Exporting Firm Dynamics and Productivity Growth: Evidence from China

Xiaobing Huang and Xiaolian Liu

Abstract

This paper analyzes the reallocation effects generated by dynamics of exporting firms adopting DOPD productivity decomposition. The authors select the exporting firm samples from the dataset of Annual Surveys of Industrial Production for the period from 2005 to 2009. The study indicates that the surviving ability of exporters is weak, and that firm turnover is turbulent. The reallocation effects generated by firm dynamics contributes almost half of productivity improvement. It mainly originates from between-firm effects, rather than firm turnover effects, with the entry effects being negative. This suggests that there is market misallocation, which maybe caused by uneven regional development, industrial monopoly or state-owned enterprises.

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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". Foreign trade is one of the powerful engines driving China's economic growth. The trade volume of China has increased by factor 37 in 25 years, from $115 billions in 1990 to $4.2 trillions in 2014, corresponding to an compound annual growth rate of 15.58%.[1] The ratio of foreign trade to GDP fluctuates around 50% in recent years. However, the development of foreign trade and economic growth in China has relied heavily on massive input of cheap labor and natural resources, it has brought out environment pollution, excess capacities in production, regional disparities and many other problems. Thus, the extensive model of growth pursued by China over last decades is widely considered unsustainable. In order to maintain rapid economic growth, it is inevitable for China to transform its economic growth model to an intensive model, which essentially requires the promotion of productivity. The promotion of productivity can in principal be achieved through innovation, technology spillovers and resource reallocations. According to Petrin and Levinsohn (2012) the innovation and spillover channels are slow and costly, whereas the resource reallocation channel is more direct and effective.

Firm dynamics can help optimize the allocation of resources and, hence, boost productivity (Hopenhayn, 1992; Ericson and Pakes, 1995). The term "firm dynamics" refers to the evolutionary processes that firms undergo in the market, including firm entry, growth and exit. Following Schumpeter, the mechanism driving aggregate productivity improvements is "creative destruction". Low productivity firms are less likely to survive and thrive than their more efficient counterparts. As a consequence, more efficient producers will occupy 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 driver of aggregate productivity changes (Foster, et al., 2001; Bartelsman et al., 2013). This finding has spurred the development of decomposition

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[1] The data comes from China National Bureau of Statistics, growth rates are computed by authors.

methods that break down aggregate productivity changes into four different components, a within-firm effect, a between-firm effect, an entry effect, and an exit effect (Baily, Hulten and Campbell, 1992; Griliches and Regev, 1995; Foster, Haltiwanger and Krizan, 2001).[2] The reallocation effect generated by firm dynamics is given by the sum of the between-firm effect, the entry effect and the exit effect.

In comparison to the dynamics on the domestic market, the dynamics of exporting firms in foreign markets are more vibrant, i.e. there are more frequent entries and exits (Das et al., 2007). 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. Also they find that survivors expand their foreign sales very rapidly. The workhorse model of trade with heterogeneous firms (Melitz, 2003) reveals 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, thus contributing to an aggregate productivity gain. 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 few of them shed light on the empirical research of productivity growth generated by firm dynamics on export markets.

Motivated by the above background, we analyze the role of firm dynamics on export markets and resource reallocations between exporters in explaining the aggregate productivity growth of Chinese exporters, using firm-level census data for the Chinese manufacturing sector from the China Statistics Bureau. The study indicates that the surviving ability of exporters is weak and that firm turnover is turbulent. The reallocation effects generated by firm dynamics explain almost half of the aggregate productivity improvement of Chinese exporters, but this mainly originates from resource reallocations between incumbent exporters (between-firm effect), rather than firm turnover effects (entry effect and exit effect). Moreover, the entry effect is negative, which suggests that there exist severe market misallocations. These misallocation maybe caused by uneven regional development, industrial monopoly and state-owned enterprises.

This paper contributes to the existing literature in several respects. First of all, we investigate firm dynamics at foreign markets, which is a novel perspective. We attempt to fill the research gap

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[2] 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.

between firm heterogeneity in international trade and firm dynamics. In terms of methods, we strive to improve the accuracy of our productivity decomposition by adopting the Dynamic Olley-Pakes Decomposition (DOPD) method proposed by Melitz and Polanec (2015). Eventually, we provide detailed comparative analyses for different samples in order to investigate the reasons leading to market misallocation.

This paper closely relates to the strand of research 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 labour 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, whereas, the contribution of innovation is just 0.2%-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 structure of the paper is as follows. Section 2 presents the dynamics of Chinese exporting firms. Section 3 describes our data source and processing. Section 4 reviews some productivity estimation and decomposition methods. Section 5 discusses the empirical results. Finally, section 6 concludes.

2 Data

Our data for Chinese manufacturing firms is from the Annual Surveys of Industrial Production from 2005 through 2009 conducted by the Chinese government's National Bureau of Statistics (NBS). The time span of data ranges from 1999 to 2009, but the observations of export delivery value are missing for 2004. So we select the data from 2005 to 2009 for consecutive observation. 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. 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.

We filter the data by the following steps to improve data quality. Firstly we have deleted observations if key variables (industrial outputs, number of employees, and fixed assets) are missing. Then following Feenstra et al. (2013a), we have also cleaned observations violating accounting standards, for instance, profit greater than sales, liquid assets greater than total assets. Lastly, we have omitted firms with less than 8 employees, as Brandt et al. (2009).[3] Table 1 shows some basic statistics for remaining samples.

Table 1: Summary statistics, all years

	2005	2006	2007	2008	2009
Number of firms	264714	294397	330981	370395	389216
Number of exporting firms	74764	78511	78412	80848	77150
Proportion of exporting firms	28.2%	26.7%	23.7%	21.8%	20%
Mean exporting value	63653	76891	93422	91154	87094

Note: The unit of export value is 1000 RMB.

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[3] According to the China company law, the number of employees of a company must be more than 8, otherwise it is only considered a small private business rather than a company.

3 Dynamics of Chinese Exporting Firms

Exporting firms take more risks than domestic firms to do business at foreign markets due to distance, complicate transaction procedures and market fluctuations. This section analyses Chinese firm dynamics at foreign markets. We use the information on the yearly export delivery value to identify whether a firm enters into or exits from foreign markets. The appearance of a positive value identifies entry into foreign markets, and the disappearance of a positive export delivery value identifies exit from foreign markets. If a firm re-enters the export market after exits, we consider the firm as new entry firm at that year.[4] Table 2 and Figure 1 present descriptive statistics on firm survival of Chinese manufacturing firms. 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	Firm surviving time	1 year	2 years	3 years	4 years	5 years
All Firms	Number of firms	264174	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 use firm code to judge whether or not firm survives . Export volume, sales and number of employees are average value in 1000 RMB.

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[4] This approach will cause a censoring problem. Some exporting firms will vanish from the dataset if their sales value is below 5 million RMB, even though they still export.

Figure 1: Survival of Chinese manufacturing firms
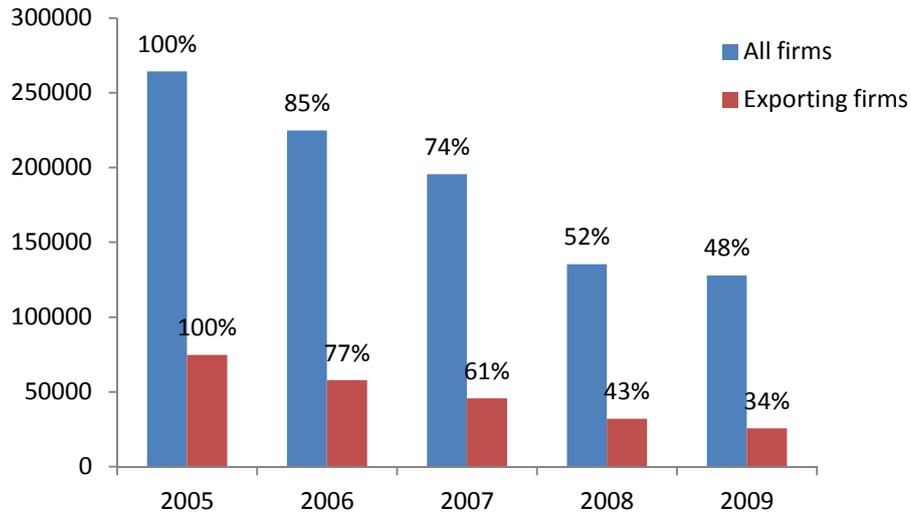
From Table 2 and Figure 1 we make three main observations relating to the dynamics of exporting firms. First, the surviving ability Chinese firms in foreign markets is weak. Only 34% of the firms exporting in 2005 continue to export until 2009. More than 20% of the exporting firms exit from foreign markets annually. Secondly, the longer firms keep exporting to foreign markets, the stronger they become. Firms that export for 5 years are lager than firms being exporters for 4 years in terms of export value, sales and employee number. Finally, when we compare exporting firms with all firms (exporters and domestic firms), it can be discovered that exporting firms are larger in all aspects, this is likely due to both self-selection and positive learning externalities because causality can run in both directions. This is another piece of evidence verifying the importance of firm heterogeneity in international trade.

Table 3 displays the firm entry and exit rates at foreign markets over the period 2005-2009. We define entrants in year t as firms that were absent in t-1, but appeared in t. We define exits in year t as firms that were present t-1 but absent in t. The exit and entry rates are calculated as the share of entering firms and exiting firms in total number of exporting firms in a year.

Table 3: Firm entry and exit rates at foreign markets

	2006	2007	2008	2009
Number of exiting firms	16882	19346	26799	23127

Exit rate	21.5%	24.8%	33.1%	30%
Export value of exiting firms	31251	33351	67817	47773
Number of entering firms	20647	19247	29235	19429
Entry rate	26.3%	24.5%	36.2%	25.2%
Export value of entering firms	48121	49434	66733	60177

Note: Export value of exit firms refers to the observations of last year, and the export value is average value in 1000 RMB

Table 3 reveals that the exit and entry behavior of Chinese firms in foreign markets are highly turbulent, the annual firm turnover rate fluctuates between 49% and 70% during the period 2006-2009.[5] Entrants into the export 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 foreign markets each year. These figures are very close to the turnover rate of Columbian firms (Eaton et al, 2008), while they are much higher than those of many other countries (e.g. Fackler et al., 2012; Bartelsman et al., 2013). The high churning rate of exporting firms likely reflects the strong competition on exporting markets.

4   Firm Productivity Estimation and Decompositions

4.1   Firm Productivity Estimation

There are several methods for productivity estimation including Solow's residual method, data envelopement 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.

In this section, we also adopt the OP method to estimate firm productivity using added value as

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

the dependent variable. 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.[6] All variables are deflated by appropriate price indices.[7] Our paper executes Solow residual (OLS) and OP estimations for comparison. The coefficients of capital and labor are listed in Table 4.

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 is 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.

4.2   Productivity Growth Decompositions

In this section, we review several methods of productivity growth decomposition in order to highlight key differences between those methods. The first productivity growth decomposition method is the BHC method developed by Baily, Hulten and Campbell (1992). The BHC method decomposes productivity growth into four parts:

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[6]   Some papers adopt other lower depreciation rates, such as 10% or 5%. The choice of different depreciation rates does not affect our qualitative results.
[7]   All kinds of price indices are from China Statistical Yearbook.

$$\Delta\Phi = \sum_{i\in S} s_{i1}\left(\varphi_{i2} - \varphi_{i1}\right) + \sum_{i\in S}\left(s_{i2} - s_{i1}\right)\varphi_{i2} + \sum_{i\in E} s_{i2}\varphi_{i2} - \sum_{i\in X} s_{i1}\varphi_{i1} \tag{1}$$

Where Φ, φ and s denote aggregate productivity, firm productivity and firm share respectively. [8] Firm shares can be firm market shares or employee shares. S, E and X denote the sets of surviving, entering and exiting firms respectively. The first term at the right hand side of equation (1) is a within-firm effect which captures the contribution of innovation or management within surviving firms to aggregate productivity growth. The second term is a between-firm effect capturing the contribution of reallocations in market shares from low to high productive firms, which is a first kind of resource reallocation generated by firm dynamics. The third term is an entry effect and the final term is an exit effect. Entry and exit effects can be summarized into a firm turnover effect, which constitutes another kind of resource reallocation generated by firm dynamics.

The problem of the BHC method is that the entry effect is positive and the exit effect is negative regardless of the productivity of entering and exiting firms. This feature clashes with our intuition, if entrants are on average less productive than incumbents (suggesting a negative entry effect) or if existing firms are on average more productive than incumbents (suggesting a positive exit effect). The BHC method apparently introduces bias into the measurement of the contributions of entry and exit.

In order to solve this problem, other papers have introduced alternative methods using alternative reference productivity levels into the decomposition. One of them is the GR method (Griliches and Regev, 1995), which adopts the average aggregate productivity level between the two periods, $\overline{\Phi} = \left(\Phi_1 + \Phi_2\right)/2$, as the reference productivity level. Decomposition is then given by:

$$\Delta\Phi = \sum_{i\in S}\overline{s_i}\left(\varphi_{i2} - \varphi_{i1}\right) + \sum_{i\in S}\left(s_{i2} - s_{i1}\right)\left(\overline{\varphi_i} - \overline{\Phi}\right) + \sum_{i\in E} s_{i2}\left(\varphi_{i2} - \overline{\Phi}\right) - \sum_{i\in X} s_{i1}\left(\varphi_{i1} - \overline{\Phi}\right) \tag{2}$$

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

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[8] We define the aggregate $\Phi = \sum_i s_{it}\varphi_{it}$, the aggregate productivity growth for whole economy is calculated using Added-value shares as weights.

Yet another method is the FHK method (Foster et al., 2001) which uses the aggregate productivity level in period 1 (Φ_1) as the reference productivity level. The corresponding decomposition equation is:

$$\Delta\Phi = \sum_{i\in S} s_{i1}\left(\varphi_{i2}-\varphi_{i1}\right) + \sum_{i\in S}\left(s_{i2}-s_{i1}\right)\left(\varphi_{i1}-\Phi_1\right) + \sum_{i\in S}\left(s_{i2}-s_{i1}\right)\left(\varphi_{i2}-\varphi_{i1}\right) \\ + \sum_{i\in E} s_{i2}\left(\varphi_{i2}-\Phi_1\right) - \sum_{i\in X} s_{i1}\left(\varphi_{i1}-\Phi_1\right) \tag{3}$$

Analogous to the BHC method, the GR and FHK methods decompose aggregate productivity into within-firm, between-firm, entry and exit effects. However, different from BHC, the entry and exit effects can be either positive or negative depending on the comparison of the productivity levels for the corresponding subset of firms with the reference productivity level. In this sense, the GR method and the FHK method are able to attenuate the bias of the BHC method to some extent. However, we still argue that bias has not been eliminated completely. Intuitively, we require an unbiased measure of the entry effect to be positive only if the productivity of entrants exceeds the productivity of incumbent firms in the same year, i.e. if $\varphi_{E2} > \Phi_{S2}$. Similarly, an unbiased measure of the exit effect should be negative only if the productivity of exiters surpasses the productivity of incumbent firms in the same year i.e. if $\varphi_{X1} < \Phi_{S1}$. Thus, in general terms, the entry and exit effects should only depend on contemporaneous productivity differences. This intuitive condition is violated by the GR and the FHK methods, where the entry and exit effects are based on inter-temporal productivity differences. Hence, if aggregate productivity grows, $\Phi_{S2} > \Phi_{S1}$, the reference productivity levels $\overline{\Phi}$ and Φ_1 chosen by the GR and FHK methods are smaller than Φ_{S2}, leading to over-estimation of the contribution of entry for both decompositions and an under-measurement of the contribution of exiters and survivors.

To deal with this problem, Melitz and Polanec (2015) introduce a dynamic Olley-Pakes decomposition with entry and exit (hereafter abbreviated DOPD) based on the OP decomposition (Olley and Pakes, 1996). The original OP decomposition equation is:

$$\Phi_t = \overline{\varphi}_t + \sum_i \left(s_{it} - \overline{s}_t \right)\left(\varphi_{it} - \overline{\varphi}_t \right) = \overline{\varphi}_t + \text{cov}\left(s_{it}, \varphi_{it} \right) \tag{4}$$

The OP method decomposes 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 can reflect 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. In 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.

The DOPD method rewrites the aggregate productivity in each period as a function of the aggregate share and the aggregate productivity of survivors, entrants, and exiters:

$$\Phi_1 = s_{S1}\Phi_{S1} + s_{X1}\Phi_{X1} = \Phi_{S1} + s_{S1}\left(\Phi_{X1} - \Phi_{S1} \right) \tag{5}$$

$$\Phi_2 = s_{S2}\Phi_{S2} + s_{E2}\Phi_{E2} = \Phi_{S2} + s_{E2}\left(\Phi_{E2} - \Phi_{S2} \right) \tag{6}$$

Combining equation (4), (5) and (6), we have:

$$\begin{aligned}
\Delta\Phi &= \left(\Phi_{S2} - \Phi_{S1} \right) + s_{E2}\left(\Phi_{E2} - \Phi_{S2} \right) + s_{X1}\left(\Phi_{S1} - \Phi_{X1} \right) \\
&= \Delta\overline{\varphi}_S + \Delta COV_S + s_{E2}\left(\Phi_{E2} - \Phi_{S2} \right) + s_{X1}\left(\Phi_{S1} - \Phi_{X1} \right)
\end{aligned} \tag{7}$$

The four parts of equation (7) represent the within-firm, between-firm, entry and exit effects, respectively. Note that the DOPD method uses contemporaneous productivity differences to determine entry effect (period 2) and exit effect (period 1), hence satisfying the condition stated above. This improvement will raise the accuracy of productivity decomposition substantially.

This paper implements the DOPD method to decompose the aggregate productivity of Chinese exporting firms as we believe this is the least biased amongst these widely-used methods. We also execute GR and FHK decompositions for comparison.

5 Empirical Results and Analysis

5.1 Overall Sample Study

We initially decompose the yearly growth rates of the aggregate productivity of exporting firms between 2005 and 2009. Table 5 reports the aggregate productivity, the annual productivity growth rate, and detailed results from DOPD. The reallocation effect (last column) captures the sum of the between-firm effect, the entry effect and the exit effect. All productivity changes are reported as log percents (or log points) and can thus be interpreted as percentage point changes.

Table 5: Decomposition results from DOPD for all samples

	Productivity	Growth rate	Within-firm Effect	Between-firm Effect	Entry Effect	Exit Effect	Reallocation Effect
2006	4.143	0.033	0.019 (58%)	0.010 （30%）	-0.008 (-24%)	0.012 (36%)	0.014 (42%)
2007	4.364	0.053	0.028 (53%)	0.013 (25%)	0.007 (13%)	0.005 (9%)	0.025 (47%)
2008	4.494	0.030	0.016 (53%)	0.009 (30%)	-0.005 (-17%)	0.010 (33%)	0.014 (46%)
2009	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 average productivity of all exporting firms. The productivity growth rates (column 2) are based on the productivity of previous year, where the productivity of 2005 is 4.012. The total growth rate (0.164) is the sum of annual productivity growth rates. 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.

From Table 5 we note that the aggregate productivity for all Chinese exporting firms increased by 16.4% during the sample period.[9] The contribution of the within-firm effect is 8.7% accounting for 53% of the aggregate productivity growth and the remaining 7.8% can be attributed to

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[9] This is the sum of annual productivity growth rather than the growth of aggregate productivity during the whole period.

reallocation effects accounting for 47% of aggregate productivity growth. The result indicates that more than half of the observed aggregate productivity growth of exporters originated from within-firm effects through innovation and management improvement. But this doesn't mean that the reallocation effect is insignificant. As a matter of fact, the reallocation effect explains nearly half of the exporters' aggregate productivity growth.

Comparing our decomposition results with evidence for Slovenia (Melitz and Polanec, 2012) and New Zealand (Devine et al, 2012), the following two important points are particularly striking.[10] On the one hand, the productivity of Chinese exporting firms grows slowly. We suggest that slow innovation and management improvements (small within-firm effects) are likely to take the primary responsibility for this fact.[11] China mainly exports low-skilled and low value-added products due to comparative advantage of cheap labors and resources, and a very large proportion of export takes the form of processing trade. In such circumstances, exporting firms have little incentives to concentrate on product innovation and management improvement, which may explain a large part of the small within-firm contributions to aggregate productivity. On the other hand, China's low-end trade structure entails low fixed costs and, consequently, low productivity thresholds of exporting. This inevitably ignites severe competition on both domestic and foreign markets, leading to drastic dynamics of exporting firms as described in section 2. As a consequence, the contribution of the resource reallocation effect generated by firm dynamics is considerable.

However, when we dissect the reallocation effect and investigate its three parts carefully, we find that the between-firm effect contributes 27% to the exporters' aggregate productivity growth, which occupies a large fraction of the reallocation effect. This confirms to the observation from Table 2 that the longer firms can survive in foreign markets, the stronger they become. Moreover, the contribution of the entry effect is slightly negative, which demonstrates that entering firms will reduce aggregate productivity. We argue that this is due to the low productivity thresholds for entering export markets, which enables many low productive firms to start exporting, and causes the average productivity to be lower for entering firms than for incumbents. Bartelsman et al.

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[10] Note, 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.
[11] Melitz and Polanec (2012) find that the within-firm effect explains about 80% of the aggregate productivity growth in Slovenia. Devine et al (2012) find a within-firm effect of 76% for New Zealand.

(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, the exit effect explains 20% of productivity growth. This is in line with our descriptive evidence of a low surviving rate of Chinese exporters from Tables 2 and 3. The fierce competition on export markets forces many exporting firms with low productivity to exit from foreign markets quickly, thus promoting aggregate productivity growth. This finding very well accords with that of many other countries, including OECD economies (Bartelsman et al., 2005).

Although the churning rate of Chinese exporting firms is high, the turnover effect (sum of entry and exit effect) is low compared with many other countries (Devine et al., 2012; Acemoglu and Cao, 2010). In particular, it is striking that the contribution of entering firms is negative. Thus, we can safely conclude that resource misallocation still exists in the market and the potential productivity growth through reallocation effect is abundant given that the resources can be allocated efficiently in perfect market.[12]

Although we see DOPD as the most accurate decomposition method, as explained in section 4.2, we also execute GR and FHK for reasons of comparison. Table 6 presents the decomposition results.

Table 6: Results of different decompositions

	Productivity Growth Rate	Surviving firms			Entering firms			Exiting firms		
		GR	FHK	DOPD	GR	FHK	DOPD	GR	FHK	DOPD
2006	0.033	0.027	0.027	0.029	-0.005	-0.004	-0.008	0.011	0.010	0.012
2007	0.086	0.066	0.065	0.07	0.003	0.005	-0.001	0.017	0.016	0.017
2008	0.116	0.087	0.084	0.095	0.009	0.012	-0.006	0.020	0.020	0.027
2009	0.164	0.119	0.114	0.132	0.015	0.019	-0.002	0.030	0.031	0.034

Note: The contribution of surviving firms consists of the within-firm and between-firm effect. The productivity growth rate is the sum of the annual growth rates.

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[12] This argument may be more convincing in the short run, because it is to some degree natural that entrants are less productive than incumbents. But in the long run, some exporters will be able to tap their full potential and contribute more aggregate productivity growth.

As indicated in Table 6, the entry effect of the DOPD fluctuates between -0.8% and -0.1% during sample period 2006-2009. In contrast, the entry effect obtained by GR and FHK increases over time reaching, respectively, 1.5% and 1.9% in 2009. This illustrates that in the presence of aggregate productivity growth GR and FHK decomposition introduce upward bias into the contribution of entering firms and downward bias into the contribution to surviving firms (see also the theoretical argument in section 4.2). This bias can be effectively removed by DOPD decomposition.

5.2   Sub-sample Study

In reality, resource allocation efficiency is affected by firm heterogeneity with respect to ownership types, geographic locations and industry affiliation. Therefore, analyzing the impacts of these factors on resource allocation efficiency carries significant policy value. In this sub-section, we conduct classificatory studies on the resource reallocation effect generated by dynamics of Chinese exporting firms according to firm ownership, location and industry.

5.2.1   Study by different types of firm ownerships

In China, state-owned enterprises (SOEs) obtain more fiscal subsidies, tax mitigation and financial support than other firms (Zhang et al., 2003).[13] at the same time most of the state-owned enterprises are inefficient owing to the drawbacks of governance structure and policy obligations. Table 7 reports productivity decomposition results for exporting firms of different ownership types.

Table 7: Decomposition results for exporting firms of different ownership types (2005-2009)

	Productivity	Growth rate[14]	Within-firm Effect	Between-firm Effect	Entry Effect	Exit Effect	Reallocation Effect
SOE	4.590	0.144	0.098 （68%）	0.036 （25%）	-0.007 （-5%）	0.017 （12%）	0.046 （32%）

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[13] Five types of enterprises are distinguished in China: state-owned enterprises (SOE), collective enterprises (COE), private-owned enterprises (POE), Hongkong-Macao-Taiwan -invested enterprises (HIE) and Foreign –invested enterprises (FIE).
[14] The productivity growth rates in the sub-sample study are the growth of aggregate productivity between 2005 and 2009.

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 average productivity of all exporting firms in 2009. The productivity growth rates (column 2) are the growth of aggregate productivity during the whole period, where the productivity of 2005 is 4.012. 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.

It is evident from Table 7 that the average aggregate productivity in 2009, as well as the productivity growth rates between 2005 and 2009 and the reallocation effect of state-owned exporting enterprises are the lowest among all exporting firms. State-owned enterprises are over-protected by government leading to their under-exposure to market competition and inefficient market selection. This also explains that the privileges possessed by state-owned enterprises are pivotal factors giving birth to misallocation. Moreover, we observe that relative to overall productivity growth, the between-firm effect, the exit effect and the reallocation effect are highest for private-owned exporting enterprises while their within-firm effect and entry effect are lowest. These firms receive the least supports from government in China, and are fully exposed to market competition. Additionally, most of POEs exports low-end products and lack innovations. Productivity and its growth rate are highest for foreign-invested exporting enterprises that are also the only type of firms with positive entry effect and the one with the lowest proportion of exit effect.

5.2.2 Study by different firm locations

The economic development and market maturity vary widely between different regions of China.[15] This is also true for the resource allocation efficiency is also distinct (Nie and Jia, 2011). We study reallocation effect according to firm location in this sub-section. Table 8 shows productivity decomposition results for exporting firms of different regions.

Table 8: Decomposition results for exporting firms of different regions (2005-2009)

	Productivity	Growth rate	Within-firm Effect	Between-firm Effect	Entry Effect	Exit Effect	Reallocation Effect
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 average productivity of all exporting firms in 2009 . The productivity growth rates (column 2) are the growth of aggregate productivity during the whole period, where the productivity of 2005 is 4.012. 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.

Previous studies enunciate that the maturity of market economy positively relates to resource allocation efficiency (Hsieh and Klenow, 2009; Bartelsman and Doms, 2000). The results from Table 8 also approve this point of view. Exporting firms highly concentrate in the most developed eastern region,[16] which accelerates the pace of firm dynamics. As a consequence, the exporting

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[15] This paper divides China into four regions, the eastern region, the middle region, the northern region and the western region. 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.

[16] According to the statistics calculated by authors, in 2009, 85.7% of exporting firms in China agglomerated in this area, and the export value from eastern region accounted for 90.4% of total export value. Especially Guangdong province and Zhejiang province, the number of exporting firms and the export value from there occupied almost half of the country's total exporting firms and export value, and inside each province, about 40% of firms are exporting firms.

firms perform much better than firms in the rest regions in aggregate productivity and its all decomposing components, especially, the entry effect is slightly positive only in eastern region. In contrast, in the least developed western area, the contribution of reallocation effect to aggregate productivity is the lowest, which could be another reason for misallocation.

5.2.2   Study by different industries

The degree of concentration and the level of competition differs substantially across industries owing to differences in product characteristics. Resource allocation efficiency differs accordingly across industries. In the section, we study the reallocation effect within different industries. Table 9 shows productivity decomposition results for exporting firms of different industries.

Table 9: Decomposition results for exporting firms of different industries (2005-2009)

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 use China Standard Industry Classification (GB/T 4754-2011) to classify industry. 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. The productivity growth rates (column 4) are the growth of aggregate productivity during the whole period (2005-2009), where the productivity of 2005 is 4.012. The percentage in the rightmost parentheses is the proportion of the reallocation effect to the productivity growth rate in 2009.

As reported in Table 9, 41% of exporting firms clustered in just five concentrated industries in 2009, contributing 57.8% of total export value at that year.[17] We find that the reallocation effect contributes more to the productivity growth rate in these five industries than other industries. However, we also find that the average aggregate productivity and its growth rate of these five industries are comparatively low except for the industry of manufacturing of electronic equipments, because the large number of firms in these five industries means low entry threshold and strong competition. By contrast, in industries with low number of exporters, such as tobacco manufacturing, industries of petroleum processing, coking, nuclear fuel processing, the proportions of the reallocation effect to the productivity growth rate are low, because exporting firms of these industries could be endowed with monopoly power, which produces insufficient competition and inertia of firm dynamics. Thus, industrial monopoly is also a kind of catalyst for misallocation.

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[17] Judging by exporting firm weight and export value weight., the top 5 concentrated exporting industries are Textile industry, Textile garment and apparel industry, Electric machinery and equipment manufacturing, Manufacturing of computers, communications and other electronic equipments, General equipment manufacturing.

6   Conclusion

After decades of strong economic growth, China's traditional extensive growth model has become unsustainable. As a consequence, 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. Based on the exporting firm samples from the dataset of Annual Surveys of Industrial Production for the period from 2005 to 2009, we apply DOPD productivity decomposition to analyze the different components of productivity growth.

We find the surviving ability of exporters to be generally weak, but the longer firms can survive in foreign markets, the stronger they become. Moreover we find that firm turnover is turbulent and that the number and rate of entering firms is much higher than that of exiting firms in any years. While the productivity of China's exporting firms grows slowly, the reallocation effects generated by firm dynamics explains almost half of this productivity growth. However, this mainly originates from reallocations between incumbent exporters (between-firm effect), whereas firm turnover (entry and exit) effects are generally low. The entry effect is generally even negative, which suggests the existence of market misallocation. Moreover, several studies for different types of sub-samples suggest that this misallocation may be caused by uneven development of regional economy, industrial monopoly and state-owned enterprises.

In order to promote resource efficiency through reallocations generated by exporting firms dynamics, we suggest some valuable measures for policy makers. First, the government should encourage and support the transition of exporting firms from competition in price and quantity to competition in innovation and quality. R&D should be subsidized while some export subsidies for low-end products, such as tax rebates, should be reduced to improve the average productivity of entering firms and accelerate the exit of exporting firms with low productivity. In addition, excellent and promising exporting firms may be supported by government through measures

relating to finance, tax, R&D and trade policy, allowing these firms to acquire more resources and extent market shares. Finally, government should reduce market distortions to the greatest extent through minimizing monopoly power and protections of state-owned enterprises while improving market access of private-owned enterprises. Also the undeveloped regions should gain more support from central government.

It is obvious that resources are efficiently allocated only in perfect market, while in reality, there are many institutional frictions severely hampering efficient resource allocation. Our future research will discuss the impact of institutional frictions on firm dynamics and its reallocation effect, such as financial restraints of private-owned enterprises, trade barriers, and environmental regulations.

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