Exports and Labour Demand Elasticity in Manufacturing Industries in China

Eden S.H. Yu and Lihong Yun, City University of Hong Kong

Preliminary version prepared for the Nottingham conference
in Ningbo, China, November 9 – 10, 2010

First draft: October 17, 2010

ABSTRACT

This paper investigates the determinants of labour demand across the manufacturing sectors in China by using a three-digit level set of panel data collected from 158 manufacturing industries for 1998-2007. The estimation results confirm that increasing output will lead to a rise in the demand for labour, while higher wages will result in a decline in labour demand. Furthermore, it is shown that the total effects of exports on the elasticity of labour demand can be positive or negative, depending on the nature of the sectors and the regions. Technical progress, however, can result in less labour demand, except for the medium- to high-technology sector in the Pan Pearl River Delta region.

JEL Classification: F16, J23

Keywords: Labour elasticity, exports, China

1. INTRODUCTION

The impacts of trade reforms on growth and employment in some industrialised economies in North America and Europe have been the subject of several studies (Mourre 2006; Paul and Siegel 2001; Slaughter 2001). Recently, employment issues in developing economies such as India, Tunisia and Latin America are examined (Bhalotra 2003; Haouas and Yagoubib 2008; Fajnzylber and Maloney 2005). They argue that economic reform and growth can improve efficiency in labour utilisation, resulting in reduced demand for labour. This raises social concern particularly in those economies that have a large amount of surplus labour. The serious unemployment and possible social disturbance resulting from a lack of jobs for the mass population can be detrimental to sustaining growth in developing economies.

After two decades of economic reform and opening up, China has experienced such robust economic growth. Yet, it is facing difficulties in the labour market. In the coming years, China needs to generate at least one million jobs every year for the country's university graduates. Furthermore, while two-third of China's population is still engaging in farming activities, a large number of people from the rural areas are ready to join the labour force in industrial sectors. Facing the increasing demand for wage- earning jobs, it is hoped that China's economic reform can render more employment opportunities particularly in the manufacturing sector. However, recent reforms in industrial sectors and the labour market have brought in more competition, which has helped firms to improve their production and management efficiency. As a result, the demand for labour decreases and the unemployment rate increases in the economy.

The economic reform has also created friction in the state-owned enterprises. These enterprises serve as social entities as major job providers for the country's mass population. It is not easy for the enterprises to lay off their workers. It is only until recent years that the privatisation of state enterprises and early retirement with a golden handshake are encouraged. Workers aged 45 or above are most likely to receive the offer, and it is often difficult for them to find other jobs afterwards.

On the other hand, there appears to be a shortage of workers for private enterprises in China's coastal regions in the recent years. In order to attract and retain workers, firms in the Pearl River Delta (eg Guangdong Province) and the Yangtze River Delta (eg Shanghai and Jiangsu Province) attempt to raise the minimum wages. The pros and cons of the on-going upward adjustment of wages are still under investigation by academics and policy makers. Nevertheless, the increase of costs of production due to higher wages can also act as a disincentive for industry to hire workers.

It is apparent that the labour unemployment arising from structural, frictional and cyclical changes are not only of concerns to developed industrialised economies, but they are also of concerns in developing or emerging economies such as China. It is notable that economies around the world are all becoming increasingly interconnected. The global financial crisis in 2007 and the current economic slowdown have possibly led to a decline in the world demand for Chinese goods. To tackle this undesirable development, China is now making an effort to shift from an export-oriented economy to one that is driven by domestic demand. The concept and measure of the elasticity of labour demand, which are related to production outputs, labour wages and export values and volumes, can shed some light on the fine-tuning of industrial and labour market policies in a bid to achieve steady and sustainable economic growth amid the restructuring of the economy and labour market.

This study aims to examine the effects of exports on labour demand in China's manufacturing sectors across regions. To facilitate the study, data on three-digit level for 158 manufacturing industries located in 30 provinces during the period of 1998-2007 are analyzed. Section 2 presents a literature review. Section 3 outlines a theoretical framework for the empirical testing. Section 4 briefly describes the data and empirical estimation methods. Section 5 reports and discusses the empirical results, and Section 6 offers concluding remarks.

2. LITERATURE REVIEW

There are numerous studies on the industrial demand for labour which support the efficient wage hypothesis, i.e., firms are likely to relax their demand for labour as average wage rises, ceteris paribus. See Nickell and Wadhwani (1991), Van Reenen (1997) and Greenaway *et al.* (1999) on UK manufacturing firms and industries; Revenga (1997) on Mexican industrial firms; and Milner and Wright (1998) on the manufacturing industries of Mauritius. Further, Slaughter (2001) found that, based on a panel of US manufacturing industries during the period of 1961-1991, the own-price elasticity of demand for production workers was relatively elastic in the manufacturing sector as a whole and also in five of the eight industries within the sector. The demand was relatively less elastic for non-production workers.

Furthermore, Haouas *et al*. (2003, 2008), taking a trans-log labour demand function, argued that the wage elasticity of labour demand of six Tunisian manufacturing industries (during the period of 1971-1996) is less elastic than the value added elasticity and capital elasticity. However, they also found that in the long run some industries, for example, textile, clothing and leather, and chemical industries, can have positive wage elasticity of labour demand. Their results reflect that even if there is an increase in wage costs, job security regulation does not allow firms to dismiss their workers easily. However, Bhandari and Heshmati (2005) applied a similar method for the manufacturing industries in India during the period of 1980-2002, and found that labour intensive industries (e.g., wood, and food and beverage) were comparatively sensitive to wage rate and had negative wage elasticity of employment, while some capital intensive industries, for example, motor vehicle, electrical machinery and computing machinery, had positive wage elasticity of employment. They argued that such positive or negative wage elasticity reflect the skilled versus non-skilled nature of the respective industries.

What would be the effects of labour-saving technical progress on labour demand? Bhandari and Heshmati (2005) argued that technical change in the Indian manufacturing industries can lead to a reduced demand for labour. Haouas *et al*. (2005) found similar effect of labour saving technical progress in the Tunisian manufacturing industries. Further, Greenaway *et al.* (1999) and Milner and Wright (1998) suggested that trade-induced x-efficiency can reduce the demand for employment for the manufacturing industries of the UK and Mauritius. However, Piva and Vivarelli (2005) and van Reenen (1997) argued that employment can also positively respond to technical progress via innovation for the manufacturing firms in the UK and Italy.

In addition, micro- and macro- institutional factors, for example, union bargaining and labour tax wedge (i.e. employees' and employers' social security contributions and personal income tax as a percentage of total labour costs), can also have an impact on employment (Konings and Walsh 2000; Mourre 2006).

In sum, empirical studies generally support the postulations of negative wage and positive output elasticity of labour demand, while the effects of trade and technical progress on labour demand are less clear. This study attempts to make a contribution to the latter by estimating the export and technical progress (using time trend as a proxy) elasticity of labour demand of the Chinese manufacturing industries.

3. Theoretical Framework

Generally speaking, the demand for labour depends on wages, firms' output, international competition and technical progress. Specifically, as mentioned above, the efficiency wage hypothesis proposes that employment by firms is negatively associated with the firm's own wage level (Nickell and Wadhwani 1991; Revenga 1997). On the other hand, it is also suggested that international competition is likely to impact on the wage-elasticity of labour demand in terms of both substitution effect and scale effect (Hamermesh 1998; Cahuc and Zylbergerg 1996; Slaughter 2001). The substitution effect refers to the impact of international competition on labour cost and then the elasticity of substitution between labour and other production factors. The scale effect refers to how increasing trade can lower firms' mark-ups, and hence, increase the price elasticity of goods demand. As a result, increasing trade raises the firms' wage-elasticity of labour demand. In addition, international and innovation competition (for example, trade, FDI and R&D) in the product market can render *X*-efficiency and then impact on labour demand across firms and industries (Bruno *et al*. 2004; Greenaway *et al*. 1999).

To capture the effects of trade openness on wage-elasticity of labour demand, one can derive the labour demand function by using a standard CES production function. Based on profit-maximizing, a firm employs labour and capital at the levels where the marginal revenue of product of labour equals the wage, *w*, and the marginal revenue of product of capital equals the user cost, *r* (Arrow *et al*., 1961). Alternatively, one can derive the labour demand function from production function subjected to cost minimization (Bruno *et al*., 2004). Following Arrow *et al*. (1961) and Bruno *et al*. (2004), we postulate a reduced-form labour demand function as follows:

$$\ln L = (\delta_w + \delta_{wX} X + \delta_{wT} T) \ln(w/r) + \delta_Q \ln Q + \delta_X X + \delta_T T + \mu + \varepsilon \,, \qquad (1)$$

where the parameter δ_w reflects the wage effects on employment, controlling the output Q in the equation, δ_X and δ_{wX} caputre the effects of international competition via technical efficiency on labour demand. Data on *r* are not available, we proxy it by a set of Year dummies. The time trend and Year dummies also reflect the effect of the exogenous technical progress. Whilst δ_{wX} and δ_{wt} capture the interaction impact of *X* and the time trend *T* on the wage elasticity of the labour demand function, which is given by

$$\eta_{Lw} \equiv \frac{\partial \ln L}{\partial \ln w} = \delta_w + \delta_{wX} X + \delta_{wT} T \,, \qquad (2)$$

In other words, trade impacts on the technical efficiency via wage elasticity of labour demand (Bruno *et al*. 2004; Cahuc and Zylbergerg 1996; Hamermesh 1998; Slaughter 2001). Thus, the basic static labour demand model that captures international competition impact on *i*th industrial labour demand and the interaction effect between trade and wage on labour demand is as below (let $r = 1$) , where i= 1,…, N,

$$\ln L_{i,t} = (\delta_w + \delta_{wX} X_{i,t} + \delta_{wT} T)\ln w_{i,t} + \delta_Q \ln Q_{i,t} + \delta_X X_{i,t} + \delta_T T + Year\_dummy + \mu_i + \varepsilon_{i,t} \; . \quad (3)$$

To capture the possible adjustment costs of labour demand[1], a one-year lagged employment ($\ln L_{i.t-1}$) is augmented on the right of the equation. The basic dynamic labour demand model is expressed as

$$\ln L_{i,t} = \varphi \ln L_{i,t-1} + (\delta_w + \delta_{wX} X_{i,t} + \delta_{wt} t)\ln w_{i,t} + \delta_Q \ln Q_{i,t} + \delta_X X_{i,t} + \delta_T T + Year\_dummy + \mu_i + \varepsilon_{i,t} \; . \quad (4)$$

The coefficent on the lagged employment φ captures the labour cost adjustment[2] (Hamermesh 1993). The long-run wage elasticity is $\frac{1}{1-\varphi}(\delta_w + \delta_{wX} X_{i,t} + \delta_{wt} t)$.

4. DATA AND ESTIMATION METHOD

The data employed for this study was procured from “All China Marketing Research”, a firm which processes the data released by the Statistics Bureau of China. The Bureau

[1] For a detailed discussion on factor adjustment cost, see Hamermesh and Pfann (1996). Briefly, there are two types of adjustment costs of labour demand: net costs and gross costs. The net costs refer to reorganising workers’ assignment on account of changing the number of employees in the firm. The gross costs refer to those involving with the flow of workers, such as search costs, training costs, severance pay and overhead costs of maintaining that part of the personnel function engaging in recruitment and worker outflows.

[2] For factor cost adjustment, a half- life adjustment is the ratio of the log of one half to the log of estimated lagged employment coefficient.

conducts annual surveys which provide accounting information on manufacturing industries at the four-digit level for the period of 1998-2007. The dataset covers both state-owned industrial enterprises and non-state-owned industrial enterprises with annual sales revenue over five million RMB. The pre-2002 data is arranged according to the Chinese Industrial Classification document GB/T 4754–1994, and the data since 2003 is based on the Chinese Industrial Classification document GB/T 4752–2002.[3] Some industry codes at four-, three- and two-digit level are adjusted in the GB/T 4752– 2002, which is relatively compatible with the International Standard Industrial Classification ISIC Rev. 3 issued by the United Nations.

In order to pool the data before and after 2002, we adjusted the industrial codes at four-digit level and aggregated them up to the three-digit level according to the "GB/T 4752-1994", with some minor exceptions. Appendix A1 outlines the variables and their measurements applied in this study. Appendix A2 describes the two-digit codes for the Chinese manufacturing industries.

The data covers a total of 31 provinces, autonomous regions and "direct-controlled municipalities" of China. We group them into five regions: (1) The Pan Pearl River Delta region that includes Fujian, Jiangxi, Hunan, Guangdong, Guangxi, Hainan, Sichuan, Yunnan, Chongqing and Guizhou; (2) the Yangtze River Delta region that includes Shanghai, Jiangsu and Zhejiang; (3) the Northeastern region that includes Liaoning, Jilin and Heilongjiang; (4) the Western region that includes Inner Mongolia, Shaanxi, Tibet, Qinghai, Ningxia, Xinjiang and Gansu; and (5) the Middle region that includes Beijing, Tianjin, Hebei, Shandong, Shanxi, Anhui, Henan and Hubei.

---

[3] For detailed classifications and differences between the two versions, see GB/T 4752 – 2002 published by China Standard Publication Press 2007.

With reference to empirical and analytical frameworks presented in Sections 2 and 3 above, it is expected that:

- the wage elasticity of employment will be negative, while the output elasticity of employment will be positive;
- trade induced technical progress can be labour saving, neutral or labour using. The resulting type of technical progress is an empirical question for investigation.

In the empirical estimation, there is a need to control for possible industry-specific effect. That's why we take a first-difference on the variables in the labour demand function. Although the study cannot control for each and every industry-specific effects, given the relatively short span of time of the panel data, one may argue that factor endowments or labour demand can be sector-specific. We use the OECD classifications (OECD, STI Scoreboard 2001) and group the manufacturing industries into four sub-sectors: low-technology (low-tech), medium-low technology (med-low-tech), medium-high technology (med-high-tech) and high-technology (high-tech) industries (See Appendix A2).

The Generalized Methods of Moments – System (GMM-SYS) approach is applied in the estimation of the labour demand function. This approach serves to overcome the problem arising from the weak instruments in GMM-DIF for a panel with a short span of time (for methodological issues, see Arellano and Bond 1991; Arellano and Bover 1995; Blundell and Bond 1998). In the GMM-SYS estimation, the lagged levels of the predetermined and endogenous variables dated (t-s) are used as instruments in the first-differenced equation, whilst the lagged first differences of the variables dated (t – s +1) are used as instruments in the level equation.

The Hansen J-statistics test the validity of the instruments sets to see whether the instruments are exogenous, and robust to heterocedasticity or autocorrelation. The M1 and M2 statistics indicate, respectively, the first-order and the second-order autocorrelation in the error term in the first-differenced equation. First-order autocorrelation is expected in the first differences. But the higher-order autocorrelation indicates that some lags of the variables which might be used as instruments are endogenous, and thus they are not used as instruments.

4. EMPIRICAL RESULTS

Before presenting the econometric results of labour demand function, we take a glance at employment, wages and exports of the manufacturing industries in the five regions in the study. Figure 1 shows the ratio of employment in each of the five regions to total employment. It is notable that three of the regions, the Pan Pearl River Delta, the Yangtze River Delta and the Middle regions, employ approximately 80% of China's manufacturing workers. Further, among the three regions, the manufacturing employment ratios of the Pan Pearl River Delta region and the Yangtze River Delta region have increased over the years. Whilst the Middle region used to have much higher employment ratio among the five regions, it showed a declining trend, and its ratio started to fall below that of the Pan Pearl River Delta region since Year 2004. The employment ratios of the Northeastern and Western regions have also shown a decline.

Figures 1.1, 1.2, 1.3 and 1.4 further show the employment ratios by sectors and by regions, which have pattern quite similar to that of Figure 1. Among the five regions, the Middle region absorbs comparatively high employment ratios in the low-technology, medium-low-technology and medium-high-technology sectors. Yet its ratios in the high-technology sector are lower than that of the Pan Pearl River Delta region. Figure 1.4 shows that, in the period of 1998-2007, the employment ratios of high-technology sector of the Pan Pearl River Delta region are the highest among the five regions -- 38% of the total employment of high-technology sector in 1998 and 47% in 2007.

Figure 2 shows the monthly manufacturing wages of the five regions. The overall average monthly wage is tripled, increasing from 514 RMB in 1998 to 1,574 RMB in 2007. The average monthly wages of the Pan Pearl River Delta region and the Yangtze River region are near or higher than the overall average wages. Between the two regions, the manufacturing workers in the latter region enjoy higher wages. For instance, in 2007, workers in the Pan Pearl River Delta region and the Yangtze River region are paid 1,644 RMB and 1,913 RMB per month respectively. The average monthly wages of the Middle, Northeastern and Western regions were lower than the overall average wage with the Western region having the lowest wages among all five regions. The wages in these three regions are moving closer to the overall average in recent years. For example, in 2007, the workers in the three regions were paid monthly average wages of 1,464 RMB, 1,550 RMB and 1,327 RMB respectively.

Figures 2.1, 2.2 2.3 and 2.4 show the average manufacturing wages by sectors and by regions. The wage patterns are similar to that in Figure 2. Further, we can observe the levels of average monthly wages by sectors, which reflect the levels of technology classifications. The better the technology level, the higher the wages. For instance, the overall average monthly wages in 2007 of the low-technology sector are 1,291 RMB, while that of the high-technology sector are 2,353 RMB.

Figure 3 shows the manufacturing export ratios of the five regions. The Pan Pearl River Delta region and the Yangtze River region contribute about 75% of the overall exports. The former region has higher export ratios than the latter until 2005, but it starts trailing behind during the period of 2005-2007. The Middle region contributes 17% over the observed years while the Northeastern and Western regions have less than 10% of the overall exports.

Figures 3.1, 3.2, 3.3 and 3.4 show the export ratios by sectors and by regions, mostly resembling that of Figure 3. The export ratios of low-technology sector of the Pan Pearl River Delta region are higher than that of the Yangtze River Delta region during the period of 1998-1999. Yet, the former starts trailing behind the Yangtze River Delta region since Year 2000. The export ratios of medium-low-technology and high-technology sectors of the Pan Pearl River Delta region used to be higher than those of the Yangtze River Delta region. They decline in the period of 2006-2007, while that of the Yangtze River Delta region have been increasing and reach the similar levels of the Pan Pearl River Delta region. The export ratios of medium-high-technology sector of the Pan Pearl River Delta region used to be lower than that of the Yangtze River Delta region, and then they become higher than that of the Yangtze River Delta region in 2007.

In short, the Pan Pearl River Delta region and the Yangtze River Delta region are the manufacturing and exporting hubs of the national economy -- they absorb more than half of the country's manufacturing workers and contribute to more than half of manufacturing exports. The manufacturing workers also enjoy relatively higher wages in the two hubs.

Turning to the econometric results, the GMM-SYS estimation results based on Equation (4) covering the four types of manufacturing sectors and the five regions of China are presented in the tables. For robust checks, the interaction effects of exports and wages and such effects of time trends and wages are alternatively included in the empirical results. We compute and summarise the long-run elasticity of the key variables in Table 1 and Table 2. The long-run models for some regions and sectors cannot be defined (the lag employment variable is not statistically significant or the models do not fit in the GMM-SYS tests), and thus is denoted as missing (-) in the tables. For those individual variables that are not statistically significant also are denoted as missing (-) in the tables. For example, in Table 1, the long-run models cannot be defined for the three sectors (medium-low-technology, medium-high-technology and high-technology) in the Middle region, indicating that the variables controlled in the models cannot capture the long-run elasticity of the labour demand in the region. Yet, once we include the interaction effects of exports and wages (see Table 2), we can capture the long-run elasticities of labour demand of the high-technology sector in the Middle region.

Table 1 presents the results when the interaction effects of exports and wages are not included, while Table 2 reports the results with such interaction effects and the time- trend effect included. The results reveal that adjustment costs of labour demand do exist across the manufacturing sectors and the regions. Once the interaction effects of exports and wages are included, the cost of adjustment index for the respective sectors across regions becomes moderate. For example, the period of labour adjustment of low-technology and medium-high-technology sectors in the Pan Pearl River Delta region appear to be around 9 months and 13 months in Table 1. Yet, the adjustment period becomes 5 months in Table 2. This indicates that interactions effects of exports and wages, to some extent, can help attract and retain workers in the region and thereby reduce its adjustments costs of hiring and firing workers. This also explains huge inflow of immigrant workers from other regions of China into the Pan Pearl River Delta region, which pioneered the implementation of economic reform and open-door policies. Once the interaction effects are included in Table 2, the total effects of exports (based on the effects of exports and the interaction effects of exports and wages) on the labour demand across regions and sectors become statistically significant.

Here, we discuss the results in Table 2. Note that in most cases, the time period (half-life) for adjustment is positive and significant, indicating that it takes time and is costly to adjust labour demand. For example, in the low-technology sector, the longest adjustment process takes 6 to 7 months in the Yangtze River Delta region, whilst the fastest adjustment process in the Western region takes only 4 months. The time length needed for the adjustment reflects the availability of workers in the respective region. The Western region, the least developed region of China, has a relatively large pool of labour that stands ready to shift from the agriculture sector to the low-technology manufacturing sector. In contrast, the industries in the Yangtze River Delta region, one of the two manufacturing hubs of China, require relatively sophisticated labour in their production and it is particularly so for export-oriented industries, which also need to compete with its counterparts in the Pan Pearl River Delta region. It is notable that to attract and retain good workers, local governments play a significant role in setting policies regarding labour. For example, the city of Shanghai in the Yangtze River Delta region raised its minimum wages from 960 RMB to 1,120 RMB in April 2010[4].

It is also found that the higher the technology level, the easier the adjustment of the labour demand. For example, in the Yangtze River Delta region, the half lives of adjustment are around 3 months in the high-technology sector while they are 6-7months in the low-technology sector, suggesting that the relatively sophisticated workers in the high-technology sector are more mobile. In recent years, we often hear that there is a "shortage of workers" in the two manufacturing hubs, the Pan Pearl River Delta and Yangtze River Delta regions. The labour shortage may be due to the relatively high living costs in the two regions. Those immigrant workers with relatively unsophisticated work experience from the Western region appear to be less interested in relocating to work in the low-technology sector in the two regions. They are more likely to choose to work near their hometown, as many new and on-going developmental projects in the Western region can provide jobs to them.

As expected, the total effects of wages (calculated based on the coefficients of wages, the interaction effects of exports and wages and the interaction effects of time

[4] Shanghai has set up its standard for minimum wages since 1993. The standard has been adjusted almost once a year for 17 times by April 2010, except for Year 2009. In addition, according to the National Regulations on Minimum Wages implemented in Year 2003, the minimum wages are subject to adjustment at least once every two years. http://www.chinadaily.com.cn/usa/2010-08/19/content_11176419.htm

trend and wages) are negative and significant in most of the cases, confirming that the higher the wages, the lower the demand for workers. For example, the long-run wage elasticity of labour demand in the low-technology sector in the Pan Pearl River Delta region is -0.402, while it is -0.616 in its high-technology sector.

In relation to the above discussion on the standard of minimum wages, the manufacturing sector faces a dilemma. Along with the economic and productivity growth, the wages are expected to be increased so as to retain workers. However, the increasing wages lead to a rise in production costs, and this can deter the manufacturing activities, particularly in those firms with products mainly for export markets.

Concerning the long-run output (value-added as proxy) elasticities of labour demand, as expected they are mostly positive and significant. The higher the output, the greater the demand for labour. The scale effects on labour demand appear to be relatively dominant across sectors and regions. For example, the long-run output elasticity is 0.888 in the low-technology sector in the Pan Pearl River Delta region while it is 0.528 in the high-technology sector. The recent global financial crisis leads to reduced demand for goods in the world markets, which in turn causes slowdown in production. To cope with this challenge, China adopts the policy of encouraging domestic consumption so as to maintain and even step up domestic production amid the recession elsewhere. This is also intended to tackle the rising unemployment problem in China.

Having controlled the output effect (value-added as a proxy) in the estimations, the total effects of exports (calculated based on the coefficients of exports and the interaction effects of exports and wages) are mostly positive and significant. For instance, exports promote the demand for labour demand in the low- tech sector in the Pan Pearl River Delta region. However, learning-by-exports lead to labour-saving in the Western region. Along with the exports growth, the production activities have become more robust in the Pan Pearl River Delta region, resulting in a rise in the demand for labour. In contrast, the Western region is in the initial stage of economic development. The learning-by-exports practice can lead to reallocation of workers and hence reduce demand for workers in the sector. Meanwhile, learning from its counterparts in the Pan Pearl River Delta region, the Western region also develops its high-technology industries. The total effects of exports in the high-technology sector are found to be positive and significant in the Western region.

In the medium-high-technology sector, the total effects of exports are negative and significant in the The Pan Pearl River Delta and the Yangtze River Delta regions. Industries such as chemical products, general/special purpose machinery and electrical machinery and apparatus are relatively capital/knowledge-intensive and tend to need less labour. However, in the Northeastern region, demand for labour increases, possibly due to the recent restructuring and enhanced efficiency in its manufacturing sector. The export ratios of the Northeastern region are still relatively low when compared to other regions, implying that the increase of exports can promote firms' production and profit and resulting in a greater demand for labour.

It is noteworthy that the total effects of exports on labour demand are positive and significant in the high-technology sector in four of the regions: the Pan Pearl River Delta, the Yangtze River Delta, the Western and Middle regions. See Table A3.8. The results suggest that upgrading the manufacturing activities and promoting the exports in the high-technology industries in these regions will be useful to labour employment. A case in point, the manufacturing of pharmaceuticals is in line with China's current reform in its medical-care system.

In addition, there is evidence to show that the greater the technical progress (time trend as proxy), the lesser the demand for labour. If anything, the total effects of time trend (T) (calculated based on the coefficients of the time trend and the interaction effects of time trend and wages) are mostly negative. For example, technical progress can lead to less demand for labour in: (1) the low-technology sector of the Pan Pearl River Delta region and the Western region; (2) the medium-low-technology sector of the Northeastern region; (3) the medium-high-technology sector of the Yangtze River Delta region and the Northeastern region.

Comparing to the other regions in China, the Yangtze River Delta and the Northeastern regions are known for machinery manufacturing. If technical progress in the sector results in efficiency, this can lower the demand for labour. However, we found that technical progress can also promote labour demand in the medium-high technology sector in the Pan Pearl River Delta region. This can be explained by the fact that this region engages mainly in the processing industry. Technical progress and innovation can help upgrade its manufacturing profiles and thereby leads to a greater demand for labour in the relatively capital/knowledge-intensive sectors, e.g. medium-high-technology.

5. CONCLUSIONS

Employing a set of panel data for the three-digit level of 158 manufacturing industries of China during 1998-2007, this study investigated the determinants of labour demand across manufacturing sectors and across regions. The estimation results reveal that the increase in output results in a rise in the demand for labour, whilst the increase in wages will result in a decline in labour employment. The total effects of exports on labour demand can be either positive or negative, varying by sectors and by regions. In particular, the increase in exports in the high-technology sector leads to a rise in demand for labour. Nonetheless, technical progress could result in less demand for labour, except for the medium-high-technology sector in the The Pan Pearl River Delta region.

Our results have the following administrative and policy implications. First of all, despite the fact that technical progress is essential for sustainable economic development, it can cause unemployment. To mitigate the problem, it is advisable to formulate industrial policy by developing appropriate technology and labour training program. At the macro level, appropriate education reform can lead to improvement in the quality of workers to better cope with advanced technology. As the the human capital and labour market mature, the disturbing effect of technical progress upon the labour markets can be diminished.

Second, as the value-added elasticity of employment is positive and robust, the manufacturing sector can still be the main production area for providing jobs. Firms can be encouraged to employ more “local content” for their production. It is known that Chinese manufacturing industries are now highly integrated with international production process. Their activities mainly involve assembling imported intermediates or processing imported raw materials, and efforts should be made to expand these activities to other higher value-added components of the supply chain to create more high value-added jobs.

It is advisable to give domestic consumption a strong boost amid the declining demand in the world market. In addition, continuous effort to upgrade production technology and exporting profiles will help sustain economic growth, particularly in the high-technology sector.

Third, economic reform should be continued to further liberalize the labour market by allowing more flexibility in labour wages in accordance with their “own price elasticity of employment” across sectors and across regions. In general, the minimum wages set to protect marginal workers with relatively low skills can dampen the demand for labour . Efficient wages, on the other hand, can provide incentives and promote labour productivity and loyalty. Furthermore, relaxing regulations and restrictions on labour mobility, e.g. residence-registration system and related schooling and medical benefits, can also help eliminate frictions in the labour markets.

Table 1 Long-run elasticity of exports and labour demand, 1998-2007

	Pan Pearl River	**Yangtze River**	**Northeastern**	**Western**	**Middle**
Low-tech					
Adjustment cost	0.870 ***	0.873 ***	0.573 ***	0.489 ***	0.555 ***
Wage	-0.883 ***	-	-0.386 **	-0.294 **	-0.513 ***
Value-added	1.051 ***	0.821 ***	0.604 ***	0.641 ***	0.588 ***
X	-	-	-	-0.949 ***	
Med-Low-tech					
Adjustment cost	1.210 ***	-	0.671 ***	0.351 *	-
Wage	-0.725 **	-	-0.702 ***	-0.405 ***	-
Value-added	0.651 ***	-	0.616 ***	0.614 ***	-
X	-1.837 **	-	-	1.261 **	-
Med-High-tech					
Adjustment cost	1.309 ***	0.610 ***	0.454 ***	0.428 **	-
Wage	-1.141 ***	-	-	-	-
Value-added	1.168 ***	1.004 ***	0.669 ***	0.642 ***	-
X	-	-1.920 **	-1.610 **	-	-
High-tech					
Adjustment cost	0.637 ***	0.467 **	-	-	-
Wage	-0.926 ***	-0.753 ***	-	-	-
Value-added	0.551 ***	0.854 ***	-	-	-
X	-	-	-	-	-

Note The long-run elasticities are calculated based on the related coefficients in tables A3.1, A3.3, A3.5 and A3.7; - denotes that lagged employment variable is insignificant or related variables are insignificant, or models are not specified such as med-low tech sector and med-high tech sector in the middle region; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table 2 Long-run elasticities of interaction of exports and wages and labour demand, 1998-2007

	Pan Pearl River	Yangtze River	Northeastern	Western	Middle
Low-tech					
Adjustment cost	0.543 ***	0.664 ***	0.579 ***	0.486 ***	0.507 ***
Total Effects of Wage	-0.402 ***	-	-0.606 *	-	-0.510 ***
Output	0.888 ***	0.704 ***	0.659 ***	0.584 ***	0.519 ***
Total Effects of X	0.361 ***	-	-	-0.580 *	-
Total Effects of t	-0.098 *	-	-	-	-
Med-Low-tech					
Adjustment cost	-	0.459 **	0.407 *	-	-
Total Effects of Wage	-	-0.482 ***	-0.591 ***	-	-
Output	-	0.751 ***	0.566 ***	-	-
Total Effects of X	-	0.975 *		-	-
Total Effects of t	-	-	-0.176 ***	-	-
Med-High-tech					
Adjustment cost	0.523 **	0.595 ***	0.327 **	0.415 **	-
Total Effects of Wage	-0.644 ***	-0.031 *	-0.260 ***	-0.352 *	-
Output	0.736 ***	0.953 ***	0.551 ***	0.633 ***	-
Total Effects of X	-0.293 ***	-0.832 ***	1.073 ***	-	-
Total Effects of t	0.065 ***	-0.043 *	-0.218 **	-	-
High-tech					
Adjustment cost	0.452 ***	0.346 *	-	0.534 **	0.365 *
Total Effects of Wage	-0.616 ***	-0.615 ***	-	-0.781 ***	-0.482 **
Output	0.528 ***	0.809 ***	-	0.840 ***	0.555 ***
Total Effects of X	0.084 ***	0.324 **	-	-	-
Total Effects of t	-	-	-	-	-

Note The long-run elasticities are calculated based on the related coefficients in tables A3.2, A3.4, A3.6 and A3.8; - denotes that lagged employment variable is insignificant or related variables are insignificant, or models are not specified such as med-low tech sector and med-high tech sector in the middle region; * significant at 10% level, ** significant at 5% level,*** significant at 1% level.

Figure 1 Employment ratios by regions (Lregion/Ltotal), 1998-2007

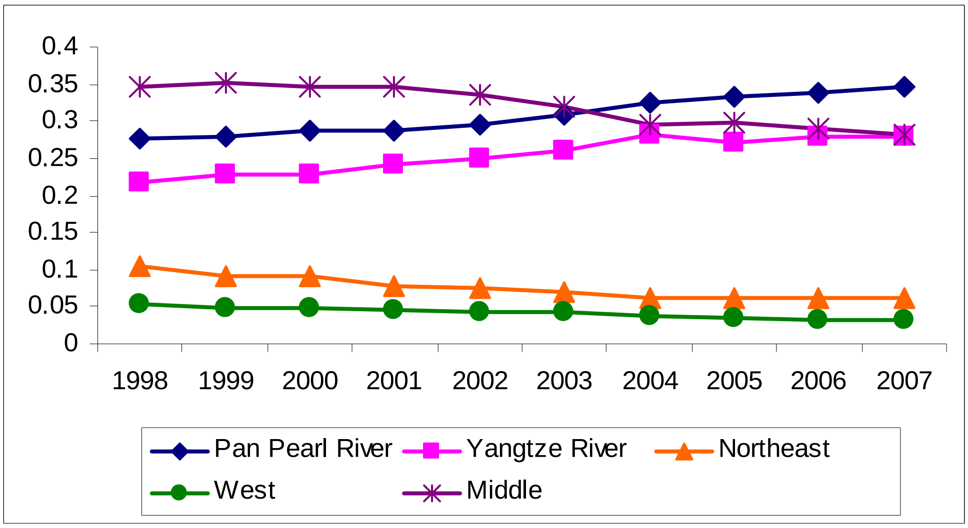


Figure 1.1 Low-tech: Employment ratios by regions, 1998-2007

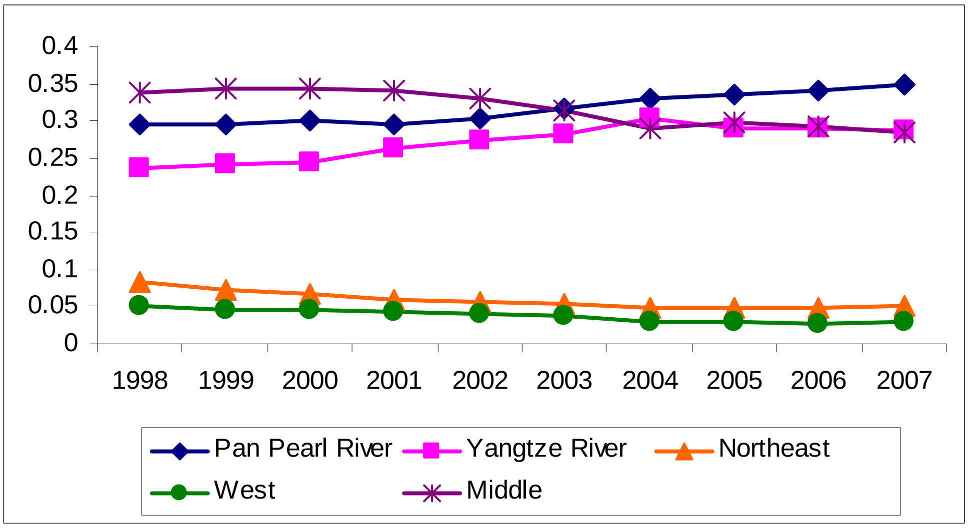


Figure 1.2 Med-low-tech: Employment ratios by regions, 1998-2007

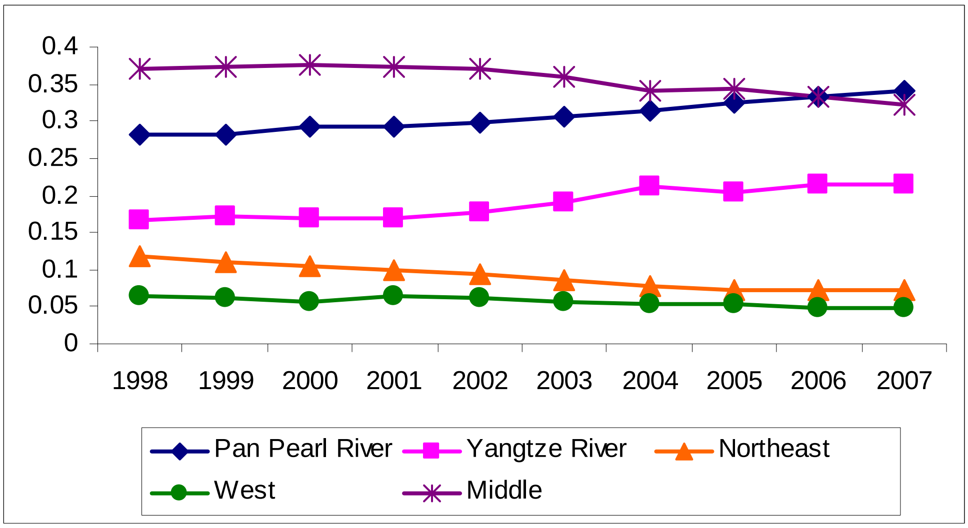


Figure 1.3 Med-high-tech: Employment ratios by regions, 1998-2007

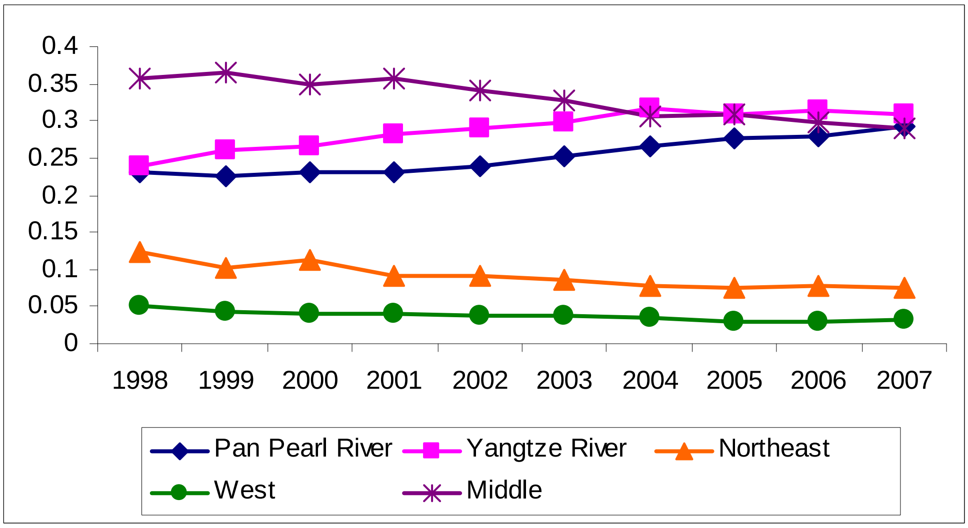


Figure 1.4 High-tech: Employment ratios by regions, 1998-2007

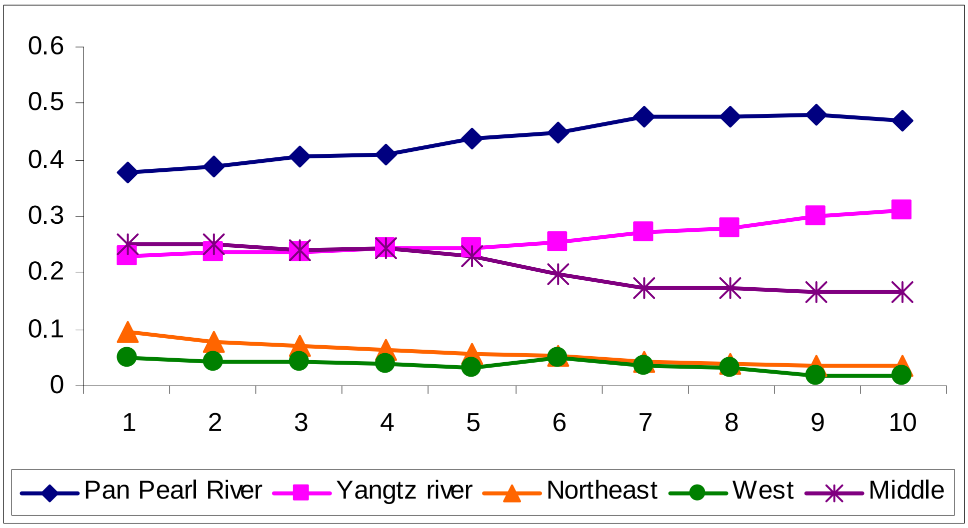


Figure 2 Average monthly wages (RMB) by regions, 1998-2007

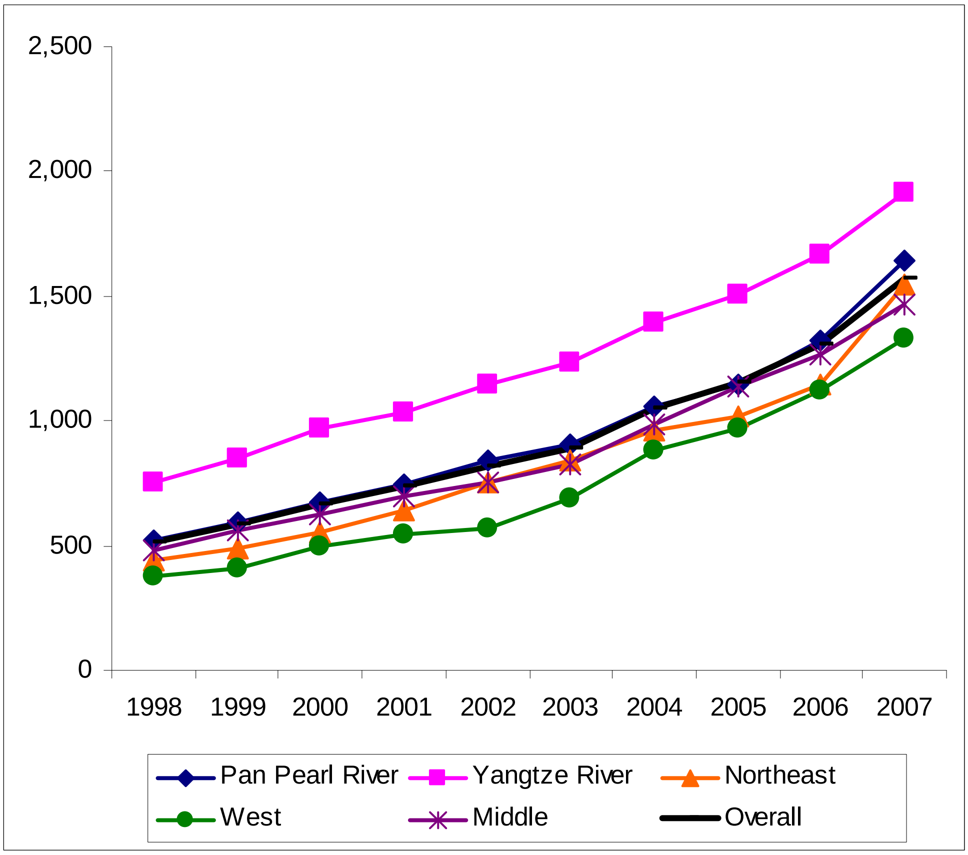


Figure 2.1 Low-tech: Average monthly wages by regions, 1998-2007

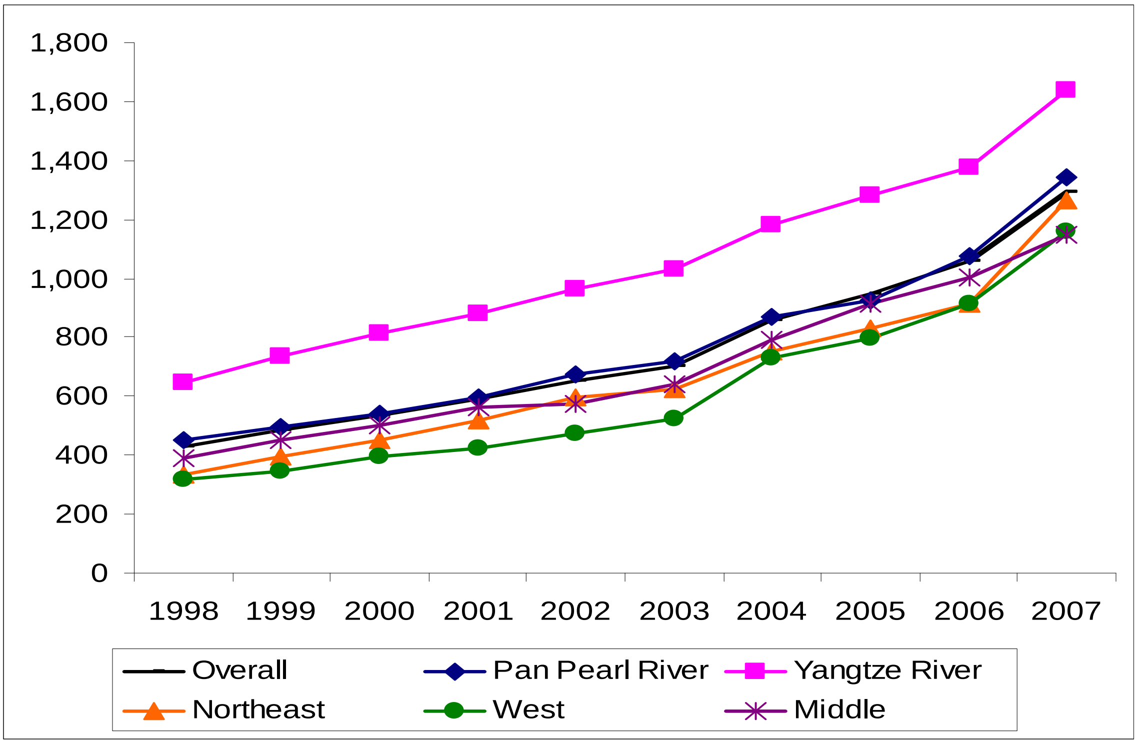


Figure 2.2 Med-low-tech: Average monthly wages by regions, 1998-2007

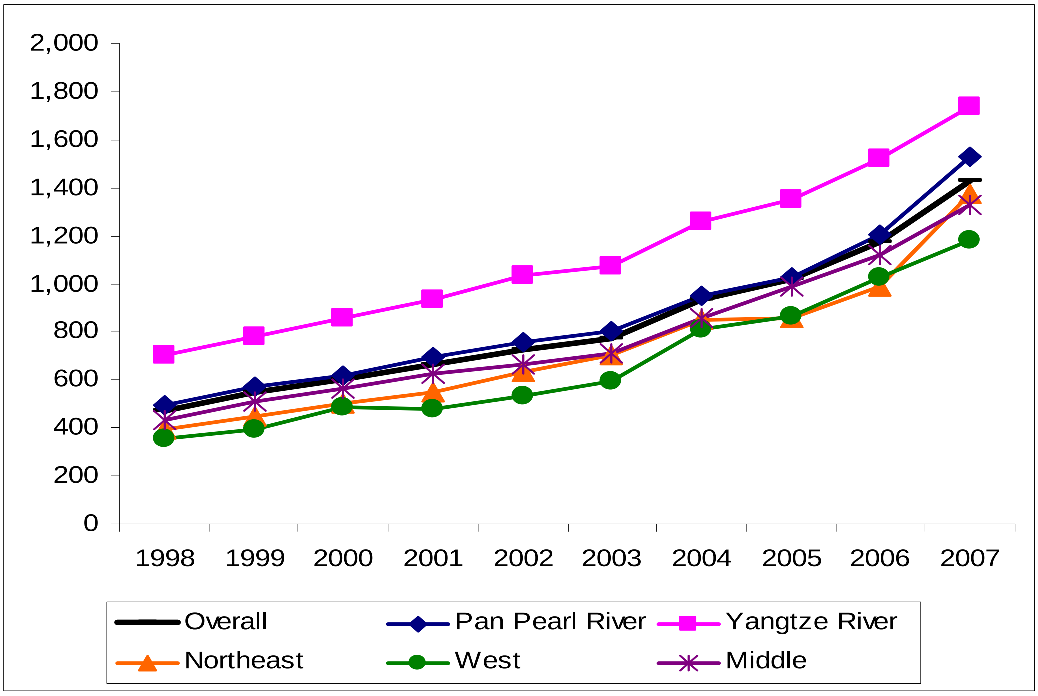


Figure 2.3 Med-high-tech: Average monthly wages by regions, 1998-2007

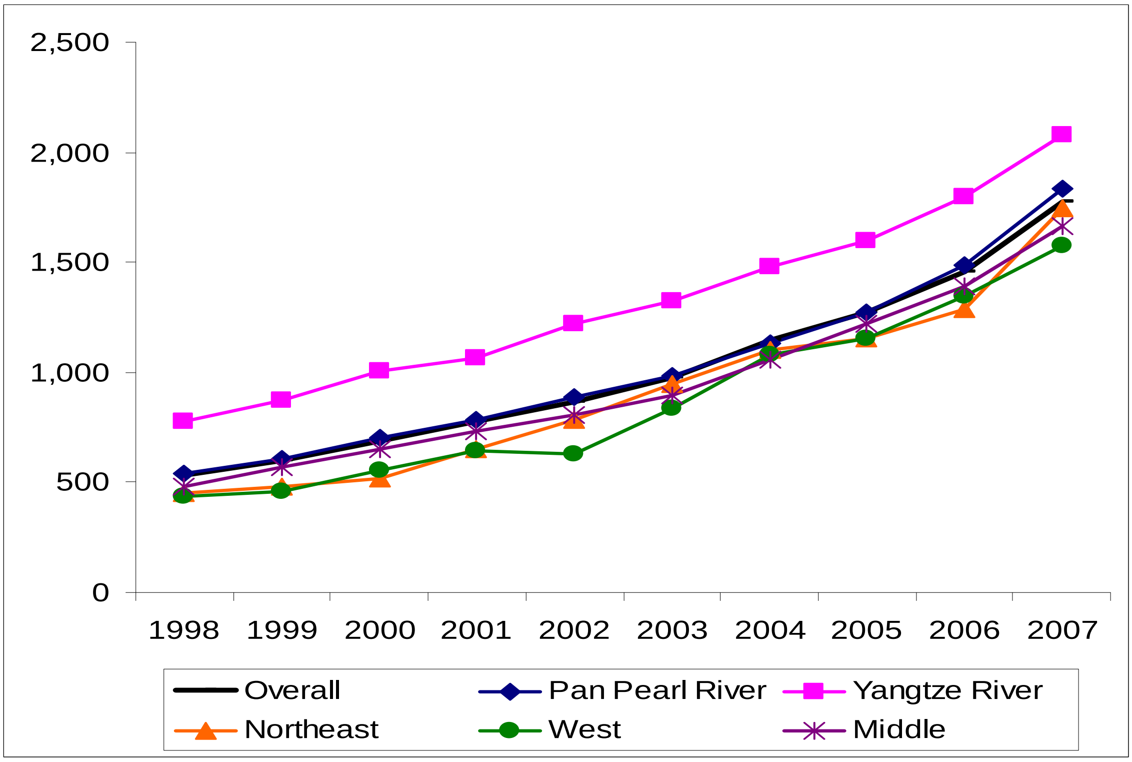


Figure 2.4 High-tech: Average monthly wages by regions, 1998-2007

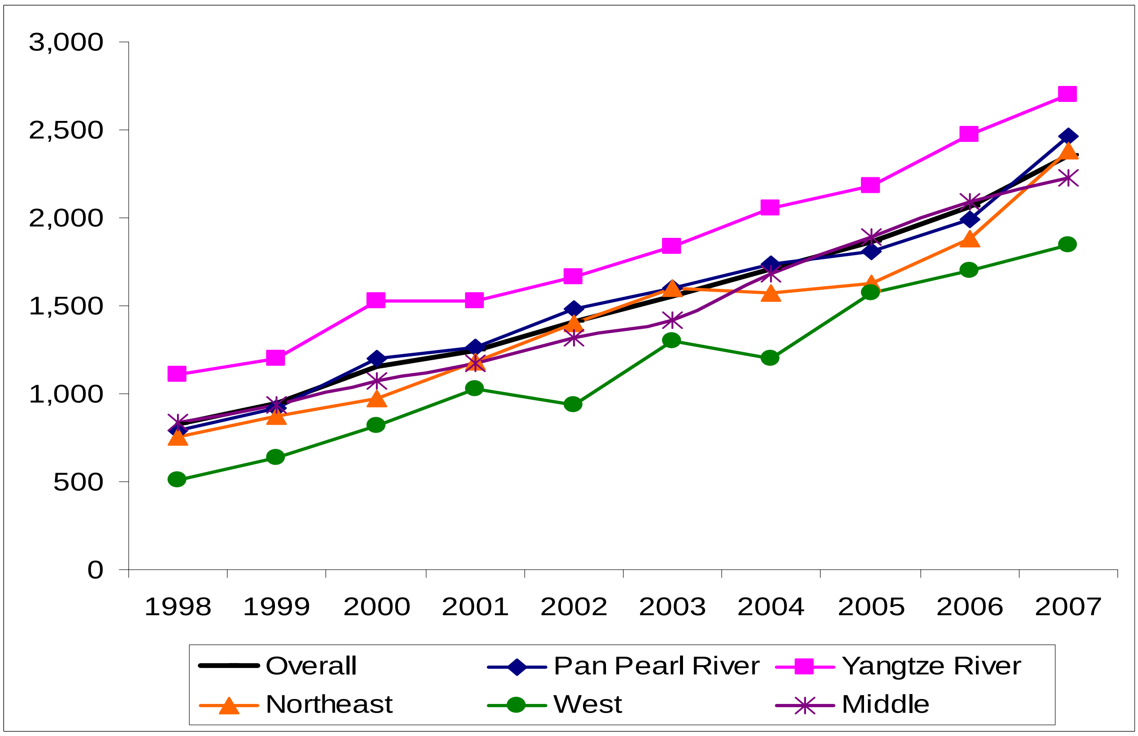


Figure 3 Export ratios (EXregion/EXtotal) by regions, 1998-2007

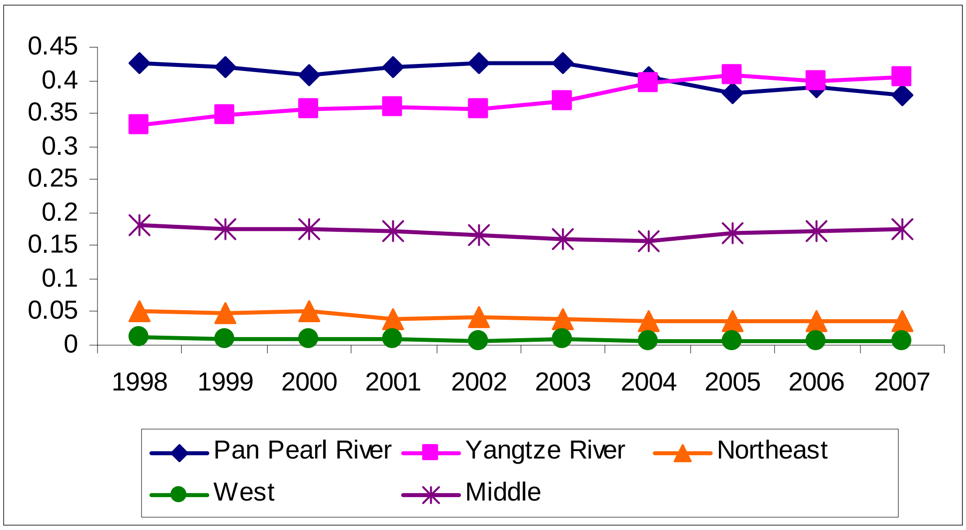


Figure 3.1 Low-tech: Export ratios by regions, 1998-2007

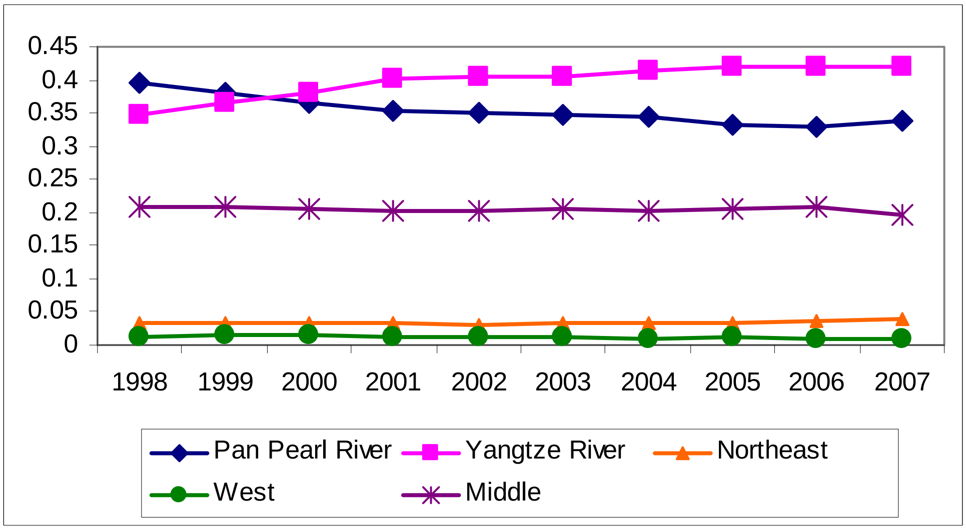


Figure 3.2 Med-low-tech: Export ratios by regions, 1998-2007

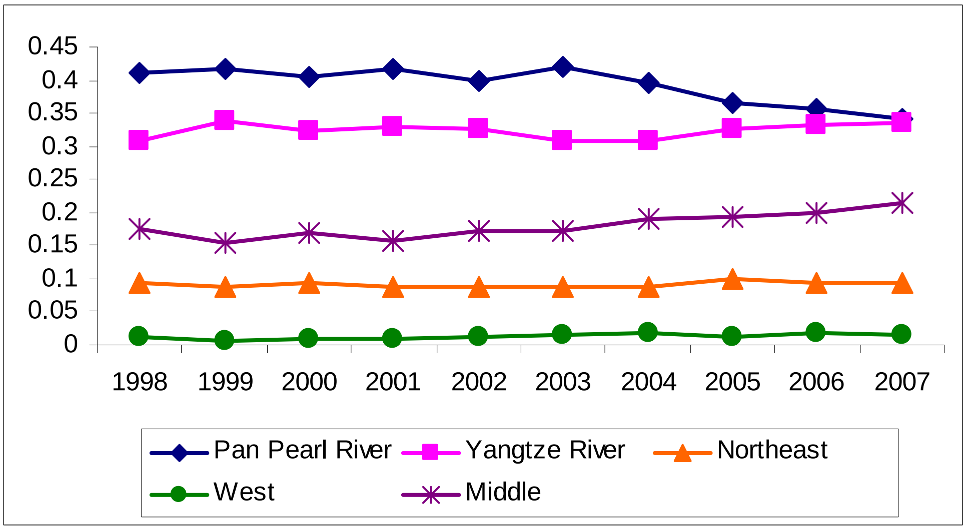


Figure 3.3 Med-high-tech: Export ratios by regions, 1998-2007

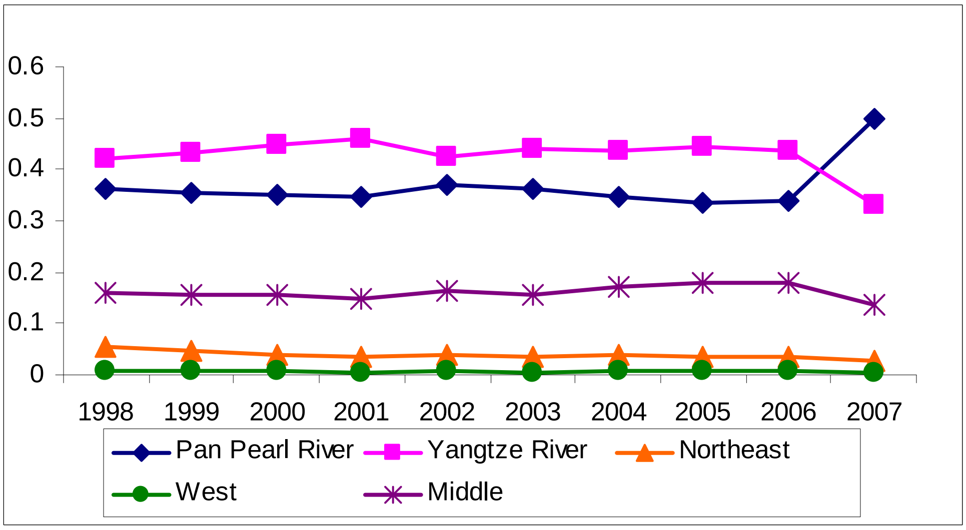
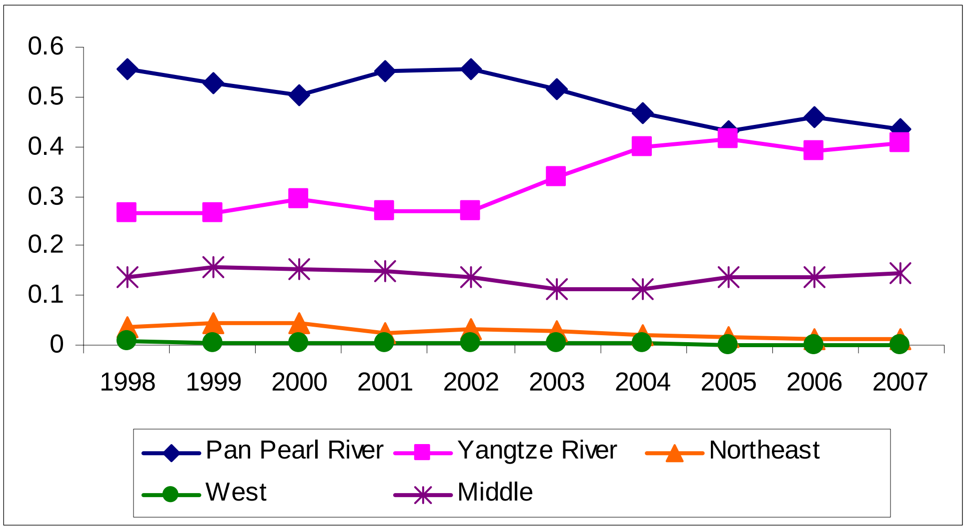


Figure 3.4 High-tech: Export ratios by regions, 1998-2007



REFERENCES

Arellano, M. and Bond, S. (1991), 'Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations', *The Review of Economic Studies*, 58(2), 277-297.

Arellano, M. and Bover, O. (1995), 'Another look at the instrumental variable estimation of error-components models', *Journal of Econometrics,* 68, 29-51.

Blundell, R. and Bond, S. (1998), 'Initial conditions and moment restrictions in dynamic panel data models', *Journal of Econometrics*, 87, 115-143.

Bhalotra, S. R. (2003), 'The impact of economic liberalization on employment and wages in India', Geneva: International Labour Office, Working Paper No. 12.

Bruno, G.S.F., Falzoni, A. M. and Helg, B. (2004), 'Measuring the effect of globalization on labour demand elasticity: An empirical application to OECD countries', Milano: CESPRI-Universita Bocconi, Working Papers 153.

Fajnzylber, P. and Maloney, W.F. (2005), 'Labor demand and trade reform in Latin America', *Journal of International Economics*, 66, 423-446.

Hamermesh, D.S. (1993), *Labour Demand,*Princeton University Press, New Jersey.

Hamermesh, D.S. and Pfann, G.A. (1996), 'Adjustment costs in factor demand', *Journal of Economic Literature*, 34(3), 1264-1292.

Haouas, I. and Yagoubi, M. (2008), 'Trade liberalization and labour demand elasticities: Evidence from Tunisia', *Applied Economics Letters*, 15(4), 277-286.

Haouas, I., Yagoubi, M. and Heshmati, A. (2003), 'Labour-use efficiency in Tunisian manufacturing industries', *Review of Middle East Economics and Finance*, 1(3), 195-215.

Haouas, I., Yagoubi, M. and Heshmati, A. (2005), 'Impacts of Trade Liberalization on Employment and Wages in Tunisian industries', *Journal of International Development*, 17(4), 527-551.

Konings, J. and Walsh, P.P. (2000), 'The impact of product market competition on employment determination in unionised and non-unionised firms: firm level evidence for the U.K., *Review of Industrial Organization*, 17, 385-394.

Milner, C. and Wright, P.W. (1998), 'Modelling labour market adjustment to trade liberalisation in and industrialising economy', *The Economic Journal*, 108(447), 509-528.

Mourre, G. (2006), 'Did the pattern of aggregate employment growth chance in the Euro area in the late 1990s?', *Applied Economics*, 38, 1783-1807.

Nickell, S. and Wadhwani, S. (1991), 'Employment determination in British industry: Investigations using micro-data', *The Review of Economic Studies,* 58(5), 955-969.

Organisation for Economic Co-operation and Development, Science, Technology and Industry Scoreboard (2001), 'Towards a Knowledge-Based Economy'.

Paul, C.J.M. and Siegel, D.S. (2001), 'The impacts of technology, trade and outsourcing on employment and labour composition', *Scandinavian Journal of Economics*, 103(2), 241-264.

Piva, M. and Vivarelli, M. (2005), 'Innovation and employment: Evidence from Italian Microdata', *Journal of Economics*, 86(1), 65-83.

Revenga, A. (1997), 'Employment and wage effects of trade liberalization: the case of Mexican manufacturing', *Journal of Labour Economics*, 15(3), S20-S43.

Slaughter, M. J. (2001), 'International trade and labour elasticities', *Journal of International Economics*, 54, 27-56.

van Reenen, J. (1997), 'Employment and technical innovation: Evidence from U.K. manufacturing firms', *Journal of Labour Economics*, 15(2), 255-284.

APPENDIX A1 Description of variables

Variables	Description
lnL	The log of the number of the Year-end employed persons
lnw	= log (real wages/year-end employed persons) Wages (in 1000 Yuan) is deflated
lnQ	The log of real value-added
X	The ratio of Exports to Output
T	Time trend
Y	Year dummies

APPENDIX A2 Chinese manufacturing industry codes

cni	Chinese manufacturing industry
Low-technology industries (low-tech)	
13	Processing of food products
14	Manufacture of food products
15	Manufacture of beverages
16	Processing of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel and other fibre products
19	Manufacture of leather, furs, down and related products
20	Processing of wood, manufacture of articles of bamboo, cane, palm fibre and straw
21	Manufacture of furniture
22	Manufacture of paper and paper products
23	Printing and reproduction recorded media
24	Manufacture of cultural, educational, and sports goods
Medium-low-technology industries (med-low-tech)	
25	Processing of petroleum and manufacture of coke
29	Manufacture of rubber products
30	Manufacture of plastics products
31	Manufacture of non-metallic mineral products
32	Casting and pressing of ferrous metal
33	Casting and pressing of nonferrous metal
34	Manufacture of metal products
376	Building ships and boats
378	Repairing transport equipment
Medium-high-technology industries (med-high-tech)	
26	Manufacture of chemical raw materials and chemical products
28	Manufacture of chemical fibre
35	Manufacture of general purpose machinery and equipment
36	Manufacture of special purpose machinery and equipment
37	Manufacture of transport equipment (excluding 376, 377, 378)
40	Manufacture of electrical machinery and apparatus
High-technology industries (high-tech)	
27	Manufacture of pharmaceuticals
377	Aircraft and spacecraft
41	Manufacture of electronic and communication equipment and apparatus
42	Manufacture of instrument and appliances, and culture and office machinery

Note OECD, STI Scoreboard 2001.

APPENDIX A3 Tables

Table A3.1. Low-tech sector: Exports and Labour Demand

	Pan Pearl	**Yangtze**	**Northeastern**	**Western**	**Middle (a)**
l.lnL	0.451 (0.085) ***	0.452 (0.085) ***	0.298 (0.096) ***	0.242 (0.074) ***	0.287 (0.105) ***
ln*w*	-0.485 (0.107) ***	-0.123 (0.115)	-0.271 (0.131) **	-0.223 (0.112) **	-0.366 (0.126) ***
ln*Q*	0.577 (0.077) ***	0.450 (0.092) ***	0.424 (0.091)***	0.486 (0.072) ***	0.419 (0.078) ***
X	-0.375 (0.261)	0.089 (0.324)	-0.014 (0.315)	-0.719 (0.255) ***	-0.131 (0.237)
Joint effects ofyears	F (7, 349) = 4.60 ***	F (7, 135) = 6.01 ***	F (7, 103) = 3.50 ***	F (7, 141) = 4.95 ***	F (7, 321) = 3.06 ***
***chi*2**	*chi*2(121) = 135.15	*chi*2(93) = 101.44	*Chi*2(91) = 91.98	*chi*2(93) = 91.94	*chi*2(46) = 54.99
***AR*(1)**	z = -5.42 ***	z = -4.15 ***	z = -3.39 ***	z = -3.43 ***	z =-3.72 ***
***AR*(2)**	z = 0.53	z = 0.59	z = 1.25	z = -0.48	z = 0.79
Observations	2451	1013	719	849	2299

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments, except (a) that use second and third lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table A3.2. Low-tech sector: Interactions between Exports and Wages and Labour Demand

	Pan Pearl	**Yangtze**	**Northeastern**	**Western**	**Middle (a)**
l.lnL	0.279 (0.092) ***	0.352 (0.071) ***	0.302 (0.099) ***	0.240 (0.065) ***	0.255 (0.104) **
Ln*w*	-0.620 (0.147) ***	-0.260 (0.157) *	-0.503 (0.257) *	-0.097 (0.171)	-0.363 (0.116) ***
ln*Q*	0.640 (0.067) ***	0.456 (0.083) ***	0.460 (0.086)***	0.444 (0.067) ***	0.387 (0.071) ***
X	-1.340 (0.383) ***	-0.730 (0.558)	0.316 (0.537)	-0.612 (0.280) **	-0.435 (0.357)
*lnw*X*	0.789 (0.263)	0.318 (0.179) *	-0.098 (0.244)	0.097 (0.172)	0.116 (0.227)
T	-0.148 (0.065) **	-0.047 (0.072)	-0.143 (0.092)	0.031 (0.082)	0.005 (0.063)
*lnw*T*	0.038 (0.016) ***	0.011 (0.019)	0.041 (0.027)	-0.011 (0.026)	-0.004 (0.016)
Joint effects of *lnw*	F (3, 349) = 6.98 ***	F (3, 135) = 1.32	F (3, 103) = 2.45 *	F (3, 141) = 1.50	F (3, 321) = 3.94 ***
Joint effects of *X*	F (2, 349) = 6.13 ***	F (2, 135) = 1.57	F (2, 103) = 0.24	F (2, 141) = 2.72 *	F (2, 321) = 1.11
Joint effects of *T*	F (2, 349) = 2.94 *	F (2, 135) = 0.23	F (2, 103) = 1.27	F (2, 141) = 0.09	F (2, 321) = 0.17
Joint effects of *T* and *years*	F (8, 349) = 7.83 ***	F (8, 135) = 5.35 ***	F (8, 103)= 3.30 ***	F (8, 141) = 4.71 ***	F (9, 321) = 4.09***
*chi*2	*chi2*(134) = 151.46	*chi*2(122) = 126.22	*Chi*2(89) = 91.01	*chi*2(120) = 124.68	*chi*2(68) = 75.81
AR(1)	z = -5.08 ***	z = -4.16***	z = -3.50 ***	z = -3.35 ***	z =-3.66 ***
AR(2)	z = 0.24	z = 0.54	z = 1.02	z = -0.59	z = 0.75
Observations	2451	1013	719	849	2299

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments, except (a) that use second and third lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

TableA3.3. Medium-low tech: Exports and Labour Demand

	Pan Pearl	**Yangtze**	**Northeastern**	**Western**	**Middle (a)**
l.lnL	0.564 (0.115) ***	0.191 (0.128)	0.356 (0.078) ***	0.139 (0.083) *	-
Ln*w*	-0.316 (0.150) **	-0.415 (0.111) ***	-0.452 (0.105) ***	-0.349 (0.135) ***	-0.374 (0.265)
ln*Q*	0.284 (0.106) ***	0.595 (0.046) ***	0.397 (0.138) ***	0.529 (0.067)***	0.390 (0.103) ***
X	-0.801 (0.404) **	0.563 (0.322) *	-0.399 (0.425)	1.086 (0.489) **	-0.073 (0.298)
Joint effects of *years*	F (7, 344) = 3.45 ***	F (7, 129) = 5.51 ***	F (7, 112) = 4.51 ***	F (7, 140) = 5.82 ***	F (8, 330) = 5.00 ***
*chi*2	*chi*2(93) = 109.29	*chi*2(93) = 96.24	*chi*2(93) = 95.50	*chi*2(93) = 94.02	*chi*2(33) = 29.8
AR(1)	Z = -3.81 ***	z = -2.53 **	z = -4.09***	z = -3.28 ***	z = -4.33 ***
AR(2)	Z = 1.41	z = 0.29	z = 0.08	z = 0.07	z = 1.01
Observations	2375	1023	766	863	2752

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments, except (a) that use second and third lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table A3.4. Medium-low-tech: Interactions between Exports and Wages and Labour Demand

	Yangtze	**Northeastern**	**Western**	**Middle (a)**
l.lnL	0.221 (0.095) **	0.182 (0.099) *	0.081 (0.063)	-
Ln*w*	-0.351 (0.197) *	-0.986 (0.199) ***	-0.317 (0.199)	-0.393 (0.246)
ln*Q*	0.585 (0.043) ***	0.463 (0.079)***	0.539 (0.065) ***	0.419 (0.072) ***
X	-0.360 (0.901)	0.731 (1.044)	0.052 (1.414)	-0.219 (0.803)
*lnw*X*	0.444 (0.374)	-0.395 (0.449)	0.365 (0.708)	0.291 (0.320)
T	0.041 (0.085)	-0.349 (0.115) ***	-0.120 (0.094)	-0.149 (0.070) **
*lnw*T*	-0.020 (0.023)	0.102 (0.029) ***	0.010 (0.029)	0.034 (0.019) *
Joint effects of *Lnw*	F (3, 129) = 4.26 ***	F (3, 112) = 9.63 ***	F (3, 140) = 2.10	F (3, 330) = 1.38
Joint effects of *X*	F (2, 129) = 2.95 *	F (2, 112) = 0.61	F (2, 140) = 1.47	F (2, 330) = 2.89 *
Joint effects of *T*	F (2, 129) = 1.03	F (2, 112) = 6.09 ***	F (2, 140) = 2.30	F (2, 330) = 2.30
Joint effects of *T* and *years*	F (8, 129) = 5.19 ***	F (8, 112)= 6.41 ***	F (8, 140) = 4.90 ***	F (9, 330) = 4.93***
*chi*2	*chi*2(122) = 126.22	*Chi*2(98) = 99.63	*chi*2(125) = 132.56	*chi*2(57) = 55.02
AR(1)	z = -4.16***	z = -3.09 ***	z = -3.59 ***	z =-5.12 ***
AR(2)	z = 0.54	z = -0.27	z = -0.34	z = 0.77
Observations	1023	766	863	2752

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments, except (a) that use second and third lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table A3.5. Medium-high tech: Exports and Labour Demand

	Pan Pearl	**Yangtze**	**Northeastern**	**Western**	**Middle**
l.lnL	0.589 (0.111) ***	0.321 (0.080) ***	0.217 (0.064) ***	0.198 (0.088) **	-
Ln*w*	-0.469 (0.177) ***	0.038 (0.234)	-0.052 (0.201)	-0.232 (0.150)	-0.341 (0.225)
ln*Q*	0.480 (0.114) ***	0.682 (0.093) ***	0.524 (0.087) ***	0.515 (0.103) ***	0.465 (0.094) ***
X	0.103 (0.480)	-1.304 (0.655) **	-1.261 (0.577) **	-0.422 (0.568)	0.180 (0.448)
Joint effects of *years*	F (7, 279) = 11.99 ***	F (7, 107) = 9.93 ***	F (7, 89) = 9.00 ***	F (7, 103) = 6.79 ***	F (8, 267) = 9.11 ***
*chi*2	*chi*2(93) = 100.41	*chi*2(93) = 103.99	*chi*2(78) = 74.03	*chi2*(87) = 90.73	*chi*2(33) = 31.32
AR(1)	z = -5.78 ***	z = -2.47 **	z = -2.81***	z = -3.94***	z = -3.48 ***
AR(2)	z = 1.52	z =-1.01	z = 1.21	z = -0.75	z =-0.36
Observations	1962	849	657	630	2292

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments, except (a) that use second and third lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table A3.6. Medium-high tech: Interactions between Exports and Wages and Labour Demand.

	Pan Pearl	**Yangtze**	**Northeastern**	**Western**	**Middle**
l.lnL	0.266 (0.117) **	0.312 (0.070) ***	0.120 (0.052) **	0.188 (0.078) **	-
Ln*w*	-0.739 (0.170) ***	0.011 (0.240)	-0.821 (0.246) ***	-0.354 (0.220)	-0.388 (0.158) **
ln*Q*	0.540 (0.085) ***	0.656 (0.077) ***	0.485 (0.081) ***	0.514 (0.101) ***	0.514 (0.104) ***
T	-0.011 (0.102)	0.040 (0.065) **	-0.421 (0.170) **	0.002 (0.144)	-0.109 (0.100)
X	-3.464 (1.127) ***	-2.344 (0.775) ***	-0.343 (1.863)	1.151 (1.613)	-0.573 (1.050)
ln*w**T*	0.025 (0.021)	-0.026 (0.016)	0.104 (0.037) ***	0.017 (0.045)	0.023 (0.021)
ln*w**X*	1.383 (0.433) ***	0.663 (0.298) **	0.585 (0.704)	-0.510 (0.666)	-0.137 (0.414)
Joint effects of Ln*w*	F (3, 279) = 7.93 ***	F (3, 107) = 2.35 *	F (3, 89) = 9.80 ***	F (3, 103) = 2.17 *	F (3, 267) = 2.13 *
Joint effects of *X*	F (2, 279) = 5.11 ***	F (2, 107) = 4.83 ***	F (2, 89) = 5.83 ***	F (2, 103) = 0.29	F (2, 267) = 1.14
Joint effects of *T*	F (2, 279) 5.41 ***	F (2, 107) = 2.62 *	F (2, 89) = 4.04 **	F (2, 103) = 0.56	F (2, 267) = 0.60
Joint effects of *T* and *years*	F (8, 279) = 11.66 ***	F (8, 107) = 11.68 ***	F (8, 89) = 10.62 ***	F (8, 103) = 5.14 ***	F (9, 267) = 6.18 ***
*chi*2	*chi*2(133) = 142.43	*chi*2(94) = 104.37	*chi*2(76) = 75.04	*chi2*(85) = 88.01	*chi2*(57) = 66.24
AR(1)	z = -4.92 ***	z = -3.13 ***	z = -2.53 ***	z = -3.92 ***	z = -4.18 ***
AR(2)	z = 0.57	z = -1.23	z = 0.59	z = -0.83	z = -0.51
Observations	1962	849	657	630	2292

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments, except (a) that use second and third lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table A3.7. High-tech: Exports and Labour Demand.

	Pan Pearl	**Yangtze**	**Northeastern**	**Western**	**Middle**
l.lnL	0.337 (0.078) ***	0.227 (0.102) **	0.086 (0.075)	0.280 (0.199)	0.104 (0.095)
Ln*w*	-0.614 (0.132) ***	-0.582 (0.103) ***	-0.112 (0.212)	-0.516 (0.204) **	-0.435 (0.172) **
ln*Q*	0.365 (0.079) ***	0.660 (0.072) ***	0.539 (0.080) ***	0.585 (0.122) ***	0.469 (0.102) ***
X	0.261 (0.359)	0.469 (0.296)	-0.566 (0.555)	0.802 (0.484)	0.348 (0.427)
Joint effects of *years*	F (7, 120) = 2.17 **	F (7, 58) = 1.79	F (7, 41) = 1.64	F (7, 35) = 0.93	F (7, 128) = 0.94 *
*chi*2	*chi*2(93) = 104.38	*chi*2(47) = 43.75	*chi*2(30) = 32.16	*chi*2(22) = 24.82	*chi*2(93) = 92.16
AR(1)	z = -3.79 ***	z = -2.57 ***	z = -2.57 ***	z = -2.33 **	z = -3.62 ***
AR(2)	z = 0.43	z = -0.95	z = -0.56	z = -1.23	z = 0.09
Observations	782	449	259	181	870

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.

Table A3.8. High-tech: Interactions between Exports and Wages and Labour Demand.

	Pan Pearl	**Yangtze**	**Northeastern**	**Western**	**Middle**
l.lnL	0.216 (0.068) ***	0.135 (0.071) *	0.078 (0.075)	0.273 (0.120) **	0.150 (0.088) *
Ln*w*	-0.599 (0.174) ***	-0.570 (0.124) ***	-0.020 (0.355)	-0.821 (0.270) ***	-0.437 (0.175) **
ln*Q*	0.414 (0.080) ***	0.700 (0.054) ***	0.504 (0.058) ***	0.611 (0.111) ***	0.472 (0.109) ***
T	0.101 (0.102)	0.132 (0.081)	-0.016 (0.118)	-0.384 (0.271)	-0.051 (0.077)
X	-2.017 (0.721) ***	-1.412 (0.883)	0.074 (1.204)	3.739 (4.650)	2.070 (1.072)
ln*w** *T*	-0.009 (0.026)	-0.028 (0.021)	0.005 (0.038)	0.067 (0.059)	0.020 (0.020)
ln*w***X*	0.767 (0.216) ***	0.577 (0.277) **	-0.196 (0.359)	-1.327 (1.861)	-0.553 (0.328)
Joint effects of Ln*w*	F (3, 120) = 8.18 ***	F (3, 58) = 11.94 ***	F (3, 41) = 0.11	F (3, 35) = 4.41 ***	F (3, 128) = 3.35 **
Joint effects of *X*	F (2, 120) = 6.67 ***	F (2, 58) = 3.62 **	F (2, 41) = 0.81	F (2, 35) = 0.54	F (2, 128) = 1.89
Joint effects of *T*	F (2, 120) 1.74	F (2, 58) = 1.39	F (2, 41) = 0.01	F (2, 35) = 1.60	F (2, 128) = 0.69
Joint effects of *T* and *years*	F (8, 120) = 1.37	F (8, 58) = 1.19	F (8, 41) = 1.87 *	F (8, 35) = 2.22 **	F (8, 128) = 0.95
*chi*2	*chi*2(106) = 115.67	*chi*2(45) = 36.21	*chi*2(28) = 31.37	*chi2*(20) = 19.65	*chi2*(115) = 117.43
AR(1)	z = -3.54 ***	z = -2.69 ***	z = -2.66 ***	z = -2.03 **	z = -3.80 ***
AR(2)	z = 0.49	z = -0.45	z = -0.46	z = 0.14	z = 0.05
Observations	782	449	259	181	870

Note GMM-SYS two-step estimator is presented; use third and further lags as instruments; time dummies are included as instruments in the level equation; robust standard errors are in parenthesis; * significant at 10% level, ** significant at 5% level, *** significant at 1% level.