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Technical Change, Exports, and Employment Growth in China: A Structural Decomposition Analysis*

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Abstract: *This paper analyses the sources of employment growth and assesses the contribution of exports to job creation in China. To do so, we utilise an input–output table to decompose employment growth into contributions from technical change, labour productivity, domestic final demand, and exports of domestically produced output. Our main data source is the annual input–output data from the China Industrial Productivity Database covering 1981–2010, of which employment figures have been adjusted to account for serious structural breaks observed in official statistics. The input–output framework allows us to explore both the direct impact of exports on employment within a given industry and the indirect impact through inter-industry transactions. Our major findings are fourfold. First, the increase in final demand, including both domestic demand and exports, is the main driver of employment growth in China. The strong growth in final demand offsets the decline in employment caused by enhanced labour productivity, especially during the 2000s. Second, the contribution of exports to job creation has increased significantly, especially in manufacturing and agriculture, following China's accession to the World Trade Organization. Third, labour productivity accelerated in all sectors, led by manufacturing. Last, most technical upgrading occurs in manufacturing, while agriculture experiences increased technical upgrading through the decline in labour usage.*

Keywords: Export, employment, input–output analysis, China
JEL Classification: F14, F16

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1. Introduction

One of the most significant events in global trade in the past few decades has been the spectacular rise of China (Feenstra and Sasahara, 2018). The ratio of exports to gross domestic product (GDP) skyrocketed from 4.6% in 1978 to a record high of 37.0% in 2006 (World Bank, 2018). Deep participation in the global value chain has won China the name of 'the world factory', with a high concentration in the labour-intensive production stages. Through vigorous economic integration, coupled with comprehensive domestic reform, China has lifted itself out of poverty and has become one of the largest economies in the world. In 2015, the country shared about 15% of global GDP. Per capita GDP also increased dramatically from $300 in 1978 to about $7,000 in 2017 (Hofman, 2018).

Employment is one of the various channels through which trade affects economic welfare (Lee, 2005). Based on the literature, this paper aims to shed light on the long-run nexus between employment and exports in China. We focus on the impact of export demand – together with domestic demand and technological change – on job creation by sector, using structural decomposition analysis. In particular, our study addresses three questions. First, to what extent do exports contribute to job creation in China? Second, how does this effect compare with the employment impact from other sources, namely domestic final demand and technical changes? Third, how does the export–employment linkage evolve across the years in response to reform policy in different sub-periods?

China's economic take-off has created the model for developing countries which seek to move to higher income status within a generation. However, the country's strong presence in the global market has also posed challenges to close trading partners. In their seminal work, Autor, Dorn, and Hanson (2013) found that rising Chinese imports result in higher unemployment, lower labour market participation, and lower wages. Similarly, Acemoglu et al. (2016) attributed the remarkable decline in United States (US) manufacturing employment to the swift rise of import competition from China. The mechanism works through both direct exposure of manufacturing industries and input–output linkages. Pierce and Schott (2016) linked the decline in US manufacturing employment to China's receipt of permanent normal trade relations status in 2001. Their study found that the designation of permanent normal trade relations had a significant impact on the sharp job loss because of the substitution effects between imports and labour usage, and the increased investment in labour-saving technologies of US firms.

From a policy perspective, serious concern regarding China's rise has provoked a backlash against free trade and, in the case of the US, resulted in strict defensive instruments. Facing the return of protectionism, the relevant questions for Chinese policymakers should then be to what extent China is dependent on foreign demand, whether reliance on international markets will be sustainable, and what the appropriate policy responses for China are to maintain high growth momentum amid the turbulence. Solving these questions is critical to assess the sustainability of the Chinese economy. By examining the drivers of employment growth over 3 decades, our study can inform policymakers about the pattern and important factors behind this growth.

To obtain our research goals, we employ the newly developed annual input–output data from the China Industrial Productivity (CIP) Database and decompose sources of employment growth into the contribution of labour requirement, technical change, and increase in final demand. Our main findings are as follows. First, the increase in final demand, including both domestic demand and exports, is the main driver of employment growth in China. The strong growth in final demand offsets the decline in employment caused by enhanced labour productivity, especially during the 2000s. Second, the contribution of exports to job creation has increased significantly, especially in manufacturing and agriculture, following China's accession to the World Trade Organization (WTO). Third, labour productivity accelerated in all sectors, led by manufacturing. Last, most technical upgrading occurs in manufacturing, while agriculture also experiences increased technical upgrading through the decline in labour usage.

The dataset, which covers 30 years of economic reforms in China, offers several advantages for our study. First, the long time span allows us to examine changes in the sources of employment during China's transformation from a centrally planned economy to a market economy. Although the literature on the 'China shock' focuses on the post-WTO period, China has followed steady steps to move up the development ladder since the early 1980s. Wu (2016) categorised China's reform into three sub-periods with distinct policy directions. During the first period (1981–1990), the reform focused on decentralisation of agriculture, coupled with more operational autonomy in the industrial sector. The second period (1991–2000) began with Deng Xiaoping's call for bolder and deeper reform towards a market-driven economy and the official adoption of the 'socialist market economy' in 1993. Various policies to attract foreign direct investment (FDI) had encouraged a new wave of investment in export-oriented manufacturing. Serious state-owned enterprise (SOE) reforms started and the development of private firms was nurtured. China's accession to the WTO in 2001 marked the beginning of the third wave of reform. Substantial tariff reductions enhanced the competitiveness of Chinese exports and generated competition pressure for domestic firms to improve their performance. Urbanisation accelerated thanks to the rapid expansion of megacities linking local and global markets and the relaxation of the strict migration restriction which prevents free flow of labour across provinces (Hukou system). Better resource allocation and strong SOEs are other key components of this phase. Different policy priorities across periods thus set different paces for the restructuring of employment at both the aggregate and sector levels. Accordingly, the importance of each driving force also varies.

Another advantage of our data is consistency. As Los, Timmer, and de Vries (2015) noted, it is notoriously difficult to construct consistent time-series data on output and employment in China. The availability of such annual data is an important condition for our analysis, since it makes it feasible to track and compare the evolution of employment. In addition, the decomposition framework – using input–output tables – provides us with a detailed picture of drivers of employment growth. The input–output framework also allows us to measure both the direct employment effect of exports within a given industry and the indirect effect through backward linkages. While other papers such as Kiyota (2016) and Los et al. (2015) focused on the employment generated from exports and domestic demand, we extend the analysis to technical change and labour productivity.

The rest of our paper is organised as follows. Section 2 provides a brief review of related literature, while methodology and data are presented in section 3. Section 4 presents our empirical results and discusses them, and section 5 concludes.

2. Literature Review

Our motivation comes from two strands of research. The first strand is the impact of trade on labour demand. Milner and Wright (1998) is an early attempt to investigate the relationship at the industry level. Employing dynamic panel techniques to estimate the labour demand function with trade-augmented variables, the study found that employment increases in response to trade openness in the case of Mauritius. Interestingly, employment in both the exportable and importable sectors expands following trade liberalisation. The authors argued that the increase in labour supply resulting from female participation in the labour market allows employment in importable sectors to maintain while exportable sectors grow. Employing the same analytical framework for China, Fu and Balasubramanyam (2005) found that exports made a positive contribution to employment growth by absorbing surplus labour and surplus production capacity, especially from firms in rural areas.

Greenaway, Hine, and Wright (1999) arrived at a contrasting result, where both imports and exports reduced employment in manufacturing in the United Kingdom. The authors suggest trade-induced improvement in labour efficiency as the reason. Similarly, Onaran (2008) did not detect a robust positive effect of trade on employment in a study on manufacturing in eight Central and Eastern European countries. In most cases, the impact is insignificant, with some evidence of negative effects. The only exception is highly skilled sectors in Romania and Lithuania, suggesting a skill-biased impact of international trade. Onaran (2008) cited international competitive pressure, which discourages firms from hiring more workers, as the reason behind this 'jobless growth'.

The second strand of research explores the relationship between trade and job creation, utilising input–output tables. Leclair (2002), for example, examined the effect of export composition on manufacturing employment in the US. The results demonstrate the differential in the impact of export composition on job growth. In particular, job creation resulting from a rise in exports from labour-intensive sectors such as textiles is four times larger than a similar increase in exports from capital-intensive sectors. The net impact of exports, then, depends on the sectoral share of exports. James and Fujita (2000) estimated the employment effects of exports in Indonesia during 1985–1990 and 1990–1995. They showed that the contribution of manufactured exports was the greatest contributor to employment growth in the former period, while services generated the largest gains in the latter. Another study on Indonesia by Aswicahyono et al. (2011), focusing on the period following the Asian financial crisis, established that slower growth of manufacturing exports after the crisis and a composition shift toward light manufacturing reduced the employment effect of exports. Similar to James and Fujita (2000), the paper found an increasing role of services. Kiyota (2012) addressed the issue in Japan. Contrary to the Indonesian case, the study showed a larger impact of exports on employment over the period. In addition, backward linkages contributed more to employment growth than direct effects.

In the case of China, several attempts have been made to measure the export–employment relationship. Feenstra and Hong (2010) found that the contribution of exports to employment rose during 1997–2005. However, growth induced by domestic demand accounted for the same amount as growth generated by exports. Employing the same data, Feenstra and Sasahara (2018) showed positive net labour demand in the US, generated through trade in both goods and services. In a cross-country analysis covering China, Japan, the Republic of Korea, and Indonesia from 1995 to 2009, Kiyota (2016) arrived at the same conclusion regarding the high dependency of employment on exports, though the trend declined in Indonesia. Los, Timmer, and Vries (2015) used the World Input–Output Database to examine the impact of foreign demand on Chinese employment from 1995 to 2009. Their study suggested that exports boosted demand for low-skilled workers, while the impact on highly skilled workers is limited. This is in line with the export composition of China, where routine tasks dominate.

At the micro-level, Ma, Qiao, and Xu (2015) was amongst the first attempts to examine the impact of trade liberalisation on the employment dynamics of Chinese manufacturing firms. Utilising firm-level data from 1998 to 2007, the authors found a positive change in net employment as the result of both job creation and job destruction through SOE reform and greater integration into the world market. More recently, Rodriguez-Lopez and Yu (2017) explored the employment dynamics of Chinese firms in response to changes in firm-level tariffs. The authors showed that productivity is one key factor behind firms' employment adjustments. In particular, low-productivity firms are likely to contract in size when facing tariff reductions in both input and output markets. High-productivity firms, on the contrary, experience job creation.

3. Methodology and Data

We follow James and Fujita (2000) and Kiyota (2012) to decompose growth in employment through various channels. We denote n the number of sectors in the economy. Sectoral output can be expressed as follows:

$$X = AX + F \quad (1)$$

where X and F are the $n \times 1$ vectors of output and final demand, respectively. A is the $n \times n$ input coefficient matrix. Let F^D, E, and M denote the $n \times 1$ vectors of domestic final demand, exports, and imports. The total final demand can then be written as

$$F = F^D + E - M \quad (2)$$

Substituting (2) into (1), we get

$$X = AX + F^D + E - M \quad (3)$$

Assuming that import is proportional to domestic final demand

$$m_i = \frac{M_i}{\sum_j (q_{ij} + F_{di})} \quad (4)$$

Then the output equation (3) can be rewritten as

$$X = AX + F^D + E - \widehat{M}(AX + F^D) \quad (5)$$

where $\widehat{M}$ is an $n \times n$ diagonal matrix with diagonal elements m_i. We denote I identity matrix of $n \times n$. The solution to equation (5) is

$$X = \{I - (I - \widehat{M})A\}^{-1}\{(1 - \widehat{M})F^D + E\} \quad (6)$$

For brevity, we denote $\Psi = \{I - (I - \widehat{M})A\}^{-1}$ as the Leontief inverse matrix, representing technical change.

The implied gross output can be further decomposed into output resulting from domestic demand and from exports, $X^D and\ X^E$, respectively.

$$X^D = \Psi(1 - \widehat{M})F^D X^E = \Psi E \quad (7)$$

$$X^E = \Psi E \quad (8)$$

We denote L $n \times 1$ employment vector with elements $l_j = L_j/X_j$. Let $\hat{L}$ be an $n \times n$ diagonal matrix with diagonal elements l_j, which is the labour requirement for a unit of output. The employment effects of movement in domestic final demand and exports are:

$$L = \hat{L}\Psi\left[\left(I - \bar{\bar{M}}\right)F^D + E\right] \tag{9}$$

To further decompose the growth of employment into improvement in technology and final demand (both domestic final demand and export), we use the structural decomposition analysis methods (Miller and Blair, 2009). For brevity, we rewrite equation (9) as

$$L = \hat{L}\,\Psi F \tag{10}$$

where F is the total demand and $F \equiv \left(I - \bar{\bar{M}}\right)F^D + E$

We have employment at time $t = 1$ and at $t = 0$ as follows:

$$L^1 = \hat{L}^1\,\Psi^1 F^1 \text{ and } L^0 = \hat{L}^0\Psi^0 F^0$$

The employment change from time $t = 0$ to time $t = 1$ will be:

$$L^1 - L^0 = \Delta L = \hat{L}^1\,\Psi^1 F^1 - \hat{L}^0\Psi^0 F^0 \tag{11}$$

By construction, the labour requirement for producing a unit of output at time $t = 1$ ($\hat{L}^1$), the Leontief technical coefficient matrix (Ψ^1), and the final demand (F^1) could be expressed as follows:

$$\hat{L}^1 = \hat{L}^0 + \Delta\hat{L}; \Psi^1 = \Psi^0 + \Delta\Psi\,; F^1 = F^0 + \Delta F$$

where $\Delta\hat{L}$ is changes in the labour requirement for producing a unit of output; $\Delta\Psi$ is the change in the Leontief technical matrix, and ΔF is the change in the final demand.

Using the structural decomposition analysis method, we can decompose the growth of L (ΔL) as follows:

$$\Delta L = \hat{L}^1\,\Psi^1 F - \hat{L}^0\Psi^0 F^0 = \hat{L}^1\,\Psi^1 F^1 - \left(\hat{L}^1 - \Delta L\right)\Psi^0 F^0 = \Delta\hat{L}\Psi^0 F^0 + \hat{L}^1(\Psi^1 F^1 - \Psi^0 F^0)$$

Continuing to replace $\Psi^0 = \Psi^1 - \Delta\Psi$ into the above question, then pluging $F^0 = F^1 - \Delta F$, we can have

$$\Delta L = \Delta\hat{L}\Psi^0 F^0 + \hat{L}^1 \Delta\Psi F^0 + \hat{L}^1 \Psi^1 \Delta F \quad (12)$$

Similarly, we express the change in employment as follows:

$$\Delta L = \hat{L}^1 \Psi^1 F^1 - \hat{L}^0 \Psi^0 F^0 = (\hat{L}^0 + \Delta\hat{L})\Psi^1 F^1 - \hat{L}^0 \Psi^0 F^0 = \Delta\hat{L}\Psi^1 F^1 + \hat{L}^0(\Psi^1 F^1 - \Psi^0 F^0)$$

After some continuing algebra (with $\Psi^1 = \Psi^0 + \Delta\Psi\,; F^1 = F^0 + \Delta F$), we can have

$$\Delta L = \Delta\hat{L}\Psi^1 F^1 + \hat{L}^0 \Delta\Psi F^1 + \hat{L}^0 \Psi^0 \Delta F \quad (13)$$

So, combining the two equations (12) and (13), we can have employment change ΔL as follows:

$$\Delta L = \frac{1}{2}\left[\Delta\hat{L}(\Psi^1 F^1 + \Psi^0 F^0)\right] + \frac{1}{2}\left[(\hat{L}^1 + \hat{L}^0)\Delta\Psi(F^1 + F^0)\right] + \frac{1}{2}\left[(\hat{L}^1\Psi^1 + \hat{L}^0\Psi^0)\Delta F\right] \quad (14)$$

Changes in employment are further decomposed into improvements in labour productivity (first component), changes in the Leontief technical coefficients (second component), and final demand change (third component). Of these, the first and second components could be viewed as the technology changes. The final demand change can be further decomposed into two components:

$$\frac{1}{2}\left[(\hat{L}^1\Psi^1 + \hat{L}^0\Psi^0)\Delta \mathrm{F}\right]$$

$$= \frac{1}{2}\left[(\hat{L}^1\Psi^1 + \hat{L}^0\Psi^0)\Delta F^D\right] - \frac{1}{2}\left[(\hat{L}^1\Psi^1 + \hat{L}^0\Psi^0)\Delta\widehat{M}F^D\right] + \frac{1}{2}\left[(\hat{L}^1\Psi^1 + \hat{L}^0\Psi^0)\Delta E\right] \quad (15)$$

The second component on the left-hand side is the substitution effect (between imported final goods and domestic final goods), while the third component represents the export effect.

Data

Data for this study come from the CIP database version 3.0. As a joint research effort between the Institute of Economic Research at Hitotsubashi University and the Research Institute of Economy, Trade and Industry, both in Japan, the project aims at constructing a consistent industry-level input and output data series. As such, the outcome of the project serves as a reliable source for academic research in a general production function framework. Constructed in line with the European Union and World KLEMS projects (Timmer, O'Mahony, and Van Ark, 2007), the data also provide a framework for international comparison of output and productivity.

The CIP database round 3.0 is an extension of previous rounds of data – CIP 1.0 released in 2011 and three other revisions for internal use only.[4] The data cover the entire Chinese economy at two-digit industry level, based on the Chinese System of National Accounts, from 1981 to 2010. Industrial classification conforms to the China Standard of Industrial Classification and is regrouped into 37 sectors following KLEMS classification (Timmer, O'Mahony, and Van Ark, 2007), 19 of which are manufacturing (see the Appendix for industry classification). Data include annual input–output tables constructed using the World Input–Output Database SUTRAS program (Temurshoev and Timmer, 2011); capital stock and investment, broken down by type of asset (equipment versus non-residential structures) and type of enterprise (industrial versus non-industrial); and labour input, measured as the number of employees and hours worked. For the analysis, we utilise information on outputs, intermediate inputs, employment, exports, and imports. We convert all value data to constant 1990 prices. Employment is defined as the number of employees.

The CIP database offers two advantages over existing input–output tables for China. First, the CIP covers a long period starting in 1981 when China had just begun economic reform. Thus, the database allows us to examine questions of interest in the long run, taking into consideration extraordinary structural transformation as well as various benchmarks in Chinese economic development. Second, for employment, the CIP has made important adjustments for the serious structural break observed in the official data, 'presenting a huge gap (80 to 100 million) between the population census-recorded employment and annual estimates since 1990 and allocates the additional employment to industries' (Wu, 2012:3). In addition, industrial employment is also reconstructed based on detailed statistics from reports and censuses. These adjustments result in a more consistent and reliable dataset for employment-related studies.

[4] For more details, see Wu (2012; 2016).

4. Empirical Results

Employment Growth by Sector

Table 1 illustrates employment growth in China over the 30-year period by broad sectors – agriculture, mining, manufacturing, utility and construction, and services. Two features stand out from the table. First, employment in absolute values grew significantly during the period, from 500 million in 1981 to almost 785 million workers in 2010, equivalent to a 56.6% increase. However, the speed of growth declines. When we break down the whole period into three sub-samples covering 10 years each, employment growth decreases from 27.2% in 1981–1990 to only 9.2% in 2000–2010. These figures are equivalent to a drop in the annual employment growth rate from 2.71% to 1.56%.

Second, there is sectoral heterogeneity in terms of employment growth. In particular, services and utility and construction experienced fast growth throughout the period, while manufacturing exhibited negative growth in the 1990–2000 sub-period. Moreover, employment in agriculture declines significantly. The share of agricultural employment dropped from 58% to only 31%, while the share of services workers escalated from 16% to nearly 40%. The manufacturing share remains constant at about 20%, however. These figures demonstrate the massive scale of structural transformation in the Chinese economy. Interestingly, we do not observe changes in the employment share of the labour- and capital-intensive manufacturing sectors. One possible reason is that the industry classification does not take into account the concept of global value chains, where China specialises in labour-intensive tasks within capital-intensive sectors.

The aggregate decline in employment growth and the heterogeneous sectoral patterns reflect the demographic transition following the one-child policy, first adopted in 1979, and economic development resulting from comprehensive reform towards a more market-oriented economy. SOE restructuring and the development of the private sector, institutional arrangements for land use rights, and opening up the economy are amongst key instruments for the reform.

Table 1: Employment Growth in China

Sector	Employment (number of people engaged, '000)			
	1981	1990	2000	2010
Agriculture	291,165	328,885	328,550	249,888
Mining	13,738	18,276	13,267	13,091
Manufacturing	101,476	122,017	109,562	148,087
Labour-intensive	*43,234*	*49,220*	*43,717*	*58,643*
Capital-intensive	*58,243*	*72,797*	*65,799*	*89,434*
Utility and construction	12,126	29,775	48,764	64,985
Services	82,395	138,121	218,460	308,514
Whole economy	500,900	637,075	718,602	784,565
	Employment growth (%)			
	1981–1990	**1990–2000**	**2000–2010**	**1981–2010**
Agriculture	13.0	–0.1	–23.9	–14.2
Mining	33.0	–27.4	–1.3	–4.7
Manufacturing	20.2	–10.2	35.2	45.9
Labour-intensive	*13.8*	*–11.2*	*34.1*	*35.6*
Capital-intensive	*25.0*	*–9.6*	*35.9*	*53.6*
Utility and construction	145.6	63.8	33.3	435.9
Services	67.6	58.2	41.2	274.4
Whole economy	27.2	12.8	9.2	56.6
	Annualised growth rate (%)			
	1981–1990	**1990–2000**	**2000–2010**	**1981–2010**
Agriculture	1.36	–0.01	–2.70	–0.53
Mining	3.22	–3.15	–0.13	–0.17
Manufacturing	2.07	–1.07	3.06	1.31
Labour-intensive	1.45	–1.18	2.98	1.06
Capital-intensive	2.51	–1.01	3.12	1.49
Utility and construction	10.50	5.06	2.91	5.96
Services	5.91	4.69	3.51	4.66
Whole economy	2.71	1.21	0.88	1.56

Note: Industry classification, including the labour- and capital-intensive sectors, is presented in the Appendix.
Source: Authors' calculation based on Research Institute of Economy, Trade and Industry (RIETI), CIP database 2015. https://www.rieti.go.jp/en/database/CIP2015/index.html (accessed 20 February 2017).

In the initial phase of transition, 1981–1990, employment expanded rapidly thanks to sweeping changes in rural policies, including land tenure. Two notable policy reforms during this period are the introduction of the household responsibility system and the establishment of township and village enterprises (TVEs). The household responsibility system, aiming at de-collectivising agricultural activities, provides incentives for production by giving farmers freedom of land use rights and, unlike the previous production team model, creates a close link between performance and compensation

(Lin, 1987). Consequently, agriculture underwent a major revival. At the same time, the surplus labour in agriculture could either find opportunities in TVEs in rural areas or move to urban areas because of the gradual relaxation of the Hukou system. The number of workers in TVEs, for example, increased dramatically from about 25 million in 1980 to 100 million in 1990 (Majid, 2015). As a result, overall employment grew at a high rate of 27.2% throughout the period.

Turning to employment structure, agriculture still accounted for more than 50% of total employment, thus absorbing a significant proportion of workers in rural areas. It is worth noting the impressive climb in employment in construction and services. Despite being small in absolute numbers, the utility and construction sector witnessed a 145.6% rise in employment. Services also surpassed manufacturing to become the second-largest sector in terms of employment, accounting for up to 20% in 1990. The spectacular leap of the tertiary sector corresponded to the development of special economic zones (SEZs) in 1980, followed by the opening of 14 coastal cities for foreign investment in 1984 (Zeng, 2011). The initial wave of FDI flew in, mostly from Taiwan and Hong Kong. Apart from generating industrial work directly, SEZs created service jobs indirectly through the formation of a large labour pool. In addition, rural–urban migration began to increase with the development of new cities, driving further demand for services and construction.

The second phase of economic reform started in the early 1990s, with the fundamental restructuring of SOEs. With the approval of the Company Law in 1993 and the Competition Law in 1994, the government established a regulatory framework for the multi-ownership enterprise sector and kept SOEs under close supervision (Mattlin, 2007). Under the ‘grasping the large, letting go of the small’ policy (Horfman, 2018), large-scale redundancies occurred because of the abolishment of medium-sized and small SOEs. Even for the remaining large SOEs, job dismissals happened as enterprises began to cut redundancies to improve productivity (Hu, 2004). As a result, traditional sectors where SOEs still dominated – mining and manufacturing – witnessed a slide in employment demand. By 2000, manufacturing accounted for only 15% of total employment.

On the contrary, the tertiary sector was able to maintain its growth momentum thanks to the extraordinary structural shift away from agriculture and the increasing flow of rural–urban migration. Rural employment continued to decline, accounting for 66% of total employment in 2000 compared with 75% in 1990 (Majid, 2015). The annual employment growth rate of services and construction were 5.0% and 4.7%, respectively. By 2000, services contributed one third of total employment.

WTO membership in 2001 opened the third phase of reform when the transition to a market economy was basically completed. The surge in FDI and trade presents ample opportunities for China's vast labour resources. With its low labour cost and improved business environment, China became the top destination for labour-intensive manufacturing FDI. After a decade of slashing employment, manufacturing employment revived, growing at 35.2% from 2000 to 2010.

The globalisation of production has greatly accelerated the pace of urbanisation. The formation of megacities linking local and global markets, accompanied by an increasing urban wage premium, continued to attract a massive flow of rural workers. To accommodate investment and housing demand, the central government also revised the land use policy. The Land Administration Law of 1998 encouraged the transfer of land use rights. Users of state-owned land would follow the paid use system, thus reducing the ratio of allocated land and improving usage efficiency. The total supply of construction land increased by about 10% annually during this period (Liu, 2018). The urbanisation rate also increased from 35% in 2000 to nearly 50% in 2010 (World Bank, 2018). Demand for services and construction workers grew, while agriculture employment plummeted. By 2010, services and construction accounted for 45% of total employment, while agriculture's share dropped to only 30%.

In addition to globalisation and vigorous land reform, strong SOEs are another important characteristic of this period. SOE restructuring continued and SOE competitiveness improved. Despite their decreasing number, SOEs still contributed a non-trivial fraction of aggregate output. In the industrial sector, for example, the ratio of SOEs collapsed to about 4% of the total number of firms in 2010, down from 30% in 2000. However, the output contribution, albeit declining, still accounted for 25% of total output (National Bureau of Statistics of China, various years). The parallel upward movement of both SOEs' productivity and output fostered job creation.

Sources of Employment Growth

Table 2 presents the contribution of exports through both direct and indirect channels to employment. The major findings are twofold. First, we observe an overall increasing dependency of employment on exports. This pattern is particularly strong in manufacturing, where up to 41% of employment, equivalent to 60 million jobs, was generated from exports in 2010. Second, Table 2 also suggests the growing role of exports in capital-intensive manufacturing and services to job creation. Even during the 1990–2000 period when aggregate employment declined, the contribution of these two sectors remains positive at 9.4% and 9.6%, respectively. Again, while the observation for the capital-intensive sector may seem counter-intuitive, China's participation in the low value-added stages of production networks in those sectors may be the answer.

Table 2: Contribution of Exports to Employment (%)

Panel A	**1981**	**1990**	**2000**	**2010**
Agriculture	10.2	11.4	11.0	20.0
Mining	14.1	17.0	22.7	28.0
Manufacturing	15.2	24.5	32.2	41.0
Labour-intensive	*21.0*	*33.2*	*34.0*	*43.0*
Capital-intensive	*11.0*	*18.6*	*31.1*	*40.0*
Utility and construction	1.3	2.5	2.2	2.0
Services	8.3	13.2	14.5	16.0
Whole economy	10.8	14.0	14.9	21.0
Panel B	**1981–1990**	**1990–2000**	**2000–2010**	**1981–2010**
Agriculture	2.6	–0.4	4.2	7.0
Mining	8.4	–0.5	4.7	12.3
Manufacturing	14.2	4.4	23.2	44.6
Labour-intensive	*16.8*	*–3.0*	*23.4*	*37.1*
Capital-intensive	*12.3*	*9.4*	*23.1*	*50.2*
Utility and construction	4.8	1.1	1.0	11.5
Services	13.8	9.6	8.4	52.2
Whole economy	7.0	2.8	8.2	22.3

Notes:

1. Industry classification, including the labour- and capital-intensive sectors, is presented in the Appendix.
2. Statistics in panel A are computed as the ratio of implied employment from exports (L_E) over total employment (L).
3. Statistics in panel B are $\Delta L_E/L$.

Source: Authors' calculation based on Research Institute of Economy, Trade and Industry (RIETI), CIP database 2015. https://www.rieti.go.jp/en/database/CIP2015/index.html (accessed 20 February 2017).

Table 3 reports the sources of employment growth in China. The major findings are as follows. First, the increase in final demand is the most important engine of employment growth throughout the period, of which the contribution of foreign demand increases in most sectors. Normalising the total final demand to 100%, in relative terms the domestic final demand contributes to about 70% of job creation derived from total demand, while exports account for the remaining 30%. Domestically, the huge population base, later accompanied by accelerated urbanisation and improved living standards, could be the driving factors for the final demand. Internationally, China's deeper integration into the global market through the WTO has paved the way for export expansion.

At the aggregate level, this proportion is relatively stable over time. However, a further breakdown by sector reveals a more heterogeneous picture. Not surprisingly, the importance of exports is most notable in manufacturing, China's key export sector. The contribution of overall manufacturing exports expands steadily from 34% to 47%. More impressively, the exports of capital-intensive manufacturing accounted for 47.9% of total demand-induced job creation at the end of the period. This figure was only 28.4% in 1981–1990. Agriculture exports also account for a significant share of agriculture employment, climbing from 16.9% to 33.8% in the corresponding period. The contribution of agriculture exports rose dramatically following China's accession to the WTO, when China became one of the world's largest exporters of agricultural products. The pattern for services does not show remarkable changes, which may be attributable to limited exports in services. Utility and construction remain largely intact.

Table 3: Sources of Employment Growth in China (%)

Sector	Employment Growth (1)	Labour requirement (2)	Technical upgrading (3)	Increase in Demand (4)	Domestic final demand (5)	Export (6)
			1981–1990			
Agriculture	13.0	–36.0	–7.0	55.0	46.0 (83)	9.4 (17)
Mining	33.0	–60.0	–4.0	97.0	80.0 (82)	16.9 (18)
Manufacturing	20.0	–177.0	49.0	148.0	97.6 (66)	50.7 (33)
Labour-intensive	*13.8*	*–87.9*	*–6.0*	*107.7*	*56.9 (53)*	*50.8 (47)*
Capital-intensive	*25.0*	*–242.5*	*89.1*	*178.4*	*127.7 (72)*	*50.7 (28)*
Utility and construction	145.6	49.2	2.5	93.9	89.1 (95)	4.7 (5)
Services	67.6	–1.7	–5.5	74.8	55.5 (74)	19.3 (26)
Whole economy	27.2	–54.6	3.4	78.3	59.4 (76)	18.9 (24)
			1990–2000			
Agriculture	–0.1	–66.0	–17.7	83.6	67.0 (80)	16.5 (20)
Mining	–27.4	–147.4	9.8	110.2	68.8 (62)	41.4 (38)
Manufacturing	–10.2	–196.0	39.6	146.2	83.1 (57)	63.1 (43)
Labour-intensive	*–11.2*	*–162.2*	*37.9*	*113.1*	*66.9 (59)*	*46.2 (41)*
Capital-intensive	*–9.6*	*–218.8*	*40.8*	*168.4*	*94.0 (56)*	*74.4 (44)*
Utility and construction	63.8	–71.6	3.5	131.8	128.3(97)	3.5 (3)
Services	58.2	–67.9	–1.7	127.7	96.8 (76)	30.9 (24)
Whole economy	12.8	–83.4	1.4	94.8	68.8 (73)	26.1 (27)
			2000–2010			
Agriculture	–23.9	–50.7	–27.2	54.0	35.8 (66)	18.2 (34)
Mining	–1.3	–152.3	–32.1	183.1	122.3 (67)	60.8 (33)
Manufacturing	35.2	–166.8	15.4	186.6	98.1 (53)	88.4 (47)
Labour-intensive	*34.1*	*–136.7*	*26.2*	*144.6*	*77.8 (54)*	*66.8 (46)*
Capital-intensive	*35.9*	*–186.8*	*8.2*	*214.4*	*111.7 (52)*	*102.8 (48)*
Utility and construction	33.3	–144.7	–3.1	181.1	175.4 (97)	5.6 (3)
Services	41.2	–62.5	–11.2	114.9	86.6 (75)	28.4 (25)
Whole economy	9.2	–79.8	–14.2	103.1	71.4 (69)	31.8 (31)

Notes:

1. Industry classification, including the labour- and capital-intensive sectors, is presented in the Appendix.
2. The labour requirement is computed as employment/output ($l_j = L_j/X_j$). The decrease in the labour requirement implies productivity improvement.
3. Technical upgrading is measured by changes in Leontief coefficients, defined as $\Psi = \{I - (I - \hat{M})A\}^{-1}$.
4. The increase in final demand F includes two subcomponents: domestic final demand F^D and exports E.
5. The number in parentheses represents the relative contribution of employment generated from domestic final demand and exports to total final demand. (1)=(2) + (3) + (4); (4)=(5) + (6).
6. Detailed figures at two-digit industry classification are available upon request.

Source: Authors' calculation based on Research Institute of Economy, Trade and Industry (RIETI), CIP database 2015. https://www.rieti.go.jp/en/database/CIP2015/index.html (accessed 20 February 2017).

Second, the contribution of technical upgrading is the largest in manufacturing. The ratio, however, fluctuates between the labour-intensive and capital-intensive sectors. In the early years of the reform, technical upgrading in capital-intensive sectors accounted for a 89.1 percentage point rise in the number of jobs, while that in labour-intensive sectors shows a decline of 6 percentage points. During the second sub-period from 1990 to 2000, the contribution of technical upgrading in the two sub-sectors is comparable at about 40 percentage points. From 2000 onward, the ratio of employment induced by technical upgrading in labour-intensive sectors is three times larger than that in capital-intensive industries. In addition, the contribution of technical upgrading in manufacturing declined significantly from 49% in the 1980s to 15% in the 2000s. It is possible that technology adoption before the WTO period is more complementary to labour, as firms continued to exploit the excess labour supply. On the contrary, technology applied in the post-WTO period, particularly when China surpassed its Lewis turning point around 2004–2005 (Zhang, Yang, and Wang, 2011; Liu, 2015), tends to be more labour-saving in response to the increasing wage rate.

Third, labour productivity accelerated in all sectors, reducing the labour requirement. The labour requirement shrank significantly, contributing to a decline of about 80 percentage points in employment growth in the latter periods compared with 54 percentage points during 1981–1990. Amongst the sectors, manufacturing productivity exhibits the fastest growth. The strong growth of labour productivity resulted in negative employment growth in the 1990–2000 period. However, after 2000, the drastic productivity enhancement was offset by the huge increase in final demand, thus the overall employment growth rebounded.

These findings together suggest the increasing importance of exports to job creation in China, particularly in agriculture and manufacturing. However, as domestic final demand has also expanded quickly, pressure on foreign dependency can be relaxed. Although the agricultural share in employment has declined substantially, the sector still plays an important role in job creation. Therefore, aside from manufacturing, the expansion of agricultural exports should be taken into account for an inclusive growth strategy.

5. Conclusion

This paper analyses the sources of employment growth and the contribution of exports to job creation in China. To do so, we utilise the consistent annual CIP Database 3.0 covering the 1981–2010 period. Our major findings are fourfold. First, the increase in final demand, including both domestic demand and exports, is the main driver of employment growth in China. The strong growth in final demand offsets the negative impact of enhanced labour productivity on employment, especially during the 2000s. Second, the contribution of exports to job creation has increased significantly, especially in manufacturing and agriculture, following China's accession to the WTO. Third, labour productivity accelerated in all sectors, led by manufacturing. Last, most technical upgrading occurs in manufacturing, while agriculture also experiences an increasing role of technical upgrading through the decline in labour usage.

Our study provides further evidence to support the positive role of exports in economic growth. While exports in manufacturing could possibly generate more jobs with higher income, agricultural exports also make an important contribution to job creation and could be more inclusive. On the one hand, export expansion should still be encouraged. However, it is worth noting that the advantage of low labour costs has gradually eroded. Increasing wage rates, in turn, are a disincentive for FDI investment in labour-intensive sectors. In addition, unfavourable external conditions, including the economic downturn and growing anti-globalisation sentiment, imply the need to reduce reliance on foreign demand. For China, domestic final demand is large and remains the dominant source of employment growth. Therefore, boosting domestic demand further would help mitigate the negative impact of external shocks.

Our study has some limitations. First, because of lack of data, instead of separating intermediate imports and final goods imports from total imports, we rely on a rather strong assumption that the share of imports is equal for final goods and intermediate goods. Second, there are several sources of changes in the Leontief technical coefficients, including the improvement in the production process, and the substitution between (lower quality) domestic input and (higher quality) imported inputs. However, because of lack of data, we cannot clearly distinguish the effects of each source. Third, China's exports are characterised by two types of trade: processing trade and normal trade. However, data limitations did not allow us to distinguish the contribution of processing trade from that of normal trade on employment growth. Fourth, using the input–output table also has some limitations. For example, we also have to assume that the production technique for exports and for final demand are the same (this may be not the case for developing countries, where exports are usually of a higher standard than domestic products and services). Another issue is that the structural decomposition analysis method, as well as other methods using the input–output table, is ex-post analysis. We cannot capture the interaction effects of prices and quantities in our calculation. Such limitations call for further studies on the role of international trade (both imports and exports) on employment growth in China.

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Appendix: Sector and Industry Codes in CIP

CIP Code	CIP sector description	Our code	Factor intensity
1	Agriculture, forestry, animal husbandry, and fishery	Agriculture sector	
2	Coal mining	Mining sector	
3	Oil and gas excavation	Mining sector	
4	Metal mining	Mining sector	
5	Non-metallic minerals mining	Mining sector	
6	Food and kindred products	Manufacturing sector	Labour-intensive
7	Tobacco products	Manufacturing sector	Labour-intensive
8	Textile mill products	Manufacturing sector	Labour-intensive
9	Apparel and other textile products	Manufacturing sector	Labour-intensive
10	Leather and leather products	Manufacturing sector	Labour-intensive
11	Saw mill products, furniture, fixtures	Manufacturing sector	Labour-intensive
12	Paper products, printing, and publishing	Manufacturing sector	Labour-intensive
13	Petroleum and coal products	Manufacturing sector	Capital-intensive
14	Chemicals and allied products	Manufacturing sector	Capital-intensive
15	Rubber and plastics products	Manufacturing sector	Capital-intensive
16	Stone, clay, and glass products	Manufacturing sector	Capital-intensive
17	Primary and fabricated metal industries	Manufacturing sector	Capital-intensive
18	Metal products (excluding rolling products)	Manufacturing sector	Capital-intensive
19	Industrial machinery and equipment	Manufacturing sector	Capital-intensive
20	Electric equipment	Manufacturing sector	Capital-intensive
21	Electronic and telecommunication equipment	Manufacturing sector	Capital-intensive
22	Instruments and office equipment	Manufacturing sector	Capital-intensive
23	Motor vehicles and other transportation equipment	Manufacturing sector	Capital-intensive
24	Miscellaneous manufacturing industries	Manufacturing sector	Capital-intensive
25	Power, steam, gas, and tap water supply	Utility and construction sector	
26	Construction	Utility and construction sector	

27	Wholesale and retail trades	Service sector
28	Hotels and restaurants	Service sector
29	Transport, storage, and post services	Service sector
30	Information and computer services	Service sector
31	Financial intermediations	Service sector
32	Real estate services	Service sector
33	Leasing, technical, science, and business services	Service sector
34	Government, public administration, and political and social organisations, etc.	Service sector
35	Education	Service sector
36	Healthcare and social security services	Service sector
37	Cultural, sports, entertainment services; residential and other services	Service sector

CIP = China Industrial Productivity.
Note: Industries are classified into labour- and capital-intensive industries following Organisation for Economic Co-operation and Development (2002).
Source: Research Institute of Economy, Trade and Industry (RIETI), CIP database 2015. https://www.rieti.go.jp/en/database/CIP2015/index.html (accessed 20 February 2017).

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