

**The Strategy of Economic Growth for China
From A Post-Keynesian Perspective**

The Interpretation of Verdoorn's Law

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Abstract

The objective of this paper is to explain and solve the contradiction between an excess supply and an insufficient demand in the Chinese economy, taking a Post Keynesian perspective. The paper starts with a background review of the Chinese economy, going over the statistical data of the previous years, which allows pinpointing the contradiction. Through an analysis of the Chinese macroeconomic policy and the current export-led economic growth strategy, we argue that China should develop a domestic demand-led economic growth approach as a long term strategy. To be successful with such a new strategy, China should use its productive manufacturing industry as the driving force to achieve a high level of growth for the entire economy. This is what Kaldor interprets as being Verdoorn's law. In the empirical part of the paper, we use different approaches to test the traditional Verdoorn's law as well as models that include some modification of it. Besides, in order to eliminate different econometrics problem, we use time series data and cross section data separately.

Keywords: Economic growth, export-led growth, Kaldorian model, Verdoorn's law, returns to scale, Chinese economy.

1 Introduction

Many studies have found that over the past 25 years, China has faced a contradiction between a high GDP growth rate on the one hand, with on the other hand a falling consumption price index and rising unemployment rates. It is very obvious that China has been experiencing unbalanced economic growth in recent years.

Economic growth is caused either by stimulating consumption (demand), or by increasing production (supply). As far as growth theory is concerned, most economists focus on the neoclassical supply-orientated approach, with the use of aggregate production functions. But recent work has underlined the limited success of neoclassical theory in explaining actual economic growth, both in cross-section and time-series data (Durlauf and Quah, 1999). It has been argued that this was because of the high level of aggregation of the variables under observation. Considering the determinants of growth in developed countries after the Second World War, the evidence suggests that the labour force was endogenous to the growth process.

In contrast to the neoclassical supply-orientated approach, the Post-Keynesian view of economic growth denies that the economic performance of the majority of the advanced countries has been seriously constrained by the growth of factor supplies. Thirlwall, McCombie and others have developed this view into a new theoretic framework that analyzes the relationship between supply and demand. Briefly speaking, the theory has the following characteristics: Contrary to what most people believe, the Keynesian model can be used to analyze long-term phenomena like

economic growth, and they emphasize that the role of the balance of payments as a constraint on economic growth is important. It argues that the growth is demand constrained rather than supply determined. In other words, the economic growth strategy in developed countries should be based on a demand-side approach. This demand-side approach is also called demand oriented analysis or Post-Keynesian analysis. According to traditional Keynesian theory, an increase in demand aggregates such as consumption, investment, or exports stimulate increases in output. Under this approach, for most developing countries, like China, the strategy of economic growth is either based on rising exports or on stimulating domestic consumption. However, this approach has not been used widely. According to McCombie and Thirlwall (1994), this is because the remnant of Say's Law still reign among decision makers. Most people believe that the major constraints of modern economic growth lie on the supply side instead of on the demand side. In other words, only increases in factor inputs and improvements in economic efficiency can stimulate economic growth. In this paper, we will use the Post-Keynesian analysis to investigate economic growth in China during the past 50 years.

This paper also provides a Kaldorian interpretation for empirical regularities of productivity growth at the sectoral level of the economy. The empirical work focuses on the growth rate of output and productivity in China. The starting point of this analysis is Verdoorn's Law. Although Verdoorn's Law has been mostly applied and analyzed within the framework of advanced countries, it has also been claimed that the law was general enough to be applied to developing countries (Kaldor, 1978). For

China, where labour surpluses are prevalent, it will be argued that Verdoorn's law provides a consistent and relevant framework for the analysis of productivity growth and the growth of employment. In addition, since most modern economies can have more than one sector subject to increasing returns, it seems that Verdoorn's law could also be analyzed at the sectoral level within the Chinese economy. Finally, most of the criticisms of Verdoorn's Law have concentrated on the constancy of Verdoorn's coefficient. The paper will also address this problem in the context of China.

The paper provides econometric tests of Verdoorn's law and of propositions suggested by Kaldor's models of the dual economy. The statistical evidence is based on the time series data and regional data (cross section data) of China. The time series data range from 1961 to 2004. Standard estimations of Verdoorn's law will be based on the entire observation period but also on selected sub-periods. The modified model is also tested in this way. The regional data is made up of 28 provinces cross section data, ranging from 1985 to 2003. The detrended method is to be used.

The remainder of the paper is divided as follows. Section 2 reviews the background of economic growth in China and points to the contradictions due to the Chinese unbalanced growth -- excess supply and insufficient demand. Section 3 and Section 4 present a possible solution to unbalanced growth -- stimulating domestic consumption. Section 3 describes the export-led growth strategy pursued in China, and section 4 describes the domestic demand-led growth strategy. Section 5 discusses the dual nature of the Chinese economy. Section 6 sets up the basic model of Verdoorn's law and presents some empirical results using Chinese data. Section 7

concludes and discusses possible directions for future research.

2 Background of Economic Growth in China

Economic growth is the primary task of developing countries. China, one of the largest developing countries of the world, has been experiencing unbalanced economic growth in recent years. Before we start to analyze this problem, we first take a look at some Chinese data.

In 2002, China's annual GDP reached US\$ 12671.36 billion; the growth rate reached 8.3%; Total fixed assets investment was US\$ 5240.95 billion, and its rate of growth was 16.9%; Total retail consumption was US\$ 4928.9 billion, with a rate of growth of 8.8%; Housing, communication, automobiles, etc., have become the main consumption industries. These positive economic phenomena are based on the implementation of a rational fiscal policy and a moderate monetary policy. The yearly total income in 2002 was US\$ 2277.55 billion, with an overall rate of growth of 15.4%, and the yearly total expenditures was US\$ 2657.01 billion, with a growth rate of 16.4%; the government deficit was US\$ 379.46 billion. Disposable income for city families, per person, was US\$ 928.05, an increase of 12.2% compared with the previous year, while net income for rural families, per person, was only US\$ 298.27, an increase of only 4.6%.

The above data show some notable success for the Chinese government. But behind these thriving figures, we should also be aware of the following figures. In 2002, the overall consumer price index fell by 0.8%, with the city consumer price

index falling by 1%, and the rural consumer price index falling by 0.4%. The retail price index fell by 1.3%. (Data source: CEDB, please refer to the table 1.) In addition, the unemployment rate remained high: the city registered unemployment rate was 3.1% in 1999, and 3.6% in 2002, (X. Chang, 2002) so that, the contradiction between high growth and high unemployment is very clear. In the past, high speed economic growth has always been connected with price inflation and full employment. The experience of Japan, Singapore, South Korea, and Hong Kong all validate this claim: they maintained full employment over 20 years. Their experience tells us that economic growth and employment should have a positive relationship. But the data of China shows an abnormal phenomenon: fast output growth, but slow employment growth.

China is one of the largest developing countries. The Chinese government established a strategy of economic growth which was based on capital accumulation and investment. Under this strategy, the allocation of resources to the investment sector, especially fixed assets investment, is higher than for the consumption sectors. Since China is a developing country, the strategy is to renovate producing facilities and upgrade equipment. This has been achieved to a large extent. The manufacturing industry is the "engine of growth" for developing countries. Now automobiles, housing, and personal computers become the key industries to drive the increase of domestic demand in China, and large efforts have been devoted to improve the development of these industries. So the allocation of resources is biased towards these key industries. As we all know the capital to labour ratio in China is very low, and the

key industries have the priority to get capital investments, while enterprises prefer to invest their profit to upgrade the equipment and enlarge the scope of production rather than improve the welfare of their employees. All this has caused a low rate of increase in employee salaries, a low rate of increase in resources being allocated to the non-industry department, and hence a low rate of increase in average purchasing power. Under the market economy system, competition will cause excess supplies in some industries, like the automobile industry. The mixture of this allocation of resources and restricted wage inflation has caused a poorly adjusted industry structure and a lack of effective demand in China.

The causes of excess supply and insufficient demand in China are diverse. It is the inevitable result of China's macroeconomic policy which was launched 27 years ago (China implemented an open economy innovation in 1978). We can find useful and meaningful conclusions by analyzing the evolution of the last 25 years.

During the past 25 years, the Chinese government has appropriated large amounts of financial resources to finance fixed assets investment and establish a strong economic system. The industrialized countries already have an affluent society, so their aims are to maintain low-speed economic growth with balanced consumption, population and export growth. Developing countries like China also need to increase consumption, but the strategy, the model, and the problem they are faced with are totally different from those of developed countries. At the beginning of its open economy innovation, China's national power was very weak, its accumulation potential was very limited, and the consumption level was very low. Starting with

1993, there was a boom all over the country, and accumulation started to proceed at a fast pace, sometimes with over-investment. Due to its inappropriate macroeconomic policy, China got into a contradiction phase (high accumulation and low consumption) towards the end of last century. It is very obvious that the "High accumulation policy" is the primary reason for this contradiction. Behind this high accumulation policy, there have been poor investment decisions, over-investment in some fields, and low rates of increase in the quality of life. Under the high accumulation policy, the income and the consumption of residents have been restrained for a long period, the consumption-investment ratio declined all the while. But insufficient consumption demand was concealed by investment demand. Briefly speaking, insufficient consumption leads to excess production, and excess accumulation leads to falling enterprise profits, and hence to a slowdown in investment. The contradiction of insufficient consumption in China is a long term problem which the Chinese government must tackle. In order to solve this problem, the Chinese government should adjust the short term stimulation and long term growth objective, improve the economic growth quality and the investment efficiency.

From 1996, the Chinese government took some expansionary macroeconomic steps to stimulate demand gradually. For example, from May 1996 to June 1999, the Chinese government continually adjusted downwards the interest rate, seven times (and rates have still been reduced recently); it enhanced its public expenditures; it let national debt grow; it increased the salary of low income residents and even imposed an interest tax to stimulate resident expenditures (by taxing the proceeds of savings).

During this process, the objective of macroeconomic policy was changed from “smoothly increase” to “outstretch”. Although there was a short term effect, however, these methods did not achieve any notable effect, as domestic consumption and investment did not really increase.

It is said that governments should use macroeconomic policy to regulate the overall national economy. To do so, governments can adjust the interest rate, engage in public capital expenditures, or set the exchange rate. While the Chinese government may aim for high and stable GDP growth rates by engaging in, or encouraging, investment expenditures, it should also set conditions that stimulate the increase in consumption expenditures, in order to keep aggregate supply and demand balanced. Using the data of 2002 as before, we see that the fixed assets investment growth rate is 16.9%, thereby showing that capital accumulation is still doing very well in China. So the main problem for China now is an insufficient amount of consumption.

3 Export-led Growth Strategies in China

Generally, there are two methods to boost consumption: one is to increase exports, and the other is to enlarge domestic demand. China has been experiencing export-led growth for a long time, and obtained very enviable achievements. There are two main reasons for believing in the importance of export-led growth. “One is that export growth can lift a balance of payments constraint on demand and therefore permit faster growth if factor supplies are available to be utilized. The other is that export

growth may create a virtuous circle of growth by virtue of the link between output growth and productivity growth.” (J. S. L. McCombie and A. P. Thirlwall, 1994, p. 421).

China has been using an export-led growth strategy for the last 25 years. In 2002, the total amount of imports was US\$ 2943.37 billion, and its rate of growth was 21.2%; the total amount of exports was US\$ 3246.73 billion, with a rate of growth of 22.35%. (Data source: CEDB, please refer to Table 2). One can also observe the rising dependence of China on exports. With the increase in exports, the contribution of export growth to GDP is getting bigger and bigger. The degree of dependence on export was only 4% in 1977, but this number increased to about 22% in 1994. It now exceeds the ratio of other developing countries like Brazil. China has dramatically increased its exports to developed countries like the US and some European countries. Indeed, the largest US trade deficit is with China. To sum up, the Chinese economy is clearly an export-led growth economy.

The constraint on growth comes from the demand for exports and not from the supply of labour (Kaldor, 1970). The export-led growth theory which McCombie and Thirlwall (1994) developed emphasizes that exports are an autonomous component of demand; the role that exports play in an open economy model is as important as that of investment in a closed economy model. The export-led growth approach insists that when economic expansion proceeds under a balance of payment constraint, the government has to either accelerate exports or restrict imports. The conventional international trade theory considers that under the free trade system resources can be

effectively allocated. The balance of trade can be achieved through an adjustment of the exchange rate. The successful cases for export-led growth are some European countries that experienced this method in the early 1960, like Italy. Italy implemented the export expansion stratagem through the depreciation of the lira; with the rapid growth of finished products in the world trade market, Italy's market share was increased as well. The depreciation of the lira had a positive impact on the balance of payment current account, producing a surplus.

Another way to stimulate exports, as Japan experienced, is to improve the productivity of domestic industries. Large capital investments leading to high exports are the key characteristics of the Japanese growth model. Now, more and more people are convinced of the limitation of this model. In order to balance the discrepancy between aggregate supply and demand, the Japanese government was forced to regulate the money and financial markets, leading to some difficulties and a crisis in the 1990s. So China should learn a lesson from this, and should circumvent the problem by stimulating economic growth correctly.

China has benefited from an export-led growth strategy for several years now, but in recent papers some economists indicate that China must abandon the export-led growth strategy in order to avoid risking a global economic contraction. China has become a global manufacturing powerhouse, and its size renders its export-led growth strategy no longer sustainable. "China must immediately and significantly revalue its currency to avoid stalling the U.S. recovery." (Thomas I. Palley, 2004, p.1). The possible appreciation of the Chinese Renminbi has been a hot topic lately (indeed the

currency did appreciate relative to the dollar by a little bit more than 2% on July 21, 2005), but there are many different points of view on this, and the Chinese government should proceed very carefully.

Other than that, overextended export growth may result in a high risk that China will have to face. Firstly, China will be enslaved to foreign import and export strategies. On the other hand, after China entered WTO, China has made some concessions on tariffs, import quantities and agriculture subsidies. Moreover, the WTO enacted special rules on trade of primary products, for example, the subsidy on export primary products was forbidden. These actions had tremendous impact on the output and export of primary products for China. Now, the global economy is slowing down, the US economic bubble has broken up, and some demand from North America may turn towards Mexico, so the demand for Chinese exports may decline correspondingly. If there are no other new sources of demand to absorb the ever rising production of Chinese goods, China's economic growth will be very frail. Thus, in order to achieve a healthy economic growth, and to balance aggregate supply and demand, China should establish a self-dependent economic growth model by enlarging domestic effective demand.

4 Methods to Enlarge Domestic Effective Demand in China

There is no doubt that China has already imposed various means to enlarge domestic demand by using macroeconomic policy and industrial policy. The booming automobile, housing, and telecommunication industries have given some impetus to

consumption, but it is not enough as a whole. Although the total retail amount of consumable goods has increased by 8.8%, the decrease in the retail price index is still a sign of insufficient consumption demand. The main reasons for this, in my opinion, are the low income level, wealth inequality and lower purchasing power of rural resident, as well as the insufficient purchasing power of city residents. (In 2002, the rural retail amount of consumable goods was only US\$ 1808.78 billion, in comparison with the total retail amount of consumable goods which was US\$ 4928.9 billion). So both city residents and rural residents are faced with the problem of an insufficient amount of consumption. For city residents, this required consumption structure change is from basic consumer goods towards more luxurious consumer goods (like house, automobile) and towards amusement expenditures (like travel, entertainment). This upgrade will be a long process since it needs a strong accumulation. Relatively speaking, the consumption structure upgrade for rural resident is from necessities to basic consumer goods (like televisions and washing machines). So this upgrade does not need a high increase in income levels. Thus, the increase in consumption demand of rural residents could be a big contribution to the GDP growth rate, and is a practical means to accelerate economic growth for China. There is an appraisal by the national statistical bureau, according to which when rural resident increase their consumption expenditures by 1000 billion (Yuan), it generates 2356 billion of consumption demand for the national economy; consequently, it will enlarge the indirect demand by 1253 billion Yuan for the industry sector, 620 billion Yuan for the agricultural sector, and 478 billion Yuan for the service sector. (X. Chang, 2002). By

this token, the prosperity of rural economy is very important for China.

Now, a lot of industry corporations are in great difficulty, their products cannot be sold, and employees must be laid off. There are various reasons for this, but the lower purchasing power of rural residents is the primary one. If 70% of the population does not have a strong purchasing power, it is impossible to build a large domestic market. It is obvious that the farmers' poor ability to consume leads to an insufficient demand in rural markets, and this leads to growth in productive capacity far beyond the expansion that consumer markets can bear. And then it will aggravate the excess supply of finished products in the manufacturing industries, thereby impeding industrialization. As farmer's income keeps growing slowly, their share of consumption expenditures drops ever faster, and hence a vicious circle appears, which solidifies the dual economy structure, so much that economic prosperity might be jeopardized. (More details about the dual economy will be presented in the next section.)

Given the above, China should increase wage income, especially the rural residents income level, reduce wealth disparities, and generate a consumption structure upgrade. Consumption is a function of income, so the slow increase of farmer's income becomes the obstacle to rural consumption structure upgrade. The growth rate of farmer's income per year from 1979 to 1996 in China was about 16%, and this number drops to 4% between 1997 and 2000. (Data source: CEDB)The decline in the relative farmer's net income over the last few years is one of the reasons for which the price of primary products has dropped every year. The other reason is

that it is more and more difficult for the surplus labour force to migrate from country to city since the job opportunities in the city have been reduced, and hence the capacity to absorb the employment in factory-farm enterprise has declined. In order to improve the farmer's consumption structure, the key issue is the increase in the farmer's income. As far as it goes, the capacity to increase farmers' incomes in the country is weak, since the prices of most primary products in China are higher than the international market price, so there is little room to set higher markups; some other means must be found to increase rural income.

Firstly, China should develop high quality and highly efficient cash crops which can generate high market demand, as well as sound stockbreeding. Stockbreeding in developed countries takes up 40% to 50% of total agriculture GDP, far more than in China. (X. Chang, Chinese Academy of Social Sciences, 2002). Other than that, improving the primary product processing industry and boosting the industrialization of rural areas are possible options. The second way to increase farmer's income is by transferring the surplus labour force to cities, and improving city planning. If most of consumption is done in cities, while most of the population lives in rural areas, it is very hard to create employment opportunities and fulfill the ambition to achieve a sufficient amount of consumption demand. Our urban population is one-third of total population (39% in 2002), but this percentage in other countries like Japan, Korea is over two-thirds, and even 75% when they were at our stage of development. In the long run, the prime method to solve the farmer's income problem is to create job opportunities for farmers. With the increase of the job opportunities, more and more

farmers will transfer to become farm workers or other types of workers. So, in the final analysis, to enlarge the domestic effective demand, China should develop its city planning, improve the purchasing power of citizen, and transfer some parts of population from rural areas to cities.

Actually, “city planning” and “employment” are closely related. Extending opportunities of employment becomes an urgent affair for China. Only when there exists enough opportunities of employment and more and more people can get a job, can the income level be increased accordingly. The employment in China has long been pulled by the economic growth in the past, but recently, the elasticity between them is falling. In 1999, the rate of GDP growth was 4.8%, the rate of employment growth was 1.1%; in 2000, the rate of GDP growth was 9.0%, the rate of employment growth was 1.0%; in 2001, the rate of GDP growth was 8.8%, the rate of employment growth was 1.3%; in 2002, the rate of GDP growth was 8.1%, the rate of employment growth was 1.0%; in 2003, the rate of GDP growth was 11.6%, the rate of employment growth was 0.9% (Data Source: CEDB).

The substantial and persistent differences between rates of growth of employment (viz. the rates of growth of productivity) and output is the most important phenomena of economic performance of China. We will use econometric method to test this relationship in the later part of this paper.

Eventually, compared with export-led growth strategies, domestic demand-led strategies rely on self-dependence. This strategy can help avoid international risks and maintain stable growth despite shocks abroad. So China should persist in developing

this growth model as a long term strategy. Provided it does so, China will gradually build up a balanced economy and establish a rational economic system.

5 The Dual Nature of the Chinese Economy

According to the general process of economic growth, a country will appear as a dual economy in the development process. The dual economy divides the economy into two sectors, a high productivity (capital intensive) industry sector with rapid technical change and an agricultural sector with low productivity and surplus labour. (Lewis, 1954)

It was quoted by McCombie and Thirlwall in 1994 (McCombie, Thirlwall, 1994) that Kindleberger (1967) and Cornwall (1977) have argued that it is much more useful to analyze the advanced countries as exhibiting the characteristics of “dual economies”, in the same way as Arthur Lewis (1954) who explains the growth of less developed countries. Kindleberger and Cornwall found that “the growth of labour input in the advanced countries far from exogenously determining the growth of output, largely responded passively to the growth of demand for labour, especially demand emanating from the industrial sector.” (McCombie, Thirlwall, 1994, pp 157-158)

A dual economy describes the early phase of developing process for a developing country. When an economy reaches a sufficiently high stage of development, the dual economy structure will disappear gradually. This transition process has been characterized by high growth. The dual economy in China has also generated a

contracted trend, but this trend is very slow and more evidence shows that it tends to expand again. It results that the dual economy structure is rigid in China. The form of industrialization in China is by government intervention. Under this model, agriculture and industry, city and rural economic growth exhibit an irrelevant process. Agriculture was a deprived sector at the beginning, and becomes a redemptive sector when the economy reaches a more advanced state. This explains the rigidity of the dual economic system in China. The duality is very strong in 1970 in China, where the ratio of agriculture productivity to non-agriculture productivity was 16%, (data source: China statistical yearbook, 1998). This number was to increase after the Chinese economy went through successive innovations, which means the duality structure was slow and improved. But the speed of this improvement was very slow, the duality coefficient was 20.2% in 1978, 34% in 1988 and 35.1% in 1995. (Data source: China statistical yearbook, 1998)

The declining sign of the natural resource sector is a strategy of industrialization in developing countries. But the excessive decline in natural resource will lead to an intensive dual structure; it will harm the economic growth. China implemented this special economic development stratagem after 1949. However, this policy became a serious obstacle to economic growth. The decline in natural resource allocation in China represents the imbalance in the allocation of resources between the industrial sector and the agriculture sector, so there is a great lag between the growth of industry and the growth of agriculture. Because of the improvement of specialization and the division of labour, the productivity of the agricultural sector took a major leap

forward in 1978. But from 1984, the potential yields of innovation have been used up, so that the growth of agriculture is slowing down. This is the first reason of the formation of a rigid dual economy in China.

The other reason is that the transformation of surplus labour from rural to city has been suppressed, and the progress of city planning is tardy. The rigidity of the dual system not only limits the progress of industrialization, it also destroys social cohesion. So China should pay highly attention to this problem.

6 The Kaldorian Model and Verdoorn's Law

6.1 A Kaldorian Framework

After reviewing the theory and problem of economic growth in China, let us start to interpret some empirical regularities of productivity growth at the sectoral level of the economy. The empirical work focus on the growth rate of output and productivity in China.

Nicholas Kaldor argued that it is impossible to understand the growth and development process without taking a sectoral approach, distinguishing between the manufacturing industry (labour based) which has increasing returns and the primary product activities (land based) which have decreasing returns. The presence of increasing returns to scale is a main focus of the empirical part of this paper.

Kaldor, in the spirit of Allyn Young (1928), conceived "returns to scale as a macroeconomic phenomenon related to the interaction between the elasticity of

demand for and supply of manufactured goods. It is this strong and powerful interaction which accounts for the positive relationship between manufacturing output and productivity growth, otherwise known as Verdoorn's law." (J. S. L. McCombie and A. P. Thirlwall, 1994, p. 165) Thus increasing returns in the manufacturing industry makes reference to what Kaldor terms Verdoorn's Law (Kaldor 1966b). Verdoorn's law is the statistical relationship between the growth of manufacturing output and the growth of labour productivity in manufacturing where the causality runs from the former to the later. The growth of labour productivity in manufacturing is an endogenous result of output growth. Emphasizing the effect of economies of scale provides an enormous contribution to the theory of economic growth.

Productivity growth is good for the economy in the long run because it can suppress inflation and raise our standard of living. In the short-term, however, productivity growth limits employment growth since the definition of aggregate employment is the ratio of aggregate output and the average productivity of labour.

Kaldor also stressed the fact that those countries that are industrialized remain dual economies subject to underemployment or disguised unemployment outside of the secondary sector when surplus labour was depleted in the primary sectors. He argued: "It is the existence of an elastic supply curve of labour to the secondary and tertiary sectors which is the main pre-condition of a fast rate of development."

(Kaldor, 1968, p. 120)

Agricultural surplus plays an important role in the process of economic development. This surplus impacts on industrial development. Kaldor (1967, 1989)

assumed that there is an unlimited labour supply at a constant real wage rate in terms of “food”, and the industrial price level would rise in the same proportion as wage when it rises in response to an increase in the price of “food”, which means that the industrial price is determined by a constant proportional mark-up on unit variable cost which consists of wages. Kaldor (1967) clearly explained that a fall in agricultural prices has an impact on the terms of trade, and then on the industry sector. “These movements tend to be destabilizing rather than stabilizing and, once again, give rise to the possibility that both industrial and overall growth may become constrained by an insufficient growth of effective demand from agriculture.” (Roberts and McCombie, 2004, p.2). In this framework, a shift in the terms of trade is an autonomous factor; it may result from a change in the pricing policy of the government or from a change in technology rather than a response to excess supply which is arising from the imbalance between the agriculture and industry sectors. This autonomous shift would increase the purchasing power of the agricultural sector and result in a potential market for the industrial sector that would procure an expansion of demand. Thirlwall also emphasized the role of agriculture in providing a market for industrial goods, and claims that the Kaldorian model is better than Lewis’s (1954, 1972), because Lewis’s model did not take demand factors into account.

Kaldor’s model consists of the following propositions: “the faster the rate of growth of the manufacturing sector, the faster will be the rate of growth of GDP; ...the faster the rate of growth of manufacturing output, the faster will be the rate of growth of labour productivity in manufacturing owing to static and dynamic

economies of scale, or increasing returns in the widest sense; ...The faster the rate of growth of manufacturing output, the faster the rate of transference of labour from other sectors of the economy where there are either diminishing returns, or where no relationship exists between employment growth and output growth..... The faster the rate of growth of manufacturing output, the faster the rate of growth of productivity in the economy as a whole.” (McCombie and Thirlwall, 1994, pp.164-165). This is a consequence of the large transfers of labour from the low productivity agricultural sector to the high productivity industrial sector.

Overall, the presence of increasing returns to scale and the labour surplus assumption imply that the Kaldorian framework departs from the neoclassical growth model.

6.2 Verdoorn's law

Verdoorn's Law was specified by Kaldor as:

$$p = a + b * q \quad (1)$$

Where p is the exponential growth rate of labour productivity, q is the exponential growth rate of output. The slope coefficient, b, is the “Verdoorn coefficient”. There is a stylized relationship between the exponential growth rate of employment and the growth rate of labour productivity:

$$Q = (Q/E) * E$$

Where Q is output, E is employment and P (equal to Q/E) is productivity.

Differentiating and taking logs, we get:

$$d\log(Q) = d\log(P) + d\log(E)$$

Therefore,

$$q = p + e$$

Rearranging gives:

$$p = q - e \quad (2)$$

Where e is the growth rate of employment, hence we get:

$$e = q - p$$

which becomes

$$e = q - a - b * q$$

making use of equation (1), and hence:

$$e = a' + b' * q \quad (3)$$

Where

$$a' = -a; \quad b' = 1 - b$$

The intercept a' reflects the technological progress, it is the exogenous variable in this model. The negative sign ($-a$) means that at zero output growth employment in the sector decreases due to technical progress generated from outside the sector. The employment elasticity with respect to output growth in the sector is measured by the coefficient b' .

Equations (1) and (3) can be associated to a production function of the classical Cobb-Douglas form, where labour (N) and capital (K) are assumed to be the unique inputs, so that:

$$Y = Ae^{st} K^\alpha N^\beta \quad (4)$$

where α and β are the output elasticity of capital and labour, g is the exogenous rate of growth of total factor productivity (A), α and β define the nature and size of existing returns to scale. From (4), taking logs of both sides and using lower-case letters for the derived variables, we get:

$$y = \log A + gt + \alpha k + \beta n \quad (5)$$

And then, differentiating with respect to time yields:

$$q = g + \alpha * k + \beta * e \quad (6)$$

Where q is growth rate of output, k is growth rate of the capital stock and e is the growth rate of employment.

It is straightforward to manipulate equation (6) to give:

$$p = \frac{g}{\beta} + \frac{(\beta - 1)}{\beta} * q + \frac{\alpha}{\beta} * k$$

Then the more correctly specified Verdoorn's Law is give by:

$$p = a_1 + b_1 * q + b_2 * k \quad (7)$$

From (6) an implicit employment function can be derived, given by:

$$e = \frac{1}{\beta} q - \frac{1}{\beta} g - \frac{\alpha}{\beta} k = -c + d * q - f * k \quad (8)$$

Where c , d , f are coefficients, this is the general form of Verdoorn's law that ought to be estimated or alternatively equation (6), which is Rowthorn's reformulation.

However, the traditional estimate of Verdoorn's law is given by equation (1) and (3). In order to reconcile equation (8) with equation (3), which we will test in this paper, we introduce Kaldor's stylized facts of industrial countries, noting that, in the long run, the ratio between output and capital is constant. Thus if $K/Y=v$ and $k=q$, by substituting into (8) we get:

$$e = -c + (d - f)q = -\frac{1}{\beta}g + \frac{1}{\beta}(1 - \alpha)k \quad (9)$$

Equation (9) is thus immediately transformed into equation (3).

Equation (3) is preferred for estimation purposes due to the correlation between p and q . Kaldor writes: "Clearly, since by definition $p=q-e$ in any situation in which e is either zero or constant there must be a perfect correlation between p and q but one which does not assert anything, since it is the automatic consequence of measuring the same thing twice over." (Kaldor, 1975b, p. 892) However, there is no real harm in using equation (1) when doing the regressions, because it should yield exactly $b' = 1-b$. We are concerned with testing if or not b' is statistically significantly different from one or whether b significantly differs from zero. Both of the specifications will lead to the same conclusion. In this paper, we will use equation (1) to test the traditional Verdoorn's law. If coefficient b is positive and different from zero, we obtain increasing returns to scale. In addition, if b is negative and significantly different from zero, then there are decreasing returns to scale. Otherwise, we get the result of constant returns to scale.

But it should be added that, the traditional formulation of Verdoorn's law implies introducing some simplified assumptions either on capital growth or on the capital-output ratio; if the simplifying assumptions about capital are not justified, the employment coefficient in equation (3) is biased.

Kaldor tested the validity of this law for a cross section of industrial countries using equation (3); he used the data of twelve developed countries and the data ranged from 1953 to 1964. He obtained the regression result and found values of b and b' of

around 0.5, so his interpretation of this is that increasing returns to scale do exist and are substantial. (With the obvious implications that if the estimated marginal elasticity of employment is less than one, then returns to scale are increasing, while if the same coefficient is equal to one then returns are constant, and if it is more than one, the returns are decreasing.) This also makes it clear that Kaldor attributes the evidence of increasing returns to the existence of static and dynamic economies of scale; in this sense, the phenomenon is considered to be an intrinsic feature of manufacturing, while other sectors of the economy should typically exhibit decreasing returns (Kaldor, 1966).

Indeed, when testing for the validity of the law in other sectors, Kaldor found that the evidence was either controversial or weak.

Verdoorn's law has been tested in various ways focusing on the manufacturing industry. Time series analysis have progressively become more popular among researchers because cross countries studies could give rise to spurious correlations, when countries are at different stages of economic development or if they have very different technological features. Cross region analyses require that the various regions or countries should have the same technological characteristic or at least that the differences are not too big. We will test the law for the Chinese economy, both by time series and with a cross section of regions.

Rowthorn (1975) argued that since Kaldor's interpretation of the slow rate of growth of manufacturing industries in UK was a shortage of labour, the exogenous variable ought to be the rate of growth of employment. Rowthorn (1975) pointed out

an additional problem regarding the variables defined by the growth rate of productivity ($p = q - e$). For example, Kaldor interprets the Verdoorn relationship in terms of a cumulative growth model. The identification problem in equation (3) results in the independent variable output growth (q) term to be positively correlated with the residual term. Moreover, the positive bias implies that a least-squares estimator of the employment elasticity is biased upward, or against increasing returns to scale. Thus, in the case of equation (3) rejecting the null hypothesis of constant returns to scale will be more difficult due to the identification problem. So from this point of view, the equation of Verdoorn's law should be changed to equation (6):

$$q = g + \alpha * k + \beta * e$$

Rowthorn argued that the appropriate specification of Verdoorn's law should be the regression of q on e. Kaldor explained that Rowthorn's criticism is based partly on misunderstanding and partly on misrepresentation. (Kaldor, 1975, p.891)

We will use Kaldor's equations to test the traditional Verdoorn's law (equation (1)) and the more specified Verdoorn's law (equation (7)) at the sector level in the following part of this paper.

6.3 Data analysis for the Chinese Economy

Now let us estimate the traditional Verdoorn's law using the time series approach. This approach has the advantage of stressing possible structural breaks in the studied range. Time series data enables to analyse the law in selected sub-periods and avoid the influence of cyclical fluctuations by choosing a specific time range. We are using

annual data range from 1961 to 2004. The estimates are performed on the basis of equation (1), with the OLS technique. The observations of rates of growth of both labour productivities and output are broken down into seven activities to test Verdoorn's law separately. They are: agriculture; industry; service; construction industry; narrowly defined industry (total industry excluding construction industry); non-agriculture industry (industry sector plus service sector); and the whole economy.

The hypothesis tests if the estimate for the sectoral productivity elasticity is significantly greater than zero; if so, this is interpreted to be evidence for the existence of increasing returns to scale; alternatively a negative coefficient on output growth would represent decreasing returns to scale. The null hypothesis is constant returns to scale, when output growth has no impact on productivity growth.

From an econometric standpoint, the traditional estimates of Verdoorn's law using growth rates of the relevant variables are to be preferred to corresponding regressions in levels, "because the series are shown to be integrated; since the appropriate test seems to indicate the absence of co-integration, only a difference specification is allowed." (Carluccio Bianchi, 2001, p.8)

Data of the Chinese domestic product (GDP) at current prices and at constant prices were obtained from the China Economy Database (CEDB) for the period 1952 to 2004. Data on components of annual GDP were also available. The Consumer Price Index (CPI) is 1950=100. From annual GDP and CPI data, we can get the real GDP data. All the annual data come from one source and no adjustment to any of the indicators was necessary. The employment data was also obtained from CEDB. As it

is a long time series over 50 years, we decided to reduce the variability by taking logs of each of the two variables (real GDP and employment). One thing that has to be pointed out here is that, before 1985 the CPI data (to be used to calculate the real GDP data) refers to the price index of living expenses of residents. The growth rate of variables can be obtained by differentiating.

First of all, we test the growth rate of real GDP and labour productivity for the whole period. The basic reference scatter plots, with a regression line, are shown in *figure 1*, which provides a representation of productivity growth and output growth. A line with a unit slope and zero intercept implies the presence of constant returns to scale. The necessary complementary relationships between employment and output are shown in *figure 2*. From *figure 1*, we can tell that all diagrams are comparable in scale, so the slope of the regression line reflects the coefficient of the original Verdoorn's equation. (That is equation (1) in this paper). This figure also shows us that all industrial sectors exhibit obvious increasing returns to scale. From *figure 2*, it is interesting to notice that agricultural labour shows a decreasing trend from 1975 to 1978 and from 1990 till now, while industrial labour shows an upward trend for the whole period, with labour units in the construction industry also decreasing from 1996; thus we can tell that there exists a structural break. The other groups almost exhibit a continuous rise in employment. In these groups, there exists a positive relationship between the growth rate of employment and of output.

The formal results can be found from standard regression analysis with Eviews. (Please refer to table 3 in appendix.). According to *table 3*, we get a result which is

very close to the one obtained by Kaldor in his 1966 test (cross countries regression): the Verdoorn coefficient is around 0.5 in the industry sector in China, and this value is significant at a 95% level of confidence interval. It follows that increasing returns to scale exist in the Chinese industrial sector. When the real GDP growth rate increases by 1%, the estimated increase in the growth rate of labour productivity is about 0.5%. And the R-squared value is 0.55, which means that about 55% of the variation in the growth rate of labour productivity is explained by the growth rate of real GDP.

Although the sample regression line does not fit the data very well, it is acceptable for this kind of model. The non-agricultural sector and the services sector exhibit the same results as the industry sector, but the level of increasing returns is less than that of the industry sector. The estimated coefficient b in the agricultural sector in this regression is 0.89, and it is significant at a 95% level of confidence interval. It shows very strong increasing returns to scale in the agriculture sector; and the whole economy also shows significant results by this model; the size of returns in the whole economy appears to be greater than in the industry sector. ($b=0.93$)

The potential problem in this regression is that there is an aggregation problem or a negative correlation between the dynamics of capital and labour in the Chinese economy. So the Verdoorn's coefficient (b) is possibly overestimated. This phenomenon is particularly relevant in agriculture. As figure 2 shows, the agriculture sector is peculiar, since a higher growth rate of real GDP is associated with falling employment from 1975 to 1978 and from 1990 to 2004. So it requires a change in the specification of the model to evaluate the level of the returns to scale, and the

modification will be introduced later in the paper. (The previous annual employment data of the construction sector before 1978 are not available, so the tests for the construction sector and the narrowly defined industry sector in this paper start from 1978)

Due to the abnormal trend between the growth rate of GDP and of employment in the agriculture sector, we should to use the traditional model to regress the data in different time periods. We break the data from 1978 and 1990. The regression results are shown in *table 4* and *table 5* of the appendix. Table 4 is for 1961 to 1990.

Regarding Kaldor's test, for all sectors, estimates of the productivity growth with respect to output growth is significantly greater than zero. In other words, this result exhibits the increasing returns to scale for this period in China. Table 5 is for 1978 to 1990. In this regression, the industry sector and the narrowly defined industry sector (which is the industry minus construction sector) show an insignificant result, and the R-square values for both of them are very low. It is possibly caused by the insufficient observations.

As mentioned at the beginning of this chapter, we now present the regional cross section approach to test Verdoorn's law, using the data of 28 provinces of China. In order to take into account the cyclicity in the annual cross section data, we de-trended the sectoral employment and output series by taking three-year averages based on log-growth rates. (Normally, this de-trended method works better by taking five-year or ten-year averages, but since we only can get the regional data of employment and output from 1985 to 2003, we have to take three-year averages in

this paper to ensure that we have enough observations in the model. Another data problem is that the CPI data for 2003 is not available in CEDB, so I used the CPI 2002 instead of 2003). The use of cross section data permits the control of unobservable heterogeneity between individuals.

The regional data of the Chinese domestic product (GDP) at current prices and at constant prices were also obtained from the China Economy Database for the period 1985 to 2003. The Consumer Price Index (CPI) is 1985=100. The employment data were obtained from the China statistical year book (2004).

The regression also used OLS, with fixed effects models. The result is shown in *table 6*. We find a stable positive relationship between the rate of growth of productivity and the rate of growth of output when fixed effects are included. And Kaldor's null hypothesis of constant returns to scale can be rejected for the whole economy. That is to say, the whole economy presents a high level of increasing returns to scale according to the results provided by this model.

But as mentioned at the beginning of the empirical part of the paper, when using cross regional data the technology characteristics cannot be too large. The Chinese economy has a dualistic nature: the technology differences between regions are substantial, so this is a distinct disadvantage to use cross region method to test Verdoorn's law for China. So the result from cross regional regression may not be reliable.

The traditional Verdoorn's formulation, as said before, introduces some simplified assumptions about capital growth or capital output ratios. The explaining

capacity of the traditional model is limited. So a more comprehensive model should be used to test the data of China. Equation (7) includes two independent variables, the growth rate of output and the growth rate of the capital stock. The dependent variable is the growth rate of labour productivity. So it explicitly considers the effects of both labour and capital inputs.

However, with the capital stock introduced into the model, the size of returns to scale can be inferred by the coefficients α and β of equation (6). Defining the coefficient of q as b_1 and of k as b_2 it follows from equation (7). That:

$$(\alpha + \beta - 1) / \beta = b_1 + b_2$$

Since the standard condition for increasing returns to scale for equation (6) is for $\alpha + \beta$ to be greater than one, a sufficient condition for increasing returns to scale is for b_1 to be significantly greater than zero for equation (7) if there is no multicollinearity between the q and k , but if there is multicollinearity, then we can not obtain directly an estimate of the degree of returns to scale because the coefficients of q and k are not well determined. (McCombie and Thirlwall, 1994, p. 178). Thus we have to measure $b_1 + b_2$ to obtain an estimate of degree of returns to scale. In order to find the relationship between q and k , we regress k on q using the data of the industry sector, the agriculture sector and the whole economy separately. We see that the R-squared values are all less than those of the multiple regressions. This means there is not high multicollinearity for these two variables with Chinese data. So we can obtain an estimate of the degree of returns to scale from the coefficients of q , that is b_1 . The regression results of equation (7) are reported in *Table 7*. The OLS

technique has been used. From this regression, we get almost the same result as with the first regression in the paper. All sectors show significant results by this model, and the agriculture sector shows the highest level of increasing returns to scales, while the size of returns to scale in the whole economy appears to be greater than in the industry sector. As mentioned before, if the rate of growth of labour productivity is high, *ceteris paribus*, the rate of growth of employment will fall, so surplus labour in the agriculture sector will appear in China. Therefore, we can draw the conclusion that China should transfer its labour surplus in agriculture towards industry in the process of economic development.

At last, as the complementary test for this paper, we proceed to test another of Kaldor's law, that is: "the growth rate of an economy is positively related to the growth rate of its manufacturing sector." (McCombie and Thirlwall, 1994, p. 165). We still use the time series data which have been used in the test of traditional Verdoorn's law in this paper. (The independent variable in this test is the rate of growth of industry sector instead of the manufacturing sector because the accurate data of manufacture for China is hard to get.) The regression result is shown in *table 8*.

And it can be expressed as:

$$q_gdp = 0.026 + 0.552 * q_ind$$

(6.522) (21.31)

Where the q_gdp is the rate of growth of GDP, and q_ind is the rate of growth of the industry output, the t-statistics are in the parentheses. Thus, for China, this other Kaldorian law is significant in this specification. The positive relationship between the growth rate of whole economy and that of the industry sector has been verified. If

the rate of growth of industry output increases by 1%, the rate of growth of GDP will increase by 0.55% in China. Using agricultural data to do the same regression, we get:

$$q_gdp = 0.044 + 0.378 * q_agr$$

So it would seem to confirm that industry is the “engine of growth” for China. However, there is a possibility of a collinearity problem in the model, and a possible heteroskedasticity problem in the data, but here we will not attempt to find a remedy to these.

7 Conclusions

From the empirical work presented in this paper, we can draw the following conclusion. Verdoorn’s law using time series data for the sample period is verified in all sectors; increasing returns to scale for the whole of the Chinese economy is verified by regional panel data; and the central role of the industry sector for the economic growth is also justified in the analysis. All these laws of Kaldor seem to give a satisfactory description of the growth process in China. The growth in the industry sector motivates the whole economy and has a strong impact on productivity growth in all sectors as well as in the whole economy.

Of course there exist various problems in the empirical work underlying, specification and estimation of Verdoorn’s Law which have been criticized by famous economists in the past (for example, the faulty data, the omitted variable bias especially from the omission of the growth of capital stock, simultaneous equation bias, the problem of exogeneity and the problem posed by the diffusion of

innovations). The tests presented in this paper do seem to indicate that for China, the industrial sector is indeed the engine of economic growth. With the growth process based on industries using surplus labour from the agricultural sector, China should be able to have the entire economy grow in the long run.

In order to maintain high speed growth, balance aggregate supply and demand, and solve its contradictions, China should on the one hand insure a stable growth rate of export, while expanding domestic consumption on the other hand. Recognizing the presence of a dual economy in China helps us understand Kaldor's emphasis on the importance of the transfer of labour between the agriculture sector and the industry sector when there is surplus labour in agriculture.

This paper focused on the regularities of productivity growth at the sector level of the Chinese economy, and ignored the technology factor, however, the role of technology in economic growth are expected to be important for developing countries. Future work should address these issues.

Data Source:

[1]CEDB: *China Economy Database*

<http://cedb.cei.gov.cn/scorpio/asp/main.aspx?width=1014&height=710>

[2]*China Macroeconomic Information Network*

<http://edu1.macrochina.com.cn/userlogin.asp>

[3] *China statistic yearbook*, National Bureau of Statistics, 2004

<http://www.stats.gov.cn/english/statisticaldata/yb2004-e/indexeh.htm>

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Appendix:

Table 1

YEAR	GDP	GDP	Fixed Assets Investment	Employment	Total retail amount of consumable	Yearly total income	Yearly total expenditure	Financial deficit	Disposable income for city family per person	Net income for rural family per person	Price index number of total consumption	Price index number of city resident consumption	Price index number of rural resident consumption
	(Billion US\$)	(Billion US\$)	(Billion US\$)	(万人)	(Billion US\$)	(Billion US\$)	(Billion US\$)	(Billion US\$)	(US\$)	(US\$)	(-)	(-)	(-)
1980	4517.8	544.313	109.747	42361	257.831	139.751	148.052	-8.301	57.542	23.048	-	107.5	-
1981	4862.4	585.831	115.783	43725	283.133	141.663	137.157	4.506	60.289	26.916	-	102.5	-
1982	5294.7	637.916	148.241	45295	309.639	146.060	148.193	-2.133	64.494	32.542	-	102	-
1983	5934.5	715.000	172.301	46436	343.301	164.699	169.819	-5.133	68.024	37.325	-	102	-
1984	7171	863.976	220.831	48197	406.795	197.940	204.940	-7.012	78.566	42.807	-	102.7	-
1985	8964.4	1080.048	306.410	49873	518.675	241.545	241.476	0.069	89.048	47.904	109.3	111.9	107.6
1986	10202.2	1229.181	375.976	51282	596.386	255.663	265.651	-9.988	108.542	51.060	106.5	107	106.1
1987	11962.5	1441.265	456.831	52783	701.205	264.988	272.554	-7.566	120.735	55.735	107.3	108.8	106.2
1988	14928.3	1798.590	572.747	54334	896.386	284.000	300.145	-16.145	142.193	65.651	118.8	120.7	117.5
1989	16909.2	2037.253	531.373	55329	976.072	321.072	340.214	-19.142	165.530	72.470	118	116.3	119.3
1990	18547.9	2234.687	544.217	64749	1000.012	353.867	371.517	-17.649	181.947	82.688	103.1	101.3	104.5
1991	21617.8	2604.554	674.036	65491	1134.410	379.455	408.027	-28.571	204.892	85.373	103.4	105.1	102.3
1992	26638.1	3209.410	973.506	66152	1324.542	419.683	450.867	-31.184	244.169	94.458	106.4	108.6	104.7
1993	34634.4	4172.819	1574.976	66808	1501.458	523.970	559.313	-35.343	310.530	111.036	114.7	116.1	113.7
1994	46759.4	5633.663	2053.265	67455	1959.602	628.687	697.906	-69.219	421.229	147.108	124.1	125	123.4
1995	58478.1	7045.554	2411.964	68065	2484.337	752.072	822.135	-70.063	516.018	190.089	117.1	116.8	117.5
1996	67884.6	8178.867	2760.663	68950	2984.831	892.529	956.331	-63.802	583.000	232.060	108.3	108.8	107.9
1997	74462.6	8971.398	3004.952	69820	3289.024	1042.306	1112.477	-70.171	621.723	251.819	102.8	103.1	102.5
1998	78345.2	9439.181	3422.434	70637	3512.349	1189.873	1300.986	-111.112	653.627	260.482	99.2	99.4	99
1999	82067.5	9887.651	3596.952	71394	3751.169	1378.805	1588.876	-210.071	705.301	266.301	98.6	98.7	98.5
2000	89468.1	10779.289	3965.988	72085	4114.771	1613.883	1914.036	-300.153	756.624	271.496	100.4	100.8	99.9
2001	97314.8	11724.675	4483.554	73025	4529.542	1974.222	2277.419	-303.198	826.458	285.108	100.7	100.7	100.8
2002	105172.3	12671.361	5240.953	73740	4928.976	2277.547	2657.006	-379.459	928.048	298.269	99.2	99	99.6
2003	117390.2	14143.398	6694.772	74432	5523.133	2616.295	2969.873	-353.578	1020.747	315.933	101.2	100.9	101.6
2004	136515	16447.590	8442.530	75200	6500.012	3175.410	3416.964	-241.555	1135.181	353.735	103.9	103.3	104.8

Data Source: CEDB

Table2

YEAR	I/E Amount (Billion US\$)	Import Amc (Billion US\$)	Export Amc (Billion US\$)	I-E (Billion US\$)	FI I/E Amou (Million US\$)	FI Import Amo (Million US\$)	FI Export Amc (Million US\$)	FDI-Manuf (Million US\$)	FDI Amount (Billion US\$)
1980	71.25	37.35	33.9	-19	-	-	-	-	-
1981	91.9125	45.9625	45.95	-0.1	-	-	-	-	-
1982	96.4125	44.6875	51.725	30.3	-	-	-	-	-
1983	107.5125	52.725	54.7875	8.4	-	-	-	-	17.3
1984	150.125	77.5625	72.5625	-12.7	-	-	-	-	26.5
1985	258.3375	157.225	101.1125	-149	-	-	-	-	59.31
1986	322.55	187.2875	135.2625	-119.7	-	-	-	-	28.3
1987	385.525	201.775	183.75	-37.7	-	-	-	-	37.1
1988	477.725	256.8875	220.8375	-77.5	-	-	-	-	53
1989	519.5	274.9875	244.5125	-66	-	-	-	-	56
1990	695.0125	321.7875	373.225	87.4	-	-	-	-	65.96
1991	903.225	424.8375	478.3875	81.2	-	-	-	-	119.8
1992	1139.95	555.4125	584.5375	43.5	4372689	2637070	1735619	-	581.2
1993	1408.875	748.275	660.6	-122.2	6707037	4183320	2523717	-	1114.4
1994	2547.7375	1245.0125	1302.725	54	8764715	5293418	3471297	-	826.8
1995	2937.4875	1381.0125	1556.475	167	10981858	6294271	4687587	-	912.82
1996	3016.725	1444.675	1572.05	122.2	13711016	7560380	6150636	4651933	732.77
1997	3370.9	1475.8125	1895.0875	404.2	15262121	7772135	7489986	2706457	510.04
1998	3356.2125	1453.2625	1902.95	434.7	15767938	7671749	8096189	3082722	521.02
1999	3737.025	1717.05	2019.975	292.3	17451127	8588361	8862766	2533180	412.23
2000	4909.15	2329.85	2579.3	241.1	23671390	11727269	11944121	4425430	623.8
2001	5272.95	2519.9	2753.05	225.5	25906106	12584296	13321810	4884686	691.9455
2002	6422.275	3053.7875	3368.4875	304.3	33023948	16025439	16998509	5926985	827.6833
2003	8810.4375	4274.45	4535.9875	254.7	47216996	23186398	24030598	8074727	1150.6969
2004	11944.7625	5806.4	6138.3625	319.5	66317568	32456852	33860716	-	1534.8

Data Source: CED

□

Table 3***Estimates of the traditional Verdoorn's Law 1961—2004 (Equation 1.)***

Sector	b	P	R-Square
Agriculture	0.8882	0.0000	0.68
Industry	0.52594	0.0000	0.55
Service	0.30001	0.0038	0.18
Non-Agriculture	0.38541	0.0000	0.40
Construction industry	-	-	-
Industry-Construction industry	-	-	-
Whole	0.93314	0.0000	0.92

Table 4***Estimates of the traditional Verdoorn's Law 1961—1990 (Equation 1.)***

Sector	b	P	R-Square
Agriculture	0.83924	0.0000	0.69
Industry	0.48999	0.0000	0.55
Service	0.24558	0.0400	0.14
Non-Agriculture	0.34838	0.0003	0.38
Construction industry	-	-	-
Industry-Construction industry	-	-	-
Whole	0.90661	0.0000	0.93

Table 5***Estimates of the traditional Verdoorn's Law 1978—1990 (Equation 1.)***

Sector	b	P	R-Square
Agriculture	0.83182	0.0006	0.67
Industry	0.29294	0.2217	0.13
Service	0.72693	0.0004	0.69
Non-Agriculture	0.4766	0.0364	0.34
Construction industry	0.55199	0.0144	0.55
Industry-Construction industry	0.55476	0.1223	0.27
Whole	0.92108	0.0025	0.58

Table 6***Estimates of the traditional Verdoorn's Law using regional data***

Method: Pooled Least Squares

Date: 07/30/05 Time: 21:05

Sample(adjusted): 2 7

Included observations: 6 after adjusting endpoints

Number of cross-sections used: 28

Total panel (unbalanced) observations: 166

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DGDP?/3	0.868238	0.052077	16.67205	0
Fixed Effects				
_BEIJING--C	-0.020588			
_TIANJING--C	0.006988			
_HEBEI--C	-0.010356			
_SHANXI--C	-0.01222			
_NEIMENGGU--C	-0.005673			
_LIAONING--C	-0.000788			
_JILIN--C	-0.002712			
_HEILONGJIANG--C	-0.010058			
_SHANGHAI--C	-0.000479			
_JIANGSU--C	-0.00095			
_ZHEJIANG--C	-0.009467			
_ANHUI--C	-0.016923			
_FUJIAN--C	-0.017547			
_JIANGXI--C	-0.007534			
_SHANDONG--C	-0.013125			
_HENAN--C	-0.020993			
_HUBEI--C	-0.003697			
_HUNAN--C	-0.010523			
_GUANGDONG--C	-0.017686			
_GUANGXI--C	-0.01461			
_SICHUAN--C	-0.00585			
_GUIZHOU--C	-0.052208			
_YUNNAN--C	-0.014073			
_XIZANG--C	-0.007567			
_GANSU--C	-0.006979			
_QINGHAI--C	-0.013352			
_NINGXIA--C	-0.023052			
_XINJIANG--C	-0.006687			
R-squared	0.703523	Mean dependent var		0.014162
Adjusted R-squared	0.642929	S.D. dependent var		0.038982
S.E. of regression	0.023294	Sum squared resid		0.074337
Durbin-Watson stat	2.136866			

Table 7**Estimates of the coefficients in standard Verdoorn's test—Industry sector****(1991-2003) Equation: $p = a_1 + b_1 * q + b_2 * k$**

Sector	Agriculture	Industry	Whole
b1	1.309723	0.973901	1.024479
t-statistic	9.790844	4.037113	34.4191
P	0.0000	0.0024	0.0000
R-square	0.913807	0.798732	0.99

Table 8**Estimates of the Kaldor's Law (the relationship between the rate of growth of productivity in the overall economy and the rate of growth of manufacturing (industry) output)**

Dependent Variable: DRGDP_WHOLE

Method: Least Squares

Date: 07/31/05 Time: 01:49

Sample: 1961 2004

Included observations: 44

Variable	Coefficient	Std. Error	t-Statistic	Prob.
DRGDP_IND	0.552116	0.025909	21.30976	0
C	0.026741	0.0041	6.522391	0
R-squared	0.915341	Mean dependent var		0.064622
Adjusted R-squared	0.913325	S.D. dependent var		0.083239
S.E. of regression	0.024506	Akaike info criterion		-4.53541
Sum squared resid	0.025223	Schwarz criterion		-4.45431
Log likelihood	101.7791	F-statistic		454.1059
Durbin-Watson stat	1.552176	Prob(F-statistic)		0

Figure 1 Productivity growth and output growth

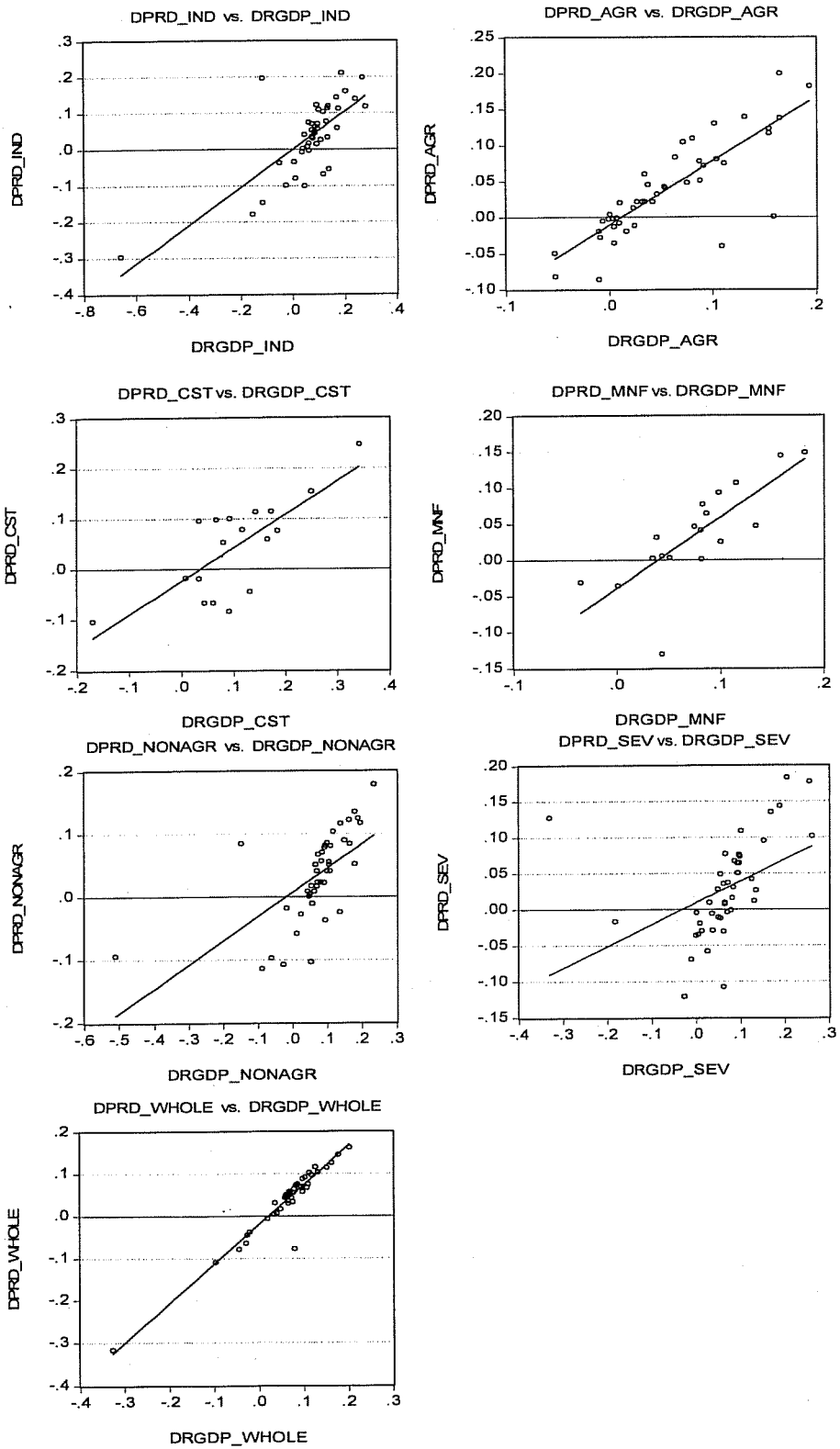


Figure 2 Employment growth and output growth

