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# China's Industrial Structure and its Changes in Recent Years: An Analysis of the 1997–2005 Input-Output Tables\*

Hitoshi Sasaki<sup>†</sup> and Satoko Ueyama<sup>‡</sup>

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## Abstract

This paper investigates the features and recent changes of China's industrial structure using input-output tables for different periods from 1997 to 2005. We find that the domestic production inducement coefficients of China's material and machinery industries have declined while the import coefficients of these industries have risen. This indicates that China has strengthened its position as “the factory of the world”, in which it imports parts and materials, processes or assembles them, and then ships the final products. It also indicates that China's resource-securing activities have increasingly intensified because of the increasing demand for resources and energy associated with its high economic growth. We then calculate the degree of China's income dependence on foreign demand, which shows a dramatic rise, especially after 2002, shortly after China joined the WTO and embarked on liberalizing a wide range of markets including those of both goods and services. Lastly, it is shown that the labor input inducement coefficient for the agriculture sector is by far the largest and that the rates of labor input inducement differ significantly by industry depending on whether they are labor intensive or not. Labor input inducement coefficients have also been on the decline in most of the industries reflecting the improvement of labor productivity. Behind this trend is the migration of rural workers to urban areas and increased capital equipment especially in the manufacturing sector.

*Keywords:* input-output table, production inducement coefficient, degree of income dependence, labor input inducement coefficient

*JEL Classification Number:* C67, O53

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## 1. INTRODUCTION

China has been playing an increasingly important role in the global economy. It is now the third largest economy in the world and is second only to Germany in the annual value of exports. Not only is the manufacturing sector of the Chinese economy playing a critical role as “the factory of the world,” but China has also gained significance in the global economy as a rapidly growing and highly promising consumer market. As such, in assessing the global economic situation, there is a strong need for a better understanding of the structure and development of the Chinese economy.

In this regard, the input-output table (IO table hereafter) is extremely useful and informative; it provides systematic descriptions of the input-output structures between industries and enables quantitative analysis of industry structure, interindustry relationships and their development. The opportunities for IO table analysis have improved with relatively recent data now available; the latest 2005 IO table was published in September 2008. Although possible changes to the IO relationships during the years after 2005 should be considered, the 2005 IO table can still provide valuable insights into the nature and magnitude of recent changes in China’s industry structure.

The contribution of this paper is that we investigate the features and recent changes to China’s industry structure, interindustry relationships, degree of income dependence of different industries and labor input inducement coefficients using China’s IO tables, including the latest 2005 table. To examine these issues, we (1) construct industry-level deflators following the procedure of Hu (2003) and (2) estimate the number of employees in each industry in the IO table. The former enables intertemporal comparisons of production inducement coefficients in real terms instead of nominal terms while the latter allows us to measure labor input inducement coefficients.

The remainder of the paper is organized as follows. In Section 2, we discuss China’s industry structure and its changes over time using the IO tables. In Section 3, we examine the changes in the degree of interdependence between China’s domestic industries. Specifically, as is widely done in standard IO analysis, the production inducement coefficients are derived from the IO tables for different periods and analyzed. In Section 4, we investigate the degrees of income dependence of each industry. In Section 5, labor input inducement coefficients, calculated on our estimate of the number of employees in each industry, are presented. Finally, Section 6 presents our conclusions.

## 2. AN OVERVIEW OF CHINA'S INDUSTRY STRUCTURE

We first examine China's industry structure and its recent changes using IO tables<sup>1</sup>. By simply looking at each industry's share of the total output and the number of employees, we can identify the following three prominent characteristics of China's economic structure.

First, the strikingly high relative size of secondary industry should be noted. As can be seen in Table 1, they account for more than 60 percent of total output. Widely known as the Petty–Clark Law, the industrial structure of a country, in general, depends on its level of per capita income, as shown in Table 2; as the per capita income of country increases from the low- to middle-income level, the relative size of primary industry tends to decline while that of secondary industry expands; furthermore, as per capita income rises to the high-income level, tertiary industry accounts for a large part of total industry<sup>2</sup>. In this respect, the table shows that the relative size of secondary industry in China is even higher than in other countries with similar per capita income levels.

Second, as can be seen in Table 1, China's industry structure has recently been experiencing considerable change. Specifically, the relative size of tertiary industry has been on the rise while that of primary industry has been on the decline.

Third, the number of employees in the agriculture industry accounts for more than 40 percent of the country's labor force and this industry remains by far the largest employer; this is in stark contrast with its share of total output, which was below 10 percent in 2005.

In the next section, we use the IO tables to estimate production inducement coefficients and analyze the degree of interdependence between industries.

## 3. PRODUCTION INDUCEMENT ANALYSIS

This section investigates interdependence among China's different industries by analyzing production inducement coefficients derived from the IO tables. After explaining the concept and derivation of the production inducement coefficients in Section 3.1, we present the result of the analysis in Section 3.2.

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<sup>1</sup> China's IO tables in different years are not comparable in the strict sense; the first census occurred in China in 2004, and the concepts, definitions and coverage of each industrial sector in the IO tables were not chronologically adjusted for the purpose of intertemporal comparison.

<sup>2</sup> Strictly speaking, the data in Table 1 and Table 2 are not comparable because the former represents the shares of total output while the latter shows those of GDP, or value-added. However, both the current characteristics and the nature of the changes in China's industry structure described in this section based on Table 1 can also be observed in the composition of GDP.

### 3.1. The Production Inducement Coefficient Analysis

The production inducement coefficient for a certain industry is defined as the amount of domestic production induced by an additional unit of final demand for the industry. Intuitively, the concept can be understood as follows. When the final demand for an industry increases, it not only induces production in that particular industry but also requires increased production in a wider range of industries, which provide intermediate products/services to the industry. These industries in turn require increased intermediate inputs from themselves and other industries, which results in further production inducement. Taking into account the infinite repetition of such inducement rounds, the production inducement coefficient represents the sum of the total amount of induced production. As such, the coefficient indicates the degree of interdependence between industries through trade of intermediate products/services. Mathematically, the coefficient can be derived as follows.

Let us denote the number of industries in the IO table as  $n$ . On the supply side, we define an  $(n \times 1)$  vector of the total outputs of industries in the IO table as  $x$ , and an  $(n \times n)$  matrix of intermediate inputs as  $Z$ , respectively.

On the demand side, we define an  $(n \times 1)$  vector of the final demands of industries as  $f$ . Because the final demand of an industry equals the sum of domestic final demand (i.e., the sum of consumption and investment) and exports less imports of the industry, we define three  $(n \times 1)$  vectors of the final demand components as  $f^d$ ,  $ex$ , and  $im$ , respectively. It then follows that:

$$f = f^d + ex - im. \quad (1)$$

The IO matrix presents data for each element of the vectors and matrix defined above so that the demand and the supply are balanced. With an  $(n \times 1)$  vector  $\tau$  defined as a vector in which each element is unity, the following equation holds for the IO table:

$$x = Z\tau + f$$

$$\Leftrightarrow \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1n} \\ z_{21} & z_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ z_{n1} & \cdots & \cdots & z_{nn} \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix} + \begin{bmatrix} f_1 \\ f_2 \\ \vdots \\ f_n \end{bmatrix}. \quad (2)$$

Substituting equation (1) for  $f$  in equation (2), we derive:

$$x + im = Z\tau + f^d + ex$$

$$\Leftrightarrow \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} + \begin{bmatrix} im_1 \\ im_2 \\ \vdots \\ im_n \end{bmatrix} = \begin{bmatrix} z_{11} & z_{12} & \cdots & z_{1n} \\ z_{21} & z_{22} & & \vdots \\ \vdots & & \ddots & \vdots \\ z_{n1} & \cdots & \cdots & z_{nn} \end{bmatrix} \begin{bmatrix} 1 \\ 1 \\ \vdots \\ 1 \end{bmatrix} + \begin{bmatrix} f_1^d \\ f_2^d \\ \vdots \\ f_n^d \end{bmatrix} + \begin{bmatrix} ex_1 \\ ex_2 \\ \vdots \\ ex_n \end{bmatrix}. \quad (3)$$

To analyze how a change in the final demand affects the amounts of inputs and outputs of an economy, we assume that there is a fixed and linear relationship between inputs and outputs. Let  $A$  be the following  $(n \times n)$  matrix:

$$A = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ a_{n1} & \cdots & \cdots & a_{nn} \end{bmatrix},$$

where input coefficient  $a_{ij}$  is defined as  $a_{ij} \equiv \frac{z_{ij}}{x_j}$  for  $i, j = 1, \dots, n$ .

Then,  $Z\tau = Ax$  holds, and equation (3) can be rewritten as:

$$x + im = Ax + f^d + ex$$

$$\Leftrightarrow \begin{bmatrix} x_1 + im_1 \\ x_2 + im_2 \\ \vdots \\ x_n + im_n \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ a_{n1} & \cdots & \cdots & a_{nn} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} + \begin{bmatrix} f_1^d \\ f_2^d \\ \vdots \\ f_n^d \end{bmatrix} + \begin{bmatrix} ex_1 \\ ex_2 \\ \vdots \\ ex_n \end{bmatrix} = \begin{bmatrix} a_{11}x_1 + a_{12}x_2 + \cdots + a_{1n}x_n + f_1^d + ex_1 \\ a_{21}x_1 + \cdots + a_{2n}x_n + f_2^d + ex_2 \\ \vdots \\ a_{n1}x_1 + \cdots + a_{nn}x_n + f_n^d + ex_n \end{bmatrix}. \quad (4)$$

In IO analysis, there are several different assumptions we could make regarding imports, depending on the role imports play in the economy. For some countries, it might be the case that most of the imports are final goods and they all directly fill the final demand. In other countries, some of the imports are used as intermediate inputs for domestic production while the rest directly fill the final demand. For China, the latter would clearly be a more appropriate description of the reality given the fact that it imports a large amount of natural resources and that it is known for its processing trade. It should be noted that in such cases, production inducement effects on domestic industries are smaller than in the case where all the intermediate inputs are produced domestically, because the required intermediate inputs are partly supplied by imports.

Let us define  $m_i$ , the import coefficient of industry  $i$  as the ratio of imports of the industry to the sum of total domestic demand:

$$m_i = \frac{im_i}{(a_{i1}x_1 + a_{i2}x_2 + \cdots + a_{in}x_n + f_i^d)}.$$

It should be noted that the denominator excludes exports; this is because of the assumption that imported goods or services posted in the IO matrix are not exported

directly to foreign countries without being processed in domestic industries. Let us assume that within an industry, the proportion filled by imports is exactly the same for both the intermediate and the final demand and that the ratio of the  $i$ th industry's demand met by imports equals  $m_i$ . Using this notation, the right-hand side of equation (4) can be divided into two parts, i.e., one supplied by domestic industries and the other supplied by imports:

$$\Leftrightarrow x_i + im_i = a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n + f_i^d + ex_i \quad (4)$$

$$\begin{aligned} \Leftrightarrow x_i + im_i &= (1-m_i)(a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n) + (1-m_i)f_i^d + ex_i \\ &\quad + m_i(a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n) + m_i f_i^d. \end{aligned} \quad (5)$$

The first half of the right-hand side of equation (5),  $(1-m_i)(a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n) + (1-m_i)f_i^d + ex_i$ , corresponds to the amount supplied by domestic industries, and the latter,  $m_i(a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n) + m_i f_i^d$ , represents the amount supplied by imports. From the definition of  $m_i$ , we obtain:

$$im_i = m_i(a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n + f_i^d).$$

Subtracting each side of this equation from each side of equation (5) yields:

$$x_i = (1-m_i)(a_{i1}x_1 + a_{i2}x_2 + \dots + a_{in}x_n) + (1-m_i)f_i^d + ex_i. \quad (6)$$

Let us define an  $(n \times n)$  diagonal matrix that has  $m_i$  as its  $i$ th diagonal element:

$$\hat{M} = \begin{bmatrix} m_1 & 0 & \dots & 0 \\ 0 & m_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \dots & 0 & m_n \end{bmatrix}.$$

Using this matrix, equation (6) can be rewritten as:

$$\begin{aligned} x &= (I - \hat{M})Ax + (I - \hat{M})f^d + ex \\ \Leftrightarrow x &= (I - (I - \hat{M})A)^{-1}(I - \hat{M})f^d + (I - (I - \hat{M})A)^{-1}ex. \end{aligned} \quad (7)$$

Hence, the  $ij$  element of the matrix  $(I - (I - \hat{M})A)^{-1}(I - \hat{M})$  shows the amount of production induced in industry  $i$  because of a unit increase in the domestic final demand for industry  $j$ . Furthermore, the sum of the  $j$ th column of the matrix represents the amount of production induced in all the industries because of a unit increase in the domestic final demand for industry  $j$ . As such, the matrix  $(I - (I - \hat{M})A)^{-1}(I - \hat{M})$  can be regarded as the production inducement coefficient for domestic demands when use

of imports as intermediate inputs is considered. The values of the production inducement coefficients reported in this paper are calculated based on this formula<sup>3</sup>.

It is worthwhile to reiterate here some important assumptions and characteristics of the production inducement analysis. First, it is a *static*, not a *dynamic*, analysis. It shows the amount of change in equilibrium production in each industry induced by an increase in final demand of a certain industry; it does not take into account the effects that take place over time caused by economic behaviors such as capital formation. Second, we also need to mention that the assumptions on production technology are strong in the analysis. Each industry cannot adjust the composition of intermediate inputs in response to the changes in relative prices; that is, the elasticity of substitution for intermediate inputs is assumed to be zero. In addition, constant returns to scale are assumed in the analysis<sup>4</sup>.

### 3.2. Changes in the Degree of Interdependence in China's Domestic Industries

Figure 1 shows the production inducement coefficients for China's different industries in chronological order for 1997, 2000, 2002, and 2005. All the coefficients in the figure are calculated at 2000 prices. Because the IO tables are only published at current prices from China's statistics agency, we construct deflators for the respective industries following Hu (2003). Details of the deflator construction are provided in Appendix A.

Figure 2 shows the import coefficients. The import coefficient of an industry is defined as the ratio of the import value of the industry over the sum of domestic intermediate and final demand. It should be noted that a rise in the import coefficient means that a larger portion of the domestic demand is met with imports instead of domestic production and thus leads to a decline in the production inducement coefficient for the domestic demand.

Figures 1 and 2 present some notable changes in the way China's domestic industries interact with each other. First, in sectors such as the chemical industry and the machinery and equipment industry, we can observe a fall in the production inducement coefficients along with a rise in the import coefficients. This indicates that these industries are increasingly relying on imports for supply of parts and other intermediate goods. Behind the trend is the fact that there has been the dramatic development of a global production network centered in East Asia since the late 1990s. It is in this context

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<sup>3</sup> Likewise, the  $j$  th column of the matrix  $(I - (I - \hat{M})A)^{-1}$  represents the effect of a unit increase in the external demand for industry  $j$ . The value of the production inducement coefficient for external demands for industry  $j$ , though not reported explicitly in this paper, can be easily obtained by multiplying the  $j$  th industry's production inducement coefficient for domestic demands by  $1/(1 - m_j)$ .

<sup>4</sup> In IO analysis, the input-output ratios, i.e., the ratio of intermediate (or labor) inputs to total outputs, in respective industries are assumed to be constant irrespective of the amount of production.



that China has established its position as “the factory of the world,” which imports parts and materials, processes or assembles them, and then ships the final products to the ultimate destination<sup>5</sup>.

Regarding the above interpretation, there has been a view that the ratio of onshore procurement or self-manufacturing in China’s manufacturing sectors has been on the rise in recent years and that interdependence between China’s domestic manufacturing industries has strengthened despite globalization<sup>6</sup>. However, the results obtained in the analysis suggest quite the contrary; the degree of dependence on domestic industries in sourcing intermediate inputs has been falling, at least up until 2005.

Second, the production inducement coefficients of the coking, gas and petroleum refining industry and the mining and quarrying industry have increased dramatically. It should be noted that for these industries, the import coefficients have also been rising. This can be considered the result of the rapid increase in China’s demand for energy and resources in recent years.

A closer examination of the changes in the production inducement coefficient reveals that the final demand in the coking, gas and petroleum refining industry in 2005 induces more production in other industries than in 1997; especially in the mining and quarrying industry, the transportation, postal and communication services industry, the production and supply of electric power, heat power and water industry, the machinery and equipment industry, and the metal products industry (Figure 3-1). This indicates heightened intensity in China’s resource securing activities; the figure suggests that China now requires intermediate inputs such as mining and exploration equipment, energies necessary with which to move such equipment, and transportation services in a significantly larger amount than it did before to gain the same amount of coke, refined gas, and petroleum products.

In this context, China is clearly more energy consuming compared with other countries. According to the IEA statistics, China’s total primary energy supply<sup>7</sup> per unit of GDP is as high as nine times that of Japan and more than four times that of the US (Figure 3-2). Although it goes beyond the scope of our analysis, it is likely that China would need to improve its energy efficiency to achieve high yet sustainable growth in the

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<sup>5</sup> The results obtained in the analysis are also consistent with those in Mori and Sasaki (2007), which investigates recent interdependencies between Asia-Pacific economies by using the Asian International Input-Output Table.

<sup>6</sup> During the first half of the 2000s, it was widely observed that a number of major automotive and electrical parts suppliers in developed countries found their way into China’s coastal areas such as Shanghai or Guangzhou, building up supply chains so that automotive and electrical companies operating in China could procure their intermediate inputs within the regions.

<sup>7</sup> Total primary energy is made up of indigenous production + imports – exports – international marine bunker +(-) stock changes. For details, see IEA (2008) “Key World Energy Statistics 2006.”

future. In fact, China's government has set a goal of reducing energy consumption per unit of GDP by 20 percent in its 11<sup>th</sup> five-year plan ending in 2010.

#### 4. DEGREES OF INCOME DEPENDENCE

In this section, we consider to what extent China's income depends on domestic and foreign demand. In Section 4.1, we introduce the measure of the degree of income dependence and explain in detail how it is calculated. Section 4.2 discusses the characteristics and the recent changes in the degree of China's income dependence on foreign demand.

##### 4.1. *The Degrees of Income Dependence on Domestic and Foreign Demand*

Within the framework of the IO table, a country's income, or equivalently its value-added, equals the total production of the country less the amount of intermediate inputs. Therefore, to determine the degree of income dependence on the domestic and the foreign demand for a certain industry, we only have to calculate the ratio of produced goods or services that ultimately fill the domestic final demand or the foreign demand. To represent this ratio, the specific measure we use here is the degree of income dependence; this takes into account not only the ratio of the domestic and the foreign demand within the final demand, but also what proportion of production used as intermediate inputs ultimately fills the domestic and the foreign demand. The degree of income dependence on the domestic or the foreign demand can be derived as follows.

Let  $v_i$  denote the value-added ratio of industry  $i$ . An industry's income equals the value-added of the industry,  $v_i x_i$ . We define an  $(n \times n)$  diagonal matrix  $V$ , which has  $v_i$  as the  $i$ th diagonal element:

$$V = \begin{bmatrix} v_1 & 0 & \cdots & 0 \\ 0 & v_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & v_n \end{bmatrix}.$$

The value-added of industries can be derived by multiplying both sides of equation (7) by  $V$ :

$$Vx = V(I - (I - \hat{M})A)^{-1}(I - \hat{M})f^d + V(I - (I - \hat{M})A)^{-1}ex. \quad (8)$$

The first term,  $V(I - (I - \hat{M})A)^{-1}(I - \hat{M})f^d$ , shows the income of industries earned through production induced by the domestic demand while the second term,  $V(I - (I - \hat{M})A)^{-1}ex$ , represents the industries' income earned through production

induced by the foreign demand. Showing the elements of the matrices more explicitly, we can rewrite equation (8) as follows:

$$\begin{aligned}
(8) \Leftrightarrow & \begin{bmatrix} v_1 & 0 & \cdots & 0 \\ 0 & v_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & v_n \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} v_1 & 0 & \cdots & 0 \\ 0 & v_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & v_n \end{bmatrix} \begin{bmatrix} b'_{11} & b'_{12} & \cdots & b'_{1n} \\ b'_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ b'_{n1} & \cdots & \cdots & b'_{nn} \end{bmatrix} \begin{bmatrix} f_1^d \\ f_2^d \\ \vdots \\ f_n^d \end{bmatrix} \\
& + \begin{bmatrix} v_1 & 0 & \cdots & 0 \\ 0 & v_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & v_n \end{bmatrix} \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ b_{n1} & \cdots & \cdots & b_{nn} \end{bmatrix} \begin{bmatrix} ex_1 \\ ex_2 \\ \vdots \\ ex_n \end{bmatrix} \\
\Leftrightarrow & \begin{bmatrix} v_1 x_1 \\ v_2 x_2 \\ \vdots \\ v_n x_n \end{bmatrix} = \begin{bmatrix} v_1 b'_{11} f_1^d + v_1 b'_{12} f_2^d + \cdots + v_1 b'_{1n} f_n^d \\ v_2 b'_{21} f_1^d + \cdots & \cdots & + v_2 b'_{2n} f_n^d \\ \vdots & & \vdots \\ v_n b'_{n1} f_1^d + \cdots & \cdots & + v_n b'_{nn} f_n^d \end{bmatrix} + \begin{bmatrix} v_1 b_{11} ex_1 + v_1 b_{12} ex_2 + \cdots + v_1 b_{1n} ex_n \\ v_2 b_{21} ex_1 + \cdots & \cdots & + v_2 b_{2n} ex_n \\ \vdots & & \vdots \\ v_n b_{n1} ex_1 + \cdots & \cdots & + v_n b_{nn} ex_n \end{bmatrix}, \\
\text{where } B' = & \begin{bmatrix} b'_{11} & b'_{12} & \cdots & b'_{1n} \\ b'_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ b'_{n1} & \cdots & \cdots & b'_{nn} \end{bmatrix} = (I - (I - \hat{M})A)^{-1} (I - \hat{M}), \text{ and} \\
B = & \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & \ddots & & \vdots \\ \vdots & & \ddots & \vdots \\ b_{n1} & \cdots & \cdots & b_{nn} \end{bmatrix} = (I - (I - \hat{M})A)^{-1}, \text{ respectively.}
\end{aligned}$$

Hence, the degree of income dependence on the domestic demand for industry  $i$  can be calculated as:

$$\frac{v_i b'_{i1} f_1^d + v_i b'_{i2} f_2^d + \cdots + v_i b'_{in} f_n^d}{v_i x_i} = \frac{b'_{i1} f_1^d + b'_{i2} f_2^d + \cdots + b'_{in} f_n^d}{x_i},$$

while that on the foreign demand is:

$$\frac{v_i b_{i1} ex_1 + v_i b_{i2} ex_2 + \cdots + v_i b_{in} ex_n}{v_i x_i} = \frac{b_{i1} ex_1 + b_{i2} ex_2 + \cdots + b_{in} ex_n}{x_i}.$$

Note that an industry's degree of income dependence on either the domestic or the foreign demand does not depend on its value-added ratio.

Meanwhile, the degree of income dependence on the domestic and the foreign demand for the whole economy can be calculated as:

$$\frac{\sum_{i=1}^n (v_i b'_{i1} f_1^d + v_i b'_{i2} f_2^d + \dots + v_i b'_{in} f_n^d)}{\sum_{i=1}^n v_i x_i} \text{ and } \frac{\sum_{i=1}^n (v_i b_{i1} ex_1 + v_i b_{i2} ex_2 + \dots + v_i b_{in} ex_n)}{\sum_{i=1}^n v_i x_i}, \text{ respectively.}$$

Unlike the degrees of dependence on either the domestic or the foreign demand for a certain industry, these figures depend on the relative magnitudes of the value-added ratios of different industries.

#### 4.2. *Characteristics and Recent Changes in the Degree of China's Income Dependence on Foreign Demand*

Table 3 presents the calculated degrees of China's income dependence on the foreign demand for different industries in 1997, 2000, 2002, and 2005. There are important results that should be noted.

First, Table 3 shows that the degrees of income dependence on foreign demand are particularly high in (1) light industries such as the textile, sewing, leather and furs products industry and other manufacturing industries including toys and miscellaneous products, and (2) the material and machinery industries such as the metal product, the chemical, and the machinery and equipment industries. It is not surprising that they are the industries in which China has a comparative advantage.

Second, the degree of income dependence on foreign demand as a whole has been on increasing steadily since 1997 with a period of especially rapid growth since 2002. A closer look also reveals that the degrees of income dependence on foreign demand rose in most of the industries during the period. Behind this acceleration is China's entry into the WTO, after which China began to liberalize a wide range of markets including those of both goods and services.

Third, after the steady rise in the past, China's degree of income dependence on foreign demand in 2005 (28%) is much higher than the figure at the time of the Asian financial crisis in 1997 (19%) by as much as nine percentage points. In addition, as major developed economies have been falling into recession, the magnitude of the negative shocks that the global economy has been experiencing in the current economic downturn is also larger than those during the Asian financial crisis. Therefore, the influence of falling external demand on the Chinese economy at the present time should be considered to be the most serious China has ever experienced.

Whether the Chinese government is able to achieve its target growth rate of eight percent this year, when faced with such a severe decline in exports and the bleak outlook for the external demand, attracts global attention. The key to this question, obviously, is

the effectiveness of the economic stimulus package worth RMB 4 trillion, which is to be implemented over the two years ending 2010<sup>8</sup>.

## 5. LABOR INPUT INDUCEMENT ANALYSIS

This section presents an analysis of the labor input inducement coefficients. After a brief explanation and mathematical derivation of the labor input inducement coefficient in Section 5.1, the results of the analysis are presented in Section 5.2.

### 5.1. Labor Input Inducement Coefficient

The labor input inducement coefficient is defined as the number of employees ultimately induced by an additional unit of final demand. As well as the production inducement coefficient in Section 3, the labor input inducement coefficient is calculated as the total number of employees required to meet both the additional final demand and the infinite rounds of intermediate demand indirectly induced. The labor input inducement coefficient analysis shares the same set of assumptions of the production inducement analysis. Mathematically, the coefficient can be derived as follows.

In addition to the elements introduced so far, we consider another element required for production, labor input. Let us denote labor input for the  $i$ th industry as  $l_i$ , and an  $(n \times 1)$  vector of  $l_i$  as  $l$ :

$$l = \begin{bmatrix} l_1 \\ l_2 \\ \vdots \\ l_n \end{bmatrix}.$$

We define the labor input coefficient for the  $i$ th industry,  $\bar{l}_i$  as the ratio of the labor input to the total output of the industry, i.e.,  $\bar{l}_i = \frac{l_i}{x_i}$ . Let us also define an  $(n \times n)$  diagonal matrix  $\hat{L}$ , of which the  $i$ th diagonal element equals  $\bar{l}_i$ :

$$\hat{L} = \begin{bmatrix} \bar{l}_1 & 0 & \cdots & 0 \\ 0 & \bar{l}_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & \bar{l}_n \end{bmatrix}.$$

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<sup>8</sup> What offers a glimmer of hope is that at the time of the Asian financial crisis China did succeed in sustaining a relatively high growth rate following the government's stimulus policies including construction of infrastructure and support for rural agricultural areas.

$$\text{Because } \hat{L}x = \begin{bmatrix} \bar{l}_1 & 0 & \cdots & 0 \\ 0 & \bar{l}_2 & & \vdots \\ \vdots & & \ddots & 0 \\ 0 & \cdots & 0 & \bar{l}_n \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_n \end{bmatrix} = \begin{bmatrix} \bar{l}_1 x_1 \\ \bar{l}_2 x_2 \\ \vdots \\ \bar{l}_n x_n \end{bmatrix} = \begin{bmatrix} l_1 \\ l_2 \\ \vdots \\ l_n \end{bmatrix} = l \text{ by the definition of } \hat{L} ,$$

multiplying both sides of equation (7) by  $\hat{L}$  yields:

$$l = \hat{L}(I - (I - \hat{M})A)^{-1}(I - \hat{M})f^d + \hat{L}(I - (I - \hat{M})A)^{-1}ex. \quad (9)$$

$$\Leftrightarrow l = \hat{L}B'f^d + \hat{L}Bex.$$

By assuming a fixed and linear relationship between labor input and output of an industry, we can calculate the amount of labor input induced for an additional unit of demand, just as we did for the amount of production induced in Section 3.1. The  $ij$  element of the matrix  $\hat{L}B'$  represents the labor input induced in industry  $i$  because of a unit increase in the final demand for industry  $j$ . It follows that the sum of the elements in the  $j$ th column of the matrix  $\hat{L}B'$  represents the total amount of employment induced by a unit increase in the final domestic demand for the  $j$ th industry. Hence, the matrix  $\hat{L}B'$  can be considered to be the labor input inducement coefficient matrix for the domestic demand while the matrix  $\hat{L}B$  can be regarded as the labor input inducement coefficient matrix for the external demand.

Although it is simply an expansion of the widely used production inducement coefficient, calculation of the labor input inducement coefficient for the Chinese economy is not straightforward because of a lack of data; there is no readily available data of the total number of workers for each of the IO table industries. To derive the labor input inducement coefficient, we first estimated the number of workers in each IO table industry. Details of the estimation are provided in Appendix B.

## 5.2. Characteristics and Recent Changes in the Labor Input Inducement Coefficient

Figure 4 shows the calculated labor input coefficients for different industries in 2005. The results are presented in terms of the number of employees required to meet an additional RMB 10,000 of final demand. This offers some interesting insights regarding the labor input of China's different industries.

First, the labor input inducement coefficient of the agriculture industry is by far the largest among all industries. This can be partly explained by the extremely low labor productivity of China's agriculture sector. Table 4 shows that the latest data for value-added of the agriculture sector divided by the number of workers in the sector in China is significantly lower than in both Japan and the US. It should also be noted that China's labor productivity is lower than those of countries of the same per capita income. The low labor productivity in China is possibly related to the family registration system that

prevents residents in rural areas from moving freely into urban areas, along with the low level of mechanization and the fragmented ownership of farmland.

Second, we can observe relatively high labor input inducement coefficients in labor-intensive industries such as the construction, the textile, sewing, leather and fur products, and other services industries. Given the massive size of the domestic labor force, construction of infrastructure and the promotion of the trend toward a service economy can be regarded as an important industrial policy to create employment. In fact, nearly 40 percent of the current RMB 4 trillion stimulus plan is devoted to construction of infrastructure such as railways, highways, and airports.

Third, industries with the lowest labor input inducement coefficients are the machinery and equipment, the coking, gas and petroleum refining, the metal, and the real estate, leasing and business services industries. These industries are capital intensive and require less labor input per unit of output compared with other industries.

Finally, recent changes in the labor input inducement coefficients is another point of interest. Figure 5 presents the magnitude of the fall in the labor input coefficient in each industry from 2000 to 2005. It is clear from the figure that the labor input inducement coefficients declined from 2000 to 2005 in most industries, suggesting improvement of the country's labor productivity. The large decline in the labor input inducement coefficient of the agriculture industry seems to be at least partly attributed to the migration from rural areas to urban areas<sup>9</sup>. Regarding the manufacturing sector, the declines in the coefficients are likely to be a result of increased capital equipment<sup>10, 11</sup>.

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<sup>9</sup> In fact, the number of employed persons in the primary industry at the end of 2005 was 340 million, or 44.8% of total employed persons, compared with 360 million, or 50.0% at the end of 2000. During the same period, the number of employed persons in the secondary and the tertiary industries increased from 162 million (22.5%) to 181 million (23.8%) and from 198 million (27.5%) to 238 million (31.3%), respectively.

<sup>10</sup> China's fixed asset investment continued double-digit year-on-year growth for five years in a row from 2001 to 2005, of which the last three years recorded annual growth rates close to 30 percent. As a result, the contribution ratio of fixed asset investment to total GDP growth during the period is, on average, equivalent to 51.1%, which is higher than 32.8% for 1978–2000. It is likely that the improvement of labor productivity in the manufacturing sector during the first half of the 2000s was, to some extent, a result of the increase in the capital equipment ratio.

<sup>11</sup> In addition, it is possible that the total factor productivities have recently improved because of increasingly fierce global competition especially in the manufacturing industries. However, research suggests that estimates of China's total factor productivity growth vary to a significant degree depending on how data are handled. Young (2003), for instance, argues that the nonagricultural total factor productivity estimates for 1978–1998 presented in the paper “should not, by any means, be taken as definitive”, showing a range of other possible estimates from as low as –0.4 percent per year to as high as 5.6 percent per year. In relation to this, see the Japan Center for Economic Research website (<http://www.jcer.or.jp/report/asia/detail3843.html>), titled “Comparative Analysis on Productivities of Japanese, Chinese, South Korean, and Taiwanese Companies and Japanese and South Korean Organization Capitals (in Japanese),” for recent changes in the productivities of major Asian economies including China.

## 6. CONCLUDING REMARKS

In this paper, we investigated features and recent changes in China's industrial structure using the IO tables, including the latest 2005 table. In particular, by (1) constructing deflators for the respective industries in the IO table following Hu (2003), we succeeded in comparing the production inducement coefficients for different periods of time at constant prices. Additionally, by (2) estimating the number of employees for a disaggregated set of industries, we calculated the labor input inducement coefficient.

Our analysis of the production inducement coefficients indicated that China's manufacturing sector, including the material and machinery industries, have been increasingly integrated into the global production network. The analysis also underpinned China's intensified resource-securing activities in recent years.

We then examined the degrees of China's income dependence on foreign demand, which showed a steady increase in recent years. The rise has accelerated, especially since 2002, shortly after China gained membership to the WTO and embarked on liberalization of a wide range of industries. Combined with the fact that the current global economic downturn involves major developed economies, unlike the Asian financial crisis, it would be fair to conclude that China is now facing the most serious negative external shock it has ever experienced.

Examination of labor input inducement coefficients served as confirmation of the extremely low labor productivity in China's agriculture sector. It also suggested that focusing on such sectors as the construction and the service sector is relatively effective in terms of job creation, which is often argued to be the greatest concern of the Chinese government in terms of maintaining social stability. Comparison of labor input inducement coefficients for 2000 and 2005 presented a clear decline of the coefficient in most of the industries, suggesting improvement of China's labor productivity. Behind the decline of the coefficient is the migration of the labor force from the agricultural sector to the other sectors and a likely rise in the capital equipment ratio, especially in the manufacturing sector.

We believe that our analysis successfully sheds light on the significant structural changes of the Chinese economy in recent years and offers some important implications in assessing its economic condition<sup>12</sup>. However, the Chinese economy has possibly gone

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<sup>12</sup> For instance, the analysis can be extended to assess the impact of both a decline in exports and an increase in the final demand in the construction sector. China's exports declined by more than 20 percent year on year in the first five months of 2009. On the other hand, China's government announced a stimulus package worth RMB 4 trillion, a large part of which consists of infrastructure construction. Based on the production inducement coefficient and the labor input inducement coefficient we calculated, the impact on both production and employment caused by a 20 percent decline in external demand can be offset roughly by a RMB 1 trillion increase in final demand in the construction industry. He *et al.* (2009) estimate the



through further structural changes even in the few years after 2005 that we have not examined in this paper<sup>13</sup>. As China will continue to play an important role both as “the factory of the world” and “the highly promising consumer market,” we need to further investigate China’s industry structure, which is expected to continue developing and changing in the future.

## APPENDIX A

To compare the production inducement coefficients for different periods of time in real terms, we construct deflators for the industries on the IO table. Following Hu (2003), we use either the producer price index (PPI hereafter) or GDP deflator. The specific series used as deflators are presented in the table below. We assume that the law of one price holds and use the same deflator for both domestic production and imports.

	Industry Classification in the IO Table	Deflators
1	Agriculture	GDP •Primary Industry
2	Mining and Quarrying	PPI •Mining and Quarrying
3	Foodstuff	PPI •Food
4	Textile, Sewing, Leather and Furs Products	PPI •Textile •Tailoring •Leather
5	Other manufacturing	PPI •Total
6	Production and Supply of Electric Power, Heat Power and Water	PPI •Power
7	Coking, Gas and Petroleum Refining	PPI •Coal •Petroleum
8	Chemical Industry	PPI •Chemical
9	Building Materials and Nonmetal Mineral Products	PPI •Building Materials
10	Metal Products	PPI •Metallurgical
11	Machinery and Equipment	PPI •Machine Building
12	Construction	GDP •Construction
13	Transportation, Postal and Telecommunication Services	GDP •Transportation, Postal and Telecommunication Service

effect of the fiscal stimulus package in a more elaborate manner although they did not explicitly compare the effect with that of a decline in exports.

<sup>13</sup> Among the most prominent changes in the Chinese economy since 2005 are (1) the revaluation of the currency, the Yuan, in July 2005 and its ensuing appreciation, (2) a shift in the industrial policy of China’s government, and (3) a rapid increase in wages in recent years. To detail the second point, for instance, Chinese Premier Wen Jiabao and Ma Kai, former Director of the National Development and Reform Commission, mentioned in October 2005 in their proposals regarding the 11<sup>th</sup> five-year plan that the Chinese economy had been heavily dependent on exports and fixed asset investment and that the contribution of consumption to economic growth should be made larger.

14	Wholesale and Retail Trades, Hotels and Catering Services	GDP	• Wholesale and Retail Trades • Hotels and Catering Services
15	Public Utilities and Resident Services (only for 95, 97, and 00)	GDP	• Tertiary Industry
	Real Estate, Leasing and Business Services (only for 02 and 05)	GDP	• Real Estate
16	Banking and Insurance	GDP	• Financial Intermediation
17	Other Services	GDP	• Tertiary Industry

For industries in the IO table for which more than one series of deflators are listed, the deflators of the industries were constructed as a weighted average of the listed PPIs or GDP deflators. Specifically, for the textile, sewing, leather and furs products industry, listed fourth in the table above, three PPIs are weighted using the value-added production of the textile industry, the garment, footwear and headgear manufacturing industry, and the leather, fur, down and related products industry, respectively. For the coking, gas and petroleum refining industry listed in the seventh row in the table, two PPIs are weighted using the sales data of the coal and related products industry and the petroleum and related products industry. For the wholesale and retail trades, hotels and catering services industry listed in the 14<sup>th</sup> row, the GDP deflators for the wholesale and retail trades industry and the hotels and catering services industry are combined using the value of nominal output for each industry as the weight.

## APPENDIX B

To estimate the number of workers in each IO table industry, we use the following two sets of data:

- (a) “Number of Employed Persons at Year-end by Three Strata of Industry,” and
- (b) “Number of Staff and Workers at the Year-end by Status of Registration and Sector in Detail.”

While data set (a) offers a reliable figure for the total number of employees (758 million in 2005), it does not offer as detailed a breakdown as the industry classification in the IO table. Data set (b), on the other hand, covers only a small fraction of the total number of employees. However, the industry classification for (b) is more detailed.

We estimated the number of employees in industries by (1) calculating the ratio of employees in different industries within the same strata using data (a), and (2) dividing the number of employees for each strata of industry given by data (a) in proportion to the ratio calculated with the data (b)<sup>14</sup>. A detailed list of the allocations of industries into the

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<sup>14</sup> In calculating the labor input inducement effect, He *et al.* (2009) use the data of annual sectoral wages while Zhao (1994) uses the data of the number of employees as we did in this analysis. In this respect, we

IO industry classification for both 2000 and 2005 is available upon request from the authors.

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wage based on our estimate of the number of employees in 2005 is RMB 10,251, much less than the average annual wage of RMB 18,364. This also suggests that both the number of employees and the labor inducement effect would be much lower if we estimated them based on the data of annual sectoral wages.

**Table 1: Composition of Total Outputs by Industry**

	(Share of output, %)			(Change per annum, %)		Number of employees (at the end of 2005)	
	1997	2000	2005	97-00	00-05	10,000 persons	Share
Agriculture	12.3	10.3	7.2	-0.7	-0.6	33,970	44.8%
Mining and Quarrying	3.4	3.1	3.6	-0.1	0.1	1,898	2.5%
Foodstuff	6.9	5.7	4.7	-0.4	-0.2	918	1.2%
Textile, Sewing, Leather and Furs Products	7.7	6.6	5.1	-0.4	-0.3	2,020	2.7%
Other Manufacturing	4.9	3.5	4.0	-0.5	0.1	1,045	1.4%
Production and Supply of Electric Power, Heat Power and Water	2.0	3.3	3.6	0.5	0.0	1,120	1.5%
Coking, Gas and Petroleum Refining	1.6	3.2	2.4	0.5	-0.2	206	0.3%
Chemical Industry	7.6	8.4	7.3	0.3	-0.2	1,609	2.1%
Building Materials and Nonmetal Mineral Products	4.4	2.4	2.8	-0.7	0.1	789	1.0%
Metal Products	6.4	6.1	7.7	-0.1	0.3	1,346	1.8%
Machinery and Equipment	12.8	16.2	16.6	1.1	0.1	3,875	5.1%
Construction	8.7	8.6	7.8	-0.0	-0.2	3,258	4.3%
Transportation, Postal and Telecommunication Services	3.5	4.1	6.4	0.2	0.5	2,418	3.2%
Wholesale and Retail Trades, Hotels and Catering Services	6.7	6.6	6.2	-0.0	-0.1	2,817	3.7%
Real Estate, Leasing and Business Services	-	-	3.8	-	-	-	-
Public Utilities and Resident Services	3.8	4.3	-	0.2	-	1,384	1.8%
Banking and Insurance	1.8	2.0	1.9	0.1	-0.0	1,232	1.6%
Other Services	5.5	5.6	8.9	0.0	0.7	15,921	21.0%
Primary Industry	12.3	10.3	7.2	-0.7	-0.6	33,970	44.8%
Secondary Industry	66.4	67.2	65.7	0.2	-0.3	18,084	23.8%
Tertiary Industry	21.2	22.6	27.1	0.4	0.9	23,771	31.3%

*Note.* The numbers of employees at the end of 2005 are estimated by the authors.

**Table 2: Composition of GDP by Industry (2006)**

(%)

	China	Low-income Economies	Middle-income Economies	High-income Economies
Primary Industry	12	20	8	2
Secondary Industry	48	28	37	26
Tertiary Industry	40	52	54	72

*Note.*

1. Primary Industries: Agriculture; Secondary Industries: Industry; Tertiary Industries: Services.
2. Low-income economies are those with a GNI per capita of \$905 or less in 2006; high-income economies are those with a GNI per capita of \$11,116 or more. Composition of GDP by industry for each income bracket is calculated as a weighted average of the corresponding economies.
3. China's GNI per capita in 2006 is \$2,000.

*Source:* World Bank "World Development Indicators."

**Table 3: Degrees of Income Dependence on Foreign Demand**

(%)

	1997	2000	2002	2005	97-00	00-02	02-05
Total	18.7	20.8	21.0	27.8	2.1	0.2	6.8
Agriculture	10.5	12.1	12.0	18.0	1.6	0.0	6.0
Mining and Quarrying	24.8	26.2	26.7	36.8	1.4	0.5	10.2
Foodstuff	11.2	13.1	14.4	16.6	1.9	1.3	2.2
Textile, Sewing, Leather and Furs Products	45.6	51.6	57.1	60.4	5.9	5.5	3.3
Other Manufacturing	28.8	31.0	31.5	42.0	2.2	0.4	10.5
Production and Supply of Electric Power, Heat Power and Water	20.4	24.0	21.7	30.9	3.6	-2.3	9.2
Coking, Gas and Petroleum Refining	21.6	21.0	25.3	33.7	-0.6	4.3	8.3
Chemical Industry	29.6	32.1	33.7	44.6	2.5	1.6	10.9
Building Materials and Nonmetal Mineral Products	9.9	13.5	16.8	18.7	3.6	3.3	1.9
Metal Products	28.2	32.1	29.5	43.1	3.9	-2.6	13.6
Machinery and Equipment	27.0	35.5	37.7	48.4	8.4	2.3	10.7
Construction	0.9	1.0	1.3	2.0	0.1	0.3	0.7
Transportation, Postal and Telecommunication Services	21.8	20.7	26.7	29.9	-1.1	6.0	3.3
Wholesale and Retail Trades, Hotels and Catering Services	22.9	24.4	25.2	31.9	1.5	0.8	6.7
Real Estate, Leasing and Business Services	-	-	17.1	18.4	-	-	1.3
Public Utilities and Resident Services	18.9	18.5	-	-	-0.4	-	-
Banking and Insurance	15.8	17.1	18.3	20.5	1.3	1.2	2.2
Other Services	2.0	2.1	6.4	9.2	0.1	4.3	2.8
Primary Industries	10.5	12.1	12.0	18.0	1.6	0.0	6.0
Secondary Industries	23.0	26.3	27.5	35.3	3.3	1.2	7.8
Tertiary Industries	16.2	16.1	17.0	21.6	-0.2	0.9	4.7

**Table 4: Agricultural Labor Productivity**

(2000=100 US\$)

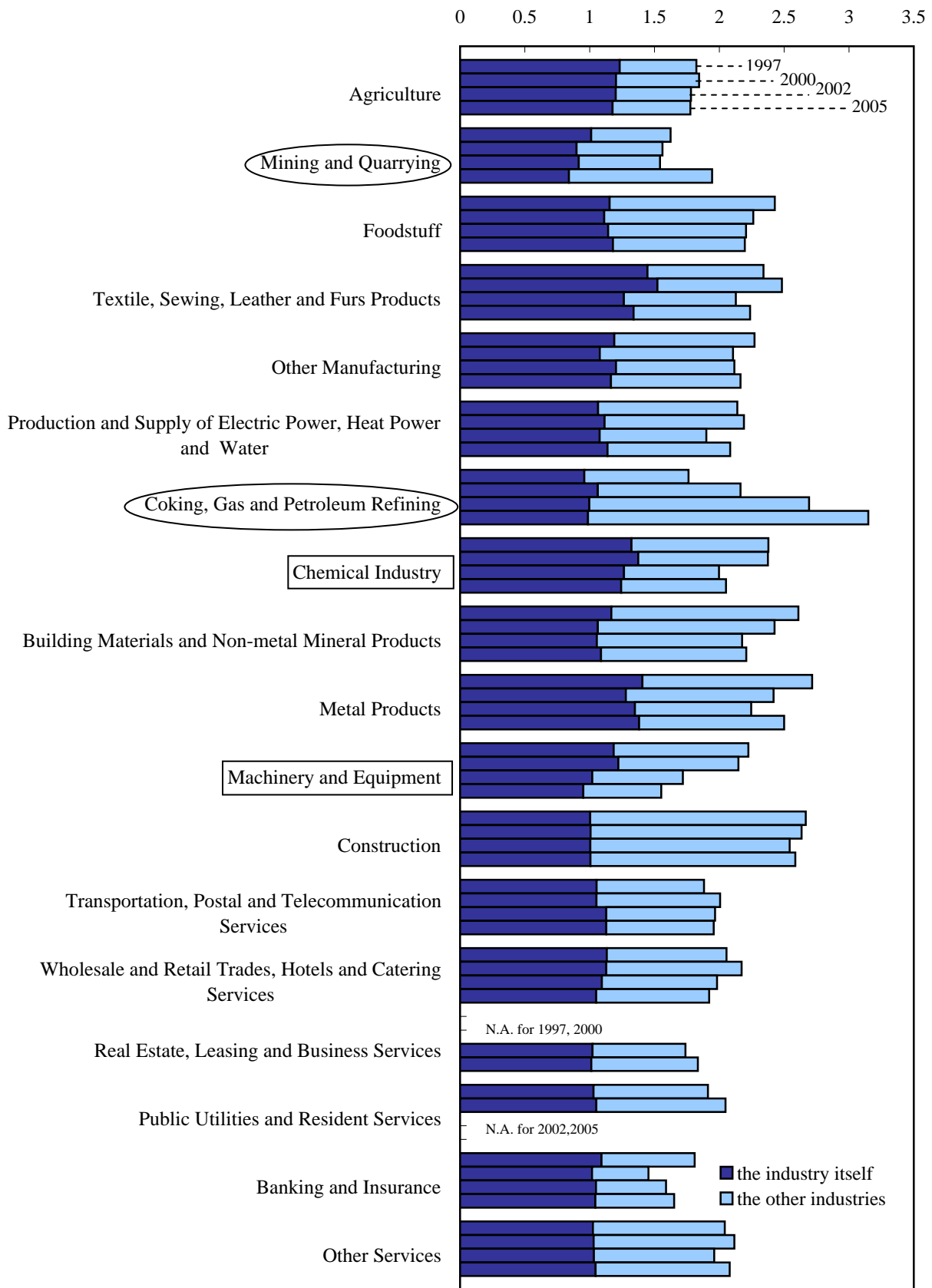
	90-92 (a)	03-05 (b)	(b)/(a)
China	254	401	1.6
Thailand	497	621	1.2
Japan	20,445	35,517	1.7
United States	20,793	41,797	2.0
Low-income Economies	303	376	1.2
Middle-income Economies	531	763	1.4
High-income Economies	15,072	26,940	1.8

*Note.*

1. Agricultural productivity is the ratio of agricultural value added, measured in 2000 U.S. dollars, to the number of workers in agriculture. Agricultural labor productivity for each income bracket is calculated as a weighted average of the individual economies.
2. For definitions of low-income, middle-income, and high-income economies, refer to note 2 of Table 2.

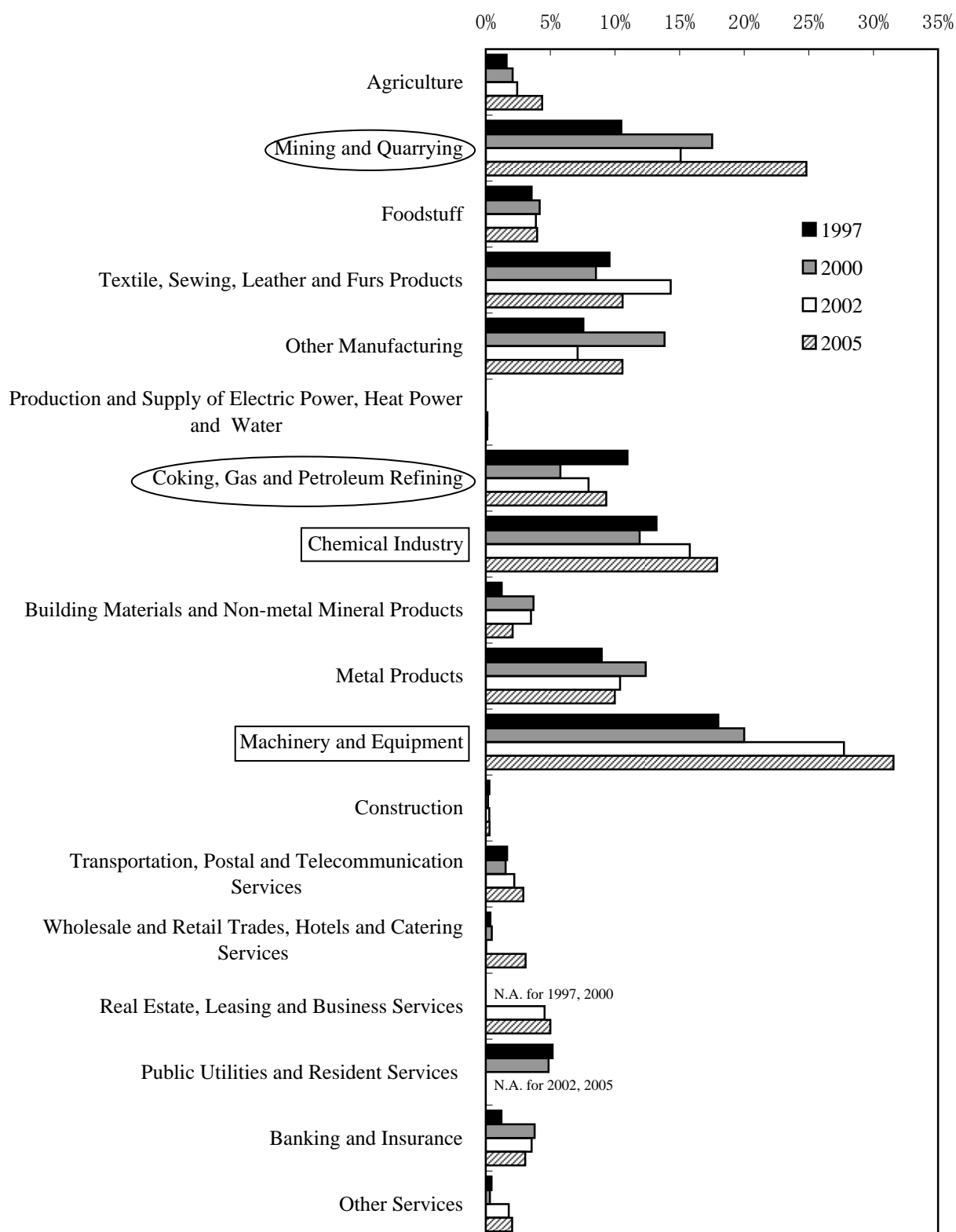
*Source:* World Bank “*World Development Indicators.*”

**Figure 1 : Production Inducement Coefficients**





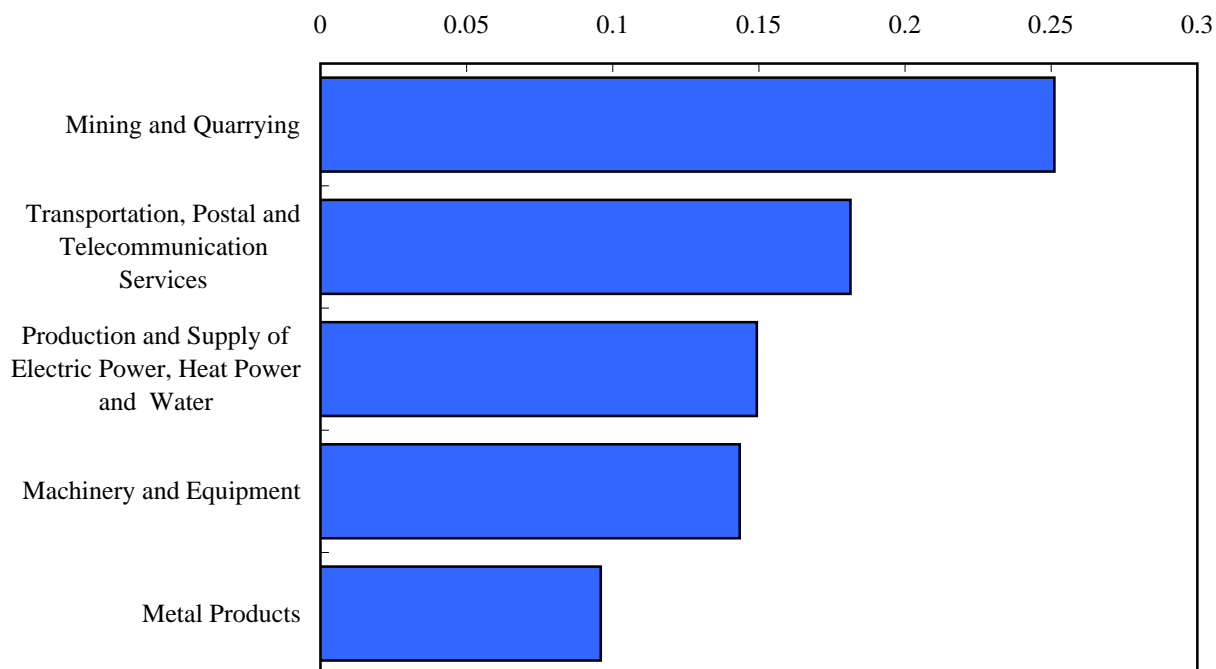
**Figure 2 : Import Coefficients**



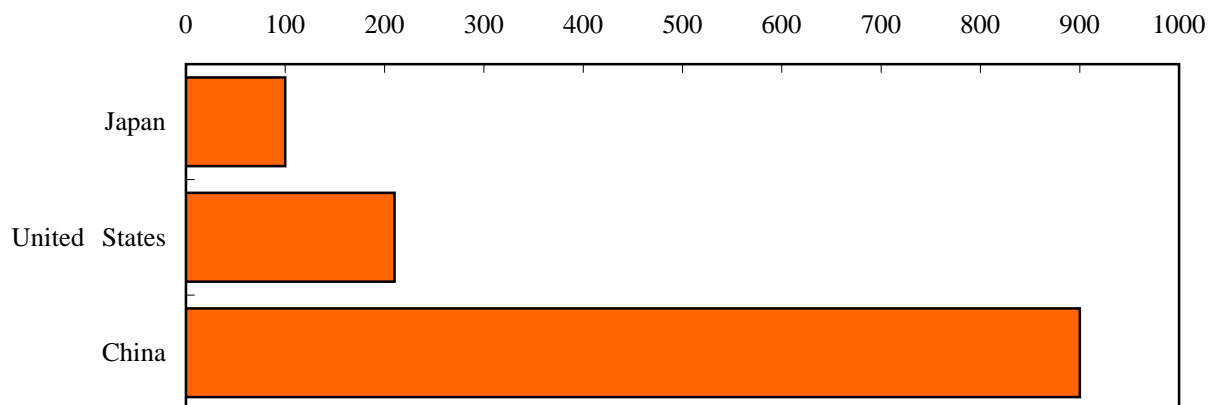
*Note.*

The import coefficient of industry  $i$  is defined as the ratio of imports of industry  $i$  to the sum of total domestic demand for industry  $i$ : (imports of industry  $i$ ) / (intermediate and domestic final demands for industry  $i$ ).

**Figure 3-1 : Changes in the Production Inducement Coefficient of the Coking, Gas and Petroleum Refining Industry from 2000 to 2005**



**Figure 3-2 : Total Primary Energy Supply / GDP (2006)**



*Note.*

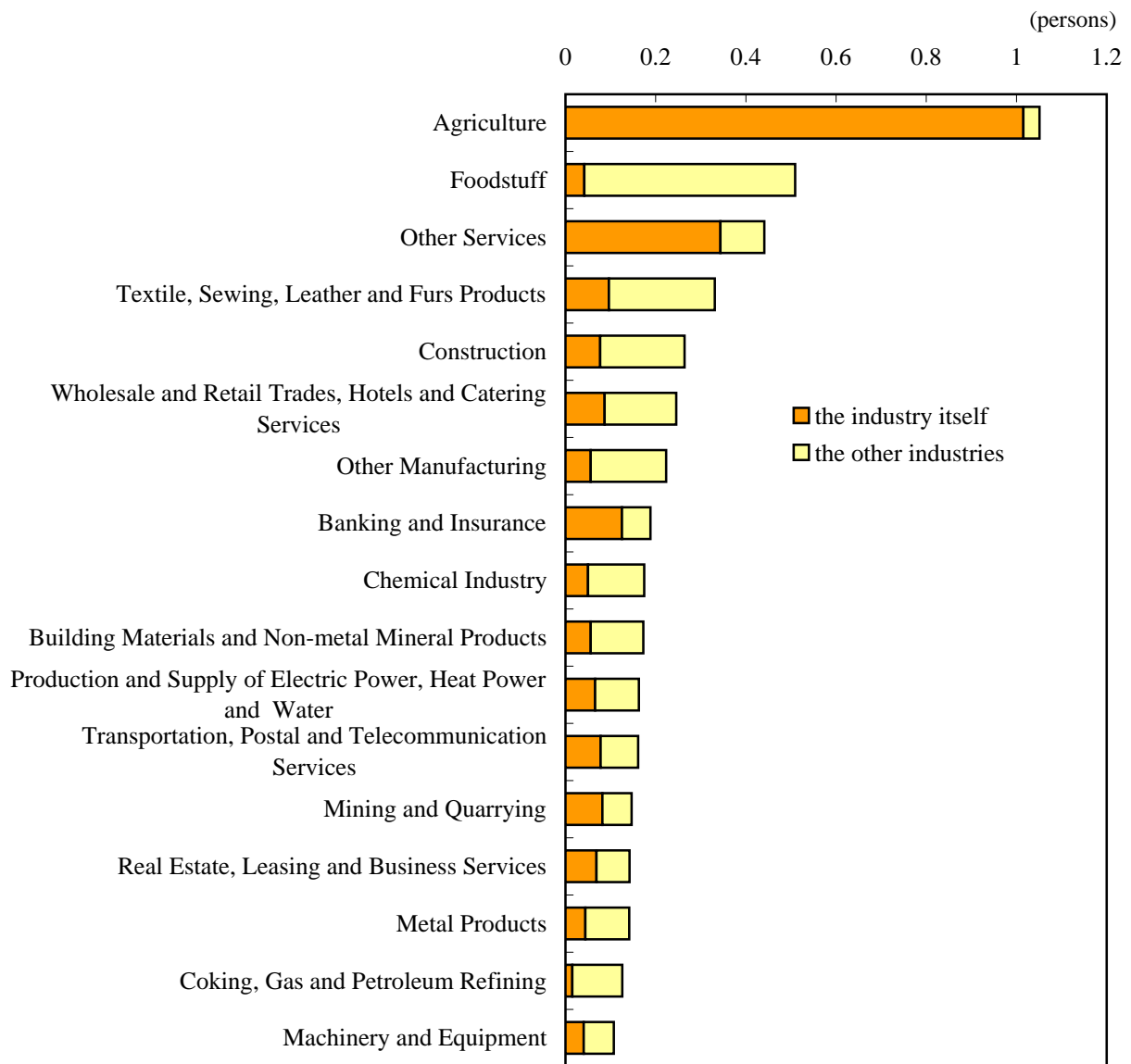
Total primary energy is made up of indigenous production + imports – exports – international marine bunker +(-) stock changes. For details, see IEA (2008) “Key World Energy Statistics 2006.”

*Source:*

IEA "Key World Energy Statistics 2008."

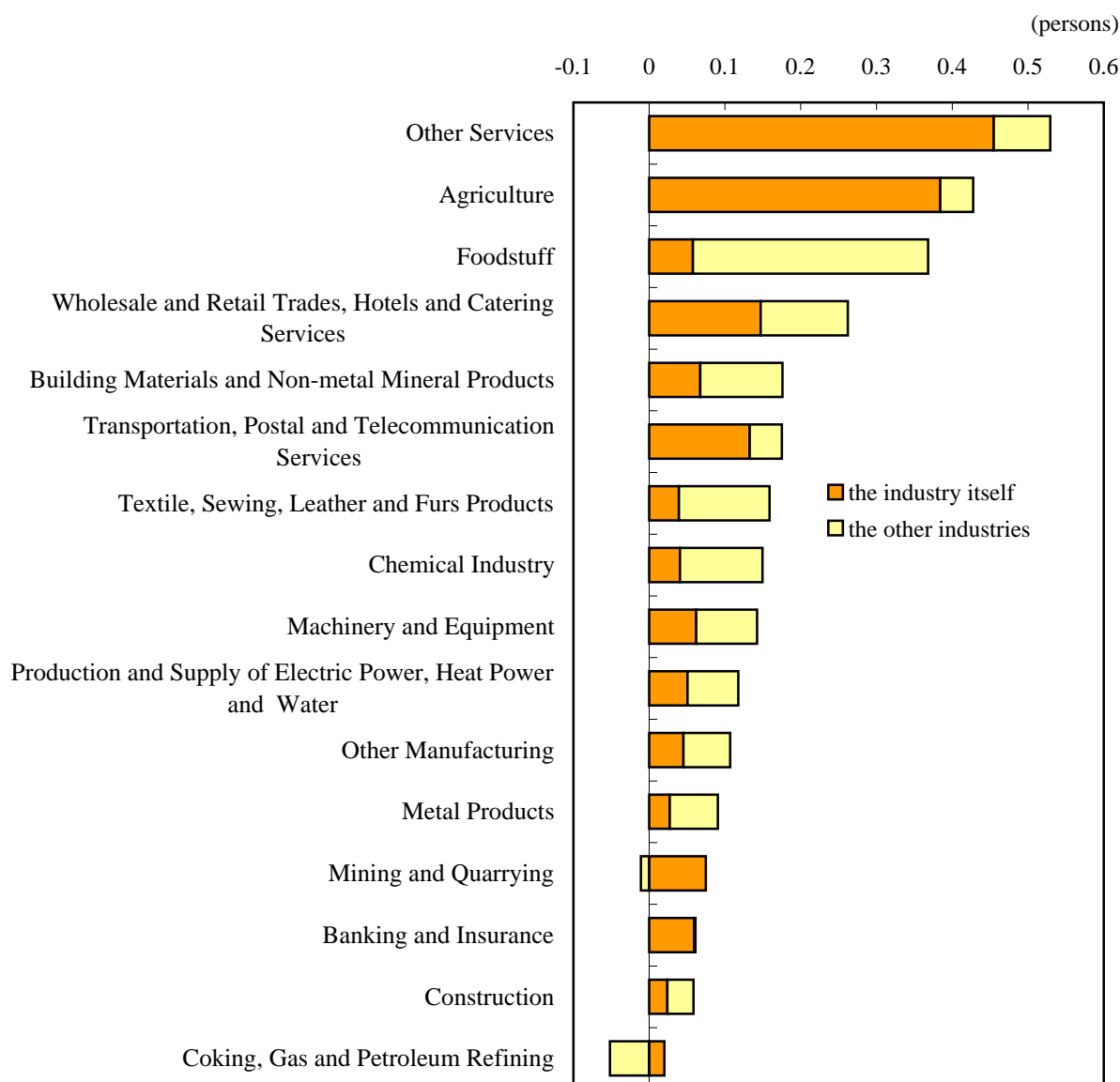
**Figure 4 : Labor Input Inducement Coefficients (2005)**

**(Labor input induced by a 10,000 Yuan increase in the final demand of different industries)**



## Figure 5 : Changes in the Labor Input Inducement Coefficients

(Magnitude of decline in the labor input inducement coefficient from 2000 to 2005)



*Note.*

1. Labor input inducement coefficients are calculated as the amount of labor input induced by an increase of 10,000 Yuan (at the 2000 price) in the final demand.
2. Strictly speaking, the labor input inducement coefficients of "other services" for 2000 and 2005 are not comparable because of a change in the industry classification of the service sector.
3. A negative bar shows that the labor input inducement effect of the industry increased from 2000 to 2005.