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Has China Passed its Lewis Turning Point? -A study of regional variation

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Abstract

This paper examines the dynamic relationship between the supply of labor and wages in the Chinese agricultural sector using the Lewis model. The Lewis model predicts that as economic growth takes off in a low-income country, workers will move from the agricultural sector to the industrial sector and at a certain point called "The Lewis turning point" surplus labor in the agricultural sector will be depleted and this will lead to sharply increased wages. This study uses provincial level data to estimate the turning point for China between 1996-2011 on both a national and regional level. The turning point is determined by comparing the marginal product of labor and wages in the agricultural sector. The result indicates that the national turning point occurred in 2006, and that there is a wide variation in the timing of the turning point on a regional level.

Contents

1 Introduction

The Chinese economy may have reached a time of major transformation, as in recent years strong economic forces have been affecting the Chinese labor market like never before. In the past decades wages in the Chinese manufacturing industry have been sharply increasing, and during the period 1998 – 2010 the average annual growth rate of real wages were 13.8 percent (Carsten A Holtz, 2014). This steady wage growth has been affecting production cost and China's competiveness in the world market (Carsten A Holtz, 2014). At the same time reports of labor shortage in the Chinese manufacturing industry have been frequent and Guangdong province in southern China alone was short of two million migrant workers in 2004 (Zhan and Huang, 2012). This account matches the casual observations of firm managers. The CEO of an automobile component factory located outside of Shanghai worries: "It is getting harder to attract workers to the factory, before it was a line of workers waiting for job opportunities, but now it is getting harder to find qualified workers, even if we are constantly raising the wages"[1]. Availability of a large pool of labor and low production costs have been one of the major advantages of the Chinese economy, but the recent development indicates that things may have changed. Is this the ultimate state of the Chinese labor market or is it just a cyclical labor shortage?

Various studies have tried to explain this development and some have turned to the Lewis turning point to find answers (Knight et al, 2011; Zhan and Huang, 2012; Islam and Yokota, 2008; Golley and Meng, 2011 etc.). The theory of the Lewis turning point was developed by Arthur Lewis (1954) and analyses the relationship between labor supply and wage changes during economic development. The Lewis model predicts that as economic growth takes off in a low-income country, workers' real wages will be kept stable for a period of time and labor will move from the agricultural sector to the industrial sector. However, at a certain point called The Lewis turning point the surplus labor in the agricultural sector will be depleted and this will lead to sharply increased wages as the demand for workers in the industrial sector continues but the supply of workers is limited (Lewis, 1954).

[1] See appendix 1, interview 1.

A variation of techniques has been applied to determine and analyse the Lewis turning point for the Chinese economy. Some have estimated the rural labor surplus and the occurrence of labor shortage in China (Knight et al, 2011; Zhuan and Huang, 2012; Cai 2010; Golley and Meng, 2011) while others prefer to approach the turning point from the development of wages in the agricultural sector (Minami and Ma 2011; Islam and Yokota, 2008). These previous studies have focused on the development of the Lewis turning point on a national level before 2005, bundling together all the 31 provinces of China without considering regional variation and characteristics that may have a significant impact on the determination of the turning point. A manager from a tool and mining manufacturer in Southern China highlights the regional differences: "Xinjiang (western part of China) may provide the cheapest labor in China, but it is far from the coast and we don't speak the same language or share the same culture"[2] China is a country of diversity and regional variation, stretching from culture and geographical features to economic development, and this may have an impact on wages and labor productivity and by extent the development of the Lewis turning point. Thus, regional heterogeneity is considered and accounted for in this in this paper by comparing three regions in China.

This paper provides an updated analysis and uses provincial data from 1996-2011 to estimate the Lewis turning point in China and addresses the gap of research in recent years by applying macro level analysis and by studying regional differences of the turning point in China. For this paper nine interviews have been conducted with company representatives in the Chinese manufacturing industry in order to get a more in depth view of the Lewis turning point in China.

1.1 Previous Research on the Lewis Turning Point

The Lewis framework has been used extensively to analyse economic growth in Asia. Notable are Fei and Ranis (1961,1964) whom applied a modified version of the Lewis framework to the Japanese economy and studied the relation between productivity and wages in Japan to identify the Lewis turning point. The economist Minami (1973) refined the analysis of the Lewis turning point and developed the Minami's criterion

[2] See appendix 1, interview 2.

to determine the turning point, which is used in this essay and explained in further detail in chapter 4.

In recent years the Lewis model has been applied to analyse the Chinese economy. Islam and Yokota (2008) use a different approach in which they estimate a production function using provincial data. They argue that the Chinese economy had not reached its turning point during their sample time between 1989-2005. Yao and Zhang (2010) found a similar result by estimating a supply and demand function for migrant workers in the Chinese economy. They obtain equilibrium levels for different years and conclude that the demand for migrant labor has not yet exceeded the surplus labor pool estimated indicating that no turning point has been reached.

On the other hand, Xiaobo, Jin, Shenglin (2006) estimate the Lewis turning point using micro-level data from six rural Chinese provinces and conclude that the Lewis turning point was already reached in 2003. They argue that the rural turning point and rising wages observed can be seen as a precursor to the development of wages in urban areas. Ercolani and Wei (2011) analyse the Chinese economy between 1978 and 2009 and find that by 2009 the marginal productivity of labor has likely exceeded the institutional wage in China and that China most likely passed its turning point. There are also studies finding that China is far from its Lewis turning point. For example Das and N'Diaye (2013) analyse demographic shifts and changes in working age population and conclude that the workforce is decreasing and at current trend the turning point will be reached by 2025.

Wei and Kwan (2014) argue that wages in the eastern and central parts of China are increasing faster compared to the western region, indicating different stages in the Lewis model. They argue that this regional heterogeneity underlies the diverse level of economic development in the region and that this should be taken into account when analysing the Chinese economy.

Consequently, previous research indicates that there are many different possible approaches when analysing economies using the Lewis model framework. In the case of China this has given a wide spread of results and there are still disagreements about whether China passed its turning point or not, and few attempts have been made to explore regional variation in the development of the Lewis turning Point.

1.2 Research Question

As presented above, previous research indicates that there are still disagreements if China passed its turning point, but that it is steadily moving towards it (Islam and Yokota, 2008; Minami and Ma, 2009). In this thesis Minami's criterion-I is used to identify the Lewis turning point and data from the period 1996-2011 is used to conduct an up to date analysis of the turning point. Beyond the scope of previous research this paper also analyse regional differences. The research question to be answered is: *"Has China passed its Lewis turning point and are there regional differences in the development of the turning point within China?"*

1.3 Method and Data

According to Minami criteria-I the Lewis turning point is reached when the marginal product of labor surpasses the real wage in the agricultural sector (Miniami, 1968). The marginal product of labor in the agricultural sector is estimated using a Cobb-Douglas production function, which is plotted and compared with an estimated real wages in the agricultural sector. When the productivity surpasses the real wage the turning point has been passed. This estimation is also done on regional level and compares the development of the Lewis turning point for eastern, central and western China. A strongly balanced provincial panel data set is used in this study during the time period 1996–2011 and is collected from China Statistical yearbooks (1997-2012). Nine interviews with company representatives in China are used to get a more nuanced picture of the Chinese labor market and the Lewis turning point. The method and data used in this thesis are further explained in section 4.

1.4 Limitations

The main limitation in this thesis is the availability of data, which limits the scope and time period to 1997-2011. Preferably more recent data would have been used in this study, but no complete dataset is currently available covering all variables needed. However, it is still the most updated research on the Lewis turning point for China (Islam and Yokota, 2008; Zhuan and Huang, 2012; Cai 2010, Golley and Meng, 2011). The reliability of statistical data used in this essay is an issue and it has been argued that Chinese statistical sources can contain errors and be manipulated (Cao and Simon 2011, Rawski 2001). This concern is further discussed in the data section.

1.5 Disposition

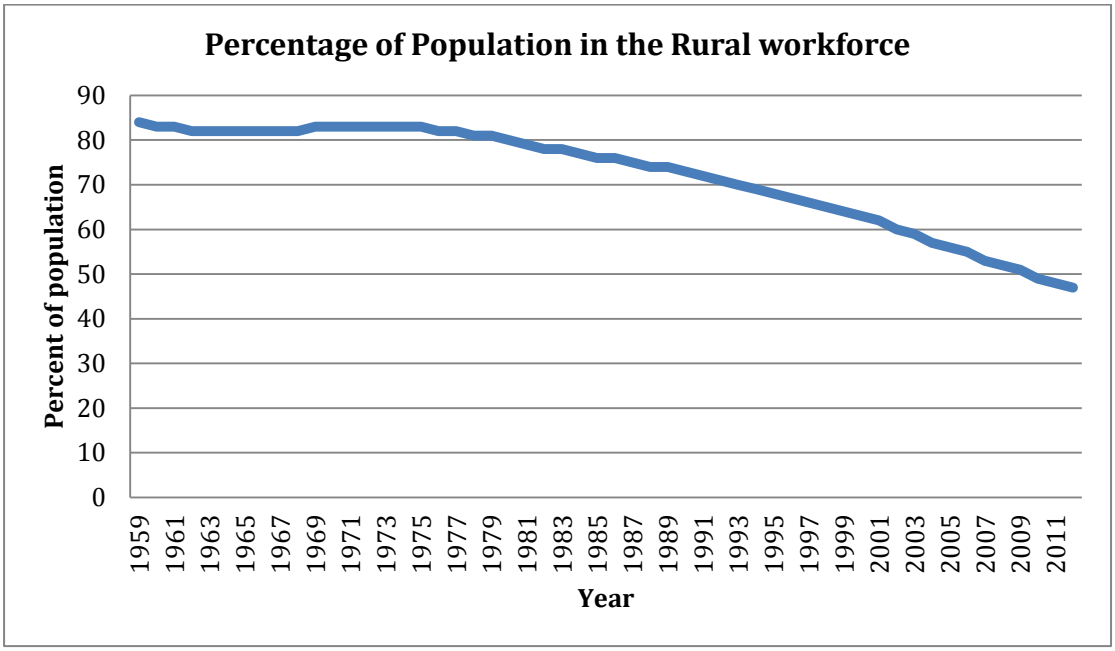
The paper is structured as follows: In section 2 the development of institutional reforms in the Chinese labor market between 1978-2011 is outlined. In section 3 the theoretical framework is provided and the tested hypotheses are introduced. In section 4, the method and data used to test the hypothesis are shown. Section 5 presents descriptive data of the development of the main variables. Section 6 presents the empirical result. In section 7 the implications of the result is discussed and in the final section conclusions from this study are drawn.

2. Background: China's Path towards the Lewis Turning Point

In this section the institutional reforms that shaped China between 1978-2011 are discussed. This is done in order to present the context in which this study takes place and to understand the underlying mechanisms that affect the Lewis turning point in China. This thesis focuses on the Chinese labor market from the mid-1990s until present day, a time of major change. However, to understand the transformation of the Chinese labor market and its path along the Lewis curve we have to go back to the beginning of the People's Republic of China.

During Mao Zedong's leadership between 1949-1976 China was a highly centralized socialist economy and the government planned and allocated all economic matters. In the urban sector the government owned all large factories as well as infrastructure and in the rural sector farmers were organized in agricultural collectives. During this command economy workers were lifetime members of either the rural or urban workforce with few opportunities to change occupation. The rural population was the largest (shown in fig 1) and the greater majority of the rural households worked the land in collective farming. (Appleton et al 2014).

Figure 1. The Chinese Rural Workforce



Source: World Bank, 2014.

In the early years of the People's Republic of China the agricultural workforce was large but ineffective and collective organization of workers resulted in poor monitoring and incentive mechanisms in the agricultural sector. This resulted in low agricultural output, as worker benefits were not linked to productivity and a farmer would receive the same benefits from work independent of the effort. The low agricultural output combined with poor resource allocation had devastating effect, and from time to time, China struggled to feed its growing population (Naughton, 2007).

Workers' incentives were a problem in the urban workforce as well and during the command economy the majority of urban employees were involved in capital-intensive production. The state owned companies offered lifetime employment and more or less fixed wages independent of performance, which generated slacking and low productivity. The products manufactured in the state owned factories lacked in quality and purpose in an economy struggling to provide necessities for its population. At the time of Mao Zedong's passing in 1976, the new leader of China saw an opportunity to gradually reconstruct the economy and do something about the problems. In 1978 Chinese political leaders came together at the "Third Plenum" session, a political conference were it was decided to do fundamental changes to the

old economic and political system. This was the start of China's labor market transformation and path towards its Lewis turning point (Xu, 2011).

The Chinese labor market was both directly and indirectly affected by the institutional reforms targeting nearly every aspect of the Chinese economy in the early 1980s. The rural labor market was the first to be affected and the dissolution of the agricultural collectives resulted in smaller household farm businesses. In this system every rural household was entitled to a piece of arable land on contract for a fixed period of time. During the time of the lease the household was obliged to produce a certain quota of goods to the government and everything exceeding the production quota could be kept by the farm owners (Nee, Opper, 2012). This change increased the incentives and productivity of farmers, as they were now allowed to keep a part of the crop for themselves and could allocate their own labor, which was not allowed in the old system. When farmers now were free to allocate their own labor millions of surplus rural workers not needed anymore in the agricultural production were, in the early 1980s, ready to leave the agricultural sector and look for new opportunities (Li et al, 2000).

At the same time in the urban labor market reforms were slower to change, although gradually, new labor contract terms were introduced in state-owned companies. This meant that workers now were hired on contract instead of lifetime employment, which had been standard during the time of command economy (Zhou, 2014). A gradual reduction of the state's monopoly led to a rapid entry of new companies in the market. It became easier for workers in both the urban and agricultural sector to change jobs and start their own businesses, resulting in many new companies and ownership forms. These new companies began to grow and compete in a freer market and they were competing for employees (Appleton et al 2014). The substantial surplus labor pool that had emerged in the rural areas met the increasing demand for workers in the non-agricultural businesses perfectly. As the activity in the non-agricultural businesses increased and new companies entered the market, more workers were needed to saturate the demand for low-skilled workers in factories and companies. This was the start of a movement of underemployed surplus labor from the agricultural sector to the labor demanding non-agricultural sector (Naughton, 2007). This migration movement is very similar to the concept in the Lewis Theory but

Lewis instead uses the concepts of "traditional" and "capitalist" sector, but the mechanisms and shift between sectors is just the same. The labor movement in China was encouraged and further intensified by the government through institutional reforms throughout the 1980s. An entrepreneur from Wuxi outside of Shanghai recalls the importance of rural labor migration flows to the family business as the business started to grow in the 1990s. In the start-up process, only family members and friends were employed in the business but as the demand for the company's products increased, rural workers were employed in manufacturing. The entrepreneur further explains that the rural workers most often only been through a limited amount of education, but this was not an issue for the business as the job in the factory could be learnt in a few days time. "Many of the workers had escaped rural poverty and were convinced that the urban labor market could offer them opportunities to have a better life". [3]

Another institutional change that led to a growing flow of jobseekers from the rural to the urban areas was the relaxation the Chinese *hukou system*[4] that since long separated the rural and urban population (Zhao, 2004). Now, rural workers were not only allowed to work in non-agricultural business in the rural areas but were to larger extent also allowed to move in to the cities and enter the urban labor market. The gradual relaxation of rural-urban migration combined with the increasing amount of job opportunities in the fast growing areas of eastern China, Guangdong provinces in particular paved the way for workers from rural provinces to compete for jobs in the cities. Many of the rural workers started to work in low-skilled manufacturing jobs with simple production techniques and in industries heavily dependent on manual labor (Opper, Nee, 2012). This is also the experience of a Kunshan based HR manager in the heavy industry that primarily recruits rural migrant workers for lower skilled positions. The reason is that the majority of applicants for blue-collar jobs are holders of rural household registration and that urban residents tend to avoid these positions. He explains that the urban population think they are "too good" to do

[3] See appendix 1, interview 3.

[4] The hukou system was introduced in 1958 and divided every Chinese citizen as a rural or urban worker. This was done to control labor movement and limit mass migration to ensure structural stability. The rural and urban workers are also treated differently with respect to public provided welfare programs in the cities and historically the rural workers have had less access compared to its urban counterpart. The hukou system is still in place and discrimination between the rural and urban class has become less, but is still a problem (Song, 2014).

certain manual labor[5]. The movement of rural workers is both within provinces, between the agricultural and non-agricultural sector, but also across provinces allocating labor were it is most needed.

Migration was further encouraged by a wage gap between the rural and urban sector and wage levels in the urban areas attracted workers to the cities (Yao, Zhang, 2010). In an interview with an entrepreneur outside of Shanghai she explains that the wage in the factory is much higher compared to what the worker would receive in the countryside. In her company the workers contracts also include accommodation and all daily meals. In recent years she has experienced an increasing demand from workers to receive higher wages additional to employee benefits such as health insurance[6]. Many rural workers have seized the opportunity to work in the urban industries and in 1990s the amount of rural- urban migrants had been increasing from approximately 15 million in 1990 to 105 million in 2002 and 145 million in 2009 (Zhang, Huang, 2009) The workers migration flow can be seen in figure 2 were the division of western, central and costal China is also shown.

Figure 2. Internal Labor Movement 1990-1995

Source: National Bureau of Statistics 1997.

[5] See appendix 1, interview 4.

[6] See appendix 1, interview 3

As seen in figure 2, the movement across provinces has not been the evenly disturbed and a majority of the migration has been from the central and western regions of China to the eastern provinces with a focus on the Guangdong province and Shanghai municipality, provinces that have experienced among the fastest economic development in all of China. This is also in line with the observation made by a factory manager in Shanghai. He explains that the rural workers often come from the rural parts within the province, but there are also workers coming from as far away as Sichuan province. "Sometimes they bring their whole family, but it is most common that they travel and look for jobs alone or that they travel with people in similar situation from their home villages"[7]

Despite the steadily growing amount of migrant workers, scholars have argued that a there has been a labor shortage since 2004, mostly in the costal regions (Zhan, Huang, 2009 Das, Diaye, 2013). The number of migrant workers is still increasing, but at a lower rate than before and according to a BSR (2010) survey among Chinese companies the migrant supply cannot satisfy the demand in several industries. This is also in line with four companies in the Shanghai region interviewed, which have observed a decrease in respondents to job application for low-skilled positions. In response to increased wages they have focused on automatize the production process and invested in capital. The companies have also considered to relocate production to the central and western part of China were labor is cheaper[8].

China's labor market shift from having a large underemployed agricultural workforce that has gradually been "pushed" to the expanding non-agricultural sector displays many of the characteristics that the Lewis model tries to capture. Institutional barriers such as restriction of labor migration and planned labor allocation have been reformed to further encourage the movement. The rise in agricultural productivity observed and the increase in urban wages also make China suitable and highly interesting to analyse within the Lewis framework.

[7] See appendix 1. interview 3.

[8] See appendix 1, interview 1,7,8.

3. Theoretical Framework: The Lewis Turning Point

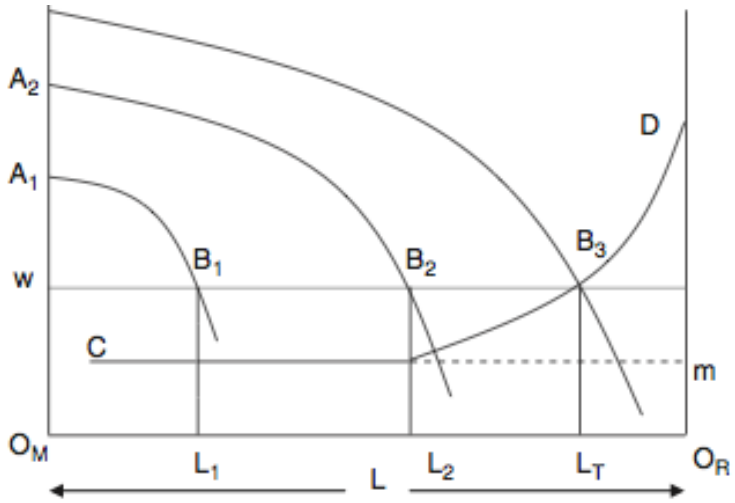
The Lewis model was developed by Arthur C Lewis (1959) to analyse the relationship between labor supply and wage changes during economic development. A key assumption by classic writers from Smith to Marx is that unlimited supply of labor is available at subsistence wages. This is also the starting point for Lewis, as his theory predicts how wages in a developing economy changes with the supply of labor. The Lewis model predicts that as economic growth takes off in a low income country, workers real wages will be kept stable for a period of time and surplus labor will move from the agricultural sector to the industrial sector. However, at a certain point called "The Lewis turning point" the surplus labor will be depleted and this will lead to sharply increased wages as the demand for workers in the industrial sector continues.

Lewis illustrates the turning point in a dual economy framework with the agricultural (subsistence) and the industrial sector (capitalist sector). The agricultural sector is assumed to have a large population relative to land, and the marginal productivity of labor in the agricultural sector is close to zero, indicating a severe labor surplus as workers can be removed from the sector without affecting production output. The industrial sector is supported by capital inflows and as the economy expands new jobs are available in the sector. The industrial workers are offered higher wages relative to the agricultural sector, which leads to the migration of workers from the agricultural sector to the industrial sector (Gollin, 2014). When workers move from the agricultural to the industrial sector, the savings rate of the economy rises which leads to a steadily rise in the per capita income in the economy. The capitalist sector will continue to hire labor until the marginal labor of product is equal to the wage. The size of the agricultural surplus labor pool lets the industrial sector continue to grow without any labor supply constraints. Lewis argues that this will hold until a certain point when the industrial sector has absorbed the greater amount of agricultural sector, indicating the Lewis turning point (Lewis, 1954).

A two-sector model is used to graphically illustrate the labor migration in the agricultural and industrial sector shown in figure 3. L is the total labor force in the economy, OR represents the origin of the agriculture and OM represent the origin of

the industrial sector. W represents wages in the industrial sector and as can be seen it is relatively higher than the wages in the agricultural sector represented by M. The CD curve is the MP_L in the agricultural sector, which is flat in the beginning and then quickly rises. The AB curve represents MP_L in the industrial sector.

Figure 3. Labor Migration and Wage Change



(Adapted from Basu, 2000)

In the initial stage the economy is in point $B_1$and the labor force is located at $L_1$and the majority of the economy is engage in agricultural production. It is assumed that both industries seeks to profit maximize and the wage is set equal to the MP_L in the different sectors. This creates a wage gap between the two sectors creating an incentive for agricultural workers to move to the industrial sector. In the second stage the economy further develops as companies in the industrial sector reinvest part of its profit in to more capital. The capital stock increases which leads to higher MPL in the industrial sector. This is shown in figure 1 as the shift from position B_1 to $B_1$and a rightward shift in the MP_L curve for the industrial sector. As a result, more workers are needed in the industrial sector and agricultural workers continue to move to the industrial sector. The total labor force is reallocated and more workers are in the industrial sector in position L_2. From this point, MP_L in the agricultural will start to exceed the initial wage M and workers will start to demand higher wages. As more capital is invested, the economy will start to move towards B_3 and more workers are moving to industrial sector and the economy passes its Lewis turning point. At the Lewis point the labor surplus in the agricultural sector is no longer unlimited, and the

industrial sector will start to face an upward-sloping labor supply curve, pushing up the wages with further economic growth (Ge, Yang, 2011).

Since the introduction of the Lewis model in the 1950's it has frequently been applied to analyse economic growth. However, the model has some methodological shortcomings. The concept of subsistence and capitalist sector are hard to define and has given rise to many different interpretations and applications of the model. In this paper the agricultural sector and urban industry is used as proxies. For more discussions related to the model see Gollin, (2014).

The prediction of the Lewis model and the previous research in the field enables the following hypotheses:

(1) China has reached its Lewis turning point.

(2) There are regional turning points in China as a result of different endowments and regional characteristics.

4. Method and Data

4.1 Method

In this paper the MP_L in the agricultural sector is compared with the real wage of labor in the agricultural sector. This makes it possible to estimate if the MP_L has passed the real wage of labor, which would indicate that China has passed its Lewis turning point. This method to determine the turning point is based on Minami's criterion-I. Wei and Kwan (2014) argue that the Minami's criterion is the most well-known framework applied to study the Lewis turning point and according to Minami, criterion-I is the most essential test, if it is fulfilled it is likely that the other criteria's are also satisfied (Minami, 1968).

The application of the Minami criterion is based on Minami's research on Japan (1971) and on Islam and Yokota's (2008) previous research on the relationship between agricultural productivity and real wage in China. However, this paper departs from previous research and use macro-level data from 1995-2011 to estimate four different turning points for China. The first estimation is for the whole sample to estimate a national turning point for China. The other three estimations will estimate

regional turning points for western, central and eastern China. This is done to capture regional variations and it is likely that the turning point may occur at different time periods across the region as a result of different endowments and labor market development.

The marginal product of labor in the agricultural sector is estimated as the product of the output elasticity of labor (BL) and the average productivity of labor (AP_L).

$$APL = \frac{gross\ agricultural\ output}{Agricultural\ workers} \quad (1)$$

$$MP_L = \beta_L * AP_L \quad (2)$$

A Cobb-Douglas agricultural production function is used to estimate the output elasticity of labor β_L, by combining cross-sectional (31 provinces) and (annual) time-series data for the years 1996-2011. A pooled three year estimation is used to estimate the equations for each year. For example, the equation 1997, data is pooled for 1996, 1997 and 1998 and year dummies are used to control for year effects. This method is most efficient as the main purpose of the estimations is to find the output elasticity of labor for each year and region, which requires separate estimations (Yokota and Islam, 2008). Pooling technique is also done to increase the number of observations and make a regional comparison possible, without pooling it would be too few observations for each province (N<30), which would make statistical inference impossible. The variables in the estimation are transformed into per land and natural logarithm form. This is done because the variables in their original form have a correlation of 0.9 and above, and the transformation results in lower correlation between the variables and multicolinearity can be avoided. The Cobb-Douglas production function is given in equation 3:

$$ln\frac{Y_i}{LD_i} = \beta_0 + \beta_L Ln\frac{L_i}{LD_i} + ln\frac{K_i}{LD_i} + ln\frac{LD_i}{LD_i} + \sum \delta_j D_{ij} + year\ effects + \varepsilon_i \quad (3)$$

In equation 3, Y_I is the dependent variable representing gross output in the agricultural sector. The independent variables are: L_i is the total amount of labor, LD_i is the total amount of land and K_i is the capital input. δ represents dummy variables that are included for eastern, central and western China, this is done to capture regional

differences in total factor productivity (Wooldridge, 2008). The regional estimate for the output elasticity of labor β_L in western, central and eastern China is given by the following Cobb-Douglas production function:

$$ln\frac{Y_i}{LD_i} = \beta_0 + \beta_L Ln\frac{L_i}{LD_i} + ln\frac{K_i}{LD_i} + ln\frac{LD_i}{LD_i} + +year\ effects + \varepsilon_i \quad (4)$$

In equation 4 the regional dummy term is removed as the western, central and eastern part of China is estimated separately.

After the output elasticity of labor β_L is obtained from equation 3 and 4 the estimated MP_L can be calculated from the relationship $MP_L = \beta_L * AP_L$ for each year. The MP_L is then compared with the real wages in the agricultural sector to determine if China passed its Lewis turning point.

Chinese statistical reports do not provide wage data in the agricultural sector and earnings is reported as household income. Therefore the real wage per worker needs to be approximated. There are several different approaches when approximating rural wage, for example per capita net income and consumption expenditure of rural households or the net rural household real operating income per laborer used in previous studies on China (Minami & Ma, 2011;Wei, Kwan, 2014). Islam and Yokota (2008) suggest that the real agricultural wage can be approximated by an average provincial net income per labor for each year in the farming sector, which is used in this thesis as it account it does take into account that not all members of a rural household are engage in agricultural production. The calculation of the rural wage (w) is given in equation 5 and 6.

$$W_i = \frac{F_i * \bar{N}}{\bar{L} * C_i} \quad (5)$$

$$W = \frac{1}{N}\sum_{i=1}^{n} w_i \quad (6)$$

Where F_i represent the net per capita income in the agricultural sector for each province, $\bar{N}$ is the average number of members in a rural household. $\bar{L}$ is the average number of workers in a family and C_i is the consumer price index for each province, included to deflate wages in constant (2000) yuan and make the years comparable. In equation 2 the wage level for every province is summed and divided by the number of provinces in order to calculate the national real wage average.

4.2 Data

The data is collected from 1997–2012 for 31 Chinese provinces excluding Hong Kong and Macau, and the data is organized in a strongly balanced panel data set from *China Statistical Yearbooks* (1997-2012) and *China Rural Statistical Yearbooks* (1997-2012). This paper only focuses on the farming side of the agricultural sector because of data availability reasons. Farming is the main agricultural activity in China and this limitation makes an estimation of a Cobb-Douglas agricultural production function possible. If other parts of agricultural would be included (fishery, husbandry and forestry) it would not be possible to estimate an accurate production function as data of production technologies for the necessary variables are not available for these types of agricultural activity.

The division of China into three parts is done to capture regional differences between the western (10 provinces), central (10 provinces) and eastern (11 provinces) parts of China and is especially interesting when estimating regional turning points. The three different regions have different regional endowment, climate, economic development and other factors that may affect the Lewis turning point. This classification of China has been applied by scholars before and is suitable for regional comparison (Islam and Yokota, 2008, Ma and Minami, 2011, Xiaobo et al, 2011).

The main dependent variable in the Cobb-Douglas production function estimation is the gross output in the agricultural sector (Y), which is collected from China Rural Statistical Yearbook (1997-2012). This variable refers to the total scale of agricultural production for each year in 100 million RMB deflated by provincial price index. The independent variable land (LD) refers to the area of land sown with crops in 1000 of hectares. Capital (K) is a difficult variable to measure and could according to Butzer et al (2009) be measured as structures, equipment and machinery used in agricultural production. In this paper the total power of agricultural machinery in 10 000kw is used to measure capital (China Statistical Yearbook, 1997-2012). Other measurements available for capital would be the numbers of small and medium size tractors, which would not capture smaller tools and machinery used in agricultural production. The amount of labor (L) engage in farming is measured in 10 000 of persons. The variables used to estimate the net per capita income in the agricultural sector (real wage) and the AP_L in the agricultural sector are obtained from the China

rural statistical yearbook (1997-2012). It is also important to note that wages and all production measured in monetary values are deflated by the consumer price index.

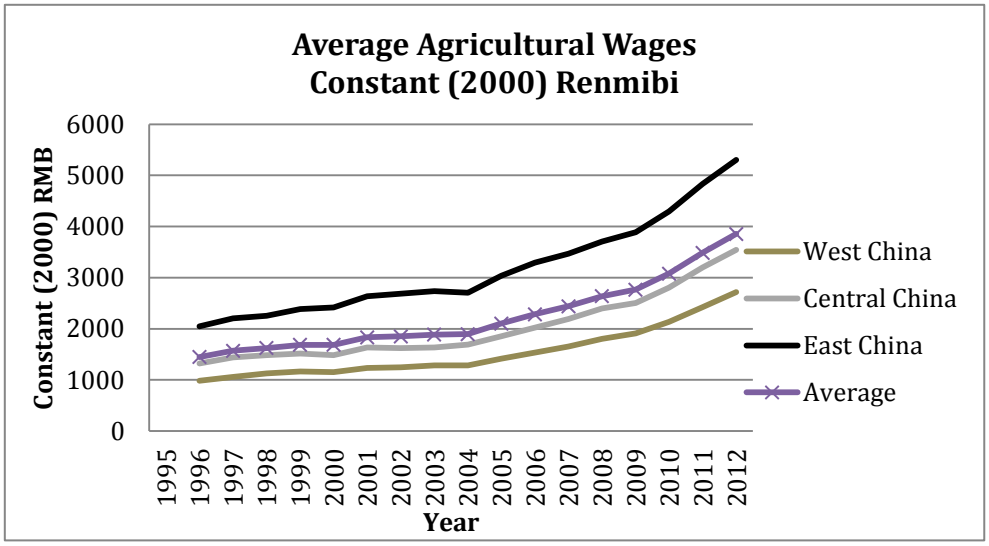
Chinese statistics have been criticized for containing statistical over- and underreporting in certain key areas such as employment, inflation and GDP growth. According to Cao and Simon (2011) this can be a result of fear of punishment if not certain results are met and by manipulating the reports punishment is avoided. However, according to Rawski (2001) and Chow (2006) the quality of Chinese statistical reports have been greatly improved over the years since the reform era of 1978, during which the Chinese government reformed the statistical report system in order to regain control and increase the reliability. Chow (2006) argues that Chinese statistics can be used in econometric models and is an important tool to understand the Chinese economy. Consequently, Chinese statistical data has been used in this study to carry out the regression analysis in section 5.

5. Descriptive Statistics: National and Regional development

China is a large country with a wide variation in demographic, geographic and economic endowments. The country can roughly be divided into three main regions, western, central and eastern China. In this section an overview of the development of the main variables between 1996-2011 for each region will be presented. Detailed descriptive statistics for all variables are presented in appendix 3.

Figure 3 shows the development of rural wages in the western, central and eastern China as well as the average wage in the agricultural sector, which is used to determine the Lewis turning point. Wages in the three regions have increased during the time period and a notable difference can be observed between the provinces in the eastern regions compared to the others. This can be due to a higher economic activity in these regions as it contains highly developed metropolitan areas such as Shanghai, Beijing and Guangzhou that may increase the general wage level in the region. The yearly wage growth has been 6,2% for the eastern region, 6.4% for the central region, and 6.8% for the western region. This is an indicator that the western region is slowly closing the wage gap, if the current wage trend would persist.

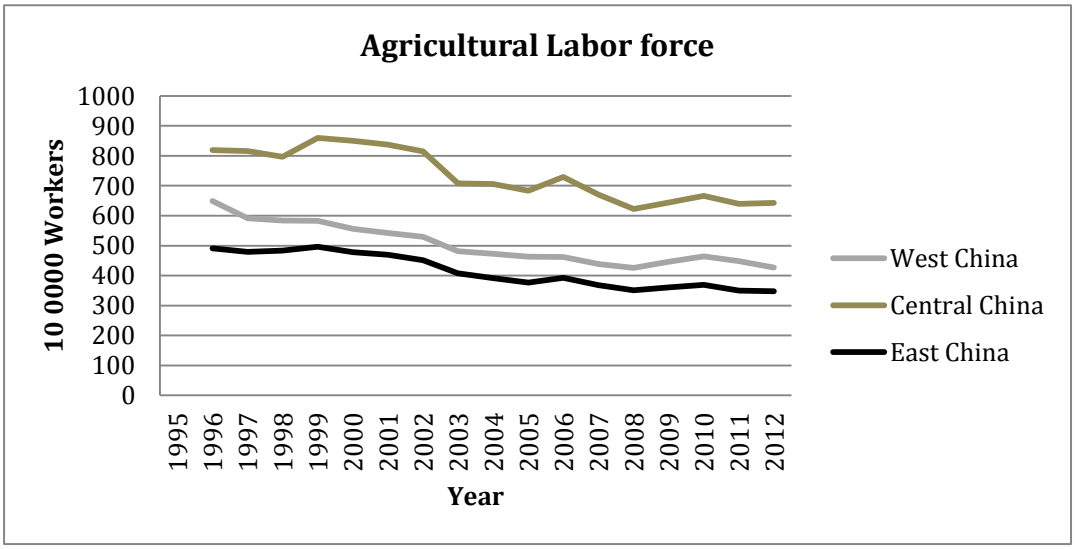
Figure 3. Agricultural Wage Development



Source: China Rural Statistical Yearbook 1997-2012

The main independent variable in this study is the total agricultural labor force engaged in farming, shown in figure 4. This is the main variable as its coefficient value is the output elasticity of labor, which will used to calculate the Marginal productivity of labor. The marginal productivity of labor will be used to determine the Lewis turning point in accordance to Minami criterion-I. As shown in figure 4 the variable has decreased during the time period 1996-2011 from approximately 20 million in 1996 to 14 million in 2011. This is an indication that the agricultural labor force gradually has been leaving the farming sector in all of China's regions. In the western part of China it has decreased the most, with more than 2.6 million workers. The largest drop in labor can be seen between 1996 and 2003. After that the labor force has continued to decrease but at a slower rate. The central and western part of China has the largest labor pools and has also experienced the most fluctuation in the amount of labor. This could be a result of a dynamic labor market and a constant flow of migration of workers to urban areas.

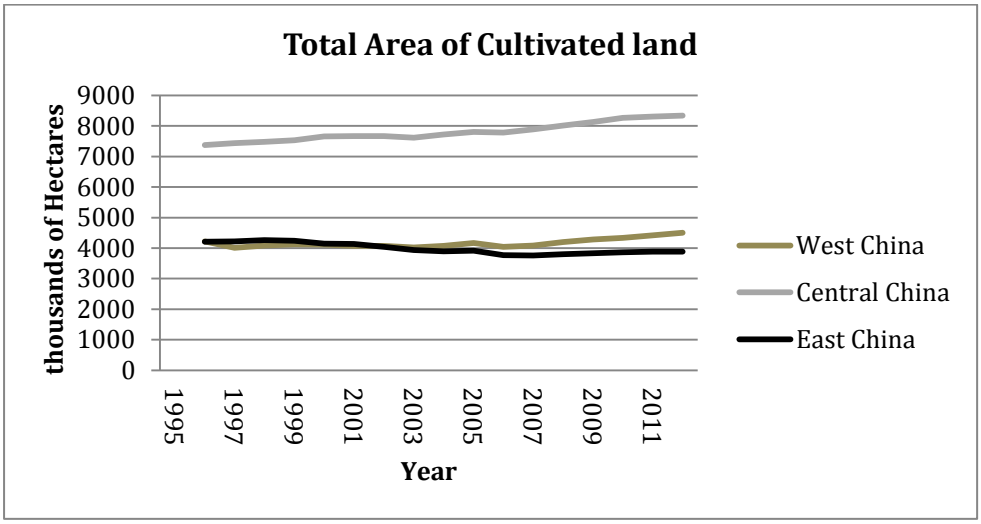
Figure 4. Development of The Agricultural Labor Force



Source: China Rural Statistical Yearbook 1997-2012

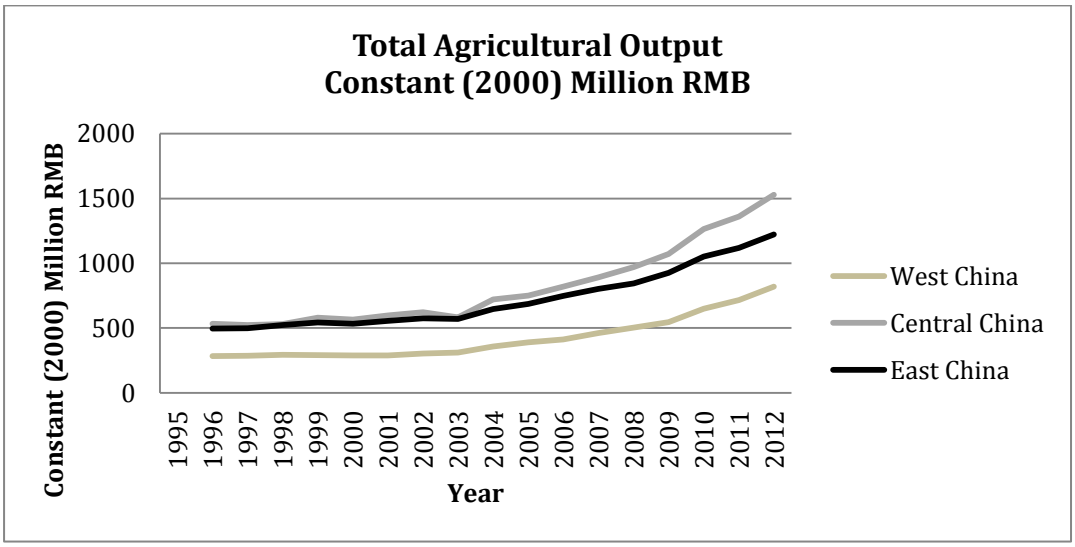
The central part of China does not only have the largest labor force but it also has the largest amount of sown land, with 8338 thousands of hectares of sown land in 2011 compared to 4497 and 3884 thousands of hectares in the western and eastern regions respectively (shown in figure 5). An interesting remark is that the area of sown land has expanded in the central part of China between 1996-2011, while in the western and central part it has been at a rather constant. This may be an indication that the central part still has areas to expand agricultural production while the western and eastern part may be saturated. The decrease in sown land may also be because of urbanization, converting the agricultural land to urban areas or because of land degradation making the land unusable.

Figure 5.Area of Cultivated land



Source: China Rural Statistical Yearbook 1997-2012

Figure 6. Total Agricultural Output

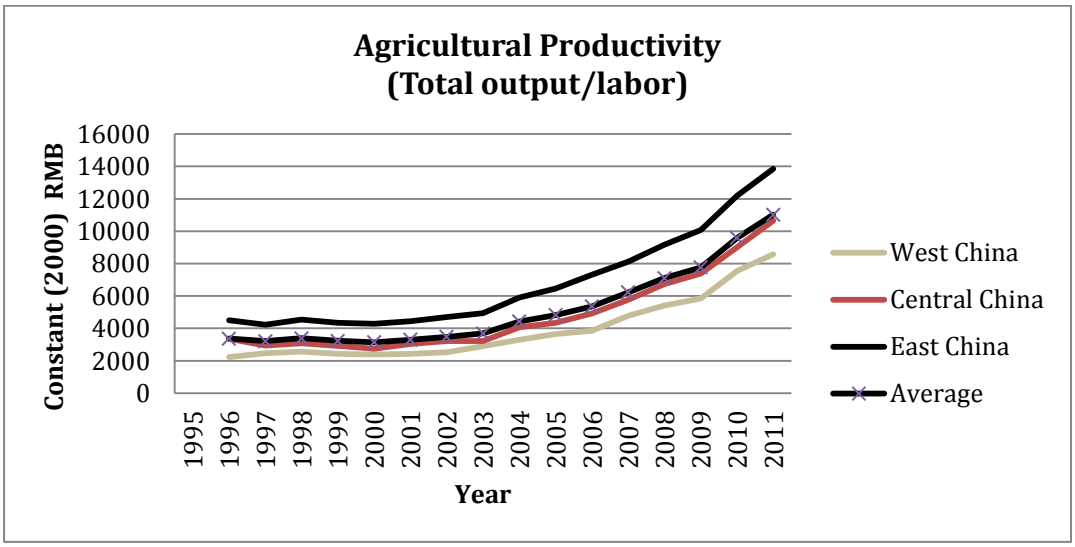


Source: China Rural Statistical Yearbook 1997-2012

In figure 6, it can be seen that the total agricultural output constant (2000) million RMB have been increasing in China between 1996-2012 for all regions. In 2011 the central region of China produced the largest agricultural share of the three regions. This is not so surprising as this region has the largest amount of land and labor force. However, as seen in figure 7, the eastern region seems to have higher productivity and is not far from having the same output level as the central region. The development of

agricultural output in the western region has also been increasing, but is lagging behind the eastern and central part in total production.

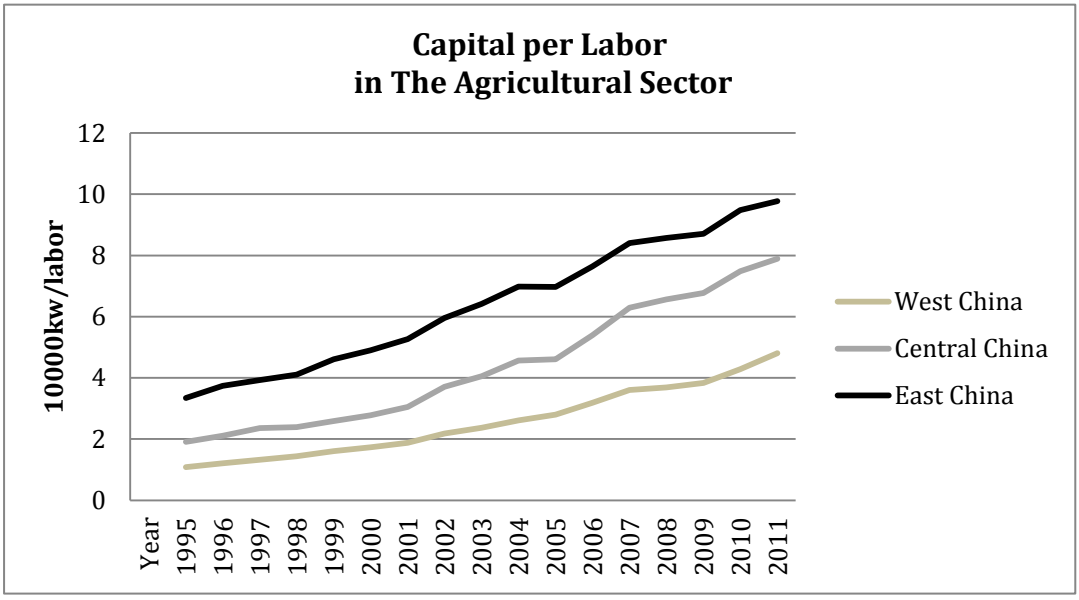
Figure 7. Agricultural Productivity



Source: China Rural Statistical Yearbook 1997-2012

Turning to the productivity in the agricultural sector, measured as the average productivity per labor shown in figure 7, it can be seen that the east part of China has a significantly higher productivity per labor than in the central region and is producing approximately 14000 constant (2000) RMB per worker yearly compared to 8500 RMB in the western and 10640 RMB in the central region. This can be a result of more modern production techniques and more intensive use of capital in the eastern regions. The amount of capital per worker in each region is shown in figure 8 and indicates that the eastern region is more capital intensive than the western and central provinces, which can be the reason why the eastern region seems to be able to extract more output from its land. However, it can also be because of geographical reasons and the eastern region of China may have a better climate for agricultural production.

Figure 8.Amount of capital per labor



From this presentation of the descriptive data the conclusion is that there is a wide variation in regional agricultural endowments. The central region seems to have the largest labor force, sown land and total output in all of China. Nevertheless, accounting for the difference in labor force the eastern region is more productivity per worker, which may be a result of different use of capital in the agricultural production. The western region is lagging behind in agricultural production and in use of capital relative to the other regions.

6. Results

In this section the result from the estimations of the Cobb-Douglas equation 1 and 2 will be presented. These estimations will give the output elasticity of labor for national and regional level, which will be used to compute the MP_L in the agricultural sector. When the MP_L is obtained it is possible to determine the Lewis turning points for China on both a national and regional level by comparing the MP_L to the wage level in the agricultural sector. To control for multicollinearity the correlation between the different variables are compared. At first the correlation matrix reveals high correlation (> 0,9) between the variables and by transforming the variables to per land form, multicollinearity is avoided and the correlation between the variables is substantially lower. A VIF test signals that multicollinearity will not pose a problem. To correct for heteroskedasticity White's robust standard error is applied (Wooldridge, 2008). Another problem that may arise in the estimations is endogeneity, which can be caused by omitted variables, measurement error or simultaneity and may cause biased results. To address this issue the regression is also specified using lagged input variables, which are highly correlated with independent variables but not with the dependent variable acting as instrument variables (Baltagi, 2011). The result from this endogeneity test yields similar results as the original estimation and support that the estimation does not suffer from endogeneity.

6.1 Regression Results: National Level

The result from the Cobb-Douglas production function for the national estimation including all Chinese regions is presented in table 1. The adjusted R^2 in the estimation indicates that about 10-18% of the variation in gross agricultural output can be explained by the labor, capital and land variables. The Adjusted-R^2 is decreasing during the time period, which indicates that the estimation explains a lower degree of the variation in the latter part of the sample period.

The main variable in this estimation is the labor variable and its coefficient value is the output elasticity of labor that is used to calculate the MP_L in the agricultural sector. The labor variable is significant for all of the years except in 2002, and the output elasticity of labor coefficient has been on a rather constant level over the time period from 0.394 in 1996 to 0.414 in 2011. This can be seen as an indication that labor is as important in agricultural production in 1996 as it is in 2011. The capital variable has been insignificant for the majority of the years but has showed some years with positive significant results in the latter part of the sample.

The coefficient of land is estimated as $1 - B_L - B_K$ and the high coefficient values of land indicate that it is the dominant factor in agricultural production compared to the other variables. This can be seen as quite logical and more sown land is the dominant strategy to increase agricultural output. Although as discussed in the descriptive statistic chapter, the total area of sown land in China has been decreasing and land may have become a scarce resource, especially in the western and eastern regions. The coefficient values of land have been increasing from 0.404 in 1996 to 0.876 in 2011 and land is the variable adding the majority of value in the Chinese agricultural sector. This result shows that a large portion of agricultural input and by extension the income of farmers are attributed to non-labor inputs and the best way to increase output is to get more land.

The dummy variables for the central and western region (Dummy C, Dummy W) are significant and have negative coefficient values, indicating that the eastern region, which is the benchmark, has higher total factor productivity in the agricultural sector. The western part of China in particular is lagging behind and combined with the observations made in the descriptive statistics section this indicates that there are striking regional differences between the regions of China, which may affect the development of the Lewis turning point.

In the first estimation shown in table 1 a Cobb-Douglas production function for all of China is estimated, revealing the general trend of the country when all regions are combined in a pooled estimation. In the next section the Cobb-Douglas production is estimated but this time for each region of China separately. The estimations for the western, eastern and central China are presented in table 2, 3 and 4 respectively. This is mainly done in order to obtain the regional output elasticity of labor but also to reveal regional differences in what drives agricultural output on a regional level.

Table 1. Regression output of Equation 1 (All China) $ln\frac{Y_i}{LD_i} = \beta_0 + \beta_L Ln\frac{L_i}{LD_i} + ln\ \frac{K_i}{LD_i} + ln\frac{LD_i}{LD_i} + \sum \delta_j D_{ij} + year\ effects + \varepsilon_i$

YEAR	Labor	Capital	Constant	Land	Dummy C	Dummy W	Observations	R^2
1996	0.394***	0.010	0.234**	0.404	-0.0629**	-0.112***	62	0.180
	(0.094)	(0.106)	(0.108)		(-3.50)	(-4.15)		
1997	0.435***	-0.053	0.258***	0.435	-0.0643***	-0.111***	93	0.163
	(0.088)	(0.140)	(0.098)		(-3.72)	(-4.26)		
1998	0.435***	-0.051	0.275***	0.465	-0.0664***	-0.112***	93	0.143
	(0.089)	(0.117)	(0.100)		(-4.30)	(-4.55)		
1999	0.454***	-0.059	0.308***	0.501	-0.0700***	-0.116***	93	0.126
	(0.088)	(0.152)	(0.101)		(-4.99)	(-4.90)		
2000	0.449**	-0.074	0.346***	0.542	-0.0730***	-0.120***	93	0.111
	(0.094)	(0.124)	(0.108)		(-5.12)	(-5.25)		
2001	0.466*	-0.073	0.410***	0.617	-0.0762***	-0.122***	93	0.102
	(0.096)	(0.154)	(0.113)		(-5.55)	(-5.58)		
2002	0.481	0.145	0.487***	0.684	-0.0766***	-0.121***	93	0.081
	(0.097)	(0.092)	(0.117)		(-5.83)	(-5.80)		
2003	0.45**	0.081	0.554***	0.752	-0.0764***	-0.122***	93	0.077
	(0.098)	(0.104)	(0.120)		(-6.24)	(-6.02)		
2004	0.42**	0.045	0.596***	0.783	-0.0780***	-0.122***	93	0.164
	(0.100)	(0.107)	(0.124)		(-6.50)	(-6.29)		
2005	0.405*	0.025	0.633***	0.146	-0.0801***	-0.122***	93	0.183
	(0.103)	(0.109)	(0.120)		(-6.70)	(-6.29)		
2006	0.463**	0.266*	0.669***	0.83	-0.0821***	-0.124***	93	0.102
	(0.102)	(0.068)	(0.115)		(-6.78)	(-7.08)		
2007	0.0.522**	0.264*	0.727***	0.881	-0.0812***	-0.122***	93	0.151
	(0.118)	(0.063)	(0.137)		(-6.60)	(-7.63)		
2008	0.569*	0.267*	0.759***	0.844	-0.0772***	-0.118***	93	0.193
	(0.090)	(0.063)	(0.110)		(-6.86)	(-8.27)		
2009	0.485**	0.264*	0.766***	0.843	-0.0744***	-0.114***	93	0.115
	(0.109)	(0.065)	(0.137)		(-7.15)	(-8.75)		
2010	0.419**	0.238	0.766***	0.929	-0.0729***	-0.110***	93	0.112
	(0.085)	(0.072)	(0.107)		(-7.47)	(-9.15)		
2011	0.414**	0.198	0.802***	0.876	-0.0717***	-0.107***	62	0.132
	(0.097)	0.266*	(0.128)		(-7.57)	(-8.93)		

***, **, * represent significance level at the 1%, 5%, 10% level. White's heteroskedasticity standard error estimates in the variable paranthesis. Value for land is calculated as 1-labor-capital.

Table 2. Western China $ln\frac{Y_i}{LD_i} = \beta_0 + \beta_L Ln\frac{L_i}{LD_i} + ln\frac{K_i}{LD_i} + ln\frac{LD_i}{LD_i} + +year\ effects + \varepsilon_i$

YEAR	Labor	Capital	Land	Obs	R^2
1996	0.587***	0.007	0.404	30	0.180
	(0.168)	(0.238)			
1997	0.481***	-0.319	0.435	30	0.163
	(0.171)	(0.274)			
1998	0.420**	-0.529	0.465	30	0.143
	(0.181)	(0.323)			
1999	0.371*	-0.653*	0.501	30	0.126
	(0.184)	(0.331)			
2000	0.388**	-0.643*	0.542	30	0.111
	(0.174)	(0.292)			
2001	0.352**	-0.643**	0.617	30	0.078
	(0.165)	(0.250)			
2002	0.326**	-0.652*	0.684	30	0.081
	(0.157)	(0.217)			
2003	0.264*	-0.720*	0.752	30	0.077
	(0.150)	(0.189)			
2004	0.323**	-0.617*	0.783	30	0.064
	(0.140)	(0.169)			
2005	0.378***	-0.515*	0.146	30	0.083
	(0.132)	(0.135)			
2006	0.405***	-0.420*	0.83	30	0.079
	(0.125)	(0.092)			
2007	0.377***	-0.422*	0.881	30	0.051
	(0.130)	(0.089)			
2008	0.299**	-0.475*	0.844	30	0.093
	(0.128)	(0.087)			
2009	0.304***	-0.455**	0.843	30	0.081
	(0.101)	(0.063)			
2010	0.304***	-0.455*	0.929	30	0.115
	(0.101)	(0.053)			
2011	0.274**	-0.446**	0.876	20	0.052
	(0.125)	(0.078)			

***, **, * represent significance level at the 1%, 5%, 10% level

Table 3. East China $ln\frac{Y_i}{LD_i} = \beta_0 + \beta_L Ln\frac{L_i}{LD_i} + ln\frac{K_i}{LD_i} + ln\frac{LD_i}{LD_i} + +year\ effects + \varepsilon_i$

YEAR	Labor	Capital	Land	Obs	R^2
1996	0.462***	-0.154	0,692	33	0.530
	(0.073)	(0.093)			
1997	0.425***	-0.102	0,677	33	0.524
	(0.171)	(0.079)			
1998	0.350***	-0.066	0,716	33	0.694
	(0.063)	(0.061)			
1999	0.264***	-0.023	0,759	33	0.711
	(0.039)	(0.043)			
2000	0.224***	-0.022	0,798	33	0.610
	(0.046)	(0.047)			
2001	0.187***	-0.001	0,814	33	0.464
	(0.051)	(0.052)			
2002	0.170***	-0.010	0,84	33	0.493
	(0.051)	(0.053)			
2003	0.173***	-0.023	0,85	33	0.527
	(0.052)	(0.052)			
2004	0.188***	-0.065	0,264	33	0.622
	(0.048)	(0.044)			
2005	0.197***	-0.072*	0,875	33	0.666
	(0.047)	(0.040)			
2006	0.202***	-0.094*	0,892	33	0.655
	(0.041)	(0.035)			
2007	0.205***	-0.111*	0,906	33	0.553
	(0.055)	(0.046)			
2008	0.189***	-0.080	0,891	33	0.581
	(0.052)	(0.050)			
2009	0.190***	0.082*	0,892	33	0.644
	(0.043)	(0.042)			
2010	0.190***	0.082*	0,892	33	0.644
	(0.043)	(0.042)			
2011	0.186***	0.071**	0,885	22	0.753
	(0.051)	(0.054)			

***, **, * represent significance level at the 1%, 5%, 10% level

Table 4. Central China $ln\frac{Y_i}{LD_i} = \beta_0 + \beta_L Ln\frac{L_i}{LD_i} + ln\frac{K_i}{LD_i} + ln\frac{LD_i}{LD_i} + +year\ effects + \varepsilon_i$

YEAR	Labor	Capital	Land	Obs	R^2
1996	0.258	-0.066	0,808	32	0.059
	(0.224)	(0.197)			
1997	0.458*	-0.158	0,7	32	0.165
	(0.258)	(0.225)			
1998	0.579**	-0.230	0,651	32	0.309
	(0.226)	(0.227)			
1999	0.765***	-0.411*	0,646	32	0.536
	(0.210)	(0.228)			
2000	0.833***	-0.493*	0,66	32	0.610
	(0.200)	(0.214)			
2001	0.813***	-0.534*	0,721	32	0.550
	(0.206)	(0.207)			
2002	0.770***	-0.529*	0,759	32	0.621
	(0.180)	(0.179)			
2003	0.780***	-0.612	0,832	32	0.652
	(0.164)	(0.169)			
2004	0.880***	-0.777	0,89	32	0.658
	(0.152)	(0.172)			
2005	0.991***	-1.018	1,027	32	0.770
	(0.162)	(0.207)			
2006	1.101***	-1.225*	1,024	32	0.672
	(0.189)	(0.273)			
2007	0.875***	-0.921*	1,046	32	0.651
	(0.197)	(0.349)			
2008	0.771***	-0.703	0,932	32	0.569
	(0.100)	(0.184)			
2009	0.748***	-0.722	0,974	32	0.770
	(0.071)	(0.146)			
2010	0.748***	-0.722*	0,974	32	0.770
	(0.071)	(0.146)			
2011	0.757***	-0.753*	0,996	24	0.754
	(0.083)	(0.182)			

6.2 Regression Result: Regional Level

The regional pooled estimations for western, eastern and central China show similar trends to the estimation of the national sample in table 1. However, the estimations also show regional characteristics not captured in the national estimation. The R^2 values is significantly higher for the regional estimations compared to the national sample and the regional estimations clearly better explains the relation between agricultural output and the input variables. In table 3 and 4 it is shown that labor as an input factor in the agricultural production has been decreasing in importance during the time period 1996-2011 for the eastern and western part of China. In the central region labor is still an important input factor in the agricultural production. Capital as an input factor is insignificant for many years in the sample, which is an observation also made by Islam and Yokota (2008) and Lin (1992). Islam and Yokota (2008) explain the insignificance as a result of capital being of minor importance in the agricultural production in China during their research on agricultural production between 1989-2005. In recent years there are a few observations in the eastern part of China with positive significant (5% and 10% level) observations for capital and this can be an indication that capital is becoming more important for some regions of China and the economy is moving towards a more capital-intensive agricultural production.

On a regional level it can be seen in tables 1, 2 and 3 that land is the most important input factor for all parts of China, which is the same result as on the national level estimation. The land variable is also revealing an increasing trend during the time period, which indicates that land is becoming more important in agricultural production. It would be expected that during the time period, more modern production methods should decrease the importance of land but it is still the most important input factor.

From this discussion of the result the following observations can be made. Firstly, the coefficient of land is dominating the result both on a national and on a regional level and is overall the most important input factor to create agricultural production. Secondly, capital is insignificant for many of the years in the estimations, this may be due to the fact that capital does not have an important role in the Chinese agricultural production and a majority of the agricultural work is still done by hand. Thirdly, the

labor coefficient, which is the main variable of interest in this thesis, is significant for most of the years both on a national and regional level and is used to estimate the MP_L in the agricultural sector. It is interesting to note that there is a high regional variation in the importance of labor to agricultural production and that it is contributing to a minor part of the total agricultural output in the western and eastern part of China while in the central region it is important.

6.3 Real Wages, Average productivity and Marginal Productivity of Labor

When the output elasticity of labor coefficient in the agricultural sector is estimated it is possible to calculate the MP_L and compare it to the real wage in the agricultural sector. This is done in order to determine whether or not MP_L is at a higher level than wages, which would indicate that the Lewis turning point has been reached in China. The MP_L is calculated using the labor coefficients and the Cobb-Douglas relationship $MP_L = \beta_L * AP_L$. AP_L is computed by dividing the total output in the agricultural sector with the total number of workers. In table 5, the average productivity of labor, marginal productivity of labor and the average real wage are presented on both a national and regional level for each sample year. Compound annual growth rate is also calculated for the period 1996-2003 and 2004-2011 to see if there are differences in growth rate in the earlier and latter period of the sample.

By observing the development of the real wages in each region it is clear that the agricultural real wages have been rising steadily in all parts of China during the time period 1996-2011. It is a level difference in wages between the different regions and workers in the eastern part of China are on average having higher wages. The growth rates of wages have been increasing at a faster rate in the second sub period compared to in the first sub period 2004-2011 the national average growth rate has been 7,91% compared to 3,35% in the second period 1996-2004. According to the original formulation of the Lewis theory real wages should be at a constant level for a period time before strictly rising, but in time of significantly increase in agricultural productivity it may force the wages to rise (Lewis, 1973). This seems to have happened in China and by observing the average productivity of labor we can see that productivity in the agricultural sector has in the latter part of the sample between 2004-2011 been rising at a fast pace with a national average increase of 12,08% per year.

Table 5. Real Wage, Average productivity of labor and Marginal Productivity of Labor Results

	Real Wage (2000) RMB				**APL (2000) RMB**				**MPL (2000) RMB**			
Year	West	Central	East	National	West	Central	East	National	West	Central	East	National
1996	983,29	1319,30	2046,37	1449,65	2233,92	3355,26	4510,92	3366,70	1311,31	865,66	2084,05	1327,57
1997	1061,12	1443,86	2206,02	1570,33	2465,66	2934,56	4226,24	3208,82	1185,98	1344,03	1796,15	1396,80
1998	1127,66	1484,61	2255,07	1622,44	2557,79	3070,41	4539,43	3389,21	1074,27	1777,77	1588,80	1476,57
1999	1163,23	1515,64	2384,13	1687,67	2432,78	2925,19	4337,93	3231,97	902,56	2237,77	1145,21	1469,47
2000	1152,18	1485,98	2417,37	1685,18	2388,98	2737,79	4294,04	3140,27	926,93	2280,58	961,86	1412,07
2001	1231,39	1633,44	2636,50	1833,78	2421,81	3033,98	4442,61	3299,47	852,48	2466,63	830,77	1539,75
2002	1248,14	1621,96	2684,32	1851,48	2529,07	3208,87	4696,40	3478,11	824,48	2470,83	798,39	1675,29
2003	1287,20	1635,85	2736,84	1886,63	2907,84	3224,88	4942,43	3691,71	767,67	2515,40	855,04	1663,73
2004	1285,40	1694,22	2706,43	1895,35	3302,05	4077,65	5896,97	4425,56	1066,56	3588,33	1108,63	1867,59
2005	1417,41	1855,17	3034,44	2102,34	3957,57	4337,00	6464,91	4819,83	1495,96	4297,96	1273,59	1955,24
2006	1534,27	2022,18	3292,92	2283,12	3857,41	4911,77	7303,05	5357,41	1562,25	5407,86	1475,22	2484,05
2007	1656,00	2193,19	3468,42	2439,20	4778,04	5774,18	8127,40	6226,54	1801,32	5052,40	1666,12	3250,25
2008	1805,22	2400,40	3704,52	2636,71	5917,08	6737,32	9165,96	7106,79	1769,21	5194,48	1732,37	4046,13
2009	1910,19	2502,52	3885,65	2766,12	6851,73	7384,62	10080,20	7772,18	2082,93	5523,70	1915,24	3774,69
2010	2137,92	2803,53	4297,66	3079,70	7545,75	9015,56	12181,75	9581,02	2165,63	6653,49	2558,17	4020,83
2011	2423,50	3197,28	4834,49	3485,09	8566,70	10640,43	13850,30	11019,14	2347,28	8054,81	2576,16	4561,93
Compound Annual Growth Rate												
1996-2003	3,42%	2,72%	3,70%	3,35%	3,35%	-0,49%	1,15%	1,16%	-6,47%	14,26%	-10,54%	2,86%
2004-2011	8,25%	8,26%	7,52%	7,91%	12,66%	12,74%	11,26%	12,08%	10,36%	10,64%	11,12%	11,81%

Real wage is the average provincial annual wage, in constant (2000) yuan. Average product of labor is calculated from total agricultural output per labor.

EQ1 are estimated by multiplying Equation 1 with the average product of labor for each year.

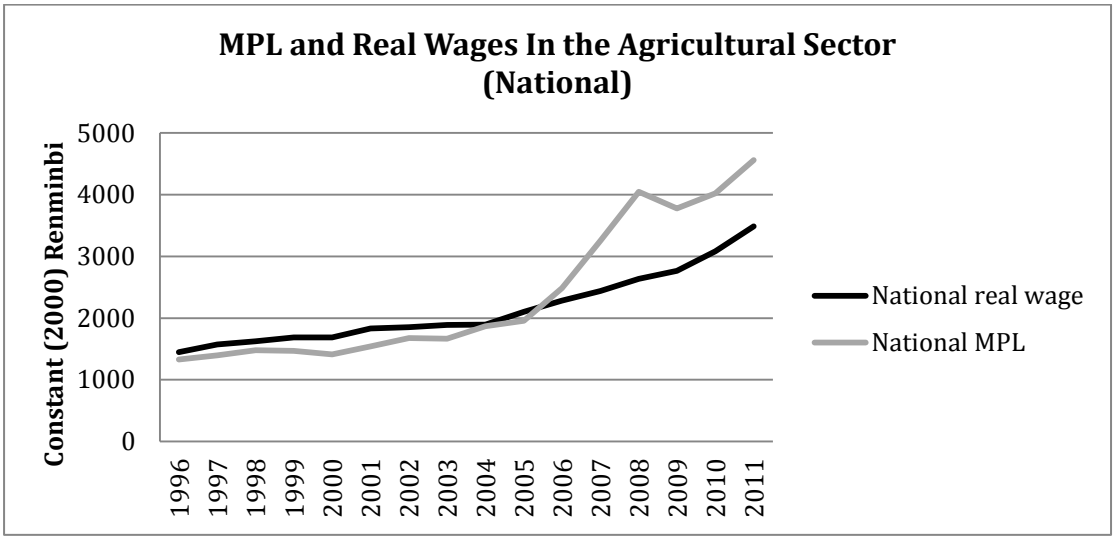
The increase in average productivity of labor has had a significant effect on the estimated MP_L in the agricultural sector as it is calculated as the product of APL and the output elasticity of labor. However, as previously noted in table 2-4 the output elasticity of labor has a wide variation across the region, which is reflected in the estimates of the MP_L. The highest MP_L in 2011 can be seen in the central region with 8054 constant (2000) RMB, which is a remarkable increase from 865 constant (2000) RMB in 1996. During the time period, MP_L has in total been increasing in the western and eastern regions, but not at the same pace as the central region. This is an indication that the central region may have been more affected by labor migration, increasing the MP_L in the sector as more workers are leaving the agricultural sector to look for jobs in the cities.

In the first sub-period between 1996-2003 both the western and eastern part of China have experienced a decreasing trend in MP_L. During the same time period MP_L in the central region has increased by 14,26% on average per year. This development is interesting as it highlights the regional variations in China and how these can be seen as differences in the production in the agricultural sector. In the second time period between 2004–2011 all regions have increasing MP_L and this development is also reflected in the annual growth rate that in the second period is 11,81%. An interesting remark is that the increasing trend in MP_L started in the central region several years before the eastern and western region, which can be an indication that the Lewis turning point passed earlier in this region.

6.4 Graphical Analysis and Hypothesis Testing

The analysis presented above reveals that both MP_L and wages have been increasing in the agricultural sector both on a national and regional level, however there has been a difference in wage growth and regional variation in the development of the MP_L. Given the Lewis turning point theory the rise in MP_L and wages is a result of labor being transferred from the traditional sector to the capitalist sector and as more labor is shifting sector the MP_L is increasing until the growth in MP_L exceeds the growth in real wages. At the time when MP_L is at par with real wages the Lewis turning point is reached. The timing of the Lewis turning point becomes much clearer in a graphical examination, shown on a national level in figure 9.

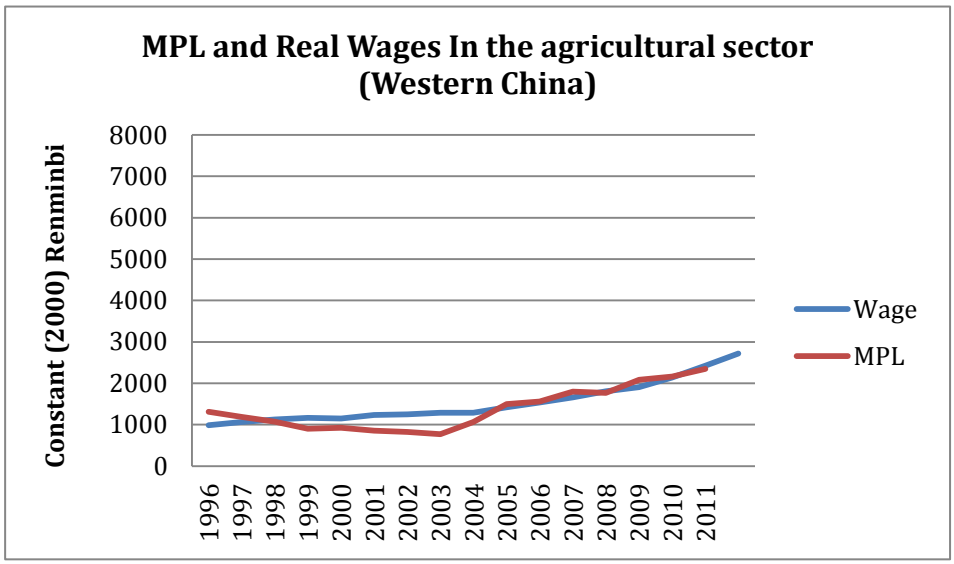
Figure 9. Lewis Turning Point, national level



In figure 9 it can be seen that the growth rate of MP_L has been slightly positive or at a constant level between 1996 until 2006 when the variables start to rapidly increase. The real wage has a similar development with constant positive trend during the whole time period. By examining the variables in figure 9 it indicates that hypothesis 1 is confirmed and that China passed its Lewis turning in 2006 when the MP_L surpassed the real wage in the agricultural sector.

A graphical analysis of the Lewis turning point on a regional level reveals the different paths of the turning point depending on region, which indicates that the regional variation within China clearly has had a large impact on the development of the Lewis turning point. Starting by examining the development in the western region figure 10 shows the timing of the turning point, which is not as obvious as on the national level. The development of real wages and MP_L in western China has been following a similar growth trend, where wages have been slightly higher in the period 1996-2005 and from 2005-2011 MP_L and wages have been more or less on the same growth trend. A possible turning point would be in 2004-2005 as MP_L is rapidly increasing and then continues on a similar growth trend.

Figure 10. Lewis Turning Point, Western china



In the central region of China the development of the MP_L and wages have been much more volatile and, as previously discussed, the growth in MP_L in the central region has been extraordinary. Figure 11 shows that MP_L surpassed real wages already in 1997, 10 years before the national turning point in 2007. This great increase in MP_L in the central region is interesting as the central region in 1996 had the lowest MP_L of all regions and have been strongly affected by labor migration that decreased there surplus labor pool and increased the MP_L.

Figure 11. Lewis Turning Point, Central China

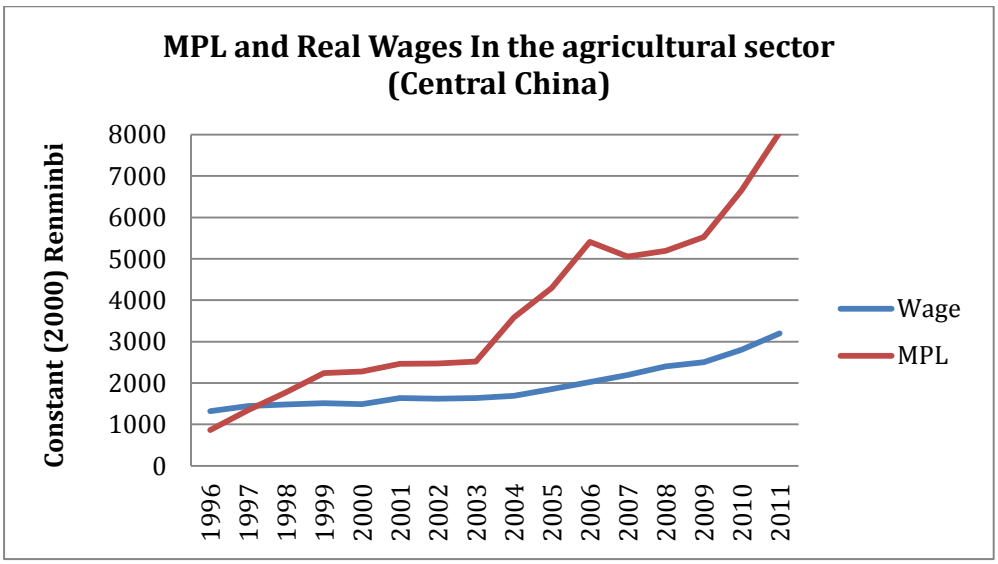
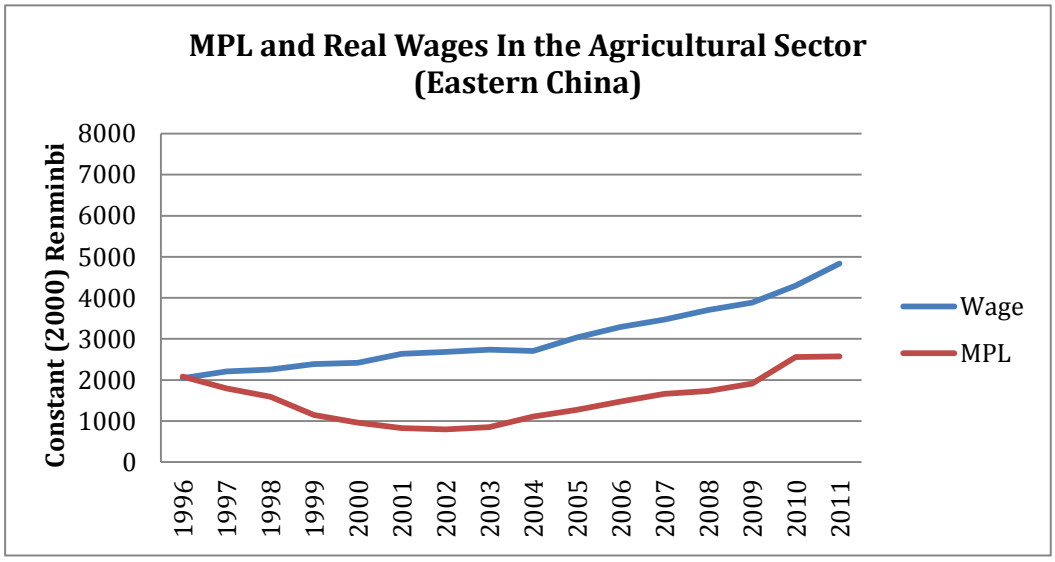


Figure 12 reveals the most peculiar findings of this study and indicates that MP_L in the eastern region is well below the real wage rate. The gap between the variables is increasing between 1996 until 2004 and from thereon both variables are having a similar growth rate but with a gap between the variables of about 1300 RMB. According to the Lewis framework this finding indicates that the eastern region is still in an early development of the Lewis curve and still faces a challenge with productivity among agricultural workers. However, it can also be that the eastern part already passed its turning point before 1996 and its high wage levels is because of higher living standards among farmers in the wealthy eastern region.

Figure 12. Lewis Turning Point, Eastern China



The graphical examination presented above presents several interesting findings on both a national and a regional level. It confirms hypothesis 2 concerning regional turning point in China and indicates that there is a significant variation in the timing of the turning point that is caused by local characteristics. On a country level the turning point was reached in 2006 when MP_L in the agricultural sector passed the wage level. For the central part of China the turning point was reached already in 1997, which may be an indication that the central region of China been more heavily affected by the labor migration. For the western part of China the turning point was reached in 2004. The turning point for the eastern region remains unclear and it may not have been reached.

7. Discussion

The regression results indicate that the Lewis turning point was passed in 2006. This is a result in in line with Islam and Yokota's (2008) and Yao and Zhang's (2010) predictions for the development of the Lewis turning point using data from 1989-2005. The national sample reveals that the labor migration from the agricultural sector to the capitalist sector has rapidly increased wages and productivity in the agricultural areas leading up to the turning point. The Lewis curve has had an interesting development especially when comparing the national and regional results. This study show that the turning point does not occur simultaneously for all of China and that there is striking differences in the timing on a regional level. The result of the national turning point is interesting in the sense that it can be used in a general way to draw conclusion about China's labor market status and wage development. The result suggests that China is moving from being an economy with abundant labor to one with labor shortage and increasing wages, although with regional characteristics. The regional estimations are interesting they indicate where the turning point has not yet been crossed. The difference in timing of the turning point could be because of the variation of agricultural and economic development across the regions. It is also connected to the likelihood of migrant workers leaving the agricultural sector. Regions with good labor market conditions for agricultural workers will not be as attracted to leave, and there will be a slower shift of labor between the traditional and capitalist labor market. The regional variation can also explain the difficulties in previous studies determining the turning point as the use of regional samples and different estimation techniques give different results that cannot be generalized for the entire country.

On a national level the importance of labor as an input factor in agricultural production has been rather stable, while the regional level shown mixed results. A potential answer why labor is a more important input factor in the central region can be because the sectors have developed differently and that some areas are more suitable for manual labor as an input. As an example it could be in mountainous areas where it is difficult to use machines or areas specialised in crops that requires manual labor.

It is also interesting to note the development of wages in the eastern region of China compared to the western and central parts. The wage level in the eastern region is almost double compared to the western region and 66% larger than in the central region even if the MPL is relatively low, indicating that the eastern region has not passed its turning point.

The insignificance of capital as an input factor in the regression is surprising and the only likely explanation is in line with Islam and Yokota (2008). They argue that agricultural

machinery is not used to a large extent in agricultural production and that manual labor is still most common. Capital is also a difficult variable to approximate and an alternative way to measure capital is to use the number of large and medium-sized tractors, which nonetheless gives similar insignificant estimations. As seen in the chapter 3 the use of capital per labor has been increasing and it was positive significant (5% and 10% level) for a few years in the eastern province while negative significant in the western and central region.

The finding of this paper is that China has passed its Lewis turning point in 2006. From 2006 and on China has entered a new phase of development, a time when the advantage of a large rural labor pool available at subsistence wages can no longer be counted for and continued transfer of labor between the agricultural and capitalist sector result in strictly increase in wages.

8. Conclusion

The Lewis turning point has frequently been used to study economic development since its introduction in the 1950s. In recent years scholars have remarked the resemblance between the pre turning-point characteristics of wage growth and reports of labor shortage and the development in China. In the 2000s several studies have indicated that the turning point was soon to be crossed (for example, Zhang Yang et al 2010; Islam Yokota, 2008; Cai 2007) but few attempts have recently been made to solve this puzzle using updated provincial level data. There has also been a lack in papers studying regional development of the turning point and account for the variation between regions in China. The present paper addresses this gap and uses a data set from 1995–2011 and applies Minami's Criterion I to test for the Chinese turning point both on a national and a regional level. By comparing the MP_L in the agricultural sector with the real wage development this paper argue that the turning point for the Chinese economy was crossed in 2006 on a national level. The variation in the timing of the turning point in parts of the country is higher than expected and the turning point in the central part of China occurred almost 10 years before the national level.

As China enters a new stage of demographic transition and economic growth following the arrival of the Lewis turning point a new growth strategy must follow. After many years of enjoying a competitive advantage towards the world market with low wages and a large pool of underemployed rural workers conditions have changed. It is still too early to say what the consequences of the Lewis turning point will be for China and there are many different possible outcomes. It is likely that a transformation of the economic growth pattern will not automatically occur and the development is in the hands of the companies in China, which have to adapt to the new circumstances with higher wages and shortage of workers. A

possible strategy would be for the companies in the manufacturing sector dependent to invest more heavily in new machinery or aim at higher-value activities. A recent study by the World Bank shows that China's imports of parts and components in manufacturing have been declining substantially, from 60% in 1995 to 35% in 2013, which indicates that the amount of domestic value added in its exports have risen and that the Chinese industry seem to be aware of how to address the development (WTO, 2015). The Chinese government also seems to be informed of this trend and a "Made in China 2025" strategy has been launched, intended as a roadmap for the development of the manufacturing industry in China with focus on upgrading manufacturing technology and increasing global competitiveness. The increased wages levels may have a temporary negative effect for manufacturer in China, but it will have significant positive effect for low-income workers. As wages raise the living conditions for millions of people will increase and it will most likely also have a positive spill over effect on the countryside through increased demand and remittances. For future studies it would be interesting to analyse China's development after the Lewis turning point. Also a more in-depth regional approach is encouraged in order to understand why the Lewis turning point occurs in different time periods depending on the region.

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Appendix 1.

Interview Summary

Interview Number	Date	Industry	Location	Occuption
1	2014-11-05	Industrial tools	Shanghai	HR Manager
2	2014-11-20	Information technology	Shanghai	General Manager
3	2014-11-20	Information technology	Shanghai	General Manager
4	2014-12-06	Steel Manufacturer	Kunshan	Financial Officer
5	2014-12-06	Steel Manufacturer	Kunshan	HR Manager
6	2014-11-17	Automobile	Jarding	HR Manager
7	2014-12-22	Autmobile components	Shanghai	CEO
8	2014-11-26	Packaging industry	Shanghai	General Manager

Appendix 2.

Summary Statistics

Province	Region	Output Agricultural		Labor		Capital		Land	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD
Beijing	East	100,26	38,94	28,23	4,9	353,44	72,43	387,43	103,51
Tianjin	East	112,88	35,41	41,2	7,56	585,37	33,14	507,43	51,75
Hebei	East	1401,71	730,41	867,67	100,45	7923,31	1844,03	8817,09	146,27
Shanxi	Central	355,91	206,46	415,43	23,33	2104,13	551,472	3802,7	145,94
Inner Mongolia	West	516,52	289,79	274,92	20,97	1905,43	808,74	6228,87	630,52
Liaoning	East	714,57	331,48	279,62	34,3	1673,66	489,26	3787,82	193,57
Jilin	Central	564,49	255,41	271,73	38,29	1403,78	581,82	4700,27	448,67
Heilongjiang	Central	854,94	531,3	425,61	72,46	2330,049	1043,32	10465,51	1366,6
Shanghai	East	114,02	29,82	27,96	5,72	123,66	26,47	457,2	69,71
Jiangsu	East	1487,57	596,5	664,03	212,92	3157,85	594,31	7732,173	203,81
Zhejiang	East	691,72	237,28	423,21	124,21	2094,26	279,71	3066,58	631,21
Anhui	Central	963,29	396,23	960,93	169,46	3771,79	1269,22	8849,29	273,35
Fujian	East	614,78	274,75	295,06	34,29	984,99	167,44	2551,48	285,37
Jiangxi	Central	543,73	205,54	456,55	82,19	1932,66	1318,56	5519,65	306,83
Shandong	East	2091,44	1030,6	1192,39	136,27	8367,95	2685,83	10914,64	186,22
Henan	Central	1927,89	979,2	1823,3	227,84	7210,74	2434,31	13450,04	774,9

Hubei	Central	1090,25	597,34	605,75	106,07	2096,57	886,65	7503,381	341,49
Hunan	Central	1037,77	728,09	968,43	75,66	3043,85	1196,79	7913,551	304,87
Guangdong	East	1177,55	458,71	722,88	42,29	1894,96	287,79	4899,842	408,69
Guangxi	West	783,03	430,75	784,62	57,69	1899,14	654,97	6065,394	286,26
Hainan	East	206,06	108,59	80,14	5,77	279,81	102,01	850,995	63,01
Chongqing	West	393,73	186,87	425,4	139,06	760,8	232,22	3427,001	168,08
Sichuan	West	1227,77	643,67	1307,85	435,83	2209,65	711,58	9888,3	1107,19
Guizhou	West	384,07	169,91	806,81	119,06	1016,44	556,89	4648,85	236,47
Yunnan	West	612,19	298,54	938,04	96,57	220,35	135,05	5846,18	530,2
Tibet	West	31,9	10,82	42,7	4,59	1376,32	476,65	232,75	5,78
Shaanxi	West	586,47	384,73	639,42	80,75	1360,64	471,95	4310,99	250,55
Gansu	West	413,1	237,2	510,85	14,53	306,5	80,53	3798,926	145,22
Qinghai	West	47,25	28,43	57,85	9,48	508,51	179,32	530,2	35,25
Ningxia	West	96,32	64,92	86,06	8,92	1122,8	395,16	1110,62	105,19
Xinjiang	West	667,4	423,34	246,43	25,44	1121,55	224,13	3864,627	684,64

Output Agricultural refers to gross output value of agriculture in 100 million RMB. Labor refers to agricultural employed persons in 10000 persons. Capital is Total power of agricultural machinery in 10000kw.

Land is total sown areas of farm crops in 1000 heactares.