Exporting-Firm Dynamics and Productivity Growth: An Evidence from China

Huang Xiaobing and Liu Xiaolian

Abstract

This paper assesses the productivity growth contributed by the dynamics of exporting firms using a firm-level production data 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 in 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 be 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 exporting firms at foreign markets varies with ownership, location and industry, which suggests a higher contribution of reallocation effect to the growth of aggregate productivity to private-owned firms, firms situated in the Eastern region and firms from high concentration industries.

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Key words 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 reform and opening-up policy began, 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 37 in 25 years, from $115 billions in 1990 to $4.2 trillions in 2014, corresponding to a compound annual growth rate of 15.58%.[2]

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

Firm dynamics can optimize resource allocation, hence promote productivity (Hopenhayn, 1992; Ericson and Pakes, 1995). The "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" under efficient markets as exploited by Schumpeter: Low productive firms are less likely to survive and thrive than their more efficient counterparts, as a consequence, more efficient producers 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

[1] Over the sample period of 2005-2009, China's annual GDP growth rates are 11.31%, 12.68%, 14.16%, 9.63% and 9.21%.
[2] The data comes from China National Bureau of Statistics, growth rates are computed by authors.
[3] Yong (2003) find that TFP contribute only 15% of the aggregate economic growth. Most previous studies find low TFP growth rates in China. The annual TFP growth rate is 3.8% over the period of 1978-2005 in Perkins and Rawski (2008) and 3.6% in Bosworth and Collins (2008) over the period of 1978-2004.

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]

Comparing with the domestic firms, the dynamics of exporting firms are more violent because they operate in domestic market as well as foreign markets, and exporting behavior is always associated with a higher risk owing to the 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 were 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 indentifies a new gain of trade that the exposure to trade forces the least productive firms to exit, through such 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 contributed by the dynamics of exporting firms, thus how much is this gain of trade is still a black box.

Owing to the important role of exports on China's economy, we are motivated in this paper to explore the productivity growth contributed by the dynamics of exporting firms using a Chinese firm-level production data over the period of 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 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 survival ability and firm performance, and the entries and exits by ownership, location, main sectors and export

[4] The within-firm effect refers to the productivity improvement caused by firm innovation or management, while between-firm effect is originated 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.

intensity. After a review of existing decompositions, We move 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.

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 be 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 private-owned firms, firms situated in the Eastern region and firms from high concentration industries.

This paper contributes to the existing literature in several respects. First of all, we investigate firm dynamics at foreign markets and its contribution to productivity growth, which is a novel perspective but 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 that other methods and thus could improve the quality of the productivity decomposition. Eventually, 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 the 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 explains 1.7%-2.1%

of American productivity growth, while the contribution of aggregate technical efficiency ranges from 0.2% to 0.6%. Devine et al. (2012) observe that aggregate productivity of New Zealand increased by 0.1826 of which 0.1398 is contributed by surviving firms, -0.0704 is contributed by entering firms and 0.1132 is accounted for by exiting firms. Melitz and Polanec (2015) discover that the aggregate productivity of Slovenian firms increases by 50% during the period 1996-2000, where surviving firms contribute 35% of the observed productivity growth and firm dynamics contribute the remaining 15%. Many studies pay attention to the issues of Chinese resource misallocation. Dollar and Wei (2007) discover that there exists severe capital misallocation in China. Hsieh and Klenow (2009) find that moving 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 increase productivity drastically.

The reminder 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 decomposition for aggregate productivity growth. Section 6 presents several subsample studies. Finally, section 7 concludes.

2 Data

We employ a firm-level data on production from the Annual Surveys of Industrial Production for Chinese firms over the period of 2005-2009 conducted by the Chinese government's National Bureau of Statistics (NBS). The Annual Survey of Industrial Production is a census of all non-state 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 GDP. The raw data consists of over 200,000 firms every 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 following steps. Firstly we

[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.

delete the samples if the observations of key variables miss, for example, added-value, number of employees, fixed-assets. We also drop the observations with impossible negative values, such as employees. Then following Feenstra et al. (2013b), we clean samples violating accounting standards as follows:

- 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 samples whose employees are less than 8 persons.[6] After strict filter, we obtain a sample with 1649163 observations, which accounts for about 60% of the original dataset. We simply describe the dataset for the remaining samples in Table 1 by ownership, location and main sectors.[7]

We can reach several findings from Table 1: First, on the whole, about one quarter of firms are exporters in the dataset over the period of 2005-2009. 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 quarter of firms and more than half of exporting firms locate in east region of China. At last, the number of firms from 5 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 main sectors have a higher probability of become an exporter.

Table 1: Firm distribution

[6] According to the China's company law, the number of employees for a company must be more than 8, 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; 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 includes Textile garment and apparel industry, Electric machinery and equipment manufacturing, Manufacturing of computers, communications and other electronic equipments, General equipment manufacturing.

		2005	2006	2007	2008	2009
Number of all firms:		264714	294397	330981	370395	389216
By ownership:	SOEs	15584	14066	10924	9703	9882
	COEs	15930	14912	13083	6526	6072
	POEs	177751(67%)	205743(70%)	240618(72%)	295659(80%)	315874(81%)
	FIEs	28348	30960	34832	37221	37292
	HIEs	27101	28776	31524	21286	20096
By location:	East	139980(53%)	152566(52%)	171352(52%)	283521(76%)	300183(77%)
	Middle	54903	62707	71523	43803	45336
	West	38435	42039	46333	21269	21269
	North	31396	37085	41773	21802	22428
By sectors:	Main sectors	59416(23%)	86279(29%)	98505(30%)	114435(31%)	115936(30%)
Number of exporting firms:		74764(28%)	78511(27%)	78412(24%)	80848(22%)	77150(20%)
By ownership:	SOEs	1900	1622	1211	916	954
	COEs	2463	1724	872	717	617
	POEs	35731(48%)	38442(49%)	36425(46%)	43248(53%)	42940(55%)
	FIEs	17793	19230	21107	22722	20906
	HIEs	16697	17493	18797	13250	11732
By location:	East	46898(63%)	49996(64%)	37328(48%)	54173(67%)	67695(88%)
	Middle	14582	14562	9379	5967	5230
	West	7347	7464	7963	1779	1529
	North	5937	6489	6897	3269	2696
By sectors:	Main sectors	29211(39%)	30773(39%)	32246(41%)	34312(42%)	32316(42%)

Note: The export values are in 1000 RMB.

3 The dynamics of exporting firms

Exporting is associated with more risks than domestic operations due to institutional differences, complicate 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 yearly export delivery value to identify whether a firm is an exporting firm and firms' ID to identify firms' dynamics.[8] The appearance of a firm's IDs suggests an entry, and the disappearance of a firm's ID indicates an exit. Apparently, the disappearance of both export delivery value and firm's ID leads to the exit of exporting firms. This approach allows us to capture the dynamics of domestic markets and foreign markets simultaneously, but excludes firms who stop 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 benchmark and observe the performance in subsequent years.

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' ID to indentify firm survival for all firms and exporting firms. Export volume, sales and number of employees are average values in 1000 RMB.

[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 over 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) the M&A in China over the sample period isn't active. Data from Chinese M&A yearbook shows that the yearly number of domestic M&As is 117 in 2007,109 in 2008, 223 in 2009. (2) About 40% of M&As happened in manufacturing industry. (3) not all M&As lead to firm disappearances.

Figure 1: Survival of Chinese manufacturing firms

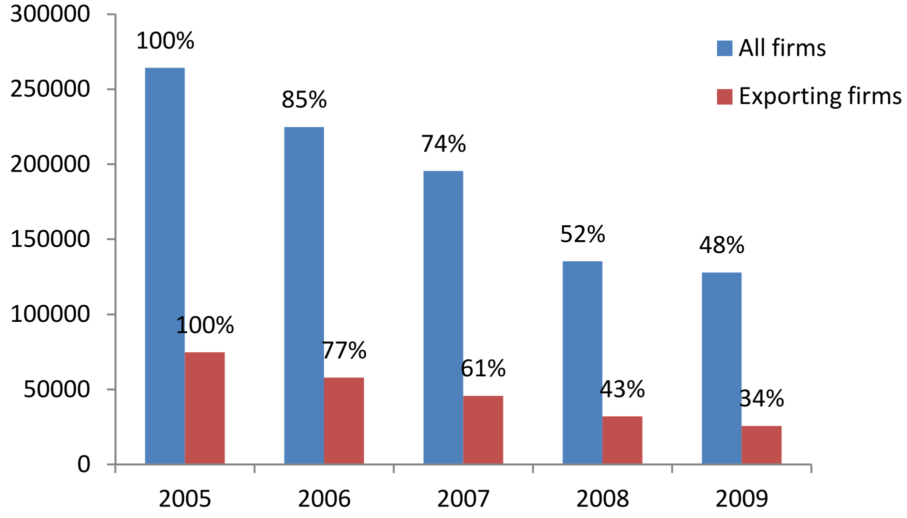

Table 2 and Figure 1 suggest three main findings with respect to the dynamics of all firms and exporting firms. First, Only 48% of firms can survive for 5 years. Only 34% of the firms who export in 2005 succeed to export until 2009. More than 20% of the exporting firms exit from foreign markets annually. Second, the longer firms can survive, the stronger they become. Firms surviving for 5 years gain a better performance than firms surviving for 4 years in terms of export value, sales and employee number. Finally, looking at the differences between exporters and all firms, we find that the indicators of exporting firms are higher than 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 over the period of 2005-2009. We define entrants in year t as those firms whose IDs don't appear in t-1, but in t. We define exiters in year t as those firms who are active in the database in t-1 but absent in t. If a firm re-enters into the database after exit, we treat that firm as a new entry firm at 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.

Table 3: Entry and exit of exporting firms

		2006	2007	2008	2009
Number of exiting firms (exit rate)		16882(21.5%)	19346(24.7%)	26799(33.1%)	23127(30%)
By ownership:	SOEs	630	683	645	307
	POEs	9366(55%)	11829(61%)	13495(50%)	12141(52%)
	FIEs	2929	3054	6383	5867
	COEs	1036	952	420	261
	HIEs	2921	2828	5856	4551
By location:	East	9213(55%)	8953(46%)	17156(64%)	17521(75%)
	Middle	4600	7470	4065	2950
	West	1624	1449	2982	947
	North	1445	1474	2596	1709
By export intensity:	Low	6037	8987	6339	6553
	High	10845(64%)	10359(54%)	20460(76%)	16574(72%)
Export value of exiting firms		31251	33351	67817	47773
Number of entering firms (entry rate)		20647(26.3%)	19247(24.5%)	29235(36.2%)	19429(25.2%)
By ownership:	SOEs	403	264	359	349
	POEs	11653(56%)	10003(52%)	15468(53%)	10949(56%)
	FIEs	4531	4752	7527	4519
	COEs	460	180	242	171
	HIEs	3600	4048	5639	3441
By location:	East	12327(60%)	13144(68%)	22692(77%)	14664(75%)
	Middle	4582	2276	3325	2729
	West	1741	1953	1175	915
	North	1997	1874	2043	1121
By export intensity:	Low	6533	4901	7690	6099
	High	14114(68%)	14346(75%)	21545(74%)	13330(69%)
Export value of entering firms		48121	49434	66733	60177

Note: We report the previous export values for exit firms. The export values are average values in 1000 RMB. Export intensity is measured by the ratio of export value over sales. Low and high export intensity is divided according to the mean of export intensity.

As indicated in Table 3, the annual turnover rates fluctuate between 49% and 70% over the period of 2006-2009.[9] The number of entrants into foreign markets account on average 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

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

rate of Columbian firms (Eaton et al, 2008), whereas they are much higher than those of many other countries (e.g. Fackler et al.,2012; Bartelsman et al., 2013).Mover, 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 locate in eastern China. There are much more entries and exits for firms with a higher export intensity. what we find in this table indicates that private exporter, eastern exporters and exporters of main sectors are more likely to enter foreign markets and fail in export markets or domestic market.

4 Firm productivity estimation and decompositions

4.1 Firm Productivity Estimation

There are several methods for productivity estimation including Solow's residual method, data envelopment analysis (DEA) method, Olley-Pakes (OP; 1996) method, and Levinsohn-Petrin (LP; 2003) method. Solow's residual method is most used for 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]

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

Our paper also estimates Solow residual (OLS) for comparison. The estimated elasticity

[10] The command opreg can be used to implement the production function estimator of OP.
[11] Some papers adopt other 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 China Statistical Yearbook.

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%.

Olley and Pakes (1996) state that simultaneity bias and selectivity bias generated by 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 on the contrary, the labor coefficient is lower for OP than for OLS. The estimation results, thus, conform with the conclusion of Olley and Pakes (1996), which makes us confident that the risk of biased productivity estimates is considerably reduced by the use of OP estimation. Table 5 describes the China's unweighted aggregate log TFP over the period of 2000-2007.

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

[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.

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

Table 5 reveals that the aggregate productivity of exiting exporters, entering exporters and surviving exporters keep increasing over time during the period of 2005-2009. Looking at the differences between groups, we find the aggregate productivities of surviving exporters are higher than exiting exporters and entering exporters. However, the productivities of foreign-invested and eastern surviving exporters are lower than 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 following form:

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

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 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) $\Delta\Phi = \Phi_2 - \Phi_1$.

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 at 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 to high productive 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 concern 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 than incumbents suggests a negative entry effect and the higher productivity of existing firms than incumbents suggests a positive exit effect. The BHC approach apparently introduces biases into the contributions of entry and exit.

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

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

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

The other approach is the FHK decomposition (Foster et al., 2001) who employs the aggregate productivity level of period 1 (Φ_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 BHC decomposition, the entry and exit effects in 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 decomposition are able to reduce the biases born in 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 the contemporaneous productivity differences. This intuitive condition is violated by the GR and FHK decompositions whose entry and exit effects are associated with the inter-temporal productivity differences. Assume aggregate productivity grows, $\Phi_{S2} > \Phi_{S1}$, the reference productivity levels $\overline{\Phi}$ 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:

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

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 (Bartlesman et al., 2009). Apparently, the OP method approximately depicts resource misallocation and doesn't 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:

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

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 firms 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 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, which is computed as the ratio of the difference of aggregate log TFP over the aggregate log TFP of previous year, $\frac{\Delta\Phi}{\Phi_1}=\frac{\ln TFP_2-\ln TFP_1}{\ln TFP_1}$.[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 who stop exporting even they continue to survive in the domestic market, which 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.

[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 operation will be included in the with-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.

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 sums the results in 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.

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.

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 within-firm effect is 8.7% accounting for 53% of the productivity growth and the remaining 7.8% can be attributed to the reallocation effects 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 and the reallocation effect explains the rest growth of the aggregate productivity of exporting firms. Comparing with evidences for Slovenia (Melitz and Polanec, 2015) and New Zealand (Devine et al, 2012), we find the reallocation effect from Chinese firms is sizable.[16] The likely explanation to this result is the

[16] Melitz and Polanec (2015) find that the reallocation effect explains about 20% of the aggregate productivity

high turnover rates as described in Table 3, which is 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 contributes most (27%) to the exporters' aggregate productivity growth, which verifies the finding of Table 2 that the longer firms can survive in foreign markets, the stronger they become. Moreover, the total contribution of the entry effect is found to be negative with a small magnitude, which indicates that entering exporting firms have a negative effect on the aggregate productivity growth during 2005-2009. This finding is in line with the study of Melitz and Polanec (2015). The possible reason to explain this lies in the lower productivity of entering exporters than 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 have a negative contribution 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 than exiting exporters as shown in Table 5.

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. The 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 weight to calculate aggregate productivity.

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	0.019	-0.006	0.011	0.022

growth in Slovenia. Devine et al (2012) find a reallocation effect of 33% for New Zealand. However, that our decomposition results are based on the aggregate productivity of exporters while the evidence for Slovenia and Nea Zealand refers to both exporters and non-exporters, thus limiting our ability to fully juxtapose the results.

			(52%)	（38%）	(-12%)	(24%)	(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 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.

The results of Table 7 suggest similar findings with the baseline study as follows: (1) the reallocation effect contributes 49% of aggregate productivity growth, which is a little bit higher than the result of 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 imposes a negative influence on the productivity growth.

5.3 Results of different decompositions

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

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.

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

6 Sub-sample studies

Resource allocation efficiency may differ with firm characteristics in terms of ownership types, geographic locations and industry affiliation. This section explore several subsample studies in order to exam how the components of aggregate productivity growth of exporters differ across firms. we decompose each subsamples' 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 can not execute overtime tests of differences because the OP and DOPD decompositions are cross-sectional and static.

[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 can not capture the dynamics during the period.

6.1 Firm ownerships

In China, State-Owned Enterprises (SOEs) generally enjoy more fiscal subsidies, tax mitigation and financial supports 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 exams the decomposition results for firms with different types of ownerships.

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 （68%）	0.036 （25%）	-0.007 （-5%）	0.017 （12%）	0.046*** （32%）
COE	4.682	0.160	0.104 （65%）	0.038 （24%）	-0.003 (-2%)	0.021 (13%)	0.056*** (35%)
POE	5.041	0.241	0.127 (53%)	0.072 (30%)	-0.012 （-5%）	0.054 （21%）	0.114*** （46%）
HIE	5.082	0.256	0.148 (58%)	0.074 (29%)	0.004 (1%)	0.030 (12%)	0.108*** (42%)
FIE	5.134	0.278	0.167 (60%)	0.073 (26%)	0.011 (4%)	0.027 (10%)	0.111*** (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.

We are aware from Table 9 that the aggregate productivity, the productivity growth, as well as the contribution of reallocation effect are the lowest for state-owned exporting enterprises among all exporting firms. The reason to this result is that they are least likely to enter and exit from the markets as display in Table 3, which is brought out by the over-protection of government and under-exposure to market competition. On the contrary, 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 that (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 inclined to be locked in the low-end of value chain. At last, foreign-invested exporting enterprises have the highest productivity and productivity growth, and only they have 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 the foreign-invested surviving exporters.

6.2 Firm locations

The 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 including 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.

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 Region	5.047	0.258	0.142 (55%)	0.070 (27%)	0.006 (2%)	0.040 (16%)	0.116 (45%)
Middle Region	4.787	0.193	0.116 (60%)	0.048 (25%)	-0.002 (-1%)	0.029 (16%)	0.077 (40%)
Northern Region	4.813	0.199	0.117 (59%)	0.052 (26)	-0.004 (-2%)	0.034 (17%)	0.082 (41%)
Western Region	4.665	0.162	0.100 (62%)	0.046 (28%)	-0.007 (-4%)	0.023 (14%)	0.062 (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.

The results of Table 10 show that exporting firms situated in the most developed eastern region gain a better performance in terms of aggregate productivity, aggregate productivity growth and its all decomposing components, in particular, only they capture a positive entry effect. The reason why this results occur 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 reallocation effect to aggregate productivity is the lowest for firms located in the least developed western region, because a few exporters locate in this area and thus they are less likely to enter and exit foreign markets as illustrated in Table 2 and Table 3. The findings we draw in this section are consistent with previous studies which demonstrates that the maturity of market economy positively relates to resource allocation efficiency (Hsieh and Klenow, 2009; Bartelsman and Doms, 2000).

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 causes distinct resource allocation efficiency to 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.

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 total number of exporting firm in 2009. Export weight (column 3) refers to the proportion of export value in that industry to total export value in 2009. *Note:* 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.

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 enters and exits in these industries as presented in Table 3. On the contrary, the contribution of the reallocation effect to the productivity growth rate are found to be relatively low in these industries with few number of exporters because of the inertia of firm dynamics.

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

[19] The top 5 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 equipments, General equipment manufacturing. While the top 5 exporting industries of lowest concentration are alcohol, beverage and refined tea manufacturing, tobacco manufacturing, alcohol, beverage and refined tea manufacturing, chemical fiber manufacturing, and industry of comprehensive utilization of waste resources.

7 Conclusion

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

We are motivated to explore the productivity growth contributed by the dynamics of exporting firms employing a firm-level data on production for Chinese firms from 2005 to 2009 in this paper. 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 in 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 a review of existing decompositions, We move 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 reallocation effect amounts to almost half of the change in aggregate productivity. The between-firm market reallocation is found to be 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.

References

Acemoglu, Daron., Cao, Dan. (2010). Innovation by Entrants and Incumbent. *MIT working paper*, No. 16411.

Baldwin, John R, Gu, Wulong. (2008). Firm Turnover and Productivity Growth in the Canadian Retail Trade Sector. *Economic Analysis (EA) Research Paper Series,* 2008053e.

Baily, M., Hulten, C., and Campbell, D. (1992). Productivity dynamics in manufacturing plants. *Brookings Papers on Economic Activity: Microeconomics*, 4:187-267.

Bartelsman, E.J., Doms, M. (2000). Understanding Productivity: Lessons from Longitudinal Microdata. *Journal of Economic Literature*,38(3):.569-594.

Bartelsman E., S. Scarpetta, and F. Schivardi (2005). Comparative analysis of firm demographics and survival: Micro-level evidence for the OECD countries. *Industrial and Corporate Change*, 14(3):365–391.

Bartelsman, E., J.C. Haltiwanger and Scarpetta, S. (2013). Cross-Country Differences in Productivity: The Role of Allocation and Selection. *American Economic Review*, 103 (1), 30534.

Brandt, Loren, Biesebroeck, Johannes, Zhang Yifan (2009). Creative Accounting or Creative Destruction? Firm－level Productivity Growth in Chinese Manufacturing. *NBER Working Paper*, No.15152.

Bosworth, Barry and Susan M. Collins (2008). Accounting for Growth: Comparing China and India. Journal of Economic Perspectives, 22 (1): 45–66.

Das, Sanghamitra, Roberts Mark J. and James R. Tybout (2007). Market Entry Costs, Producer Heterogeneity, and Export Dynamics. *Econometrica,* 75(3):.837-873.

Devine, H., Doan, T., Iyer, K., Mok. P. and Stevens, P. (2012). Exit and entry of New Zealand firms. *NZAE Annual Conference*, 2012.

Dollar, D., Wei, S.J., Das, K. (2007). Firm ownership and Investment Efficiency in China. *NBER Working Paper*, No:13103.

Eaton, J., Eslava, M., Kugler, M., Tybout, J.(2007).Export Dynamics in Colombia: Firm-Level Evidence. *Working Paper Series,* NO.07-050, Harvard University, John F. Kennedy School of Government.

Ericson, R., and Pakes, A. (1995). Markov Perfect Industry Dynamics: A Framework for Empirical Analysis. *Review of Economic Studies,* 62(1): 53-82.

Fackler, D., C. Schnabel and J. Wagner (2012). Establishment Exits in Germany: The Role of Size and Age. *IZA Discussion Papers,* No.6349.

Feenstra, R., Mandel B., Reinsdorf M., and Slaughter M. (2013b), Effects of terms of trade gains and tariff changes on the measurement of U.S. productivity growth. *American Economic Journal: Economic Policy*, 5(1): 59–93.

Foster, L., Haltiwanger, J.C., and Syverson, C. (2008). Reallocation, Firm Turnover and Efficiency: Selection on Productivity or Profitability?. *American Economic Review*, 98(1): 394-425.

Foster, L., Haltiwanger, J.C., and Krizan, C.J. (2001). Aggregate Productivity Growth: Lessons from Microeconomic Evidence. *New Developments in Productivity Analysis*. University of Chicago Press.

Griliches, Z. and Regev, H. (1995). Firm productivity in Israeli Industry: 1979-1988. *Journal of Econometrics*, 65: 175-203.

Heckman, J. (1979). Sample selection bias as a specification error. Econometrica, 47,153–161.

Hsieh, C.T., and Klenow, P.J. (2009). Misallocation and Manufacturing TFP in China and India. *Quarterly Journal of Economics,* 124(4): 1403-1448.

Hopenhayn, H. A. (1992). Entry, Exit, and Firm Dynamics in Long Run Equilibrium. *Econometrica,* 60(5): 1127-1150.

Melitz, M. (2003). The impact of trade on intra-industry reallocations and aggregate industry productivity.

Econometrica, 71: 1695-1725.

Melitz, M, Polanec. S. (2015). Dynamic Olley-Pakes Productivity Decomposition with Entry and Exit. *The RAND Journal of Economics,* 46: 362-375.

Nie huihua, Jia ruixue (2011). Productivity of Chinese Manufacturing Firms and Resource Misallocation. *World Economy*, 55(7): 28-42.

Olley, S. and Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Industry. *Econometrica,* 64(6): 263-1298.

Petrin, A. and Levinsohn, J. (2012). Measuring Aggregate Productivity Growth Using Plant level Data. *The RAND Journal of Economics,* 43(4): 705-725.

Perkins, Dwight H. and Thomas G. Rawski, (2008). Forecasting China's Economic Growth to 2025, Chapter 20, in Loren Brandt, Thomas G. Rawski (eds.) China's Great Economic Transformation, Cambridge University Press.

Young, Alwyn (2003). Gold into Base Metals: Productivity Growth in the People’s Republic of China during the Reform Period. Journal of Political Economy, 111, 1221–1261

Zhang weiyin, Zhou lian, Gu quanlin (2003). Firm Exiting Mechanism in Transitional Economy-an Empirical Study for Technology Zone of Beijing. *Economy Research*, 10: 3-14.