<u>University of Southampton</u>

Faculty of Social Sciences

School of Economic, Social and Political Sciences

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Determinants and Effects of Productivity and Profitability in the Omani Manufacturing Industry

by

Said Al Brashdi

A thesis submitted for the degree of Doctor of Philosophy

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Abstract

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The aim of this thesis is to investigate the determinants of productivity and profitability, as well as their role in market survival and the decision to export in resource-based economies. This thesis extends the literature on firms' performance, international trade, innovation, and market dynamic selection in the context of a resource based economy, using unique plant-level panel data from the Omani manufacturing industry. The quantitative analysis of this dissertation aims at explaining why some plants are more productive and profitable than others. The empirical results indicate that plants that undertake exports and innovation activities are more productive and profitable than plants that do not. The results also show that larger plants and those with foreign capital participation are more productive and profitable than smaller and domestic plants. Furthermore, the investigation into the sources of aggregate productivity growth shows that resource reallocation between surviving plants is the main driver for aggregate productivity growth in the Omani manufacturing industry. In addition, entering plants negatively impact aggregate productivity growth, as their average productivity is less than of surviving plants. Although both productivity and profitability are found to positively impact plants' survival, productivity is revealed as being the dominant factor for market dynamic

selection in the Omani manufacturing industry. By examining the impact of productivity and profitability on plants' decision to start and to stop exporting, our results suggest, on the one hand, that productivity has a positive impact on plants' decision to enter the export market and on their survival rate in the international market. Furthermore, productivity of export-starters improves upon their entry to the foreign markets. On the other hand, this thesis does not find any evidence of the impact of profitability on plants exporting decisions and similarly, there is no evidence of the impact of exports on profitability. Based on the above findings, this thesis advises the government to formulate polices to promote competition in the manufacturing industry, as well as polices to encourage plants to undertake innovative steps and exporting activity.

Table Contents

List of tables

List of figures

Declaration of Authorship

I, Said Al Brashdi, declare that the thesis entitled *Determinants and Effects of Productivity and Profitability in the Omani Manufacturing Industry* and the work presented in it is my own and has been generated by me as the result of my own original research.

I confirm that:

1. This work was done wholly or mainly while in candidature for a research degree at this University;

2. Where any part of this thesis has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated;

3. Where I have consulted the published work of others, this is always clearly attributed;

4. Where I have quoted from the work of others, the source is always given. With the exception of such quotations, this thesis is entirely my own work;

5. I have acknowledged all main sources of help;

6. Where the thesis is based on work done by myself jointly with others, I have made clear exactly what was done by others and what I have contributed myself;

7. None of this work has been published before submission;

Signature: Date:

Acknowledgment

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Abbreviations

AIS	Annual Industrial Survey
ATT	Average effect of treatment on the treated
DID	Difference-in-difference
DOPD	Dynamic Olley and Pakes decomposition method with the extension by Melitz and Polanec (2015)
ECGA	Export Credit Guarantee Agency
FE	Fixed effects model
FHK	Foster, Haltiwanger and Krizan
GCC	Gulf Cooperation Council
GR	Griliches and Regev
LP	Levinoshn and Petrin (2003)
MCI	Oman Ministry of Commerce and Industry
MENA	Middle East and North Africa
NCSI	Oman National Centre for Statistics and Information
OLS	Ordinary least square
OP	Olley and Pakes (1996)
ROS	Return on sales
TFP	Total factor productivity
R&D	Research and development

Chapter 1 Introduction

Economic literature has considered productivity among the key determinants for long-term economic growth and international competitiveness (Tang & Wang, 2004; Du et al., 2014; and Ding et al., 2016). Early empirical studies have focused on investigating the sources of aggregate productivity growth using different decomposition approaches. The literature documents the fact that the selection and market reallocation of resources from low-performance to high-performance firms is the main source of aggregate productivity growth (see for example, Baily et al., 1992, Bartelsman & Domas, 2000, and Harris & Moffat, 2019 among others).

Existing studies have also documented noticeable dispersions in productivity between firms in manufacturing industries (see for example, Bernard et al., 2003). This dispersion is linked to firm-specific factors such as innovation and export activities and environmental factors such as market competition (for details see Syverson, 2011).

Furthermore, a large volume of empirical studies has documented that exporters are more productive than non-exporters (see Fryges & Wagner, 2010; and Garcia & Voigtländer, 2019 among others). Two different hypotheses have been formulated to explain why this is the case. The first one is the self-selection hypothesis, which argues that firms improve their productivity before they enter the export market. This hypothesis is based on the fact that firms must pay additional sunk costs, or irretrievable expenses, when they start exporting. For example, they often invest money in researching the requirements of new markets, as firms will only enter foreign markets if their expected revenue from exporting is higher than the exporting costs. Melitz (2003) argues that only productive firms have the ability to afford and pay these additional entry costs. The second hypothesis is learning by exporting, which argues that exporters' productivity improves upon their entry to the international markets because of their exposure to more advance technology and intensively competitive markets. Although a plethora of empirical works has supported the self-selection hypothesis, evidence on learning by exporting has been mixed (see for example, Wagner, 2007 & 2012; Syverson, 2011; and Atkin et al., 2017).

More recent studies have also looked at the role of profitability in determining firms' survival. Foster et al. (2008) note that previous studies considered productivity as the main determinant for market dynamic selection, with the assumption that highly productive firms also generate high profits, and therefore highly productive firms grow and expand, while less productive ones are forced to exit the market. However, they claim that productivity is not the main determinant for market selection, demonstrating that the impact of profitability on a plant's survival is higher than the impact of productivity. They also argue that productivity is only one component of profitability, and it is not always the case that highly profitable firms are highly productive too. This is because, although some factors might have a positive effect on productivity, they can also affect firms' profitability in two contradictory ways. For example, on the one hand, more competition forces firms to increase productivity, and thus expand their markets, which in turn allow firms to charge higher prices, leading to increased profits. However, despite the fact competition can lead to increased productivity, it can sometimes force firms to reduce their prices. As a result, their profits fall, as firms pass their costs reductions onto customers by charging lower prices. Thus, productivity increase does not always lead to an increase in profitability.

Since the seminal paper by Foster et al. (2008) researchers have started to use panel data to investigate the role of profitability on different aspects such as market selection and exports. For example, researchers have begun to examine the relationship between exports and profitability in terms of four different aspects: i) whether exporters are more profitable than non-exporters, ii) whether high profit firms self-select into the export market, iii) whether exporting leads to an increase in firms' profitability, and iv) whether profitability plays an important role in firms' decision to exit the export market.

While the relationship between productivity and innovation, export activities and market selection has been largely investigated, the number of studies that have looked at the relationship between profitability and exporting, innovation and market selection is scant and covers a limited number of countries. This thesis tries to fill in this gap by investigating the determinants of productivity and profitability and their role in market survival and export decision using unique plant-level data for the Omani manufacturing industry over the period 1993-2016.

Oman's manufacturing industry is an interesting context to study because of two main reasons. Firstly, from the literature point of view, although there are a vast number of empirical studies on manufacturing firms' performance, to the best of the authors' knowledge, there are no such studies in oil based economies in the Middle East and North Africa region (MENA) using a plant-level panel detail dataset. Therefore, this study aims to make original contributions to the knowledge in the literature of firms' performance, international trade, innovation and dynamic market selection.

The second reason is that the manufacturing industry has been identified as being amongst the most important pillars for the Omani economic diversification. In order to promote the manufacturing industry, the Omani government has invested in infrastructure and provided several incentives (such as exemption from profit taxes and import customs duties) to promote the establishment of industrial projects. Furthermore, several incentives have been formulated to encourage manufacturing plants to engage in exporting and innovative activities such as exporting insurance services and innovation funds. Thus, this thesis provides Omani policy makers and business owners with useful information about the impact of exporting and innovations on plants' performance. In addition, the findings of this thesis may be relevant to other economies such as all of the other Gulf Cooperation Council (GCC) countries.

This thesis consists of six Chapters. The next Chapter provides key facts about the Omani manufacturing industry.

Chapter 3 focuses on the relationship between export and innovation and plants' productivity and profitability. In particular, this chapter examines i) whether exporters are more productive and profitable, and ii) whether innovative plants are more productive and profitable. In this chapter, plants' productivity is estimated as the residual of a production function using the Levinoshn and Petrin (LP) (2003) approach. While plants' profitability is measured by the ratio of profits to sales i.e. the return on sales (ROS). By using the OLS model and controlling for plants specific fixed effects, the results of this chapter show that exporting and innovative plants are more productive and profitable.

Chapter 4 investigates the role of productivity and profitably on market dynamics. The chapter starts by investigating the sources of aggregate productivity growth, and examining whether market reallocation is the main driver for the growth in the Omani manufacturing industry, using the Dynamic Olley and Pakes (1996) decomposition method, with the extension by Melitz and Polanec (2015) (DOPD). Following this, we examine whether there is a persistence in the distribution of productivity and profitability, as documented in the literature. Finally, we investigate the role of productivity and profitability on Omani manufacturing plants' survival during the 1993-2016 period. This chapter finds that resource reallocation between plants is the main driver for aggregate productivity growth in the Omani manufacturing industry and there is a persistence in plants' productivity, but not in its profitability. Furthermore, the results reveal that plants' productivity dominates the market dynamic selection in the Omani manufacturing industry.

Our findings in Chapter 3 show that, on average, exporters are more productive than non-exporters in the Omani manufacturing industry. In chapter 5 we further investigate the relationship between exporting and both productivity and profitability, by exploring: i) whether best plants self-select into the export markets, ii) whether the performance of export-starters is enhanced upon their entry to the foreign markets and iii) whether productivity and profitability impacts plants' decision to exit export markets. Using the probit and fixed effects models, this chapter finds that plants that are more productive self-select into the export markets, while plants that are more profitable are less likely to enter the export markets. Further, we find that the productivity of export-starters improve once they start exporting, however, there is no evidence regarding the impact of export activities on a plant's profitability. Finally, our findings also show that plants that are more productive are more likely to survive in the export market, however, no evidence for the impact of profitability on plants' decision to exit from the export market is found.

Chapter 6 presents the key findings and conclusions of the thesis, with a discussion on potential policy implications.

Chapter 2 Key facts about the Omani manufacturing industry

2.1 Background

Oman is one of the Gulf Cooperation Council (GCC) countries and is located on the south eastern coast of the Arabian Peninsula. The total population of Oman is around 4.4 million, with an annual growth of 5.7% over the period from 2007-2016 [NCSI (2017)]. Nearly 20% of Omani people are aged between 10 and 24 [NCSI (2017)].

In 1970, there was a critical change in the Omani economy, as His Majesty Sultan Qaboos became the Sultan (king) of Oman. Prior to 1970, there were just three schools and two government hospitals in Oman and the economy depended on agriculture and fishing as the main source of income.

However, since 1970, the Oman economy has experienced a sharp growth thanks to oil revenue. However, oil is not infinite and is not, therefore, a sustainable source of income. Indeed, the Omani oil reserves are very limited compared with other GCC countries. In addition, Oman is facing several other challenges such as huge fluctuations in oil prices and an increasing demand for employment from the growing population. Therefore, like other countries in the region, Oman's government is working to diversify its economy.

Over the last four decades the Omani government have defined a series of five-year development plans and identified several pillars for economic diversification through investment in human capital, education, health and infrastructure. In addition, the manufacturing industry has been identified amongst the most important areas for economic diversification. In 1976, the Omani government proposed the first development plan for the period 1976-1980. During that period, the primary objective for the manufacturing industry was to improve its levels of import substitution[1]. In 1996, Oman's first long-term plan was created (vision 2020), with the main objectives being to diversify the economy, reduce the dependence on oil and create jobs for Omanis. The vision 2020 plan set a target for the manufacturing industry to increase its GDP share contribution from 4.6% in 1996 to 15% by 2020.

In order to develop the non-hydrocarbon sectors of its economy, the government has been investing in infrastructure such as roads, electricity and communication as well as education. In addition, the government has introduced different policies to promote industrial projects and to attract foreign investments in manufacturing. Example of these industrial polices include tax exemption on revenue for a minimum of five years and exemption from customs duties for imported machinery and equipment. Raw materials are also exempt from import customs duties for the first five years they are used by a newly established firm.

Exports play an important role in promoting the manufacturing industry, given that the local Omani market is relatively small. In 1999 the government created the Export Credit Guarantee Agency (ECGA) with the aim of supporting manufacturing firms to export their products. Among the initiatives created by the ECGA, there are the provision of credit lines at favourable conditions as well as export insurance to manufacturers. Some of these include providing export insurance facilities to manufacturers, as well as supporting manufacturers to obtain attractive financing.

In order to provide an attractive environment in which firms can construct their industrial projects, the government constructed nine industrial estates or parks and four free industrial zones. The first estate was established in 1983 and the remaining eight estates were established between 1992 and 2010, while the free zones were established in 1999, 2006, 2010 and 2011, respectively. These estates and zones provide high quality infrastructure, low rents for business activities and administrative

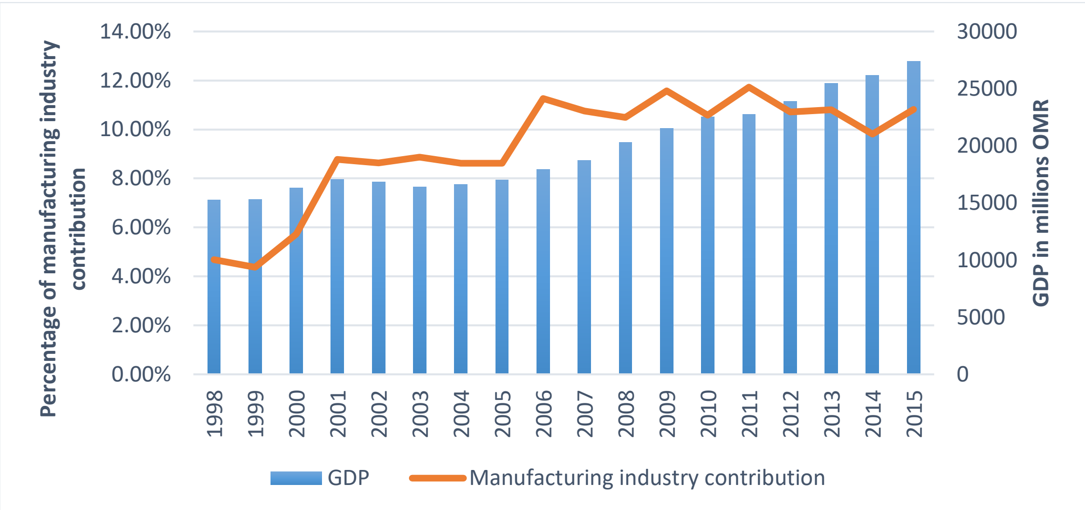
[1] Polices that aims to promote domestic plants to produce goods for domestic consumption and reduce the dependence on importing (Baer, 1972).

and security services. Furthermore, in order to attract foreign direct investments, investors that establish their industrial activities in these estates and zones can benefit from very attractive tax regimes.

As innovation plays an important role in economic growth in many countries, the Oman government has, in recent years, given considerable attention to research. For example, in 2009, the industrial innovation centre was established with the objective of promoting a culture of research and innovation among Omani manufacturing firms. The centre also aims to link the manufacturing industry with academic and research institutions. Moreover, in 2017 the first Oman National Innovation Strategy was approved and one of its pillars is innovation in the manufacturing industry.

Over the last forty-five years, the Omani GDP and the contribution of the manufacturing industry to GDP have both more than doubled. Figure 2-1 shows the growth of both GDP and the manufacturing industry share in GDP over the period 1998 to 2015. Omani GDP jumped from OMR 15253 million in 1998 to OMR 27384 million in 2015 and the share of manufacturing industry raised from 4.7% in 1998 to 10.8% in 2015 (NCSI, 2017).

Figure 2-1. Oman GDP and manufacturing industry contribution over the period 1998-2015

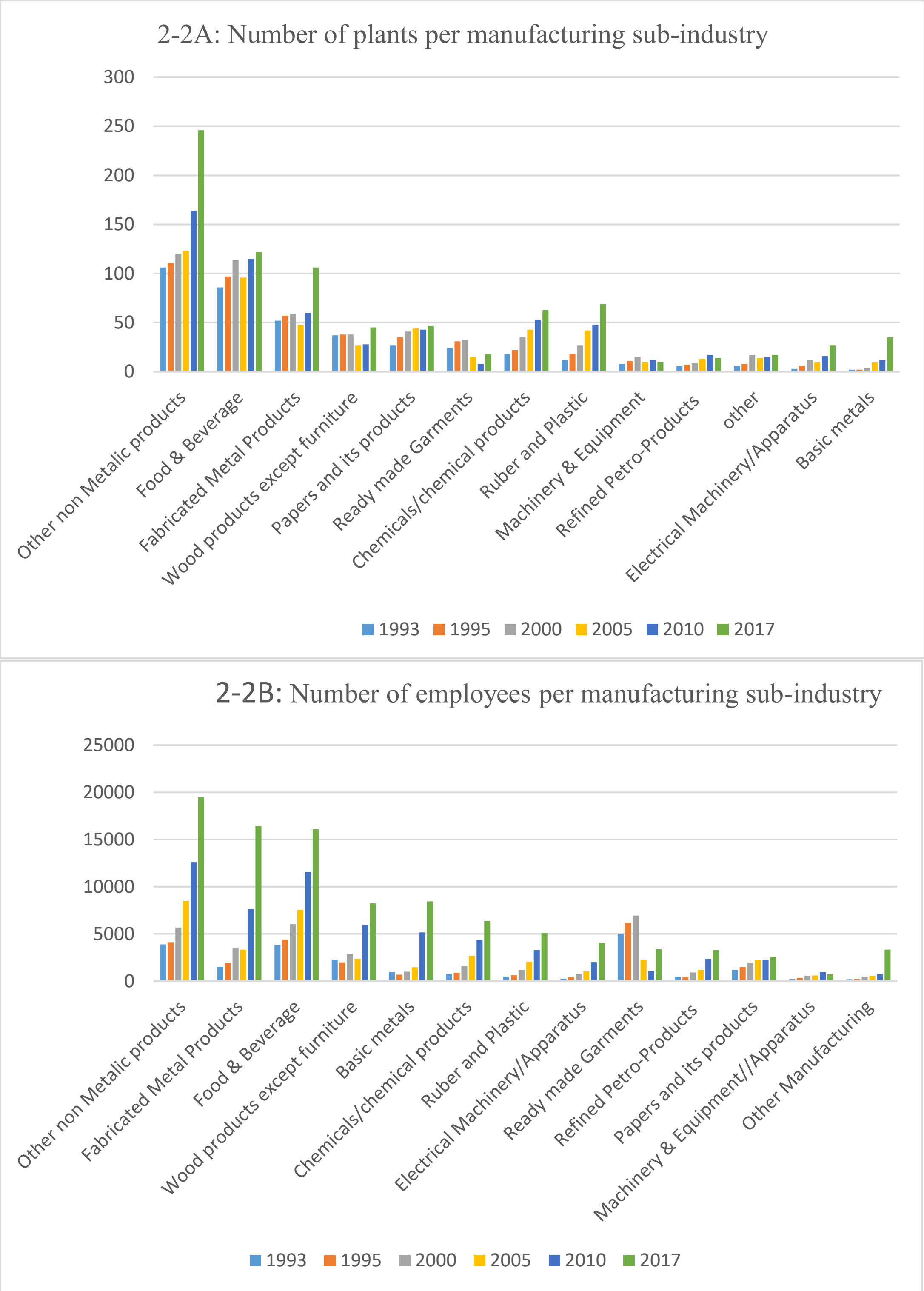


Source: Compiled by the author using data gained from the National Centre for Statistics and Information (NCSI), 2017.

During the period 1993 to 2017, the Omani manufacturing industry experienced massive growth. The number of manufacturing plants also increased from 387 in 1993 to 819 in 2017. In addition, the manufacturing industry workforce more than trebled during the same period, with the number of employees jumped from 20,958 in 1993 to 97,466 in 2017.

Looking at the sectorial level, during the period from 1993 to 2017, all of the industries experienced growth in the number of plants and in employment levels, except the manufacturing of ready-made garments and the textile industry. The levels of growth varied between industries. For example, the level of growth for the number of plants ranged from around 1650% for the manufacturing of basic metals to around -25% for the manufacturing of readymade garments and the textile industry. Figures 2-2A and 2-2B show that in 2017, other non-metallic products, food and beverages, and fabricated metal products were the three biggest industries in terms of the number of plants and employees. Around 57.9% of manufacturing plants relate to those three sub-industries, accounting for 53.3% of the employment share. This may indicate an expansion in the building and construction industry, since Oman is a developing country and invests heavily in infrastructure, as it needs to catch up with developed countries (MCI, 2015).

Figure 2-2. Evolution of the Manufacturing Industry over the period 1993-2017



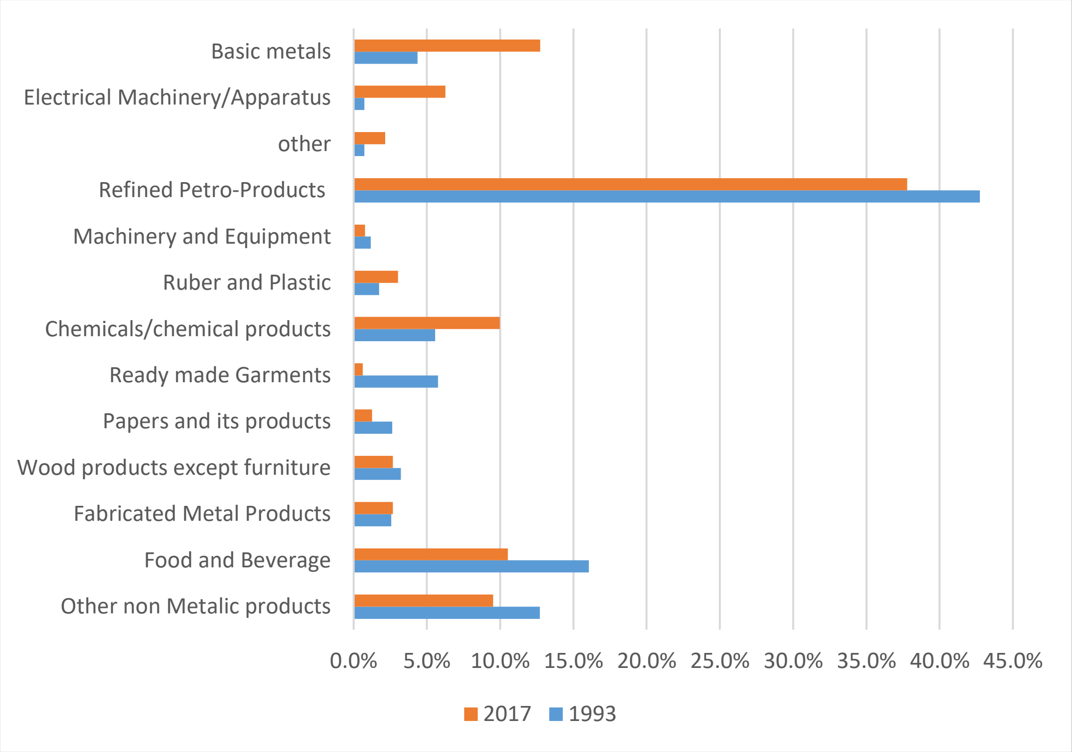
Source: Compiled by the author using data gained from the Ministry of Commerce and Industry (MCI), 2018.

Similarly, over the study period, the volume of sales in the manufacturing industry increased sharply. Table 2.1 shows that there was considerable variation in the growth in sales across the industries, from 43.7% for the manufacturing of readymade garments and the textile industry to more than 11000 % for the manufacturing of electrical machinery/apparatus industry. This growth variation led to a significant change in the composition structure of the manufacturing industry, as shown in Figure 2-3. For example, some industries lost their market share such as the manufacturing of readymade garments and textiles industry, food and beverages industry and non-metallic products industry. However, the market share of other industries such as the manufacturing of the basic metal industry, the chemical industry, the electrical machinery industry and the rubber and plastic industry increased.

Table 2.1. Sales volume by industry (1993-2017)

Industry	Sales (Million OR) 1993	2017	growth % (93-2017)
Foods and beverages	88.6	769.6	768.6
Readymade garments and textile	31.8	45.7	43.7
Wood products except furniture	17.8	196.7	1005.1
Papers and printing	14.5	92.4	537.2
Refined petro-products	235.9	2764.1	1071.7
Chemicals/chemical products	30.7	730.4	2279.2
Rubber and plastic	9.6	220.9	2201.0
Other non-metallic products	70.2	696.7	892.5
Basic metals	24.1	932.3	3768.5
Fabricated metal products	14.2	195.2	1274.6
Machinery and equipment	6.5	57.0	776.9
Electrical machinery/apparatus	4.0	457.9	11347.5
Other	4.0	156.9	3822.5
Overall industry	552	7316	1225.57

Figure 2-3. Composition change within the Manufacturing Industry over the period 1993-2017



Source: Compiled by the author using data gained from the Ministry of Commerce and Industry (MCI), 2018.

To sum up, the figures above show that the Omani manufacturing industry is growing and that some emerging industries are not related to oil and gas. Overall, industry is moving towards more tech industries, which emphasises the needs for innovation and productivity improvement in order to be competitive on international markets.

In the following chapters of this thesis, we will investigate the determinants of productivity and profitability and the relationship between them and innovation, export activities and market selection in the Omani manufacturing industry.

Chapter 3 On the Determinants of Plants Productivity and Profitability in the Omani Manufacturing Industry

3.1 Introduction

The aim of this chapter is to contribute to the study on productivity and profitability using an original dataset related to Omani manufacturing plants for the period 1993-2016. Specifically, the chapter investigates i) whether exporters are more productive and profitable ii) and whether innovative plants are more productive and profitable. This chapter also estimates the production function and plants' productivity using the two-step approach created by Levinsohn and Petrin (LP) (2003). As OLS leads to biased estimates of production function and TFP, we adopt the LP approach in order to obtain consistent and unbiased estimates. We then apply an econometric model to examine whether exporters and innovative plants are more productive and profitable.

As mentioned previously, the Omani economy has experienced impressive growth over the last four decades, due to oil and gas revenues, which are the main sources for Oman's economy. As these sectors are not a sustainable source of income, the Omani government is working to diversify its economy, with the manufacturing industry having been identified as being amongst the most important pillars for this economic diversification. According to Oman vision 2020, which was first announced in 1995, one aim is to increase the contribution of the manufacturing industry to the GDP from 11% in 2015 to 15% by 2020. To reach this goal, the Omani government has invested in infrastructure and provided several incentives (such as exemption from profit taxes and import customs duties) to promote the establishment of industrial projects.

Both economic theory and empirical studies have considered productivity growth among the major pillars of long-term economic growth (Ding et al., 2016). Productivity can be defined as the amount of output produced by a given amount of inputs such as labour, capital and materials. Total factor productivity (TFP) is the most common measure used in the literature (Syverson, 2011).

Productivity reflects plants' efficiency in producing a given amount of outputs using a given set of inputs (Syverson, 2010). While researchers often measure productivity as the residual of the production function, most of databases do not contain quantity and prices of inputs and outputs. Accordingly, empirical works use deflated revenues (based on industry wide cost or price indexes) as proxy for output to estimate plants' productivity (revenue-based productivity TFPR), which differs from theoretical quantity-based productivity (TFPQ) (Foster et al., 2008 & 2017; & Haltiwanger, 2016). Revenue-based productivity reflects both quantity-based productivity (technology) and demand factors (price) (Foster et al., 2008 & 2017; & Haltiwanger, 2016). Although TFPR combines TFPQ and prices, empirical studies that estimate both productivities report that the two measures are positively highly correlated (Foster et al., 2008 & 2017; & Haltiwanger, 2016). Because of data limitation, we follow the literature and estimate revenue-based productivity using deflated plants' value added.

Existing studies have documented noticeable differences in productivity between firms in manufacturing industries (see for example, Bernard et al., 2003). This has spurred the interest of several researchers in explaining the causes of this large variation in productivity. The main findings of this growing body of research are that productivity differences are due to firm-specific factors such as management quality and environmental factors such as market competition (for details see Syverson, 2011). Innovation and export activities have also been identified among the key factors explaining the dispersion in firms' productivity.

Firms' objectives are to maximise their profits. Profitability reflects plants' ability to generate profits using their resources. The literature identifies several factors that might have an impact on firms' profitability, with productivity being one of them. Foster et al. (2008) argue that previous studies focus on productivity and oversimplifying the relationship between productivity and profitability by assuming profitability is an increasing function of productivity. They argue that high profits do not always mean high productivity as firms can increase their profit without increasing productivity. For example, firms could increase their profits if they are faced with higher demand from markets, and in turn they could sell their products at higher prices, thus leading to increased profits, although their productivity may be low. Recently, researchers have begun to investigate the relationship between exports and profitability. The studies into this have been limited to a few countries and the findings are varied (for more details see, for example, Wagner, 2012). Comparing the estimated productivity and profitability, productivity estimation approach consider plants' capital stock while profitability estimation doesn't. The correlation between plants' productivity and profitability is not high (0.36), which is consistent with the view that productivity is only one component of profitability.

The contributions of this chapter are twofold. First, there is no consensus in the literature about the impact of export on firms' productivity and profitability. Second, although a vast number of empirical studies have been conducted into manufacturing firms' productivity and profitability determinants, to the best of the authors' knowledge, there have been no such studies in the context of oil based economies in the Middle East and North Africa region (MENA) using a plant-level panel detail dataset. Thus, this study will contribute to the literature of plants' performance by filling the gap on oil-based economies context. Furthermore, the findings of this study may lead to the proposal of some policies that may, in turn, promote firms' productivity in Oman and other similar economies such as all Gulf Cooperation Council (GCC) countries.

This chapter finds that exporters are more productive and profitable. In addition, the results indicate that innovative plants are more productive and profitable, but the estimated coefficients are not significant. We also find that larger plants and plants with foreign capital participation are more productive and profitable than smaller and domestic plants.

The rest of the chapter is organised as follows: Section 2 provides an overview of the related literature on productivity and profitability determinants; Section 3 describes the data and defines the variables; Section 4 introduces the empirical models; Section 5 analyses the empirical results and Section 6 concludes the paper.

3.2 Related literature

Productivity dispersions between firms has attracted the attention of both applied and theoretical economic researchers from several fields such as macroeconomics, the labour market, industry organisation and international trade. Chad Syverson (2011) reviewed and summarised productivity determinants that have been identified in the literature. He divided the factors into two different groups. The first group includes firm-specific characteristics that a firm can control, such as export and innovation activities, while the second group includes industry or environmental factors that firms cannot control.

Research and development (R&D) is considered one of the main drivers of productivity growth. The relationship between innovation and productivity has been the subject of a vast amount of theoretical and empirical studies. The theoretical research relates R&D to knowledge creation, and resource-based theories argue that investment in R&D helps firms' to develop, enhance and accumulate skills and knowledge of its internal resources. This enables firms to anticipate market trends and quickly change or restructure its processes to meet market requirements, thus providing firms with a competitive advantage (Harris & Moffat, 2015). The potential outcomes of R&D activities are that firms will become more efficient either by re-engineering and improving their production lines (process innovation) or by producing new products (product innovation). Various measures have been used in the literature to measure innovation, including dummy variables (R&D spending), innovative sales and innovation expenditure (Hall, 2011). Several empirical studies have examined the impact of R&D and/or innovation activities on firms' productivity.

The common findings among these studies are that these activities positively affect productivity (e.g. Harris & Moffat, 2015).

Furthermore, several studies have confirmed that innovation positively affects firms' profitability. For example, Geroski et al. (1993) argued that innovative firms are associated with higher market shares and profits. The authors examine how both product and process innovation can affect profitably and note that product innovation allows firms to increase their market share and markups, at least until rival firms imitate the innovation. At the same time, process innovation allows firms to build up internal competencies, which makes firms more flexible and adaptable when dealing with changing market conditions. Consistent with the findings of Geroski et al. (1993), Cassiman and Vanormelingen (2013) find that both product innovation and process innovation increase firm profitability (markups).

The impact of innovation on firms' productivity and profitability have been examined in the context of both developed and developing countries, but no study – to the best of the authors' knowledge – has examined the relationship between innovation and productivity or profitability in the case of oil-based economies in the MENA region using a plant-level panel detail dataset.

Another important factor that can explain a difference in productivity is exports, as indicated by several empirical studies that have examined the relationship between export and firms' productivity using data from different periods and countries. Bernard and Jensen (1995) report the first positive impact of firms' exporting activities on productivity in their study on US manufacturing industries. Since then several firm-level studies have investigated the impact of exporting activities on firms' productivity in different parts of the world. These works have stimulated theoretical scholars to develop a conceptual theoretical intuition behind the potential impact of exporting on firms' productivity, and consequently Melitz (2003) developed the first model (Wagner, 2012). Although the common findings among the studies are that exporting firms are more productive than non-exporting firms, there have been some alternative findings (Syverson, 2011; Wagner, 2012; and Ding et al., 2016). For example, in their study about the determinants of productivity in large and medium-sized Chinese industrial firms, Ding et al. (2016) report that exporters are more productive in only nine out of 26 sectors.

To enter the export markets firms need to incur in additional costs such as transportation and market research, all of which might affect firms' objectives to maximise their profits. Foster et al. (2008) pointed out that productivity is only one component of profitability determinants and that an increase in productivity does not always leads to an increase in profitability. Thus, investigating the effect of these additional costs on firms' profitability is crucial. However, studies that have investigated the relationship between exports and profitability have only begun to appear recently, and have had a limited scope, covering only a few countries (for more details, see, for example, Wagner, 2012). The findings of these works have been varied, as some studies have shown that exporting firms are more profitable that non-exporting firms (see, for example, Fryges & Wagner, 2010), while other have found that there is no difference between the profit of exporting firms and non-exporting firms (Grazzi, 2012). Thus, there is no consensus in the literature about the impact of export activities on firms' productivity and profitability.

3.3 Data and variables definitions

The data used in this thesis are retrieved from the Annual Industrial Survey (AIS), which was conducted on unbalanced panel of Oman manufacturing plants for the period from 1993 to 2016. The AIS is conducted by the Ministry of Commerce and Industry in Oman. AIS started in 1993 and for the period from 1993 to 2000 it covers all manufacturing plants in Oman that are registered with the Ministry. From 2001 onwards, the AIS only covers plants that have at least 10 employees. The Ministry sends questionnaires to all plants that are registered with it, which are then followed up as needed, and the data which has been collected is entered into the Ministry database system. A unique code number in the database (ENO) has been used as an identification code for each plant so changes in plants can be tracked over their lifetime. The survey provides rich source of detailed data about manufacturing plants on an annual basis. The data includes the number of labourers and their wages, the quantity and cost of the raw materials, as well as water, electricity and fuel, which are used. The data also includes plant sales and exports. Furthermore, the AIS includes details about plants' fixed assets book value, and investments, as well as different characteristics of the plants in terms of their ownership, legal structure and location.

Although the AIS contains detailed plant data, there seem to be some noise in the data as a number of plants report abnormal values for some variables and there are measurement errors. Therefore, in order to get a clean and valid dataset, the authors of this study use a cleaning procedure that has also been used in previous empirical studies. We delete all observations with missing or zero or negative values on the main variables such as the number of employees, value of sales, and value of raw materials. In addition, the values were corrected to resolve any data entry problems.

As is the case with similar databases, the main limitation of the AIS dataset is that plants do not report all of the required survey information. Most of the time, plants only report the total value of their sales and intermediates materials without clarifying the quantity produced or used. However, in spite of these limitations, the AIS database still provides sufficiently detailed information on the chosen explanatory variables about the Omani manufacturing industry. In any case, there are no other statistical sources provide the required data about manufacturing plants in Oman on an annual basis. Furthermore, as the AIS covers all large and medium-size manufacturing plants registered with the Ministry, it means that all of large and medium-size manufacturing plants operating in Oman are covered by the AIS. The only exceptions are those plants operating in free zones, as those are not registered with the Ministry. Therefore, the sample used in the study is a good representation of large and medium-size manufacturing plants operating in Oman.

As plants that have less than 10 employees were not covered by AIS from 2001 onward, as well as noisy data before 2001, the sample used consisted of plants that appear in the dataset for a minimum of three years and have at least 10 employees in any given year of their appearance in the dataset.

The original data set contains 18,632 observations representing 3,035 plants. Around 8,388 observations were excluded, of those, 4,879 representing 1,451 small plants that have less than 10 employees. After cleaning the data, about 10,244 observations remain in the sample, representing 1,030 plants. The excluded plants are from a variety of industries, districts and years, which supports the claim that data are missing randomly.

In order to examine whether exporters and innovative plants are more productive and profitable, we construct a set of explanatory variables that might affect plants' productivity and profitability. The criteria for the selection of these variables is based on the availability of the data, the literature review and previous empirical studies that have been carried out in several countries around the world.

Following the literature, a plant's output is measured by using the deflated plant's value added. Plant's labour is measured by the total plant's reported number of employees. Plant's capital stock is measured using the following two-step procedures. Firstly, a yearly plant investment was computed using the reported investment value (I_{it}). Where the investment (I_{it}) value is missing, this was imputed using the reported capital book value (BV) as follows: $I_{it} = BV_{yr\ t\ end} - BV_{yr\ t\ beg}$. In the second step, the plant nominal capital stock (K_{it}) was calculated using the perpetual inventory method: $K_{it} = (1-\delta)K_{it-1} + I_{it}$, where a depreciation rate (δ) of 10% was used, based on the literature. The plant initial nominal capital stock is assumed to be the plant's capital ending book value for its first year appearance in the dataset, and the real capital stock was calculated by deflating the nominal capital stock.

Because of data limitations, there is no data about innovation outputs such as innovation sales or patents. Therefore, the literature is followed, by using R&D

spending as a dummy variable to proxy for innovation (Hall, 2011). The innovation dummy variable is taking a value of one when a plant *i* indicates that it is spending on R&D at year *t* and zero otherwise. As shown in Table 3.1, only 5% of the sample plants were engaged in R&D activities[2]. It is not easy to predict the effect of innovation on Omani plants' productivity or profitability, as there is lack of awareness about the importance of R&D and innovation activities among plants in Oman.

To examine the effect of getting access to foreign markets on plants' productivity level and profitability, we create an export dummy variable taking a value of one when a plant *i* exports its products in year *t,* and zero otherwise. Table 3.1 shows that about 52% of the sample are plants that are engaging in exporting activities. Plants' exposure to international markets is expected to have positive effect on their productivity and profitability, as exporters' interactions with international clients provides them with many opportunities to learn different types of skills, which in turn help to enhance their productivity and profitability. These skills may be related to new technology or management practices.

Following the literature, plant size is measured by using the logarithm of plant number of employees. In addition, the model includes the plant age variable, which is estimated from either the production-starting year or plant registration year in the Ministry database whichever is the oldest year. This variable will help in understanding the productivity distribution patterns of the manufacturing plants, and whether these patterns can be explained by the vintage effect model or the learning by doing effect model. The former effect assumes that younger plants are more productive than incumbent plants, as new plants are more likely to adopt new technology, while the latter effect assumes that older plants are more productive because they have accumulated knowledge and experience by repeatedly doing the same tasks (Baily et al., 1992). Table 3.1 shows that the average size of the workforce

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[2] This is a low percentage compare to other countries. For example, in the European Union countries, more than 50% of enterprises engaged in innovation activities during period 2014-2016 (https://ec.europa.eu/eurostat/web/products-eurostat-news/-/DDN-20190312-1).

in the large and medium size manufacturing plants is 85.39 and the average age is 17.29 years.

Moreover, we also control for plants' ownership by constructing a dummy variable (foreign capital participation), taking a value of one if the plant has foreign capital participation, and zero otherwise. The literature documents that plants with foreign capital participation have comparative advantage, as they often have better knowledge, skills and technology, which provide them with the opportunity to be more productive and profitable. Table 3.1 shows that around 29% of the plants in the Omani manufacturing industry have foreign capital participation.

In order to capture unobservable factors, this chapter follows the standard approach used in the empirical literature. To clarify, we construct 13 dummy variables for the sub-industries and 22 dummy variables for the time. These dummy variables capture the sub-industries and time effects, respectively. Table 3.1 reports variables definition and their summary and statistical data.

To calculate the real value of the used variables, we use the consumer price index, as the Omani manufacturing industry producer price index is only available from 2007 onwards. In addition, the inflation rate was very small, ranging from 1.1 in 1993 to 1.6 in 2017. Furthermore, when using either the producer price index or wholesale price index (available only for the period from 2000-2010) as a deflator, the estimated production function coefficients are identical to the estimated coefficients when using consumer price index using both OLS and FE as shown in Table A1 in the appendix for the period from 2007 to 2010.

Table 3.1. Variables definition

Variables	Definition	Mean	St. Dev.	Min	Max	Number of observations
Employees	plants total number of employees	85.39	168	2	4419	10244
lncapital	Log of plant's total capital stock deflated by the consumer price index	12.52	1.89	5.54	20.97	10244
Age	The number of years elapsed from whichever is the oldest date, in terms of either the production starting year or the registration year with the Ministry	17.29	9.21	1	46	10244
Foreign	Dummy variable taking one if the plant has foreign capital participation, and zero otherwise	0.29	0.46	0	1	10244
lnvalue added (output)	Log of plant's value added deflated by the consumer price index	12.27	1.82	4.42	20.80	10211

Table 3.1 Variables definition (Contd.)

Variables	Definition	Mean	St. Dev.	Min	Max	Number of observations
Export	Dummy variable taking a value of one if the plant export its products and zero otherwise	0.52	0.50	0	1	10244
Innovation	dummy variable taking one if the plant spend in R&D and zero otherwise	0.05	0.21	0	1	10244
Return on Sales (ROS)	(value added – employees compensations – other taxes on production + subsidies)/total sales	0.26	0.46	-10.32	9.91	10244

3.4 The Empirical Models

The increasing availability of a firm's micro data of their production inputs and outputs has stimulated a large and growing number of studies into estimating production function and firm's productivity using a number of different approaches. In turn, that has led to the development of several total factor productivity estimation approaches (Ackerberg et al., 2007; and Van Beveren, 2010). The choice of measurement technique is normally influenced by several factors, such as the type of data available, the literature review and the previous empirical works that have been done on several countries around the world. Each of the measurement approaches has its strengths and weaknesses.

Most empirical studies measure productivity as the residual from firms' production function which considers output as a function of a product of observable inputs used in the production process and its efficiency (Katayama et al., 2009; Syverson, 2011; and Van Beveren, 2010). So TFP measures outputs growth which are not explained by observable inputs.

The basic production function is based on the general form of Cobb-Douglas production function which is as follows:

$$Y_{it} = F(A_{it}, K_{it}, L_{it}) = A_{it} K_{it}^{\beta_k} L_{it}^{\beta_l}, \quad 0 \le \beta \le 1 \qquad (1)$$

where Y_{it} is firm, *i* output at time *t*. We use value-added as proxy for the output, following Petrin and Levinsohn (2012). K_{it} and L_{it} are firm *i* capital stock and labours used to produce the output Y_{it} in time *t*, respectively, A_{it} is the efficiency level of firm *i* at time *t*, $(\beta_k, \beta_{l,})$ are the elasticity of output with respect to capital and labour used, respectively.

Taking the log of (1) leads to a linear function:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \epsilon_{it} \qquad (2)$$

where $ln(A_{it}) = \beta_0 + \epsilon_{it}$, β_0 is the constant term and ϵ_{it} is the residual term.

Dividing the disturbance term ϵ_{it} in the equation (2) into two components, factors that are unobservable for both the firm and researchers (η_{it}) and factors that are observable to the firm and not to the researchers (ω_{it}), equation (2) results as:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \eta_{it} \qquad (3)$$

where ω_{it} could represent labour quality, management skills, and productivity shocks, as expected machine breakdown and η_{it} could represent measurement errors. Researchers used to estimate unobserved productivity ω_{it} by solving eq. (3) as follow:

$$\omega_{it} = y_{it} - \beta_k k_{it} - \beta_l l_{it} \qquad (4)$$

As ω_{it} is observable to the firm's management, the firm determines the amount of inputs (k_{it}, l_{it}) to be used, in order to produce (y_{it}), then the production function observed variables (k_{it}, l_{it}) will be correlated with an unobserved variable (ω_{it}). Thus using OLS to estimate β_k, β_l results in bias estimation, because of this endogeneity (or simultaneity) problem (Griliches & Mairesse, 1995; Olley & Pakes, 1996; Levinsohn & Petrin, 2003; Ackerberg et al., 2007; and Van Beveren, 2010).

The direction of the bias for β_l is likely to be upward, as firms' labour input is positively correlated with the productivity shock. For example, if a firm expects that it will have a negative productivity shock, then it will reduce the amount of labour input, and this will cause the estimated labour coefficient by OLS, to be larger than their actual value (Griliches & Mairesse, 1995).

The direction of the bias for β_k is likely to be downward, as the survival probability rate for firms with larger capital stock will be higher, compared with smaller capital stock firms. The less productive, smaller firms exit the market, so we observe only small firms with good productivity which leads to sample selection problems. Consequently, using OLS to estimate the capital coefficient results in lower estimates than the actual value, indicating that firms with large capital stock are not more productive than firms with small capital stock. Therefore, using OLS to estimate β_k leads to a downward bias (Griliches and Mairesse, 1995).

In order to overcome the endogeneity problem of unobserved productivity shock (ω_{it}), the production function model (3) can be written as:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + \omega_i + \eta_{it} \qquad (5)$$

where ω_i is now plant specific. By using, the fixed effects model, all of the plant specific characteristics are controlled for, provided that these characteristics do not change over time. Thus, the estimated production function coefficients are consistent and not biased. However, the strict exogeneity assumption between inputs variables and ω_i cannot be hold for the whole study period. As explained by Griliches and

Mairesse (1995) ω_{it} can be divided into two components a_{it} and e_{it}. Where a_{it} could represents labours quality and management skills, which are known by the firm at the current time t, and thus the firm uses this information when deciding on the amount of inputs variables (such as labours) used for the current year. While e_{it} could represents unpredictable factors such as unusual weather conditions, which are not known by the firms when they decide the amount of inputs for the current time, but are revealed during the year and can affect the firm's decisions for future years. In order to eliminate this endogeneity problem, there is a need to use an instrument variable, as neither the within transformation nor difference transformation procedure can eliminate the effect of a_{it} on a firm's inputs choice decision. Therefore, using the Fixed Effects model to estimate production function leads to bias estimation of inputs parameters.

The seminal paper by Olley and Pakes (1996) suggested a new approach to dealing with the problem of endogeneity due to unobserved heterogeneity in productivity, which consists of using an observable variable, such as investments, as a proxy for the unobserved productivity shocks. The Olley and Pakes (OP) approach is a two-step approach to estimate production function coefficients and then TFP. In the first stage, the variable input parameter (such as labour) is estimated, while in the second stage, the state coefficient (such as capital) is identified. As plant investments do not occur every year, using the OP model requires the deletion of plants with zero investment observations, which, in turn, means losing information about the industry. To reduce the risk of losing data because of zero investment, Levinsohn and Petrin (2003) propose the use of materials as a proxy for unobserved productivity shock.

Under a set of assumptions, Levinsohn and Petrin (2003) show that by adopting their model it gives consistent and unbiased estimates of production function coefficients and TFP. As firms know their expected productivity shocks, they can adjust their level of materials input. Levinsohn and Petrin assume that materials are a monotonically increasing function in productivity shocks and the productivity term follows a first order Markov process, and it is the only unobservable state variable.

They show that materials input as the following function: $m_{it} = m_t(k_{it}, \omega_{it})$. Taking the inverse of productivity shock, the function can be written as: $\omega_{it}(k_{it}, m_{it})$. So, equation (5) can be written as:

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + h_t(k_{it}, m_{it}) + \eta_{it} \quad (6)$$

and define:

$$\emptyset_t(k_{it}, m_{it}) = \beta_0 + \beta_k k_{it} + h_t(k_{it}, m_{it}) \quad (7)$$

Then, they estimate the production function parameters in two stages. In the first stage, they use a non-parametric approach to recover the labour coefficient, by treating the materials function, $h_t(k_{it}, m_{it})$. So, equation (6) is written as:

$$y_{it} = \beta_l l_{it} + \emptyset_t(k_{it}, m_{it}) + \eta_{it} \quad (8)$$

In the second stage, they recover the capital coefficient using the estimated coefficients from the first stage; β_l and $\emptyset_{jt}$.

Using equation (7), productivity can be written as:

$$\omega_{it}(\beta_0, \beta_k) = \widehat{\emptyset}_t - \beta_0 - \beta_k k_{it} \quad (9)$$

By decomposing productivity ω_{it} into its conditional expectation given information known by the firm at time *t-1* and residual;

$$\omega_{it} = E(\omega_{it} | I_{it-1}) + \xi_{it} \quad (10)$$

Using the assumption that productivity follows the first-order Markov process, (10) can be written as

$$\omega_{it} = E(\omega_{it} | \omega_{it-1}) + \xi_{it}$$

$$= g(\omega_{it-1}) + \xi_{it} \quad (11)$$

By substituting (9) and (11) in equation (6) and rearranging them leads to:

$$y_{it} - \beta_l l_{it} = \beta_0 + \beta_k k_{it} + g(\omega_{it-1}) + \xi_{it} + \eta_{it}$$

$$= \beta_0 + \beta_k k_{it} + g(\emptyset_{it-1} - \beta_0 - \beta_k k_{it-1}) + \xi_{it} + \eta_{it}$$

$$= \beta_0 + \beta_k k_{it} + \tilde{g}(\emptyset_{it-1} - \beta_k k_{it-1}) + \xi_{it} + \eta_{it} \quad (12)$$

As almost all plants report positive value in materials and energy, this chapter adopts the LP approach in the estimation of production function and plants productivity using model (12).

Using the estimated TFP from model (12) we examine whether exporting and innovative plants are more productive and profitable using the following specification model:

$$y_{it} = \beta_0 + \beta_1 export_{it} + \beta_2 innovation_{it} + \beta' Z_{it} + D_j + D_t + D_j D_t + \varepsilon_{it} \quad (13)$$

where y_{it} is the productivity level or profitability of a plant *i* in year *t*; β_0 is a plant specific effect; Z_{it} is a set of plant characteristics such as age, size and foreign capital participation; D_j, D_t are dummy variables for sector and time specific effects, respectively; $D_j D_t$, is interaction of sector and time variables; and ε_{it} is the error term which contains omitted factors and other unobserved plants heterogeneity. The term β_0 captures possible plant specific unobservable factors that might affect the plant productivity level such as quality of labours or management practices. The sector and time dummies and interaction variables capture all possible unobservable industry and time factors such as market competition and concentration.

To measure plants' profitability, we use return on sales ratio (ROS). This indicator has been used in several papers in economic and management fields such as those by Bottazzi et al. (2008), Fryges and Wagner (2010), Yu et al. (2017) and Van den B. et al. (2018). The ratio is calculated by using the following equation:

$$ROS_{it} = \frac{Value\ added_{it} - \ wages_{it} - \ other\ production\ taxes_{it} + subsidies_{it}}{total\ sales_{it}}$$

The analysis is run using ordinary least square (OLS) regression with plant specific fixed effects. By using all of the dummy control variables, the estimated effect from the model is expected to be the actual impact of that factor on plant productivity or profitability. The impact of the potential determinants is examined by testing the following hypotheses:

> *Hypothesis 1:* $\beta_1 > 0$*, exporters are more productive (profitable) than non-exporters.*
>
> *Hypothesis 2:* $\beta_2 > 0$*, innovative plants are more productive (profitable) than non-innovative plants.*

3.5 Empirical Results

3.5.1 Production function estimation

The production functions for industry overall and the 10 sub-industry groups are estimated. Table 3.2 shows the production function parameters estimates using the LP method, while the estimation using OLS and FE can be found in Table A2 in the appendix. The elasticity of output with respect to labour and capital are all positive and highly significant across almost all of the industries. The estimated capital elasticity ranges from 0.097 for the wood and furniture industry to 0.401 for the chemical industry. The estimated labour elasticity ranges from 0.625 for the rubber and plastic industry to 0.776 for the readymade garments and textile industry.

Using LP to estimate the production function parameters helps to correct the simultaneity problem, which is found to be important. The estimated labour coefficients using LP are smaller than the estimated labour coefficients using OLS for the manufacturing industry overall, as well as for all sub-industries. The reduction of the estimated labour coefficients when using LP ranges from 6.5 percent for the manufacturing of chemicals industry to around 32.8 percent for the manufacturing of rubber and plastic industry[3].

Table 3.2 also shows that half of the sub-industries exhibit a mild increase returns to scale and four industries show constant returns to scale during the period 1993 to 2016. In contrast, the manufacturing of wood and furniture industry experience a decrease return to scale.

[3] The correction for the selection problem bias is noticeable in the increased estimated capital coefficients when using LP compared to OLS. In addition, in six sub-industry groups, the estimated coefficients for capital are higher when using LP, compared with OLS estimation. Moreover, the selectivity problem was not found to be important for the manufacturing of foods and beverages, wood products, paper and printing, and refined-petro products industries, as the estimated capital coefficient using LP is smaller than the estimated capital coefficient using OLS. This finding is similar to the findings reported by Griliches and Mairesse, (1995).

Table 3.2 Output coefficients from the regression

Industry	α_L	α_K	Number of observations	Returns to scale
Overall industry	0.755***	0.317***	10143	1.072
	(0.042)	(0.043)		
Foods and beverages	0.682***	0.285***	2125	0.967
	(0.076)	(0.043)		
Readymade garments and textiles	0.776***	0.382***	348	1.158
	(0.062)	(0.116)		
Wood products and furniture	0.763***	0.097*	674	0.86
	(0.105)	(0.056)		
Paper and Printing	0.744***	0.204**	865	0.948
	(0.118)	(0.094)		
Refined petro-products	0.682***	0.380**	233	1.062
	(0.132)	(0.164)		
Chemicals/chemical products	0.712***	0.401***	832	1.113
	(0.122)	(0.081)		
Rubber and plastic	0.625***	0.325***	755	0.95
	(0.104)	(0.032)		
Building and construction products	0.661***	0.348***	2759	1.009
	(0.028)	(0.013)		
Metals products	0.771***	0.269***	1323	1.04
	(0.023)	(0.046)		
Machinery and equipment/Apparatus	0.682**	0.236	229	0.918
	(0.277)	(0.393)		

* significance at 10% , ** significance at 5% , *** significance at 1%.
Standard errors are in parentheses.

3.5.2 Exports, innovation and productivity

To examine whether exporting and innovative plants are more productive, we estimate model (13) using the OLS with plants specific fixed effects for the pool plants productivity for the entire manufacturing industry. As documented in the empirical literature, model (13) specification may suffer from an endogeneity problem between explanatory variables and productivity. The endogeneity problem might arise because of the omitted variables or the casualty direction. For example, if the estimated coefficient of innovation variable suggests that innovative plants are more productive, this positive relationship may be because innovation activities promote productivity, or because plants that are more productive invest in innovation activities. Therefore, in order to soften endogeneity problem, we follow the method used in several past studies, which consists in using the past value of the explanatory variables (lag_{t-1}) (see for example Castigilionesi and Ornaghi, 2013). The lag value of explanatory variables correlates with the current value of the explanatory variables, but they are uncorrelated with the current level of productivity. Table 3.3 shows the estimation results using plant productivity level (TFP) as a dependent variable and lag of explanatory variables with different sets of fixed effects.

The estimated coefficient associated with the export variable is positive and significant in all specifications. More specifically, when we control for plant specific effect in column (3), the estimated elasticity of 0.086 indicates that exporting plants on average are more productive than non-exporting plants by 8.6%. This result supports the first hypotheses and is in line with Melitz's theory (2003), as well as it might hints to the existence of learning by exporting. In addition, our finding is consistent with the findings in other studies (see for example, De Loecker, 2007; Forlani et al., 2016, among others).

Concerning plants innovation activities, the estimated coefficient is positive and significant, as seen in column (2) suggesting that plants that undertake innovation activities on average are more productive than plants which are not involving in innovation activities. This result supports the first hypothesis and is in line with the endogenous growth theories, as well as the results of several studies (see, for example, Hall, 2011, among others). However, when we control for plants' specific fixed effect in column (3) the coefficient become not significant. This might be linked to the low percentage of plants that are engaging in innovation activities (only 5%, as shown in Table 3.1).

The estimated coefficient of foreign variable in Table 3.3 is positive and significant in all specifications with fixed effects. It indicates that plants with foreign capital participation are more productive than domestic plants. This finding is consistent with Hymer's (1976) view, as well as empirical findings, that foreign firms perform better than domestic firms, because of their comparative advantage, access to better marketing and worldwide links, as well as the fact they have advance technology and better management practices and skills (see, for example, Ding et al., 2016).

With regards to plants' size and age, column (3) shows that the estimated coefficient of age is positive and significant, while the size coefficient is positive and not significant. As the sample for this study only includes plants that have at least 10 employees and they are observed for at least three years, we create an interaction variable to control for the impact of this sensor effect. Column (4) presents the results. The estimated coefficient of plants' size is positive and significant. This suggests that larger plants are more productive than smaller ones. This finding is consistent with Jovanovic's (1982) theory and the findings of empirical works in both developed and developing countries see, for example, Forlani et al., (2016). Similarly, the results reveal that plants' age has a positive and significant impact on productivity. This finding is in line with the learning by doing hypothesis, which argues that plants productivity increases as age increases (Arrow, 1962).

Table 3.3 Exports, innovation and productivity

	(1)	(2)	(3)	(4)
Dependent variables	TFP	TFP	TFP	TFP
$export_{t-1}$	0.229***	0.291***	0.086**	0.086**
	(0.085)	(0.048)	(0.041)	(0.041)
$innovation_{t-1}$	0.033	0.250**	0.095	0.103
	(0.125)	(0.100)	(0.070)	(0.070)
$lnemp_{t-1}$	0.225***	0.171***	0.041	0.274**
	(0.036)	(0.022)	(0.043)	(0.107)
$lnage_{t-1}$	-0.042	0.024	0.129**	0.349***
	(0.049)	(0.031)	(0.064)	(0.126)
$foreign_{t-1}$	0.093	0.151***	0.951***	0.847***
	(0.095)	(0.050)	(0.127)	(0.127)
$lnemp - lnage_{t-1}$				-0.081**
				(0.036)
Constant	5.333***	5.244***	5.140***	4.581***
	(0.156)	(0.120)	(0.145)	(0.295)
Year FE	No	Yes	Yes	Yes
Sector FE	No	Yes	Yes	Yes
Year-sector FE	No	Yes	Yes	Yes
Plant FE	No		Yes	Yes
Observations	8,001	8,001	8,001	8,001
R-squared	0.073	0.576	0.791	0.791

Robust standard errors adjusted for clusters in plants in parentheses

*** p<0.01, ** p<0.05, * p<0.1

3.5.3 Exports, innovation and profitability

Foster et al. (2008) pointed out that productivity and profitability positively correlate, and that productivity is one component that determines profitability, and it is not necessarily the case that more productive plants are more profitable or vice versa. Therefore, we examine whether exporting, innovative and high productive plants are also highly profitable plants. Table 3.4 shows the results of regressing plants' profitability on one-year lag of the explanatory variables (lag_{t-1}) using model (13).

The estimated coefficient of 0.025 associated with the export variable in column (4) of Table 3.4 indicates that exporters have higher profits than non-exporters by 2.5%. This finding supports the first hypothesis given above and is consistent with previous empirical studies (see, for example, Fryges and Wagner, 2010).

In terms of plants innovation activities, the estimated coefficient of innovation shows that plants that undertake innovation activities have higher profits than plants that do not. However, in the case of the Omani manufacturing industries, the coefficient is not significant. Similar to the previous section, this might be linked to the low percentage of innovative plants in our sample.

The estimated coefficients of size and foreign are positive and significant indicating that larger plants and plants with foreign capital participation have more profits than smaller and domestic plants. The estimated elasticity of age is positive but not significant.

Table 3.4 Exports, innovation and profitability

Dependent variables	(1) ROS	(2) ROS	(3) ROS	(4) ROS	(5) ROS
$export_{t-1}$	0.035***	0.040***	0.025*	0.025**	0.022*
	(0.011)	(0.011)	(0.013)	(0.013)	(0.013)
$innovation_{t-1}$	-0.005	0.000	0.013	0.015	0.013
	(0.019)	(0.017)	(0.017)	(0.017)	(0.017)
$lnemp_{t-1}$	0.007	0.011**	0.008	0.056**	0.055**
	(0.005)	(0.005)	(0.010)	(0.027)	(0.025)
$lnage_{t-1}$	-0.003	-0.008	-0.007	0.038	0.026
	(0.006)	(0.006)	(0.019)	(0.032)	(0.030)
$foreign_{t-1}$	0.018	0.019*	0.179***	0.158***	0.132***
	(0.011)	(0.011)	(0.033)	(0.034)	(0.032)
$lnemp\ x\ lnage_{t-1}$				-0.017*	-0.016*
				(0.009)	(0.008)
TFP_{t-1}					0.035***
					(0.005)
Constant	0.234***	0.192***	0.087**	-0.028	-0.194***
	(0.021)	(0.029)	(0.037)	(0.074)	(0.074)
Year FE	No	Yes	Yes	Yes	Yes
Sector FE	No	Yes	Yes	Yes	Yes
Year-sector FE	No	Yes	Yes	Yes	Yes
Plant FE	No		Yes	Yes	Yes
Observations	8,001	8,001	8,001	8,001	8,001
R-squared	0.013	0.117	0.425	0.425	0.433

Robust standard errors adjusted for clusters in plants in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The last column in Table 3.4 shows the estimation results when plant productivity level has been added to the model. Plant productivity has a significant positive impact on its profit indicating that the profits of high productive plants are greater than the profits of less productive plants. This result is in line with the idea that productivity is one of the components of profitability (Foster et al., 2008). Our previous results remain unchanged when we control for plant productivity.

In order to check the robustness of these findings on profitability, we use plants' estimated markups[4] as a proxy for profitability instead of ROS. Table 3.5 displays the results, which confirm our findings in Table 3.4. The magnitude of the explanatory variables are larger when we use markup. The estimated coefficient of exports is positive and significant in all specifications, indicating that exporters' markups are higher than non-exporters' markups. This finding is consistent with other empirical findings (see for example, De Locker & Warzynski, 2012; and Cassiman & Vanormelingen, 2013). Similar to our findings in Table 3.4, the estimated coefficient of innovation is positive but not significant.

Comparing the results of the impact of plants' size on productivity and profitability, we notice that the magnitude is larger in the case of productivity. This might suggests that productivity plays an important role in the dynamics of market selection in the manufacturing industry in Oman. In the next chapter, this will be investigated further.

[4] We estimate markups for each plant, following De Locker and Warzynski's (2012) approach. The methodology assumes that $\mu_{it} = \frac{\theta_{it}^{X}}{\alpha_{it}^{X}}$, where $\mu_{it}$is firm i mark up at period t, θ_{it}^{X} is the output elasticity of input X_{it}, and α_{it}^{X} is the share of expenditure on input X_{it} in value-added. For θ_{it}^{X} we use the estimated labour parameter from our production function estimation in Table 3.2. α_{it}^{X} is defined as the plant's total compensation over its value-added in period t.

Table 3.5 Exports, innovation and profitability (using markups as proxy for profitability)

Dependent variables	(1) lnmarkup	(2) lnmarkup	(3) lnmarkup	(4) lnmarkup	(5) lnmarkup
$export_{t-1}$	0.262***	0.251***	0.132***	0.132***	0.116***
	(0.041)	(0.039)	(0.044)	(0.044)	(0.042)
$innovation_{t-1}$	0.222*	0.196**	0.093	0.099	0.091
	(0.116)	(0.090)	(0.073)	(0.071)	(0.067)
$lnemp_{t-1}$	0.027	0.039**	-0.026	0.160*	0.159*
	(0.020)	(0.019)	(0.040)	(0.096)	(0.086)
$lnage_{t-1}$	-0.048*	-0.041	0.010	0.186	0.133
	(0.025)	(0.025)	(0.063)	(0.120)	(0.108)
$foreign_{t-1}$	0.132***	0.094**	0.258**	0.174	0.059
	(0.044)	(0.039)	(0.121)	(0.117)	(0.106)
$lnemp\ x\ lnage_{t-1}$				-0.065*	-0.063**
				(0.033)	(0.030)
TFP_{t-1}					0.162***
					(0.019)
Constant	0.540***	0.414***	0.192	-0.257	-1.020***
	(0.080)	(0.095)	(0.132)	(0.264)	(0.256)
Year FE	No	Yes	Yes	Yes	Yes
Sector FE	No	Yes	Yes	Yes	Yes
Year-sector FE	No	Yes	Yes	Yes	Yes
Plant FE	No		Yes	Yes	Yes
Observations	8,001	8,001	8,001	8,001	8,001
R-squared	0.052	0.168	0.507	0.508	0.52

Robust standard errors adjusted for clusters in plants in parentheses
*** p<0.01, ** p<0.05, * p<0.1

3.6 Conclusion

This chapter uses detailed plant level data to investigate the contribution of various factors that have been identified in the literature, in order to explain plant productivity and profitability in the Omani manufacturing industry over the period 1993-2016. In particular, we examine whether exporters and innovative plants have higher productivity and profitability. We estimate production function and TFP separately for each industry to allow for heterogeneity between industries using the empirical approach, as proposed by Levinsohn and Petrin (2003). Our estimation shows mild increase returns of scale in most industries.

After controlling for unobserved plant and industry heterogeneity and consistent with what is documented in the literature, exporting plants are found to have higher productivity and profits than non-exporters. The results also reveal that plants that undertake innovation activities are more productive and profitable than plants that do not undertake any innovative activities but the estimated coefficients are not significant.

Although the findings provide some evidence that exporting plants are more productive and profitable than non-exporters, it is still not clear whether exporters are more productive before they enter the export market (self-selection hypothesis) or if they become more productive as a consequence of entering export markets (learning by exporting hypothesis). Therefore, the fifth chapter will test these hypotheses.

Moreover, the estimates suggest that larger plants are more productive and profitable than smaller plants. The magnitude of the estimated coefficient is larger in productivity than in profitability. This might hints that productivity plays an important role in explaining plant growth and survival in the Omani manufacturing industry.

As productivity plays an important role in a country's competitiveness and long-term economic growth, and given the findings above, the questions that now need to be addressed are whether a plant's productivity and profitability play a dominate role in a plant's decision to exit the market in Oman manufacturing industry market? Moreover, what are the sources of Oman manufacturing industry's aggregate productivity growth? Addressing these questions will help to understand whether the growth comes from the improvement of internal productivity surviving plants (those firms that are active during the two periods), or from the reallocation of resources between surviving plants, or from the contribution of entrant and exiting plants. So, understanding the sources of aggregate productivity growth would help to propose effective policies to promote plant productivity. Therefore, the next chapter will investigate the sources of aggregate productivity growth, as well as the role of productivity and profitability on plants' decision to exit the Omani manufacturing industry market.

Chapter 4 Decomposition of Productivity Growth and Dynamic Market Selection in the Omani Manufacturing Industry

4.1 Introduction

This Chapter aims at investigating the sources of aggregate productivity growth and the role of productivity and profitability on plants' survival in the Omani manufacturing industry using rich panel plant-level data. In particular, we investigate: i) the sources of aggregate productivity growth, ii) whether market reallocation is the main driver for the growth in the Omani manufacturing industry, as has been found in other countries, iii) whether there is a persistence in the distribution of productivity and profitability across plants, as documented in the literature and iv) the role of productivity and profitability on Omani manufacturing plants' survival during the 1993-2015 period.

Productivity has been identified among the key determinants for long-term economic growth and international competitiveness (Tang & Wang, 2004; and Du et al., 2014). A plethora of studies in economics have tried to identify the sources of aggregate productivity growth using different decomposition approaches. The literature identifies two main sources of aggregate productivity growth. First, the contribution that comes from the improvement of internal productivity of surviving or incumbent firms (active firms during all of the years of the study period). Firms improve their productivity by enhancing their resource utilisation, that is to say, by upgrading technology and improving the skills of their workforce. Several papers have documented the persistence of firms' productivity over time (see for example, Baily et al., 1992; and Foster et al., 2008).

Second, aggregate productivity could be improved by reallocating resources reallocation from lower-performing firms to higher-performing ones. This can be done between surviving firms or through the exit of less productive firms and the entry of more productive firms. Large volumes of empirical works have documented the important role of resource reallocation in promoting aggregate productivity growth (see for example, Harris & Moffat, 2019).

While there is a general consensus that aggregate productivity growth is driven by market selection and the reallocation of resources from low-performance firms to high-performance firms (Foster et al., 2008), it is not clear whether the determining factors that influence the selection mechanism are based on productivity or profitability.

Early empirical studies considered productivity as the main determinant for market dynamic selection, due to the fact that less productive firms are forced to exit the market and more productive firms are able to grow and expand (Baily et al., 1992). However, some recent studies have argued that productivity is not the main determinant for market selection. Foster et al. (2008) show that plant profitability is the dominant factor in a firm's survival. They argue that previous empirical works oversimplify the correlation between productivity and profitability by assuming profitability is an increasing function of productivity. The authors' argue that it is not always the case that the correlation between productivity and profitability is positive, as there are other factors that might have increased the profitability of low-productive firms. For example, if a low-productive firm operates in a high demand market, it could increase its profit by charging high prices that increase its survival rate, even though its productivity is low. Foster et al. (2008) show that the impact of profitability on a plant's survival is higher than the impact of productivity. Since then, researchers have examined the impact of both productivity and profitability on a plant's exit decision. However, details of the outcome are still scant.

Thus, this chapter contributes to the growing literature regarding dynamic market selection in two ways. First, it helps us to further understand the role of productivity and profitability on the process of dynamic selection, using unique data from Omani manufacturing plants for the first time. Second, this chapter also documents evidence of the sources of aggregate productivity growth in the Omani manufacturing industry for the first time. This will help policy makers to formulate policies that encourage plants to enhance their productivity.

To identify the sources of aggregate productivity growth, we adopt the Dynamic Olley and Pakes (1996) decomposition method, with the extension by Melitz and Polanec (2015) (DOPD). Similar to the findings of other empirical works such as Harris and Moffat (2019), we find that resource reallocation between plants is the main driver for aggregate productivity growth in the Omani manufacturing industry. The findings of this study also show that there is persistence in plants' productivity, but not in its profitability.

Concerning the impact of productivity and profitability on plants' exit decisions, when using each of them in two separate specifications, we find that both productivity and profitability positively affected plants' survival. However, when both are included simultaneously in one specification, the impact of productivity remains unchanged, while profitability becomes not significant. This indicates that the market dynamic selection in the Omani manufacturing industry is based on productivity and not profitability. This puzzling result is similar to the findings by Dosi. et al. (2017) and consistent with the point made by Foster et al. (2008) that it is not always the case that high profitable plant is high productive too. The correlation between productivity and profitability is not high (0.36 and 0.45) for ROS and markup, respectively, as shown in Table 4.1. Furthermore, the result is also linked to the industrial dynamics models (such as Dosi et al., 1995 & 2017; & Winter et al. 2003) which assume that market selections are the results of learning process among plants. These models argue that in order for plants to survive in the market they need to enhance their capabilities to generate knowledge, learn from their experience and act very quickly to any market shocks (such as more competition). So, the ability of more productive plants to compete and cope with the shock is higher than the ability of less productive and high profitable plants.

The remainder of this chapter is organised as follows. In the next section, we present the methodology. Section 3 describes the data and the entry and exit rates. In section 4, the results of the aggregate productivity decompositions, transition matrices, and plant exit decisions are analysed. Section 5 concludes the paper.

4.2 Methodology

4.2.1 Productivity decomposition

Aggregate productivity growth can be decomposed into three different sources: productivity growth of the surviving firms, reallocation of the market shares among the surviving firms (from the least productive to the most productive), and the entry and exit of firms (Foster et al., 2001). In order to understand the sources of aggregate productivity growth, several productivity decompositions methods have been developed in the literature. They include: Baily, Hulten and Campbell (1992), Griliches and Regev (GR) (1995), Olley and Pakes (1996), Foster, Haltiwanger and Krizan (FHK) (2001) and Meltiz and Polanec (2015). These decomposition methods decompose aggregate productivity changes into four categories: change of surviving firms' internal productivity (within), change of market share between surviving firms (between), entrant firms, and exiting firms (Melitz & Polanec, 2015).

As mentioned previously, this chapter uses the Dynamic Olley and Pakes (1996) decomposition method, with the extension by Melitz and Polanec (2015). (DOPD). The method considers the contribution of surviving, entrant and exiting firms. Comparing DOPD with other decompositions methods, DOPD estimates the contributions of the entrant and exiting firms to aggregate productivity growth, by comparing their productivity with the average productivity of surviving firms only. On the contrary, the FHK model takes into account the aggregate productivity of all of the firms in the industry in the start year, and the GR model uses the average productivity of all of the firms over a certain time period. Thus, DOPD reflects the changes in firms' market share compositions, while this reflection is not clear with other decompositions (Melitz & Polanec, 2015).

Olley and Pekas (1996) decompose the aggregate productivity into two components: the firm's unweighted average productivity (within plants productivity) and the reallocation of market share between surviving firms, from less productive to more productive firms (between or covariance or reallocation) using the following equation:

$$lnTFP_t = \overline{lnTFP_t} + \sum_i (s_{it} - \overline{s_t})(lnTFP_{it} - \overline{lnTFP_t})$$
$$= \overline{lnTFP_t} + cov(s_{it}, lnTFP_{it}) \quad (1)$$

where $lnTFP_t$ is the industry aggregate productivity in period *t*, $\overline{lnTFP_t}$ is the unweighted mean of industry productivity in period *t* and is calculated as $\overline{lnTFP_t} = \frac{1}{n_t}\sum_{i=1}^{n_t} TFP_{it}$, s_{it} is the market share of firm *i* in period *t* and is measured by the firm market share, using either sales, employment or value-added. This chapter uses a value-added as weights similar to Melitz and Polanec (2015). $\overline{s_t}$ is the industry average market share in period *t*. The first part of the equation (1) ($\overline{lnTFP_t}$) represents the contribution to aggregate productivity that comes from within the firm's productivity, while the second part ($cov(s_{it}, lnTFP_{it})$) comes from resource reallocation between surviving firms, as resources are moved from less productive firms to more productive ones. The larger the second part ($cov(s_{it}, lnTFP_{it})$), the more market reallocation there is, and the more productive firms dominate the market share. A positive first part ($\overline{lnTFP_t}$) indicates that firms enhance their own productivity and become more productive during the study period.

Melitz and Polanec (2015) added the entry and exit components to Olley and Pakes' method. They considered aggregate productivity in each period as the sum of aggregate share and aggregate productivity of the surviving, exiting and entrant firms as follows:

$$lnTFP_1 = s_{S1} lnTFP_{S1} + s_{X1} lnTFP_{X1}$$
$$= lnTFP_{S1} + s_{X1}(lnTFP_{X1} - lnTFP_{S1})$$

$$lnTFP_2 = s_{S2} lnTFP_{S2} + s_{E2} lnTFP_{E2} = lnTFP_{S2} + s_{E2}(lnTFP_{E2} - lnTFP_{S2}) \quad (2)$$

where $lnTFP_1$ is the first-period aggregate productivity, S represents the surviving firms group, X is the exiting firms' group (firms that are active in period one, although not active in period two), E is entrant firms group (firms that are not active in period one, but active in period two), s_S, s_X, s_E are the market share for surviving, exiting and entrants group, respectively. The aggregate market share of the group (G)[5] is computed by $S_{Gt} = \sum_{i \in G} s_{it}$ and a group's aggregate productivity is calculated by $lnTFP_{Gt} = \sum_{i \in G}(s_{it}/s_{Gt}) lnTFP_{it}$. Therefore, the aggregate productivity change between the two periods is:

$$\Delta lnTFP = lnTFP_2 - lnTFP_1$$
$$= (lnTFP_{S2} - lnTFP_{S1}) + s_{E2}(lnTFP_{E2} - lnTFP_{S2})$$
$$+ s_{X1}(lnTFP_{S1} - lnTFP_{X1})$$

$$= \Delta \overline{lnTFP_S} + \Delta cov_S + s_{E2}(lnTFP_{E2} - lnTFP_{S2}) + s_{X1}(lnTFP_{S1} - lnTFP_{X1}) \quad (3)$$

where the first two components of equation (3) are similar to equation (1) of Olley and Pekas' decomposition. The first part ($\Delta \overline{lnTFP_S}$) captures the contribution of average productivity changes of the surviving firms to aggregate productivity growth., while the second part captures the aggregate productivity changes due to the resource reallocation between the surviving firms. The entrants and exiting' firms' contributions are shown in the last two parts of equation (3), respectively. The summation of the last three parts of the equation yields the contribution of the total resource reallocation to aggregate productivity growth.

[5] (G) is one of the three groups (S, X or E).

Furthermore, previous studies have documented the existence of large heterogeneity around firms' productivity, as well as the persistence in productivity dispersion (Baily et al., 1992; and Dosi et al., 2017). Different approaches have been used to examine the existence of persistence. One of these approaches is the use of transition matrices that have been used in the literature to study market dynamics, identify and follow firms' movement among the different quintiles and show the fraction of firms' performance changes over time (see Baily et al., 1992). Accordingly, this chapter investigates whether there is any persistence in the level of plants' productivity and profitability in the Omani manufacturing industry using transition matrices.

4.2.2 Exit decision

To examine whether selection in the Omani manufacturing industry is based on productivity or profitability, we follow Zingales (1998) and Greenaway et al. (2008) and use probit specification for the following model:

$$\Pr(\, exit_{it} = 1) = \Phi\{(TFP_{i,t-1}, profitability_{i,t-1}, X_{i,t}, sector, year)\} \quad (4)$$

where $exit_{it}$is a dummy variable taking a value of one if plant *i* exits the market in year *t*, and zero otherwise, $\Phi(.)$ is the normal distribution function, TFP is plant *i* productivity in year *t-1* estimated as the residual of the production function using the Levinshon and Petrin (2003) approach[6], $profitability$ is plant *i* profitability in year *t-1*. Two proxies are used for profitability; return on sales (ROS)[7] and markup[8]. X is a vector of plant *i* characteristics that might affect plants' survival rate. A full set of

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[6] The details of the estimation technique are described in Chapter Three.
[7] ROS is defined as ratio of (value added – wages)/total sales. This indicator has been used in several papers in economics and management fields, such as Bottazzi et al. (2008), Fryges and Wagner (2010), Yu et al. (2017) and Van den B. et al. (2018).
[8] Markups for each plant are estimated, by following the De Loecker and Warzynski (2012) approach. The methodology assumes that $\mu_{it} = \frac{\theta_{it}^{X}}{\alpha_{it}^{X}}$, where $\mu_{it}$is firm i mark up at period t, θ_{it}^{X} is the output elasticity of input X_{it}, and α_{it}^{X} is the share of expenditures on input X_{it} in value-added. For θ_{it}^{X} the estimated labour parameter from our production function estimation in Table 3.2 in Chapter Three was used. α_{it}^{X} is defined as a plant's total compensation over its value-added in period t.

year and sector dummies are also included to control for the time and sector-specific fixed effects, respectively.

The specification above is motivated by recent debate in the literature whether the determining factors that influence the selection mechanism are based on productivity or profitability. The market selection mechanism is described as the process in which high-performance firms increase their market share and grow, while low-performance firms reduce their market share and eventually exit the market (Dosi et al., 2017).

Several theoretical industry or market dynamic models, such as those created by Jovanovic (1982) and Hopenhayn (1992), argue that productivity plays an important role in market dynamic selection (Bellone et al., 2006). They assume that more productive plants are less likely to exit the market, while less productive plants are forced to exit, if their productivity is less than a specific threshold point. These models assume that profitability is an increasing function of productivity. Several empirical studies from different countries have supported this hypothesis and documented that less productive firms are more likely to exit the market (see for example, Baily et al., 1992; and Dosi et al., 2017).

In contrast, Foster et al. (2008), in their seminal paper, argue that previous works oversimplified the relationship between productivity and profitability by assuming that profitability is positively correlated with productivity. They argue it is not necessary for high profit firms to also be highly productive ones, because of other demand factors that might increase the profits of low productive firms such as a long-term fixed contract. They show that the impact of profitability on plants’ survival is higher than the impact of productivity in their study on plants' survival in the manufacturing of homogenous products in the U.S. Since then, several empirical studies have examined the impact of profitability on firms’ survival. The findings of these studies are still scant. For example, in their studies of Swedish firms, Delmar et al. (2013) report that profitability positively affects firms' survival. They argue that as plant profit increases, it generates the required financial resources to survive.

While, Dosi et al. (2017) in their study of new firms in the U.S. manufacturing industry report that productivity has a positive impact on firms' survival, while profitability only has a negligible impact.

In addition to productivity and profitability, the economic literature has documented several factors that affect plants' survival. Many empirical studies have shown that plant size and age have a positive impact on a firm's survival (see for example, Fackler et al., 2013). These findings are linked to the Jovanovic (1982) theoretical selection model for industry evolution. The model assumes that new plants start their operations on a small scale, as they do not know what their productivity is likely to be; yet they learn about their industry and productivity over time. Therefore, small productive plants grow and less productive plants are forced to exit the market. Furthermore, foreign ownership, innovation and exporting activities are other factors that have been identified as important contributors to a plant's survival (see for example, Cefis & Marsili, 2005; Greenaway et al. (2008); Baldwin & Yan, 2011; and Wagner, 2012). Accordingly, we account for those factors by including in our model variables for plants' age, capital and size (proxies by number of employees). Also, we include three dummy variables. The first, *innovation* is taking a value of one if the plant *i* spends on R&D, and zero otherwise. The second, *foreign* is taking a value of one if plant *i* has a foreign capital participation, and zero otherwise. The last one, *exporter* is taking a value of one if plant *i* exports in any year during the study period, and zero otherwise.

4.3 Data and entry and exit rate

This chapter uses data from the Annual Industrial Survey (AIS) for plant-level panel data for the period 1993-2016. The AIS is conducted by the Ministry of Commerce and Industry in Oman. The AIS is described in more detail in section 3.3 in Chapter Three. Table 4.1 displays the correlation between the main variables that are used in the analysis for this study, as well as a summary of their statistics.

Table 4.1. Summary statistics for the main variables

Variables	lnsales	lnvalue_added	TFP	ROS	lnmarkup	lncapital	lnemp	lnage	Innovation	Exporter	Foreign
	Correlations										
lnsales	1.000										
lnvalue_added	0.946	1.000									
TFP	0.350	0.422	1.000								
ROS	0.203	0.434	0.359	1.000							
lnmarkup	0.442	0.586	0.446	0.770	1.000						
lncapital	0.777	0.758	0.040	0.148	0.278	1.000					
lnemp	0.830	0.819	0.253	0.083	0.127	0.694	1.000				
lnage	0.116	0.122	0.023	-0.006	-0.025	0.032	0.146	1.000			
Innovation	0.195	0.181	0.042	0.008	0.073	0.177	0.131	0.057	1.000		
Exporter	0.487	0.463	0.190	0.083	0.172	0.443	0.430	-0.024	0.112	1.000	
Foreign	0.345	0.329	0.112	0.064	0.124	0.313	0.285	-0.071	0.069	0.253	1.000
	Mean and Standard deviations										
Mean	13.151	12.247	6.134	0.267	0.646	12.489	3.668	2.662	0.045	0.514	0.292
St. deviation	1.740	1.761	1.240	0.230	0.829	1.881	1.124	0.637	0.208	0.500	0.455

In this study, an entrant plant is defined as a plant that is active in year *t,* but not active in previous years, while an exit plant is a plant that is active in year *t-1,* but not active in year *t*, nor the following years, and a surviving or incumbent plant is an plant that is active during all years of the study period. Since AIS covers plants that have at least 10 employees[9], plants may disappear from the dataset when its workforce is reduced to less than 10 employees or it switches its activities from manufacturing to trading. In this chapter, a plant that disappears from the dataset is considered as an exit plant, although it may be possible that it is still active in the market. Therefore, interpreting the results of this chapter needs to be done with some caution, since applying these definitions may underestimate entry rates and overestimate the exit rates.

Following the literature, plant entry and exit rates for the Omani manufacturing industry are estimated using the following equations:

[9] Before 2001, all manufacturing plants were covered, however, from 2001 onward, the survey only covers plants with at least 10 employees.

$$Entry\ rate_{jt} = \frac{\text{Total number of new entrants in industry (j) in year (t)}}{\text{Number of total plants in industry (j) in year (t−1)}} \quad (5)$$

$$Exit\ rate_{jt} = \frac{\text{Total number of exit firms in industry (j) in year (t)}}{\text{Number of total plants in industry (j) in year (t−1)}} \quad (6)$$

Table 4.2 shows the evolution of a plant's entry and exit rates in the Omani manufacturing industry during the 1994-2014 period. During this period, the average entry rate was 7.2%, the average exit rate was 4.2% and the average turnover rate was 11.4%.

In 2011, no data was collected, and consequently the entry and turnover rates in 2012 were high. With the exception of 2012, Table 4.2 illustrates that 2010 exhibited the highest turnover rate (16.5%), since both entry and exit rates were high, while in 2003 the lowest turnover rate (6.1%) was observed. The entry rate varied across the years ranging from 0.9% in 2003 to 13.3% in 1994.

The average entry rate of the Omani manufacturing (7.2%) is comparable to those documented in other countries, namely, Cable and Schwalbach (1991) report the entry rate for Germany (3.8 %), Canada (4%), Belgium (5.8%), UK (6.5%) and the USA (7.7%). Other empirical studies have found the entry rate for the manufacturing sector in Colombia was 8.4% (Eslava et al, 2006) and in Slovenia, France and Sweden has been 9% (Bojnec & Xavier, 2004; Bellone et al., 2006; and Nystrom, 2007)[10].

[10] Statistics vary as in some countries data are firm-level while in others are plant-level. The most comparable rates are from France and Colombia as they are for plant-level data.

Table 4.2. Average entry and exit rates by year for the period 1994 – 2014

Year	Entry rate	Exit rate	Average turnover	Year	Entry rate	Exit rate	Average turnover
Average	7.2%	4.2%	11.4%	2004	5.7%	4.2%	9.8%
1994	13.3%	0.0%	13.3%	2005	8.2%	4.1%	12.3%
1995	10.1%	5.1%	15.3%	2006	3.7%	3.8%	7.5%
1996	4.3%	3.6%	7.9%	2007	5.4%	2.2%	7.6%
1997	11.7%	4.1%	15.9%	2008	9.0%	2.7%	11.8%
1998	10.1%	4.0%	14.1%	2009	7.2%	4.1%	11.3%
1999	9.7%	2.1%	11.8%	2010	10.1%	6.4%	16.5%
2000	4.9%	5.4%	10.3%	2012	24.5%	3.8%	28.3%
2001	5.6%	15.5%	21.2%	2013	8.8%	2.9%	11.7%
2002	7.5%	0.0%	7.5%	2014	1.2%	10.8%	12.0%
2003	0.9%	5.3%	6.1%				

The turnover rate is the sum of entry and exit rate

Over the entire period, exit rates are generally smaller than entry rates. In 2001, the exit rate was 15.5%, because of the adoption of a new data collection strategy. Furthermore, the exit rates vary over the years, ranging from 0% in 2002 to 10.8% in 2014. The average exit rate in the Oman manufacturing industry (4.2 %) is in the same range as the exit rates in other countries such as Canada (4.8%) and the UK (5.1%) (Cable & Schwalbach, 1991), and Slovenia (5%) (Bojnec & Xavier, 2004), and lower than the exit rates in the USA (7%) (Cable & Schwalbach, 1991), France (10%) (Bellone et al., 2006), Colombia (10.7%) (Eslava et al, 2006) and Sweden (11%) (Nystrom, 2007).

Table 4.3. Average entry and exit rates by sub industry for the period 1994 - 2014

Industry	Average entry rate	Average exit rate	Average turnover
Industries overall	7.2%	4.2%	11.4%
Food and beverages	6.5%	5.3%	11.8%
Readymade garments and textiles	5.5%	7.1%	12.6%
Wood products	6.2%	4.8%	11.1%
Paper and printing products	4.8%	2.9%	7.8%
Refined Petro-Products	7.0%	3.1%	10.1%
Chemical Products	7.4%	2.6%	10.0%
Rubber and Plastics	8.6%	2.1%	10.8%
Building and construction materials	7.9%	4.7%	12.7%
Metal products	9.1%	4.2%	13.3%
Machinery, equipment and electrical/apparatus	7.9%	2.5%	10.4%
Others	11.3%	4.0%	15.3%

The turnover rate is the sum of entry and exit rate

Table 4.3 reports the average entry and exit rates by sub-industries over the period 1994-2014. It shows that the average turnover varies between industries, ranging from a low of 7.8% for the manufacturing of paper and printing products to a high of 13.3% for the manufacturing of metal products. The same variability exists in entry and exit rates, since the entry rates range from 4.8% to 9.1%, and the exit rates range from 2.1% to 7.1%. This variation is in line with the evolution and decomposition of manufacturing industry over the last decades. The variation of entry and exit rates has also been documented in other empirical studies (see for example, Bellone et al., 2006).

Table 4.3 also illustrates that in most industries, the average entry rate is higher than the average exit rate, except for the manufacturing of ready-made garments and textiles. Some industries exhibited high entry and low exit rates. For example, the entry rates in the rubber and plastic industry, and the machinery and electrical apparatus industry, and the chemical industry are 8.6%, 7.9%, and 7.4%, while the exit rates are 2.1%, 2.5% and 2.6%, respectively. This is consistent with the development of the manufacturing industry during the period, and it might imply that the manufacturing industry in Oman is moving toward more advanced technology industries.

In summary, Table 4.3 figures might suggest that plants' entry and exit play an important role in the growth of aggregate productivity, by shifting resources from less productive plants to more productive ones.

4.4 Estimation results

4.4.1 Productivity growth decompositions results

To examine the sources of aggregate productivity growth, we adopt the extended Melitz and Polanec (2015) of Olley and Pakes (1996) decompositions method. First, we estimate the aggregate productivity level and the market share for the survival, entrant and exit groups in 1993 and 2015 by using equation (2). Table 4.4 displays the results. The aggregate productivity level of the Oman manufacturing industry exhibited a decrease by (0.505) log points, as it dropped from 6.703 in 1993 to 6.198 in 2015. This negative growth was driven by a huge resource misallocation among the surviving plants in the manufacturing of refined-petro products industry as this industry dominates more than 30% of the whole manufacturing industry value-added in 2015.

Table 4.4. Aggregate productivity and market share for survival, entrants and exit plants over the period 1993 – 2015

Years	Period 1 (1993)				
	Surviving[a] plants		Exiting[b] plants		All plants
	Market share	Aggregate TFP	Market share[d]	Aggregate TFP	Aggregate TFP
1993-2015	0.889	6.700	0.111	6.723	6.703
	Period 2 (2015)				
	Surviving plants		Entering[c] plants		All plants
	Market share	Aggregate TFP	Market share	Aggregate TFP	Aggregate TFP
1993-2015	0.509	5.801	0.491	6.611	6.198

a. surviving plants are those that are active during all years of the study period, b. exiting plants are those that are active in period one, but not active in period two, c. entering plants are those that are active in any period after period one. d. to read this for example, 11.1% of the total value added in 1993, was created by exiting plants (subset of plants that were active in 1993 and not active in 2015).

To reduce the influence of the refined petro-product industry and to understand the sources of aggregate productivity growth, we estimate aggregate productivity without the refined petro-product industry. Table 4.5 displays the results. The aggregate productivity level dropped from 6.732 in 1993 to 6.627 in 2015. The aggregate productivity of surviving plants is less than the aggregate productivity of exiting plants in 1993 (Period 1), while it is larger than of entrant plants in 2015 (Period 2).

Table 4.5. Aggregate productivity and market share for survival, entrants and exit plants over the period 1993 - 2015 without the refined petro-product industry

Years	Period 1(1993)				
	Surviving plants		Exiting plants		All plants
	Market share	Aggregate TFP	Market share	Aggregate TFP	Aggregate TFP
1993-2015	0.812	6.712	0.188	6.817	6.732
	Period 2 (2015)				
	Surviving plants		Entering plants		All plants
	Market share	Aggregate TFP	Market share	Aggregate TFP	Aggregate TFP
1993-2015	0.260	6.762	0.740	6.579	6.627

In Table 4.6, we decompose the aggregate productivity growth using equation (3) without taking into account the manufacturing of refined-petro products industry. The total aggregate productivity growth for the overall manufacturing industry was -0.105 log points. This negative aggregate growth was driven mainly by the negative contribution of the entering plants, which suggests, as shown in Table 4.4, that their productivity was less than the productivity of surviving plants. Similarly, the contribution from exiting plants to aggregate productivity growth was negative.

The contribution of the between component is positive, implying that plants that are more productive dominate the market share of the manufacturing industry and the resources shift from less productive plants to more productive ones. This result is similar to the result of Baily et al., (1992) in their study about the productivity growth of the US manufacturing plants over the period 1972-87. Furthermore, the within component is negative, suggesting that surviving plants' internal productivity dropped. For example, the result of -0.088 in 2015 suggests that the internal productivity of the survival plants decreased by 0.088 log points in 2015, relative to 1993.

The reallocation of resources between surviving and entrant plants appears to be the predominant source of aggregate productivity growth in the Omani manufacturing industry. These decomposition results are consistent with the findings of other studies such as the one conducted by Harris and Moffat, (2019).

Table 4.6. Productivity growth decomposition over the period 1993 - 2015

Survival plants			Entrant plants	Exit plants	All plants
Within	Between	Total			
-0.088	0.138	0.050	-0.135	-0.020	-0.105

To understand the evolution of aggregate productivity growth, we decompose the productivity growth yearly over the study period, relative to the year 1993 (base year). Table 4.7 displays the results. The general trend is that aggregate productivity growth (last column) increases in most years over the period from 1993 until 2013, when it then declines by 0.105 log points until 2015, relative to 1993.

Table 4.7. Yearly productivity growth decomposition over the period 1993 - 2015

Period	Survival plants			Entrance plants	Exit plants	All plants
	Within	Between	Total			
1993-1994	0.001	0.027	0.027	-0.020	0.000	0.007
1993-1995	0.036	0.174	0.210	-0.024	0.000	0.187
1993-1996	0.027	-0.028	-0.001	0.002	0.005	0.007
1993-1997	0.042	0.020	0.062	0.017	0.012	0.092
1993-1998	0.038	0.076	0.114	-0.041	0.015	0.088
1993-1999	0.060	0.103	0.163	-0.021	0.015	0.157
1993-2000	0.020	-0.001	0.019	-0.042	0.016	-0.007
1993-2001	0.055	0.147	0.202	-0.080	0.005	0.128
1993-2002	-0.057	0.103	0.046	-0.089	-0.024	-0.067
1993-2003	-0.044	0.075	0.031	-0.028	-0.024	-0.021
1993-2004	-0.089	0.258	0.169	-0.076	-0.027	0.066
1993-2005	-0.117	0.439	0.322	-0.237	-0.029	0.057
1993-2006	-0.042	0.548	0.505	-0.169	-0.028	0.309
1993-2007	-0.023	0.520	0.497	-0.189	-0.031	0.277
1993-2008	-0.044	0.619	0.575	-0.450	-0.026	0.098
1993-2009	0.056	0.433	0.489	-0.230	-0.030	0.230
1993-2010	-0.039	0.343	0.303	-0.190	-0.030	0.083
1993-2012	-0.039	0.273	0.234	-0.266	-0.026	-0.059
1993-2013	-0.099	0.269	0.169	-0.097	-0.025	0.048
1993-2014	-0.187	0.026	-0.160	-0.027	-0.025	-0.212
1993-2015	-0.088	0.138	0.050	-0.135	-0.020	-0.105

Surprisingly, the within component shows that surviving plants' internal productivity is decreasing since 2002, which suggests that surviving plants do not utilise their resources efficiently. However, the contribution of the between component is positive almost every year. This indicates that the resources are moving from low productivity plants to high productivity ones.

In almost all of the years the average productivity of entering plants are less than the average productivity of the surviving plants, as the contribution of entrant plants is negative. During the period 1996-2001, the average productivity of exiting plants was lower than the average productivity of the surviving plants, since their contribution was positive. In addition, from 2002 onward, the contribution of exiting plants became negative.

Looking at the sub-industry level, Table 4.8 presents the decomposition of aggregate productivity growth for the 10 sub-industries during the 1993-2015 period. A total of four out of l0 industries show a positive total aggregate productivity growth during this period. The growth varies between industries ranging from -1.351 log points for the manufacturing of refined petroleum products industry to 0.610 log points for the manufacturing of metals industry.

The surviving plants only contribute positively to aggregate productivity growth in three industries. These industries include: rubber and plastic, metal, and machinery and equipment.

Although surviving plants improved their internal productivity in some industries, the within component is negative for half of them. This suggests that the surviving plants need to enhance their resource utilisation and upgrade their technology. The contribution of the between component is negative in most industries. This might indicate a misallocation of resources in these industries, with their market share being dominated by less productive plants. Entrants also contribute negatively in most industries. This implies that the average productivity of surviving plants is higher than the average productivity of entrants. Furthermore, as the contribution of exiting plants is positive, it indicates that less productive plants exit the market and more productive ones expand.

Table 4.8. Productivity growth decomposition of sub industries over the period 1993 - 2015

Industry	Survival plants			Entrance plants	Exit plants	All plants
	Within	Between	Total			
Foods and Beverages	0.092	-0.228	-0.136	-0.083	0.160	-0.060
Readymade garments and Textiles	-1.361	-0.784	-2.146	0.640	0.364	-1.141
Wood products and furniture	-0.538	-0.019	-0.557	-0.167	0.036	-0.688
Papers and printing	-0.267	0.152	-0.115	0.176	0.059	0.120
Refined Petro-Products	0.889	-2.256	-1.368	-0.002	0.019	-1.351
Chemicals	0.161	-0.451	-0.291	0.220	-0.066	-0.137
Rubber and Plastic	-0.110	0.708	0.598	-0.491	0.050	0.157
Buildings and construction materials	0.084	-0.296	-0.212	-0.060	0.004	-0.267
Metal Products	-0.529	0.552	0.023	0.588	-0.001	0.610
Machinery, equipment & electrical/Apparatus	0.206	0.218	0.425	-0.072	0.000	0.352

Based on the results form Table 4.7, industries' aggregate productivity could be enhanced by focusing on the components that impeded their productivity growth over the period. For example, looking at some of the large, emerging sub-industries in the Omani manufacturing industry (as discussed in Chapter Two), misallocation of resources between incumbent plants is the main component that impedes the aggregate productivity of the manufacturing of foods and beverages, refined petroleum products, chemical products, and building and construction materials industries. The low productivity of entering plants reduces the aggregate productivity growth for the rubber and plastic industry. Surprisingly, the productivity of plants that exit the market is, on average, greater than the productivity of the surviving plants in the chemical industry. Therefore, examining factors behind the misallocation of resources and the plants' exit decisions would help in the formulation of policies to promote the aggregate productivity in these industries.

4.4.2 Transitions matrices

To further understand market dynamics, this section presents the transition matrices of plants' performance during the 1993-2015 period. Table 4.9 presents the average transition matrix of the plants' productivity level. In the first row, from left to right, of the plants that were in the first quintile in 1993, 3% of them remain in the same quintile in 2015, 8% of the plants moved up to quintile two, and 83% of them exited the market by 2015. The second row indicates that 3% of the first quintile plants in 2015 were in the same quintile in 1993. Looking at the ninth row (top quintile), we see that 14% of plants that were in the top quintile in 1993 remain in the same quintile in 2015. More than half of them exit and the remaining plants had moved down by 2015. The percentage of exiting plants goes down, as we move from lower to higher quintiles in the matrix. Similar to our findings, Baily et al. (1992) and Dosi et al. (2017) report around 30% of exiting plants belong to the top two quintiles.

Table 4.9. Average transition matrix of plants productivity level over the period 1993 – 2015

Quintile in 1993	Quintile in 2015					
	1	2	3	4	5	Exit
1	0.03	0.08	0.01	0.03	0.03	0.83
	0.03	0.05	0.01	0.02	0.02	0.12
2	0.08	0.08	0.02	0.03	0.05	0.75
	0.06	0.04	0.01	0.02	0.03	0.09
3	0.07	0.05	0.07	0.14	0.05	0.62
	0.05	0.02	0.04	0.09	0.03	0.07
4	0.02	0.09	0.18	0.09	0.05	0.57
	0.01	0.02	0.11	0.06	0.03	0.06
5	0.03	0.04	0.08	0.12	0.14	0.59
	0.03	0.03	0.06	0.10	0.11	0.08
new entry	0.10	0.14	0.11	0.09	0.10	0.46
	0.82	0.82	0.76	0.70	0.77	0.59

Notes: lowest productivity plants are in quintile 1 while highest productivity plants in their sectors are in quintile 5.
Exit refers to plants that are not active in the market in 2015 but active before that.
New entry refers to plants that first appear in our dataset after 1993.

Table 4.9 also shows that some plants were able to enhance their productivity and moved from the bottom two quintiles in 1993 to the top two quintiles by 2015. Around 14% (0.03+0.03+0.03+0.05) of the plants that belonged to the first two quintiles in 1993 moved up to the top two quintiles in 2015. This result is consistent with the results of our decomposition of aggregate productivity growth, since in some industries, surviving plants improved their internal productivity. In addition, the row before last in the matrix shows that 46% of the entrants' plants exited the market by 2015 and the productivity level of non-exit plants is spread almost equally through all of the quintiles. The spread results of the entrant plants are consistent with the results reported in other studies, such as those by Baily et al., (1992), for the U.S. manufacturing industry, and Dumont, (2011) for the Belgian manufacturing industry.

Table 4.9 shows that highly productive plants also exit the markets. Therefore, it might be the case, as in the findings of Foster et al., (2008), that profitability could explain plants' exit from the Omani manufacturing industry. Table 4.10 illustrates the transition matrix for plants' profitability (proxies by ROS) during the 1993-2015 period. Similar to the productivity matrix, it is also observed that plants with high profits exit the markets. The percentage of exiting plants from the top quintile in the profit matrix is higher than the percentage in the productivity matrix. However, there is no clear trend for the percentage of exiting plants, when moving from the lower quintile to the top ones in the transition matrix of plants profitability. The lowest percentage (56%) of plants exiting by 2015 belonged to quintile 4 in 1993. This is in line with other empirical work (Dosi et al., 2017) and indicates a non-linear relationship between profitability and plants' survival.

Table 4.10. Average transition matrix of plants' profitability over the period 1993 – 2015

Quintile in 1993	Quintile in 2015					
	1	2	3	4	5	Exit
1	0.06	0.05	0.03	0.06	0.06	0.75
	0.03	0.03	0.02	0.07	0.04	0.09
2	0.05	0.08	0.03	0.02	0.02	0.81
	0.03	0.04	0.02	0.02	0.01	0.1
3	0.19	0.08	0.06	0.02	0.05	0.6
	0.1	0.04	0.04	0.02	0.03	0.07
4	0.02	0.09	0.21	0.07	0.06	0.56
	0.01	0.05	0.15	0.08	0.04	0.07
5	0.03	0.13	0.09	0.03	0.04	0.68
	0.02	0.07	0.06	0.03	0.03	0.09
new entry	0.14	0.13	0.09	0.07	0.11	0.46
	0.81	0.76	0.7	0.78	0.84	0.59

Notes: lowest profitability plants are in quintile 1 while highest profitability plants in their sectors are in quintile 5.
Exit refers to plants that are not active in the market in 2015 but active before that.
New entry refers to plants that first appear in our dataset after 1993.

To check the above findings over a shorter period, the study period is divided into four equal size sub-periods (1993-2000, 2000-2005, 2005-2010 and 2010-2015). Tables 2B and 2C in the appendix show the transition matrices of plant productivity levels and profitability over different sub-periods, respectively. Similar to the long period matrices (Tables 4.9 and 4.10) in the shorter period matrices, it is also observed that exiting plants belong to the top quintiles in both matrices; for productivity level and profitability, but with lower percentages compared to the long period matrices.

In terms of whether there is a persistence in plant productivity levels and profitability, Tables 4.9 and 4.10 show that there is no persistence on either productivity level or profitability during the 1993-2015 period. However, there is persistence in the tables for the shorter periods. Tables B in the appendix show that there is persistence in plant productivity levels in most quintiles, with a higher percentage in the top ones. For example, Tables B1.a and B1.b show that of the plants that were in the top quintile for productivity level in 1993, 38% of them were still in the same quintile in 2000, and for plants that were in quintile 5 in 2000, 44% of them were still in the same quintile in 2005.

To further check for persistence, we follow Foster et al. (2008) by using the regression analysis. Table 4.11 shows the results of regressing productivity and profitability each on its one-year lag, 5-year lag and 10-year lag, and controlling for the sector-year interaction. The table confirms the existence of persistence in plant productivity levels.

Table 4.11. Persistence in Productivity and Profitability

Variables	Ten years horizon	R^2	Five years horizon	R^2	One year lag	R^2	Observ-ations
TFP	0.574***	0.643	0.614***	0.679	0.764***	0.784	1,397
	(0.045)		(0.041)		(0.029)		
ROS	0.239***	0.23	0.323***	0.268	0.570***	0.434	1,397
	(0.043)		(0.046)		(0.045)		
lnmarkup	0.314***	0.291	0.381***	0.333	0.606***	0.493	1,397
	(0.047)		(0.049)		(0.044)		

Table shows the results of regressing current TPF, ROS and lnmarkup, respectively, on its one, five and ten years lags separately. All of the specifications include year-sector fixed effects. Robust standard errors adjusted for cluster in plants in parentheses. *** p<0.01, ** p<0.05, *p<0.1.

In summary, some of the outcomes from the transition matrices are consistent with the expectations and findings in the literature, since low performers exit the market. However, the matrices also show that more than half of the highly productive and profitable plants exit the market. The percentage goes down, when moving to a higher quintile of productivity level. However, there is no clear trend in the profitability matrix. This might hint at the potential impact of productivity on a plant's survival. To address this, in the next section, we use econometric modelling to examine the impact of plant productivity and profitability, as well as other factors, on the survival of plants in the Omani manufacturing industry.

4.4.3 Market exit decision

Table 4.12 presents the average marginal effect of the probit regression results. We regress plants' exit on productivity and profitability, while controlling for other plants' characteristics, such as size, age, and capital. In all of the specifications, we include a full set of sector-year interactions.

Following Foster et al.'s (2008) approach, in the first three columns, we report the marginal effects of productivity and profitability in isolation. The results show that both productivity and profitability (irrespective of the proxy used) have both a positive and significant impact on a plant's survival, when each of them are considered separately. This indicates that highly productive and profitable plants are less likely to exit the markets. More specifically, for example, the estimated coefficients, are negative (0.012, 0.028 and 0.012) in columns (1-3), implying that an increase by a one-standard-deviation in productivity, ROS, and mark-up, respectively, reduces the probability of plant exit by 1.5, 0.6 and 1 percentage points, respectively[11]. The magnitude of productivity is higher than profitability in both proxies. These findings are consistent with economic theories, such as those of Jovanovic (1982) and Hopenhayn (1992), that state that high performing plants expand and grow, while low performers leave the markets.

Consistent with Jovanovic's (1982) theory, the coefficient of plant size is negative and significant in all specifications. This implies that larger plants are less likely to exit the market. A coefficient of (- 0.018) in column (2) suggests that a decrease of one standard deviation increases the survival rates of larger plants by two percentage points. This finding is consistent with the evidence presented in other empirical studies (see for example, Greenaway et al., 2008; and Fackler et al., 2013).

[11] The standard deviation for TFP, ROS and markup are 1.24, 0.23 and 0.829, respectively. Table 4.1 reports them.

Table 4.12. Estimation results for exit from the market

dependent variable exit_plant	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TFP_{t-1}	-0.012***			-0.013***	-0.010*	-0.011***	-0.007
	(0.003)			(0.004)	(0.006)	(0.004)	(0.005)
ROS_{t-1}		-0.028***		0.008		0.004	
		(0.009)		(0.009)		(0.011)	
$lnmarkup_{t-1}$			-0.012***		-0.002		-0.004
			(0.003)		(0.004)		(0.004)
$lnage_{t-1}$	0.004	0.005	0.004	0.004	0.004	0.004	0.004
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
$lnemp_{t-1}$	-0.015***	-0.018***	-0.019***	-0.014***	-0.015***	-0.014***	-0.015***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$lncapital_{t-1}$	0.0003	0.001	0.002	0.0009	0.0006	0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
$innovation_{t-1}$						-0.032	-0.033
						(0.105)	(0.105)
$foriegn$						-0.011**	-0.011**
						(0.005)	(0.004)
$export$						-0.001	-0.001
						(0.003)	(0.003)
Year-sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,654	7,654	7,654	7,654	7,654	7,654	7,654
Pseudo R2	0.2166	0.2117	0.2153	0.2167	0.2167	0.2199	0.22
Log pseudolikelihood	-976.53	-982.69	-978.19	-976.37	-976.47	-972.45	-972.27

Bootstraped robust standard errors adjusted for cluster in plants in parentheses
*** p<0.01, ** p<0.05, * p<0.1

In columns (4 and 5), we include both productivity and profitability, as well as plant size, age, and capital, in the same regression model. When both productivity and profitability are controlled for in the same specification, the estimated coefficient of productivity is still negative and significant. It indicates that an increase of one standard deviation decreases the probability of highly productive plants exiting the market by 1.6 percentage points. Meanwhile, the associated coefficient of profitability becomes positive and insignificant on both proxies. One explanation for this is that highly productive plants are not necessarily highly profitable ones, and vice versa. This is in line with the correlation of (0.36 and 0.45) between productivity and ROS and mark-up, respectively, as seen in Table 4.1. Thus, the results in column (4) indicate that productivity dominates the market dynamic selection in the Omani manufacturing industry. This is also consistent with the transition matrices in the previous section, as the percentage of exit plants decreases in the productivity matrix, while it does not do so with profitability.

In columns (6 and 7) we extend the list of covariates in the model to investigate the possibility that productivity picks up the impact of other omitted factors that might have an impact on plants' decision to exit the market, such as foreign ownership, innovation, and exporting activities. Plants' exit decisions appear to be affected by plant ownership. The estimated coefficient associated with the foreign variable is negative and significant. This indicates that plants with foreign ownership are more likely to survive in the market. This finding is consistent with the findings of Baldwin and Yan (2011) in their study about Canadian manufacturing plants.

The results in the last two columns reveal that innovative plants are more likely to survive. However, the coefficient is insignificant. Similarly, the estimated coefficient associated with exporting is negative but not significant. This implies there is no evidence that exporting has a significant impact on a plant's decision to exit the market. Consistent with our finding, studies by Holger and Marina-Eliza, (2009) and Wagner (2013), report that exporting alone has no impact on plants' survival, based on UK and German manufacturing firms, respectively. Our previous findings that productivity has a positive impact on plants' survival rate and profitability does not, remain unchanged.

Furthermore, in order to check the robustness of these findings and to ensure they have not been affected by the omitted unobserved plants specific effects, we run model (4) using the fixed effects model (FE). Table 4.13 displays the results. The FE results confirm the probit results, specifically that the estimated coefficients of both productivity and profitability are negative and significant, when each of them are used in a separate regression. In addition, profitability lost its significance when combined with them in one specification. This confirms the findings that the market dynamic selection in the Oman manufacturing industry is based on productivity not profitability. In addition, the FE results also confirm that larger plants are more likely to survive in the market. Similarly, the results from Table 4.13 confirm that younger and innovative plants are less likely to exit the markets. Their estimated coefficients are significant, when using FE. In contrast, they are insignificant when using the probit model (Table 4.12).

Table 4.13. Estimation results for exit from the market using fixed effects model

dependent variable exit_plant	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TFP_{t-1}	-0.008***			-0.008*	-0.017**	-0.008*	-0.017**
	(0.003)			(0.004)	(0.008)	(0.004)	(0.007)
ROS_{t-1}		-0.021**		-0.0003		-0.0003	
		(0.009)		(0.014)		(0.014)	
$lnmarkup_{t-1}$			-0.005**		0.010		0.010
			(0.003)		(0.007)		(0.007)
$lnage_{t-1}$	0.060***	0.060***	0.060***	0.060***	0.060***	0.060***	0.060***
	(0.016)	(0.016)	(0.016)	(0.015)	(0.015)	(0.016)	(0.015)
$lnemp_{t-1}$	-0.027***	-0.027***	-0.028***	-0.027***	-0.025***	-0.027***	-0.025***
	(0.007)	(0.007)	(0.006)	(0.007)	(0.006)	(0.007)	(0.006)
$lncapital_{t-1}$	-0.001	0.001	0.001	-0.001	-0.003	-0.001	-0.003
	(0.007)	(0.007)	(0.007)	(0.007)	(0.008)	(0.007)	(0.008)
$innovation_{t-1}$						-0.021**	-0.021**
						(0.010)	(0.010)
Constant	0.000662	-0.0534	-0.0566	0.000247	0.0665	0.00218	0.0700
	(0.0657)	(0.0632)	(0.0636)	(0.0795)	(0.104)	(0.0778)	(0.102)
Year-sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	7,654	7,654	7,654	7,654	7,654	7,654	7,654
R-squared	0.107	0.107	0.107	0.107	0.108	0.108	0.108

Bootstraped robust standard errors adjusted for cluster in plants in parentheses
*** p<0.01, ** p<0.05, * p<0.1

4.5 Conclusion

This chapter uses detailed plant-level data to understand the sources of aggregate productivity growth for the Omani manufacturing industry during the 1993-2015 period, through the dynamic Olley and Pakes (1996) decomposition method with the extension by Melitz and Polanec (2015).

It is found that resource reallocation between surviving and entrant plants was the key driver for the aggregate productivity growth in the Omani manufacturing industry. The estimate also shows that there is a persistence in plants' productivity distribution, although the persistence is not clear for the profitability distribution during the 1993-2015 period.

For market dynamic selection, there is evidence that both plant productivity and profitability have a positive impact on a plant's survival, when each of them is regressed in a separate specification. However, when controlling for both of them in one specification, profitability becomes insignificant. Thus, the analysis suggests that productivity dominates market selection within the Omani manufacturing industry. These findings indicate that plant size, innovation and foreign participation in plants' ownership positively and significantly affected plant survival, while the age of the plant had a negative impact. There is also no evidence of the impact of exporting on a plant's decision to exit the markets.

Since productivity growth plays an important, long-running role in economic growth and Oman is currently working to enhance the contribution of the manufacturing industry to GDP, several policy implications arise from the findings of this chapter. Firstly, the government should set policies that encourage plants to enhance their internal productivity through innovation and technology upgrades. The focus of these policies should be targeted at those industries that have a negative contribution of the within component, such as wood and furniture products, rubber and plastic, and the metal product industries. Secondly, the government should also implement policies that facilitate the efficient allocation of resources, by reviewing the Omani regulatory system, including the regulation related to labour, market-entry, and government intervention. These policies should target those industries which make a negative contribution to the between components, such as food and beverages, refined petroleum products, chemicals, and building and construction material industries.

This chapter examines the impact of productivity and profitability on plants' decisions to exit the markets, however, it does not investigate their roles on plants growth. Thus, it would be interesting for future studies to examine the impact of productivity and profitability on plants growth in terms of output and job creations. Further, another area for future works is to examine whether there are any conflicts between policies that aim to improve plants productivity and policies that aim to create more jobs in the market. In addition, these findings indicate that there might be some misallocation of resources in some industries, so investigating the factors behind that is another area for future research.

Chapter 5 Exporting activities, Plants' Productivity and Profitability in the Omani Manufacturing Industry

5.1 Introduction

This chapter takes a fresh empirical look at the relationship between productivity and profitability, on the one hand, and export activity on the other hand, using unique plant-level data for the Omani manufacturing industry. From the dataset we ask three main questions: i) whether the best plants self-select into the export market, ii) whether the performance of export-starters is enhanced upon their entry to the foreign markets and iii) whether productivity and profitability impact plants' decision to exit the export markets.

The findings in Chapter 3 show average exporters are more productive than non-exporters across the Omani manufacturing industry. This is in line with a vast body of empirical studies, which document that exporters are more productive than non-exporters (see Fryges & Wagner, 2010; and Garcia & Voigtländer, 2019; among others). Two different hypotheses have been formulated to explain why exporters may have a competitive advantage, specifically: self-selection and the so-called learning by exporting hypotheses (see, for example, Bernard & Jensen, 1999; and Syverson, 2011). The former argues that these firms improve their productivity before they start exporting, whereas the latter suggests that plants' productivity improves upon their entry into the export markets.

While the relationship between productivity and exporting activities has been greatly investigated, the number of studies that have looked at the relationship between profitability and exports is scant. This is rather surprising given the fact that the objective of firms is to maximise profit. Foster et al. (2008) show that productivity correlates positively with profitability. However, they argue that it is not always the case that high-profitable firms are highly productive too. For example, Forlani et al.

(2016) in their work on Belgian manufacturing firms report a negative correlation between demand shocks and profitability.

Entering the export market can affect firms' profitability in different ways. First, firms may need to pay additional costs because of the need to adapt products to comply with the local legal requirements in the export market and to meet international client taste. Second, while international competition may force firms to increase productivity and reduce production costs, this may only translate into higher profits if firms can pass only part of the cost reduction to customers. However, in markets where firms are forced to pass all of their cost reductions to customers in the form of lower prices, they may experience a reduction in profitability.

The first studies that looked at the relationship between export and productivity were empirical in nature. Their findings stimulated a number of theoretical studies that aimed to provide a framework to explain such findings. Melitz (2003) developed the first model based on the existence of additional sunk costs firms having to pay to enter export markets. For example, firms need to pay to research new markets and set up distribution channels. In Meltiz's model, all firms serve domestic markets. Firms that plan to participate in export markets continue serving domestic markets until their productivity exceeds a specific threshold, when the expected revenue from exporting is higher than the costs. As a result, firms that are more productive have the ability to afford the extra costs and self-select into export markets. Moreover, exporters may gain productivity improvement upon their entry into international markets, as firms entering foreign markets are exposed to more advanced technology, new knowledge and intensive competition, which forces them to utilise their resources more efficiently. The large body of empirical work supports the self-selection hypothesis, while evidence related to learning by exporting is mixed (see for example Wagner, 2007 & 2012; Syverson, 2011; and Atkin et al., 2017).

Recently, researchers have started to use panel data to investigate the relationship between exports and profitability in three areas: i) whether exporters are more profitable than non-exporters, ii) whether high profit firms self-select into export markets, and iii) whether exports leads to an increase in firms' profitability (see, for example, Fryges & Wagner 2010; and Tamouri et al., 2013). However, studies have only covered a few countries, and their findings have been mixed and inconclusive (see, for example, Fryges & Wagner, 2010; Tamouri et al., 2013); and Demirhan, 2016).

Finally, a small number of studies have also investigated the role of firms' productivity and profitability on firms' decision to exit the export market, and have found that both productivity and profitability have a positive impact on firms' survival in international markets (Wagner, 2007; Ilmakunnas & Nurmi, 2010; Harris & Li, 2011; Engel et al., 2013; Demirhan, 2016; and Hiller et al, 2017).

This paper contributes to the literature above by studying the impact of exporting on Omani manufacturing plants' productivity and profitability, using a unique plant level dataset that spans 1993 to 2016.

In line with the existing empirical findings, the results of this study find that plants that are more productive self-select into the export markets. However, we report that plants that are more profitable are less likely to enter the export markets. Further, we find that the productivity of export-starters improves once they start exporting, while we do not find any evidence for the impact of export activities on plant's profitability. Finally, this paper finds that plants that are more productive are more likely to survive in the export market. However, the paper does not report any evidence for the impact of profitability on plants' decision to exit from the export market.

The rest of the paper is organised as follows. Section 2 provides an overview of the related literature on productivity and profitability and exporting activities. Section 3 describes the data and gives some preliminary analysis. Section 4 introduces the empirical models, while section 5 analyses the empirical results. Section 6 checks the robustness of the findings. Finally, section 7 concludes the chapter.

5.2 Related Literature

Firms' exposure to foreign markets through exporting activities has been considered among the most prominent factors promoting their productivity. Bernard and Jensen (1995) began the studies into the relationship between exporting and productivity in their seminal study of US manufacturing firms. They report that exporting firms are more productive than non-exporting firms. Since then, several firm-level studies using data from different countries have investigated the impact of exporting activities on firms' productivity. These studies have encouraged theorists and scholars to develop two alternative hypotheses to explain the relationship between exporting and firms' productivity. Firstly, the self-selection hypothesis developed by Melitz (2003) assumes that firms become more productive before they enter into the export markets. This hypothesis is based on the existence of sunk costs firms, which need to pay to enter export markets. Firms are required to spend more on their marketing and advertising costs, and firms are also sometimes forced to customise their products to meet the new market's demand. As entry to the export market requires additional costs, plants will be ready to pay these costs if expected revenues from international sales are higher than their revenues from domestic sales (Clerides et al., 1998; Melitz, 2003). Therefore, firms that are more productive are more likely to be able to afford these additional costs, while less productive firms are not.

The second hypothesis, namely learning by exporting, argues that exporters' productivity improves after they enter the export markets. This is due to a number of different reasons. First, as firms enter international markets, their sales grow, which helps them to enhance their economies of scale. Second, exporting provides firms with opportunities to gain more knowledge and skills, as they are exposed to the know-how of new competitors and the requirements of new customers (Clerides et al., 1998; and Aw et al., 2000). Third, the level of competition in the international market is higher compared to the domestic market. Thus, in order for the exporters to survive in foreign markets, they need to enhance their productivity.

Numerous empirical studies support the self-selection hypothesis, as they document that exporters' productivity tends to be higher than that of non-exporters before they enter international markets [see for example among others, Bernard & Jensen, 1995; Aw, Bee, Yan, et. al., 1997; Aw et. al., 2011; and Syverson, 2011). Conversely, Greenaway et al. (2005) in their study of Swedish manufacturing firms report no evidence that firms that are more productive self-select into the foreign markets.

Similarly, evidence related to the learning by exporting hypothesis is mixed. While Greenaway et al. (2005) report no significant impact of exporting activities on firms' productivity, some papers have found that exporters' productivity improves after they start exporting (see for example among other Van Biesebroeck, 2005, for Sub-Saharan African firms; Greenaway & Kneller, 2007b, for UK firms; De Loecker, 2007a, for Slovenian manufacturing firms; Sharma Mishra, 2012, for Indian manufacturing firms; and Atkin et al., 2017, for Egyptian manufacturing firms).

A more recent strand of literature has looked at the relationship between profitability and exporting. Kox and Rojas-Romagosa, (2010) find that firms that are more profitable self-select into export markets during their study of Netherlands manufacturing and services. On the contrary, Temouri et al., (2013) and Demirhan, (2016) document that less profitable firms in German business services and Turkish manufacturing firms, respectively, are more likely to enter export markets. Furthermore, other studies find no evidence that more profitable firms self-select into export markets (see for example Amendolagine & Petragallo, 2010, in their study of Italian manufacturing firms; Fryges & Wagner, 2010, in their study of German manufacturing firms; Ilmakunnas & Nurmi, 2010, in their study of Finnish manufacturing plants; and Temouri et al., 2013, in their study of France business services firms).

Similarly, the reported findings of the impact of exporting on firms' profitability have been inconclusive. For example, Amendolagine and Petragallo, (2010) and Atkin et al., (2017) find that exporting positively affects firms' profitability. While Kox and

Rojas-Romagosa, (2010) find no evidence that exporters' profitability increases after they start exporting activities.

Finally, an analysis of the factors that affect a firm's decision to exit export markets has received less attention (Harris & Li, 2011; and Fouskas & Robinson, 2019), as few papers examine the impact of productivity on firms' decision to stop exporting. The common findings of these papers is that productivity has a positive impact on firms' survival in export markets (see, for example, Wagner, 2007; Harris & Li, 2011; Engel et al., 2013; and Hiller et al, 2017). At the same time, only a handful of papers have looked into the role of profitability on firms' decision to exit export markets and the impact is not yet clear. However, both studies conducted by Ilmakunnas and Nurmi, (2010) and Demirhan, (2016) find that firms that are more profitable are less likely to exit export markets.

5.3 Data and preliminary analysis

The data used in this paper is retrieved from the Annual Industrial Survey (AIS), an unbalanced panel of Omani manufacturing plants for the period from 1993 to 2016. Table 5.1 provides summary statistics about the number of plants and the portion of exporters distributed by industries. The sample consists of 10,244 observations, representing 1,030 plants, of which 566 plants never export and 464 plants that are exporting plants. Among the exporters, around 152 plants initially appeared in the dataset as non-exporters, after which they started to export during the study period (export-starters). It is interesting to note that 42 plants (which represent 27.6% of all export-starters in this dataset) only exported in a single year during the study period. This large percentage of single-year exporters is not unique to the Omani manufacturing industry, as has also been observed in other studies such as in Albornoz et al.'s (2012), which centred on Argentina manufacturing exporters, and Li's (2018), which investigated Chinese ceramic and glass exporters. In addition to export-starters, the plants that have been exporting since their first appearance in our dataset have been defined as experienced exporters.

Table 5.1. Number of plants and observations by manufacturing sub-industries

Industry	Non_ex porters	Exporters			All plants
		Experience exporters	export starters	Total exporters	
overall industry	566 55.0% (4960)	312 30.3% (3316)	152 14.8% (1968)	464 45.1% (5284)	1030 100% (10244)
Foods and Beverages	113 52.8% (1003)	72 33.6% (803)	29 13.6% (333)	101 47.2% (1136)	214 100% (2139)
Readymade garments and textiles	3 8.3% (29)	30 83.3% (287)	3 8.3% (35)	33 91.7% (322)	36 100% (351)
Wood products and furniture	52 71.2% (426)	14 19.2% (150)	7 9.6% (98)	21 28.8% (248)	73 100% (674)
Papers and Printing	41 59.4% (455)	12 17.4% (170)	16 23.2% (280)	28 40.6% (450)	69 100% (905)
Refined Petro-Products	12 54.6% (131)	6 27.3% (50)	4 18.2% (57)	10 45.5% (107)	22 100% (238)
Chemicals/chemical products	19 25.3% (164)	41 54.7% (457)	15 20.0% (221)	56 74.7% (678)	75 (842) 100% (842)
Rubber and Plastic	26 36.1% (226)	24 33.3% (268)	22 30.6% (263)	46 63.9% (531)	72 100% (757)
Building and construction products	201 67.9% (1745)	69 23.3% (712)	26 8.8% (315)	95 32.1% (1027)	296 100% (2772)
Metals products	94 62.3% (757)	32 21.2% (282)	25 16.6% (298)	57 37.8% (580)	151 100% (1337)
Machinery and Equipment/ Apparatus	5 22.7% (24)	12 54.6% (137)	5 22.7% (68)	17 77.3% (205)	22 100% (229)

Note: Number of observations are in parentheses.

Over the study period, the exporting volume for the manufacturing industry increases sharply by more than 1000% between 1993 and 2016. Table 5.2 shows that there is a lot of variation in export growth across industries, from -77% for the manufacturing of readymade garments and the textile industry to more than 3000% for the manufacturing of chemicals industry, and the manufacturing of machinery and equipment industry. During the study period, there is a significant change in the export structure of the industries. For example, the share of the manufacturing of the readymade garments and textile industry plunged from 19% in 1993 to 0.3% in 2016. Similarly, the share of the manufacturing of food and beverages industry also dropped sharply from 13.2% in 1993 to 6.7% in 2016. On the contrary, the share of the manufacturing of chemical, metal, and equipment and machinery industries increased by 9.5%, 5.3% and 4.1%, respectively, in 2016 relative to 1993.

Table 5.2. Exports volume by industry (1993-2016)

Industry	Exports (Million OR)		growth %	share %	
	1993	2016	(93-2016)	1993	2016
Foods and Beverages	14	102	615.3	13.2	6.7
Readymade garments and textiles	21	5	-77.4	19.0	0.3
Wood products and furniture	4	24	515.0	3.6	1.6
Papers and Printing	0.3	2	621.9	0.3	0.2
Refined Petro-Products	33	620	1766.2	30.7	40.7
Chemicals/chemical products	9	271	3003.8	8.1	17.8
Rubber and Plastic	1	23	1495.3	1.3	1.5
Building and construction products	7	65	868.6	6.2	4.3
Metals products	17	320	1768.9	15.8	21.0
Machinery and Equipment/Apparatus	2	91	4613.9	1.8	5.9
Overall industry	108	1523	1306.7	100	100

A large number of studies have documented the fact that exporters have different characteristics from those of non-exporters (De Locker, 2007). To examine whether the reported differences between exporters and non-exporters also exist in the Omani manufacturing industry, this study follows Bernard and Jensen, (1999) and De Locker, (2007) and estimates export premium using the following specification:

$$y_{it} = \alpha + \beta \, Export_{it} + \gamma \, l_{it} + \varepsilon_{it} \qquad (1)$$

Where y_{it} represents one of plant i characteristics such as plant average wage per worker, sales per worker and capital per worker, in year t. $Export_{it}$ is a dummy variable taking a value of one if the plant i exports in year t, and zero otherwise. As in the previous literature (Bernard & Jensen, 1999; and De Locker, 2007), we control for plant size (l_{it}) proxies by the number of employees in year t. The time and industry fixed effects are also controlled for. The export coefficient (β) indicates the difference between exporters and non-exporters regarding the selected characteristics.

Table 5.3 reports the export premium. The table indicates that exporters' characteristics are different from those of non-exporters in the Omani manufacturing industry. On average, exporters have higher productivity, profitability and value-added. This study's estimations of export premium show that the results are consistent with the results reported in empirical studies elsewhere (see, for example, Bernard & Jensen, 1995; Van Biesebroeck, 2005; and De Locker, 2007, among others). Almost all of the coefficients in column (1) are highly significant at the 1% significance level. Column (1) indicates that, on average, exporters' labour productivity and sales per labour ratio are higher than non-exporters by 46.2%. The estimated coefficient of (0.191) for log of average wage in column (1) indicates that on average exporters paying higher wages than non-exporters by 19.1 %.

As this paper aims to examine the impact of productivity and profitability on plants' decision to enter the export market, we estimate the export premium using the sub-sample of export-starter plants. This sub-sample consists of all non-exporters and export-starters that export for at least two years and we observe them for at least two consecutive years before they start to export. Column (4) of Table 5.3 shows that, on average, export-starters are also bigger, more productive and profitable, and have higher value-added.

Table 5.3. Estimation results of export premium

	All plants			Export starters		
Plant characteristic	Coefficient (β)	R_square	observ.	Coefficient (β)	R_square	observ.
Value added per worker	0.443*** (0.022)	0.289	9,778	0.406*** (0.054)	0.287	3,023
Labour productivity per worker	0.462*** (0.021)	0.574	9,780	0.428*** (0.049)	0.521	3,025
TFP per worker	0.010*** (0.003)	0.666	9,780	0.040*** (0.008)	0.7137	3,023
Sales per worker	0.462*** (0.021)	0.347	9,780	0.428*** (0.049)	0.335	3,025
Capital per worker	0.568*** (0.029)	0.273	9,780	0.387*** (0.077)	0.251	3,025
Intermediate materials per worker	0.447*** (0.026)	0.286	9,780	0.436*** (0.060)	0.285	3,025
Investments per worker	0.256*** (0.054)	0.132	6,198	0.426*** (0.138)	0.150	1,670
Average wage per worker	0.191*** (0.011)	0.530	9,779	0.128*** (0.027)	0.525	3,025
Profitability per worker	0.001*** (0.0003)	0.231	9,777	0.002** (0.001)	0.247	3,025
Size	0.930*** (0.022)	0.260	9,780	0.851*** (0.057)	0.139	3,025
Age	-0.106*** (0.015)	0.113	9,780	0.019 (0.030)	0.118	3,025

Standard errors in parentheses
All regressions control for plants' size, year and two digits industry fixed effects
*** p<0.01, ** p<0.05, * p<0.1

5.4 The Empirical Models

In this chapter, we use the productivity and profitability estimated in previous chapters. Plants' productivity is estimated as the residual of a production function using the Levinoshn and Petrin (LP) (2003) approach. The details of the estimation technique used in this study are described in chapter 3. To measure plants' profitability, we use return on sales ratio (ROS). This indicator has been used in several papers in the economics and management fields such as those by Bottazzi et al. (2008); Fryges and Wagner, (2010); Yu et al. (2017); and Van den B. et al. (2018). The ratio is calculated using the following equation:

$$ROS_{it} = \frac{Value\ added_{it} - \ wages_{it} - \ other\ production\ taxes_{it} + subsidies_{it}}{total\ sales_{it}}$$

5.4.1 Estimation of exports impact on productivity and profitability

Table 5.3 shows that exporters are larger, and have higher labour productivity, but it does not tell us whether the performance (productivity or profitability) of export starters is better than the performance of non-exporters before the former enter export markets or whether plants' performance improved after they start exporting. Accordingly, in the next subsection, we test the self-selection hypothesis and the learning by exporting hypothesis in the Omani manufacturing industry.

To examine whether high performance (productivity and profitability) plants self-select into the export markets, we estimate the probability to start exporting using the following probit model:

$$\Pr(\, f_{export_{it}} = 1) = \Phi\{(TFP_{i,t-1}, ROS_{i,t-1}, k_{i,t-1}, size_{i,t-1}, age_{i,t-1}, import_{i,t-1}, foreign_{i,t-1}, innovation_{i,t-1}, sector, year)\} \qquad (2)$$

where f_export_{it} is a dummy variable taking a value of one, when plant *i* starts to export in year *t* for the first time in our dataset, and zero otherwise; $\Phi(.)$ is the normal distribution function, $TFP, ROS, and\ k$ are plant i productivity, profitability, and capital, respectively; $size$ is plant i size proxies by the number of employees, age is plant i age, $import$ is a dummy variable taking a value of one if plant i import in year *t,* and zero otherwise; $foreign$ is a dummy variable taking a value of one if plant i has a foreign capital participation, and zero otherwise; $innovation$ is a dummy variable taking a value of one if plant i spends in R&D in year *t,* and zero otherwise. In addition, we add a full set of year and sector dummies to control for the time and sector-specific effects, respectively.

The sample excludes experience exporters (plants that are exporting since their first appearance in our dataset), as we do not observe their characteristics before they start exporting. The sample consists of all export-starters that export for at least two years and we observe them for at least two consecutive years before they start to export. Further, once the export-starter plant starts exporting, it leaves the sample from year *t + 1* onwards. Following the literature, the sample also excludes the highest and the lowest percentile (Wagner, 2012).

Turning to the investigation of whether there is learning by exporting in the Omani manufacturing industry, we follow De Locker, (2007) by creating a control and treatment groups based on the propensity score matching techniques, first suggested by Rosenbaum and Rubin in 1983 and improved by Heckman et al. (1998). The average effect of export entry on plant's productivity and profitability is defined using the following:

$$E\{y_{is}^{1} - y_{is}^{0} \backslash f\_export_i = 1\} = E\{y_{is}^{1} \backslash f\_export_i = 1\} - E\{y_{is}^{0} \backslash f\_export_i = 1\} \quad (3)$$

where the first part of Eq. (3) is plant i level of performance (productivity or profitability) after it starts exporting, while the second part is the level of performance it had if not opted to export. However, the second part is not observable, so we need to identify a set of control non-exporters that have similar observable characteristics to those of export-starters, and then match the two groups (export-starters and non-exporters) using the propensity of score matching. This method of matching combines all observable information from a set of variables that might have an impact on the plant's decision to start exporting. It assumes that the potential outcomes (plant productivity or profitability) are independent from the treatment (exporting) decision, which is conditional on a given set of observed covariates (X) (Caliendo & Kopeinig, 2008). This assumption implies that the difference between export-starters and the proposed non-exporters control group can be captured by a set of observable characteristics (De Locker, 2007).

We select the covariates based on our findings of the self-selection hypothesis test and the documented factors in the literature that might affect firms' decision to start exporting (see for example, Bausch & Krist, 2007; and De Locker, 2007). Thus, plants with the same covariates are expected to have a similar or very close probability to start exporting and then plants are matched based on their probability to start exporting. The used characteristics include one-year lag of productivity (TFP), profitability (ROS), age, size, capital (k), and foreign capital participation.

Following Girma et al., (2004) and De Locker, (2007) we match within each 2-digit NACE sector. The matching process starts by estimating, for each plant, the probability to start exporting (which is the propensity score) using model (2).

Having estimated the propensity of score, we select and construct counterfactual by matching non-exporting plant j to an export-starter plant *i,* based on the estimated propensity score (p_i) using the radius matching approach. Following the literature, to increase the quality of matching and to reduce the risk of choosing bad control, we impose the common support and calliper conditions. The first condition implies that the observable characteristics of the export-starter and control non-exporters are similar and plants with the same observed covariates (X) have the possibility of being both export-starters or non-exporters (Bryson et al., 2002; and Caliendr & Kopeinig, 2008). The second condition restricts the selection of the control plants from non-exporters, whose propensity scores lie within the range of the set selected calliper (Caliendr & Kopeinig, 2008).

Thus, as we construct counterfactual, we estimate the learning by exporting effect using a difference-in-difference (DID) approach by calculating the Average effect of Treatment on the Treated (ATT) as follow:

$$ATT_s = \frac{1}{N_s} \sum_i (y_{is}^1 - \sum_{j \in C(i)} w_{ij} y_{js}^c) \quad (4)$$

where N_s is the number of export-starter plants in period *s*, (y_{is}^1) is the estimated productivity (or profitability) of an export-starter i in period s (treated plant). $(\sum_{j \in C(i)} w_{ij} y_{js}^c)$ is the weighted average of the estimated productivity (or profitability) of the non-exporters (control group) that are matched to the export-starter plant i. We consider period s=0 for plant *i* when it starts to export and we match it with non-exporter from the same year and sector.[12]

5.4.2 Plant's export market exit decision

Finally, to examine the role of productivity and profitability on plants' decision to exit export markets, we estimate the probability to exit from export markets using the following regression model as follow:

$$\Pr(x_{export_{it}} = 1) = \Phi\{(TFP_{i,t-1}, ROS_{i,t-1}, size_{i,t-1}, age_{i,t-1}, foreign_{i,t-1}, research_{i,t-1}, sector, year)\} \quad (5)$$

where x_export_{it} is a dummy variable taking a value of one if plant *i* exits the export market in year *t,* and zero otherwise.

[12] The matching approach is carried out using a written Stata *psmatch2* command developed by Leuven and Sianesi, (2003) with bootstrapped base on 400 replications.

5.5 Empirical Results

5.5.1 Does an exporter self-select into export markets?

Table 5.4 presents the marginal effects for the probit regression model (2) controlling for different sets of fixed effects. The estimation results suggest that plants' productivity and plant s' capital have a positive and significant impact on plants' decision to enter the export markets, while profitability has a negative effect.

The estimated coefficient of productivity is positive and significant in all columns. This suggests that export-starters are more productive than their counterparts before they start exporting. Specifically, the estimated coefficient of (0.013) associated with productivity in column (5) indicates that an increase of plant productivity by one percentage increases the probability of starting to export by around 1.3 percentage point. This result indicates that more productive plants are more likely to start exporting. This finding is in line with Melitz's (2003) self-selection theory and with other empirical findings such as Bernard and Jensen (1995) and Aw et al. (2011).

Column (5) also shows that more profitable plants are less likely to enter the export markets. The estimated coefficient of negative (0.042) suggests that an increase in plant profitability by one percentage reduces the probability to start exporting by around 4.2% points. This finding is similar to the reported findings by Temouri et al. (2013) and Demirhan, (2016). This negative impact of profitability on a plant's decision to export may be explained by the market-specific condition. For example, it could be the case that high profits plants have fixed-price long-term supply contracts with the government and/or domestic industrial clients. These long-term relationships help plants to meet their profit target easily, without joining international markets. The negative coefficient may also reflect the fact that high profits plants are risk-averse, and as they are uncertain about their foreign market demand, high-profit plants prefer not to engage in the exporting markets.

Table 5.4. Estimation results for export market entry decision

dependent variable: first_export_show	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TFP_{t-1}	0.005**	0.010**	0.006**		0.013***	0.012***	0.014**
	(0.002)	(0.004)	(0.003)		(0.004)	(0.005)	(0.006)
ROS_{t-1}	-0.017	-0.034*		-0.009	-0.042**	-0.041*	
	(0.011)	(0.018)		(0.013)	(0.021)	(0.023)	
$lnage_{t-1}$	-0.003	-0.001	0.000	-0.001	-0.001	-0.001	-0.002
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)	(0.005)
$lnemp_{t-1}$	0.002	0.004	0.002	0.003	-0.001	-0.001	-0.003
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)
$lncapital_{t-1}$	0.004**	0.003	0.003*	0.004*	0.004**	0.004*	0.005**
	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)
$import_{t-1}$						0.002	0.002
						(0.004)	(0.004)
$innovation_{t-1}$						0.007	0.007
						(0.025)	(0.021)
$foreign_{t-1}$						0.004	0.004
						(0.004)	(0.005)
$lnmarkup_{t-1}$							-0.012*
							(0.007)
Year FE		Yes					
Sector FE		Yes					
Year - Sector FE			Yes	Yes	Yes	Yes	Yes
Observations	2,567	2,567	2,567	2,567	2,567	2,567	2,567
Pseudo R2	0.0548	0.2713	0.4617	0.4517	0.4865	0.4905	0.4783

Bootstrapped robust standard errors adjusted for clusters in plants in parentheses

*** p<0.01, ** p<0.05, * p<0.1

It is possible that productivity picks up the effects of other omitted variables. International literature documents that importing input from foreign markets gives firms the opportunity to use high quality input to improve their productivity, which increases the probability to start exporting (Wagner, 2012). Further, the literature documents other factors such as innovation (Aw et al., 2011; and Wagner, 2016), and foreign capital participation (Alvarez & López, 2005; and Dickstein & Morales, 2018) as possibly also having a positive and significant impact on firms' decision to start exporting. In column (6) we check the robustness of our results when controlling for these confounding factors. The estimated coefficient associated with import, innovation and foreign capital participation variables are all positive but not significant. Our findings that high productive and less profitable plants are more likely to enter the export markets remain unchanged.

Further, in column (7) we use plants' markups instead of ROS as a proxy for plants' profitability. We estimate markups for each plant by following De Loecker and Warzynski's (2012) approach[13]. The estimated coefficient associated with the markups in column (7) is also negative and significant, thus confirming our previous results that profitability negatively affected plants' decision to start exporting. The finding that productivity has a positive and significant impact on plants' decision to start exporting remains unchanged.

In addition, in order to check the robustness of our findings, we estimate model (2) using the fixed effects estimator (FE). Table 5.5 displays the results. Similar to the probit regression results, the estimated coefficient associated with productivity is positive and significant in all specifications, while the estimated coefficient of the profitability is negative in both proxies (ROS and markups), but significant in the case of ROS only.

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[13]The methodology assumes that $\mu_{it} = \frac{\theta_{it}^X}{\alpha_{it}^X}$, where $\mu_{it}$is firm *i* mark up at period *t*, θ_{it}^X is the output elasticity of input X_{it}, and α_{it}^X is the share of expenditure on input X_{it} in value-added. For θ_{it}^X we use the estimated labour parameter from our production function estimation in table 3.2 in chapter three. α_{it}^X is defined as a plant's total compensation over its value-added in period *t*.

Table 5.5. Estimation results for export market entry decision using fixed effects model

dependent variable: first_export_show	(1)	(2)	(3)	(4)	(5)	(6)	(7)
TFP_{t-1}	0.007	0.009	0.002***		0.015**	0.016**	0.011*
	(0.007)	(0.008)	(0.001)		(0.006)	(0.006)	(0.007)
ROS_{t-1}	-0.027	-0.033		-0.011*	-0.050**	-0.050**	
	(0.026)	(0.027)		(0.006)	(0.023)	(0.022)	
$lnage_{t-1}$	0.026***	0.012	0.024**	0.023**	0.021**	0.020***	0.022***
	(0.008)	(0.019)	(0.009)	(0.009)	(0.008)	(0.007)	(0.008)
$lnemp_{t-1}$	0.011*	0.010	0.010***	0.010***	0.010***	0.010***	0.010***
	(0.006)	(0.006)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
$lncapital_{t-1}$	0.003	0.003	0.002	0.002	0.004	0.004	0.003
	(0.006)	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.007)
$import_{t-1}$						-0.009***	-0.009***
						(0.001)	(0.002)
$innovation_{t-1}$						0.018	0.019
						(0.018)	(0.018)
$lnmarkup_{t-1}$							-0.009
							(0.007)
Year FE		Yes					
Sector FE		Yes					
Year - Sector FE			Yes	Yes	Yes	Yes	Yes
Observations	2,567	2,567	2,567	2,567	2,567	2,567	2,567
R-squared	0.010	0.030	0.179	0.180	0.182	0.183	0.181

Bootstrapped robust standard errors adjusted for clusters in plants in parentheses

*** p<0.01, ** p<0.05, * p=<0.1

Overall, similar to other countries, it is clear from the preceding results that for the

Omani manufacturing industry more productive plants self-select into export markets, and their entry to export markets is based on plants' productivity rather than profitability.

5.5.2 Detecting the learning effect from exporting

In this section, we study the impact of exporting on plants' productivity and profitability. Table 5.6 shows the estimation results of the radius matching using 0.05 callipers. The table reports the effects of exporting on plants' performance over a period of 5 years, starting at period s=0 (where s=0 is when the export-starter plant starts its exporting activities). Panel A and B of table 5.6 display the impact on TFP and labour productivity at every period *s*, whereas panels C and D report the impacts on our two measures of profitability, respectively. Panel A shows that, on average, the impact of exporting on plants' productivity is positive. In the first and fourth period (s=0 & 3), the impact of exporting on productivity is positive and significant. On average the productivity level of export-starters is higher by 36.6% than their matched non-exporters counterparts once they enter foreign markets. This finding is in line with the argument that export-starters faced with higher competitive and advanced technological markets are forced to increase their resource utilisation and productivity (Damijan & Kostevc, 2006). Our findings are consistent with the findings of other studies such as Van Biesebroeck, (2005); De Locker, (2007); Green and Kneller, (2008) among others. Panel B confirms the fact that exporting has a positive and significant impact on labour productivity during all of the periods.

On the contrary, panels C and D show that the estimated impact of exporting on profitability is not significant throughout any of the periods for both ROS and markups. This implies that there is no evidence for the impact of exporting on the profitability of export-starters. This result is in line with the findings of Kox and Rojas-Romagosa, (2010) and Temouri et al. (2013).

Table 5.6. Estimation of learning by exporting effects on productivity and profitability

S	0	1	2	3	4
(a) productivity (TFP)					
ATT	0.366**	0.148	0.229	0.389**	0.085
	(0.151)	(0.177)	(0.251)	(0.163)	(0.244)
(b) labour productivity					
ATT	0.380***	0.304**	0.323***	0.450***	0.414**
	(0.124)	(0.121)	(0.114)	(0.133)	(0.175)
(c) profitability (ROS)					
ATT	-0.004	-0.008	0.061	0.044	-0.001
	(0.029)	(0.034)	(0.042)	(0.041)	(0.057)
(d) markup					
ATT	0.225	0.108	0.313	1.274	0.334
	(0.312)	(0.318)	(0.367)	(0.837)	(0.420)
Number of controls	1974	1628	1375	1154	981
Number of treated (on support)	75	62	54	47	45
Number of treated (off support)	40	37	37	31	32
Total number of treated	115	99	91	78	77

Note: The table reports the estimated ATT for plants that start exporting in period s=0 based on radius matching using 0.05 calliper and common support options.
Bootstrapped standard errors in parentheses.
Asterisks denote significance levels: *** p<0.01, ** p<0.05, * p≤0.1

To check and evaluate the quality of the propensity score matching approach, we use the covariate-balancing test. Table 5.7 shows that the matching approach successfully matches between the treatment and control groups, as there are no significant differences between the mean of both groups in all of the covariates.

Table 5.7. Balancing test for matching approach

Variable	Sample	Mean			%reduct	t-test		V(T)/
		Treated	Control	%bias	|bias|	t	p>|t|	V(C)
TFP_{t-1}	Unmatched	6.00	5.74	19.40		2.37	0.02	1.89*
	Matched	6.04	5.83	15.10	22.10	1.04	0.30	1.26
ROS_{t-1}	Unmatched	0.28	0.24	14.50		1.56	0.12	1.15
	Matched	0.29	0.27	8.50	41.30	0.52	0.60	0.80
$lncapital_{t-1}$	Unmatched	12.86	11.65	71.20		7.89	0.00	1.29
	Matched	12.39	12.12	15.50	78.20	1.11	0.27	1.17
$lnage_{t-1}$	Unmatched	2.26	2.65	-55.70		-6.23	0.00	1.35
	Matched	2.47	2.53	-8.90	84.00	-0.54	0.59	0.76
$lnemp_{t-1}$	Unmatched	3.63	3.19	45.50		5.14	0.00	1.39
	Matched	3.55	3.33	22.90	49.60	1.46	0.15	0.95
$foreign_{t-1}$	Unmatched	0.38	0.15	53.10		6.43	0.00	.
	Matched	0.27	0.23	7.50	86.00	0.45	0.65	

5.5.3 Exit from the export market

Now we turn to the investigation of the impact of plants' productivity and profitability on plant's decision to stop exporting in the Oman manufacturing industry. Table 5.8 illustrates the marginal effect of the probit regression model results with different sets of fixed effects. In columns (1-3), we regress plant exit from the export markets on plant productivity, profitability, age, size and capital. In column (4) we extend our specifications by adding plant ownership and innovation.

In all of the specifications with fixed effects, the estimated coefficient of productivity is negative and significant. This implies that low productivity plants are more likely to exit export markets. More specifically, the estimated coefficient of negative (0.015) in column (3) implies, as expected, the survival rate in the export markets is higher for more productive plants by 1.5 percentage points. This finding is consistent with the evidence reported in other empirical works such as Wagner, (2007); Harris and Li, (2011); Engel et al. (2013); and Hiller et al. (2017).

The estimated coefficient associated with the profitability is positive and insignificant in column (3). Our result contrasts with Ilmakunnas and Nurmi's, (2010) findings for Finnish manufacturing firms and Demirhan's, (2016) findings for Turkish manufacturing firms, as both studies report that profitability has a positive impact on firms' survival in the international markets. Although the estimated coefficient is insignificant, it is somewhat surprising as it implies that highly profitable plants are more likely to exit export markets. Two possible explanations might explain our results. First, the profits generated by exporting plants from the local market (as local market profits increase the probability to exit from export markets also increases). However, because of data limitations, it is very difficult to isolate the profits generated from the two markets. Our data does not provide the level of detail required, such as quantity, prices, quality and the allocation of inputs expenditure between sales in local and foreign markets. Second, as competition in the export market is harsher than domestic markets, exporters are forced to increase their productivity in order to survive in foreign markets. So, if plants are unable to quickly cope with competition pressure by enhancing their productivity, they will not be able to survive in the international markets. We hope that this can be investigated in future research.

Table 5.8. Estimation results for exit from the export market

Dependent variable: exit_export	(1)	(2)	(3)	(4)	(5)
TFP_{t-1}	-0.005	-0.016***	-0.015***	-0.013**	-0.016*
	(0.003)	(0.006)	(0.005)	(0.005)	(0.009)
ROS_{t-1}	0.003	0.029	0.028	0.023	
	(0.018)	(0.022)	(0.021)	(0.0222)	
$lnage_{t-1}$	0.000	0.005	0.003	0.0004	0.0001
	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
$lnemp_{t-1}$	-0.001	-0.016***	-0.018***	-0.017***	-0.016***
	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)
$lncapital_{t-1}$	-0.012***	-0.003	-0.002	-0.001	-0.002
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
$foreign_{t-1}$				-0.016**	-0.016**
				(0.008)	(0.008)
$innovation_{t-1}$				-0.007	-0.007
				(0.015)	(0.021)
$lnmarkup_{t-1}$					0.008
					(0.009)
Year FE	No	Yes			
Sector FE	No	Yes			
Year-sector FE	No		Yes	Yes	Yes
Observations	3450	3450	3450	3450	3450
Pseudo R2	0.0251	0.1465	0.2783	0.2819	0.2816

Bootstrapped robust standard errors adjusted for clusters in plants in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Similar to export market entry, the literature identifies several factors such as foreign capital participation (Harris & Li, 2011) and innovation that might affect firms' decision to stop exporting. To check that our results are not driven by these factors, we control for these variables. Column (4) displays the results. The estimated coefficient associated with foreign capital participation is negative and significant. This finding is in line with the argument that foreign firms are more likely to survive in international markets, as they have the comparative advantage of better management practices and international network connections. Our findings are consistent with other findings such as Harris and Li (2011), among others. The estimated coefficient of innovation is negative but not significant. Our findings that highly productive plants are more likely to survive in export markets remain unchanged.

In column (5) we run the model using plants' mark up as a proxy for profitability instead of return on sales. Our result that high productivity plants are less likely to exit export markets remain unchanged. Similar to the estimated coefficient associated with ROS, the markup coefficient is positive and insignificant.

In Table 5.9, we run model (5) using the fixed-effects model (FE) to control for omitted unobserved plants' fixed effects. The FE results are in line with our probit model findings. The estimated coefficient of productivity is negative and significant, while the estimated coefficients of profitability are positive and insignificant when we use return on sales (ROS) and highly significant when markups as a proxy for profitability are used.

Table 5.9. Estimation results for exit from the export market using fixed effects model

Dependent variable: exit_export	(1)	(2)	(3)	(4)	(5)
TFP_{t-1}	-0.014	-0.014	-0.017**	-0.017**	-0.033***
	(0.010)	(0.010)	(0.008)	(0.008)	(0.013)
ROS_{t-1}	0.039	0.027	0.0314	0.031	
	(0.029)	(0.027)	(0.039)	(0.033)	
$lnage_{t-1}$	0.135***	0.096***	0.092***	0.092***	0.092***
	(0.016)	(0.022)	(0.020)	(0.019)	(0.026)
$lnemp_{t-1}$	-0.030**	-0.039***	-0.042***	-0.042***	-0.038***
	(0.014)	(0.013)	(0.014)	(0.016)	(0.014)
$lncapital_{t-1}$	-0.009	-0.007	-0.009	-0.009	-0.014***
	(0.010)	(0.010)	(0.010)	(0.007)	(0.005)
$foreign_{t-1}$					
$innovation_{t-1}$				-0.020*	-0.021**
				(0.011)	(0.010)
$lnmarkup_{t-1}$					0.026***
					(0.009)
Year FE	No	Yes	Yes	Yes	Yes
Sector FE	No	Yes	Yes	Yes	Yes
Year-sector FE	No	Yes	Yes	Yes	Yes
Observations	3450	3450	3450	3450	3450
R2	0.049	0.072	0.169	0.169	0.170

Bootstrapped robust standard errors adjusted for clusters in plants in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Then we turn to examine whether the survival rate in export markets differs between export-starters and experience-exporters. Table 5.10 reports the results. The first two columns show the marginal effects using the probit model. The coefficient associated with the export-starter dummy variable is nearly zero and not significant. However, when we use the OLS model controlling for plant-specific fixed effects in columns (3 and 4), the estimated coefficient in both specifications is positive and significant. This indicates that the probability of export-starters exiting export markets is higher than for experience-exporters. This finding is consistent with the sequential exporting model developed by Albornoz et al. (2012), which is based on the existence of uncertainty regarding the performance of export-starters in foreign markets and by time. This uncertainty is resolved as exporters' knowledge about foreign markets enhanced. However, our finding contradicts with that of Li (2018), as he reports that experienced exporters are more likely to cease exporting.

Table 5.10. Estimation results for exit from the export market

	probit		OLS	
Dependent variable: exit_export	1	2	3	4
$export - starter_i$	0.0005	0.0004	0.349***	0.404***
	(0.008)	(0.008)	(0.102)	(0.111)
TFP_{t-1}	-0.014***	-0.017**	-0.017*	-0.033*
	(0.005)	(0.008)	(0.011)	(0.017)
ROS_{t-1}	0.025		0.031	
	(0.021)		(0.035)	
$lnmarkup_{t-1}$		0.009		0.026
		(0.009)		(0.016)
Year FE	Yes	Yes	Yes	Yes
Sector FE	Yes	Yes	Yes	Yes
Year-sector FE	Yes	Yes	Yes	Yes
Plant FE			Yes	Yes
Observations	3450	3450	3450	3450
Pseudo R2 / R-squared	0.2826	0.2824	0.3724	0.373

Robust standard errors adjusted for clusters in plants in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
In all specifications we control for plants age, size, ownership, innovation and the number of years plants engage in exporting activities

5.6 Robustness checks

5.6.1 Self-selection

To further check the robustness of our results regarding the positive (negative) impact of productivity (profitability) on plants' decision to start exporting, we consider outliers and single-year exporters (plants that engage in exporting activities only one time during the study period) in our regressions, provided that we observe them before they start exporting for at least two years. Table 5.11 reports the marginal effects using the probit regressions model. Column (1) shows the estimation results when we consider both outliers and single-year exporters, while in column (2) we exclude single-year exporters. In both regressions, the estimated results confirm our findings of positive (negative) and significant impact of productivity (profitability) on plants' decision to enter export markets.

Table 5.11. Estimation results for export market entry decision when the outliers and single-year exporters are included in the regression

Dependent variable: first_export_show	(1)	(2)
TFP_{t-1}	0.010**	0.012***
	(0.004)	(0.004)
ROS_{t-1}	-0.033*	-0.043***
	(0.019)	(0.016)
$lnage_{t-1}$	-0.005	-0.003
	(0.004)	(0.004)
$lnemp_{t-1}$	0.003	0.000
	(0.003)	(0.004)
$lncapital_{t-1}$	0.004**	0.004
	(0.002)	(0.002)
$import_{t-1}$	0.002	0.003
	(0.003)	(0.004)
$innovation_{t-1}$	0.015	0.007
	(0.014)	(0.031)
$foreign_{t-1}$	0.002	0.003
	(0.005)	(0.005)
Year-sector FE	Yes	Yes
Observations	2,900	2,761
Pseudo R2	0.3957	0.4826

Bootstrapped robust standard errors adjusted for clusters in plants in parentheses.
*** p<0.01, ** p<0.05, * p<0.1
In column 1 the outliers and single-year exporters are included in the regressions.
In column 2 the outliers are included in the regression however, single-year exporters are not.

From the results with different specifications in Tables 5.4, 5.5 and 5.11, the robust results reveal that export-starters in the Omani manufacturing industry are more productive and less profitable before they enter export markets.

5.6.2 Learning by Exporting

To conduct further checks regarding the sensitivity and robustness of our findings, in terms of the impact of exporting on productivity and profitability, we estimate the impact of exporting on plants' performance using different ranges for a calliper (0.1 and 0.01) adopting radius and kernel matching methods. In the appendix, Table C1 reports the results of the radius matching method with 0.1 calliper and common support condition. We do not report all findings of other callipers for space reasons, however they are available and can be shared upon request. All of the results confirm those in Table 5.6.

Further, we estimate the impact of exporting on plants' performance using different subsamples. Tables 5.12 and 5.13 display the results when we only consider plants that we observe for at least three and five consecutive years upon their entrance to the export markets, respectively. The results of both tables confirm the positive and significant impact of exporting on productivity.

Table 5.12. Estimation of learning by exporting effects on productivity and profitability using radius matching with 0.05 calliper for plants we observe for at least three consecutive years after they start to export

S	0	1	2	3
(a) productivity (TFP)				
ATT	0.333*	0.160	0.0933	0.436**
	(0.182)	(0.272)	(0.295)	(0.173)
(b) labour productivity				
ATT	0.544***	0.424***	0.389***	0.543***
	(0.150)	(0.138)	(0.122)	(0.132)
(c) profitability (ROS)				
ATT	0.009	0.030	0.023	0.041
	(0.044)	(0.054)	(0.042)	(0.042)
(d) markup				
ATT	0.389	0.326	0.389***	0.543***
	(0.545)	(0.445)	(0.134)	(0.143)
Number of controls	972	972	972	972
Number of treated (on support)	37	37	37	37
Number of treated (off support)	30	30	30	30
Total number of treated	67	67	67	67

Note: The table reports the estimated ATT for plants that start exporting in period s=0 based on radius matching using 0.05 calliper and common support options.
Bootstrapped standard errors in parentheses.
Asterisks denote significance levels: *** p<0.01, ** p<0.05, * p≤0.1

Table 5.13. Estimation of learning by exporting effects on productivity and profitability using radius matching with 0.05 calliper for plants we observe for at least five consecutive years after they start to export

S	0	1	2	3	4
(a) productivity (TFP)					
ATT	0.279	0.161	0.200	0.508**	0.323
	(0.219)	(0.314)	(0.387)	(0.217)	(0.246)
(b) labour productivity					
ATT	0.489***	0.450***	0.414***	0.583***	0.508**
	(0.181)	(0.156)	(0.145)	(0.163)	(0.201)
(c) profitability (ROS)					
ATT	-0.016	0.028	0.039	0.066	0.021
	(0.051)	(0.061)	(0.053)	(0.052)	(0.055)
(d) markup					
ATT	0.195	0.460	0.492	0.646	0.697
	(0.617)	(0.467)	(0.487)	(0.558)	(0.563)
Number of controls	629	629	629	629	629
Number of treated (on support)	30	30	30	30	30
Number of treated (off support)	20	20	20	20	20
Total number of treated	50	50	50	50	50

Note: The table reports the estimated ATT for plants that start exporting in period s=0 based on radius matching using 0.05 calliper and common support options.
Bootstrapped standard errors in parentheses.
Asterisks denote significance levels: *** p<0.01, ** p<0.05, * p≤0.1

5.6.3 Export market exit decision

To check the robustness of our findings on the impact of productivity and profitability on plants' decision to stop exporting, we include single-year exporters in our estimation. The results are reported in Table 5.14, which confirms the positive impact of productivity on plants' survival in exporting markets.

Table 5.14. Estimation results for exit from the export market when we include single-year exporters

	probit		FE	
Dependent variable: exit_export	1	2	1	2
TFP_{t-1}	-0.017***	-0.022**	-0.016**	-0.031*
	(0.006)	(0.009)	(0.008)	(0.018)
ROS_{t-1}	0.039*		0.036	
	(0.023)		(0.033)	
$lnmarkup_{t-1}$		0.015		0.025
		(0.009)		(0.018)
$lnage_{t-1}$	0.0002	-0.0002	0.094***	0.094***
	(0.006)	(0.006)	(0.014)	(0.016)
$lnemp_{t-1}$	-0.018***	-0.015**	-0.040***	-0.036**
	(0.006)	(0.006)	(0.014)	(0.015)
$lncapital_{t-1}$	-0.002	-0.004	-0.002	-0.007
	(0.004)	(0.004)	(0.009)	(0.011)
$foreign_{t-1}$	-0.005	-0.005	-	-
	(0.015)	(0.016)		
$innovation_{t-1}$	-0.014*	-0.014*	-0.015	-0.017**
	(0.008)	(0.008)	(0.011)	(0.008)
Year-sector FE	Yes	Yes	Yes	Yes
Observations	3,673	3,673	3,673	3,673
Pseudo R2 / R-squared	0.2622	0.2619	0.167	0.167

Bootstrapped robust standard errors adjusted for clusters in plants in parentheses
*** p<0.01, ** p<0.05, * p<0.1

5.7 Conclusion

This chapter uses for the first time a very unique plant-level data from Oman to examine the impact of exports on manufacturing plants' productivity and profitability over the period 1993-2016. Specifically, this paper investigates i) whether more productive and more profitable plants self-select into export markets; ii) whether the performance of export-starters improves after their entry into foreign markets; and iii) whether productivity and profitability can explain their decision to exit the export market.

After controlling for plant size, age, capital, and ownership, as well as controlling for time and sector fixed effects, this paper finds that plants that are more productive are more likely to enter foreign markets and less likely to stop exporting. However, less profitable plants are more likely to start exporting, although there is no evidence regarding the effect of profitability on plants' decision to cease exporting activities. Moreover, our findings indicate that export-starters' productivity improves once they start to export, although there is no evidence regarding the impact of exporting activities on plants' profitability.

Given that the Omani government is working to increase the contribution of the manufacturing industry to the overall GDP, several policy implementations can be drawn from the findings of this paper. First, our findings reveal that highly productive plants self-select into the export market, so the government should formulate policies that encourage plants to enhance their productivity by upgrading their technology. The government should support these activities by, for example, subsidising innovative projects. Second, the government should review competition laws to promote competition in the manufacturing industry, which will, in turn, force plants to enhance their productivity and consequently increase their overall aggregate productivity. Third, as our findings show that productivity of export-starters improved upon their entry to the international market, policies should be directed to encourage plants to enter export markets. For example, government should propose policies to reduce exporting barriers and to cover exporting costs.

Chapter 6 Conclusion

This thesis looks at productivity dynamics and the role of productivity and profitability on market survival and entry and exit on export markets in the context of a resource based economy, which in this case involved using unique plant-level panel data from the Omani manufacturing industry for the first time. Our findings provide an original contribution to the existing literature on firms' performance, international trade, innovation, market dynamic selection and natural resources economies. Furthermore, while the relationship between productivity and innovation, export activities and market selection has been largely investigated, the number of studies that have looked at the relationship between profitability and exporting, innovation and market selection is scant and covers a limited number of countries. This thesis contributes to the literature to fill in this gap.

In this thesis, several aspects about the Omani manufacturing industry are analysed and documented. Firstly, this thesis finds that certain plant characteristics can help to understand the heterogeneity in plants' productivity and profitability[14]. In particular, consistent with other empirical findings, a plant's size and ownership is found to help in explaining the differences in plant performance in the Omani manufacturing industry. It also finds that larger plants and those with foreign capital participation are more productive and profitable than smaller and domestic plants. It also finds that plants that undertake exports and innovation activities are more productive and profitable than plants that do not do.

Secondly, the results from the decomposition of aggregate productivity growth show that resource reallocation between surviving plants is the main driver for aggregate productivity growth in the Omani manufacturing industry[15]. This indicates that highly productive plants expand and less productive ones exit, and that resources shift from less productive to more highly productive plants. Furthermore, the average

[14] This is discussed in chapter three.
[15] This is discussed in chapter four.

productivity of entering plants is less than the average productivity of the surviving ones, which, in turn, drags down the aggregate productivity growth of the manufacturing industry. In addition, it also finds that internal productivity of surviving plants dropped during the period 1993-2015, which suggests the need for some policy interventions.

Thirdly, this thesis finds evidence that market dynamic selection in the Omani manufacturing industry is dominated by productivity[16]. When regressing both productivity and profitability in a separate specification, it also finds that both productivity and profitability positively affected plants' survival. However, when including both simultaneously in one specification, the impact of productivity remains unchanged, but profitability becomes insignificant. Further, it also finds that innovative plants are less likely to exit the market.

Fourthly, the results from the export market entry decision show that the productivity of export-starters are higher than the productivity of non-exporters, when the former enter the international markets[17]. This is in line with Melitz's (2003) self-selection theory. On the contrary, it also finds that high-profit plants opt out of the export markets. Moreover, there is evidence to support the argument that export-starters face highly competitive and advanced technological markets that forced them to increase their resource utilisation and productivity. The results suggest that the productivity of the export-starters improve once they start exporting, yet there was no evidence regarding the impact of export activities on plants' profitability. It also finds that plants that are more productive are more likely to survive in the export market, however, there is no evidence regarding the impact of profitability on plants' decisions to exit the export market.

Since productivity growth plays an important role in economic growth long-term, and as the Omani government is currently working to enhance the contribution of the

[16] This is discussed in chapter four.
[17] This is discussed in chapter five.

manufacturing industry to GDP, several policy implications arise from the findings of this thesis. Firstly, the findings of this study show that innovative plants are more productive than non-innovative ones. Consequently, it would be advisable for the government to formulate polices to encourage plants to undertake innovative activities, in order to enhance their productivity, by subsidising innovation projects, upgrading technology or transferring technology, providing R&D tax credits and training their workforce. This is because improving plants' internal productivity leads to an increase in the contribution of the within component of surviving plants, which, in turn, increases the aggregate productivity growth of the overall manufacturing industry.

Secondly, as this thesis finds that exporters are more productive, highly productive plants' self-select into the export markets, and the productivity of export-starters improves upon their entry to the international market, thus policies should be directed to encourage plants to enter export markets. These policies could include measures such as reducing export barriers, subsidising exporting costs, the organisation of international marketing campaign, and encouraging and facilitating mergers and acquisitions between small and less productive plants, ensuring they will be larger and more highly productive.

Finally, the findings of this study show that resource reallocation between plants is the main driver for aggregate productivity growth in the Omani manufacturing industry, thus the Omani government should review competition laws, deregulate them if necessary, and reduce entry barriers, in order to promote competition in the manufacturing industry. This will force plants to enhance their productivity to survive, thus leading to highly productive plants growing, while less productive ones will be forced to exit the market. In turn, resources will be moved from less productive plants to more highly productive ones, which will increase the aggregate productivity growth.

This thesis provides, for the first time, evidence on the determinants of productivity and profitability and their effects on exports and market dynamic selection in the Omani manufacturing industry using plant-level panel dataset. However, the thesis has several limitations that need to be considered when interpreting the findings. Firstly, this thesis uses data from the annual industrial survey, which does not cover small plants (that have less than 10 employees) and plants that are operating in free zones. Therefore, the number of entering and exiting plants may not reflect the actual number in the industry.

Secondly, this thesis takes the first step in estimating plants' productivity in the Omani manufacturing industry and examines the relationship between plants' performance and exports and innovation. However, although the importance of quantity-based productivity is acknowledged, it cannot be estimated because the dataset used in this study does not contain reliable data on quantity and prices. Therefore, an interesting area for future research would be to use quantity-based productivity.

Thirdly, due to data limitations this research uses proxies for innovation and exports. Thus, it would be fruitful for future research to take into account other measures such as innovation sales or patents and the amount of quantity exports, prices and destinations.

In spite of these limitations, most of the findings of this thesis are in line with theoretical models and empirical findings in different countries (see for example, Baily et al., 1992; Bartelsman & Doms, 2000; Syverson, 2011; Wagner, 2012; and Harris & Moffat, 2019). In addition, it is hoped that this thesis lays down the foundation for future studies in Oman and other GCC countries.

Furthermore, several other interesting areas of future research can be identified using the findings of this thesis. For example, this thesis shows that high profit plants are less (more) likely to enter (exit) export markets, so investigating the reasons behind that requires further exploration. Additionally, this thesis examines the impact of productivity and profitability on plants' decision to exit the markets, however, it does not investigate their role on plant growth. Thus, it would be interesting for future work to examine the impact of productivity and profitability on plants' growth in terms of output and job creation. Another area for future study to examine is whether there are any conflicts between policies that aim to improve plant productivity and policies that aim to create more jobs in the market. Finally, these findings show the negative contribution made by the between component, which might indicate the existence of misallocation of resources in some industries. Thus, investigating the factors behind that is another area for future research.

Appendix A to Chapter 3

Table A.1 Production function coefficients when using different deflators

parameter	OLS			FE		
	CPI	PPI	WHI	CPI	PPI	WHI
α_L	0.8772***	0.8772***	0.8772***	0.4523***	0.4523***	0.4523***
	(0.0333)	(0.0333)	(0.0333)	(0.0968)	(0.0968)	(0.0968)
α_K	0.3634***	0.3634***	0.3634***	0.1221	0.1221	0.1221
	(0.0201)	(0.0201)	(0.0201)	(0.0784)	(0.0784)	(0.0784)
Number of observations	1735	1735	1735	1735	1735	1735
R square	70.93%	74.82%	70.95%	66.79%	62.14%	66.69%

CPI is consumer price index, PPI is producer price index, and WHI is wholesale price index.

Table A.2 Production function output coefficients from the regression using OLS & FE

industry	α_L	α_K	R square	α_L	α_K	R square	Number of observation	Returns to scale OLS	Returns to scale FE
Overall industry	0.948***	0.281***	73.58%	0.769***	0.172***	21.14%	10143	1.229	0.941
	(0.013)	(0.008)		(0.023)	(0.017)				
Food and Beverage	0.941***	0.342***	76.80%	0.772***	0.086**	25.78%	2125	1.283	0.858
	(0.028)	(0.018)		(0.049)	(0.041)				
Ready made Garments and Textiles	0.954***	0.130***	61.80%	0.688***	0.475***	31.21%	348	1.084	1.163
	(0.069)	(0.047)		(0.126)	(0.110)				
Wood products and furnitures	1.037***	0.143***	79.40%	0.593***	0.166***		674	1.18	0.759
	(0.040)	(0.025)		(0.084)	(0.063)	24.52%			
Papers and Printing	1.011***	0.228***	73.70%	0.844***	0.155***		865	1.239	0.999
	(0.042)	(0.029)		(0.069)	(0.051)				
Refined Petro-Products	1.007***	0.456***	90.70%	0.694***	0.188**	38.07%	233	1.463	0.882
	(0.101)	(0.051)		(0.129)	(0.092)				
Chemicals/chemical products	0.777***	0.364***	62.90%	0.595***	0.203***	20.68%	832	1.141	0.798
	(0.053)	(0.029)		(0.100)	(0.065)				
Ruber and Plastic	0.953***	0.290***	61.50%	0.899***	0.172***	31.61%	755	1.243	1.071
	(0.051)	(0.039)		(0.091)	(0.061)				
Building and construction products	0.937***	0.263***	67.10%	0.781***	0.247***	26.99%	2759	1.2	1.028
	(0.026)	(0.014)		(0.043)	(0.032)				
Metals products	0.969***	0.231***	80.30%	0.752***	0.079*	24.56%	1323	1.2	0.831
	(0.033)	(0.021)		(0.063)	(0.042)				
Machinery and Equipment/Apparatus	0.826***	0.206***	70.00%	0.813***	0.160	46.15%	229	1.032	0.973
	(0.103)	(0.057)		(0.196)	(0.116)				

* significance at 10% , ** significance at 5% , *** significance at 1%

Appendix B to Chapter 4

Table B.1a Average transition matrix of plants productivity level over the period 1993-2000

Quintile in 1993	Quintile in 2000					
	1	2	3	4	5	Exit
1	0.23	0.20	0.09	0.10	0.04	0.34
	0.20	0.16	0.07	0.08	0.04	0.05
2	0.16	0.19	0.14	0.14	0.02	0.35
	0.11	0.13	0.09	0.09	0.01	0.04
3	0.07	0.16	0.26	0.21	0.10	0.21
	0.04	0.10	0.15	0.12	0.09	0.02
4	0.09	0.11	0.23	0.21	0.16	0.20
	0.05	0.06	0.13	0.12	0.13	0.02
5	0.01	0.11	0.14	0.22	0.38	0.14
	0.01	0.08	0.10	0.16	0.40	0.02
new entry	0.08	0.06	0.06	0.06	0.03	0.71
	0.59	0.47	0.45	0.42	0.33	0.86

Notes: lowest productivity plants are in quintile 1 while highest productivity plants in their sectors are in quintile 5.
Exit refers to plants that are not active in the market in 2000 but active before that.
New entry refers to plants that first appear in our dataset after in 1993.

Table B.1b Average transition matrix of plants productivity level over the period 2000-2005

Quintile in 2000	Quintile in 2005					
	1	2	3	4	5	Exit
1	0.30	0.06	0.04	0.08	0.02	0.50
	0.30	0.09	0.04	0.07	0.02	0.08
2	0.19	0.14	0.14	0.07	0.08	0.38
	0.19	0.22	0.14	0.08	0.09	0.06
3	0.10	0.10	0.27	0.19	0.12	0.22
	0.11	0.17	0.28	0.20	0.14	0.04
4	0.08	0.04	0.17	0.23	0.14	0.34
	0.09	0.07	0.18	0.23	0.16	0.05
5	0.03	0.03	0.04	0.16	0.44	0.30
	0.02	0.03	0.03	0.12	0.36	0.03
new entry	0.05	0.04	0.05	0.05	0.03	0.77
	0.29	0.42	0.33	0.30	0.23	0.74

Table B.1c Average transition matrix of plants productivity level over the period 2005-2010

Quintile in 2005	Quintile in 2010					
	1	2	3	4	5	Exit
1	0.31	0.15	0.11	0.03	0.04	0.60
	0.25	0.18	0.10	0.03	0.04	0.07
2	0.22	0.15	0.19	0.07	0.14	0.24
	0.11	0.12	0.11	0.04	0.08	0.03
3	0.13	0.14	0.21	0.20	0.12	0.20
	0.10	0.17	0.19	0.20	0.10	0.04
4	0.06	0.02	0.18	0.36	0.20	0.18
	0.05	0.03	0.16	0.35	0.17	0.03
5	0.01	0.07	0.09	0.16	0.54	0.13
	0.01	0.08	0.08	0.15	0.43	0.02
new entry	0.10	0.05	0.06	0.04	0.03	0.72
	0.49	0.42	0.36	0.23	0.18	0.82

Table B.1d Average transition matrix of plants productivity level over the period 2010-2015

Quintile in 2010	Quintile in 2015					
	1	2	3	4	5	Exit
1	0.14	0.21	0.08	0.08	0.11	0.38
	0.20	0.21	0.11	0.10	0.14	0.08
2	0.16	0.16	0.12	0.08	0.03	0.46
	0.15	0.10	0.10	0.07	0.02	0.06
3	0.07	0.19	0.18	0.14	0.10	0.32
	0.09	0.16	0.20	0.16	0.11	0.06
4	0.04	0.06	0.22	0.19	0.15	0.34
	0.05	0.05	0.23	0.20	0.15	0.06
5	0.04	0.06	0.05	0.21	0.22	0.42
	0.05	0.06	0.05	0.25	0.26	0.09
new entry	0.07	0.10	0.05	0.04	0.05	0.69
	0.46	0.42	0.31	0.22	0.32	0.65

Table B.2a Average transition matrix of plants profitability over the period 1993-2000

Quintile in 1993	Quintile in 2000					
	1	2	3	4	5	Exit
1	0.11	0.16	0.16	0.14	0.09	0.34
	0.08	0.12	0.10	0.09	0.08	0.04
2	0.14	0.19	0.14	0.14	0.08	0.31
	0.10	0.14	0.09	0.09	0.06	0.03
3	0.19	0.10	0.10	0.23	0.16	0.23
	0.14	0.07	0.06	0.14	0.13	0.02
4	0.07	0.08	0.24	0.30	0.13	0.18
	0.06	0.06	0.15	0.20	0.11	0.02
5	0.10	0.13	0.14	0.20	0.24	0.19
	0.08	0.11	0.10	0.14	0.22	0.02
new entry	0.07	0.06	0.08	0.05	0.05	0.70
	0.54	0.49	0.51	0.34	0.51	0.86

Notes: lowest profitability plants are in quintile 1 while highest profitability plants in their sectors are in quintile 5.
Exit refers to plants that are not active in the market in 2000 but active before that.
New entry refers to plants that first appear in our dataset after in 1993.

Table B.2b Average transition matrix of plants profitability over the period 2000-2005

Quintile in 2000	Quintile in 2005					
	1	2	3	4	5	Exit
1	0.17	0.12	0.11	0.12	0.05	0.44
	0.19	0.11	0.11	0.11	0.05	0.06
2	0.14	0.21	0.15	0.08	0.05	0.37
	0.16	0.19	0.14	0.07	0.05	0.05
3	0.11	0.19	0.15	0.15	0.06	0.34
	0.14	0.22	0.19	0.17	0.08	0.06
4	0.15	0.06	0.22	0.22	0.13	0.22
	0.19	0.07	0.26	0.23	0.16	0.04
5	0.06	0.08	0.09	0.10	0.29	0.38
	0.06	0.07	0.08	0.08	0.29	0.05
new entry	0.04	0.05	0.03	0.06	0.05	0.77
	0.26	0.34	0.22	0.34	0.37	0.74

Table B.2c Average transition matrix of plants profitability over the period 2005-2010

Quintile in 2005	Quintile in 2010					
	1	2	3	4	5	Exit
1	0.19	0.13	0.14	0.10	0.10	0.34
	0.15	0.16	0.12	0.08	0.06	0.05
2	0.21	0.14	0.19	0.17	0.08	0.21
	0.20	0.21	0.18	0.14	0.05	0.04
3	0.05	0.10	0.20	0.30	0.20	0.15
	0.04	0.13	0.18	0.24	0.12	0.02
4	0.15	0.06	0.13	0.22	0.25	0.20
	0.14	0.10	0.13	0.20	0.17	0.04
5	0.06	0.03	0.08	0.15	0.47	0.22
	0.05	0.03	0.06	0.11	0.26	0.03
new entry	0.07	0.04	0.05	0.04	0.09	0.72
	0.41	0.37	0.32	0.23	0.36	0.82

Table B.2d Average transition matrix of plants profitability over the period 2010-2015

Quintile in 2010	Quintile in 2015					
	1	2	3	4	5	Exit
1	0.20	0.10	0.17	0.06	0.15	0.32
	0.16	0.09	0.18	0.10	0.17	0.06
2	0.11	0.23	0.10	0.06	0.06	0.44
	0.06	0.12	0.07	0.07	0.04	0.05
3	0.18	0.29	0.07	0.08	0.10	0.28
	0.14	0.23	0.08	0.12	0.10	0.05
4	0.13	0.11	0.18	0.11	0.09	0.38
	0.12	0.09	0.21	0.20	0.10	0.07
5	0.10	0.13	0.13	0.08	0.09	0.47
	0.13	0.16	0.21	0.19	0.14	0.12
new entry	0.09	0.07	0.04	0.03	0.08	0.69
	0.39	0.31	0.26	0.32	0.44	0.65

Appendix C to Chapter 5

Table C.1 Estimation of learning by exporting effects on productivity and profitability using radius matching with 0.1 calliper for the whole sample

S	0	1	2	3	4
(a) productivity (TFP)					
ATT	0.277**	0.148	0.140	0.341**	0.164
	(0.119)	(0.144)	(0.207)	(0.147)	(0.204)
(b) labour productivity					
ATT	0.337***	0.269***	0.262**	0.356**	0.392***
	(0.105)	(0.0998)	(0.110)	(0.139)	(0.152)
(c) profitability (ROS)					
ATT	0.001	0.004	0.052	0.029	0.025
	(0.028)	(0.033)	(0.037)	(0.035)	(0.038)
Number of controls	1974	1628	1375	1154	981
Number of treated (on support)	75	62	54	47	45
Number of treated (off support)	40	37	37	31	32
Total number of treated	115	99	91	78	77

Note: The table reports the estimated ATT for plants that start exporting in period s=0 based on radius matching using 0.1 calliper and common support options.
Bootstrapped standard errors in parentheses.
Asterisks denote significance levels : *** p<0.01, ** p<0.05, * p≤0.1

References

Ackerberg, D., Benkard, L., Berry, S., & Pakes. A. (2007). Econometric Tools for Analyzing Market Outcomes. *in Handbook of Econometrics*, 6A, 4171-4276.

Albornoz, F., Calvo-Pardo, H., Corcos, G., & Ornelas, E. (2012). Sequential Exporting. *Journal of International Economics*, 88(1), 17–31.

Altuzarra, A., Bustillo, R., & Rodríguez, C. (2016). Understanding export market success: Evidence from manufacturing firms. *Open Economies Review, 27*(1), 161–181.

Alvarez, R. & A.López, R. (2005). Exporting and Performance: Evidence from Chilean Plants. *Canadian Journal of Economics,* 38(4), 1384–1400.

Amendola, A., Ferragina, A., Pittiglio, R., & Reganati, F. (2012). Are exporters and multinational firms more resilient over a crisis? First evidence for manufacturing enterprises in Italy. *Economics Bulletin*, 32(3), 1914–1926.

Amendolagine, Vito, Capolupo, Rosa, & Petragallo, Nadia. (2010). Export Status and Performance in a Panel of Italian Manufacturing Firms. Università degli Studi Bari Dipartomento di Scienze Economiche S.E.R.I.E.S, Working Paper No. 27.

Arnold, J. M., & Hussinger, K. (2005). Export Behavior and Firm Productivity in German Manufacturing: A Firm-Level Analysis. *Review of World Economics*, 141(2), 219–243.

Arrow, K. (1962). The Economic Implications of Learning by Doing. *The Review of Economic Studies*, 29(3), 155-173.

Atkin, D., Khandelwal, A., & Osman, A. (2017). Exporting and firm performance: Evidence from a randomized experiment. *Quarterly Journal of Economics,* 132(2), 551-614.

Aw, B. Y., Chan, X., & Robert, M. J. (1997). Plant-level Evidence on Productivity Differentials, Turnover, and Exports in Taiwanese Manufacturing. *The Pennsylvania State University*, mimeo.

Aw, B., Chung, S., & Roberts, M. (2000). Productivity and Turnover in the Export Market: Micro-Level Evidence from the Republic of Korea and Taiwan (China). *The World Bank Economic Review*, 14(1), 65-90.

Aw, B. Y., Roberts, M. J., & Xu, D. Y. (2011). R&D Investment, Exporting, and Productivity Dynamics. *American Economic Review*, 101(4), 1312–44.

Baer, Werner, (1972). Import Substitution and Industrialization in Latin America: Experiences and Interpretations. *Latin American Research Review*. 7(1), 95-122.

Baily, M., Hulten, C., Campbell, D., Bresnahan, T., & Caves, R. (1992). Productivity Dynamics in Manufacturing Plants. *Brookings Papers on Economic Activity. Microeconomics*, 1992, 187-267.

Baldwin, J. R., & Gu, W. (2011). Firm dynamics and productivity growth: a comparison of the retail trade and manufacturing sectors. *Industrial and Corporate Change*, 20(2), 367-395.

Baldwin, J., & Yan, B. (2011). The death of Canadian manufacturing plants: Heterogeneous responses to changes in tariffs and real exchange rates. *Review of World Economics,* 147(1), 131-167.

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

Bartelsman, E., Haltiwanger, J., & Scarpetta, S. (2013). Cross-Country Differences in Productivity: The Role of Allocation and Selection. *The American Economic Review*, 103(1), 305-334.

Bausch, A., & Krist, M. (2007). The Effect of Context-Related Moderators on the Internationalization-Performance Relationship: Evidence from Meta-Analysis. *MIR: Management International Review*, 47(3), 319-347.

Becker, S. O., & Ichino, A., (2002). Estimation of average treatment effects based on propensity scores. *STATA Journal,* 2(4), 358–377.

Bellone, F., Musso, P., Quéré, M., & Nesta, L. (2006): Productivity and market selection of French manufacturing firms in the nineties, *Revue De L'OFCE*, 5, 319-349.

Bernard, A., Eaton, J., Jensen, J., & Kortum, S. (2003). Plants and Productivity in International Trade. *The American Economic Review*, 93(4), 1268-1290.

Bernard, A., Jensen, J., & Lawrence, R. (1995). Exporters, Jobs, and Wages in U.S. Manufacturing: 1976-1987. *Brookings Papers on Economic Activity. Microeconomics*, 1995, 67-119.

Bernard, A., Jensen, J. (1999). Exceptional exporter performance: cause, effect, or both? *Journal of International Economics*, 47 (1), 1–26.

Bernard, A., & Wagner, J. (1997). Exports and Success in German Manufacturing. *Weltwirtschaftliches Archiv*, 133(1), 134-157.

Bojnec, S., & Xavier, A. (2004). Entry and Exit in transition Economies: The Slovenian Manufacturing Sector. *Post-Communist Economies*, 16(2), 191-214.

Bottazzi, G., Secchi, A., & Tamagni, F. (2008). Productivity, profitability and financial performance. *Industrial and Corporate Change*, 17(4), 711–751

Brandt, L., Biesebroeck, J., & Zhang, Y. (2012). Creative Accounting or Creative Destruction? Firm-Level Productivity Growth in Chinese Manufacturing. *Journal of Development Economics*, 97(2), 339-351

Bryson, A., Dorsett R., & Purdon S. (2002). The Use of Propensity Score Matching in the Evaluation of Labour Market Policies. *LSE Research Online Documents on Economics*, London School of Economics and Political Science, LSE Library.

Cable, J., & Schwalbach, J. (1991). International Comparisons of Entry and Exit, *in Geroski, P., & Schwalbach, J. (eds), Entry and Market Contestability*. Oxford, Basil Blackwell.

Caliendo, M., & Kopeinig S. (2008). Some Practical Guidance for the Implementation of Propensity Score Matching. *Journal of economic survey*, 22(1), 31-72.

Cassiman, B. & Vanormelingen, S. (2013). Profiting From Innovation: Firm Level Evidence on Markups. *IESE Business School Working Paper.*

Castiglionesi, F. & Ornaghi, C. (2013). On The Determinants Of Total Factor Productivity Growth: Evidence From Spanish Manufacturing Firms. *Macroeconomic Dynamics*, Cambridge University Press, 17(3), 501-530.

Cefis, E., & Marsili, O. (2005). A Matter of Life and Death: Innovation and Firm Survival. *Industrial and Corporate Change*, 14(6), 1167-1192.

Clerides, S., Lach, S., & Tybout, J. (1998). Is Learning by Exporting Important? Micro-Dynamic Evidence from Colombia, Mexico, and Morocco. *The Quarterly Journal of Economics*, 113(3), 903-947.

Collard-Wexler, A., & De Loecker, J. (2015). Reallocation and Technology: Evidence from the US Steel Industry. *The American Economic Review*, 105(1), 131-171.

Damijan, J. P., & Kostevc, C. (2006). Learning-by-exporting: Continuous productivity improvements or capacity utilization effects? Evidence from Slovenian firms. *Review of World Economics*, 142(3), 599–614.

De Loecker, Jan. (2007). Do Exports Generate Higher Productivity? Evidence from Slovenia. *Journal of International Economics*, 73(1): 69–98.

De Loecker J. (2011). Product differentiation, multiproduct firms, and estimating the impact of trade liberalization on productivity. Econometrica, 76(5), 1407-1451.

De Loecker, J., & Warzynski, F. (2012). Markups and Firm-Level Export Status. *The American Economic Review*, 102(6), 2437-2471.

Delmar, F., McKelvie, A., & Wennberg, K. (2013). Untangling the relationships among growth, profitability and survival in new firms. *Technovation*, 33(8-9): 276-291.

Demirhan, A. A. (2016). To Be Exporter or not to Be Exporter? Entry-Exit Dynamics of Turkish Manufacturing Firms. *Empirical Economics*, 51(1), 181-200.

Dickstein, M., & Morales, E. (2018). What Do Exporters Know?" *The Quarterly Journal of Economics*, 133(4), 1753–1801.

Ding, S., Guariglia, A., & Harris, R. (2016). The determinants of productivity in Chinese large and medium-sized industrial firms, 1998–2007. *Journal of Productivity Analysis*, 45(2), 131-155.

Disney, R., Haskel, J., & Heden, Y. (2003). Entry, Exit and Establishment Survival in UK Manufacturing. *The Journal of Industrial Economics*, 51(1), 91-112.

Doi, N. (1999). The Determinants of Firm Exit in Japanese Manufacturing Industries. *Small Business Economics*, 13(4), 331-337.

Dosi, G., Pugliese, & E., Santoleri, P. (2017). Growth and Survival of the 'fitter'? Evidence from US new-born firms. *LEM Working Paper Series*

Du, J., Liu, X., & Zhou, Y. (2014). State advances and private retreats? Evidence of aggregate productivity decomposition in China. *China Economic Review*, 31, 459-474.

Dumont, M. (2011). Working Paper 11-11 - A decomposition of industry-level productivity growth in Belgium using firm-level data. Working Papers 1111, *Federal Planning Bureau*, Belgium.

Dunne, T., Klimek, S., Schmitz, J. A. Jr. (2009). Does foreign competition spur productivity? Evidence from post WWII U.S. cement manufacturing. Working Paper, *Fed. Reserve Bank Minneapolis.*

Engel, D., Procher, V., & Schmidt, C. M. (2013). Does Firm Heterogeneity Affect Foreign Market Entry and Exit Symmetrically? Empirical Evidence for French Firms. *Journal of Economic Behavior & Organization*, 85, 35–47.

Eslava, M., Haltiwanger, J., & Kugler, M. (2006). Plant Turnover and Structural Reforms in Colombia. *IMF Econ Rev,* 53, 58–75.

Fackler, D., Schnabel, C., & Wagner, J. (2013). Establishment Exits in Germany: The Role of Size and Age. *Small Business Economics*, 41, 683-700.

Forlani, E., Martin, R., Mion, G., & Muls, M. (2016). Unravelling Firms: Demand, productivity and markups heterogeneity. *CESifo Working Paper Series*, 5725, CESifo Group Munich.

Foster, L., Haltiwanger, J. & Krizan, C.J. (2001). Aggregate Productivity Growth: Lessons from Microeconomic Evidence. *NBER Chapters, in: New Developments in Productivity Analysis*, 303-372.

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

Foster, L., Haltiwanger, J., & Syverson, C. (2016). The Slow Growth of New Plants: Learning About Demand. *Economica*, 83(329), 91–129.

Fouskas, P., & Robindon, C. (2019). Should I Stay or Should I Go? Firm Heterogeneity in the Post-crisis Period. *Manchester School*, University of Manchester, 87(3), 367-402.

Fox, J., & Smeets, V. (2011). Does Input Quality Drive Measured Differences in Firm Productivity? *International Economic Review*, 52(4), 961-989.

Fryges, H., & Wagner, J. (2010). Exports and profitability: First evidence for German manufacturing firms. *The World Economy*, 33(3), 399-423

Garcia, A., & Voigtländer, N. (2019). Exporting and Plant-Level Efficiency Gains: It's in the Measure. *Journal of Political Economy*, 127(4), 1777-1825

Geroski, P., Machin, S., & Van Reenen, J. (1993). The Profitability of Innovating Firms. The *RAND Journal of Economics*, 24(2), 198-211.

Geroski, P., & Schwalbach, J. (1991). Entry and Market Contestability: An International Comparison. *Basil Blackwell*, Cambridge, MA.

Girma, S., Greenaway, A., & Kneller, R. (2004). Does exporting lead to better performance? A microeconometric analysis of matched firms. *Review of International Economics*, 12(5).

Grazzi, M. (2012). Export and firm performance: Evidence on productivity and profitability of Italian companies. *Journal of Industry, Competition and Trade,* 12 (4), 413–444.

Greenaway, D., Gullstrand, J., & Kneller, R. (2005). Exporting May Not Always Boost Firm Productivity. *Review of World Economics*, 141(4), 561-582.

Greenaway, D., Gullstrand, J., & Kneller, R. (2008). Surviving globalization. *Journal of International Economics*, 74 (2), 264-277

Greenaway, D., & Kneller, R. (2007a). Firm Heterogeneity, Exporting and Foreign Direct Investment. *The Economic Journal*, 117(517), F134-F161.

Greenaway, D., & Kneller, R. (2007b). Industry Differences in the Effect of Export Market Entry: Learning by Exporting? *Review of World Economics*, 143(3), 416-432.

Griffith, R., Huergo, E., Mairesse, J., & Peters, B. (2006). Innovation and productivity in four European countries. *Oxford Review of Economic Policy,* 22(4), 483-498.

Griliches, Z., & Mairesse, J. (1995). Production functions: The search for identification. *NBER Working Paper,* 5067, National Bureau of Economic Research, Inc.

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

Hall, B. (1987). The Relationship Between Firm Size and Firm Growth in the US Manufacturing Sector. *The Journal of Industrial Economics*, 35(4), 583-606.

Hall, B. (2011). Innovation and productivity. *NBER, Working Paper Series*, 17178, National Bureau of Economic Research.

Harris, R., & Li, Q. (2011). The Determinants of Firm Exit from Exporting: Evidence for the UK. *International Journal of the Economics of Business*, 18(3), 381–397

Harris, R., & Moffat, J. (2015). Plant-level determinants of total factor productivity in Great Britain, 1997-2008. *Journal of Productivity Analysis*, 44(1), 1-20.

Harris, R., & Moffat, J. (2019). The decline of British manufacturing, 1973–2012: the role of total factor productivity. *National Institute Economic Review*, 247(1), R19–R31.

Heckman, J., Ichimura, H., & Todd, P. (1998). Matching as an Econometric Evaluation Estimator. *The Review of Economic Studies*, 65(2), 261-294.

Hiller, S., Schröder, P., & Sørensen, A. (2017). Export Market Exit and Firm Survival: Theory and First Evidence. *Globalization*, 183–205.

Holger, G., & Marina-Eliza, S. (2009). Financial health, exports, and firm survival: A comparison of British and French Firms. *Kiel Working Papers*, 1568, Kiel Institute for the World Economy (IfW).

Holmes, T., & Schmitz, J. (2001). Competition at work: railroads vs. monopoly in U.S. shipping industry. Quarterly Review, 25(2), 3-29.

Holmes, T., & Schmitz, J. (2010). Competition and Productivity: A Review of Evidence. *Annual Review of Economics*, 2, 619-642.

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

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

Hymer, S. (1976). The International Operation of National Firms: A Study of Direct Foreign Investment. *MIT Press*, Cambridge, MA, United States.

Ilmakunnas, P., Maliranta, M., & Vainiomäki, J. (2004). The role of employer and employee characteristics for plant productivity. *Journal of Productivity Analysis*, 21(3), 249–276.

Ilmakunnas, P., & Nurmi, S. (2010). Dynamics of Export Market Entry and Exit. *The Scandinavian Journal of Economics*, 112(1), 101-126.

Jovanovic, B. (1982). Selection and the Evolution of Industry. *Econometrica*, 50(3), 649-670.

Katayama, H., Lu, S., & Tybout J. (2009). Firm-Level Productivity Studies: Illusions and a Solution. *International Journal of Industrial Organization*, 27(3), 403–413.

Konings, J., Van Cayseele, P., & Warzynski, F. (2005). The Effects of Privatization and Competitive Pressure on Firms' Price-Cost Margins: Micro Evidence from Emerging Economies. *The Review of Economics and Statistics*, 87(1), 124-134.

Kox, H., & Rojas-Romagosa, H. (2010). Exports and productivity selection effects for Dutch firms. *De Economist*, 158 (3), 295-322.

Leiponen, A. (2000). Competencies, innovation and profitability of firms. *Journal of Economics of Innovation and New Technology,* 9(1). 1–24.

Levinsohn, J., & Petrin, A. (2003). Estimating Production Functions Using Inputs to Control for Unobservables. *The Review of Economic Studies*, 70(2), 317-341.

Leuven, E., & Sianesi, B. (2018). PSMATCH2: Stata Module to Perform Full Mahalanobis and Propensity Score Matching, Common Support Graphing, and Covariate Imbalance Testing,

Li, S. (2018). A structural model of productivity, uncertain demand, and export dynamics. *Journal of International Economics*, 115, 1-15.

Mathew, N. (2017). Drivers of Firm Growth: Micro-evidence from Indian Manufacturing. *Journal of Evolutionary Economics*, 27 (3), 585-611.

MCI, (2015). Development of the Manufacturing Industries of Oman Preparing for the Future. *Oman Ministry of Commerce and Industry.*

Melitz, M. (2003). The Impact of Trade on Intra-Industry Reallocations and Aggregate Industry Productivity. *Econometrica*, 71(6), 1695-1725.

Melitz, M., & Polanec, S. (2015). Dynamic Olley-Pakes productivity decomposition with entry and exit. *The RAND Journal of Economics*, 46(2), 362-375.

Mion, G., & Zhu, L. (2013). Import Competition From and Offshoring to China: A Curse or a Blessing for Firms? *Journal of International Economics,* 89 (1), 202–215.

Mollisi, V., & Rovigatti, G. (2017). Theory and Practice of TFP Estimation: The Control Function Approach Using Stata. *CEIS Working Paper*, 399, Tor Vergata University.

Mukim, M. (2011). Does exporting increase productivity? Evidence from India. *Working paper, London School of Economics.*

Namini, E. J., Facchini, G., & L´opez, R. A. (2013). Export growth and firm survival. *Economics Letters,* 120(3), 481–486.

NCSI, (2017). Statistical Year Book, *Oman National Centre for Statistics and Information*.

Nyström, K. (2007). Patterns and Determinants of Entry and Exit in Industrial Sectors in Sweden. *Journal of International Entrepreneurship,* 5 (3-4), 85-110.

Olley, G., & Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Equipment Industry. *Econometrica,* 64(6), 1263-1297.

Pavcnik, N. (2002). Trade Liberalization, Exit, and Productivity Improvements: Evidence from Chilean Plants. *The Review of Economic Studies*, 69(1), 245-276.

Petrin, A., & Levinsohn, J. (2012). Measuring aggregate productivity growth using plant-level data. *The RAND Journal of Economics*, 43(4), 705-725.

Roberts, M., & Tybout, J. (1997). The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs. *The American Economic Review*, 87(4), 545-564.

Schmitz, J. (2005). What Determines Productivity? Lessons from the Dramatic Recovery of the U.S. and Canadian Iron Ore Industries following Their Early 1980s Crisis. *Journal of Political Economy*, 113(3), 582–625.

Sharma, C., & Mishra, R. (2012). Export Participation and Productivity Performance of Firms in the Indian Transport Manufacturing. *Journal of Manufacturing Technology Management,* 23 (3), 351–369.

Sianesi, Barbara (2001). Implementing propensity score matching estimators with Stata, available at http://fmwww.bc.edu/RePEc/usug2001/psmatch.pdf

Sonmez, A. (2013). Firm entry, survival and exit. *Academic Journal of Interdisciplinary Studies*, 2(9), 160-167.

Syverson, C. (2004). Market Structure and Productivity: A Concrete Example. *Journal of Political Economy*, 112(6), 1181-1222.

Syverson, C. (2011). What Determines Productivity? *Journal of Economic Literature*, 49(2), 326-365.

Tang, J., & Wang, W. (2004). Sources of Aggregate Labour Productivity Growth in Canada and the United States. *The Canadian Journal of Economics,* 37(2), 421-444.

Temouri, Y., Vogel, A., & Wagner, J. (2013). Self-selection into export markets by business services firms—Evidence from France, Germany and the United Kingdom. *Structural Change and Economic Dynamics*, 25, 146-158.

Van Beveren, I. (2007). Footloose Multinationals in Belgium? *Review of World Economics* / Weltwirtschaftliches Archiv, 143(3), 483-507.

Van Beveren, I. (2010) Total factor productivity estimation: A practical review. *Journal of Economic Surveys*, 26(1).

Van Biesebroeck, J. (2005). Exporting raises productivity in sub-Saharan African manufacturing firms. *Journal of International Economics*, 67(2), 373-391.

Van den Berg, M., Van Marrewijk, C., Tamminen, S. (2018). Trade, productivity and profitability: On profit levels and profit margins. *The World Economy*, 41(8), 2149-2174.

Wagner, J. (2007). Exports and Productivity: A Survey of the Evidence from Firm-level Data. *The World Economy*, 30(1), 60-82.

Wagner, J. (2012). International trade and firm performance: A survey of empirical studies since 2006. *Review of World Economics*, 148(2), 235-267.

Wagner, J. (2013). Exports, imports and firm survival: First evidence for manufacturing enterprises in Germany. *Review of World Economics*, 149(1), 113-130.

Wagner, J. (2016). A survey of empirical studies using transaction level data on exports and imports. *Review of World Economics*, 152, 215–225.

Winter, S. G., Kaniovski, Y. M., & Dosi, G. (2003). A baseline model of industry evolution. *Journal of Evolutionary Economics*, 13(4), 355–383.

Yu, X., Dosi, G., Grazzi, M., & Lei, J. (2017). Inside the virtuous circle between productivity, profitability, investment and corporate growth: An anatomy of Chinese industrialization. *Research Policy*, 46(5), 1020-1038.

Zingales, L., (1998). Survival of the fittest or the fattest? Exit and financing in the trucking industry. *Journal of Finance*, 53(3), 905 – 938.