How Much of Chinese Exports Is Really Made in China?
Assessing Domestic Value-Added
When Processing Trade is Pervasive

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Abstract

As China's export juggernaut employs many imported inputs, there are many policy questions for which it is crucial to know the extent of domestic value added (DVA) in its exports. The best known approach is the concept of "vertical specialization" proposed by Hummels, Ishii and Yi (2001) (HIY for short). This approach is not appropriate for countries that engage in a lot of tariff/tax-favored processing exports such as China, Mexico, and Vietnam. We develop a general formula for computing domestic and foreign contents when processing exports are pervasive. Because this new formula requires some input-output coefficients not typically available from a conventional input-output table, we propose a mathematical programming procedure to estimate these coefficients by combining information from detailed trade statistics with input-output tables. By our estimation, the share of foreign content in China's exports is at about 50%, almost twice the estimate given by the HIY formula. There are also interesting variations across sectors and firm ownership. Those sectors that are likely labeled as relatively sophisticated such as electronic devices have particularly high foreign content (about 80%). Foreign-invested firms also tend to have higher foreign content in their exports than do domestic firms.

Key words: domestic content, foreign content, processing exports

JEL Classification Numbers: F1, C67, C82

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1. Introduction

The People's Republic of China is the archetype of a national economy that is well integrated into a global production chain. It imports raw material, equipment, and other intermediate inputs, and then exports a big fraction of its output **(**on the order of 37% of GDP in 2006**)** to the world market. China's export/GDP ratio is extraordinarily high for a large economy, when compared with 8% for the United States and 13% for India in the same year. With a reputation as a "world factory," China is a top supplier of manufacturing outsourcing for many global companies.

Imported inputs used in the production for exports reduce the share of value added generated by domestic producers in a nation's exports. Consider the example of iPod, which China assembles for Apple and exports to the United States and other countries. In trade statistics, the Chinese export value for a unit of a 30GB video model in 2006 was about $150. However, the best estimate of the value added attributable to producers in China was only $4, with the remaining value added coming from the United States, Japan, and other countries (Linden, Kraemer, and Dedrick, 2007; and Varian, 2007).

For many policy issues, it is important to assess the extent of domestic content in exports. For example, what is the effect of a currency appreciation on a country's exports? The answer depends crucially on the share of domestic content in the country's exports. Other things equal, a given exchange rate appreciation would have a smaller effect on trade volume, the lower the share of domestic content in the exports. As another example, what is the effect of trading with China on US income inequality? The answer depends in part on whether China simply exports products that are intensive in low-skilled labor or whether China's exports are more sophisticated. Rodrik (2006) notes that the per capita income typically associated with the kind of goods bundle that China exports is much higher than China's actual income. He interprets this as evidence that the skill content of China's exports is likely to be much higher than its endowment may imply. Schott (2008) documents an apparent fast increase in the similarity between the Chinese export structure and that of high-income countries, and interprets it as evidence of a rise in the level of sophistication embedded in

Chinese exports. However, if the domestic content in China's exports is low, especially in sectors that would have been considered sophisticated or high-skilled in the United States, then imports from China may still generate a large downward pressure on the wage of the low-skilled Americans after all (as pointed out by Krugman, 2008).

How would one assess foreign versus domestic content in a country's exports? Hummels, Ishii, and Yi (2001) (HIY for short in subsequent discussion) propose a concept of vertical specialization (VS) in a country's trade, defined as "the imported input content of exports, or equivalently, foreign value added embodied in exports," and provide a formula to compute VS share based exclusively on a country's input-output table. For a sample of 14 countries (not including China), they calculate that the average share of foreign value added in exports was about 21% in 1990**.** Yi (2003) shows that a dramatic increase in vertical specialization after the Second World War is likely to be responsible for a faster growth of world trade relative to world GDP over the last five decades. Other recent applications of the vertical specialization concept include Goh and Olivier (2004), Chinn (2005), U.S. National Research Council (2006), and Dean, Fung, and Wang (2007).

A key assumption needed for the HIY formula to work is that the intensity in the use of imported inputs is the same between production for exports and production for domestic sales. This assumption is violated in the Chinese case due to pervasive processing exports. Processing exports are characterized by imports for exports with favorable tariff treatment: firms import parts and other intermediate materials from abroad, with tariff exemptions on the imported inputs and other tax preferences from local or central governments, and, after processing or assembling, export the finished products to the international market. The policy preferences for processing exports usually lead to a significant difference in the intensity of imported intermediate inputs in the production for processing exports and in other productions (for domestic final sales and normal exports). Since processing exports have accounted for more than 50% of Chinese exports every year at least since 1996 (see Column 1 of Table 1 for detail), the HIY formula is likely to lead to a significant under-estimation of the share of foreign value added in its exports. In fact, most economies offer tariff reductions or exemptions on imported intermediate inputs used in production for exports. Ignoring processing exports is likely to lead to estimation errors, especially for economies that engage in a massive amount of tariff/tax-favored processing trade, such as Mexico and Vietnam.

In this paper, we aim to make three contributions. First, we develop a formula for computing shares of foreign and domestic value added in a country's exports when processing exports are pervasive. The HIY formula is a special case of this general formula. Second, because some of the input-output coefficients called for by the new formula are not generally available from conventional input-output tables, we propose a mathematical programming method to estimate these coefficients by combining information from trade statistics (which separate processing and normal trade) with standard input-output (I/O) tables. Third, we apply our methodology to the Chinese data in 1997, 2002, and 2006[1]. We estimate that the share of foreign value added in Chinese manufactured exports is at about 50%, almost twice as high as that implied by the HIY formula. There are also interesting variations across sectors and firm ownership. Those sectors that are likely labeled as relatively sophisticated such as computers, telecommunication equipments, and electronic devices have particularly high foreign content (about 80%). Foreign-invested firms also tend to have higher foreign content in their exports than do Chinese domestic firms.

Besides the papers on vertical specialization in the international trade literature, this paper is also related to the I/O literature. In particular, Chen et al. (2004) and Lau et al (2007) are the first to develop a "non-competitive" type I/O model for China (i.e., one in which imported and domestically produced inputs are accounted for separately) and to incorporate processing exports explicitly. However, these papers do not describe a systematic way to infer separate input-output coefficients for production of processing exports versus those for other final demands. It is therefore difficult for others to replicate their estimates or apply their methodology to other countries. In addition, they use an aggregated version of China's 1995 and 2002 input-output tables, respectively, to perform their analysis, with 20 some goods producing industries. We provide a more up-to-date and more disaggregated assessment of foreign and domestic values added in Chinese exports with 83 goods producing industries.

[1] Note that the 2002 Input-Output Table is the latest such table available; the next table— the 2007 benchmark IO table— is scheduled to be released in 2010. Our 2006 estimates make use of the 2006 trade statistics but of the 2002 I/O table.

Finally, they impose an assumption in estimating the import use matrix from the competitive type I/O table published by China's National Statistical Bureau: within each industry, the mix of the imported and domestic inputs is the same in capital formation, intermediate inputs, and final consumption. We relax this assumption by refining a method proposed in Dean, Fung, and Wang (2007) that combines China's processing imports statistics with United Nations Broad Economic Categories (UNBEC) classification.

The rest of the paper is organized as follows. Section 2 presents a conceptual framework for estimating shares of domestic and foreign value added in a country's exports when processing exports are pervasive. It also describes a mathematic programming procedure to systematically infer a set of I/O coefficients called for by the new formula but not typically available from a conventional I/O table. Section 3 presents the estimation results for Chinese exports. Finally, Section 4 offers concluding remarks.

2. Conceptual Framework and Estimation Method

2.1 When special features of processing exports are not taken into account

We first discuss how domestic and foreign contents in a country's exports can be computed when it does not engage in any processing trade. The discussion follows the input-output literature, and is the approach adopted (implicitly) by Hummels, Ishii, and Yi (2001) and Yi (2003). Along the way, we will point out a clear connection between the domestic content concept and the concept of vertical specialization[2].

When imported and domestically produced intermediate inputs are accounted separately, an input-output model can be specified as follows[3]:

$$A^D X + Y^D = X \qquad (1)$$

$$A^M X + Y^M = M \qquad (2)$$

[2] We use the terms "domestic value added" and "domestic content" interchangeably. Similarly, we use the terms "foreign value added," "foreign content," and "vertical specialization," to mean the same thing.

[3] Such a model is called a "non-competitive" model in the I/O literature. HIY (2001) do not specify this system explicitly but go straight to the implied Leontief inverse while Chen et al. (2004) specify only the first two equations. A fully specified model facilitates a better understanding of the connection between vertical specialization and domestic content, and a comparison with the model in the next sub-section that features processing exports.

$$(A^D + A^M)' X + \hat{A}_v X = X \quad (3)$$

$$uA^D + uA^M + A_v = u \quad (4)$$

Where $A^D = [a^D_{ij}]$ is an $n_x n$ matrix of direct input coefficients of domestic products; $A^M = [a^M_{ij}]$ is an $n_x n$ matrix of direct inputs of imported goods; Y^D is an n_{x1} vector of final demands for domestically produced products, including usage in gross capital formation, private and public final consumption, and gross exports; Y^M is an n_{x1} vector of final demands for imported products, including usages in gross capital formation, private and public final consumption; X is a n_{x1} vector of gross output; M is a n_{x1} vector of imports; $A_v = [a^v_j]$ is a $1_x n$ vector of each sector j's ratio of value added to gross output; $\hat{A}_V$ is an $n_x n$ diagonal matrix with a^v_j as its diagonal elements; finally, u is a $1_x n$ unity vector. Subscripts i and j indicate sectors, and superscripts D and M represent domestically produced and imported products, respectively.

Equations (1) and (2) define two horizontal balance conditions for domestically produced and imported products respectively. A typical row *k* in Equation (1) specifies that total domestic production of product *k* should be equal to the sum of the sales of product *k* to all users in the economy (to be used as intermediate inputs or for final sales to these users), the final sales include domestic consumption and capital formation, plus exports of product *k*. A typical row *h* in Equation (2) specifies that the total imports of product *h* should be equal to the sum of the sales of product *h* to all users in the economy, including intermediate inputs for all sectors, plus final domestic consumption and capital formation. Equation (3) is a vertical balance conditions, and Equation (4) describes an adding-up constraint for the input-output coefficients. Collectively, they imply that the total output (X) in any sector *k* has to be equal to the sum of direct value added in sector *k*, and the cost of intermediate inputs from all domestically produced and imported products.

From equation (1) we have

$$X = (I - A^D)^{-1} Y^D \quad (5)$$

$(I - A^D)^{-1}$ is the well-known Leontief Inverse, a matrix of coefficients for the total domestic intermediate product requirement. Define a vector of share of domestic content, or domestic value added, in a unit of domestically produced products, $DVS = \{dvs_j\}$, a $1_x n$

vector, as the additional domestic value added generated by one additional unit of final demand of domestic products ($\Delta Y^D = u'$).

$$DVS = \hat{A}_v \, \Delta X / \Delta Y^D = \hat{A}_v (I - A^D)^{-1} \quad (6)$$

Equation (6) indicates that the domestic content for an I/O industry is the corresponding column sum of the coefficient matrix for total domestic intermediate goods requirement, weighted by the direct value-added coefficient of each industry.

Under the condition that all exports and domestic sale have the same input-output coefficients, the share of domestic content in final demand and the share of domestic content in total exports should be the same. So Equation (6) is also the formula for the share of domestic content in total exports for each industry. As Chen et al (2004) points out, there is a good intuition behind the *DVS* formula. When one extra unit of product for final demand is produced at home, both direct and indirect values added are generated. The indirect value added comes from the domestic value added embedded in all the domestically produced intermediate inputs. Each of them is produced with direct and indirect value added involved. Therefore, the *total* domestic value added induced by one extra unit of domestic product is equal to the sum of direct domestic value added and multiple rounds of indirect domestic value added. Expressing this process mathematically, we have:

$$\begin{aligned} DVS &= A_v + A_v A^D + A_v A^D A^D + A_v A^D A^D A^D + ... \\ &= A_v (I - A^D)^{-1} \end{aligned} \quad (7)$$

The last step invokes the formula for the convergence of matrix power series of A^D.

Define a vector of share of foreign content (or foreign value added) in final demand for domestically produced products by $FVS = u - DVS$. By making use of Equation (4), it can be verified that

$$FVS = u - A_v (I - A^D)^{-1} = uA^M (I - A^D)^{-1} \quad (8)$$

For each industry, this is the column sum of the coefficient matrix for total intermediate import requirement. This turns out to be the exact same formula used to compute vertical specialization by HIY (2001). In other words, the concepts of vertical specialization and of foreign content are identical.

2.2 Domestic Content in Exports When Processing Trade is Prevalent

We now turn to the case in which tariff-favored processing exports are prevalent, which have a different intensity in the use of imported inputs than do domestic final sales (and normal exports). Conceptually, we wish to keep separate track of the I/O coefficients of the processing exports from those of domestic final sales and normal exports. For now, we ignore the fact that these I/O coefficients may not be directly available, and will discuss a formal approach to estimate them in the next subsection.

The expanded I/O table with a separate account for processing exports is represented by Figure 1. We use superscript P and D, respectively, to represent processing exports, and domestic sales & normal exports. Define z_{ij}^{dd} = Domestically produced intermediate good *i* used by sector *j* for domestic sales and normal exports; z_{ij}^{dp} = Domestically produced intermediate good *i* used by sector *j* for processing exports; z_{ij}^{md} = Imported intermediate good *i* used by sector *j* for domestic sales and normal exports; z_{ij}^{mp} = Imported intermediate good *i* used by sector *j* for processing exports; v_j^d = Value added by domestic and normal export production in industry *j* ; v_j^p = Value added by processing export production in industry *j*. Then direct I/O coefficients for this expanded I/O model can be written as:

$$A^{DD} = [a_{ij}^{dd}] = [\frac{z_{ij}^{dd}}{x_j - e_j^p}],\ A^{MD} = [a_{ij}^{md}] = [\frac{z_{ij}^{md}}{x_j - e_j^p}],\ A_v^D = [a_j^{vd}] = [\frac{v_j^d}{x_j - e_j^p}]$$

$$A^{DP} = [a_{ij}^{dp}] = [\frac{z_{ij}^{dp}}{e_j^p}], A^{MP} = [a_{ij}^{mp}] = [\frac{z_{ij}^{mp}}{e_j^p}], A_v^P = [a_j^{vp}] = [\frac{v_j^p}{e_j^p}]$$

Where *i* represents a row and *j* represents a column. This expanded I/O model can be formally described by the following system of equations:

$$\begin{bmatrix} I - A^{DD} & -A^{DP} \\ 0 & I \end{bmatrix} \begin{bmatrix} X - E^P \\ E^P \end{bmatrix} = \begin{bmatrix} Y^D \\ E^P \end{bmatrix} \tag{9}$$

$$A^{MD}(X - E^P) + A^{MP}E^P + Y^M = M \tag{10}$$

$$(A^{DD} + A^{MD})'(X - E^P) + \hat{A}_v^D (X - E^P) = X - E^P \tag{11}$$

$$(A^{DP} + A^{MP})' E^P + \hat{A_v^M} E^P) = E^P \quad (12)$$

$$uA^{Dk} + uA^{Mk} + A_v^k = u \qquad k = D, P \quad (13)$$

This is a generalization of the model discussed in the previous subsection. Equations (9)-(10) are a generalization of Equations (1) -(2), and Equations (11)-(12) are a generalization of Equation of (3), with a separate account for processing exports. In a slight abuse of notation, we now re-define Y^D to be final domestic sales plus normal exports while excluding processing exports. Equation (13) is the new adding up constraint for the I/O coefficients.

The analytical solution of the system is

$$\begin{bmatrix} X - E^P \\ E^P \end{bmatrix} = \begin{bmatrix} I - A^{DD} & -A^{DP} \\ 0 & I \end{bmatrix}^{-1} \begin{bmatrix} Y^D \\ E^P \end{bmatrix} \quad (14)$$

The generalized Leontief inverse for this expanded model can be computed as follows:

$$B = \begin{bmatrix} I - A^{DD} & -A^{DP} \\ 0 & I \end{bmatrix}^{-1} = \begin{bmatrix} B^{DD} & B^{DP} \\ B^{PD} & B^{PP} \end{bmatrix} = \begin{bmatrix} (I - A^{DD})^{-1} & (I - A^{DD})^{-1} A^{DP} \\ 0 & I \end{bmatrix} \quad (15)$$

Substituting equation (15) into equation (14), we have:

$$X - E^P = (I - A^{DD})^{-1} Y^D + (1 - A^{DD})^{-1} A^{DP} E^p \quad (16)$$

Substituting equation (16) into equation (10), the total demand for imported intermediate inputs is:

$$M - Y^M = A^{MD}(I - A^{DD})^{-1} Y^D + A^{MD}(1 - A^{DD})^{-1} A^{DP} E^P + A^{MP} E^p \quad (17)$$

It has three components: the first term is total imported content in final domestic sale and normal exports, and the second and the third terms are indirect and direct imported content in processing exports, respectively.

We can compute vertical specialization (VS) or foreign content share in processing and normal exports in each industry separately:

$$\begin{vmatrix} VSS^D \\ VSS^P \end{vmatrix}^T = \begin{vmatrix} uA^{MD}(I - A^{DD})^{-1} \\ uA^{MD}(1 - A^{DD})^{-1} A^{DP} + uA^{MP} \end{vmatrix}^T \quad (18)$$

The total foreign content share in a particular industry is the sum of the two weighted by the share of processing and non-processing exports s^p and u-s^p:

$$\overline{VSS} = (u - s^P, s^P)\begin{vmatrix} VSS^D \\ VSS^P \end{vmatrix} \quad (19)$$

The foreign content (or foreign value-added) share in a country's total exports is:

$$TVSS = uA^{MD}(I - A^{DD})^{-1}\frac{E - E^P}{te} + u(A^{MD}(1 - A^{DD})^{-1}A^{DP} + A^{MP})\frac{E^P}{te} \quad (20)$$

Where *te* is a scalar, the country's total exports. Equation (19) is a generalization of Equation (8), the formula to compute industry-level share of vertical specialization. Equation (20) is a generalization of the formula for country-level share of vertical specialization proposed by HIY (2001, page 80). In particular, either when $A^{DD} = A^{DP}$ and $A^{MD} = A^{MP}$, or when $E^P/te = 0$, Equation (20) reduces to the HIY formula for VS.

Similarly, the domestic content share for processing and normal exports at the industry level can be computed separately:

$$\begin{vmatrix} DVS^D \\ DVS^P \end{vmatrix}^T = \bar{A}_v B = (A_v^D \quad A_v^P)\begin{bmatrix} (I - A^{DD})^{-1} & (I - A^{DD})^{-1}A^{DP} \\ 0 & I \end{bmatrix} = \begin{vmatrix} A_v^D(I - A^{DD})^{-1} \\ A_v^D(I - A^{DD})^{-1}A^{DP} + A_v^P \end{vmatrix}^T \quad (21)$$

The total domestic content share in a particular industry is a weighted sum of the two:

$$\overline{DVS} = (u - s^P, s^P)\begin{vmatrix} DVS^D \\ DVS^P \end{vmatrix} \quad (22)$$

The domestic content share in a country's total exports is:

$$TDVS = A_V^D(I - A^{DD})^{-1}\frac{E - E^P}{te} + (A_V^D(1 - A^{DD})^{-1}A^{DP} + A_V^P)\frac{E^P}{te} \quad (23)$$

Either when $A^{DD} = A^{DP}$ and $A_v^D = A_v^P$, or when $E^P/te = 0$, Equation (22) reduces to Equation (6). Note we can easily verify that for both processing and normal exports, the sum of domestic and foreign content shares is unity.

2.3 Estimation Issues

Equations (21-23) allows us to compute the shares of domestic content in processing and normal exports for each industry as well as in a country's total exports. However, statistical agencies typically only report a traditional I/O matrix, A^D, and sometimes A^M, but not A^{DP}, A^{DD}, A^{MP} and A^{MD}separately. Therefore, we have to develop a method to estimate A^{DP}, A^{DD}, A^{MP} and A^{MD} based on available information. Or, equivalently, we have to estimate [z_{ij}^{dd}], [z_{ij}^{dp}], [z_{ij}^{md}], and [z_{ij}^{md}], respectively, instead of [a_{ij}^{dd}], [a_{ij}^{dp}], [a_{ij}^{md}], and [a_{ij}^{mp}]. In this sub-section, we propose to do this via a quadratic programming model by combining information from trade statistics and conventional I/O tables.

The following data are observable from a standard I/O table and enter our programming model as constants: x_i = Gross output of sector *i*; z_{ij} = Goods *i* used as intermediate inputs in sector *j*; v_j = Value-added in sector *j*; and m_i = Total imports of sector *i* goods; and y_i =Total final demand except for exports of goods *i*. We combine information from a standard I/O table and trade statistics to determine the values for m_i^p = Imports of sector *i* good used as intermediate inputs to produce processing exports (with the share estimated from trade statistics); m_i^d = Imports of sector *i* goods used as intermediate inputs for domestic production and normal exports (with the share also estimated from trade statistics); e_i^n = Normal exports of sector *i* and e_i^p = Processing exports of sector *i* (with the share obtained from trade statistics). To be precise, we use information from an I/O table to determine sector-level total imports/exports, and information from trade statistics to determine the relative proportion of processing and normal exports within a sector. Using the data from I/O table to determine sector-level total imports/exports helps to ensure that the balance conditions in official I/O account are always satisfied and the I/O table with separate processing exports account estimated from our model always sum to the published official table. Other parameters of the model can be inferred from the variables already discussed: y_i^m = Final demand of goods *i* from imports (residuals of m_i - m_i^p - m_i^d); y_i^d = Final demand of goods *i* provided by domestic production (residual of y_i - y_i^m). *i* and *j* are indices of sectors from 1 to K.

We wish to estimate within-industry transactions [z_{ij}^{dd}], [z_{ij}^{dp}], [z_{ij}^{md}], and [z_{ij}^{md}], as well as sector-level value added [v_j^d], and [v_j^p]. We can make initial guesses about their values based on trade statistics and coefficients from a conventional I/O table. These guesses are referred to as “initial values” below. However, these guesses are not guaranteed to satisfy various economic and statistical restrictions on the data. Therefore, we cast the estimation problem as a constrained optimization. Using the notations previously defined, our programming model is specified by the following objective function subject to ten constraints:

$$\text{Min } S = \sum_{i=1}^{K}\sum_{j=1}^{K} \frac{(z_{ij}^{dd} - z0_{ij}^{dd})^2}{z0_{ij}^{dd}} + \sum_{i=1}^{K}\sum_{j=1}^{K} \frac{(z_{ij}^{dp} - z0_{ij}^{dp})^2}{z0_{ij}^{dp}} + \sum_{i=1}^{K}\sum_{j=1}^{K} \frac{(z_{ij}^{md} - z0_{ij}^{md})^2}{z_{ij}^{md}}$$
$$+ \sum_{i=1}^{K}\sum_{i=1}^{K} \frac{(z_{ij}^{mp} - z0_{ij}^{mp})^2}{z0_{ij}^{mp}} + \sum_{j=1}^{K} \frac{(v_j^d - v0_j^d)^2}{v0_j^d} + \sum_{j=1}^{K} \frac{(v_j^p - v0_j^p)^2}{v0_j^p} \qquad (24)$$

Where z's and v's are variables to be estimated, those variables with a 0 in the suffix denote initial values**.**

$$\sum_{j=1}^{K} (z_{ij}^{dd} + z_{ij}^{dp}) + y_i^d + e_i^n = x_i - e_i^p \qquad (25)$$

$$\sum_{j=1}^{K} (z_{ij}^{md} + z_{ij}^{mp}) + y_i^m = m_i \qquad (26)$$

$$\sum_{j=1}^{K} (z_{ij}^{dd} + z_{ij}^{md}) + v_j^d = x_j - e_j^p \qquad (27)$$

$$\sum_{i=1}^{K} (z_{ij}^{dp} + z_{ij}^{mp}) + v_j^p = e_j^p \qquad (28)$$

$$\sum_{j=1}^{K} z_{ij}^{md} = m_i^d \qquad (29)$$

$$\sum_{j=1}^{K} z_{ij}^{mp} = m_i^p \qquad (30)$$

$$\sum_{j=1}^{K} (z_{ij}^{dd} + z_{ij}^{dp}) = \sum_{j=1}^{K} z_{ij} - (m_i^d + m_i^p) \qquad (31)$$

$$z_{ij}^{dd} + z_{ij}^{dp} + z_{ij}^{md} + z_{ij}^{mp} = z_{ij} \qquad (32)$$

$$v_j^d + v_j^p = v_j \qquad (33)$$

$$y_i^d + y_i^m = y_i \qquad (34)$$

The economic meanings of these ten constraints are straightforward. Equations (25) and (26) are row sum constraints for the expanded I/O account. They state that total gross output of sector *i* has to equal to the sum of domestic intermediaries, final demand and exports (both processing and normal exports) in that sector. Similarly, total imports have to equal imported intermediate inputs plus imports delivered to final users. Equations (27) and (28) are column sum constraints for the expanded I/O account. They define the value of processing exports in sector *j* as the sum of domestic and imported intermediate inputs as well as primary factors used in producing processing exports; These four groups of constraints correspond to equations (9)-(12) in the extended I/O model respectively. Equations (29) to (34) are a set of adding up constraints to ensure that the solution from the model is consistent with official statistics on sector-level trade and within-industry transactions.

The initial values for the variables are derived from the I/O industry level information. In particular, those for intermediate imports are generated by allocating m_i^d and m_i^p in proportion to input i's usage in sector j:

$$z0_{ij}^{mp} = \frac{z_{ij}}{\sum_j^K z_{ij}} m_i^p \qquad z0_{ij}^{md} = \frac{z_{ij}}{\sum_j^K z_{ij}} m_i^d \tag{35}$$

The initial values for domestically produced intermediates are generated in two steps. First, we estimate total domestic product *i* used as intermediate inputs in sector *j* as a residual of total intermediate inputs and imported intermediate inputs:

$$z_{ij}^d = z_{ij} - (z_{ij}^{md} + z_{ij}^{mp}) = z_{ij}^{dd} + z_{ij}^{dp} \tag{36}$$

Second, we assume a proportional usage:

$$z0_{ij}^{dd} = z_{ij}^d \frac{(x_j - e_j^p)}{x_j} \tag{37}$$

$$z0_{ij}^{dp} = z_{ij}^d \frac{e_j^p}{x_j} \tag{38}$$

The initial values for direct value added in the production for processing exports in sector *j* ($v0_j^p$), are generally set to be the residuals implied by Equation (28). However, we set a minimum value at the sum of labor compensation and depreciation in a sector multiplied by the share of processing exports in that sector's total output. In other words, the initial value $v0_j^p$ is set to equal the greater of the residuals from Equation (28) or the minimum value. The initial value for direct value added in the production for domestic sales and normal exports ($v0_j^d$) is set as the difference between v_j (from the I/O table) and $v0_j^p$. The proportion of processing to non-processing exports in each industry is obtained from the customs export statistics. The partition of imports is based on a combination of custom import statistics and UN BEC classification. In the application to Chinese data, we also conduct some sensitivity checks to using alternative initial values. It turns out that these alternative initial values do not materially alter our basic conclusions. We implement this quadratic programming model in GAMS.

3. Estimation Results

After describing the data sources, we report and discuss the estimation results for shares of domestic and foreign content in Chinese exports at the aggregate level, and by sector and by firm ownership.

3.1 Data

Inter-industry transaction and (direct) value-added data are from China's 1997 and 2002 benchmark I/O tables published by the National Bureau of Statistics of China (NBS). We use detailed exports and imports data from 1997, 2002, and 2006 from the General Customs Administration of China to help differentiate the processing and normal trade in each sector. The trade statistics are first aggregated from the 8-digit HS level to China's I/O industry level, and then used to compute the share of processing exports in each I/O industry. Modifying a method from Dean, Fung and Wang (2007), we partition all imports in a given industry into three parts based on the distinction between processing and normal imports in the trade statistics, and on the UN BEC classification scheme: (a) intermediate inputs in producing processing exports; (b) intermediate inputs for normal exports and other domestic final sales; and (c) those used in gross capital formation and final consumption. A summary of these trade statistics as a percentage of China's total imports during 1996-2006 is reported in Table 2, which shows a downward trend for the use of imported inputs in producing processing exports, but a moderately upward trend in their use in producing normal trade and domestic final sales.

3.2 Domestic and foreign contents in total exports

Table 3 shows decomposition results for foreign and domestic value-added shares in 1997 and 2002. Preliminary estimates for 2006 are also included[4]. For comparison, the results from the HIY method that ignore processing trade are also reported. The aggregate domestic value added share in China's merchandise exports was 52.3% in 1997, and 50.7% in 2006. For manufacturing products, these shares are slightly lower in levels but trending upward moderately at 47.6% in 1997 and 49.4% in 2006, respectively, indicating that China uses more imported intermediate inputs to produce manufacturing goods than other exports. In general, the direct domestic value-added shares are less than half of the total domestic value-added shares. However, the indirect foreign value-added share was relatively small; most of the foreign content comes from directly imported foreign inputs.

Relative to the numbers from the HIY's method, our procedure produces a much higher share of foreign value added in Chinese gross exports (approximately double) and shows a different trend over time. To be more precise, estimates from the HIY method show that the foreign content share (total VS share) increased steadily from 17.6% in 1997 to 26.3% in 2006 for all merchandise exports, and from 19.0% to 27.1% for manufacturing only during the same period. In contrast, our estimates reveal no clear trend for foreign content (with the share of foreign value added in all merchandise exports falling from 47.7% in 1997 to 46.2% in 2002, and bouncing back to 49.3% in 2006, and a similar fluctuation for the share in manufacturing exports, it fell from 52.4% in 1997 to 48.7% in 2002 but bounced back to 50.6 in 2006 , Overall, the HIY method appears to incorrectly estimate both the level and the trend in domestic versus foreign content in Chinese exports.

Table 4 reports our estimates of the shares of domestic and foreign value added in normal and processing exports, separately. Clearly, the share of domestic valued added is high in normal exports (between 88-95%), but low in processing exports (between 18-26%). This is true for both manufacturing exports and all merchandise exports.

We perform a number of robustness checks on the sensitivity of our main results to alternative ways of setting the initial values of the variables. First, we initialize $v0_j^p$ and $v0_j^d$

[4] We consider the estimates preliminary because the calculation relies on the trade statistics from 2006 but the I/O table from 2002. The 2002 I/O table is the most recent benchmark table currently available. The next benchmark table - the 2007 table – is scheduled to be released in 2010.Therefore, 2006 estimates are not directly comparable to 1997 and 2002 estimates.

by apportioning the observed direct value added in a sector to processing exports and other final demands based on their respective portions in the sector's total output. Second, we initialize $v0_j^p$ either at the residuals implied by equation (28) if the residuals are positive, or by following the previous alternative if the residuals are non-positive. Third, when we partition imports into intermediate inputs used for own-sector's processing exports, and those for other purposes, we use the average of a three-year period (previous, current, and following years) rather than just one year's number. Fourth, we experiment with 0% versus 10% annual depreciation rate for capital goods. These variations produce relatively little change in the main results. For example, the estimated share of domestic value added in manufacturing exports lies in a relatively narrow range between 47.6% and 49.0% in 1997, and between 49.5% and 50.8% in 2006. [Detailed results are not reported to save space.]

3.3 Domestic content by sector

To see if there are interesting patterns at the sector level, Table 5 reports, in ascending order, the estimated share of domestic value added in manufacturing exports in 2002 together with each sector's share in the country's total manufacturing exports. We choose to report the results from 2002 because they use the latest I/O table released. Similar results for 1997 and 2006 are omitted to save space. Note, however, that the pairwise correlation between the 1997 and 2002 estimates at the sector-level is very high (0.76)**.**

Among the 61 manufacturing industries in the table, 13 have a share of domestic value-added less than 50 percent, and collectively account for nearly 44 percent of China's manufacturing exports in 2002. Many low-DVA industries are likely to be labeled as relatively sophisticated, such as computers and accessories, telecommunications equipment, measuring instruments and electronic devices. A common feature of these industries is that processing exports account for over two-thirds of their exports. This suggests that the appearance of a sophisticated export structure in China is largely a statistical mirage.

The next 15 industries have their share of domestic value-added in the range of 51 to 65 percent; they collectively accounted for 22 percent of China's total manufacturing exports in 2002. Several labor-intensive sectors are in this group, such toys and sports products, and arts and crafts products.

The remaining 33 industries have relatively high shares of domestic value-added. However, they as a group produced only about one third of China's manufacturing exports in 2002. Apparel, the country's largest labor intensive exporting industry, which by itself was responsible for 7.5 percent of the country's total manufacturing exports in 2002, is at the top of this group with a share of domestic content at 67 percent. The 20 industries at the bottom of Table 5 collectively produced only about 11 percent of China's manufacture exports in 2002.

3.4 Domestic content in exports by firm ownership

Since foreign-invested firms account for over half of China's exports, it may be interesting to compare the share of domestic content in exports between them and other Chinese firms. Because we lack information on separate input-output coefficients by firm ownership, our estimation assume that they are the same on this dimension. The variation in the share of domestic content comes from different degrees of reliance on processing exports with a sector, and differences in the sector composition of their exports.

Estimates of the domestic content shares by firm ownership are presented in Table 6. The results show that exports by wholly foreign owned enterprises exhibit the lowest share of domestic valued-added (at 33% in 2002 but declined to 28% in 2006), followed by Sino-foreign joint venture companies (about 45% in both 2002 and 2006). Exports from Chinese private enterprises embodied the highest domestic content shares (84% and 82% in 2002 and 2006, respectively), while those from the state-owned firms were in the middle (about 70% in both years). Note that these estimates represent the best guesses based on currently available information; better estimates can be derived once information on I/O coefficients by firm ownership becomes available.

4. Concluding Remarks

The use of imported inputs in the production for exports reduces domestic content in a nation's exports. By being able to receive tariff exemptions on imported inputs, processing exports are likely to have especially low domestic value added per unit of exports.

In this paper, we first present a general framework in assessing the shares of domestic and foreign value added in a country's exports when tariff-favored processing exports are pervasive. This formula nests the existing best known approach (HIY, 2001) as a special case. Because some of the I/O coefficients called for by the new formula are not readily available from conventional I/O tables, we propose an easy-to-replicate mathematical programming procedure to estimate these coefficients by combining information from detailed trade statistics (which records processing and normal exports/imports separately) with conventional input-output tables. This methodology should be applicable to Vietnam, Mexico, and may other countries that engage in a significant amount of processing exports.

By applying our methodology to Chinese data, we have found several interesting patterns. First, we estimate that the level of foreign content in Chinese exports is close to 50%, almost twice as high as what we calculate by using the HIY formula. Second, we find interesting heterogeneity across sectors: those sectors that are likely to be labeled as sophisticated or high-skilled, such as computers, electronic devices, and telecommunication equipment, tend to have especially low shares of domestic content. Conversely, many sectors that are relatively intensive in low-skilled labor, such as apparel, are likely to exhibit a high share of domestic content in China's exports. Finally, we find that foreign invested firms (including both wholly-owned foreign firms and Sino-foreign joint venture firms) tend to have a relatively low share of domestic content in their exports.

There are several areas in which future research can improve upon the estimation in this paper. First, we assign initial values of the direct domestic value added for processing exports at the industry level based on the information in a conventional I/O table. If a firm-level survey data becomes available that tracks the direct value added for processing and normal exports separately, we can improve the accuracy of our estimates. Second, as an inherent limitation of an I/O table, the input-output coefficients are assumed to be fixed - that's the nature of a Leontief technology - rather than be allowed to respond to price changes. This could be problematic when a big change in export volume, such as what China has been experiencing, induces a change in the world market price for imported inputs, which in turn could trigger a change in the underlying production technology and in the corresponding I/O coefficients. These could be fruitful areas for future research.

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Figure 1: Input-output table with separate production account for processing trade

<table>
<tr><td colspan="2"></td><td></td><td colspan="2">Intermediate use</td><td colspan="2"></td></tr>
<tr><td colspan="2" rowspan="2"></td><td></td><td>Production for domestic use & normal exports</td><td>Production of processing exports</td><td>Final use (C+I+G+E)</td><td>Gross Output or Imports</td></tr>
<tr><td>DIM</td><td>1,2,…, N</td><td>1,2,…, N</td><td>1</td><td>1</td></tr>
<tr><td rowspan="2">Domestic Intermediate Inputs</td><td>Production for domestic use & normal exports (D)</td><td>1
.
.
.
N</td><td>Z^{DD}</td><td>Z^{DP}</td><td>Y^{D}</td><td>$X-E^{P}$</td></tr>
<tr><td>Processing Exports (P)</td><td>1
.
.
.
N</td><td>0</td><td>0</td><td>E^{P}</td><td>E^{P}</td></tr>
<tr><td colspan="2">Intermediate Inputs from Imports</td><td>1
.
.
.
N</td><td>Z^{MD}</td><td>Z^{MP}</td><td>Y^{M}</td><td>M</td></tr>
<tr><td colspan="2">Value-added</td><td>1</td><td>V^{D}</td><td>V^{P}</td><td colspan="2" rowspan="2"></td></tr>
<tr><td colspan="2">Gross output</td><td>1</td><td>$X-E^{P}$</td><td>E^{P}</td></tr>
</table>

Table 1: Processing Manufacturing Exports (excluding HS Chapters 1-27), 1996-2006

Year	*Share of processing exports in total exports (100*PE/TE)*	*Share of Processing & assembling*	*Share of Processing with imported materials*	*Share of processing imports in total imports*	*Ratio of processing imports to processing exports(100*PM/PE)*	*Processing trade surplus as share of processing exports (100*[PE-PM]/PE)*
1996	62.1	18.0	44.1	47.6	71.1	28.9
1997	**60.2**	**17.9**	**42.3**	**53.1**	**67.0**	**33.0**
1998	62.0	18.3	43.7	52.0	63.3	36.7
1999	61.2	19.9	41.3	47.9	64.7	35.3
2000	59.6	17.9	41.7	46.6	65.9	34.1
2001	59.7	17.2	42.5	43.0	62.7	37.3
2002	**58.8**	**15.6**	**43.2**	**45.6**	**67.4**	**32.6**
2003	58.5	13.2	45.4	44.0	66.7	33.3
2004	58.0	12.0	46.0	45.3	66.6	33.4
2005	57.0	11.3	45.7	48.3	64.6	35.4
2006	**54.5**	**9.9**	**44.6**	**47.9**	**61.7**	**38.3**

Source: China Customs Trade statistics, General Customs Administration of China.

Table 2: Final Use of Chinese Imports (in percent of total imports), 1997-2006

Year	Share of Intermediates		Share of Capital goods		Share of final Consumption
	for processing exports	for normal use	for processing exports	for normal use	
1997	51.2	28.2	12.1	7.3	1.2
2002	38.3	38.5	10.3	11.1	1.8
2006	35.7	43.5	10.0	9.1	1.7

Source: Authors' calculations based on the United Nation Broad Economic Categories (UNBEC) classification scheme, and Chinese trade statistics on normal and processing imports.

Note: "Normal use" refers to "normal exports and domestic sales." The UNBEC scheme classifies each HS 6-digit product into one of three categories: "intermediate inputs," "capital goods," and "final consumption." For the first two categories, we further decompose the imports into two subcategories: "processing imports" by customs declaration are classified as for processing exports, and the remaining imports are classified as for normal use. Capital goods are part of the final demand in a conventional I/O model. However, this classification may under-estimate the import content of exports. We therefore also experiment with classifying a fraction of the capital goods as inputs used in current year of production. This is discussed in Section 3.2.

Table 3 Shares of domestic and foreign value added in total exports (%)

	The HIY Method			The KWW Method		
	1997	2002	2006*	1997	2002	2006*
All Merchandise						
Total Foreign value-added	17.6	25.1	26.3	47.7	46.1	49.3
Direct foreign value-added	*8.9*	*14.7*	*15.7*	*46.1*	*42.4*	*45.7*
Total Domestic Value-added	82.4	74.9	73.7	52.3	53.9	50.7
Direct domestic value-added	*29.4*	*26.0*	*25.3*	*23.7*	*20.1*	*19.2*
Manufacturing Goods Only						
Total Foreign value-added	19.0	26.4	27.1	52.4	48.7	50.6
Direct foreign value-added	*9.7*	*15.6*	*16.3*	*50.9*	*45.0*	*47.0*
Total Domestic Value-added	81.1	73.6	72.9	47.6	51.3	49.4
Direct domestic value-added	*27.5*	*24.6*	*24.6*	*21.2*	*18.5*	*18.4*

Notes: The HIY method refers to estimates from using the approach in Hummels, Ishii, and Yi (2001). The KWW method refers to estimates from using the approach developed in this paper that takes into account special features of processing exports. The estimates for 2006 are preliminary as they use the trade statistics in 2006 but the I/O table in 2002, which is the latest available. The next one (the 2007 benchmark table) is scheduled to be released in 2010.

Table 4: Domestic and Foreign Values Added: Processing vs. Normal Exports

(in percent of total exports)

	Normal Exports			Processing Exports		
	1997	2002	2006*	1997	2002	2006*
All Merchandise						
Total Foreign value-added	5.3	10.8	11.3	81.9	74.3	81.9
Direct foreign value-added	*1.9*	*4.5*	*4.6*	*81.7*	*72.5*	*80.9*
Total Domestic Value-added	94.7	89.2	88.7	18.1	25.7	18.1
Direct domestic value-added	*34.4*	*31.0*	*29.3*	*15.0*	*11.4*	*10.5*
Manufacturing Goods Only						
Total Foreign value-added	5.7	11.6	11.7	82.3	74.9	82.3
Direct foreign value-added	*2.1*	*4.9*	*4.8*	*82.2*	*73.0*	*81.4*
Total Domestic Value-added	94.3	88.4	88.3	17.7	25.1	17.7
Direct domestic value-added	*30.9*	*28.5*	*28.3*	*15.0*	*9.5*	*10.4*

The estimates for 2006 are preliminary as they use the trade statistics in 2006 but the I/O table in 2002, which is the latest available. The next benchmark I/O table - the 2007 table - is scheduled to be released in 2010.

Table 5 Domestic Value-added Share in Manufacturing Exports by Sector, 2002

Industries	Processing exports in percent of industry exports	FIE exports in percent of industry exports	Non -processing		Processing		Weighted sum		Share in China's total exports to the World
			Direct domestic value-added	Total Domestic Value-added	Direct domestic value-added	Total Domestic Value-added	Direct domestic value-added	Total Domestic Value-added	
Electronic computer	99.1	99.4	14.5	80.6	3.9	3.9	4.0	4.6	1.3
Telecommunication equipment	91.2	88.4	28.1	82.8	5.4	8.4	7.4	14.9	3.4
Cultural and office equipment	93.4	71.6	6.1	70.7	12.8	15.5	12.4	19.1	4.6
Other computer peripheral equipment	99.2	87.6	40.7	81.0	8.4	19.1	8.7	19.7	6.2
Electronic element and device	89.7	87.5	31.7	86.9	12.7	14.8	14.7	22.2	3.6
Radio, television and communication equipment and apparatus	90.6	62.3	35.5	77.9	8.2	31.2	10.8	35.5	5.6
Household electric appliances	79.1	56.9	27.5	88.0	7.1	23.7	11.4	37.2	2.1
Plastic products	64.5	51.2	26.2	82.8	10.3	12.5	16.0	37.4	2.6
Generators	76.8	55.8	26.1	87.1	11.1	25.2	14.6	39.6	1.0
Instruments, meters and other measuring equipment	68.6	51.8	40.8	89.2	14.2	20.7	22.5	42.2	2.0
Printing, reproduction of recording media	83.0	62.7	42.5	90.7	19.9	33.3	23.8	43.1	0.3
Other electric machinery and equipment	66.8	60.1	28.4	88.3	10.6	25.2	16.5	46.1	6.1
Leather, fur, down and related products	54.3	50.3	24.1	92.3	8.8	12.0	15.8	48.7	4.9
Man-made chemical products	58.3	65.4	21.9	79.0	10.1	30.2	15.0	50.5	0.3
Toys, sporting and athletic and recreation products	72.9	57.3	43.5	89.0	19.4	39.7	25.9	53.0	3.3
Arts and crafts products	53.8	36.9	29.8	90.5	13.5	22.8	21.0	54.1	1.3
Special chemical products	46.9	48.4	24.2	81.9	12.3	24.1	18.6	54.8	0.9
Petroleum and nuclear processing	32.1	24.9	15.4	78.2	5.6	8.2	12.2	55.7	0.9
Ship building	95.8	21.0	26.1	84.7	15.8	55.5	16.3	56.8	0.7
Metal products	43.2	45.6	24.8	88.8	10.3	16.7	18.5	57.7	4.8
Other general industrial machinery	43.7	43.7	28.4	89.7	13.4	18.0	21.9	58.4	3.7
Paper and paper products	50.7	57.0	29.8	88.9	12.7	29.7	21.2	58.9	0.6
Nonferrous metal smelting	45.0	17.4	22.4	87.6	10.8	26.1	17.2	59.9	0.9
Other transport equipment	41.2	50.5	26.0	84.4	12.9	26.1	20.6	60.4	1.3
Rubber products	53.1	44.4	29.9	90.2	12.4	35.4	20.6	61.1	1.7
Other manufacturing products	48.8	39.1	30.1	90.7	12.8	30.2	21.7	61.2	0.6
Other special industrial equipment	39.9	44.0	27.9	89.1	12.9	21.7	21.9	62.1	1.4
Steel-smelting	58.8	86.1	25.6	89.8	13.2	43.8	18.3	62.7	0.0
Nonferrous metal pressing	46.9	48.7	17.2	84.6	7.8	43.9	12.8	65.5	0.4
Wearing apparel	45.1	39.2	30.6	91.2	11.9	37.6	22.1	67.0	7.5
Motor vehicles	37.8	28.4	26.4	88.2	8.8	33.8	19.8	67.6	0.2

Parts and accessories for motor vehicles and their engines	34.3	54.9	27.2	88.5	10.9	28.7	21.6	68.0	0.7
Chemical products for daily use	36.3	43.6	32.7	86.5	9.6	36.3	24.4	68.3	0.4
Other electronic and communication equipment	84.9	84.9	11.8	54.1	28.9	71.2	26.3	68.6	2.0
Cotton textiles	28.7	28.8	24.4	90.5	10.9	14.7	20.5	68.8	3.5
Chemical fibers	20.5	29.2	21.6	81.2	9.4	24.6	19.1	69.6	0.0
paints, varnishes and similar coatings, printing ink and mastics	29.1	44.4	23.1	83.7	8.8	36.5	18.9	70.0	0.5
Stationary and related products	39.4	42.6	28.2	86.9	12.3	44.7	21.9	70.3	0.2
Woolen textiles	37.7	42.6	24.1	91.9	9.3	35.3	18.6	70.5	0.4
Glass and glass products	33.0	48.8	35.9	87.6	16.8	37.7	29.6	71.1	0.6
Knitted and crocheted fabrics and articles	31.6	34.1	32.1	90.8	14.0	34.5	26.4	73.0	6.3
Alloy iron smelting	40.8	13.1	28.0	87.0	14.1	58.7	22.3	75.5	0.3
Chemical pesticides	6.2	14.4	25.8	78.2	11.8	34.3	24.9	75.5	0.2
Textiles productions	24.0	31.8	27.3	90.3	14.1	30.0	24.1	75.8	1.6
Boiler, engines and turbine	26.6	28.4	30.4	86.3	13.6	46.9	26.0	75.8	0.4
Railroad transport equipment	19.9	5.9	28.5	86.7	14.9	33.1	25.8	76.0	0.1
Furniture	47.2	56.8	28.7	88.5	12.9	62.3	21.2	76.1	1.8
Products of wood, bamboo, cane, palm, straw	19.6	45.6	28.1	87.8	11.6	30.4	24.9	76.5	1.1
Iron-smelting	23.7	3.0	23.2	88.1	11.6	53.9	20.5	79.9	0.1
Basic chemicals	11.7	18.8	29.3	86.8	12.9	29.5	27.3	80.1	2.1
Medical and pharmaceutical products	16.9	28.7	39.0	91.1	11.5	33.8	34.3	81.4	0.8
Agriculture, forestry, animal husbandry and fishing machinery	17.8	20.8	28.9	88.0	14.4	52.9	26.3	81.8	0.1
Hemp textiles	19.5	19.5	23.7	90.8	12.5	49.1	21.5	82.7	0.3
Pottery, china and earthenware	11.4	33.1	32.8	89.5	15.1	35.8	30.7	83.4	0.7
Metalworking machinery	13.3	27.0	32.3	88.7	16.8	49.4	30.2	83.4	0.2
Steel pressing	16.0	16.8	26.6	90.0	12.5	48.7	24.3	83.4	0.4
Chemical fertilizers	4.5	21.7	23.5	86.6	9.9	27.7	22.9	84.0	0.1
Fireproof materials	19.1	49.8	41.5	92.2	15.9	52.9	36.6	84.7	0.1
Other non-metallic mineral products	14.0	35.7	34.1	91.7	17.2	53.4	31.7	86.4	0.4
Cement, lime and plaster	7.0	77.7	27.9	91.2	20.3	22.9	27.4	86.4	0.1
Coking	2.6	5.3	34.3	92.7	13.9	52.2	33.8	91.6	0.3
Total manufacturing Goods except food	55.7	52.0	31.0	89.2	11.4	25.7	20.1	53.9	**100.0**

Table 6: Shares of Domestic Value Added in Exports by Firm Ownership (%)

The estimates for 2006 are preliminary as they use trade statistics in 2006 but the I/O table in 2002, which is the latest available. The next benchmark I/O table (the 2007 table) is scheduled to be released

	Share of Total Domestic Value-added	*Share of Direct Domestic Value-added*	Share of processing exports in total exports	*Share of exports by firm ownership in China's total exports*
2002				
Wholly Foreign Owned	**32.6**	14.2	87.9	*29.4*
Joint Venture Firms	44.1	16.4	71.0	*22.6*
State Owned Firms	69.7	25.2	31.8	*37.9*
Collectively Owned Firms	72.3	24.5	28.1	*5.8*
Private Firms	**83.7**	28.3	8.7	*4.3*
All Firms	**53.8**	**20.1**	**55.9**	***100.0***
2006*				
Wholly Foreign Owned	27.8	13.3	85.3	*39.3*
Joint Venture Firms	44.8	17.5	63.1	*18.6*
State Owned Firms	70.0	24.6	27.1	*19.8*
Collectively Owned Firms	70.9	24.2	24.7	*4.3*
Private Firms	82.0	27.4	10.3	*18.0*
All Firms	**50.9**	**19.3**	**53.6**	***100.0***

in 2010.