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Prof. Dr. Hans-Theo Normann
Düsseldorf Institute for Competition Economics (DICE)
Tel +49 (0) 211-81-15125, E-Mail normann@dice.hhu.de

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Born Similar, Develop Apart: Evidence on Chinese Hybrid Exporters

Xiaodong Bie Andrea Ciani*

July 2021

Abstract

Processing trade is often a leading channel for the internationalization of firms in emerging economies and to foster their integration in Global Value Chains (GVCs). This study investigates differences in performance among Chinese exporting firms differently involved in processing trade. We distinguish firms pursuing only processing trade from firms which are also involved in ordinary trade (hybrid exporters). We rely on detailed balance sheet data and on customs data on firm transactions for the period 2000-2007. Results show that hybrid exporters outperform firms exclusively involved in processing trade in terms of value added, productivity, profits, product quality, and revenue in the different export destinations. We find that this difference in performance is associated with the increase in Chinese domestic value added. Hybrid exporters can rely to a larger extent than purely processing exporters on domestic inputs which, during this period, benefited from remarkable increases in productivity.

JEL classification: F01, F10, F14, O1.

Keywords: Processing trade, Firm productivity, Domestic value added.

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Contact information:

X. Bie, Düsseldorf Institute for Competition Economics, Heinrich-Heine-Universität Düsseldorf. E-mail: Bie@dice.hhu.de.

A. Ciani, Joint Research Centre (JRC), European Commission. E-mail: Andrea.Ciani@ec.europa.eu.

1 Introduction

Export processing is a trade regime in which producers of final products offshore the last stages of production to manufacturers based in emerging economies. Under this regime, the various components of a final product are manufactured in different parts of the globe from where they are shipped to the country home of the processing firm for final assembly. Assembled products are then exported back, mostly to developed economies. Processing trade has been adopted by developing countries to benefit from their low labor cost and integrate into the final steps of Global Value Chains (GVCs). Export processing and offshoring have sizable effects on the host economies for what concerns employment volatility (Bergin et al., 2009, 2011) and returns to skills (Sheng and Yang, 2017). Processing trade accounted for the majority of Chinese exports in the first decade of the 2000s and for 25 percent of China's total trade in 2019 thus representing a relevant share of the country's trade surplus.[1]

The literature has shown that the low productivity of processing exporters affects trends in aggregate productivity in China (Dai et al., 2016). Nevertheless, Chinese exporters can pursue processing trade to a different extent, as firms can decide whether to devote some production lines to processing trade and others to ordinary trade, within the same plant. Our aim is to investigate the relation between firm performance and the relevance of processing trade for firm's exports. Given this, we first distinguish those exporters that are only involved in processing trade from those which are also doing ordinary trade (hybrid exporters). We then assess differences in performance between these firms and investigate the economic channels determining them, focusing both on external and internal factors to the firm.

Our empirical investigation relies on two sources of data. The *Annual Survey of Industrial Firms* (ASIF) available from the National Bureau of Statistics of China for the period 2000-2007 and the *Chinese Customs Trade Statistics* (CCTS), for the period 2000-2007, available from the General Administration of Customs of China. ASIF provides balance sheet data on a panel covering all state-owned firms and non-state-owned firms with annual sales of more than 5 million RMB. CCTS provides detailed information on import and export transactions at the product level for Chinese exporters.

We first focus on differences in performance between purely processing and hybrid exporters.[2] Taking into account relevant firm-level determinants and unobserved factors varying at the industry-province level over time, we find that hybrid exporters report 13.7 percent higher value added, 21.6 percent higher profit, 10 percent higher revenue, 17.5 percent higher labor productivity and, on average, 10.6 percent higher total factor productivity (TFP), compared to purely processing firms. Our estimates also show that hybrid firms

[1]Data obtained from the General Administration of Customs (GACC), People's Republic of China.

[2] We are not studying the behavior of regime switchers as our aim is to compare the performance of firms which are either pure processing or hybrids each of the years under investigation.

report higher revenues from their processing exports than purely processing firms when shipping the same products to the same destination markets.

Firms' participation in distinct trade regimes can be endogenously determined by their inherent differences in traits, as less productive and more financially constrained firms might self-select into only-processing trade flows while productive firms might be more engaged in ordinary trade (Dai et al., 2016; Manova and Yu, 2016). We observe that processing trade accounts for a large share of exports from hybrid firms in our sample. In our empirical investigation, we control for firm-level characteristics which might affect the choice of the trade regime.

We focus on firm-level domestic value added in exports which measures the total, domestically created, value contained in exports as the factor explaining differences in performance. We find that hybrid firms report a higher domestic value-added ratio (DVAR) of processing exports as they are able to benefit from the increased productivity of domestic input suppliers (Kee and Tang, 2016).[3] The DVAR of processing exports of hybrid exporters is positively associated with firm-level performance. An increase in DVAR by one unit increases value added by 9.0 percent, profit by 17.6 percent, and labor productivity by 10.3 percent. Our findings confirm that hybrid exporters substitute imported inputs with domestic inputs and achieve a higher DVAR. We show that firms benefiting from a higher DVAR operate in industries which receive more FDI inflows and benefit from larger reductions in input tariffs which stimulate competition and efficiency upgrading among Chinese input suppliers.

These factors lead hybrid firms to export products of higher quality, as measured by unit value and the quality proxy proposed by Khandelwal et al. (2013). Hybrid exporters also tend to import more equipment from abroad, spend more in R&D, and are more specialized as they supply a lower number of processed HS products to different destination markets than purely processing firms.

This paper is related to several strands of the literature. First, it is connected to studies analyzing the behaviour of exporting firms and learning by exporting. Van Biesebroeck (2005) and De Loecker (2007), find that exporting firms are more productive than non-exporting firms. Lu et al. (2010) show that this finding is mostly due to foreign-owned firms. Manova and Zhang (2012) find that Chinese exporters charging higher prices earn higher revenues in each destination, report larger worldwide sales, and enter more markets. De Loecker (2013) finds significant productivity gains from entering export markets, while Garcia-Marin and Voigtländer (2019) observe sizable efficiency gains after export entry which are then passed-on to customers via lower prices. The present study contributes to this strand of the literature by providing evidence on the different performance of Chinese exporters, depending on the trade regime under which they operate. Once

[3] As vertical integration might play a role in firms' decisions of input sources, we investigate differences in vertical integration between hybrid and pure processing exporters, and no significant difference is found. More details are reported in section 5.

taking into account several firm-level confounders, the trade regime chosen by exporters is associated with remarkable differences in outcomes.

A flourishing stream of the literature focuses on the implications of processing trade both at the aggregate and at the microeconomic level. Koopman et al. (2012) find that the domestic content of exports can be overestimated for those countries actively engaging in processing trade when employing traditional methods to calculate value added. Kee and Tang (2016) analyze the determinants of domestic value added focusing on Chinese processing exporters. They show that the substitution of domestic for imported materials by individual processing exporters led to an increase of China's domestic content in exports during the period 2000-2007.

Dai et al. (2016) find that pure processing exporters are less productive than non-processing exporters, and also report lower profitability, pay lower wages, and have lower capital intensity. They conclude that not distinguish between processing and non-processing exporters leads to the misleading finding that Chinese exporters in the early 2000s were less productive than non-exporting firms, as recently observed by Malikov et al. (2020). Manova and Yu (2016) investigate the choice between export processing and ordinary exports and argue that financial constraints are more binding for ordinary exports, thus leading firms with lower access to finance to specialize in export processing. Our analysis identifies the increase in domestic value added as a channel explaining the better performance of hybrid exporters with respect to purely processing exporters on top of credit availability, and highlights that gaps in performance are also associated with differences in the quality of exported products.

This study is also related to the vast literature on the effects of China's export boom given the centrality of GVCs (Grossman and Rossi-Hansberg, 2008; Costinot et al., 2013). Luck (2019) finds that Chinese exporters control a larger share of value added as firms move down the supply chain, towards final production. Johnson and Noguera (2012) show that the US-China trade imbalance in 2004 is 30 to 40 percent smaller when trade is measured in value added. Our findings suggest that Chinese exporters with access to domestic inputs report a better performance while still being placed in the final steps of the value chain.

This paper unfolds as follows. Section 2 outlines China's export processing regime. Section 3 describes the data at our disposal. Section 4 reports empirical evidence on the performance of firms operating under different trade regimes. Section 5 investigates the determinants of the performance of hybrid exporters. Section 6 reports robustness checks. The last section concludes.

2 Processing trade in China

China's processing trade refers to the trade regime where firms import part or all of the raw materials or intermediate inputs from abroad and re-export the finished products to foreign markets after assembly or processing. Processing trade stems from the early stage of China's reform and opening-up initiatives and was introduced with the aim of solving the contradiction between China's serious lack of capital and technology and the urgent need to open the country and integrate China with the global economy. The No. 80 document issued by the State Council of China in 1987 presented clear instructions for China to seize the favorable opportunity to further develop trade regimes such as processing and assembly with supplied inputs.[4] The document stated:

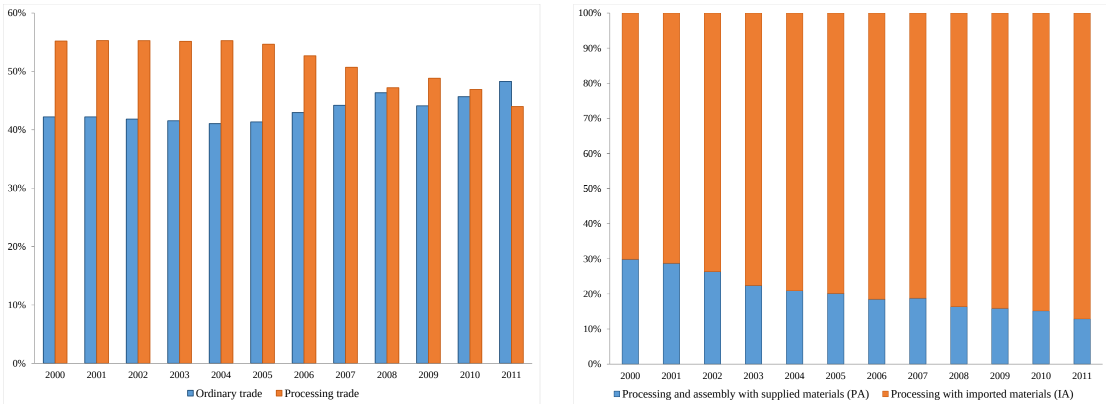
"[...] practice shows that the development of the trade regime of processing and assembly with supplied materials will help increase employment and the inflow of foreign currency, make up for insufficient funds, introduce advanced and applicable technologies, equipment, and scientific management methods. It enables firms to understand how international markets work and improve the quality of export products, and increases the country's fiscal revenue. [...] This trade regime is worth promoting."

China has implemented a number of special preferential policies to develop processing trade. First, according to the *Regulations Governing Customs Control on the Importation and Exportation of Goods for Inward Processing* (1988), imported inputs used for processing production are exempt from import tariffs and product taxes (or value-added tax), as long as all finished products are re-exported to foreign markets. Exports of processed finished products are also exempt from export tariffs. If only part of the finished product is exported, only the imported inputs used for export production are exempt from tariffs. Second, foreign-invested firms are granted the treatment of corporate income tax exemption for 2 years and halved taxation for 3 years from the tax year in which the first business income is computed. Moreover, during the period investigated in our study (2000-2007), two additional preferential policies were implemented. For foreign-invested firms located in special economic zones or engaged in production and located in economic and technological development zones, and for foreign firms setting up production in special economic zones, corporate income tax was levied at a reduced rate of 15 percent. Exporting firms also benefited from a specific income tax reduction conditional on annual exports accounting for more than 70 percent of the firm's total output. Since most firms involved in processing trade fulfill this last requirement, they were eligible for the tax incentive.

The superposition of multiple preferential policies greatly reduced investment costs associated with production for processing trade. Therefore, processing trade promoted the development of China's trade surplus

[4] Note forwarded by the General Office of the State Council given the Ministry of Economy and Trade's request for instructions on seizing favorable opportunities to further develop processing and assembly with supplied materials, 1987.

Figure 1: China's export composition in 2000-2011, by trade regime



(a) Gross export composition (b) Processing export composition

Source: China Customs Statistical Yearbook and CCTS.

by absorbing FDI and led China's integration into global value chains. As shown in Figure 1(a), before 2005, processing exports account for 55 percent of China's total exports. Hence processing trade is believed to be a center for the Chinese trade boom of the early 2000s. The proportion of processing exports declines after 2006 due to industrial development and ordinary exports accounting for the majority of Chinese exports after 2010.

Processing trade consists of two main subordinate trade regimes, processing and assembly with supplied materials (PA), and processing with imported materials (IA). The difference between these two is the ownership of the production materials. In the PA regime, foreign firms own production materials and supply firms engaged in processing production with inputs, while the latter only receive processing fees from assembling or processing inputs. In the IA regime, Chinese firms purchase inputs from abroad for processing production and then sell the finished products to the foreign firms. The PA regime generates little demand for domestic production materials as firms mostly do assembly and processing, whereas under the IA regime, firms have greater autonomy in production and might demand more domestic inputs. The greater the demand for domestic inputs, the stronger the promotion to the development of Chinese domestic suppliers. Figure 1(b) shows that in the period 2000 to 2011, the proportion of IA in China's processing exports expands from 70 percent in 2000 to 87 percent in 2011, implying that IA processing trade yields more domestic procurement and extends the domestic production chain. In section 6 we will discuss the effects of engaging in PA or IA on firm performance.

3 Data

Our empirical investigation relies on two sources of data. The *Annual Survey of Industrial Firms* (ASIF) available from the National Bureau of Statistics of China for the period 2000-2007, a panel covering all state-owned and non-state-owned firms with annual sales of more than 5 million RMB.[5] ASIF provides production statistics on Chinese industrial firms from mining and logging to manufacturing and public utilities, and provides financial information on the balance sheet, income statement, and cash flow statement of firms, as well as firm-specific information, such as firm name, the year and month of establishment, address, industrial classification, employment, and ownership structure. For instance, ASIF data for year 2004 covers 90 percent of total sales of all industrial firms in China, compared to the Chinese Economic Census for the same year. Since China's processing trade mainly comes from the manufacturing industry, we only rely on the records of manufacturing firms whose two-digit China's GB/T industry classification codes are between 13 and 42.[6] Following Dai et al. (2016), we drop: (1) records where the main variables are negative or missing, including industrial sales, export value, revenue, employment, total fixed assets, net fixed assets, and intermediate inputs; (2) records where the number of employees is less than 8; (3) records where the export value exceeds the total industrial sales, or the total assets are less than the total fixed assets or current assets, or the accumulated depreciation is less than the current year's depreciation; (4) records where the month of establishment is greater than 12 or less than 1, or the year of establishment is greater than the year of record; (4) trade intermediaries.[7]

The second database available to us is the *Chinese Customs Trade Statistics* (CCTS), for the period 2000-2007, available from the General Administration of Customs of China. CCTS provides detailed information on import and export transactions at the HS 8-digit level for Chinese trade flows, including the transaction value in US dollars, quantity, unit price, trade regime, exporting destinations or importing sources of each transaction, and firm-specific information such as firm name, zip code, and phone number. Since the Harmonized System was adjusted in 2002 and 2007, we convert all transaction records in our sample to the 2002 version of Harmonized System.

As the two datasets do not have a common identifier that allows us to match firm-level transaction data and production data, we first use the firm name as the identifier for matching. For records that fail to be matched by firm name, we use the last 7 digits of the phone number and the zip code as the second identifier. We eliminate the characters in the identifiers that would interfere with the matching so

[5] This is equivalent to 0.6 million US dollars based on the bilateral exchange rate in 2004.

[6] China's GB/T industry classification system is referred to as Chinese industry classification (CIC). The mapping between industry codes and names is provided in the Appendix.

[7] We draw on the method of Ahn et al. (2011) to identify trade intermediaries. The names of these firms have Chinese characters with the meaning of "exporter", "importer" or "trading" in English.

as to improve accuracy, and successfully merge 53 percent of exporters in ASIF.[8] The merged database includes 273,828 observations from 88,212 exporters, on average accounts for about 40 percent of China's total exports and 52 percent of processing exports from 2000 to 2007, giving then a good representation of aggregate Chinese exports.[9]

3.1 Measuring firm performance

The first goal of the present study is to assess differences in performance among firms differently involved in processing trade. Therefore, we classify exporters into three categories according to the trade regimes to which they refer each recorded year: (1) processing exporters ($Proc$), firms that only report processing exports each year; (2) non-processing exporters ($NProc$), firms that only report ordinary exports each year; (3) hybrid exporters ($Hybrid$), firms that report both ordinary and processing exports each year. The sample employed in the main body of this study excludes exporters that alter their trade regimes during the sample period, as we focus on the performance of exporters consistently participating in a given trade regime. Since our aim is to assess factors explaining possible differences in performance among firms pursuing processing trade, non-processing exporters are mostly considered for the robustness checks reported at the end of our empirical investigation.

Following the literature (Amiti and Konings, 2007; Halpern et al., 2015; Baggs and Brander, 2006), we consider firm productivity and profitability as indicators of firm performance. We employ revenue total factor productivity (TFP) and labor productivity ($lnLabPro$) as measures of the firm productivity. The literature on TFP (Brandt et al., 2012; Yu, 2015) uses the industry-level price index to deflate firms' sales, yet by doing so the heterogeneity of firms is ignored thus leading to a biased estimate (Klette and Griliches, 1996; Eslava et al., 2004; Foster et al., 2008; De Loecker, 2011). The magnitude of this bias increases when measuring productivity of multi-product firms. Most importantly, we investigate firm heterogeneity within industries so pricing heterogeneity is more important than one studying an industry-level treatment such as tariffs. In order to accurately capture the price trends of firms, we adopt the method proposed by Smeets and Warzynski (2013) to construct firm-level price index by means of the firm-product level trade information disclosed in CCTS and then deflate exporters' output. We employ the semi-parametric estimation methods developed by Olley and Pakes (1996) and Ackerberg et al. (2015) and measure total factor productivity as

[8] For example, firms may use parentheses in their names to indicate the locating city or industrial area, such as Sanyo Electric (Shekou) Co., Ltd. However, in ASIF and CCTS, one party may use full-angle parentheses while the other party may use half-angle parentheses, which leads to an unsuccessful match for the same firm. Hence the following characters are eliminated from the identifiers: full-width and half-width brackets, single and double quotes; hyphens, underline, dot, square brackets, slash, asterisk, and inequality signs. In this way we are able to merge more exporters compared to the literature. For instance, Dai et al. (2016) merge about 45 percent of exporters in ASIF for the period 2000 to 2006.

[9] Our merged data for exporters is comparable to Dai et al. (2016). Their data merged between ASIF and CCTS spans from 2000 to 2006, includes 225,853 observations from 68,865 firms. Table A1 in the Appendix demonstrates that the compositions of exporters by trade regime in the sample of Dai et al. (2016) and ours are very similar.

$TFP(OP)$ and $TFP(ACF)$.[10] We compute three variables using the statistical data provided by ASIF to measure the profitability of firms: value added (VA), profit ($Profit$), and revenue ($Revenue$). Following the procedure applied on productivity indicators, variables measuring profitability are also deflated using the firm-level price index.

3.2 Control variables

We control for firms' characteristics measuring inherent traits and financial constraints. We use the number of years a firm has been in operation (Age) to measure firm age, and use the number of employees ($Labor$) and total assets ($Asset$) of the firm to proxy firm size. In order to capture the ownership structure of firms, $Foreign\ share$ is the ratio between foreign capital and total capital. According to Manova and Yu (2016), financing constraints affect the choice of exporters on trade regimes, and firms facing tighter financial constraints tend to do processing trade. To reflect financial constraints faced by firms, we construct the variables $Liquidity$, which measures the difference between current assets and liabilities divided by total assets, and $Interest\ rate$, which is the ratio between expenses on interest and total assets. In addition, we take into consideration public subsidies received by each firm ($Subsidy$).

Table 1 provides a statistical description of the aforesaid variables for the different groups of exporters observed in our sample. Exporters engaged in different trade regimes seem to report differences in performance. On average, hybrid exporters report better results than processing exporters, and have better profitability, yet comparable productivity relative to non-processing (ordinary) exporters.[11] The three groups of exporters have different characteristics as well: as expected, processing exporters have the highest foreign share on average. Processing and non-processing exporters look similar to hybrid exporters looking at firm age. Hybrid exporters tend to be larger and receive more subsidies than processing exporters and non-processing exporters. At a first glance, the different groups do not report sizable differences in financial constraints.

[10] The Appendix provides details on the procedure followed to compute the two variables.

[11] TFP measures are demeaned by the average of 4-digit industry-year combinations.

Table 1: Descriptive statistics

	Count	Mean	Median	SD
Profitability and Productivity				
Panel A: Processing Exporters				
Value added	22,441	25,686.51	6,359	120,187.94
Profit	22,441	3,178.60	205.00	32,583.21
Revenue	22,441	119,641.90	27,417	658,243.48
TFP(OP)	21,739	-0.22	-0.24	1.05
TFP(ACF)	21,738	-0.16	-0.24	0.60
ln Labpro	21,741	3.14	3.03	1.21
Panel B: Hybrid Exporters				
Value added	37,312	41,903.14	9,809	251,353.23
Profit	37,312	8,031.40	803.00	53,956.42
Revenue	37,312	165,818.85	39,171.50	767,201.56
TFP(OP)	36,403	0.12	0.13	1.03
TFP(ACF)	36,376	0.04	-0.03	0.62
ln Labpro	36,413	3.69	3.63	1.22
Panel C: Non-processing Exporters				
Value added	56,239	19,234.21	5,525	156,057.52
Profit	56,239	4,175.68	479.00	60,744.32
Revenue	56,239	67,623.57	22,270	400,678.11
TFP(OP)	55,060	0.01	0.00	1.03
TFP(ACF)	55,037	0.04	-0.02	0.62
ln Labpro	55,066	3.72	3.65	1.21
Firm Characteristics				
Panel A: Processing Exporters				
Foreign share	22,381	0.89	1.00	0.27
Age	22,441	8.39	8.00	4.54
Employment	22,441	492.11	250.00	839.65
Total assets	22,441	82,866.38	25,619	339,051.30
Subsidy	22,441	46.09	0.00	1,308.53
Liquidity	22,441	0.14	0.13	0.34
Interest rate	22,441	0.00	0.00	0.05
Panel B: Hybrid Exporters				
Foreign share	37,258	0.75	1.00	0.37
Age	37,312	9.01	8.00	7.79
Employment	37,312	487.10	229	1,129.86
Total assets	37,312	141,377.31	32,612.50	561,684.01
Subsidy	37,312	218.53	0.00	5,700.50
Liquidity	37,312	0.10	0.11	0.32
Interest rate	37,312	0.01	0.00	0.02
Panel C: Non-processing Exporters				
Foreign share	56,135	0.38	0.25	0.43
Age	56,239	8.51	6.00	9.49
Employment	56,239	242.36	119.00	541.47
Total assets	56,239	67,642.98	15,967	405,158.11
Subsidy	56,239	138.24	0.00	1,831.29
Liquidity	56,239	0.10	0.09	0.33
Interest rate	56,239	0.01	0.00	0.02

3.3 Additional differences among exporters engaged in processing trade

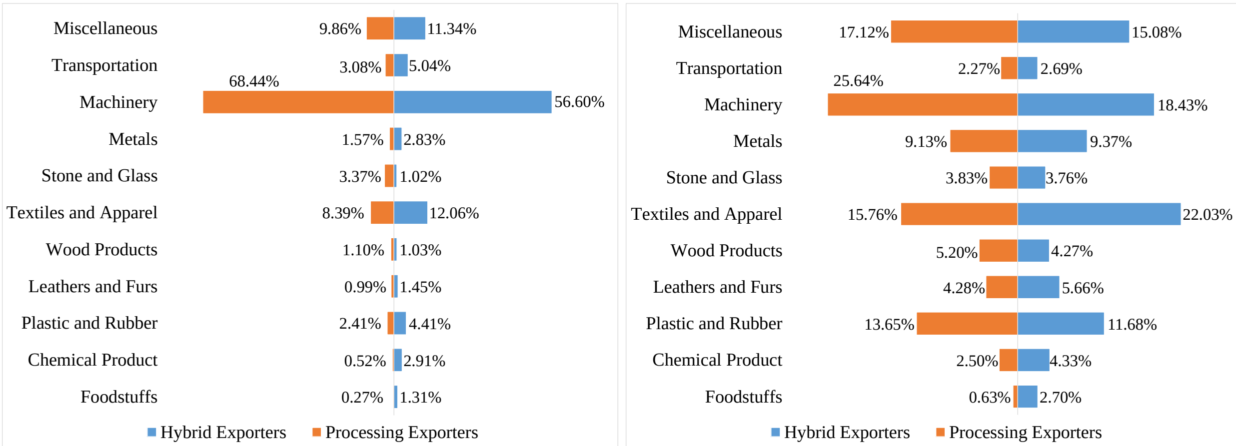
We now describe additional characteristics of the firms in the sample that might play a role in our investigation. First, we focus on the sectoral distribution of processing exporters. One can classify exported products into 11 industries according to the HS 2-digit code.[12] We calculate the distributions of hybrid exporters and processing exporters as well as the proportion of their processing export revenue in each industry, results are reported in Figure 2. The distribution of export revenue conveys the following messages. Processing exports of hybrid exporters and processing exporters mainly come from two industries: textiles and apparel and machinery. Together these industries account for about 69 percent and 77 percent of the processing exports for hybrid exporters and purely processing exporters, respectively. However, hybrid exporters and processing exporters report different levels of participation in the two industries. Machinery accounts for a larger share in the exports of processing exporters than in the total processing exports of hybrid exporters, which are respectively 68.4 percent and 56.6 percent; while textiles and apparel constitute a larger share in the processing exports of hybrid exporters than in the exports of purely processing exporters, 12.1 percent and 8.4 percent, respectively.

The distribution of exporters across industries describes a similar pattern, as hybrid exporters tend to focus more on textiles and apparel than on machinery production, and purely processing exporters do the opposite. Machinery production attracts the majority of processing exporters, at the second place with the most processing exporters is textiles and apparel. Combining this with Figure 2(a) implies that the export revenue of hybrid exporters is concentrated in few large firms, as 56.6 percent of export revenue comes from only 18.4 percent of hybrid exporters. On the contrary, the largest share of export revenue comes from a large number of processing exporters, indicating that processing exporters engaged in machinery production on average are of a smaller scale than hybrid exporters in the same industry. A prominent fact is that light industries such as textiles and apparel are labor-intensive and have low value added, while machinery is a capital-intensive industry generating high value added. The differences in the sectoral distribution of hybrid exporters and processing exporters may be a potential source of heterogeneity and we will take them into account in the empirical analysis.

We also take into account the location of hybrid exporters and processing exporters in China, as a report issued by the Hong Kong Constitutional and Mainland Affairs Bureau (Lam Tin-fuk et al., 2007) discusses the severe cost increases faced by firms in southern mainland China. The report indicates that the Pearl River Delta region of the Guangdong Province, which benefits from the geographical proximity to Hong

[12] These 11 sectors are: (1) food products (HS2 codes between 15 and 23); (2) chemical products (28-38); (3) plastic and rubber (39-40); (4) leather and fur (41-43); (5) wood products (44-49); (6) textiles and apparel (50-67); (7) stone and glass (68-71); (8) metals (72-76; 78-83); (9) machinery (84-85); (10) transportation (86-89); (11) miscellaneous (90-96).

Figure 2: Sectoral distribution of exporters engaged in processing trade



(a) Distribution of processing export revenue (b) Distribution of firms

Kong, attracts direct investments from foreign countries as well as from districts like Hong Kong. The remarkable accumulation of firms in the Pearl River Delta region has led to rising local production costs, which are mainly manifested by: tight labor supply and rising labor costs; limited land use and rising land costs; unstable supply of electricity and water, and increasing electricity prices and sewage treatment costs due to strengthened environmental protection requirements. Therefore, many firms receiving investments from Hong Kong have sprouted plans to move part or all of their production activities to other Chinese provinces so as to avoid the expensive production costs in the region.

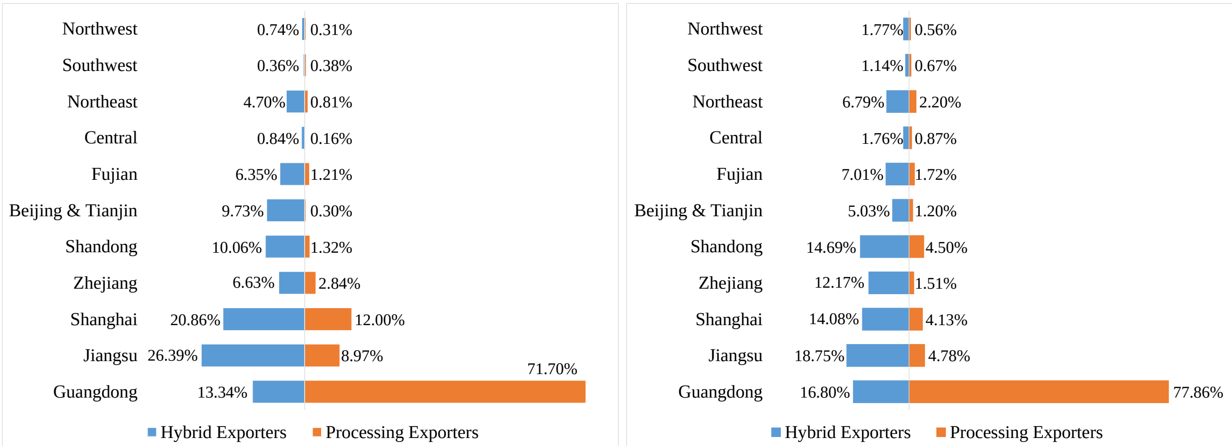
Given this information, we consider the role of firms' location in determining performance. We draw on the classification of Brandt et al. (2020) for Chinese provinces. Figure 3 illustrates the location of hybrid exporters and processing exporters. It is apparent that hybrid exporters and processing exporters report completely different patterns of geographical distribution: more than 70 percent of the export revenue of processing exporters comes from firms based in the Guangdong Province; whereas hybrid exporters are more evenly distributed in various provinces. It is worth mentioning that the Guangdong Province only ranks third among the sources of processing exports of hybrid firms with 13.3 percent.

4 Firm performance under different trade regimes

In order to investigate differences in performance between hybrid exporters and processing exporters, we estimate the following empirical specification:

$$Y_{ijrt} = \alpha + \beta Hybrid_{ijr} + X'_{ijrt}\gamma + \eta_{jrt} + \epsilon_{ijrt}, \tag{4.1}$$

Figure 3: Geographical distribution of exporters engaged in processing trade



(a) Distribution of processing export revenue

(b) Distribution of firms

where Y_{ijrt} is the dependent variable measuring the profitability and productivity of firm i belonging to industry j and region r in year t: the logarithm of value added, profits, revenue, and labor productivity, as well as measures of total factor productivity, $TFP(OP)$ and $TFP(ACF)$. $Hybrid_{ijr}$ is a dummy variable that equals to 1 for hybrid exporters, that is, firms reporting both processing exports and ordinary exports each recorded year; the comparison group is processing exporters, that is, firms reporting only processing exports each recorded year. Therefore, the coefficient β represents the difference between hybrid exporters and processing exporters for a specific performance indicator. X_{ijrt} is a vector of firm-level control variables accounting for the firm's size (measured by the logarithm of employment and total assets), the logarithm of firm's age, ownership structure (measured by the share of foreign capital in total capital), financial constraints (measured by liquidity and interest rate), and the logarithm of public subsidies received by the firm, as discussed in section 3.2. η_{jrt} is the 4-digit industry-year-province fixed effect, introduced to consider the time-varying unobserved characteristics of each industry in each province.[13]

Table 2 reports the results for specification (4.1). In columns (1)-(3), we consider the profitability of firms, and respectively regress the logarithm of value added, profit, and revenue on the dummy variable indicating the status of a firm's participation in processing export and ordinary export. In columns (4)-(6), we focus on firm's productivity, and respectively regress $TFP(OP)$, $TFP(ACF)$, and the logarithm of labor productivity on our explanatory variable. In all specifications, we control for firm size, age, ownership structure, and financial constraints.

[13] The 4-digit industry classification is derived from the 2002 version of China's GB/T industry classification.

Table 2: Firm-level performance comparison

	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Hybrid	0.137***	0.216***	0.100***	0.138***	0.074***	0.175***
	(0.019)	(0.039)	(0.022)	(0.019)	(0.025)	(0.026)
Foreign share	-0.011	0.152***	-0.009	-0.079***	-0.042*	-0.026
	(0.023)	(0.046)	(0.018)	(0.021)	(0.023)	(0.025)
ln Age	0.038***	-0.201***	0.036***	-0.004	-0.044***	-0.047***
	(0.010)	(0.027)	(0.011)	(0.012)	(0.015)	(0.017)
ln Asset	0.611***	0.849***	0.653***	0.327***	0.348***	0.244***
	(0.021)	(0.025)	(0.021)	(0.016)	(0.020)	(0.014)
ln Labor	0.360***	0.216***	0.302***	-0.103***	-0.414***	
	(0.015)	(0.022)	(0.013)	(0.014)	(0.044)	
ln Subsidy	0.004	0.033***	0.007*	0.010**	0.009***	-0.010**
	(0.004)	(0.007)	(0.004)	(0.004)	(0.003)	(0.004)
Liquidity	0.247***	0.984***	0.168***	0.391***	0.108***	0.373***
	(0.030)	(0.069)	(0.027)	(0.037)	(0.025)	(0.039)
Interest rate	0.146	-1.283***	0.133	0.088	0.190	0.229
	(0.185)	(0.249)	(0.245)	(0.146)	(0.178)	(0.143)
Year-Industry-Province FE	Y	Y	Y	Y	Y	Y
Observations	37043	37043	37043	37043	37043	37043
R^2	0.704	0.519	0.765	0.617	0.838	0.410

Notes: Dependent variables in columns (1)-(6) are the follows: log value added, log profit, log revenue, TFP(Olley-Pakes), TFP(ACF), and log labor productivity. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

We find that the coefficient of the hybrid dummy is always significant and positive when different proxies for firm performance are taken into account, indicating that although hybrid exporters and processing exporters are both engaged in processing exports, hybrid exporters have significantly better performance than processing exporters in all aspects. Compared to processing exporters, hybrid exporters report 13.7 percent higher value added, 21.6 percent higher profit, 10 percent higher revenue, 17.5 percent higher labor productivity, and an average of 10.6 percent higher TFP.[14]

Next, to provide additional evidence on the different performance of hybrid exporters with respect to purely processing exporters, we focus on export revenue and export quantity measured at a finer granularity. First, we look at the performance of hybrid exporters and processing exporters in terms of processing exports at the firm-HS6 product-destination country level. The estimated specification is:

$$Y_{ihct} = \alpha + \beta Hybrid_{ijr} + X'_{ijrt}\gamma + \eta_{jrt} + \lambda_{hct} + \epsilon_{ijrt}. \tag{4.2}$$

where Y_{ihct} is the logarithm of export revenue and quantity of every HS6 product h of firm i exported to

[14] Table A2 included in the Appendix reports results for specification (4.1) obtained when introducing separately year, 4-digit industry, and province fixed effects. We also report in Table A3 the results obtained comparing processing, hybrid, and non-processing (ordinary) exporters. The main conclusions of Table 2 are confirmed across the different specifications.

a given destination c in year t. The explanatory variable (i.e., the dummy variable for hybrid exporters) and the control variables remain the same as specification (4.1). After controlling for the 4-digit industry-year-province fixed effect, we introduce here year-HS6 product-country fixed effects λ_{hct} to consider the time-varying product-country level determinants that affect the demand for processing exports.

Then, we investigate the performance of hybrid exporters and processing exporters for processing exports at the firm-HS6 product level across destination markets. For this reason, we modify specification (4.2) as follows: the dependent variable becomes Y_{iht} which is the logarithm of export revenue and quantity of each HS6 product h of firm i in year t. The explanatory variable and control variables remain the same as specification (4.2). After controlling for the 4-digit industry-year-province fixed effect, the year-HS6 product fixed effect λ_{ht} is included to account for the time-varying global demand shocks to processing exports at the HS6 level. In all specifications, we employ the firm-level price index to deflate the revenue of processing export.

Results are reported in Table 3. In columns (1) and (2), we regress the logarithm of processing export revenue and quantity at firm-HS6 product-country level on the firm dummy variable. In columns (3) and (4), we regress the logarithm of export revenue and quantity at firm-HS6 product level against the firm dummy variable. We find that hybrid exporters ship a larger volume of processing exports to each export destination relative to processing exporters, and they also report higher revenues. Hybrid firms report 17 percent higher export revenue and 10.2 percent higher export quantity than processing exporters. In the global markets, the revenue and quantity of processing exports of hybrid exporters at HS6 product level are similar to those of processing exporters. Summing up, these results imply that hybrid exporters and processing exporters report similar outcomes at the product level across markets, while hybrid exporters are able to obtain a significantly better performance in the single destination markets, suggesting that they can be more competitive than purely processing exporters when supplying the same product to the same market.

Table 3: Firm-product level processing export performance comparison

	HS6 product-country level		HS6 product level	
	(1) ln Export Revenue	(2) ln Export Quantity	(3) ln Export Revenue	(4) ln Export Quantity
Hybrid	0.170***	0.102***	0.029	0.001
	(0.037)	(0.039)	(0.036)	(0.033)
Foreign share	-0.070**	-0.120***	0.063**	0.034
	(0.027)	(0.031)	(0.025)	(0.027)
ln Age	0.034**	-0.017	0.041***	-0.001
	(0.016)	(0.019)	(0.014)	(0.015)
ln Asset	0.146***	-0.016	0.207***	0.082***
	(0.016)	(0.018)	(0.015)	(0.015)
ln Labor	0.087***	0.142***	0.184***	0.215***
	(0.017)	(0.025)	(0.017)	(0.018)
ln Subsidy	0.008	0.007	-0.003	0.002
	(0.005)	(0.005)	(0.004)	(0.004)
Liquidity	0.095***	-0.009	0.047**	-0.000
	(0.023)	(0.024)	(0.019)	(0.019)
Interest rate	-0.149	0.328	-0.470***	-0.349***
	(0.145)	(0.270)	(0.181)	(0.105)
Year-Industry-Province FE	Y	Y	Y	Y
Year-HS6-Country FE	Y	Y	N	N
Year-HS6 FE	N	N	Y	Y
Observations	726126	726126	274123	274123
R^2	0.405	0.473	0.334	0.426

Notes: Columns (1)-(2) compare the export revenue and quantity of HS6 processing products sold in each country between hybrid exporters and processing exporters, and columns (3)-(4) compare the export revenue and quantity of HS6 processing products sold in global markets between hybrid and processing exporters. Dependent variables in columns (1)-(4) are the follows: log export revenue of an HS6 product in each destination, log export quantity of an HS6 product in each destination, log total export revenue of an HS6 product, and log total export quantity of an HS6 product. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Columns (1)-(2) include year-HS6 product-country fixed effect, and columns (3)-(4) include year-HS6 product fixed effect. Standard errors clustered at the HS6 product level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5 Mechanisms explaining differences in performance

In the previous section, we documented differences in performance between the two groups of exporters engaged in processing trade, namely, hybrid exporters and processing exporters, and observed that hybrid exporters report a higher profitability and productivity than processing exporters. In this section we describe the mechanisms behind this finding.

One possible motive explaining the difference in performance is the inherent gap between processing exporters and hybrid exporters observed since their entry into the export markets. As discussed in section 2, processing trade benefits from a number of preferential policies, moreover, processing production only involves simple processing or assembly activities and is isolated from the core production stages such as product design, development, and marketing. Hence the investment costs and productivity thresholds to enter the foreign markets for exporters pursuing processing trade should be lower than those for non-processing exporters. The subordinate trade regimes of processing trade plausibly are associated with different entry thresholds, as well. Compared to processing with imported materials (IA), processing and assembly with supplied materials (PA) requires even lower upfront costs, since the foreign buyers provide the raw materials, components, and equipment to firms engaging in processing production. As a result, less-productive and more financially constrained firms self-select into processing trade (Dai et al., 2016; Manova and Yu, 2016). That is, the share of processing production for a firm is determined endogenously by the firm's productivity, which further leads firms reporting different shares of processing trade to report different performances.

Nevertheless, self-selection can only provide a limited explanation for the differences in performance found in this study. As in our sample, 72 percent of hybrid exporters have a processing export share of more than 50 percent, and 58 percent of hybrid exporters have a processing export share of more than 75 percent, indicating that processing exports have a dominant position in the exports of most hybrid exporters. Other factors than self-selection shall then explain such striking differences in performance among firms in our sample.

The production choices of firms, such as the use of imported materials, or their different requirements for inputs' quality, might also be responsible for the different performance of hybrid exporters with respect to processing exporters. Therefore, we will focus on production behaviors of these two groups of exporters engaged in processing trade by analyzing the *ratio of domestic value added in exports to gross exports* (DVAR).

5.1 Domestic value added ratio of processing exports

5.1.1 Measuring DVAR

Domestic value added (DVA) in exports measures the total, domestically created, value contained in exports. According to Kee and Tang (2016), the domestic value added in exports (DVA_i) of firm i can be decomposed into the following components: profits (π_i), wages (W_i), costs of capital (K_i), and costs of domestic inputs (M_i^D):

$$DVA_i \equiv \pi_i + W_i + K_i + M_i^D. \tag{5.1}$$

From equation (5.1), one can see that the increase of DVA may come from the increment of any component included in the equation above. If only the expenditures on labor, capital or intermediate inputs are driving the growth of DVA, a higher DVAR does not mean an improvement in firm performance but, actually, a decline in competitiveness. On the contrary, if saved expenditures coming from such as the substitution between domestic and imported inputs lead to increasing retained profits, then DVAR is positively correlated with firm performance.[15] Kee and Tang (2016) observe that China's domestic content in exports increases from 65 to 70 percent in the period 2000-2007, mainly driven by the considerable growth of DVAR of processing exports, which increases from 46 percent in 2000 to 55 percent in 2007. The main force behind the increment is that processing exporters substitute imported inputs with domestic inputs on a large scale, as input tariffs reductions and the inward FDI stimulate the development of domestic inputs and increase the prices of imported inputs relative to domestic inputs. However, Kee and Tang (2016) do not characterize firm level DVAR conditional on the depth of the firm's participation in processing exports. Therefore, in this section, we first examine the DVAR of processing exports for hybrid exporters and processing exporters, and then determine whether DVAR can explain the different performance observed in section 4.[16]

Assume firm i is involved in processing export, then it imports some materials (IMP_i) and exports all the processed products (EXP_i) to foreign markets. Considering that domestic inputs employed for the production of exported products may contain purely domestic content (PM_i^D) and foreign content (m_i^F), and the employed imported inputs may contain foreign content (PM_i^F) and domestic content (m_i^D), the adjusted cost of domestic inputs is:

$$Adj\_M_i^D \equiv PM_i^D - m_i^F + m_i^D. \tag{5.2}$$

Equation (5.1) can be rewritten as :

$$DVA_i \equiv \pi_i + W_i + K_i + PM_i^D - m_i^F + m_i^D, \tag{5.3}$$

and firm i's exports and DVA can be expressed as

$$EXP_i = DVA_i + IMP_i + m_i^F - m_i^D, \tag{5.4}$$

$$DVA_i = (EXP_i - IMP_i) + (m_i^D - m_i^F). \tag{5.5}$$

Since the domestic content embodied in imported inputs is close to 0 for Chinese processing exports

[15] Domestic inputs in our database include materials sourced from other firms and inputs produced inside vertically integrated firms. We cannot differentiate the two sorts of inputs. Vertical integration affects firms' decisions of input sources, resulting in fewer external purchases and more within-firm transactions which are counted as the value generated by the firm and contribute to higher value-added. We therefore follow Adelman (1955), Holmes (1999), and Du et al. (2012) and use the ratio of value added to sales as the measure of the degree of vertical integration. It is worth mentioning that Du et al. (2012) and Holmes (1999) measure value added with the sales less purchased inputs while we employ the information of value added recorded in ASIF. Our check suggests no significant difference in the ratio between hybrid and pure processing exporters, indicating a similar degree of vertical integration among them, as shown in Table A4.

[16] In this study, we only focus on the DVAR of processing exports, hence DVAR refers to the DVAR of processing exports when it comes to hybrid exporters.

(Koopman et al., 2012; Wang et al., 2013), the DVAR of firm i's processing exports equal to

$$DVAR_i \equiv \frac{DVA_i}{EXP_i} = 1 - \frac{IMP_i}{EXP_i} - \frac{m_i^F}{EXP_i}. \tag{5.6}$$

After controlling for IMP_i and EXP_i, we use the industry-level estimates of m^F provided by Kee and Tang (2016) to adjust the foreign content embodied in domestic inputs and estimate the DVAR of processing exports for each firm.[17]

Some exporters doing processing trade indirectly import inputs from other domestic exporters engaged in processing production, the purchasers of such transactions are referred as excessive exporters, and the sellers are referred as excessive importers. However, these transactions are unrevealed in databases, and ignoring these transactions leads to the DVAR of excessive exporters being overestimated and the DVAR of excessive importers being underestimated or even negative, thus generating outliers. To get rid of these biases, we draw on the method developed by Kee and Tang (2016) and identify excessive importers as firms that import more processing imports than their total costs of intermediate inputs recorded in ASIF. Regarding excessive exporters, since processing imports are exempt from import tariffs whereas ordinary imports are not, ordinary exporters rely less on imported inputs. That is, the DVAR of ordinary exports should be higher than the DVAR of processing exports in the same industry. Therefore, we use the 25th percentile of DVAR of ordinary exports as the upper bound of DVAR of processing exports within the industry, and then identify exporters engaged in processing trade whose DVAR exceeds the upper bound as excessive exporters. We will use combined filters on excessive importers and excessive exporters in the following analysis to eliminate outliers in our estimation sample.

Since there are several firms operating in multiple industries among exporters pursuing processing trade, we calculate the firm-level average DVAR weighted by the share of processing exports in each industry. The yearly national DVAR of processing exports aggregated from the DVAR of single-industry firms, computed using data from our sample, is reported in Figure A1 of the Appendix and it is closely comparable to the result of Kee and Tang (2016).

[17] We use imported materials as firm i's imports in the computation of DVAR, as the capital and material imports for processing trade are separately recorded in CCTS except for year 2007, which collectively reports the imported equipment and materials. Hence proxying imported materials by the collectively reported imports will bias downward the estimation of DVAR in 2007. If hybrid exporters and processing exporters import different shares of equipment, it will lead to the fact that the DVAR of the two is underestimated to different extents. We discuss this issue in section 6.1 by comparing the difference of imported processing equipment of the two firm groups and find that, hybrid exporters import more equipment in the period 2000-2006 than processing exporters. This result shows that our estimate for the DVAR of hybrid exporters in 2007 is biased downwards, yet, the DVAR of hybrid exporters during the period 2000-2007 is still higher than that of processing exporters, as we will show in this section. Given the results, adjusting equipment imports in 2007 would only strengthen the point that hybrid exporters achieve higher DVAR. Therefore, we keep the data for 2007 in the analysis. Nevertheless, we estimate the same specifications excluding observations for the year 2007 as robustness checks and report results in Table A5 to Table A7.

5.1.2 Relation between DVAR and firm performance

To assess differences in DVAR between processing exporters and hybrid exporters, we estimate the following specification:

$$DVAR_{ijrt} = \alpha + \beta Hybrid_{ijr} + X'_{ijrt}\gamma + \eta_{jrt} + \epsilon_{ijrt}, \tag{5.7}$$

where $DVAR_{ijrt}$ is the DVAR of processing exports of firm i in year t, $Hybrid_{ijr}$ is the dummy variable for hybrid exporters. X_{ijrt} is a series of variables that control for the characteristics of the firm, as employed in specification (4.1). We take into account the influence of unobservable time-varying changes using industry-province-year fixed effect.

Table 4 reports the results. In column 1, we exclude excessive importers, and in column 2, we exclude both excessive importers and excessive exporters. In both columns, we regress DVAR on the dummy variable for hybrid firms and control for the firm's size, age, ownership structure, financial constraints, and subsidies. We find that, after dropping outliers with different filters, the coefficients of the dummy are positive and significant, indicating that hybrid exporters have higher domestic value added. The sorting pattern of DVAR between the two groups of exporters is consistent with their performance outcomes.

Table 4: A comparison in DVAR

(1)	(1) DVAR	(2) DVAR
Hybrid	0.020***	0.024***
	(0.007)	(0.006)
Foreign share	-0.022***	-0.007
	(0.008)	(0.008)
ln Age	0.004*	0.009***
	(0.002)	(0.002)
ln Asset	-0.014***	-0.010**
	(0.005)	(0.004)
ln Labor	0.015***	0.017***
	(0.004)	(0.003)
ln Subsidy	0.002**	0.001
	(0.001)	(0.001)
Liquidity	0.005	0.004
	(0.005)	(0.004)
Interest rate	0.013	0.002
	(0.014)	(0.010)
Year-Industry-Province FE	Y	Y
Observations	37844	32051
R^2	0.261	0.259

Notes: Dependent variables in columns (1)-(2) are the DVAR of processing exports. In column (1), excessive importers are excluded, and in column (2), both excessive importers and exporters are excluded. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

As discussed above, the relationship between DVAR and firm performance depends on whether the firm can retain more profits from a higher DVAR. Therefore, we now examine the contribution of DVAR to the performance of hybrid exporters and processing exporters. To this end, we estimate the following specification:

$$Y_{ijrt} = \alpha + \beta DVAR_{ijrt} + X'_{ijrt}\gamma + \delta_i + \zeta_t + \epsilon_{ijrt}, \tag{5.8}$$

where Y_{ijrt} is the indicator of firm profitability and productivity, as employed in specification (4.1). $DVAR_{ijrt}$ is the DVAR of processing exports of the firm, and X_{ijrt} denotes the firm level control variables. δ_i is the firm fixed effect, introduced to control for firm-level unknowns. ζ_t is the year fixed effect that controls unobservable factors in each sample year. We separately estimate specification (5.8) for hybrid exporters and processing exporters.

Results of hybrid exporters and processing exporters are respectively reported in Panel A and Panel B in Table 5. In columns (1) to (3), we regress the logarithm of value added, profit, and revenue on DVAR. In columns (4) to (6), we employ $TFP(OP)$, $TFP(ACF)$, and logarithm of labor productivity as outcome variables. In all columns, we control for the year and firm fixed effects. We find that DVAR plays different roles in the performance of hybrid exporters and processing exporters. Overall, the DVAR of processing exports of hybrid exporters is positively correlated with firm performance. An increase in DVAR by one unit is associated with an increase in value added by 9.0 percent, profit increase by 17.6 percent, and labor productivity increase by 10.3 percent, and has no significant effect on revenue and TFP. On the contrary, DVAR plays no role in affecting all performance indicators for purely processing exporters. This result shows that the higher DVAR of hybrid exporters is not driven by rising costs, it is due to the use of more cost-effective domestic inputs to substitute imported inputs, thus leading to higher earnings and better outcomes. Compared to hybrid exporters, processing exporters' substitution between domestic and imported inputs is lower and does not lead to higher earnings. Therefore, their DVAR is lower and the impact of DVAR on performance is basically null.

Table 5: The role of DVAR in firm performance

	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Panel A: Sample of Hybrid Exporters						
DVAR	0.090**	0.176**	-0.007	0.063	-0.038	0.103**
	(0.045)	(0.084)	(0.037)	(0.049)	(0.028)	(0.046)
Control variables	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Observations	16066	16066	16066	16066	16066	16066
R^2	0.879	0.784	0.936	0.822	0.924	0.769
	(1) lnVA	(2) lnProfit	(3) lnRevenue	(4) TFP(OP)	(5) TFP(ACF)	(6) lnLabPro
Panel B: Sample of Processing Exporters						
DVAR	0.016	0.168	-0.048	0.025	-0.038	-0.018
	(0.084)	(0.144)	(0.072)	(0.092)	(0.049)	(0.086)
Control variables	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Observations	6563	6563	6563	6563	6563	6563
R^2	0.861	0.749	0.939	0.805	0.923	0.757

Notes: Dependent variables in columns (1)-(6) are the follows: log value added, log profit, log revenue, TFP(Olley-Pakes), TFP(ACF), and log labor productivity. Both excessive importers and excessive exporters are excluded. All regressions control for firm size, age, ownership structure, financial constraints, and subsidies, and include year and firm fixed effects. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.1.3 The driving forces behind the higher DVAR

The analysis discussed above suggests that the performance of exporters participating in processing trade is related to the extent to which they use domestic inputs to replace imported inputs in processing production. The point is then understanding the reason why hybrid firms rely more on domestic inputs than processing firms. Kee and Tang (2016) show that the DVAR of a firm depends on the relative price of imported inputs to domestic inputs (referred to as the relative price, for concision), and the relative price is affected by domestic upstream varieties of products and exchange rates. Therefore, factors influencing domestic upstream varieties will indirectly affect a firm's DVAR. The following determinants of domestic upstream varieties are proposed by Kee and Tang (2016): input tariffs facing domestic input suppliers, own-industry FDI inflows, and exchange rates, the price in foreign-currency of a Chinese Yuan.

In addition, we argue that the degree of upstream market concentration may be another determinant, as market competition largely affects product prices. We summarize the possible transmission mechanisms of various factors affecting the relative price based on the arguments of Kee and Tang (2016) as follows.

—*Own-industry FDI.* A larger amount of own-industry FDI generates higher demand for domestic upstream materials, thereby increases the number of domestic upstream varieties. We further argue that the expanding downstream demand may attract more firms to enter the upstream market, thus stimulating competition in the industry.

—*Upstream input tariffs reductions.* Lower upstream input tariffs lead to more varieties of upstream products, thereby affecting the relative price. Besides, we believe that reductions in upstream input tariffs enable upstream suppliers to import raw materials at more favorable prices and reduce production costs, making domestic inputs cheaper and thus directly affecting the relative price. The general cutback in the production costs of suppliers helps strengthen upstream market competition and leads to more competitive prices further.

—*Exchange rates.* A higher exchange rate (a Yuan appreciation) refers to the stronger purchasing power of the Chinese Yuan for foreign products, as it decreases the price in Yuan of imported materials. Exchange rates thus change the relative price directly and also indirectly by affecting domestic upstream varieties. In addition, we argue that as large firms have more bargaining power in international trade than small firms, large upstream suppliers can benefit more from appreciating exchange rates. They may import more raw materials and obtain stronger market power leading to higher market concentration.

—*Upstream concentration.* We believe that an exacerbated degree of upstream concentration increases the price of domestic upstream products and lowers the relative price.

To sum up, we argue that more domestic upstream varieties, lower exchange rates, reduced upstream input tariffs, and mitigated upstream concentration should increase the relative price of imported inputs and result in higher DVAR.

In view of the different levels of DVAR between hybrid exporters and processing exporters, we believe that the heterogeneous selections in input sources stem from the fact that they face different relative prices. Therefore, we next examine this by estimating the following chained specifications and explore the reasons behind the different relative prices,

$$\boldsymbol{\Delta} DVAR_{ijrt} = \alpha^1 + \beta_P^1\, \boldsymbol{\Delta} Pr_{ijrt} + \lambda_{jrt}^1 + \epsilon_{ijrt}^1, \tag{5.9}$$

$$\boldsymbol{\Delta} Pr_{ijrt} = \alpha^2 + \beta_T^2\, \boldsymbol{\Delta} Taf_{ijrt} + \beta_V^2\, \boldsymbol{\Delta} Vd_{ijrt} + \beta_U^2\, \boldsymbol{\Delta} Up_{ijrt} + \beta_E^2\, \boldsymbol{\Delta} Ex_{ijrt} + \beta_H^2\, Hybrid_{ijr} + \lambda_{jrt}^2 + \epsilon_{ijrt}^2, \tag{5.10}$$

$$\boldsymbol{\Delta} Vd_{ijrt} = \alpha^3 + \beta_T^3\, \boldsymbol{\Delta} Taf_{ijrt} + \beta_E^3\, \boldsymbol{\Delta} Ex_{ijrt} + \beta_F^3\, \boldsymbol{\Delta} FDI_{ijrt} + \beta_H^3\, Hybrid_{ijr} + \lambda_{jrt}^3 + \epsilon_{ijrt}^3, \tag{5.11}$$

$$\boldsymbol{\Delta} Up_{ijrt} = \alpha^4 + \beta_T^4\, \boldsymbol{\Delta} Taf_{ijrt} + \beta_E^4\, \boldsymbol{\Delta} Ex_{ijrt} + \beta_F^4\, \boldsymbol{\Delta} FDI_{ijrt} + \beta_H^4\, Hybrid_{ijr} + \lambda_{jrt}^4 + \epsilon_{ijrt}^4, \tag{5.12}$$

$$\boldsymbol{\Delta} Taf_{ijrt} = \alpha^5 + \beta_H^5\, Hybrid_{ijr} + \lambda_{jrt}^5 + \epsilon_{ijrt}^5, \tag{5.13}$$

$$\boldsymbol{\Delta} FDI_{ijrt} = \alpha^6 + \beta_H^6 \, Hybrid_{ijr} + \lambda_{jrt}^6 + \epsilon_{ijrt}^6. \tag{5.14}$$

Except for the firm dummy variable $Hybrid_{ijr}$, the dependent and independent variables in specifications (5.9)-(5.14) are the change in the variable of interest for firm i in year t relative to the value in the first year that firm i enters the sample. Among them, $\boldsymbol{\Delta} Pr_{ijrt}$ is the change of the relative price of imported inputs facing firm i, $\boldsymbol{\Delta} Taf_{ijrt}$ is the change of upstream input tariffs, $\boldsymbol{\Delta} Vd_{ijrt}$ is the change of domestic upstream varieties, $\boldsymbol{\Delta} Ex_{ijrt}$ is the change of exchange rates, $\boldsymbol{\Delta} FDI_{ijrt}$ is the change of own-industry FDI, and $\boldsymbol{\Delta} Up_{ijrt}$ is the change of upstream concentration. We use the firm production data provided by ASIF to calculate the Herfindal index for each 3-digit CIC industry, combined with the consumption coefficients provided by China's Input-Output Table in 2002, then the weighted averages of Herfindal indices in the upstream industries are used as the proxy for the upstream concentration (Up_{ijrt}) faced by firms in each 3-digit CIC industry. We employ data for Pr, Vd, Taf, FDI, and Ex (in logarithm) at UN sector level provided in Kee and Tang (2016), and calculate the firm level weighted average variables with the processing export shares across sectors of the firm.[18] The terms λ_{jrt}^j and $\epsilon_{ijrt}^j, 1 \leq j \leq 6$, denote the year-2-digit industry-province fixed effect and error terms in specifications (5.9)-(5.14), respectively.

This set of chained regressions can be split into three stages. In the first stage, we explain the changes in DVAR by the changes in the relative price of imported inputs faced by firms engaged in processing production with specification (5.9), followed by specification (5.10) by which we explore how upstream input tariffs reductions, the increase in domestic upstream varieties, lower upstream market concentration, and rising exchange rates affect the relative price. After controlling for these factors, we examine whether there are other underlying factors that may cause different relative prices facing hybrid exporters and processing exporters. In the second stage, we examine whether the changes in upstream input tariffs, exchange rates, and own-industry FDI affect the relative price facing each firm through influencing domestic upstream varieties and upstream market concentration, with specifications (5.11) and (5.12). After controlling for the aforesaid factors, we examine whether there are other determinants that may lead to different domestic upstream varieties and upstream market concentration facing hybrid and processing exporters. In the last stage, with specifications (5.13) and (5.14) we examine whether hybrid and processing exporters face different upstream tariff reductions and own-industry FDI, which may directly and indirectly determine the relative price of imported inputs.

[18] These sectors are: (1) live animals (HS2 codes between 1 and 5); (2) vegetables (6-14); (3) animal or vegetable oil (15); (4) beverage and spirit (16-24); (5) mineral products (25-27); (6) chemical products (28-38); (7) plastics and rubber (39-40); (8) raw hides and skins (41-43); (9) wood and articles (44-46); (10) pulp of wood (47-49); (11) textiles (50-63); (12) footwear and headgear, etc. (64-67); (13) stone, plaster, cement, etc. (68-70); (14) precious metals (71); (15) base metals (72-83); (16) machinery, mechanic, electronic equipment (84-85); (17) vehicles and aircraft (86-89); (18) optical, photographic, etc. (90-92); (20) miscellaneous manufacturing (94-96).

Results reported in Table 6 certify our inferences. Column (1) shows that variations in the imported inputs' relative price change the DVAR of processing exports. Column (2) suggests that greater upstream input tariffs reductions, more domestic upstream varieties, intensified upstream market competition, and a depreciation of the Chinese Yuan increase the relative price, and thus lead to higher DVAR. The firm dummy's coefficient is insignificant, indicating that after controlling for these factors, there are no omitted variables that contribute to a higher relative price specifically related to hybrid exporters. Column (3) indicates that more own-industry FDI inflows result in increased domestic upstream varieties. The inconsistency with expectations is that upstream input tariffs reductions and changes in exchange rates facing firms engaged in processing production do not seem to significantly impact on domestic upstream varieties that firms have access to. Column (4) conveys that upstream input tariffs reductions and continuous own-industry FDI inflows help stimulating upstream market competition. In contrast, higher exchange rates raise the upstream concentration. Columns (5) and (6) indicate that hybrid exporters benefit from greater upstream input tariffs reductions and a larger volume of own-industry FDI relative to processing exporters.

These findings demonstrate that hybrid exporters more substitute imported inputs with domestic inputs and achieve greater DVAR because their own industries receive more FDI inflows and benefit from larger reductions in upstream input tariffs. On the one hand, abundant FDI resources and substantial reductions in upstream input tariffs help alleviating upstream market concentration faced by hybrid exporters and lead their domestic input prices to move closer to competitive prices; on the other hand, FDI inflows stimulate the enrichment of domestic upstream varieties. These two aspects indirectly lead hybrid exporters to employ more domestic inputs in processing production. The upstream input tariffs for suppliers of hybrid exporters drop more, leading to cheaper domestic inputs, thus encouraging hybrid exporters to use more domestic materials and obtain higher profits.

Table 6: Driving forces of differentiated DVAR

	(1) ΔDVAR	(2) ΔRelative price	(3) ΔDomestic upstream varieties	(4) ΔUpstream market concentration	(5) ΔUpstream input tariff	(6) ΔFDI
ΔRelative price	0.177***					
	(0.018)					
ΔUpstream input tariff		-0.445***	0.003	0.343***		
		(0.019)	(0.018)	(0.040)		
ΔDomestic upstream varieties		0.087***				
		(0.021)				
ΔUpstream market concentration		-0.062***				
		(0.014)				
ΔExchange rates		-0.889***	0.018	0.753***		
		(0.032)	(0.025)	(0.156)		
ΔFDI			0.043***	-0.047*		
			(0.010)	(0.025)		
Hybrid		0.001	0.000	0.002	-0.020***	0.037***
		(0.002)	(0.001)	(0.004)	(0.005)	(0.009)
Year-Industry-Province FE	Y	Y	Y	Y	Y	Y
Observations	36437	36437	36437	36437	36437	36437
R^2	0.077	0.805	0.186	0.448	0.208	0.289

Notes: Studied variables are the change of the variable of interest in each year relative to the value in the first year that this firm enters the sample. Dependent variables in columns (1)-(6) are the change of: DVAR, log relative price, log domestic upstream varieties, log upstream market concentration, log upstream input tariffs, and log own-industry FDI. Both excessive importers and excessive exporters are excluded. All regressions include year-2-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

5.2 Production specialization: quality and variety

An implication from the DVAR framework is that firm performance depends on the firm's ability to create retained profits in production. In addition to the impact of production-side improvements such as the adjustment of input sources, the ability of a firm to obtain higher profits is also subject to the competitiveness of its products, which might be determined by product quality. Therefore, we consider product quality as an additional determinant for the performance of hybrid and processing exporters.

An intuitive indicator for measuring product quality is the unit price since price should be proportional to product quality (Hallak, 2006). However, the price of a product also depends on other factors, and in particular on firm productivity. Therefore, we estimate product quality following the procedure proposed by Khandelwal et al. (2013). Assume the utility function of the representative consumer in the export market is a CES function which incorporates the horizontal and vertical differentiation of products, the nested-logit demand system ($q_c(h)$) derived from the utility function for a given variety (h) is determined by product quality ($\theta_c(h)$), unit price ($p_c(h)$), elasticity of substitution between varieties (σ), price index (P_c), and income (I_c) in the export market,

$$q_c(h) = \theta_c^{\sigma-1}(h)\, p_c^{-\sigma}(h)\, P_c^{\sigma-1}\, I_c. \tag{5.15}$$

After taking the logarithm of equation (5.15), the product quality of each firm-product-country-year pair is obtained by estimating the residual of the following equation:

$$ln\, q_{ihct} + \sigma ln\, p_{ihct} = \alpha_h + \alpha_{ct} + \epsilon_{ihct}, \tag{5.16}$$

where α_h is the product fixed effect, introduced to take into account different product-level characteristics. α_{ct} is the country-year fixed effect controlling for the time-varying demand shocks that come from income and local price index within an export market. Hence the estimated product quality is:

$$ln\, \hat{\theta} = \hat{\epsilon}_{ihct}/(\sigma - 1). \tag{5.17}$$

The quality-adjusted prices therefore are,

$$ln\, Adj\_Price_{ihct} = ln\, p_{ihct} - ln\, \hat{\theta}. \tag{5.18}$$

We estimate the quality and quality-adjusted price of each HS6 processing product shipped by a firm to a specific destination market in a given year, based on the information of product transaction level unit price, export quantity, and destination market provided by CCTS, as well as the data of country-sector level elasticity of substitution provided by Broda et al. (2006). Using the same method, we also estimate import quality and quality-adjusted price at the firm-product-country-year level, while the elasticity of substitution employed in this case is the one referring to HS 3-digit sectors in China. The quality estimates are truncated at the 1st and 99th percentiles to eliminate the influence of outliers. It is noteworthy that Broda et al. (2006) report the elasticity of substitution for HS3 products in 73 countries and regions around the globe. Therefore, about 15 percent of processing exports and 1.5 percent of processing imports in our sample are not included in these estimations. Since the country list covers most of the major trading countries, which are also the main importing countries of China's processing exports, the trimming procedure has a minor impact on the export side. The covered proportions of processing exports (imports) of hybrid exporters and processing exporters are close, which are 83.8 percent (98.1 percent) and 86.4 percent (98.7 percent), respectively. Therefore, the trimming of data shall exert similar effects on hybrid exporters and processing exporters, and shall not cause severe deviations in the comparison of the two.

We also count the number of varieties exported by the firm, considering the amount of different HS6 products exported by each firm to each export market in a given year. To examine the quality and varieties of processing exports and imports of hybrid exporters and processing exporters, we estimate the following specification:

$$Z_{ihct} = \alpha + \beta Hybrid_{ijr} + X'_{ijrt}\gamma + \eta_{jrt} + \mu_{hct} + \epsilon_{ihct}, \tag{5.19}$$

where Z_{ihct} is the logarithm of unit price, quality, and quality-adjusted price of processing exports and imports at country-product level of firm i in year t. When considering product variety, Z_{ihct} is replaced by Z_{ict} which is the number of varieties at firm-country-year level. $Hybrid_{ijr}$ is the firm dummy standing for hybrid exporters. X_{ijrt} is the vector of firm level control variables including the ones employed in the previous specifications, as well as firm TFP (calculated by following Olley and Pakes, 1996) and logarithm of revenue, as productivity and revenue may affect the firm's choice of quality and product varieties. η_{jrt} is the 4-digit industry-province-year fixed effect. When product price and quality are investigated, the product-country-year fixed effect, μ_{hct}, is introduced to control for time-varying unobservable shocks at the product-country level. When it comes to product varieties, we use τ_{ct}, the country-year fixed effect to replace μ_{hct} and control for unknowns in each country varying over time.

Results are reported in Table 7. In columns (1)-(2), we consider the unit price of each year-country-HS6 product pair, and regress the logarithm of the unit value of imports and exports on the firm dummy, respectively. In columns (3)-(4) and (5)-(6), we respectively consider the quality and the quality-adjusted price of each year-country-product pair. In columns (7)-(8), the firm's export and import varieties of HS6 products of each country-year pair are considered. We find that the coefficients of the hybrid dummy are significant and positive when unit price is taken into account, indicating that hybrid exporters export and import products of higher prices than processing exporters. Hybrid exporters and processing exporters import products of similar quality, nevertheless, hybrid exporters ship processed products of higher quality than purely processing exporters. When taking product quality into account, hybrid exporters still import inputs of higher price but export products of lower price with respect to purely processing exporters. Hybrid exporters import and export fewer varieties of products with respect to processing exporters.

An intriguing finding arises from the horizontal comparisons between the price difference and the quality difference between imports and exports. The price difference of imports and exports between hybrid exporters and processing exporters are of similar magnitudes: on average, hybrid firms' imports and exports are respectively 9.4 percent and 7.3 percent more expensive than these of processing exporters. No significant difference is found in import quality. However, the difference in export quality between the two groups of

Table 7: Price, quality and variety of processing exports and imports

	ln Price		ln Quality		ln Adj_Price		ln Variety	
	(1) Imports	(2) Exports	(3) Imports	(4) Exports	(5) Imports	(6) Exports	(7) Imports	(8) Exports
Hybrid	0.094***	0.073***	0.030	0.214***	0.068***	-0.130***	-0.098***	-0.070***
	(0.011)	(0.026)	(0.022)	(0.040)	(0.018)	(0.028)	(0.021)	(0.006)
ln Revenue	0.143***	0.196***	0.399***	0.414***	-0.271***	-0.221***	0.090***	0.020***
	(0.008)	(0.019)	(0.030)	(0.031)	(0.028)	(0.019)	(0.017)	(0.003)
TFP(OP)	-0.007**	-0.027***	-0.009*	-0.023*	0.004	-0.004	-0.011***	-0.005***
	(0.003)	(0.007)	(0.005)	(0.013)	(0.004)	(0.011)	(0.004)	(0.001)
Foreign share	-0.009	0.046**	-0.014	-0.035	0.009	0.067***	0.191***	0.127***
	(0.011)	(0.020)	(0.019)	(0.030)	(0.012)	(0.021)	(0.037)	(0.013)
ln Age	-0.068***	-0.030**	-0.120***	-0.055***	0.055***	0.025**	0.029*	0.042***
	(0.007)	(0.012)	(0.012)	(0.018)	(0.008)	(0.012)	(0.015)	(0.006)
ln Asset	0.107***	0.053***	0.115***	0.018	-0.008	0.035***	0.003	0.008*
	(0.006)	(0.009)	(0.012)	(0.016)	(0.011)	(0.013)	(0.016)	(0.005)
ln Labor	-0.121***	-0.105***	-0.174***	-0.087***	0.059***	-0.015	0.087***	0.068***
	(0.010)	(0.028)	(0.016)	(0.032)	(0.010)	(0.016)	(0.021)	(0.009)
ln Subsidy	-0.001	-0.003	-0.008***	-0.007	0.006***	0.003	-0.016***	-0.007***
	(0.002)	(0.003)	(0.003)	(0.005)	(0.002)	(0.004)	(0.003)	(0.001)
Liquidity	0.070***	0.085***	0.081***	0.162***	-0.014	-0.073***	-0.010	0.008
	(0.008)	(0.017)	(0.015)	(0.029)	(0.010)	(0.022)	(0.011)	(0.006)
Interest rate	-0.113**	-0.434*	-0.353***	-0.668***	0.246***	0.328**	-0.236*	-0.442**
	(0.046)	(0.230)	(0.076)	(0.258)	(0.054)	(0.139)	(0.123)	(0.178)
Year-Industry-Province FE	Y	Y	Y	Y	Y	Y	Y	Y
Year-Country-HS6 FE	Y	Y	Y	Y	Y	Y	N	N
Year-Country FE	N	N	N	N	N	N	Y	Y
Observations	1441642	710592	1400894	555588	1400894	555588	272247	401388
R^2	0.772	0.749	0.286	0.803	0.580	0.858	0.313	0.320

Notes: Dependent variables in columns (1)-(6) are at the country-HS6 product-year level and the follows: log unit price of imports and exports, log quality of imports and exports, log quality-adjusted unit price of imports and exports. Dependent variables in columns (7)-(8) are the log varieties of HS6 products of imports from each importing source and exports sold in each export market, respectively. All regressions include year-4-digit industry-province fixed effect. Columns (1)-(6) include year-country-HS6 product fixed effect, and columns (7)-(8) include year-country fixed effect. Standard errors clustered at HS6 product level in columns (1)-(6), and at country level in columns (7)-(8) are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

firms is far larger, as the quality of the exports from hybrid firms is on average 21.4 percent higher than that of purely processing exporters. This finding is reinforced by the difference of quality-adjusted prices between the two: hybrid firms' imports are 6.8 percent more costly than those of processing exporters, but their exports are 13.0 percent cheaper than the latter's, suggesting that the higher nominal prices of exports from hybrid firms are mostly due to quality. Combining these findings together we obtain a clear description of the traits of hybrid exporters in terms of product quality and pricing: hybrid exporters are more specialized and productive in the processing production of a narrower range of products. Hybrid exporters sell products of higher quality yet at a moderate-price to foreign markets relative to processing exporters, which means they don't pass on more price to consumers, and charge even lower prices given the quality. This "quality at competitive prices" strategy results in hybrid exporters gaining relevant market shares in the respective destination markets compared to processing exporters, as described in Table 3, and eventually brings about the superior performance of hybrid exporters.

Overall, our findings show that hybrid exporters report higher productivity and supply goods of higher quality at modestly higher prices to the international markets. This result is consistent with findings in Johnson (2012), Kugler and Verhoogen (2012), and Manova and Zhang (2012) which observe a positive correlation between firm productivity and output quality, as modeled in Feenstra and Romalis (2014). Even if more productive firms are more efficient at employing any type of inputs, they optimally choose to supply high-quality goods. When quality quickly augments in productivity, then we observe higher marginal costs and prices as more productive exporters rely on high-quality inputs which are more costly. Indeed, Hallak and Sivadasan (2013) suggest that higher output quality is associated with costly inputs and skilled labor, and with the adoption of capital-intensive production techniques. On the contrary, when the marginal cost does not sufficiently increase in quality, the standard predictions of the Melitz (2003) model on the negative relation between prices and productivity are confirmed.

6 Robustness checks

6.1 On the substitution between imported inputs and domestic inputs

The analysis discussed in section 5.1 shows that hybrid exporters substitute more imported inputs with domestic inputs in processing production, thereby achieve higher profits and improved performance. Here we investigate this finding from two different perspectives. First, if hybrid exporters use more domestic inputs, imported inputs should account for a smaller share in their total intermediate inputs used in processing production. But a thorny issue is that we do not have information on how firms allocate intermediate inputs between the production of products for ordinary exports, processing exports, and domestic sales. Moreover, since ASIF and CCTS employ different currencies to define variables in the databases (RMB and US dollars, respectively), using the values of exports in CCTS and total sales in ASIF may lead to biases or data frictions due to currency conversion. Therefore, we calculate the share of processing exports accounting for the firm's total exports, by which we infer the intermediate inputs employed for processing production. This approach relies on the assumption that the firm's allocation of intermediate inputs is proportional to the export composition. Although this assumption may partially ignore some implications of firm heterogeneity, it appears to be a reasonable one conditional on the current data availability. We also discuss the alternative method in Table A8, included in the Appendix, using the share of processing exports in firm's total sales (available from ASIF) as the reference to infer the allocation of intermediate inputs.

Second, as discussed in section 2, the two subordinate trade regimes of processing trade, processing with imported materials (IA), and processing and assembly with supplied materials (PA), may demand domestic inputs to varying degrees. Under the PA trade regime, foreign buyers directly provide raw and auxiliary materials for production, so firms may demand less domestic inputs. Under the IA trade regime, firms need to import raw materials from foreign markets on their own, hence have more room for the selection of input sources. Therefore, one reason for the differentiated DVAR may be that hybrid exporters and processing exporters are mainly engaged in different subordinate regimes of processing trade. We calculate the share of exports and imports under the IA trade regime in total processing exports and imports of each firm to proxy the allocation of firm's production between IA and PA trade regimes.

We make slight changes to specification (4.1) to examine these two inferences. We replace the dependent variables with $m^F\,ratio$, $IA\_exports$, and $IA\_imports$. $m^F\,ratio$ is the share of imported inputs in total intermediate inputs used in processing production, $IA\_exports$ and $IA\_imports$ are the share of IA exports and imports in the firm's total processing exports and imports, respectively. Since firm productivity may influence firm's input and output, TFP (OP) is also included as an additional control variable in these specifications. When exploring the ratio of imported inputs, we alternatively employ the full sample of hybrid exporters and processing exporters, the sample excluding excessive importers, and the sample excluding excessive importers and exporters. We further drop outliers whose ratio of imported input is greater than 1. When exploring the share of IA, the full sample is employed. Since the records of CCTS in 2007 do not distinguish between materials imports and equipment imports nor distinguish between IA and PA trade regimes, we rely on data for the period 2000 to 2006.

Results are reported in Table 8. In columns (1)-(3), we use the full sample of hybrid exporters and processing exporters, the sample excluding excessive importers, and the sample excluding excessive importers and exporters, respectively, and regress the share of imported inputs for processing production on the dummy variable for hybrid exporters together with the usual set of control variables. In columns (4)-(5), we regress the proportions of IA exports and imports in total processing exports and imports on the dummy variable. In columns (1)-(3), the coefficients of the dummy variable are significant and negative, indicating that hybrid exporters employ less imported inputs in processing production than processing exporters.[19] Columns (4)-(5) show that hybrid exporters and processing exporters have no significant differences in their participation in IA and PA trade regimes. Despite that IA exports hold a rising position in China's total processing exports, the switch from PA trade regime to IA trade regime seems not to be a motive for the better performance of hybrid exporters.

[19] Table A8 reports the results using the share of processing exports in the firm's total sales as the basis for inputs allocation, and further verifies the robustness of the results in Table 8.

Table 8: Share of imported inputs in processing production and participation in IA

	(1) m^F ratio	(2) m^F ratio	(3) m^F ratio	(4) IA_exports	(5) IA_imports
Hybrid	-0.064***	-0.063***	-0.067***	0.003	-0.004
	(0.008)	(0.009)	(0.008)	(0.013)	(0.012)
TFP(OP)	-0.015***	-0.013***	-0.015***	0.005**	0.005**
	(0.004)	(0.005)	(0.005)	(0.002)	(0.002)
Foreign share	0.114***	0.103***	0.101***	0.017	0.015*
	(0.007)	(0.007)	(0.007)	(0.011)	(0.009)
ln Age	0.002	0.001	-0.004	0.004	0.003
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
ln Asset	0.010**	0.003	-0.000	0.063***	0.061***
	(0.005)	(0.005)	(0.004)	(0.010)	(0.010)
ln Labor	0.007*	0.009**	0.008*	-0.031***	-0.030***
	(0.004)	(0.004)	(0.004)	(0.007)	(0.008)
ln Subsidy	-0.002*	-0.003	-0.001	0.003	0.002
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Liquidity	0.010	0.007	0.010	0.029***	0.029***
	(0.006)	(0.007)	(0.007)	(0.007)	(0.007)
Interest rate	-0.097	-0.098	-0.088	0.012	0.007
	(0.085)	(0.083)	(0.080)	(0.035)	(0.030)
Year-Industry-Province FE	Y	Y	Y	Y	
Observations	35069	28591	23912	40793	40793
R^2	0.259	0.271	0.275	0.441	0.446

Notes: Dependent variables in columns (1)-(3) are the share of imported inputs in total inputs used in processing production, in columns (4)-(5) are the share of IA exports and imports in firm's total processing exports and imports. In columns (1)-(3) we respectively use the full sample of hybrid exporters and processing exporters, the sample excluding excessive importers, and the sample excluding excessive exporters and importers. In columns (4)-(5) we use the full sample. We use date for the period 2000-2006 for regressions of this table. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6.2 Product quality, R&D activities, and imported equipment

Product quality may also be affected by firm's R&D activities and by the introduction of new production equipment. Firms investing more in innovation, such as product innovation and process innovation, tend to report higher product quality (Prajogo and Ahmed, 2007; López-Mielgo et al., 2009). Therefore, we examine whether R&D activities and imported equipment for processing production can explain the difference in performance between hybrid exporters and processing exporters. We use the value of R&D expenditure (*lnR&D*) and R&D intensity (*RD_intensity*) to measure firm's R&D activities. The R&D intensity is the percentage of R&D expenditure in revenue. As ASIF only discloses the R&D expenditures of firms for the time period 2005-2007, we restrict our sample to this period. Similarly, we use the value of the imported processing equipment (*lnEquipment*) and its intensity (*Equipment_intensity*) to measure the application of imported equipment in production. The imported equipment intensity is calculated as the percentage of the value of imported equipment in capital stock. We use data for the period 2000 to 2006 when investigating imported equipment. We employ these four indicators in specification (4.1) as our dependent variables.

Table 9 reports our results. In columns (1)-(2), we respectively regress the logarithm of R&D expenditure and R&D intensity on the dummy variable for hybrid exporters; in columns (3)-(4), we regress the logarithm of value of imported processing equipment and imported equipment intensity on the dummy variable. Estimates show that compared to processing exporters, hybrid exporters carry out more R&D activities and employ more imported equipment in processing production. These two aspects most likely contribute to the higher quality of products exported by hybrid exporters.

Table 9: R&D activities and imported equipment for processing production

	(1) ln R&D	(2) RD_intensity	(3) ln Equipment	(4) Equipment_intensity
Hybrid	0.352***	0.109***	0.073***	0.002**
	(0.072)	(0.040)	(0.024)	(0.001)
Foreign share	-0.359***	-0.037	-0.005	0.000
	(0.081)	(0.039)	(0.023)	(0.001)
ln Age	0.104***	0.027	0.025*	0.001*
	(0.027)	(0.020)	(0.013)	(0.001)
ln Asset	0.284***	0.032***	0.036***	0.001***
	(0.037)	(0.010)	(0.008)	(0.000)
ln Labor	0.092***	-0.017	0.036***	0.001**
	(0.021)	(0.012)	(0.012)	(0.001)
ln Subsidy	0.105***	0.014	-0.008*	-0.000**
	(0.016)	(0.015)	(0.004)	(0.000)
Liquidity	0.092**	0.042*	-0.050***	-0.002**
	(0.036)	(0.023)	(0.018)	(0.001)
Interest rate	2.691**	0.354	-0.032	-0.001
	(1.053)	(0.450)	(0.062)	(0.002)
Year-Industry-Province FE	Y	Y	Y	Y
Observations	26315	26315	42296	42296
R^2	0.303	0.408	0.158	0.148

Notes: Dependent variables in columns (1)-(4) are the following: log R&D expenditure, the percentage of R&D expenditure in revenue, log value of imported processing equipment, and the percentage of imported equipment in capital stock. In columns (1)-(2), we employ the data in 2005-2007; in columns (3)-(4), we use the data in 2000-2006. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6.3 Alternative explanations: export license and location

In this section, we discuss two other factors that may cause differences in the performance of exporters engaged in processing trade. The first is the abolition of the export license system. China implemented the export license system before 2004, during this period only firms that obtained the export license were eligible to engage in trade. This system was abolished in 2004, granting to all active firms in China the export rights except for a small number of product categories (Branstetter and Lardy, 2006). The number of exporting firms increased dramatically afterwards (Khandelwal et al., 2013). It may be the case that under the export license system, hybrid and processing exporters were subject to different regulations on the content of trade that they could engage in, which can lead to differences in performance. To examine this conjecture, we explore whether the differences in performance between hybrid exporters and processing exporters change before and after the reform of the export license system. Panel A of Table 10 reports estimates for the pre-reform period, while Panel B reports estimates for the post-reform period, suggesting that the export license system does not determine differences in performance between hybrid and processing exporters.

In section 3.3, we briefly described differences in the location of hybrid exporters and processing exporters across the Chinese territory. More than 70 percent of processing exporters are concentrated in Guangdong Province, while hybrid exporters are more evenly distributed across the different provinces. An intuitive inference would be that Guangdong Province has attracted too many firms by its excellent geographical location, which, on the contrary, may raise the prices of local production materials and general production costs. If the aggregation of firms in Guangdong Province generates negative effects, it should also affect hybrid exporters based in this province. To verify whether the location of firms can explain differences in performance, we construct the dummy variable *Guangdong* that equals 1 when the firm is located in Guangdong Province. We add this dummy variable to specification (4.1) to replace the previous dummy variable *Hybrid* and employ only data from hybrid exporters in these regressions. Panel C of Table 10 reports estimates and shows that the performance of hybrid exporters in Guangdong Province is worse than that of hybrid exporters in other Chinese provinces. This result is supportive of the conjecture that the firm's location plays a role in its performance. Notably, the majority of firms located in this area are purely processing exporters. Diseconomies due to firm agglomeration and cost increases are then additional channels to consider when discussing the dissimilar performance of firms engaged in processing trade (Lin et al., 2011; Beaudry and Swann, 2009; Folta et al., 2006).

Table 10: Alternative explanations

	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Panel A: Pre-reform of Export License System						
Hybrid	0.136***	0.204***	0.082***	0.152***	0.063**	0.175***
	(0.030)	(0.051)	(0.029)	(0.033)	(0.028)	(0.030)
Control Variables	Y	Y	Y	Y	Y	Y
Year-Industry-Province FE	Y	Y	Y	Y	Y	Y
Observations	18597	18597	18597	18597	18597	18597
R^2	0.698	0.517	0.778	0.622	0.842	0.397
	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Panel B: Post-reform of Export License System						
Hybrid	0.133***	0.225***	0.110***	0.120***	0.081***	0.171***
	(0.030)	(0.052)	(0.029)	(0.029)	(0.028)	(0.038)
Control Variables	Y	Y	Y	Y	Y	Y
Year-Industry-Province FE	Y	Y	Y	Y	Y	Y
Observations	18446	18446	18446	18446	18446	18446
R^2	0.709	0.522	0.756	0.613	0.835	0.420
	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Panel C: Sample of Hybrid Exporters						
Guangdong	-0.276***	-0.725***	-0.209***	-0.225***	-0.011	-0.405***
	(0.043)	(0.089)	(0.031)	(0.040)	(0.015)	(0.047)
Control Variables	Y	Y	Y	Y	Y	Y
Year-Industry-Province FE	Y	Y	Y	Y	Y	Y
Observations	27261	27261	27261	27261	27261	27261
R^2	0.682	0.490	0.751	0.593	0.809	0.322

Notes: Dependent variables in columns (1)-(6) are the follows: log value added, log profit, log revenue, TFP(Olley-Pakes), TFP(ACF), and log labor productivity. Panel A reports results of pre-reform period, and panel B reports results of post-reform period. Panel C uses the sample of only hybrid exporters. All regressions control for firm size, age, ownership structure, financial constraints, and subsidies, and include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

7 Concluding remarks

A relevant share of trade flows involving emerging economies is nowadays still due to processing trade. While this is a privileged avenue for emerging economies to integrate into Global Value Chains (GVCs) with developed economies, the effects on the domestic economy given the performance of firms involved in this specific trade regime has been questioned in the literature. This paper employs firm level balance sheet data and customs trade data, to provide new stylized facts on the performance of Chinese exporting firms. We investigate differences in performance distinguishing firms with respect to the share of processing trade. In particular, we assess whether the performance of processing firms which also report ordinary trade flows (hybrid) differs from the performance of exporters exclusively involved in processing trade. We find that, among others, hybrid exporters report higher value added, higher labor productivity, and higher total factor productivity, compared to purely processing firms. Our estimates also show that hybrid firms report higher export revenues than processing firms when shipping the same products to the same destination markets.

We find that these differences in firm performance are driven by the possibility of hybrid firms to access to domestic inputs. The increased productivity of domestic input suppliers is indeed positively affecting the performance of hybrid firms.

Previous studies showed that input tariff exemptions and the income tax benefits granted to processing exporters provide low innovation incentives to these firms and therefore explain their worse performance with respect to ordinary exporters. Our results suggest that, among processing trade exporters, those which are able to access domestic inputs can report a better performance. Hybrid firms also export processed goods of higher quality and tend to be more specialized as they supply a lower number of different products to the different destination markets than purely processing firms. Our findings show that sizable differences are present among exporting firms operating under different trade regimes, and that the significant reduction in the share of processing trade over Chinese total trade in recent years might be substantiated by the economic channels described in the present study.

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Appendix A

TFP estimation

Our data preparation for TFP estimation is based on Brandt et al. (2012) and Dai et al. (2016). We use the perpetual inventory method and the real depreciation rate in ASIF to calculate the capital stock. Output and input are deflated as follows. In order to accurately capture the price trends of firms, we employ the method of Smeets and Warzynski (2013) to construct firm-level price index by means of the firm-product level trade information disclosed in CCTS and then deflate the output of exporters. The input deflation index is constructed using the industry output deflation index and the Chinese Input-Output Table for the year 2002. We employ the Brandt-Rawski index to deflate investments.

We then employ the semi-parametric estimation methods proposed by Olley and Pakes (1996) and Ackerberg et al. (2015) for the TFP estimate. We rely on a logarithmic Cobb-Douglas production function:

$$Y_{it} = \beta_0 + \beta_L L_{it} + \beta_K K_{it} + w_{it} + \epsilon_{it}, \tag{A.1}$$

where Y_{it}, L_{it}, K_{it}, and w_{it} are respectively the log value added, log labor, log capital, and productivity of firm i in year t.

Olley-Pakes approach. Suppose that the firm's expectation for future productivity depends on its contemporaneous productivity (w_{it}), and firm's investment is modeled as $inv_{it} = I(w_{it}, K_{it})$ that is increasing in capital and productivity. Then, the productivity of firm i can be expressed as the inverted function of investment:

$$w_{it} = I^{-1}(K_{it}, inv_{it}). \tag{A.2}$$

Hence the specification to be estimated is:

$$Y_{it} = \beta_L L_{it} + g(K_{it}, inv_{it}) + \epsilon_{it}, \tag{A.3}$$

and $g(K_{it}, inv_{it}) = \beta_0 + \beta_K K_{it} + I^{-1}(K_{it}, inv_{it})$. We follow Olley and Pakes (1996) and use fourth-order polynomials as the approximation for $g(.)$:

$$g(K_{it}, inv_{it}) = \sum_{r=0}^{4-s} \sum_{s=0}^{4} \beta_{rs} K_{it}^{r} inv_{it}^{s}. \tag{A.4}$$

In the first step, we estimate equation (A.3) to obtain estimates for $\hat{\beta}_L$ as well as $\hat{Y}_{it}$. Then $\hat{g}(K_{it}, inv_{it})$

is derived as $\hat{Y}_{it} - \hat{\beta}_L L_{it}$.

The second step is to estimate the coefficient of K_{it}, $\hat{\beta}_K$. To do so, we assume that the firm's productivity evolves according to a first-order Markov process, $w_{i,t+1} = f(w_{it}) + \zeta_{i,t+1}$, and $f(w_{it})$ is strictly increasing in K and inv. Notice that:

$$f(w_{it}) = f(I^{-1}(K_{it}, inv_{it})) = f(g_{it} - \beta_K K_{it}). \tag{A.5}$$

Introducing $\hat{g}_t$ obtained in the first step into (A.5) provides the estimation specification for step 2:

$$Y_{i,t+1} - \hat{\beta}_L L_{i,t+1} = \beta_K K_{i,t+1} + f(g_{it} - \beta_K K_{it}) + \zeta_{i,t+1} + \epsilon_{i,t+1}. \tag{A.6}$$

We use fourth-order polynomials in $\hat{g}_{it}$ and K_{it} to approximate $f(g_{it} - \beta_K K_{it})$, and use non-linear least squares for estimation. The estimated $TFP(OP)$ is then:

$$TFP(OP)_{it} = Y_{it} - \hat{\beta}_L L_{it} - \hat{\beta}_K K_{it}. \tag{A.7}$$

Considering the possible differences in the production functions between industries, we estimate TFP by 2-digit CIC industry.

ACF approach. Ackerberg et al. (2015) make assumptions on timing as follows. K_{it} is chosen at $t-1$, intermediate input is determined at t, and L_{it} is chosen at $t-b$, $0 < b < 1$ due to labor market frictions (e.g, training time for employees). We use intermediate inputs as the proxy for unobserved productivity. Firm's demand for intermediate input at t depending on L_{it} is equal to:

$$M_{it} = m_t(w_{it}, K_{it}, L_{it}). \tag{A.8}$$

Then w_{it} derives from the inverted function of M_{it} and the first stage specification yields as:

$$Y_{it} = \beta_K K_{it} + \beta_L L_{it} + m_t^{-1}(M_{it}, K_{it}, L_{it}) + \epsilon_{it}. \tag{A.9}$$

We use third-order polynomials $\Phi(M_{it}, K_{it}, L_{it})$ to approximate $\beta_K K_{it} + \beta_L L_{it} + m_t^{-1}$, hence in the first step, $\Phi(M_{it}, K_{it}, L_{it})$ is estimated as the output net of ϵ_{it}.

Assume that productivity evolves as a first order Markov process, $w_{it} = f(w_{i,t-1}) + \zeta_{it}$, hence $E(\zeta_{it}|K_{it}) = 0$ and $E(\zeta_{it}|L_{i,t-1}) = 0$ according to the timing assumptions. Starting with an initial guess for the parameters β_K and β_L with OLS regression, we obtain a preliminary estimate of w_{it} and $w_{i,t-1}$ by the following specifications:

$$w_{it}(\beta_K, \beta_L) = \hat{\Phi}(M_{it}, K_{it}, L_{it}) - \beta_K K_{it} - \beta_L L_{it}, \tag{A.10}$$

$$w_{i,t-1}(\beta_K, \beta_L) = \hat{\Phi}(M_{i,t-1}, K_{i,t-1}, L_{i,t-1}) - \beta_K K_{i,t-1} - \beta_L L_{i,t-1}. \tag{A.11}$$

In the second step, we regress $w_{it}(\beta_K, \beta_L)$ on $w_{i,t-1}(\beta_K, \beta_L)$ to obtain the residuals $\hat{\zeta}_{it}(\beta_K, \beta_L)$, followed by the last step where we obtain the parameters $\hat{\beta}_K$ and $\hat{\beta}_L$ which set the following moment conditions to zero:

$$\frac{1}{T}\frac{1}{N}\sum_t \sum_i \hat{\zeta}_{it}(\beta_K, \beta_L) \begin{pmatrix} K_{it} \\ L_{i,t-1} \end{pmatrix} \tag{A.12}$$

The estimated $TFP(ACF)$ is finally computed with $\hat{\beta}_K$ and $\hat{\beta}_L$. The production function is estimated for each 2-digit CIC industry as well.

Chinese industries under analysis

We investigate the following Chinese manufacturing industries with a 2-digit CIC code between 13 and 42: agricultural and sideline food processing (13); food manufacturing (14); beverage manufacturing (15); tobacco products manufacturing (16); textiles (17); apparel, shoes, and hat manufacturing (18); leather, fur, feather (velvet) and their products (19); wood processing and wood, bamboo, rattan, palm, and grass products (20); furniture manufacturing (21); paper and paper products (22); printing and recording media reproduction (23); cultural, educational, and sporting products manufacturing (24); petroleum processing, coking and nuclear fuel processing (25); chemical raw materials and chemical products manufacturing (26); pharmaceutical manufacturing (27); chemical fiber manufacturing (28); rubber products (29); plastic products (30); non-metallic mineral products (31); ferrous metal smelting and rolling processing (32); non-ferrous metal smelting and rolling processing (33); metal products (34); general equipment manufacturing (35); special equipment manufacturing (36); transportation equipment manufacturing (37); electrical machinery and equipment manufacturing (39); communication equipment, computer, and other electronic equipment manufacturing (40); instrumentation, cultural, and office machinery manufacturing (41); handicrafts and other manufacturing (42).

Figure A1: DVAR of processing exports in 2000-2007, based on single-industry exporters

Table A1: Share of number of firms and of export value, by processing status

	In this paper		In Dai et al. (2016)	
	# of firms	Export value	# of firms	Export value
Processing exporters	18.06%	31.26%	15.30%	21.30%
Hybrid exporters	27.96%	55.45%	32.20%	63.70%
Non-processing exporters	53.97%	13.29%	52.40%	15.00%

Notes: Processing exporters are firms reporting only processing exports each recorded year; hybrid exporters are firms reporting both processing exports and ordinary exports each recorded year; non-processing exporters are firms reporting only ordinary exports each recorded year.

Table A2: Robustness check for firm-level performance of hybrid and processing exporters, separate fixed effects

	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Hybrid	0.121***	0.226***	0.084***	0.132***	0.069***	0.154***
	(0.018)	(0.034)	(0.021)	(0.019)	(0.020)	(0.024)
Foreign share	-0.006	0.140***	-0.014	-0.089***	-0.055***	0.001
	(0.023)	(0.041)	(0.019)	(0.022)	(0.016)	(0.029)
ln Age	0.027***	-0.187***	0.029***	-0.005	-0.048***	-0.069***
	(0.009)	(0.027)	(0.010)	(0.011)	(0.013)	(0.016)
ln Asset	0.624***	0.851***	0.660***	0.321***	0.349***	0.248***
	(0.020)	(0.024)	(0.019)	(0.014)	(0.016)	(0.012)
ln Labor	0.345***	0.207***	0.291***	-0.108***	-0.416***	
	(0.015)	(0.021)	(0.012)	(0.012)	(0.036)	
ln Subsidy	0.000	0.032***	0.005	0.005	0.006**	-0.014***
	(0.004)	(0.006)	(0.003)	(0.004)	(0.003)	(0.004)
Liquidity	0.257***	1.065***	0.176***	0.412***	0.121***	0.412***
	(0.027)	(0.070)	(0.024)	(0.033)	(0.023)	(0.035)
Interest rate	0.138	-1.353***	0.178	0.078	0.228	0.161
	(0.183)	(0.307)	(0.258)	(0.131)	(0.214)	(0.131)
Year FEs	Y	Y	Y	Y	Y	Y
Province FEs	Y	Y	Y	Y	Y	Y
Industry FEs	Y	Y	Y	Y	Y	Y
Observations	42322	42322	42322	42322	42322	42322
R^2	0.651	0.446	0.723	0.560	0.803	0.309

Notes: This table reports results of specification (4.1) with separate fixed effects. Dependent variables in columns (1)-(6) are the follows: log value added, log profit, log revenue, TFP(Olley-Pakes), TFP(ACF), and log labor productivity. Contrast group is processing exporters. All regressions include year, 4-digit industry, and province fixed effects. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A3: Firm-level performance of hybrid, processing, and non-processing exporters

	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Hybrid	0.168***	0.337***	0.112***	0.163***	0.101***	0.225***
	(0.019)	(0.037)	(0.021)	(0.019)	(0.022)	(0.027)
Non-processing	0.197***	0.377***	0.132***	0.234***	0.124***	0.392***
	(0.026)	(0.044)	(0.026)	(0.024)	(0.029)	(0.029)
Foreign share	0.015	0.208***	0.004	-0.030*	-0.039***	0.084***
	(0.016)	(0.025)	(0.015)	(0.017)	(0.012)	(0.026)
ln Age	0.039***	-0.132***	0.036***	0.010	-0.033***	-0.032**
	(0.009)	(0.018)	(0.009)	(0.010)	(0.009)	(0.013)
ln Asset	0.579***	0.821***	0.603***	0.278***	0.298***	0.224***
	(0.014)	(0.017)	(0.012)	(0.012)	(0.024)	(0.011)
ln Labor	0.359***	0.214***	0.305***	-0.098***	-0.384***	
	(0.011)	(0.015)	(0.010)	(0.011)	(0.046)	
ln Subsidy	0.005**	0.028***	0.008***	0.011***	0.009***	-0.008***
	(0.002)	(0.004)	(0.002)	(0.002)	(0.002)	(0.002)
Liquidity	0.295***	1.118***	0.205***	0.505***	0.181***	0.395***
	(0.020)	(0.050)	(0.019)	(0.024)	(0.028)	(0.025)
Interest rate	0.613	-0.454	0.589	0.513	0.500	0.451*
	(0.450)	(0.445)	(0.489)	(0.386)	(0.337)	(0.255)
Year*Industry*Province FE	Y	Y	Y	Y	Y	Y
Observations	78678	78678	78678	78678	78678	78678
R^2	0.687	0.498	0.736	0.599	0.829	0.395

Notes: Dependent variables in columns (1)-(6) are the follows: log value added, log profit, log revenue, TFP(Olley-Pakes), TFP(ACF), and log labor productivity. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A4: A preliminary check on the degree of vertical integration of hybrid and processing exporters

	(1) Value added to sales	(2) Value added to sales
Hybrid	0.001	-0.011
	(0.008)	(0.015)
Foreign share		-0.011
		(0.018)
ln Age		0.035
		(0.032)
ln Asset		0.042
		(0.053)
ln Labor		0.017***
		(0.005)
ln Subsidy		-0.009
		(0.008)
Liquidity		-0.077
		(0.112)
Interest rate		0.234
		(0.305)
Year-Industry-Province FE	Y	Y
Observations	53784	53784
R^2	0.499	0.500

Notes: This table reports results of the comparison of the degree of vertical integration between hybrid and processing exporters. Dependent variables are the ratio of value added to sales. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A5: Robustness check for the comparison in DVAR (2000-2006)

	(1) DVAR	(2) DVAR
Hybrid	0.022**	0.024***
	(0.009)	(0.007)
Foreign share	-0.022***	-0.006
	(0.008)	(0.008)
ln Age	0.004*	0.010***
	(0.003)	(0.003)
ln Asset	-0.014**	-0.010**
	(0.005)	(0.005)
ln Labor	0.015***	0.018***
	(0.004)	(0.003)
ln Subsidy	0.003**	0.001
	(0.001)	(0.001)
Liquidity	0.005	0.006
	(0.005)	(0.004)
Interest rate	-0.001	-0.000
	(0.008)	(0.008)
Year-Industry-Province FE	Y	Y
Observations	31161	26241
R^2	0.268	0.266

Notes: This table reports results of specification (5.7) with data for 2000-2006. Dependent variables in columns (1)-(2) are the DVAR of processing exports. In column (1), excessive importers are excluded, and in column (2), both excessive importers and excessive exporters are excluded. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A6: Robustness check for the role of DVAR in firm performance (2000-2006)

	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Panel A: Sample of Hybrid Exporters						
DVAR	0.085*	0.234**	-0.002	0.060	-0.034	0.100**
	(0.050)	(0.094)	(0.041)	(0.054)	(0.029)	(0.049)
Control variables	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Observations	13109	13109	13109	13109	13109	13109
R^2	0.883	0.793	0.942	0.826	0.925	0.776
	(1) ln VA	(2) ln Profit	(3) ln Revenue	(4) TFP(OP)	(5) TFP(ACF)	(6) ln LabPro
Panel B: Sample of Processing Exporters						
DVAR	-0.115	0.130	-0.115	-0.137	-0.050	-0.153
	(0.111)	(0.162)	(0.085)	(0.115)	(0.052)	(0.118)
Control variables	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
Firm FE	Y	Y	Y	Y	Y	Y
Observations	5307	5307	5307	5307	5307	5307
R^2	0.859	0.765	0.943	0.796	0.918	0.755

Notes: This table reports results of specification (5.8) with data for 2000-2006. Dependent variables in columns (1)-(6) are the follows: log value added, log profit, log revenue, TFP(Olley-Pakes), TFP(ACF), and log labor productivity. Both excessive importers and excessive exporters are excluded. All regressions control for firm size, age, ownership structure, financial constraints, and subsidies, and include year and firm fixed effects. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A7: Robustness check for the driving forces of differentiated DVAR (2000-2006)

	(1) ΔDVAR	(2) ΔRelative price	(3) ΔDomestic upstream varieties	(4) ΔUpstream market concentration	(5) ΔUpstream input tariff	(6) ΔFDI
ΔRelative price	0.206***					
	(0.021)					
ΔUpstream input tariff		-0.400***	0.008	0.379***		
		(0.020)	(0.019)	(0.036)		
ΔDomestic upstream varieties		0.090***				
		(0.020)				
ΔUpstream market concentration		-0.039***				
		(0.008)				
ΔExchange rates		-1.052***	0.036	0.642***		
		(0.031)	(0.026)	(0.142)		
ΔFDI			0.050***	-0.018		
			(0.012)	(0.018)		
Hybrid		0.001	0.001	0.003	-0.019***	0.032***
		(0.001)	(0.001)	(0.005)	(0.005)	(0.008)
Year-Industry-Province FE	Y	Y	Y	Y	Y	Y
Observations	29983	29983	29983	29983	29983	29983
R^2	0.078	0.845	0.201	0.428	0.237	0.303

Notes: This table reports results of specifications (5.9)-(5.14) with data for 2000-2006. Studied variables are the change of the variable of interest in each year relative to the value in the first year that this firm enters the sample. Dependent variables in columns (1)-(6) are the change of: DVAR, log relative price, log domestic upstream varieties, log upstream market concentration, log upstream input tariffs, and log own-industry FDI. Both excessive importers and excessive exporters are excluded. All regressions include the year-2-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table A8: Robustness check for the share of imported inputs in processing production

	(1) m^F ratio	(2) m^F ratio	(3) m^F ratio
Hybrid	-0.047***	-0.056***	-0.059***
	(0.008)	(0.008)	(0.007)
TFP(OP)	0.007***	0.014***	0.018***
	(0.003)	(0.002)	(0.002)
Foreign share	0.069***	0.045***	0.025***
	(0.007)	(0.008)	(0.007)
ln Age	0.005	-0.001	-0.008**
	(0.003)	(0.003)	(0.003)
ln Asset	0.006	0.009	0.004
	(0.006)	(0.006)	(0.005)
ln Labor	0.009*	-0.003	-0.007
	(0.005)	(0.006)	(0.005)
ln Subsidy	-0.005***	-0.005***	-0.003**
	(0.001)	(0.001)	(0.001)
Liquidity	0.002	0.001	0.004
	(0.007)	(0.007)	(0.005)
Interest rate	-0.020	-0.018	-0.013
	(0.029)	(0.021)	(0.021)
Year-Industry-Province FE	Y	Y	Y
Observations	29905	26594	21975
R^2	0.307	0.304	0.312

Notes: Dependent variables in columns (1)-(3) are the share of imported inputs in total inputs used in processing production, using the share of processing exports in the firm's total sales (recorded in ASIF) as the basis for the firm to allocate intermediate inputs. In columns (1)-(3), we respectively use the full sample of hybrid exporters and processing exporters, the sample excluding excessive importers, and the sample excluding excessive exporters and importers, for the period 2000-2006. Contrast group is processing exporters. All regressions include year-4-digit industry-province fixed effect. Standard errors clustered at the 4-digit industry level are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

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Düsseldorfer Institut für Wettbewerbsökonomie (DICE)

Universitätsstraße 1, 40225 Düsseldorf

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