The Empirical Analysis between Software Outsourcing and Employment

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Abstract
As a no-pollution, lower energy consumption knowledge-intensive industry, software outsourcing has been paid more and more attention in the world, which provide opportunities for industrial upgrading, employment expanding and the export-orient economy structure optimizing. Based on the data from 1995 to 2008, this paper analyzes the relationship between Software Outsourcing and Employment scale and structure by using co-integration analysis in econometrics. The results show that there has been a long-term stable balancing relationship and ganger causality between the software outsourcing and employment scale. The results show that software outsourcing is the causation of employment scale, and its influence on employment scale is positive. Software outsourcing has a positive effect on employment structure. There has been a long-term stable balancing relationship and Ganger causality between the software outsourcing and employment of the third industry. In short periods, employment scale and employment of the third industry can be automatically adjusted with the change of software outsourcing.

Keyword
Software Outsourcing; Employment; Co-integration Analysis

Introduction
As a non-polluting and low energy consumption industry, the software industry is the core and soul of the IT industry with high degree of standardization, generalization and globalization. Based on network and communication facilities, the software industry has realized seamless docking between upstream and downstream which makes the software industry is suitable for outsourcing (Yuan, 2009). Currently one third of the global software value is realized through outsourcing. As an emerging industry, software outsourcing set off a craze of industrial transfer.

Whether at home or abroad, in Europe and America, Japan and other developed countries, or in India, China and other developing countries, software outsourcing has drawn attention widely. However, whether China should develop the software industry service outsourcing, there are still different views: on one hand, some scholars believe that China should vigorously develop the software outsourcing for huge outsourcing market, corporate level improvement and inter-national talent cultivation (Lv, 2004; Chen, 2006; Jiang, 2006). On the other hand, some scholars think that China should not vigorously develop the software outsourcing in that the profit of outsourcing export are low, which is entirely to do the wedding dress for others (Yang, 2001; Zhan, 2004).

What is the relationship between software outsourcing and employment? What is the effect of software outsourcing on the employment scale and the employment structure? Research on these issues not only helps to understand the significance of the development of software outsourcing, but also helps to realize the impact on employment scale and the employment structure from the point of opening up, and the relationship between China’s employment structure change and industrial structure adjustment and upgrading, which will be conducive to the development of China’s software industry and employment. So this paper makes an empirical analysis about the relationship between China’s software outsourcing and employment by using co-integration theory of econometric based on time series data, the results may provide an important reference for the decision-making of software outsourcing strategies and policies.

Literature Review
Researches on software outsourcing started from the late 1990s, and were mainly about the effect on enterprise from the contracting states point at that time. The developed countries began to focus on the unemployment which software outsourcing brought about since 2003.

From the research content, the researches mainly focus on the software outsourcing motivation, impact and decision-making mechanism. From the research angle, the researches focus on not only from the management
at the micro enterprise level, but also from international trade at the macro-economic level. From the research methods, most researches are about definition, development stage analysis, descriptive analysis and case studies.

Researches on motivation for software outsourcing may come from economics, management, international trade and other theories. Firstly, the main point of the transaction cost theory is that companies can reduce transaction costs of operational activities by outsourcing (Lane, 2001) Secondly, the main argument of the core competence theory is that businesses can take advantage of external resources to obtain complementary core competencies by outsourcing, so as to strengthen their competitiveness. Thirdly, the main argument of the value chain theory is that companies can integrate the advantages at different stages of the value chain by outsourcing, so as to achieve maximum benefit. Fourth, the international division of labor theory raises more reasonable theoretical explanations on the foundation and source of outsourcing which include three major theories: comparable advantage, factor endowments and economics of scale theory.

There are researches on software outsourcing effects and impacts. For example, Amiti and Wei (2004) found that there was a positive correlation between service outsourcing and labor productivity in the United States. Gorg and Hanley (2003) found that the international service outsourcing of electronics industry in Ireland had a positive impact on productivity from 1990 to 1995.

There are also researches on software outsourcing decision-making mechanism. For example, Yeats (2001) thought that trade barriers (tariffs), labor costs, transport infrastructure and costs, government influence (tariffs, rents, infrastructure, exchange rate, communication facilities, political stability and favorable business environment), language similarities were all important factors that affecting cross-border outsourcing from developed to developing countries.

In summary, we can see that foreign scholars mainly focus on the effects of software outsourcing motivation, decision-making, etc from the contracting states other than pack states. Domestic research on software outsourcing has just started. In China, the software outsourcing is an emerging business and its theoretical analysis and empirical studies are relatively weak. Especially researches about the impact of outsourcing on employment are relatively few, let alone empirical researches. So this paper intends to make an empirical research on the relationship between China’ software outsourcing and employment from the pack states.

**Empirical Research**

**Variable and Data**

Employment scale is measured by total employment and denoted by Jiuye. Employment structure is measured by employment of tertiary industry and denoted by Sanchan. The software outsourcing is denoted by Ruan with the original data in dollars, and changes them into RMB at the average price of its current exchange rates. The data of employment and employment in the tertiary sector are derived from “China Statistical Yearbook of 2011”. The data of software outsourcing comes from the website of industrialization and informatization. The data are from 1995-2007. To avoid the volatility of data and elimination the variance, we should take the natural logarithm of the raw data and obtain the corresponding sequence of Lnjiuye, Lnsanchan and Lnruan.

**ADF Test**

Traditional regression analysis requires that the time sequence must be stationary, or will cause "spurious regression". But the reality of the economic time series is often un-stationary. To ensure that the equations we estimate are not spurious, it is important to test for non-stationary. The first step is to visually examine the data. For many time series, a diagram of the data will tell you that the mean of a variable is increasing dramatically with time and that the series is non-stationary. Time series of Lnruan and Lnjiuye are drawn as follow.

![ADF Test](http://www.seipub.org/rae)

**FIGURE 1 SCALE OF SOFTWARE OUTSOURCING**

As Figures 1 and 2 shown, both Lnruan and Lnjiuye have a growing trend, and the direction and pace of change is much consistent. This shows that a strong
Correlation may exist between Lnjiuye and Lnruan. The calculated correlation coefficient between the two variables is as high as 0.982639.

![Figure 2: Scale of Employment](http://www.seipub.org/rae)

The standard method of testing for non-stationary is the ADF test, which examines the hypothesis that the variable in question has a unit root. Test results show that Lnjiuye, Lnsanchan, Lnruan are non-stationary series. They need a first-order difference. The results show that the first-order differential Lnjiuye, Lnsanchan, Lnruan are also non-stationary series. They need a second-order difference. As Table 1 shown, the second difference of three variables is significance at the 5% level, that is, second-order difference of three variables is stationary, and we can further test co-integration relationship between them.

![Figure 3: Scatter Chart of the Relationship Between Employment and Software Outsourcing](http://www.seipub.org/rae)

TABLE 1 ADF TEST

<table>
<thead>
<tr>
<th>Variables</th>
<th>ADF</th>
<th>Critical value 1%</th>
<th>Critical value 5%</th>
<th>Critical value 10%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lnjiuye</td>
<td>-1.03</td>
<td>-4.887</td>
<td>-3.828</td>
<td>-3.3588</td>
</tr>
<tr>
<td>Δ Lnjiuye</td>
<td>-5.58</td>
<td>-6.9893</td>
<td>-5.387</td>
<td>-5.382</td>
</tr>
<tr>
<td>Δ² Lnjiuye</td>
<td>-5.43</td>
<td>-5.1152</td>
<td>-3.9271</td>
<td>-3.4104</td>
</tr>
<tr>
<td>Lnsanchan</td>
<td>-2.41</td>
<td>-4.887</td>
<td>-3.828</td>
<td>-3.3588</td>
</tr>
<tr>
<td>Δ Lnsanchan</td>
<td>-4.86</td>
<td>-4.9893</td>
<td>-3.873</td>
<td>-3.382</td>
</tr>
<tr>
<td>Δ² Lnsanchan</td>
<td>-5.42</td>
<td>-5.1152</td>
<td>-3.9271</td>
<td>-3.4104</td>
</tr>
<tr>
<td>Lnruan</td>
<td>-1.80</td>
<td>-4.887</td>
<td>-3.828</td>
<td>-3.3588</td>
</tr>
<tr>
<td>Δ Lnruan</td>
<td>-3.23</td>
<td>-4.9893</td>
<td>-3.873</td>
<td>-3.382</td>
</tr>
<tr>
<td>Δ² Lnruan</td>
<td>-5.23</td>
<td>-5.1152</td>
<td>-3.9271</td>
<td>-3.4104</td>
</tr>
</tbody>
</table>

![Figure 4: Residual Sequence](http://www.seipub.org/rae)

Co-integration

The scatter chart of the relationship between Lnjiuye and Lnruan is drawn as Figure 3.

As Figure 3 shown, the relationship between employment and software outsourcing is similar linear which showns that employment and software outsourcing are likely to be co-integrated.

1) Impact of Software Outsourcing on Scale of Employment

There are two variables in our long-term static model, so Engle-Granger co-integration test can be used. The model as follows:

$$\ln \text{jiuye} = a + b\ln \text{ruan} + \epsilon$$  \hspace{1cm} (1)

First, we should make single integration test for the sequence Lnjiuye and Lnruan respectively. After the above ADF test, results in both second-order differences are stationary, which meet co-integration requirement.

Secondly, we make an OLS regression of model 1, and the result shows that Lnjiuye and Lnruan are of autocorrelation. Considering adding the appropriate lag, we can obtain distributed lag model:

$$\ln \text{jiuye}_t = 0.664 + 0.0003\ln \text{ruan}_t + 0.942\ln \text{jiuye}_{t-1} - 0.00096\ln \text{ruan}_{t-1}$$  \hspace{1cm} (2)

DW is 2.5 which means autocorrelation is eliminated. The square of R of the model is 0.9995, indicating that the model has high goodness of fit. It can be considered that Lnjiuye has long-term stable relationship with Lnruan. Make a unit root test to their residual, the results are shown in Table 2.

<table>
<thead>
<tr>
<th>ADF</th>
<th>1% critical value</th>
<th>5% critical value</th>
<th>10% critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>-4.1938</td>
<td>-4.1366</td>
<td>-3.1483</td>
<td>-2.718</td>
</tr>
</tbody>
</table>

![Table 2: ADF Test of Residual](http://www.seipub.org/rae)
Since residuals ADF test statistic value is -4.193789 and is significant at the 5% level, it can be estimated that the residuals are stationary sequence, indicating that the sequence Lnjiuye and Lnruan are long-term co-integration.

Making stabilized time series e1 as the error correction term, error correction model can be established as follows:

$$\Delta \ln jiuye_t = 0.000198 \Delta \ln ruan_t + 0.9446 \Delta \ln jiuye_{t-1} - 0.000824 \Delta \ln ruan_{t-1} - 1.285 e_{t-1}$$

The coefficient of error correction term is negative, indicating that when short-term fluctuations of employment are deviated from the long-term equilibrium, (-1.285) efforts will be adjusted back from a non-equilibrium to equilibrium which is in accord with reverse repair mechanisms.

2) Impact of Software Outsourcing on Employment Structure

The scatter chart of the relationship between Lnsanchan and Lnruan is drawn as Figure 5.

![Figure 5: Scatter Chart of the Relationship Between Employment of Tertiary Industry and Software Outsourcing](image)

As Figure 5 shown, the relationship between employment of tertiary industry and software outsourcing is similar linear which shows that employment of tertiary industry and software outsourcing are likely to be co-integrated.

There are two variables in our long-term static model, so Engle-Granger co-integration test can be used. The model as follows:

$$\ln sanchan_t = a + b \ln ruan_t + u_t$$  \hspace{1cm} (4)

First, we should make single integration test for the sequence Lnsanchan and Lnruan respectively. After the above ADF test, results in both second-order differences are stationary, which meet co-integration requirement.

Secondly, we make an OLS regression of model 4, and the result shows that Lnsanchan and Lnruan are of autocorrelation. Considering adding the appropriate lag, we can obtain distributed lag model:

$$\ln sanchan_t = 2.484 - 0.00959 \ln ruan_t + 0.75 \ln sanchan_{t-1} + 0.02246 \ln ruan_{t-1}$$

DW is 2.135, which means autocorrelation is eliminated. The square of R of the model is 0.9931, indicating that the model has high goodness of fit. It can be considered that Lnsanchan has long-term stable relationship with Lnruan. Making a unit root test to their residual, the results are shown in Table 3.

<table>
<thead>
<tr>
<th></th>
<th>ADF</th>
<th>1% critical value</th>
<th>5% critical value</th>
<th>10% critical value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residual</td>
<td>-3.7357</td>
<td>-4.1366</td>
<td>-3.1483</td>
<td>-2.718</td>
</tr>
</tbody>
</table>

Since residuals ADF test statistic value is -3.7357 and is significant at the 5% level, it can be estimated that the residuals are stationary sequence, indicating that the sequence Lnsanchan and Lnruan are long-term co-integration.

Making stabilized time series e3 as the error correction term, error correction model can be established as follows:

$$\Delta \ln sanchan_t = -0.004147 \Delta \ln ruan_t + 0.7376 \Delta \ln sanchan_{t-1} + 0.0154 \Delta \ln ruan_{t-1} - 1.071 e_{t-1}$$

The coefficient of error correction term is negative, indicating that when short-term fluctuations in employment of tertiary industry are deviated from the long-term equilibrium, (-1.071) efforts will be adjusted back from a non-equilibrium to equilibrium which is in accord with reverse repair mechanisms.
Granger Causality Test

The above results show that there exist the long-term equilibrium between software outsourcing and employment scale and employment structure through the co-integration analysis, but it can not explain whether it constitutes a causal relationship. The so-called causality is whether the development of software outsourcing brings job growth, or employment growth brings the development of software outsourcing. This requires further verification. Here Granger causality test will be used. Such a test is useful when we know that two variables are related but don't know which variables cause the other to move.

1) **Granger Causality Test between Scale of Employment and Software Outsourcing**

<table>
<thead>
<tr>
<th>Null hypothesis</th>
<th>F-Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Employment is not the Granger cause of software outsourcing</td>
<td>3.47781</td>
<td>0.09178</td>
</tr>
<tr>
<td>Software outsourcing is not the Granger cause of Employment</td>
<td>3.25645</td>
<td>0.10130</td>
</tr>
</tbody>
</table>

As Table 4 shown, when the lag period is 1, total employment is the Granger cause of software outsourcing at 10% confidence level, that is, total employment growth will cause an increase in software outsourcing. The software outsourcing has slightly affected the increase in employment.

2) **Granger Causality Test between Employment Structure and Software Outsourcing**

<table>
<thead>
<tr>
<th>Null hypothesis</th>
<th>F-Statistic</th>
<th>Probability</th>
</tr>
</thead>
<tbody>
<tr>
<td>The employment of tertiary industry is not the Granger cause of software outsourcing</td>
<td>1.34037</td>
<td>0.27387</td>
</tr>
<tr>
<td>Software outsourcing is not the Granger cause of employment of tertiary industry</td>
<td>5.81562</td>
<td>0.03659</td>
</tr>
</tbody>
</table>

As Table 5 shown, on one hand, when the lag period is 1, software outsourcing is the Granger cause of employment of tertiary industry at 5% confidence level, that is, software outsourcing will cause an increase in employment of tertiary industry. The software outsourcing has slightly affected the increase in employment. On the other hand, the employment of tertiary industry is not the Granger cause of software outsourcing at 5% confidence level.

**Conclusion**

This paper makes an empirical analysis of the relationship between software outsourcing and employment scale and employment structure by using co-integration and error correction theory based on the data from 1995 – 2008. The result shows that software outsourcing is the causation of employment scale, and its influence on employment scale is positive. Software outsourcing has a positive effect on employment structure. There has been a long – term stable balancing relationship and Ganger causality between the software outsourcing and employment of the third industry. In short periods, employment scale and employment of the third industry can be automatically adjusted with the change of software outsourcing.

As a green knowledge-intensive industry, software outsourcing which is characteristic for wide application, strong penetration and low resource consumption, has played an important supporting and leading role on the development of the national economy, and especially has a significant role of expanding employment and improving employment structure. India, Ireland and other countries, have achieved a sustained and rapid development of software industry in the whole world and made a big profit in the industry chain so that enhancing the economic strength and national status through software outsourcing. Our service industry also faces good chances of global transfer, the software outsourcing market growth continues being unabated in spite of later start. If we can catch and make good use of this opportunity during the international financial crisis, there will be conducive to expand employment, accelerate the development of China's software industry, promote the upgrading of industrial structure and raise our economy development to a new level. Just as China had actively undertaken manufacturing outsourcing, software industry outsourcing is the foundation of software industry development, so in the near future, we should vigorously develop software outsourcing, and gradually shift it from low-end to high-end of value chain by undertaking software outsourcing projects.

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