EMPIRICAL ANALYSIS OF LEWIS RANIS-FEI MODEL IN PAKISTAN

Rummana Zaheer¹ and Adeel Sultan Kadri²

Abstract

The study focuses on stage of Lewis Ranis-Fei model, role of capital accumulation in economic growth and impact of labour reallocation in economic development. Using time series data from 1984 to 2013 the study develops a Cobb-Douglas production function of agriculture and non-agriculture sector. Sectoral growth decomposition approach was used to reveal the contribution of factors of production in economic growth. Labour reallocation was estimated by labour reallocation equation to investigate its effect on economic growth. Further it also indicates the stage of economic development. The study found that the role of capital accumulation in agriculture and non-agriculture sector was highly significant whereas the role of labour reallocation was very low in economic development. Further the study reveals that Pakistan stands on the first stage of Lewis Ranis-Fei model where MP_L is lower than AP_L.

Keywords: Dualistic growth, measurements of economic growth, agriculture, development

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¹-Department of Economics, University of Karachi, Karachi, Pakistan.
²-Department of Economics, Iqra University, Karachi, Pakistan.
Introduction

Determinants of economic growth and development are one of the important area of development studies. Due to its importance, different scholars have discussed different theories in order to find patterns, structures, hurdle and road map to economic growth and development.

Lewis (1954) proposed the theory of dualistic economy addressing the stages of economic development of under and over populated economies. Due to this arch contribution in development theories, the author was awarded the Nobel Prize in 1979. Lewis (1954) focuses on surplus labour in agriculture sector and by drawing those surplus labours through capital formation in non agricultural sector, rapid economic development can be achieved. The author described two stages, labour surplus and labour scare stages.

Ranis & Fei (1961) contributed further to Lewis theory by dividing stage one of lewis model into two stages thus making it a three stage model. The stages are illustrated in diagram 1. The entry into each stage is called a turning point and stages are classified by the marginal productivity of agricultural labour.

Since, Lewis Ranis – Fei model provides a strong, competent and reliable framework for understanding the growth path of labour surplus economies. The Study uses the framework to investigate the process of economic growth in Pakistan.

Pakistan’s population stands the 7th largest in the world. Nearly 50% of the population is accommodated by agriculture sector (UNDP 2013). Agricultural wage rate is very low as compared to non agricultural sector due to surplus labour. Although reforms in early 60’s ignites the flourishing of non agricultural sector but wage rate of agricultural sector is still on the lower side. To achieve a remarkable
Diagram No. 1

**Agricultural Output, Agricultural Labour and Lewis Ranis Fei model stages of Economic growth**

Diagram displays Lewis Ranis – Fei stages of growth. Growth, great labour inflows are required in non agricultural sector (Knight 2007).

This paper attempts to find out the answers of the following questions:

1. Is Non agriculture sector’s capital accumulation the main source of economic development in Pakistan?
2. What is the effect of labour reallocation from agricultural sector to non agricultural sector in Pakistan?
3. At which stage the economy of Pakistan is standing as per Lewis Ranis-Fei model?

The study uses annual observations from 1984 to 2013 in order to estimate Cobb Douglas production function for Pakistan’s agricultural and non-agricultural sector.
By using Cobb Douglas production function, the study analyzes labour reallocation effect from agricultural sector to non agricultural sector by comparing labour productivities.

The study also identifies the phase of Pakistan’s economic development as per Lewis Ransi-Fei model (1961).

**Theoretical Underpinning**

Lewis (1954) presented the theory of dualistic economy where capital accumulation in non agricultural sector is considered as the main source of economic development of a country. In Lewis theory it is assumed that economy is divided into two sectors agriculture and non agriculture sector. Agricultural sector is a labour abundant sector which has huge surplus labour resulting very low $MP_L$. The Institutional wage rate is presumed to be equal to $AP_L$. The non agricultural sector has capital abundance relative to labour input so it employs labour at higher wage rate. This drawing of surplus labour from agriculture sector encourages the expansion of non agriculture sector. When surplus labour is exhausted the labour supply curve becomes upward sloping.

Ranis–Fei (1961) further contributed by formalizing theory with Rostow’s (1956) linear stages of growth model. They assume that the economy is in a stagnant state. The breakpoint makes infant non agricultural sector. Agricultural sector has surplus labour and its $MP_L$ is very low. Institutional wage is also low due to surplus of labour. This is the stage one of the model. The reallocation of labour from agriculture to non agriculture sector starts increasing the $MP_L$ but still institutional wage $AP_L$. At this point the economy is at the second stage of development. The absorption of abundant labour force continues till the economy reaches its commercialization point and enters stage three. The diagram illustrates the stages of Lewis Ranis-Fei model.
Empirical Studies:

As far as the empirical evidence regarding this issue is concerned, the results have been mixed. Minami (1967 a) & Ohkawa (1965) analyses the labour reallocation in Japanese economy. The study found that labour reallocation has a very important contribution in economic growth. Ranis & Fei (1973) analyzed the lewis model for Korea and Taiwan by using descriptive statistics. Their study supports the Lewis theory. However, Ho (1972) tested lewis theory for Taiwan 1951-1965. The result shows that the technological progress is more important for economic growth then sectoral labour migration.

Mianmi (1967 b) examines the condition for commercialization of agri sector of Japanese economy. Cai (2007) argued that the decline in population growth and rural migrants has accelerated agricultural commercialization of China but Knight (2007) raises some doubts in Cai (2007) claims. He argues that the rapid growth in real wages of agricultural sector is not because of labour scarcity and there is still huge surplus labour in agricultural sector. Therefore, he argued that china’s economy has not progressed to the second stage but moving towards it. Ercolani & Wei (2010) examines China’s economy. They find out the Lewis stages of development and effect of labour reallocation in Chinese economy. The study find out that the Chinese economy is moved from stage one to stage two and labour reallocation has a significant impact on Chinese economic development. Islam & Yokota (2008) empirically analyzed Lewis Ranis-Fei model. The author estimated production function of agriculture sector using provincial level data and compared MPL and wage of this sector. The result indicated that Chinese economy is moving towards Lewis turning point.

Field (2004) evaluated Lewis model after fifty years and found out that many of the core assumptions are still intact however minute changes are being required. Young (2010) studied Lewis transition of China and India. The article concluded that labour migration helped
both the economies to grow with such a high pace. However, different arrangements are made to channelize the labour migration explains partially the different trajectory of economic path.

**Methodology**

The study uses production function of agriculture and non agriculture sector, equation for growth decomposition and labour reallocation equation.

**Production Function and growth decomposition:**

We assume agriculture and non agriculture sectors are traditional and modern sectors according to Lewis theory. The equation of production function of agriculture and non agriculture sectors are;

\[ Q_A = F(K_A, L_A, H_A) \]  \hspace{1cm} (1)
\[ Q_N = F(K_N, L_N) \]  \hspace{1cm} (2)

A and N in subscript represents agricultural and non agricultural sector. Where Q represents Output produced by respective sector, K represents capital accumulation in respective sector and H is land cultivated.

Converting functional form into log linear form we get equation 3 & 4.

\[ \ln Q_A = \alpha_1 + \alpha_2 \ln K_A + \alpha_3 \ln L_A + \alpha_4 \ln H_A + \mu_A \]  \hspace{1cm} (3)
\[ \ln Q_N = \beta_1 + \beta_2 \ln K_N + \beta_3 \ln L_N + \mu_N \]  \hspace{1cm} (4)

The study differentiates equation 3 and 4 with respect to time for sectoral Growth decomposition.

\[ g_{QA} = \frac{\delta Q_A}{\delta T} + \alpha_2 g_{KA} + \alpha_3 g_{LA} + \alpha_4 g_{HA} \]  \hspace{1cm} (5)
\[ g_{QN} = \frac{\delta Q_N}{\delta T} + \beta_2 g_{KN} + \beta_3 g_{LN} \]  \hspace{1cm} (6)
Labour Reallocation Effect

To observe labour reallocation effect (LRE) away from agriculture sector, the study uses APL and MPL approach (Ercolani & Wei, 2010). Where APL approach overestimates the LRE and MPL approach underestimates the LRE. Hence by taking averages of the values we can estimate the range of LRE.

\[
LRE_{APL} = \frac{M}{Y} (APL_N^N - APL_A^A)
\]

\[
LRE_{MPL} = \frac{M}{Y} (MPL_N^N - MPL_A^A)
\]

Where M represents net number of migrating labour and Y represents real GDP. Taking the averages of both \(LRE_{APL}\) and \(LRE_{MPL}\) equations the study identifies the range of Labour reallocation effect. The study used an annual dataset from 1984 to 2013 taken from state bank of Pakistan and Pakistan Bureau of statistics.

Analysis

The sectoral labour force share is a key to analysis. Agriculture sector of Pakistan almost absorbs 50% of the labour force. This leads to a huge number of abundant labour force in this sector. Similarly the Lewis Ranis-Fei model explains the phenomena of abundance of labour force in agriculture sector and its implications on economic development.

Labour force distribution in Agriculture and non agriculture sector

Source: Handbook of Statistics
Production function estimates:

The Production function in table 1 on represents agriculture sector of the economy. The variables in the model 2 are statistically significant at 1%.

Table 1
Production function of agriculture sector

<table>
<thead>
<tr>
<th>Dependant Variable Log QA</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimation method</td>
<td>OLS</td>
<td>GLS</td>
</tr>
<tr>
<td>Log KA</td>
<td>9.435462* (0.714959)</td>
<td>0.769875* (0.0354)</td>
</tr>
<tr>
<td>Log LA</td>
<td>-11443.3 (7038.834)</td>
<td>-1.85208* (0.508636)</td>
</tr>
<tr>
<td>Log HA</td>
<td>0.12212* (0.038441)</td>
<td>5.873929* (1.249478)</td>
</tr>
<tr>
<td>AR(1)</td>
<td>-0.03216 (0.172177)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-1855676*** (1045243)</td>
<td>-86.8757* (22.82248)</td>
</tr>
<tr>
<td>Adjusted $R^2$</td>
<td>0.958457</td>
<td>0.98962</td>
</tr>
<tr>
<td>F-Statistics</td>
<td>231.7161</td>
<td>692.1882</td>
</tr>
<tr>
<td>Prob (F-Statistics)</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Observation</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Durban Watson stats</td>
<td>0.762377</td>
<td>1.948299</td>
</tr>
</tbody>
</table>

*Authors Estimation

*, **, *** represents statistical significance at 1%, 5%, 10% respectively.
Model 1 is estimated through OLS whereas model 2 is estimated through GLS. The OLS estimates were found to be affected by autocorrelation and GLS estimation is used in order to overcome the issue. The coefficients of capital and Land are positive however the negative coefficient of labour suggests the negative relationship between labour and agriculture output. Table 2 represents the production function of non agriculture sector. The coefficients are statistically significant at 1% and have positive signs.

**Table: 2**  
*Production function of Non agriculture sector*

<table>
<thead>
<tr>
<th>Dependant Variable</th>
<th>Log QN</th>
<th>(1)</th>
<th>(2)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Estimation method</strong></td>
<td>OLS</td>
<td>GLS</td>
<td>AR(1)</td>
</tr>
<tr>
<td>Log KN</td>
<td>6.764503*</td>
<td>0.846681*</td>
<td>AR(1)</td>
</tr>
<tr>
<td>(0.390546)</td>
<td>(0.036364)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Log LN</td>
<td>6361.362</td>
<td>0.4697*</td>
<td>(0.166864)</td>
</tr>
<tr>
<td>(10720.63)</td>
<td>(0.166864)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>AR(1)</td>
<td></td>
<td>1.014052*</td>
<td>(0.032676)</td>
</tr>
<tr>
<td>Constant</td>
<td>-378842</td>
<td>3.024564</td>
<td>(5.540368)</td>
</tr>
<tr>
<td>(492487.8)</td>
<td>(5.540368)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Adjusted R²</td>
<td>0.952515</td>
<td>0.997636</td>
<td></td>
</tr>
<tr>
<td>F-Statistics</td>
<td>301.8894</td>
<td>4081.047</td>
<td></td>
</tr>
<tr>
<td>Prob (F-Statistics)</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>Observation</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>Durban Watson stats</td>
<td>0.404186</td>
<td>1.858568</td>
<td></td>
</tr>
</tbody>
</table>

*Authors Estimation  
*, **, *** represents statistical significance at 1%, 5%, 10% respectively.
Graph 1

Average productivity of labour
Authors estimation

Graph 2

Marginal productivity of labour
Authors estimation

The average productivity of agriculture sector is almost constant whereas the average productivity of non agriculture sector has an increasing trend. The Marginal productivity of is almost same and oscillates roughly around its average value as shown in graph no...
2. This shows that Pakistan is still in the first stage of Lewis Ranis-Fei model where marginal productivity is lower than the institutional wage (average productivity). The insignificant improvement in Marginal productivity suggests that Pakistan is still on its first phase of economic development.

The labour reallocation equation suggests that the contribution of labour reallocation from agriculture to non agriculture sector only attributes to 0.04% to 0.06% of the overall economic growth. This clearly indicates that the withdrawal of labour from agriculture to non agriculture sector is insufficient. This result reinstates our previous findings that the labour in agriculture is abundant and there is no improvement.

The sectoral growth decomposition shows that the labour in agriculture sector attributes negatively (18%) in growth of agriculture sector where as capital in agriculture sector has very significant role (114%) in the growth of agriculture sector. The role of labour in non agriculture sector growth is 7.6% whereas capital contributes to 92% in the growth of non agriculture sector.
Table: 3

<table>
<thead>
<tr>
<th>Sectoral Growth Decomposition</th>
<th>Parameter Estimates (1)</th>
<th>Average Growth (2)</th>
<th>Product of parameter and growth (3)</th>
<th>Contribution to sectoral growth (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Agriculture Sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>-1.852</td>
<td>2.15%</td>
<td>-3.987</td>
<td>-18.44%</td>
</tr>
<tr>
<td>Capital</td>
<td>0.769</td>
<td>32.015%</td>
<td>24.647</td>
<td>114.004%</td>
</tr>
<tr>
<td>Land</td>
<td>5.873</td>
<td>0.163%</td>
<td>0.960</td>
<td>4.442%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>21.62</td>
</tr>
<tr>
<td><strong>Non agriculture sector</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Labour</td>
<td>0.4696</td>
<td>3.29%</td>
<td>1.547</td>
<td>7.69%</td>
</tr>
<tr>
<td>Capital</td>
<td>0.846</td>
<td>21.91%</td>
<td>18.557</td>
<td>92.32%</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td>20.1</td>
</tr>
</tbody>
</table>

Notes: Column (1) is the parameter estimates of GLS equation taken from table 1 and 2. Column (2) is the average growth rates of the variables. Column (3) is the product of column 1 and 2. Column (4) parameter products are divided by total of respective sectors to find out the percentage contribution in growth.

**Conclusion**

The study reveals that the role of capital in economic growth of Pakistan is very significant. The Both in agriculture and non agriculture sector capital drives a very vital role in development contributing 114% and 92% respectively. However the study negates that capital of non agriculture is the main driving force in economic development but certainly it has a very crucial role to play. Labour reallocation effect ranges to 0.04% to 0.06% of the economic growth.
which is very low and has very huge room of improvement. The countries focusing on labour reallocation has a very quick transition speed under Lewis Ranis-Fei model (Ercolani & Wei, 2010). The study also identifies that Pakistan is at the first stage of economics development of Lewis Ranis-Fei model and $MP_L$ is lower than institutional wage (APL).
Reference


