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Exporting Firm Dynamics and Productivity Growth: Evidence from China

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Abstract
This paper assesses the productivity growth contributed by the dynamics of exporting firms using firm-level production data of Chinese firms from 2005 to 2009. The authors apply the dynamic Olley–Pakes decomposition with entry and exit proposed by Melitz and Polanec (*Dynamic Olley–Pakes Productivity Decomposition with Entry and Exit*, 2015), which allows them to decompose the change in aggregate productivity into contributions of surviving firms, entering firms and exiting firms. The study shows that in China, the combined contribution of the three components capturing reallocation amounts to almost half of the change in aggregate productivity. The between-firm market reallocation is found to contribute the most among the three components, followed by the exit of inefficient producers. It also shows that the aggregate productivity growth generated by the dynamics of exporting firms in foreign markets varies according to ownership, location and industry. More specifically, the data suggest that private firms, firms situated in the eastern region of China and firms from high-concentration industries provide a higher contribution to the growth of aggregate productivity.

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Keywords Exporting firms; firm dynamics; productivity growth; reallocation effect; China

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1 Introduction

China's economy has maintained rapid growth for more than 30 years since the start of the reform and opening up policies, a fact that is considered the “China Miracle”.[1] Foreign trade is one of the powerful engines driving China’s economic growth. The trade volume of China has increased by a factor of 37 in 25 years, from $ 115 billion in 1990 to $ 4.2 trillion in 2014, resulting in a compound annual growth rate of 15.58 %.[2]

However, the development of foreign trade and economic growth in China was mainly achieved by the massive input of cheap labor and natural resources rather than productivity growth (Young, 2003),[3] which comes at the price of environmental degradation, overcapacity, regional disparities and many other problems. This extensive model of growth pursued by China over the last decades has proved to be unsustainable. In order to maintain fast economic growth, China should undergo an economic transformation from the current extensive model to an intensive model, where productivity growth plays the most important role. Theoretically, productivity growth can be achieved principally through innovation, technology spillovers and resource reallocations (Acemoglu and Dan, 2015). Petrin and Levinsohn (2012) find that the options of innovation and spillover are slow and costly, whereas resource reallocation is more direct and effective.

Firm dynamics can optimize resource allocation and hence promote productivity (Hopenhayn, 1992; Ericson and Pakes, 1995). “Firm dynamics” refers to the evolutionary processes that firms undergo in the markets, including firm entry, growth and exit. The mechanism how firm dynamics drive productivity growth is the “creative destruction” in efficient markets, as introduced by Schumpeter: firms with low productivity are less likely to survive and thrive than their more efficient counterparts. As a consequence, more efficient producers

[1] In the sample period of 2005–2009, China’s annual GDP growth rates were 11.31 %, 12.68 %, 14.16 %, 9.63 % and 9.21 %, respectively.

[2] The data come from the National Bureau of Statistics of China, the growth rates were computed by the authors.

[3] Young (2003) finds that TFP contributes only 15 % of the aggregate economic growth. Most previous studies have found low TFP growth rates in China. The annual TFP growth rate is 3.8 % during the period of 1978–2005 in Perkins and Rawski (2008) and 3.6 % in Bosworth and Collins (2008) during the period of 1978–2004.

enjoy more market shares either through market share shifts among incumbents or through entry and exit. Empirical studies spanning many different countries, industries, and time horizons have consistently shown that this "creative destruction" mechanism is an important catalyst of aggregate productivity changes (Foster, et al., 2001; Bartelsman et al., 2013). In order to clarify the source of productivity growth, several methods have been explored to decompose the aggregate productivity changes into different components including the within-firm effect, the between-firm effect, the entry effect, and the exit effect (Baily, Hulten and Campbell, 1992; Griliches and Regev, 1995; Foster, Haltiwanger and Krizan, 2001).[4]

Compared to domestic firms, the dynamics of exporting firms are more intense because they operate in both domestic markets and foreign markets, and exporting behavior is always associated with a higher risk owing to long-distance transportation, different legal systems and exchange rate fluctuations. Das et al. (2007) find that there are more entries and exits in export markets. Eaton et al. (2008) find that, in a typical year, nearly half of all Colombian exporters are not exporters in the previous year, and most do not continue exporting in the following year. They also find that survivors expand their foreign sales very rapidly. The workhorse model of trade with heterogeneous firms identifies a new gain of trade in that the exposure to trade forces the least productive firms to exit. Due to these export market selection effects, market shares are reallocated to more efficient firms, which leads to an aggregate productivity growth (Melitz, 2003). The Melitz model has stimulated many studies highlighting the importance of producer heterogeneity in international trade (Das et al., 2007; Bernard et al., 2007), but nothing has yet been said about the productivity growth generated by the dynamics of exporting firms. Thus, it is still a black box to what extent this gain of trade is due to firm dynamics.

Since exports play an important role in China's economy, we seek to explore the productivity growth contributed by the dynamics of exporting firms, using Chinese firm-level production data from 2005 to 2009. We apply the dynamic

[4] The within-firm effect refers to the productivity improvement caused by firm innovation or management, while the between-firm effect originates from market share reallocations among survivors. The reallocation effect generated by firm dynamics is given by the sum of the between-firm effect, the entry effect and the exit effect.

Olley–Pakes decomposition with entry and exit proposed by Melitz and Polanec (2015), which allows us to decompose aggregate productivity growth into contributions of surviving firms, entering firms and exiting firms.

We firstly describe the dynamics of exporting firms, including the analysis of viability and firm performance, and the entries and exits by ownership, location, main sectors and export intensity. After reviewing existing decompositions, we proceed to decompose the growth rates of the aggregate log TFP of exporting firms. Meanwhile, we decompose the export-share weighted aggregate productivity to address the concern that the contribution of domestic operation to the aggregate productivity of exporters isn't captured in our identification. We further adopt several alternative methods to decompose the aggregate productivity growth to make comparisons. Finally, we explore several subsample studies to investigate how the reallocation differs among different groups of exporting firms.

Our study suggests that in China, the combined contribution of the three components capturing reallocation amounts to almost half of the change in aggregate productivity. The between-firm market reallocation is found to contribute the most among the three components, followed by the exit of inefficient producers. This paper also shows that the aggregate productivity growth generated by the dynamics of exporting firms in foreign markets varies according to ownership, location and industry. More specifically, the data suggest that private firms, firms situated in the eastern region of China and firms from high-concentration industries provide a higher contribution to the growth of aggregate productivity.

This paper contributes to the existing literature in several respects. First of all, we investigate firm dynamics in foreign markets and its contribution to productivity growth, which is a novel perspective that has been overlooked by previous studies and allows us to fill the literature gap between firm heterogeneity in international trade and firm dynamics. Moreover, in terms of methodology, we apply the dynamic Olley–Pakes decomposition with entry and exit proposed by Melitz and Polanec (2015) to decompose productivity growth, which is more accurate than other methods and could therefore improve the quality of the productivity decomposition. Finally, we explore several subsample studies in order to investigate how the aggregate productivity growth contributed by the dynamics of exporters varies with ownerships, locations and industries.

This paper closely relates to the strand of literature on firm dynamics and its resource reallocation effect. Baldwin and Gu (1995) find high firm turnover in the Canadian retail trade sector, where about 60 % of the firms present in 1984 were no longer in operation in 1998. Entry and exit account for 70 % of labor productivity growth. Foster et al. (2001) report that reallocation, broadly defined to include entry and exit, accounts for around 50 % of manufacturing and 90 % of US retail productivity growth. Petrin et al. (2011) find that resource reallocation increases productivity growth by 1.7–2.1 % in US, while the contribution of aggregate technical efficiency ranges from 0.2 % to 0.6 %. Devine et al. (2012) observe that the aggregate productivity of New Zealand increased by 0.1826, of which 0.1398 was contributed by surviving firms, –0.0704 was contributed by entering firms and 0.1132 was contributed by exiting firms. Melitz and Polanec (2015) discover that the aggregate productivity of Slovenian firms increased by 50 % during the period of 1996–2000, where surviving firms contributed 35 % of the observed productivity growth and firm dynamics contributed the remaining 15 %. Many studies pay attention to the issue of Chinese resource misallocation. Dollar and Wei (2007) discover that there exists severe capital misallocation in China. Hsieh and Klenow (2009) find that catching up to U.S. efficiency would increase TFP by 30–50 % in China and by 40–60 % in India. Brandt et al (2009) reveal that if there were no barriers for resource movement in China, the reallocation effect would dramatically increase productivity.

The remainder of the paper is organized as follows. Section 2 presents some characteristics of the dynamics of exporting firms. Section 3 describes the data we use in the paper. Section 4 reviews relevant productivity estimation and decomposition methods. Section 5 executes the decomposition of aggregate productivity growth. Section 6 presents several subsample studies. Finally, section 7 concludes.

2 Data

We employ firm-level data on production from the Annual Surveys of Industrial Production for Chinese firms from 2005 to2009, conducted by the Chinese government's National Bureau of Statistics (NBS). The Annual Survey of Industrial Production is a census of all private firms with more than 5 million

RMB in sales (about $ 600,000) plus all state-owned firms.[5] The total sales of all firms account for 95 % of the GDP. The raw data include over 200,000 firms each year. The data provides fruitful firm information including basic information, such as name, address, age, number of employees, ownership, and financial indicators, such as output, wages, value-added, export volumes, profit and fixed-assets. This firm-level data is widely used by many authors in their studies for China.

The dataset contains much noisy information. We filter the data through the following steps. First we delete observations where key variables such as added-value, number of employees or fixed-assets are missing. We also drop observations with invalid negative values, for instance, for number of employees. Then, following Feenstra et al. (2013b), we clean out the observations violating accounting standards, i.e. observations where

- liquid assets are greater than total assets;
- total fixed assets are greater than total assets;
- the net value of fixed assets is greater than total assets,
- the firm's identification number is missing.

Finally, we omit the observations of firms with less than eight employees.[6] Having applied these strict filters, we obtain a sample with 1,649,163 observations, which accounts for about 60 % of the original dataset. We simply describe the dataset for the remaining observations in Table 1 by ownership, location and main sectors.[7]

[5] There is a left truncation problem: some firms will vanish from the dataset if their sales value is below 5 million RMB, even though they still survive in the markets.

[6] According to China's company law, the number of employees for a company must be more than eight, otherwise it only can be considered as a small private business rather than a company.

[7] Five types of enterprises are distinguished in China according to the registration types, including State-Owned Enterprises (SOEs), Collective–Owned Enterprises (COEs), Private-Owned Enterprises (POEs), Hongkong–Macao–Taiwan–Invested Enterprises (HIEs) and Foreign–Invested Enterprises (FIEs). Four districts are classified: The eastern region consists of Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong; the middle region consists of Anhui, Jiangxi, Henan, Hubei, Hunan; The northern region consists of Beijing, Tianjin, Hebei, Liaoning, Jilin, Heilongjiang; the western region consists of Shanxi, Sichuan, Chongqing, Guizhou, Yunnan, Tibet, Shanxi, Gansu, Qinghai, Ningxia, Inner Mongolia, Guangxi. Main sectors include the textile garment and apparel industry, electric machinery and equipment manufacturing, manufacturing of computers, communications and other electronic equipment, and general equipment manufacturing.

Table 1: Firm distribution

		2005	2006	2007	2008	2009
Number of all firms:		264,714	294,397	330,981	370,395	389,216
By ownership:	SOEs	15,584	14,066	10,924	9,703	9,882
	COEs	15,930	14,912	13,083	6,526	6,072
	POEs	177,751	205,743	240,618	295659	315,874
		(67%)	(70%)	(72%)	(80%)	(81%)
	FIEs	28,348	30,960	34,832	37,221	37,292
	HIEs	27,101	28,776	31,524	21,286	20,096
By location:	East	139,980	152,566	171,352	283,521	300,183
		(53%)	(52%)	(52%)	(76%)	(77%)
	Middle	54,903	62,707	71,523	43,803	45,336
	West	38,435	42,039	46,333	21,269	21,269
	North	31,396	37,085	41,773	21,802	22,428
By sectors:	Main sectors	59,416	86,279	98,505	114,435	115,936
		(23%)	(29%)	(30%)	(31%)	(30%)
Number of exporting firms:		74,764	78,511	78,412	80,848	77,150
		(28%)	(27%)	(24%)	(22%)	(20%
By ownership:	SOEs	1,900	1,622	1,211	916	954
	COEs	2,463	1,724	872	717	617
	POEs	35,731	38,442	36,425	43,248	42,940
		(48%)	(49%)	(46%)	(53%)	(55%)
	FIEs	17,793	19,230	21,107	22,722	20,906
	HIEs	16,697	17,493	18,797	13,250	11,732
By location:	East	46,898	49,996	37,328	54,173	67,695
		(63%)	(64%)	(48%)	(67%)	(88%)
	Middle	14,582	14,562	9,3,79	5,967	5,230
	West	7,347	7,464	7,963	1,779	1,529
	North	5,937	6,489	6,897	3,269	2,696
By sectors:	Main sectors	29,211	30,773	32,246	34,312	32,316
		(39%)	(39%)	(41%)	(42%)	(42%)

Note: The export values are in 1,000 RMB.

We can reach several conclusions from Table 1: First, on the whole, about one quarter of firms are exporters in the dataset of the period from 2005 to 2009. However, the export participation rates are decreasing during this period. Second, the proportions of private firms over all firms and exporting firms keep increasing, 67 %–80 % of firms are private firms, and about half of exporting firms are private firms. Third, half to three quarters of firms and more than half of exporting firms are located in the eastern region of China. Finally, the number of firms from the five main sectors accounts for about 30 % of all firms and 40 % of exporting firms. These findings imply that private firms, eastern firms and firms of the main sectors have a higher probability of becoming an exporter.

3 The Dynamics of exporting firms

Exporting is associated with higher risks than domestic operations due to institu tional differences, complicated transaction procedures and market fluctuations, so that exporting firms experience more dynamics. The first step of our paper is to identify exporting firm dynamics.

We use information of the annual export delivery value to identify whether a firm is an exporting firm and firms' IDs to identify firms' dynamics.[8] The appearance of a firm's ID suggests an entry, and the disappearance of a firm's ID indicates an exit. Apparently, the disappearance of both export delivery value and the firm's ID marks the exit of exporting firms. This approach allows us to capture the dynamics of domestic markets and foreign markets simultaneously, but excludes firms which have stopped exporting even if they continue to serve the domestic markets.

We first look at the survival of all firms and exporting firms in the database. Table 2 describes and Figure 1 plots the duration dependence of all Chinese manufacturing firms and exporting firms separately. We treat the cohort of firms active in 2005 as a benchmark and observe the performance in subsequent years.

[8] Actually, we first drop the non-exporters from the database, and then apply firms' IDs to indentify the dynamics of exporting firms. Some firms' IDs are changed in the data, which is corrected with further checks with firm name, postcode and address. Meanwhile, there must be some firm M&As during the sample period. Some merged firms are excluded from the data. However, we argue that this isn't a major concern in our data, because (1) M&As were quite rare in China during the sample period. Data from the Chinese M&A yearbook show that the number of domestic M&As was 117 in 2007, 109 in 2008, 223 in 2009. (2) About 40 % of M&As happened in the manufacturing industry. (3) not all M&As lead to firm disappearances.

Table 2: Survival and performance of Chinese manufacturing firms

Firm type	Surviving time	1 year	2 years	3 years	4 years	5 years
All Firms	Number of firms	264714	224872	195565	135255	127964
	Sales	132981	135584	139724	143540	145969
	Export value	25582	26378	27348	30234	30802
	Number of employees	276	279	284	288	290
Exporting Firms	Number of firms	74764	57864	45826	32040	25740
	Sales	235023	245853	260626	262237	281251
	Export value	94013	99582	107231	115265	123888
	Number of employees	488	504	527	528	554

Note: We apply firms' IDs to identify firm survival for all firms and exporting firms. Export volume, sales and number of employees are average values in 1,000 RMB.

Figure 1: Survival of Chinese manufacturing firms

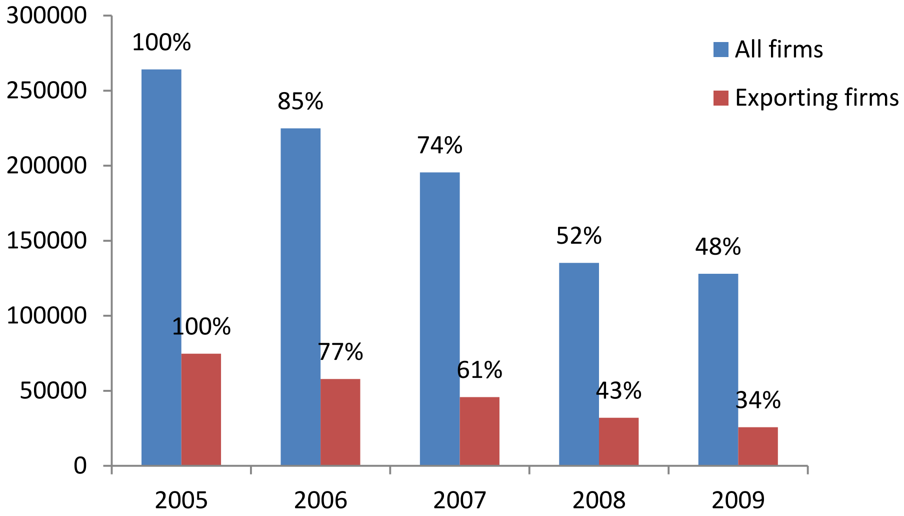

Table 2 and Figure 1 suggest three main findings with respect to the dynamics of all firms and exporting firms. First, only 48 % of firms can survive for five years. Only 34 % of the firms which export in 2005 succeed to export until 2009. More than 20 % of the exporting firms exit from foreign markets annually.

Second, the longer firms can survive, the stronger they become. Firms surviving for five years gain a better performance than firms surviving for four years in terms of export value, sales and number of employees. Finally, looking at the differences between exporters and all firms, we find that the indicators of exporting firms are higher than those of all firms, which can likely be explained by the self-selection effect and the positive learning externalities.

We then look at the entry and exit of exporting firms in the database. Table 3 displays the entry rates and exit rates during the period of 2005 to 2009. We define entrants in year t as those firms whose IDs do not appear in $t-1$ but do appear in t. We define exiters in year t as those firms that are active in the database in $t-1$ but absent in t. If a firm re-enters into the database after a previous exit, we treat that firm as a new entry firm in that year. The exit and entry rates are calculated as the shares of the number of entering firms or exiting firms over the number of exporting firms in each year.

As indicated in Table 3, the annual turnover rates fluctuate between 49 % and 70 % during the period of 2006–2009.[9] The number of entrants into foreign markets on average account for 28 % of the total number of exporting firms each year, while an average of 27 % of the exporting firms exit from domestic market or foreign markets each year. These figures are very close to the turnover rate of Colombian firms (Eaton et al, 2008), whereas they are much higher than those of many other countries (e.g. Fackler et al., 2013; Bartelsman et al., 2005, 2013). Moreover, looking at the distribution of each subsample, we find that more than half of exiting exporters and entering exporters are private firms. 46–75 % of exiting exporters and 60–75 % of entering exporters are located in eastern China. There are much more entries and exits for firms with a higher export intensity. What we see in this table indicates that private exporters, eastern exporters and exporters of the main sectors are more likely to enter foreign markets and fail in export markets or domestic markets.

9 Firm turnover rate is the sum of entry rate and exit rate.

Table 3: Entry and exit of exporting firms

		2006	2007	2008	2009
Number of exiting firms		16,882	19,346	26,799	23,127
(exit rate)		(21.5%)	(24.7%)	(33.1%)	(30%)
By ownership:	SOEs	630	683	645	307
	POEs	9,366	11,829	13,49	12,141
		(55%)	(61%)	5(50%)	(52%)
	FIEs	2,929	3,054	6,383	5,867
	COEs	1,036	952	420	261
	HIEs	2,921	2,828	5,856	4,551
By location:	East	9,213	8,953	17,156	17,521
		(55%)	(46%)	(64%)	(75%)
	Middle	4,600	7,470	4,065	2,950
	West	1,624	1,449	2,982	947
	North	1,445	1,474	2,596	1,709
By export intensity:	Low	6,037	8,987	6,339	6,553
	High	10,845	10,359	20,460	16,574
		(64%)	(54%)	(76%)	(72%)
Export value of exiting firms		31,251	33,351	67,817	47,773
Number of entering firms		20,647	19,247	29,235	19,429
(entry rate)		(26.3%)	(24.5%)	(36.2%)	(25.2%)
By ownership:	SOEs	403	264	359	349
	POEs	11,653	10,003	15,468	10,949
		(56%)	(52%)	(53%)	(56%)
	FIEs	4,531	4,752	7,527	4,519
	COEs	460	180	242	171
	HIEs	3,600	4,048	5,639	3,441
By location:	East	12,327	13,144	22,692	14,664
		(60%)	(68%)	(77%)	(75%)
	Middle	4,582	2,276	3,325	2,729
	West	1,741	1,953	1,175	915
	North	1,997	1,874	2,043	1,121
By export intensity:	Low	6,533	4,901	7,690	6,099
	High	14,114	14,346	21,545	13,330
		(68%)	(75%)	(74%)	(69%)
Export value of entering firms		48,121	49,434	66,733	60,177

Note: We report the previous export values for exit firms. The export values are average values in 1,000 RMB. Export intensity is measured by the ratio of export value over sales. Low and high export intensity is defined according to the mean of export intensity.

4 Firm productivity estimation and decompositions

4.1 Firm productivity estimation

There are several methods for productivity estimation, including Solow's residual method, the data envelopment analysis (DEA) method, the Olley–Pakes (OP; 1996) method, and the Levinsohn–Petrin (LP; 2003) method. Solow's residual method is most frequently used because of its simplicity, but it generates simultaneity bias and selectivity bias. Olley and Pakes (1996) proposed a semi-parametric estimator to reduce simultaneity bias, which has become the most popular method for estimating firm productivity.

We adopt the OP method to estimate firm productivity using added-values to measure production as Melitz and Polanec (2015) do.[10] We use fixed assets and the number of employees as measures of the explanatory variables capital and labor. We utilize the perpetual inventory method to calculate capital stocks, assuming a 15 % depreciation rate.[11] All variables are deflated by appropriate price indices.[12]

$$\ln TFP_{it} = \ln \mathrm{Y}_{it} - \hat{\alpha} \ln K_{it} - \hat{\beta} \ln \mathrm{L}_{it} \qquad (1)$$

Our paper also estimates Solow residual (OLS) for comparison. The estimated elasticity coefficients of capital and labor are listed in Table 4.[13]

Table 4: Productivity estimation results

	OLS	OP
Capital	0.361***	0.473***
	(241.92)	(6.77)
Labor	0.464***	0.458***
	(226.8)	(25.9)

Note: T-values are in parentheses. Significant at * 10 %, ** 5 % and*** 1 %.

[10] The command opreg can be used to implement the production function estimator of OP.

[11] Some papers adopt lower depreciation rates, such as 10 % or 5 %. The choice of different depreciation rates does not affect our qualitative results.

[12] All kinds of price indices are from the China Statistical Yearbook.

[13] Unlike Melitz and Polanec (2015), we offer aggregate estimators of capital and labor rather than disaggregate estimators in order to avoid the changes of productivity growth caused by different estimators, so that decomposition results are comparable.

Olley and Pakes (1996) state that simultaneity bias and selectivity bias generated by an OLS estimation cause an upward bias for the labor coefficient and a downward bias for the capital coefficient. As shown in Table 4, the capital coefficient is indeed higher for OP than for OLS, while the labor coefficient is lower for OP than for OLS. The estimation results thus conform with the conclusion of Olley and Pakes (1996), which gives us confidence that the risk of biased productivity estimates is considerably reduced by the use of OP estimation. Table 5 describes China's unweighted aggregate log TFP during the period of 2000–2007.

Table 5 reveals that the aggregate productivity of exiting exporters, entering exporters and surviving exporters keeps increasing over time during the period of 2005–2009. Looking at the differences between groups, we find that the aggregate productivities of surviving exporters are higher than those of exiting exporters and entering exporters. However, the productivities of foreign-invested and eastern surviving exporters are lower than those of the foreign-invested and eastern entering exporters. Furthermore, within each group, exiting exporters and entering exporters of private ownership and main sectors are more productive than their counterparts.

4.2 Productivity growth decompositions

In this section, we proceed to review several productivity growth decompositions proposed by previous studies to highlight their major differences. The starting point of all decompositions is the definition of aggregate productivity which is given by the following formula:

$$\Phi = \sum_i s_{it} \varphi_{it} \tag{2}$$

where Φ, φ and s denote aggregate productivity, firm productivity and weight respectively. There are many choices to estimate firm productivity and represent weight. We choose the OP method to estimate firm productivity and use value-added shares as weights. The main interest is the change in aggregate productivity over time (from t=1 to 2) $\Delta\Phi = \Phi_2 - \Phi_1$.

Table 5: Firm productivity of entering exporters and exiting exporters

		2006	2007	2008	2009
Productivity of exiting firms		3.94	4.09	4.14	4.22
By ownership:	SOEs	3.32	3.45	3.80	3.89
	POEs	4.07	4.23	4.33	4.27
	FIEs	4.06	4.21	4.21	4.25
	COEs	3.80	3.87	3.97	4.10
	HIEs	3.94	4.08	4.18	4.22
By location:	East	4.92	4.03	4.15	4.15
	Middle	4.02	4.13	4.25	4.33
	West	3.73	3.81	3.94	4.19
	North	3.96	4.05	4.13	4.23
By sector:	Main	4.06	4.16	4.20	4.33
	Rest	3.93	4.03	4.09	4.18
Productivity of entering firms		4.02	4.08	4.23	4.26
By ownership:	SOEs	3.51	3.93	3.82	3.84
	POEs	4.15	4.26	4.32	4.46
	FIEs	4.09	4.16	4.31	4.33
	COEs	3.88	3.92	4.23	4.19
	HIEs	4.01	4.06	4.21	4.21
By location:	East	4.07	4.12	4.32	4.29
	Middle	4.06	4.06	4.16	4.37
	West	3.87	3.88	3.94	4.04
	North	3.97	4.06	4.39	4.13
By sector:	Main	4.07	4.16	4.24	4.34
	Rest	3.92	4.00	4.08	4.16
Productivity of surviving firms		4.05	4.11	4.25	4.29
By ownership:	SOEs	3.59	3.78	3.95	4.05
	POEs	4.14	4.18	4.19	4.26
	FIEs	4.08	4.15	4.20	4.30
	COEs	3.80	3.86	3.97	4.09
	HIEs	4.09	4.17	4.20	4.31
By location:	East	4.06	4.12	4.16	4.26
	Middle	4.14	4.21	4.29	4.42
	West	3.81	3.94	4.04	4.22
	North	3.99	4.08	4.11	4.24
By sector:	Main	4.06	4.15	4.20	4.33
	Rest	4.04	4.10	4.17	4.27

The first decomposition of productivity growth is the BHC decomposition proposed by Baily, Hulten and Campbell (1992). The BHC method decomposes productivity growth into four parts including the within-firm effect, the between-firm effect, the entry effect, and the exit effect:

$$\Delta\Phi = \sum_{i\in S} s_{i1}\left(\varphi_{i2}-\varphi_{i1}\right) + \sum_{i\in S}\left(s_{i2}-s_{i1}\right)\varphi_{i2} + \sum_{i\in E} s_{i2}\varphi_{i2} - \sum_{i\in X} s_{i1}\varphi_{i1} \tag{3}$$

S, E and X denote the sets of surviving, entering and exiting firms, respectively. The first term on the right-side of equation (3) is the within-firm effect capturing the contribution of innovation or management within surviving firms to aggregate productivity growth. The second term is the between-firm effect capturing the contribution of reallocations in market shares from low-productivity to high-productivity firms, which serves as the first component of resource reallocation generated by firm dynamics. The third term is the entry effect and the final term is the exit effect. Entry and exit effects can be aggregated into the firm turnover effect, which serves as the other component of resource reallocation generated by firm dynamics.

The potential drawback of the BHC method is that the entry effect is definitely positive and the exit effect is definitely negative, regardless of the productivity difference between entering and exiting firms. As a matter of fact, the higher productivity of entrants over incumbents suggests a negative entry effect and the higher productivity of existing firms as compared to incumbents suggests a positive exit effect. The BHC approach apparently introduces biases into the contributions of entry and exit.

In order to address this concern, some other studies explore a different approach using alternative reference productivity levels. One of them is the GR decomposition (Griliches and Regev, 1995) adopting the average aggregate productivity level between the two periods, $\Phi = (\Phi_1 + \Phi_2)/2$, as the reference productivity level. Decomposition is then given by:

$$\Delta\Phi = \sum_{i\in S} \overline{s_i}\left(\varphi_{i2}-\varphi_{i1}\right) + \sum_{i\in S}\left(s_{i2}-s_{i1}\right)\left(\overline{\varphi_i}-\overline{\Phi}\right) + \sum_{i\in E} s_{i2}\left(\varphi_{i2}-\overline{\Phi}\right) - \sum_{i\in X} s_{i1}\left(\varphi_{i1}-\overline{\Phi}\right) \tag{4}$$

where $\bar{s}_i = (s_{i1} + s_{i2})/2$ and $\bar{\varphi}_i = (\varphi_{i1} + \varphi_{i2})/2$.

The other approach is the FHK decomposition (Foster et al., 2001) which employs the aggregate productivity level of period 1 ($\Phi 1$) as the reference productivity level. The corresponding decomposition equation is given by:

$$\begin{aligned}\Delta \Phi = &\sum_{i\in S} s_{i1}\left(\varphi_{i2}-\varphi_{i1}\right)+\sum_{i\in S}\left(s_{i2}-s_{i1}\right)\left(\varphi_{i1}-\Phi_1\right)+\sum_{i\in S}\left(s_{i2}-s_{i1}\right)\left(\varphi_{i2}-\varphi_{i1}\right)\\ &+\sum_{i\in E} s_{i2}\left(\varphi_{i2}-\Phi_1\right)-\sum_{i\in X} s_{i1}\left(\varphi_{i1}-\Phi_1\right)\end{aligned} \quad (5)$$

Analogous to the BHC decomposition, the GR and FHK approaches decompose the aggregate productivity into the within-firm, the between-firm, the entry and exit effects. Unlike the BHC decomposition, the entry and exit effects in the GR and FHK decompositions can be either positive or negative, depending on the productivity difference of the corresponding subset of firms with the reference productivity level. As a consequence, the GR and FHK decompositions can be used to reduce the biases inherent to the BHC decomposition to some extent.

However, we observe that biases have not been eliminated completely. Intuitively, the positive entry effect necessitates that the productivity of entrants outweighs the productivity of incumbent firms in the same year, i.e. if $\varphi_{E2} > \Phi_{S2}$. Similarly, the negative exit effect necessitates that the productivity of exiters outnumbers the productivity of incumbent firms in the same year, i.e. if $\varphi_{X1} < \Phi_{S1}$, which implies that the entry and exit effects should only relate to contemporaneous productivity differences. This intuitive condition is violated by the GR and FHK decompositions whose entry and exit effects are associated with inter-temporal productivity differences. Assume aggregate productivity grows $\Phi_{S2} > \Phi_{S1}$, the reference productivity levels $\bar{\Phi}$ and Φ_1 employed by the GR and FHK decompositions are smaller than Φ_{S2}, leading to an overestimation of the contribution of entrants in both decompositions and an underestimation of the contributions of exiters and survivors.

To address this concern, Melitz and Polanec (2015) explore a dynamic Olley–Pakes decomposition with entry and exit (hereafter abbreviated DOPD) on the basis of the OP decomposition (Olley and Pakes, 1996). The original OP decomposition equation is:

$$\Phi_t = \bar{\varphi}_t + \sum_i \left(s_{it} - \bar{s}_t\right)\left(\varphi_{it} - \bar{\varphi}_t\right) = \bar{\varphi}_t + \operatorname{cov}\left(s_{it}, \varphi_{it}\right) \quad (6)$$

As shown in equation (6), The OP approach decomposes the aggregate productivity into the unweighted average of the productivity of firms $\overline{\varphi_t} = \frac{1}{n}\sum_{i=1}^{n_t}\varphi_{it}$ and the covariance between market shares and productivity. The covariance term captures resource allocation efficiency (Olley and Pakes, 1996): if the resources are allocated efficiently, more productive firms should acquire more resources and have higher market shares resulting in high covariance. By contrast, a low covariance can be interpreted as a sign for misallocation of resources, lack of competition or market distortions (Bartelsman et al., 2013). Apparently, the OP method approximately depicts resource misallocation and does not take the contribution of firm dynamics into account.

Melitz and Polanec (2015) rewrite the aggregate productivity in each period as the function of the aggregate share and the aggregate productivity of the three firm groups including survivors (S), entrants (E), and exiters (X):

$$\Phi_1 = s_{S1}\Phi_{S1} + s_{X1}\Phi_{X1} = \Phi_{S1} + s_{S1}\left(\Phi_{X1} - \Phi_{S1}\right) \tag{7}$$

$$\Phi_2 = s_{S2}\Phi_{S2} + s_{E2}\Phi_{E2} = \Phi_{S2} + s_{E2}\left(\Phi_{E2} - \Phi_{S2}\right) \tag{8}$$

Combining equation (6), (7) and (8), we have:

$$\begin{aligned}\Delta\Phi &= \left(\Phi_{S2} - \Phi_{S1}\right) + s_{E2}\left(\Phi_{E2} - \Phi_{S2}\right) + s_{X1}\left(\Phi_{S1} - \Phi_{X1}\right) \\ &= \Delta\overline{\varphi}_S + \Delta COV_S + s_{E2}\left(\Phi_{E2} - \Phi_{S2}\right) + s_{X1}\left(\Phi_{S1} - \Phi_{X1}\right)\end{aligned} \tag{9}$$

The four parts of equation (9) capture within-firm effect, between-firm effect, entry effect and exit effect respectively. Note that the DOPD method uses contemporaneous productivity differences to gauge entry effect (period 2) and exit effect (period 1), thus satisfying the condition stated above. This adjustment raises the accuracy of productivity decomposition substantially.

5 Empirical results

In order to evaluate the contribution of exporting firm dynamics to aggregate productivity, we employ the DOPD to decompose the aggregate productivity growth of Chinese exporting firms, as we believe this is the least biased option among these widely-used methods. We also execute GR and FHK decompositions for comparison. As the firm's productivity is estimated in a logarithm, most previous studies decompose the productivity change as approximated by the difference of aggregate log TFP. However, the comparison of the difference of logarithms to a percentage is only sensible if the difference is small. Unlike previous studies, we decompose the growth rate of the aggregate log TFP, and this growth rate is computed as the ratio of the difference of aggregate log TFP over the aggregate log TFP of the previous year, $\frac{\Delta\Phi}{\Phi_1} = \frac{\ln\mathrm{TFP}_2 - \ln\mathrm{TFP}_1}{\ln\mathrm{TFP}_1}$.[14]

We begin with the decomposition of the growth rates of the aggregate log TFP of exporting firms in Section 5.1. As our identification approach of exporting firm dynamics excludes firms, which stop exporting even though they continue to survive in the domestic market. This identification conceives a concern that the contribution of domestic operation to the aggregate productivity of exporters isn't captured in our identification, we try to address this concern by using the ratio of exports over sales as weights to measure the aggregate productivity in Section 5.2.[15] We further adopt several alternative methods to decompose the growth rates of aggregate productivity to make comparisons.

5.1 Baseline results

Table 5 decomposes the growth rates of aggregate productivity on an annual basis in order to illustrate how the results differ across years. The last row of the table gives the sums of each column. The reallocation effect is defined as the sum of the between-firm effect, the entry effect and the exit effect in the far-right column.

Looking at the bottom row of Table 6, we note that the growth rate of aggregate log TFP of exporting firms increased by 16.4 % over the sample period. The contribution of the within-firm effect is 8.7 % accounting for 53 % of the

[14] Obviously, the direction and importance of each component remain unchanged in comparison with the results decomposing the difference of aggregate log TFP. We can easily transfer the results to the difference of log TFP by multiplying Φ_1 .

[15] In fact, even we don't use the export-share weighted productivity; the contribution of firms' domestic operations will be included in the within-firm effect, because the aggregate productivity is the average of all exporters and each exporter's productivity captures the contribution of exporting activity and domestic operation simultaneously.

productivity growth. The remaining 7.8 % can be attributed to the reallocation effect, which accounts for 47 % of aggregate productivity growth. This result indicates that more than half of the aggregate productivity growth of exporting firms originated from within-firm effects through innovation and management improvement, whereas the reallocation effect explains the remaining effect on the aggregate productivity growth of the exporting firms. Drawing on evidence for Slovenia (Melitz and Polanec, 2015) and New Zealand (Devine et al., 2012), we find the reallocation effect from Chinese firms to be sizable.[16] This result may be explained by the high turnover rates as described in Table 3, and these high turnover rates are possibly caused by China's low-end trade structure. Next, looking at the three components of the reallocation effect, we find that the between-firm effect accounts for the largest part (27 %) of the exporters' aggregate productivity growth; this verifies the finding of Table 2 according to which firms become the stronger the longer they can survive in foreign markets. Moreover, the total contribution of the entry effect is found to be negative with a small magnitude, which indicates that firms entering exporting have a negative effect on the aggregate productivity growth in the period of 2005-2009. This finding is in line with the study of Melitz and Polanec (2015). A possible reason to explain this lies in the lower productivity of entering exporters as compared to surviving exporters as described in Table 5. Bartelsman et al. (2009) also find that in countries where market entry barriers are low, entering firms are more likely to have lower productivity growth, and hence contribute negatively to aggregate productivity growth, and vice versa.

Remarkably, we find that the exit effect explains 20 % of aggregate productivity growth, which is much bigger than the result estimated by Melitz and Polanec (2015) and Devine et al. (2012). This decomposition result can also be explained by the higher productivity of surviving exporters as compared to exiting exporters as shown in Table 6.

[16] Melitz and Polanec (2015) find that the reallocation effect explains about 20 % of the aggregate productivity growth in Slovenia. Devine et al (2012) find a reallocation effect of 33 % for New Zealand. By contrast, our decomposition results are based on the aggregate productivity of exporters while the evidence for Slovenia and New Zealand refers to both exporters and non-exporters, thus limiting our ability to fully juxtapose the results.

Table 6: Results of DOPD for the overall sample

	Productivity Φ	Growth $\Delta\Phi/\Phi_1$	Within $\Delta\overline{\varphi_S}/\Phi_1$	Between $\Delta COV_S/\Phi_1$	Entry $s_{E2}(\Phi_{E2}-\Phi_{S2})/\Phi_1$	Exit $s_{X1}(\Phi_{S1}-\Phi_{X1})/\Phi_1$	Reallocation
2005–06	4.143	0.033	0.019 (58%)	0.010 (30%)	-0.008 (-24%)	0.012 (36%)	0.014 (42%)
2006–07	4.364	0.053	0.028 (53%)	0.013 (25%)	0.007 (13%)	0.005 (9%)	0.025 (47%)
2007–08	4.494	0.030	0.016 (53%)	0.009 (30%)	-0.005 (-17%)	0.010 (33%)	0.014 (46%)
2008–09	4.712	0.048	0.024 (50%)	0.013 (27%)	0.004 (8%)	0.007 (15%)	0.024 (50%)
Total		0.164	0.087 (53%)	0.045 (27%)	-0.002 (-1%)	0.034 (21%)	0.078 (47%)

Note: Productivity (column 1) is the value-added weighted aggregate productivity of all exporting firms. The productivity of 2005 is 4.012. The bottom row of the table sums the results in each column. The within contributions to aggregate productivity growth of the four different effects are displayed in parentheses. The reallocation effect consists of the between-firm effect, the entry effect and the exit effect.

Table 7: Results of export-share weighted productivity

	Productivity Φ	Growth $\Delta\Phi/\Phi_1$	Within $\Delta\overline{\varphi_S}/\Phi_1$	Between $\Delta COV_S/\Phi_1$	Entry $s_{E2}(\Phi_{E2}-\Phi_{S2})/\Phi_1$	Exit $s_{X1}(\Phi_{S1}-\Phi_{X1})/\Phi_1$	Reallocation
2005–06	1.586	0.050	0.026 (52%)	0.019 (38%)	–0.006 (–12%)	0.011 (24%)	0.022 (48%)
2006–07	1.686	0.063	0.032 (51%)	0.020 (32%)	0.006 (10%)	0.005 (7%)	0.031 (49%)
2007–08	1.722	0.021	0.010 (48%)	0.008 (38%)	–0.003 (–15%)	0.006 (29%)	0.011 (52%)
2000–09	1.784	0.036	0.019 (53%)	0.011 (30%)	–0.003 (–8%)	0.009 (25%)	0.024 (47%)
Total		0.170	0.087 (51%)	0.058 (34%)	–0.006 (–3%)	0.031 (18%)	0.083 (49%)

Note: Productivity (column 1) is the value-added weighted aggregate productivity of all exporting firms. The productivity of 2005 is 4.012. The bottom row of the table sums the results in each column. The within-firm contributions to aggregate productivity growth of the four different effects are displayed in parentheses. The reallocation effect consists of the between-firm effect, the entry effect and the exit effect.

5.2 Decomposition results of export-weighted productivity

One concern with the baseline decomposition is that it may overestimate the contribution of firms' exporting operations to the change in aggregate productivity as exporters are also involved in the domestic market. One possible way to address this concern could be the export-share weighted measure of aggregate productivity. Specifically, Table 7 reports the decomposition results using the ratio of export delivery value over sales value as a weight to be included in the calculation of aggregate productivity.

The results of Table 7 suggest similar findings as the baseline study, namely: (1) the reallocation effect contributes 49 % of aggregate productivity growth, which is a little bit higher than the result of the baseline study, (2) the between-firm effect contributes most to the reallocation effect among all three components, which accounts for 34 % of aggregate productivity growth, (3) the entry effect still exerts a negative influence on the productivity growth.

5.3 Results of different decompositions

In order to validate the results of the DOPD, we also implement the GR and FHK decompositions for comparison. Table 8 reports the decomposition results of GR, FHK and DOPD from 2005 to all subsequent years until 2009.

As indicated in Table 8, the contribution of the entry effect to aggregate productivity growth in DOPD fluctuates between –0.8 % and –0.1 % over the sample period of 2006–2009. By contrast, the contribution of the entry effect in the GR and FHK decompositions increases by 1.5 % and 1.9 % respectively. The difference of the decomposition results testifies that the GR decomposition and FHK decomposition biases the contribution of entering firms upward and the contribution of surviving firms downward (see also the theoretical review in section 4.2). While the biases can be effectively removed by DOPD decomposition.

Table 8: Results of different decompositions

	Productivity Growth Rate	Surviving firms			Entering firms			Exiting firms		
		GR	FHK	DOPD	GR	FHK	DOPD	GR	FHK	DOPD
2005–06	0.033	0.027	0.027	0.029	–0.005	–0.004	–0.008	0.011	0.010	0.012
2005–07	0.086	0.066	0.065	0.07	0.003	0.005	–0.001	0.017	0.016	0.017
2005–08	0.116	0.087	0.084	0.095	0.009	0.012	–0.006	0.020	0.020	0.027
2005–09	0.164	0.119	0.114	0.132	0.015	0.019	–0.002	0.030	0.031	0.034

Note: The productivity of 2005 is 4.012. The contribution of surviving firms includes within-firm effect and between-firm effect

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6 Sub-sample studies

Resource allocation efficiency may differ with firm characteristics in terms of ownership types, geographic locations and industry affiliation. This section explores several subsample studies in order to exam how the components of aggregate productivity growth of exporters differ across firms. For each subsample, we decompose the aggregate productivity growth rates year by year and then sum the decomposition results as we do in the last row of baseline study.[17] We test the statistical significance of differences of reallocation effect across subsamples. However, we cannot execute overtime tests of differences because the OP and DOPD decompositions are cross-sectional and static.

6.1 Firm ownership

In China, State-Owned Enterprises (SOEs) generally enjoy more fiscal subsidies, tax mitigation and financial support from governments than other kinds of firms, but State-Owned Enterprises are more likely to be inefficient owing to their inherent defects of governance structure and policy obligations (Zhang et al., 2003). Table 9 examines the decomposition results for firms with different types of ownership.

We are aware from Table 9 that among all exporting firms, the aggregate productivity, the productivity growth, as well as the contribution of the reallocation effect are the lowest for state-owned exporting enterprises. The reason for this result is that they are least likely to enter and exit from the markets as displayed in Table 3, which is due to the over-protection by the government and under-exposure to market competition. In contrast, the aggregate productivity growth, the between-firm effect, the exit effect, as well as the reallocation effect are found to be the highest for private-owned exporting enterprises, whereas their within-firm effect and entry effect are lowest. This is because (1) private-owned firms are fully exposed to market competition, so that their dynamics are more frequent as illustrated in Table 3, (2) private-owned firms' exports are more likely

[17] The reason why we don't present the decomposition results obtained from one single decomposition exercise performed over the whole five years' period is that it cannot capture the dynamics during the period.

to be locked in the low end of the value chain. And lastly, foreign-invested exporting enterprises have the highest productivity and productivity growth, and only they have a positive entry effect and the lowest contribution of exit effect. This result is confirmed by the fact that productivities of foreign-invested entering exporters are higher than those of foreign-invested surviving exporters.

6.2 Firm locations

Economic development and market maturity widely vary with geographic regions in China, so that the resource allocation efficiency in different regions is also different (Nie and Jia, 2011). We divide China into four regions, the eastern region, middle region, northern region and western region, in order to investigate the reallocation effect in this sub-section. Table 9 shows the productivity decomposition results for exporting firms of different regions.

The results of Table 10 show that exporting firms situated in the most developed eastern region achieve a better performance in terms of aggregate productivity, aggregate productivity growth and all of its decomposing components. In particular, only these capture a positive entry effect. The reason for these results is that a great number of exporting firms cluster in the eastern region, which gives birth to stronger competition and accordingly accelerates exporters' turnover, and the higher productivity of eastern exporters than eastern surviving exporters. By contrast, the contribution of the reallocation effect to aggregate productivity is the lowest for firms located in the least developed western region, because few exporters are located in this area and thus they are less likely to enter and exit foreign markets as illustrated in Table 2 and Table 3. Our findings in this section are consistent with previous studies demonstrating that the maturity of market economy relates positively to resource allocation efficiency (Hsieh and Klenow, 2009; Bartelsman and Doms, 2000).

Table 9: Decomposition results for exporting firms of different ownership types (2005–2009)

	Productivity Φ	Growth $\Delta\Phi/\Phi_1$	Within $\Delta\overline{\varphi_S}/\Phi_1$	Between $\Delta COV_S/\Phi_1$	Entry $s_{E2}(\Phi_{E2}-\Phi_{S2})/\Phi_1$	Exit $s_{X1}(\Phi_{S1}-\Phi_{X1})/\Phi_1$	Reallocation
SOE	4.590	0.144	0.098	0.036	-0.007	0.017	0.046***
			(68%)	(25%)	(-5%)	(12%)	(32%)
COE	4.682	0.160	0.104	0.038	-0.003	0.021	0.056***
			(65%)	(24%)	(-2%)	(13%)	(35%)
POE	5.041	0.241	0.127	0.072	-0.012	0.054	0.114***
			(53%)	(30%)	(-5%)	(21%)	(46%)
HIE	5.082	0.256	0.148	0.074	0.004	0.030	0.108***
			(58%)	(29%)	(1%)	(12%)	(42%)
FIE	5.134	0.278	0.167	0.073	0.011	0.027	0.111***
			(60%)	(26%)	(4%)	(10%)	(40%)

Note: Productivity (column 1) is the value-added weighted aggregate productivity of all exporting firms in 2009. Growth rates (column 2) are the growth rate of aggregate log TFP over the whole period. The contributions to aggregate productivity growth of the four different effects are displayed in parentheses. The reallocation effect consists of the between-firm effect, the entry effect and the exit effect. *** p<0.01, ** p<0.05, * p<0.1.

Table 10: Decomposition results for exporting firms of different regions (2005–2009)

	Productivity Φ	Growth $\Delta\Phi/\Phi_1$	Within $\Delta\overline{\varphi_S}/\Phi_1$	Between $\Delta COV_S/\Phi_1$	Entry $s_{E2}(\Phi_{E2}-\Phi_{S2})/\Phi_1$	Exit $s_{X1}(\Phi_{S1}-\Phi_{X1})/\Phi_1$	Reallocation
Eastern	5.047	0.258	0.142	0.070	0.006	0.040	0.116***
Region			(55%)	(27%)	(2%)	(16%)	(45%)
Middle	4.787	0.193	0.116	0.048	− 0.002	0.029	0.077***
Region			(60%)	(25%)	(− 1%)	(16%)	(40%)
Northern	4.813	0.199	0.117	0.052	− 0.004	0.034	0.082***
Region			(59%)	(26)	(− 2%)	(17%)	(41%)
Western	4.665	0.162	0.100	0.046	− 0.007	0.023	0.062***
Region			(62%)	(28%)	(− 4%)	(14%)	(38%)

Note: Productivity (column 1) is the value-added weighted aggregate productivity of all exporting firms in 2009. Growth rates (column 2) are the growth rate of aggregate log TFP over the whole period. The contributions to aggregate productivity growth of the four different effects are displayed in parentheses. The reallocation effect consists of the between-firm effect, the entry effect and the exit effect. *** p<0.01, ** p<0.05, * p<0.1.

6.3 Industries

The degree of concentration and the level of competition differ substantially across industries owing to the differences of product characteristics, which hence leads to different levels of resource allocation efficiency in different industries. In the sub-section, we study the reallocation effect for 30 different industries. Table 11 presents the productivity decomposition results for exporting firms of different industries.

As reported in Table 11, about 40 % of exporting firms cluster in the top five enterprise-intensive industries in 2009,[18] and they contribute about 55 % of total export value. However, only about 1 % of exporting firms belong to the last five enterprise-intensive industries with a contribution of about 1.5 % to total export value.[19] We also find from Table 9 that the reallocation effect contributes more to the productivity growth in the top five enterprise-intensive industries, but the aggregate productivity and productivity growth of these five industries are relatively low, which could be explained by the fact that there are more entries and exits in these industries as presented in Table 3. In contrast, the contribution of the reallocation effect to the productivity growth rate is found to be relatively low in these industries with a low number of exporters because of the inertia of firm dynamics.

[18] We define and judge industry concentration by the number of exporting firms and export value as weights, which is different from the generally accepted definition.

[19] The top five exporting industries with the largest number of firms are textile industry, textile garment and apparel industry, electric machinery and equipment manufacturing, manufacturing of computers, communications and other electronic equipment, and general equipment manufacturing. The five exporting industries of the lowest concentration are alcohol, beverage and refined tea manufacturing, tobacco manufacturing, chemical fiber manufacturing, and industry of comprehensive utilization of waste resources, industries of petroleum processing, coking, nuclear fuel processing.

Table 11: Decomposition results for exporting firms of different industries (2009)

Industry	Firm Weight	Export Weight	Productivity (Growth Rate)	Reallocation Effect
Agricultural and sideline food processing industry	3.32%	1.96%	4.494(0.135)	0.791(58%)**
Food manufacturing	1.61%	0.7%	4.138(0.118)	0.649(55%) ***
Alcohol, beverage and refined tea manufacturing	0.50%	0.23%	3.955(0.085)	0.038(44%)***
Tobacco manufacturing	0.03%	0.02%	4.443(0.112)	0.043(38%) ***
Textile industry	10.4%	5.36%	4.192(0.103)	0.670(65%)***
Textile garment and apparel industry	9.68%	4.21%	4.103(0.098)	0.060(62%) ***
Leathers, furs, feathers and related products industry	4.75%	2.93%	4.483(0.121)	0.726(60%) ***
Wood processing and wood, bamboo and straw product industry	1.81%	0.76%	4.205(0.114)	0.059(49%) **
Furniture manufacturing	2.14%	1.38%	4.069(0.092)	0.048(52%) ***
Papermaking and paper product industry	1.11%	0.71%	4.017(0.088)	0.043(50%) ***
Printing and recording media reproduction industry	0.76%	0.3%	4.859(0.168)	0.078(48%) ***
Manufacturing of stationery, industrial arts, sports, entertainments	3.25%	1.66%	4.955(0.177)	0.101(57%) *
Industries of petroleum processing, coking, nuclear fuel processing	0.09%	0.51%	4.185(0.103)	0.031(31%)***
Manufacturing of chemical raw materials and chemical products	4.91%	3.32%	4.783(0.175)	0.099(57%) ***
Pharmaceutical industry	1.33%	0.84%	4.703(0.161)	0.087(54%) **
Chemical fiber manufacturing	0.32%	0.46%	4.694(0.166)	0.069(42%) ***
Industry of rubber products	1.34%	1.2%	4.530(0.146)	0.081(55%) ***
Industry of plastic products	5.06%	2.43%	4.251(0.119)	0.073(61%) ***
Industry of non-metallic mineral products	3.94%	1.75%	4.064(0.092)	0.054(58%) ***
Industry of ferrous metal smelting and rolling processing	0.74%	3.51%	4.363(0.122)	0.056(46%) ***
Industry of non-ferrous metal smelting and rolling processing	1%	1.44%	4.494(0.146)	0.078(54%) ***
Metal product industry	6.06%	3.73%	4.138(0.127)	0.077(61%) **
General equipment manufacturing	6.86%	3.8%	3.955(0.099)	0.058(60%) ***
Special-purpose equipment manufacturing	3.78%	1.95%	4.443(0. 139)	0.113(58%) ***
Manufacturing of railways ,ships, aircrafts, spacecrafts and others	3.92%	5.25%	4.892(0.186)	0.101(54%) ***
Electric machinery and equipment manufacturing	7.27%	8.11%	4.203(0.103)	0.054(52%) ***
Manufacturing of computers, communications and other equipments	7%	36.33%	4.883(0.185)	0.102(55%) ***
Instrument and meter manufacturing	2.11%	2.6%	4.205(0.134)	0.068(51%) ***
Other manufacturing industries	4.42%	1.77%	4.069(0.95)	0.058(61%) ***
Industry of comprehensive utilization of waste resources	0.03%	0.006%	4.317(0.147)	0.058(40%) **

Note: We divide industries according to the China Standard Industry Classification. Firm weight (column 2) refers to the proportion of the number of exporting firms in that industry to the total number of exporting firms in 2009. Export weight (column 3) refers to the proportion of export value in that industry to the total export value in 2009. Growth rates (column 4) are the growth rate of aggregate log TFP over the whole period. The contributions to aggregate productivity growth of the four different effects are displayed in parentheses. The reallocation effect consists of the between-firm effect, the entry effect and the exit effect. *** p<0.01, ** p<0.05, * p<0.1.

7 Conclusion

After decades of rapid economic growth, China's traditional extensive growth model has become unsustainable. China is currently undergoing a transition toward a new model of intensive growth based on the promotion of productivity growth through innovation and technology upgrading. In this context, it is of great importance to classify and evaluate the contributions of different channels to productivity growth.

In this paper, we are motivated to explore the productivity growth contributed by the dynamics of exporting firms employing firm-level data of production for Chinese firms from 2005 to 2009. We apply the dynamic Olley–Pakes decomposition with entry and exit proposed by Melitz and Polanec (2015), which allows us to decompose the change in aggregate productivity into the contributions of surviving firms, entering firms and exiting firms.

We firstly describe the dynamics of exporting firms including the analysis of survival ability and firm performance, and the entries and exits by ownership, location, main sectors and export intensity. After reviewing existing decompositions, we proceed to decompose the growth rates of the aggregate log TFP of exporting firms. Meanwhile, we decompose the export-share-weights aggregate productivity to address the concern that the contribution of domestic operation to the aggregate productivity of exporters isn't captured in our identification. We further adopt several alternative methods to decompose the aggregate productivity growth to make comparisons. Finally, we explore several subsample studies to investigate how the reallocation differs across different groups of exporting firms.

The study suggests that in China, the combined contribution of the three components capturing the reallocation effect amounts to almost half of the change in aggregate productivity. The between-firm market reallocation is found to contribute most among the three components, followed by exit of inefficient producers. This paper also finds that the aggregate productivity growth contributed by the dynamics of exporters at foreign markets varies with ownership, location and industry, which suggests a higher contribution of reallocation effect to the growth of aggregate productivity to foreign-owned firms, firms situated in the eastern region and firms from high-concentration industries.

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