



Domestic Value-added in China's Exports and its Distribution by Firm Ownership

Hong Ma . Zhi Wang . Kunfu Zhu

Tsinghua . USITC. CAS

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What we do?

- Decompose gross exports into domestic and foreign value added by ownership type and trade mode ;
- Estimate factor ownership by firm type based on firm level data to further study how domestic value-added generated from production of exports is distributed among various factor owners thus quantify gross national income generated from exports;
- Split every sector in the conventional IO table into several sub-accounts, incorporating firm heterogeneity into the IO-based approach to reduce aggregate bias in measuring DVA in exports.
- Use constrained optimization to estimate the volume of inter-firm transaction flows.
- our empirical estimation is based on Chinese data, but our methods can be used to portray the domestic intra-firm IO linkages of any countries.



Aggregation bias in standard SUTs and IOTs

- Standard IO table assumes that only one single homogenous production technology exists for all of the firms (and all of the products) in the same industry classification, a single average production technology is assumed to produce the entire output of an industry. In reality, different firms, even those produce the same products, often use different production technologies, and thus have different IO coefficients and import intermediate use intensities.
- However, any empirical works based on real world data have to involve some degree of aggregations, such “aggregate bias” therefore cannot be completely eliminated, it only can be reduced. The challenge for statistician is how to minimize such “aggregation bias” under given resource constraints.



Firm heterogeneity really matters

Final use of total imports-2007, China

% of total imports

Firm type	Imported intermediate		Imported capital goods		Share of exports	
	processing	normal	processing	normal	processing	normal
Wholly-Foreign	58.1	18.1	17.6	2.7	83.9	15.8
SOE	10.7	73.5	2.1	11.3	27.0	64.9
Private	12.2	65.9	1.5	13.3	10.0	83.6
All	32.7	47.3	9.0	7.6	51.6	44.9

FIEs use significantly higher imported intermediate inputs for processing exports, but significantly lower imported inputs for normal exports and domestic sales. Their trading behavior are very different from COEs.



Domestic and foreign value-added in Mexico manufacturing exports - 2003

3 digit NAICS vs. 4 digit NAICS with and without firm heterogeneity

	HIY Method	KWW Method	
Based on 3-digit NAICS I-O Table		Lower bound ^a	Upper bound ^b
Total Foreign value-added	48.9	55.0	70.5
Direct foreign value-added	44.0	51.8	68.9
Total Domestic Value-added	51.1	45.0	29.5
Direct domestic value-added	28.0	24.1	16.7
Based on 4-digit NAICS I-O Table			
Total Foreign value-added	46.6	52.4	66.2
Direct foreign value-added	42.4	49.9	64.5
Total Domestic Value-added	53.4	47.6	33.8
Direct domestic value-added	32.4	28.8	20.3



Firm heterogeneity really matters

- The difference from trade regime aggregation is much larger than the difference from more aggregated sector classifications. There is only about 2-4 percentage point difference in domestic or foreign content share estimates between the 3-digit and 4-digit NAICS classification regardless using the HIY or KWW formula
- However, the estimated shares are nearly 10 and 20 percentage point different depend on whether treat processing and normal trade separately. This clearly shows that taking different institution arrangement into account are much important than more detailed industrial classifications, a finding consistent with what KWW(2012) found using Chinese data.



Identify what is the most important firm heterogeneity from micro data

- Firm heterogeneity (import use intensity in our case) within each industry is identified by linking the NBS enterprises survey and the Customs' firm-level trade data.
- Combine information from two datasets
 - the Annual Surveys of Industrial Production (ASIP) for 2007
 - the firm-level export and import transaction for 2007, from China's General Administration of Customs (CGAC)
- Split firms into four groups:
 - processing exports by COEs (CP)
 - processing exports by FIEs (FP)
 - normal exports and domestic sales by COEs (CN)
 - normal exports and domestic sales by FIEs (FN).



Export structure by firm types

% of exports in 2007

		trade regime	
		normal	processing
Ownership	COEs	35.08	8
	FIEs	13.25	43.66



Mean and percentile comparisons in input intensity among groups

Imported input/total input

Type	Freq.	mean	variance	p50	p75	p90
CP	4,112	0.144	0.127	0.028	0.124	0.392
FP	22,495	0.436	0.655	0.217	0.536	0.899
CN	41,885	0.003	0.000	0.000	0.000	0.000
FN	24,136	0.037	0.015	0.000	0.002	0.089



Results from Scheffe multiple-comparison tests

All group means are significantly different from each other:

- within processing exports, FP firms, on average, use significantly more imported input over total input as compared with CP firms;
- within FIEs, FN firms, on average, use a significantly less proportion of imported input than FP firms;
- within COEs, CN firms, on average, use significantly less proportion of imported input than CP firms.
- Firms under different groups have distinct patterns of input usage.
- Similar patterns are also found when the mean and variance of import intensity are compared across four types of firms within each manufacturing sector



Why we do not further split normal exporter and non-exporters, which may further reduce the aggregate bias

➤ Lack of data to estimate IO coefficients:

Although there are a large number of non-exporting producers in the ASIP data, no information is available on where their intermediate inputs are sourced from.

➤ Incentive mechanism special to China:

Under the processing regime, firms can obtain imported intermediate inputs free of tariffs and value-added taxes (VAT). When importing inputs is necessary to fulfill its export contracts, a firm tends to import under processing regime. While the difference between normal exporters and firms that sell only to domestic market in terms of imported input use intensity may not be as significant without such incentives. VAT ranges from 13-17 percent. In addition, being recognized as “processing importer” reduces the procedures for tax “collection” and then “rebate”, since value-added tax is not collected for imported intermediate goods under processing trade regime.



Domestic value-added in exports and domestic income from exports

- Domestic value-added is value-added generated by domestic producers. This includes value-added generated by all type enterprises operating in domestic territory, a concept that is consistent with a country's GDP statistics.
- This production side concept is different from income from trade. How domestic value-added generated from production is distributed to different type of factor owners, such as workers obtain compensation and capitals gain profits, is an different issue, which converts domestic value-added generated from production into gross income to various factor owners thus contribute to a country's GNI.



Split factor income for each type of firms within a sector

- The combined dataset also provides information for all four types of industrial firms on foreign share in total paid-in capital, and detail decomposition of total value added, including labor compensation and capital income
- BOP table compiled by PBC provide additional information to identify income transfer from domestic value-added to foreign factor owners. More specifically, we use the sector-level income table (expenditure side) in BOP. Foreign investment income accounts for nearly 95% of the total foreign factor income



Structure of the Spitted IO Table

Output Input		Intermediate use by COEs		Intermediate use by FIEs		Final use	Exports	Gross Output or Imports
		N	P	N	P			
Domestic Intermediate input of COEs	N	Z^{CCN}	Z^{CCP}	Z^{CFN}	Z^{CFP}	Y^C	E^{CN}	$X^C - E^{CP}$
	P	0	0	0	0	0	E^{CP}	E^{CP}
Domestic Intermediate input of FIEs	N	Z^{FCN}	Z^{FCP}	Z^{FFN}	Z^{FFP}	Y^F	E^{FN}	$X^F - E^{FP}$
	P	0	0	0	0	0	E^{FP}	E^{FP}
Imports		Z^{MCN}	Z^{MCP}	Z^{MFN}	Z^{MFP}	Y^M	0	M
Value added		V^{CN}	V^{CP}	V^{FN}	V^{FP}			
Gross Input		$X^C - E^{CP}$	E^{CP}	$X^F - E^{FP}$	E^{FP}			
Foreign income		G^{CN}	G^{CP}	G^{FN}	G^{FP}			



Distribution of Domestic Value-added by Firm Types (%), 2007

	COEs exports			FIEs exports		
	normal	processing	<i>total</i>	normal	processing	<i>total</i>
Gross exports	35.1	8.0	43.1	13.2	43.7	56.9
Domestic Value-added	49.9	4.8	54.7	17.8	27.5	45.3

FIE created about 45% China's domestic value-added in Chinese exports, while Chinese domestic processing firm only contribute less than 5%



Distribution of Domestic Value-added by Sector and Firm Types (%), 2007

Low DVS sectors

Industry						Process
	CP	FP	CN	FN	Total	ing share
Household Audiovisual Apparatus	27.5	25.4	77.3	74.7	30.3	91.0
Electronic Component	36.8	21.9	72.8	76.7	31.4	83.1
Cultural and office equipment	37.7	27.6	75.2	75.5	33.1	90.5
Telecommunication equipment	33.3	33.2	74.7	66.8	39.6	83.1
Generators	31.3	27	80.5	71.1	40.4	73.9
Electronic computer	19.7	42.4	66.2	70.9	42.5	94.7

More sophisticated products have lower DVA share



Distribution of Domestic Value-added by Sector and Firm Types (%), 2007

High DVS sectors

Industry						proces
	CP	FP	CN	FN	Total	sing share
Other non-metallic mineral products	65.2	62.7	87.5	72.7	82.5	11.3
Fire-resistant Materials	63.1	60.1	88.2	81.3	82.5	9.4
Medicines	60	58.1	87.9	83.7	82.9	13.9
Hemp textiles	64.1	62.5	88	80.7	84.8	9.9
Cement, Lime and Plaster	61.2	43	89.8	81.7	86.2	2.8
Coking	N/A	N/A	90.8	73.9	88.8	0



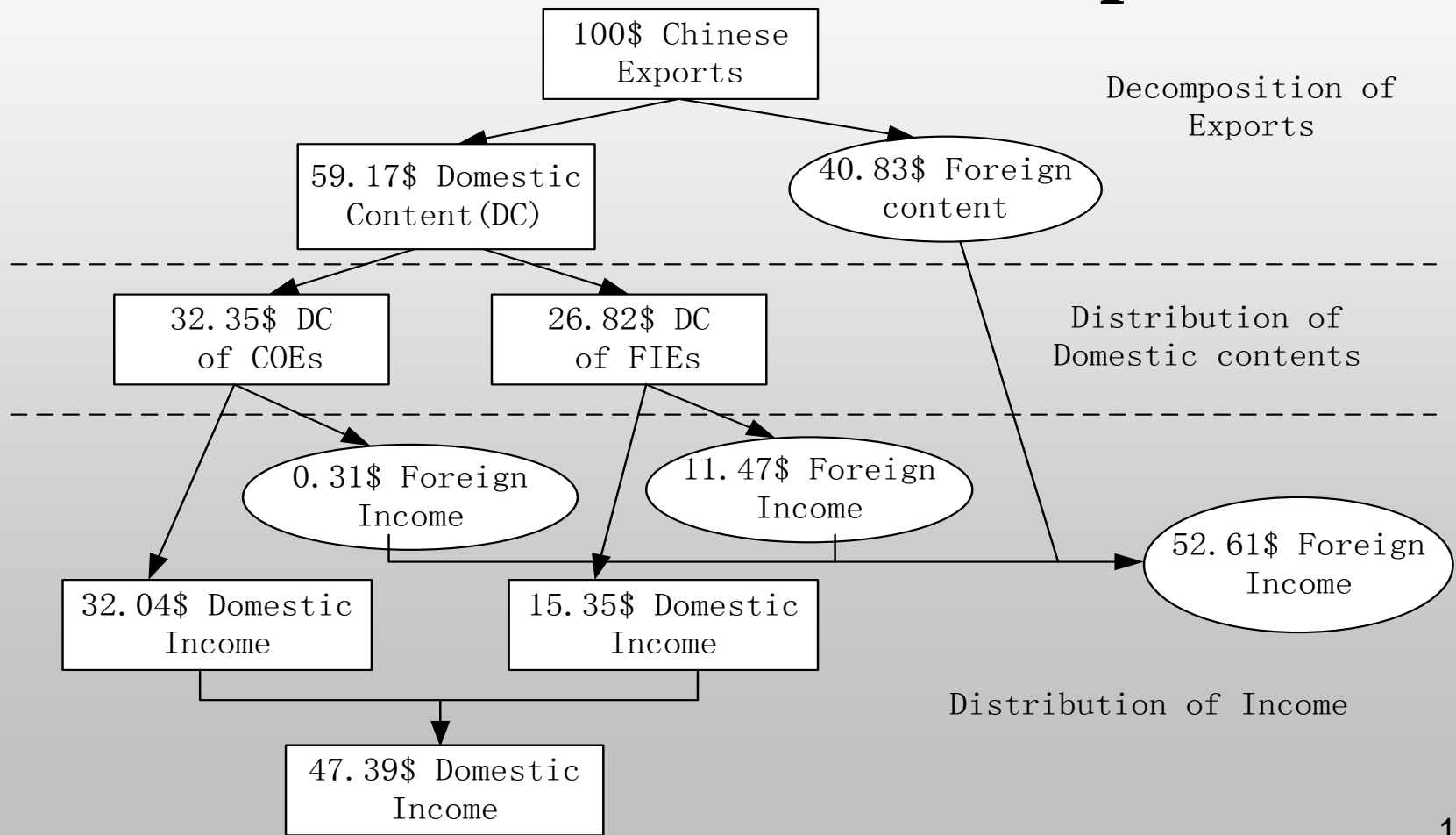
National Income and Foreign Income Share in China's Exports, 2007 (%)

	Processing exports		Normal exports		Aggregate
	COEs	FIEs	COEs	FIE	
Total DVS	35.5	37.3	84.1	79.5	59.2
Total FVS	64.5	62.7	15.9	20.5	40.8
Total DNI	35.0	21.0	83.4	46.8	47.4
Total FNI	65.0	79.0	16.6	53.2	52.6

- Within trade mode, DVA share are similar, but DNI share differ
- FNI share are much higher for processing exports, regardless of ownership
- Income transfer from DVA in exports to foreign factor owner is higher for FIEs



DVS Estimates and Income Distribution of 100\$ Chinese Gross Exports





Conclusion

- We explore the usefulness of firm level production and trade data to reduce the aggregate bias in measuring domestic value-added in a country's gross exports.
- We also explore the statistically meaningful way of separating different group of firms within an industry based on available micro data collected by national statistical agencies.
- We extended the KWW(2012) and Chen et al (2012) by considering firm ownership thus able to measure the distribution of domestic value-added in exports across domestic and foreign factor owners – similar to the concept of GNI.
- We find that FIEs operating in China created nearly 45% of the domestic value-added in Chinese exports, whereas processing COEs only contributed by less than 5%; in terms of income distribution, about 52.6% of the value of Chinese exports was captured by foreign factor owners.



Variables to be estimated

Variables ($o, l=C, F, k =N, P$)	Definition	# unkno wns
z_{ij}^{olk}	Intermediate good i produced by type o firms and used by type l firms and trade mode k in sector j	$8n^2$
z_{ij}^{mlk}	Intermediate good i imported to be used by firms of type l in sector j for trade mode k	$4n^2$
v_j^{lk}	Value added by l type firms in sector j for trade mode k	$4n$
y_j^l	Final goods used domestically produced by l type firms in sector j	$2n$



What we know from official statistics

x_j, v_j, y_j, e_j, m_j	Output, value added, final demand, and export and imported intermediates by sector, from the official I/O table
z_{ij}	Goods i used as intermediate inputs in sector j , without distinguishing ownership and trade mode, from the official I/O table
x_j^l, v_j^l	Output and value added by <i>type</i> l firms in sector j , known from the ASIP data the official I/O table, and China Statistical Yearbook.
y_j^m	Imported final goods of sector j , known from trade statistics and the official I/O table.
m_j^{lk}	Normal and processing imported intermediate inputs of sector j by FIEs and COEs respectively, known from the combined dataset and the official I/O table
e_j^{lk}	Normal and processing exports of sector j by FIEs and COEs respectively, known from the combined dataset and the official I/O table