**The Impact of Technology Adoption on Employment: Exploration from the perspective of manufacturing industry in transitional China**

**Abstract:** Using the manufacturing industry-level panel data from 1998 to 2004 in transitional China, this paper empirically analyzes the impact of technology adoption on the employment quantity and employee skill structure. The econometric results indicate that basically the technology adoption has positive impact on the employment quantity, and demands the improvement of the labor skill structure. However the impact of different types of technology varies, contrary to the prediction of traditional theory, the impacts of process innovation on both the employment quantity and the employee skill structure are positive, whereas the impacts of product innovation on employment quantity are virtually negative or insignificant. The performances in different ownership enterprise also vary. The coefficient of technology's impact on employment quantity in foreign enterprises is lower or insignificant. Regarding to the coefficient of technology's impact on employee skill structure, the state-owned enterprises' is lower or insignificant.

**Key words:** Technology Adoption Employment Skill Structure Process Innovation Product Innovation

**JEL Classification:** J230, O330, P310.

Since executing economic reform and open policy in late 1970's, China economy keeps a high annual growth rate and the technology innovation has also been stepping on. The technology adoption promoted economy growth, at the same time it exerted great impact on employment quality and skill structure. Further technological change coincided with institution innovation. During the transitional process many previous state-owned enterprises are reformed into stock-limited company, combined with foreign companies or been privatized. Do Different ownership enterprises perform differently in the process of technology adoption and have different impact on employment? Answering these questions needs us to conduct some empirical analyses. This paper tries to investigate the impact of technology input expenditure on the employment quantity and skill structure from the perspective of manufacturing industry.

Ordinarily technical progress and labor productivity growth will exert effect on wage firstly,

then influence employment further lately. However, if the wage's market mechanism is unhealthy and wage itself could not be sensitive to technology or becomes sluggish, the impact on employment and skill structure should be considered seriously (Alexandra Spitz-Oener 2006). The wage forming mechanism has not been perfect in China by now (Ning 2007). Under the circumstance that wage could not respond fully to technical change and labor productivity, directly investigating technology's impact on employment and structure becomes essential. The plan of the paper is as follows, section 2 is literature review and analysis framework establishing, section 3 contains theoretical foundation, section 4 gives econometric function and data description, section 5 holds the results and discussion. Finally we offer some conclusions and policy implication.

The data for econometric analysis comes from China Technology Statistics Yearbook 1999-2005, reflecting the technical development condition of enterprise above scale. Because of the change of ownership classification, we have to divide the data into two groups, one is for 1998-2002, comprising of state-owned enterprise and foreign firm, the other is 2003-2004, including state-owned enterprise, limited responsibility company, stock limited company and foreign firm.

First of all we use the function below to analyze the impact of technology adoption on employment quantity.

$$\begin{aligned}\ln L = {} & \beta_0 + \beta_1 \ln TE + \beta_2 \ln LD + \beta_3 SZ + \beta_4 GY + \beta_5 GF + \beta_6 (\ln TE * SZ) \\ & + \beta_7 (\ln TE * GY) + \beta_8 (\ln TE * GF) + \beta_9 NF + \beta_{10} HY + \mu\end{aligned} \quad (1)$$

$L$ stands for the employment number at the end of certain year in this industry. $TE$ is the technological input expenditure. The ratio of technology expenditure to output value is also useful, reflecting more accurately the direction of technology upgrading. We do not use R&D expenditure to represent technology, because R&D expenditure is the input taken place in the product experiment process, which cannot reflect accurately the condition of technology adoption. Technical expenditure has the stock state and flow one, as the change of ownership classification, the time longitude is relatively short and we only select the flow one. $LD$ represents the firm number in this industry, if the coefficient is positive, it means that the strengthened market competition will result in employment expansion, otherwise it maybe that over-competition ruins the employment growth or this industry should be the nature monopoly one. $SZ$ , $GY$ and $GF$ are the dummy variable to represent foreign firm, state-owned enterprise and stock limited

company respectively. The last three variables are the cross multiple item of enterprise ownership and technical expenditure. $NF$ is the dummy variable of 1998-1999 or 2003 to reflect the macro economic condition's effect. $HY$ is the dummy variable of industries. We classify the 38 industries into 8 categories according to their characteristics.

The function of different kinds of technology adoption's impact on employment is shown as below:

$$\ln L = \gamma_0 + \gamma_1 \ln(WD/SB) + \gamma_2 \ln(XCP/Y) + \beta_3 \ln LD + \gamma_4 SZ + \gamma_5 GY + \gamma_6 GF + \gamma_7 NF + \gamma_8 HY + \mu \quad (2)$$

Where $XCP/Y$ is the ratio of new product value to aggregate value of the product, which represents the development level of product innovation. $WD/SB$ is the ratio of ME control machinery value to production machinery value. It acts as an indictor of process innovation.

The function for technology's effect on employment structure is as follow:

$$\ln(LS/L) = \lambda_0 + \lambda_1 \ln TE + \lambda_2 \ln LD + \lambda_3 SZ + \lambda_4 GY + \lambda_5 GF + \lambda_6 (\ln TE * SZ) + \lambda_7 (\ln TE * GY) + \lambda_8 (\ln TE * GF) + \lambda_9 NF + \lambda_{10} HY + \mu \quad (3)$$

$LS/L$ denotes the ratio of engineer and technical worker number to total employee number, an indicator for labor's skill structure. If we have other data such as education structure, job type or management worker structure, we can also use those indicators.

To assess the impact of different technology on employment structure, the function is similar to function (2).

Using the manufacturing industry's panel data from 1998 to 2004 in transitional China, this paper empirically analyzes the impact of technology adoption on the employment quantity and employment structure at the industry level. The econometric results indicate that basically the technology adoption has positive impact on the employment quantities. This is mainly because as a developing country, China's technology adoption can improve the competition power, expand the product demand and increase employment. Technical change also demands the improvement of the labor skill structure. However the impact of different types of technology varies, contrary to the prediction of traditional theory, the impacts of process innovation on both the employment quantity and the employment structure are positive, whereas the impacts of product innovation on employment quantity are virtually negative or insignificant, which implies that our industries still rely on labor productivity improvement to win competition, product innovation are not performing

well and could not bringing forth employment expansion. During the transitional period, the technical adoption co-acted with enterprise ownership reform and market structure (competition) will generate negative shock on employment. The performances in different ownership enterprise also vary. The coefficient of technology's impact on employment quantity in foreign enterprises is lower or insignificant. Regarding the coefficient of technology's impact on employment skill structure, the state-owned enterprises' is lower. When the foreign firm works as a dummy variable, the impact on both employment quantity and structure are negative, showing foreign firm's limited ability to create employment. It needs to mention that we should be conservative about our results.

The paper stresses great emphasis on the employment's role in economy development. Its policy implication is that strengthening the manufacturing industry's technology process, upgrading the international competition power can be realized with the employment expansion. Apart from persisting in developing process innovation, we should carry out real meaningful product innovation in order to expand the employment. In the transitional period, the technology progress and institution structure adjustment happened at the same time, which placed greater pressure on employment. Therefore we should consider it seriously. The policy for foreign firms should also be adjusted accordingly so that the technology spillover effect and employment creation can be undertook smoothly.

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