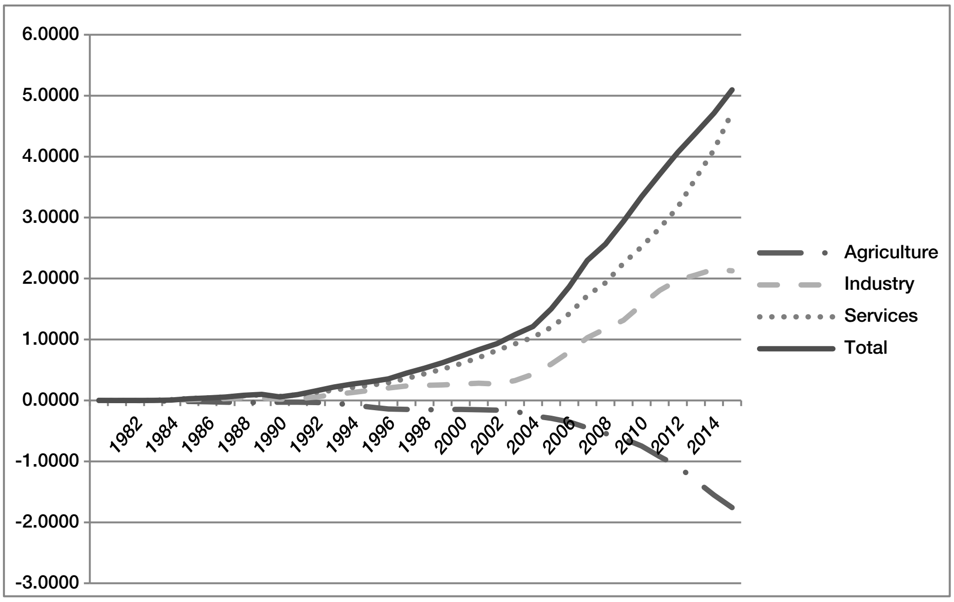

Source: National Bureau of Statistics of China and Author's calculations.

**Figure 7 Cumulative Within-Sector Productivity Growth Effect (WSPGE) on Productivity Growth (Output Per Worker) by Sector in China 1980-2015**



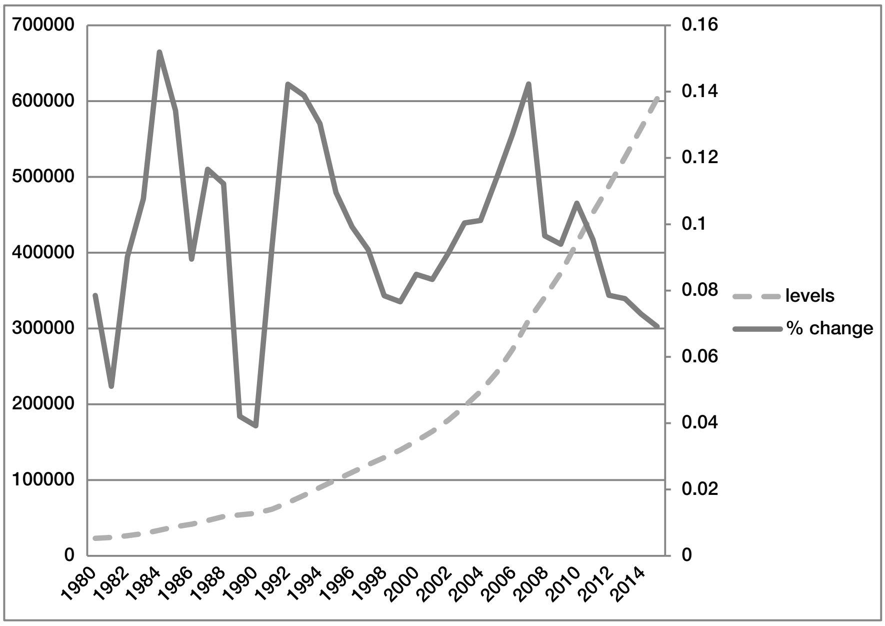

Source: National Bureau of Statistics of China and Author's calculations.

**Figure 8 Cumulative Static Structural Reallocation Effect (DSRE) on Productivity Growth (Output Per Worker) by Sector in China 1980-2015**



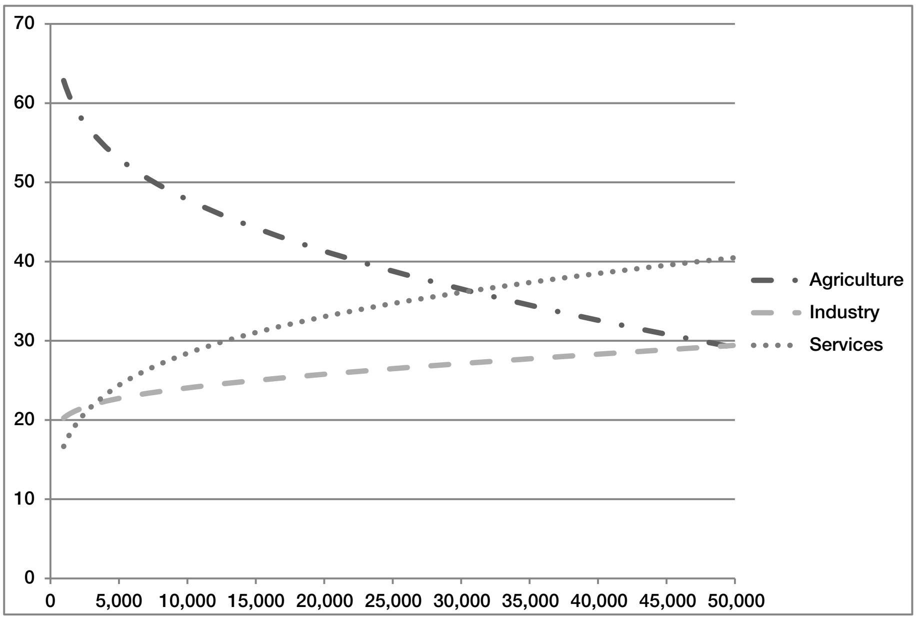

Source: National Bureau of Statistics of China and Author's calculations.

**Figure 9 Real GDP Levels (Left Scale) and Yearly Percentage Changes (Right Scale) in China 1980-2015**



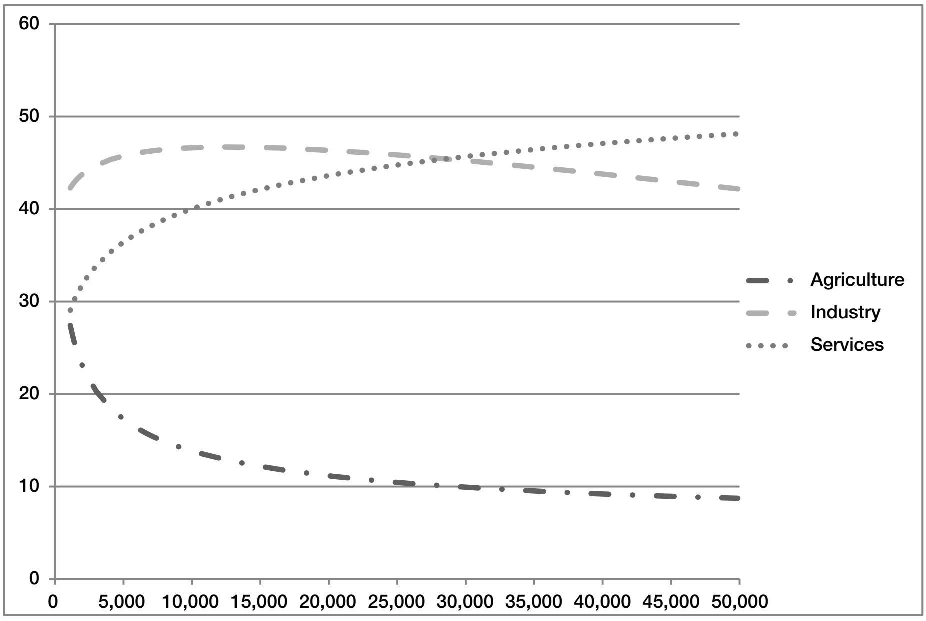

Source: National Bureau of Statistics of China and Author's calculations. Left scale=100 million yuan

**Figure 10 Per Capita Income (Nominal Yuan Per Head) and Sectoral Shares of Employment in China**




Source: National Bureau of Statistics of China and Author's calculations.

**Figure 11 Per Capita Income (Nominal Yuan Per Head) and Sectoral Shares of Aggregate Output in China**




Source: National Bureau of Statistics of China and Author's calculations.

**Table 1a China's Real GDP Growth Decomposition in Supply Side Components**

| Year | Y | Y/L | L/F | F/P | P |
|---|---|---|---|---|---|
| 1980 | 7,9 | 4,5 | 0,1 | 1,9 | 1,2 |
| 1981 | 5,1 | 1,8 | 0,3 | 1,5 | 1,4 |
| 1982 | 9,0 | 5,2 | 0,2 | 1,8 | 1,6 |
| 1983 | 10,8 | 8,0 | 0,3 | 0,9 | 1,3 |
| 1984 | 15,2 | 11,0 | 0,1 | 2,4 | 1,3 |
| 1985 | 13,4 | 9,6 | 0,0 | 2,0 | 1,4 |
| 1986 | 8,9 | 6,0 | 0,0 | 1,3 | 1,6 |
| 1987 | 11,7 | 8,5 | 0,0 | 1,2 | 1,7 |
| 1988 | 11,2 | 8,0 | 0,0 | 1,4 | 1,6 |
| 1989 | 4,2 | 2,3 | -0,1 | 0,5 | 1,5 |
| 1990 | 3,9 | -11,2 | -0,2 | 5,6 | 1,4 |
| 1991 | 9,3 | 8,0 | 0,0 | -0,1 | 1,3 |
| 1992 | 14,2 | 13,1 | 0,0 | -0,1 | 1,2 |
| 1993 | 13,9 | 12,8 | 0,0 | -0,1 | 1,1 |
| 1994 | 13,0 | 12,0 | 0,0 | -0,1 | 1,1 |
| 1995 | 11,0 | 10,0 | -0,2 | 0,0 | 1,1 |
| 1996 | 9,9 | 8,5 | 0,0 | 0,3 | 1,0 |
| 1997 | 9,2 | 7,9 | -0,2 | 0,5 | 1,0 |
| 1998 | 7,8 | 6,6 | -0,6 | 0,9 | 0,9 |
| 1999 | 7,7 | 6,5 | 0,1 | 0,2 | 0,8 |
| 2000 | 8,5 | 7,5 | -0,7 | 0,9 | 0,8 |
| 2001 | 8,3 | 7,3 | 1,1 | -0,8 | 0,7 |
| 2002 | 9,1 | 8,4 | -0,2 | 0,2 | 0,6 |
| 2003 | 10,0 | 9,4 | 0,1 | 0,0 | 0,6 |
| 2004 | 10,1 | 9,3 | 0,2 | -0,1 | 0,6 |
| 2005 | 11,4 | 10,8 | -0,6 | 0,5 | 0,6 |
| 2006 | 12,7 | 12,2 | 0,2 | -0,3 | 0,5 |
| 2007 | 14,2 | 13,7 | 0,2 | -0,2 | 0,5 |
| 2008 | 9,7 | 9,3 | -0,3 | 0,2 | 0,5 |
| 2009 | 9,4 | 9,0 | -0,3 | 0,1 | 0,5 |
| 2010 | 10,6 | 10,2 | -0,8 | 0,6 | 0,5 |
| 2011 | 9,5 | 9,1 | 0,2 | -0,2 | 0,5 |
| 2012 | 7,9 | 7,5 | 0,0 | -0,1 | 0,5 |
| 2013 | 7,8 | 7,4 | -0,2 | 0,0 | 0,5 |
| 2014 | 7,3 | 6,9 | -0,1 | 0,0 | 0,5 |
| 2015 | 6,9 | 6,6 | -0,2 | 0,0 | 0,5 |

Source: National Bureau of Statistics of China and Author's calculations.

**Table 1b China's Real GDP Growth (Constant 2010 Prices) and Sectoral Contributions**

| Year | Total | Agriculture | Industry | Services |
|---|---|---|---|---|
| 1980 | 7,9 | 1,3 | 4,9 | 1,7 |
| 1981 | 5,1 | 3,3 | 0,3 | 1,6 |
| 1982 | 9,0 | 4,4 | 2,7 | 1,9 |
| 1983 | 10,8 | 3,3 | 4,4 | 3,1 |
| 1984 | 15,2 | 3,8 | 5,2 | 6,2 |
| 1985 | 13,4 | 0,1 | 5,5 | 7,8 |
| 1986 | 8,9 | 1,1 | 4,7 | 3,2 |
| 1987 | 11,7 | 2,8 | 4,9 | 4,1 |
| 1988 | 11,2 | 1,7 | 5,1 | 4,4 |
| 1989 | 4,2 | 0,4 | 0,8 | 3,0 |
| 1990 | 3,9 | 3,0 | 0,1 | 0,8 |
| 1991 | 9,3 | -0,3 | 4,3 | 5,3 |
| 1992 | 14,2 | 0,3 | 7,8 | 6,1 |
| 1993 | 13,9 | 0,7 | 9,5 | 3,8 |
| 1994 | 13,0 | 2,7 | 6,0 | 4,3 |
| 1995 | 11,0 | 2,3 | 5,7 | 3,0 |
| 1996 | 9,9 | 1,6 | 5,0 | 3,2 |
| 1997 | 9,2 | 0,2 | 4,3 | 4,7 |
| 1998 | 7,8 | 0,6 | 2,3 | 4,9 |
| 1999 | 7,7 | 0,1 | 3,0 | 4,5 |
| 2000 | 8,5 | -0,1 | 4,0 | 4,6 |
| 2001 | 8,3 | 0,5 | 3,0 | 4,9 |
| 2002 | 9,1 | 0,5 | 3,7 | 4,9 |
| 2003 | 10,0 | 0,3 | 5,8 | 4,0 |
| 2004 | 10,1 | 1,9 | 4,9 | 3,3 |
| 2005 | 11,4 | 0,1 | 6,5 | 4,9 |
| 2006 | 12,7 | 0,3 | 6,6 | 5,8 |
| 2007 | 14,2 | 1,1 | 6,0 | 7,1 |
| 2008 | 9,7 | 1,0 | 4,6 | 4,1 |
| 2009 | 9,4 | 0,5 | 3,3 | 5,7 |
| 2010 | 10,6 | 0,8 | 5,4 | 4,4 |
| 2011 | 9,5 | 0,8 | 4,4 | 4,3 |
| 2012 | 7,9 | 0,7 | 2,4 | 4,7 |
| 2013 | 7,8 | 0,6 | 2,1 | 5,0 |
| 2014 | 7,3 | 0,4 | 2,2 | 4,6 |
| 2015 | 6,9 | 0,4 | 0,7 | 5,8 |

Source: National Bureau of Statistics of China and Author's calculations.

**Table 1c China's Aggregate and Sectoral Output Per Worker (Yuan at Constant 2010 Prices)**

| Year | Total | Agriculture | Industry | Services |
|---|---|---|---|---|
| 1980 | 5,457 | 2,352 | 14,414 | 9,321 |
| 1981 | 5,557 | 2,555 | 13,957 | 9,282 |
| 1982 | 5,848 | 2,814 | 14,162 | 9,827 |
| 1983 | 6,319 | 3,068 | 14,953 | 10,306 |
| 1984 | 7,013 | 3,453 | 15,131 | 11,149 |
| 1985 | 7,687 | 3,440 | 15,770 | 13,462 |
| 1986 | 8,145 | 3,560 | 16,205 | 14,149 |
| 1987 | 8,836 | 3,877 | 17,230 | 15,071 |
| 1988 | 9,547 | 4,059 | 18,580 | 16,312 |
| 1989 | 9,769 | 4,004 | 19,181 | 17,553 |
| 1990 | 8,676 | 3,837 | 16,635 | 15,185 |
| 1991 | 9,372 | 3,773 | 18,169 | 17,096 |
| 1992 | 10,598 | 3,864 | 21,057 | 19,031 |
| 1993 | 11,951 | 4,091 | 24,637 | 19,457 |
| 1994 | 13,379 | 4,798 | 27,209 | 19,988 |
| 1995 | 14,712 | 5,523 | 29,904 | 19,963 |
| 1996 | 15,964 | 6,109 | 32,000 | 20,611 |
| 1997 | 17,221 | 6,176 | 34,225 | 22,834 |
| 1998 | 18,357 | 6,325 | 35,776 | 25,468 |
| 1999 | 19,554 | 6,270 | 38,565 | 28,041 |
| 2000 | 21,011 | 6,167 | 42,524 | 30,399 |
| 2001 | 22,540 | 6,304 | 45,276 | 33,543 |
| 2002 | 24,437 | 6,501 | 50,759 | 36,097 |
| 2003 | 26,723 | 6,721 | 56,445 | 38,330 |
| 2004 | 29,217 | 8,046 | 59,605 | 39,320 |
| 2005 | 32,379 | 8,414 | 63,974 | 42,624 |
| 2006 | 36,337 | 9,063 | 68,578 | 47,188 |
| 2007 | 41,319 | 10,414 | 72,248 | 54,653 |
| 2008 | 45,161 | 11,690 | 77,924 | 58,242 |
| 2009 | 49,234 | 12,646 | 81,260 | 64,004 |
| 2010 | 54,271 | 14,093 | 87,735 | 69,132 |
| 2011 | 59,203 | 16,050 | 93,120 | 73,241 |
| 2012 | 63,618 | 17,835 | 95,058 | 79,843 |
| 2013 | 68,311 | 20,222 | 99,875 | 82,854 |
| 2014 | 73,032 | 22,429 | 105,279 | 86,052 |
| 2015 | 77,883 | 24,437 | 108,791 | 92,198 |

Source: National Bureau of Statistics of China and Author's calculations.

**Table 2 Decomposition of China's Productivity Growth (Output Per Worker) in Selected Periods**

| | SSRE | WSPGE | DSRE | **Total** |
|---|---|---|---|---|
| **1980-2015** | | | | |
| Agriculture | -0.1825 | 2.9577 | -1.7584 | 1.0167 |
| Industry | 0.3128 | 3.1922 | 2.1268 | 5.6318 |
| Services | 0.5272 | 2.0036 | 4.7284 | 7.2592 |
| **Total** | 0.6575 | 8.1535 | 5.0967 | 13.9078 |
| **1980-1990** | | | | |
| | SSRE | WSPGE | DSRE | **Total** |
| Agriculture | -0.0429 | 0.2279 | -0.0318 | 0.1532 |
| Industry | 0.1084 | 0.1761 | 0.0407 | 0.3251 |
| Services | 0.1007 | 0.2006 | 0.0904 | 0.3917 |
| **Total** | 0.1662 | 0.6045 | 0.0992 | 0.8700 |
| **1990-2000** | | | | |
| | SSRE | WSPGE | DSRE | **Total** |
| Agriculture | -0.0408 | 0.1393 | -0.0231 | 0.0754 |
| Industry | 0.0266 | 0.4294 | 0.0269 | 0.4830 |
| Services | 0.1544 | 0.1965 | 0.0923 | 0.4432 |
| **Total** | 0.1402 | 0.7653 | 0.0961 | 1.0016 |
| **2000-2010** | | | | |
| | SSRE | WSPGE | DSRE | **Total** |
| Agriculture | -0.0385 | 0.1633 | -0.0391 | 0.0857 |
| Industry | 0.0947 | 0.5022 | 0.1048 | 0.7016 |
| Services | 0.1032 | 0.4947 | 0.1324 | 0.7304 |
| **Total** | 0.1594 | 1.1603 | 0.1981 | 1.5178 |
| **2010-2016** | | | | |
| | SSRE | WSPGE | DSRE | **Total** |
| Agriculture | -0.0252 | 0.0912 | -0.0235 | 0.0426 |
| Industry | 0.0248 | 0.1555 | 0.0084 | 0.1886 |
| Services | 0.1079 | 0.1953 | 0.0475 | 0.3507 |
| **Total** | 0.1075 | 0.4420 | 0.0324 | 0.5819 |

Source: National Bureau of Statistics of China and Author's calculations.

**Table 3.1 OLS Estimation of $Ln\left(\frac{\alpha_i}{100-\alpha_i}\right) = a + bY_i + c\ln Y_i$ where $\alpha_i$ is the Share of Workers in Agriculture**

Model CHENERY:
The number of behavioral equations to be estimated in block ONE is 1.
The total number of coefficients is 3.

Behavioral Equation DIP1 (Block ONE)
Estimation Technique:
Ordinary Least Squares
Autoregression of Order 2 (Cochrane-Orcutt procedure)

```
DIP1   =      .0244
              ( .6563)

            – .1119       *   Y
              (-6.0904)

            – .2191       *   LY
              (-10.9327)
```

Final Values of Autoregressive Parameters

| RHO | STD ERROR | T-STATISTIC |
|---|---|---|
| 1.2694 | .1483 | 8.5589 |
| -.55154 | .1366 | -4.0362 |

| | | |
|---|---|---|
| R-Squared | : | .9978 |
| Adjusted R-Squared | : | .9975 |
| Durbin-Watson Statistic | : | 2.0951 |
| Sum of squares of residuals | : | .0164 |
| Standard Error of Regression | : | .0234 |
| Log of the Likelihood Function | : | 84.5219 |
| F-statistic (4, 30) | : | 3,454.6722 |
| F-probability | : | .0000 |
| Mean of Dependent Variable | : | .0070 |
| Number of Observations | : | 35 |
| Number of Degrees of Freedom | : | 30 |
| Current Sample | : | 1981 1 2015 1 |

**Table 3.2 OLS Estimation of $Ln\left(\frac{\alpha_i}{100-\alpha_i}\right)=a+bY_i+c\ln Y_i$ where $\alpha_i$ is the Share of Workers in Industry**

Model CHENERY:
The number of behavioral equations to be estimated in block ONE is 1.

The total number of coefficients is 3.

Behavioral Equation DIP2 (Block ONE)
Estimation Technique:
Ordinary Least Squares
Autoregression of Order 2 (Cochrane-Orcutt procedure)

| | | | | | |
|---|---|---|---|---|---|
| DIP2 | = | – | 1.1860 | | |
| | | | (-19.5701) | | |
| | | + | .0363 | * | Y |
| | | | (1.2354 ) | | |
| | | + | .0804 | * | LY |
| | | | (2.4377) | | |

Final Values of Autoregressive Parameters

| RHO | STD ERROR | T-STATISTIC |
|---|---|---|
| 1.5057 | .1350 | 11.1517 |
| -.67927 | .1309 | -5.18767 |

| | | |
|---|---|---|
| R-Squared | : | .9860 |
| Adjusted R-Squared | : | .9841 |
| Durbin-Watson Statistic | : | 2.1608 |
| Sum of squares of residuals | : | .0167 |
| Standard Error of Regression | : | .0236 |
| Log of the Likelihood Function | : | 84.1737 |
| F-statistic (4, 30) | : | 527.5609 |
| F-probability | : | .0000 |
| Mean of Dependent Variable | : | -1.1782 |
| Number of Observations | : | 35 |
| Number of Degrees of Freedom | : | 30 |
| Current Sample | : | 1981 1 2015 1 |

**Table 3.3 OLS Estimation of $Ln\left(\frac{\alpha_i}{100-\alpha_i}\right)=a+bY_i+c\ln Y_i$ where $\alpha_i$ is the Share of Workers in Services**

Model CHENERY:
The number of behavioral equations to be estimated in block ONE is 1.
The total number of coefficients is 3.

Behavioral Equation DIP3 (Block ONE)
Estimation Technique:
Ordinary Least Squares
Autoregression of Order 2 (Cochrane-Orcutt procedure)

DIP3 = – .9431
(-24.2044)

\+ .0194 * Y
(1.0111)

\+ .2864 * LY
(13.5661)

Final Values of Autoregressive Parameters

| RHO | STD ERROR | T-STATISTIC |
|---|---|---|
| 1.1516 | .1724 | 6.6805 |
| -.46806 | .1649 | -2.8389 |

| | | |
|---|---|---|
| R-Squared | : | .9965 |
| Adjusted R-Squared | : | .9960 |
| Durbin-Watson Statistic | : | 2.0871 |
| Sum of squares of residuals | : | .0230 |
| Standard Error of Regression | : | .0277 |
| Log of the Likelihood Function | : | 78.5552 |
| F-statistic (4, 30) | : | 2,132.3408 |
| F-probability | : | .0000 |
| Mean of Dependent Variable | : | -1.0864 |
| Number of Observations | : | 35 |
| Number of Degrees of Freedom | : | 30 |
| Current Sample | : | 1981 1 2015 1 |

**Table 4.1 OLS Estimation of $Ln\left(\frac{\alpha_i}{100-\alpha_i}\right) = a + bY_i + c\ln Y_i$ where $\alpha_i$ is the Share of Output in Agriculture**

Model CHENERY:
The number of behavioral equations to be estimated in block ONE is 1.
The total number of coefficients is 3.

Behavioral Equation DIP1 (Block ONE)
Estimation Technique:
Ordinary Least Squares
Autoregression of Order 2 (Cochrane-Orcutt procedure)

DIP1 = – 1.8613
(-30.4289)

\+ .0326 * Y
(1.0812)

– .4032 * LY
(-12.0495)

Final Values of Autoregressive Parameters

| RHO | STD ERROR | T-STATISTIC |
|---|---|---|
| .9082 | .1665 | 5.4537 |
| -.2948 | .1525 | -1.9325 |

| | |
|---|---|
| R-Squared | : .9912 |
| Adjusted R-Squared | : .9900 |
| Durbin-Watson Statistic | : 1.9364 |
| Sum of squares of residuals | : .0874 |
| Standard Error of Regression | : .0540 |
| Log of the Likelihood Function | : 55.2037 |
| F-statistic (4, 30) | : 841.4319 |
| F-probability | : .0000 |
| Mean of Dependent Variable | : -1.5953 |
| Number of Observations | : 35 |
| Number of Degrees of Freedom | : 30 |
| Current Sample | : 1981 1 2015 1 |

**Table 4.2 OLS Estimation of $Ln\left(\frac{\alpha_i}{100-\alpha_i}\right) = a + bY_i + c\ln Y_i$ where $\alpha_i$ is the Share of Output in Industry**

Model CHENERY:
The number of behavioral equations to be estimated in block ONE is 1.
The total number of coefficients is 3.

Behavioral Equation DIP2 (Block ONE)
Estimation Technique:
Ordinary Least Squares
Autoregression of Order 2 (Cochrane-Orcutt procedure)

DIP2 = – .0424
(-.8125)

– .0927 * Y
(-3.7134)

+ .1178 * LY
(3.8879)

Final Values of Autoregressive Parameters

| RHO | STD ERROR | T-STATISTIC |
|---|---|---|
| .9600 | .1630 | 5.8890 |
| -.2306 | .1434 | -1.6089 |

| | | |
|---|---|---|
| R-Squared | : | .8172 |
| Adjusted R-Squared | : | .7928 |
| Durbin-Watson Statistic | : | 1.8455 |
| Sum of squares of residuals | : | .0351 |
| Standard Error of Regression | : | .0342 |
| Log of the Likelihood Function | : | 71.1896 |
| F-statistic (4, 30) | : | 33.5263 |
| F-probability | : | .0000 |
| Mean of Dependent Variable | : | -.2066 |
| Number of Observations | : | 35 |
| Number of Degrees of Freedom | : | 30 |
| Current Sample | : | 1981 1 2015 1 |

**Table 4.3 OLS Estimation of $Ln\left(\frac{\alpha_i}{100-\alpha_i}\right)=a+bY_i+c\ln Y_i$ where $\alpha_i$ is the Share of Output in Services**

Model CHENERY:
The number of behavioral equations to be estimated in block ONE is 1.
The total number of coefficients is 3.

Behavioral Equation DIP3 (Block ONE)
Estimation Technique:
Ordinary Least Squares
Autoregression of Order 2 (Cochrane-Orcutt procedure)

DIP3 = – .3962
(-5.2662)

– .0083 * Y
(-.2244)

+ .2256 * LY
(5.5226)

Final Values of Autoregressive Parameters

| RHO | STD ERROR | T-STATISTIC |
|---|---|---|
| 1.2646 | .1585 | 7.9808 |
| -.53326 | .1538 | -3.4669 |

| | | |
|---|---|---|
| R-Squared | : | .9831 |
| Adjusted R-Squared | : | .9808 |
| Durbin-Watson Statistic | : | 2.1192 |
| Sum of squares of residuals | : | .0616 |
| Standard Error of Regression | : | .0453 |
| Log of the Likelihood Function | : | 61.3217 |
| F-statistic (4, 30) | : | 435.4876 |
| F-probability | : | .0000 |
| Mean of Dependent Variable | : | -.5469 |
| Number of Observations | : | 35 |
| Number of Degrees of Freedom | : | 30 |
| Current Sample | : | 1981 1 2015 1 |

**Hong Kong Institute for Monetary Research**

55th Floor, Two International Finance Centre,
8 Finance Street, Central, Hong Kong
Telephone (852) 2878 1978
Facsimile (852) 2878 7006
E-mail hkimr@hkma.gov.hk
Website http://www.hkimr.org