Lund university
Department of economics
NEKP01
Supervisor: Olof Ejermo
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Firm dynamics & productivity growth

Evidence from Sweden

Author:
Fredrik Dunér

Abstract

The process of firms entering and exiting the market has since Schumpeter's introduction of the concept of creative destruction been a subject of interest for economists aiming to determine what drives economic growth. However, limited availability of data has long been a hindrance to such ambitions and it is not until recent decades that empirical studies on the role of firm dynamics for economic development have become possible. This paper examines the relationship between firm dynamics and productivity growth in Sweden. The analysis is performed using panel data on individual Swedish firms across eight different regions for the period 2008-2017 by fitting a production function where firm value added is assumed to be dependent on, amongst other factors, one of three separate measures of firm dynamics. The findings of the study are at odds with those from most previous research. Rather than predicting that firm dynamics has a short-term negative impact on productivity growth followed by a long-term positive one the empirical results indicate that the opposite is true for the period in question.

Keywords: Firm dynamics, productivity growth, panel data

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1 Introduction

”Capitalism, then, is by nature a form or method of economic change and not only never is but never can be stationary… The fundamental impulse that sets and keeps the capitalist engine in motion comes from the new consumers’ goods, the new methods of production or transportation, the new markets, the new form of industrial organization that capitalist enterprises creates” (Schumpeter, 1943, p 82-83)

First coined by Joseph Schumpeter, the concept of creative destruction has become an important piece of the puzzle used to describe how the composition of economies change and evolve. Using the idea that progress and growth stems from the constant reallocation of production factors as a starting point the rate at which new firms enter the market and incumbent firms exit has become a field of increased study. Economic theory suggests that the process of new firms entering the market bring about new products as well as technologies that help increase overall productivity. Additionally, the implied competition of potential new entrants puts pressure on incumbent firms either to improve their own means of production or file for bankruptcy in the face of diminishing or non-existent profit margins. As such, the promotion of small businesses and start-up companies has become an increasingly popular measure when attempting to boost economic performance (Johnson, 2005).

However, empirical works suggest that the impact of entrepreneurship has differed markedly during the past decades (Carre and Thurik, 2008). In a study of Germany firm dynamics were found to have had a positive impact on productivity in the 1990s but not during the previous decade, suggesting that the effect is not universal (Audretsch and Fritsch, 2003). Increasing availability of data has also allowed studies to compare how the effect of entrepreneurship differs between industries, showing even more disparities both within and between countries (Nyström, 2007). Moreover, when changing firm compositions have been shown to have a significant impact on economic performance there is evidence to suggest that the effect is not altogether positive (Bosma and Nieuwenhuijsen, 2002). Instead there appears to be a period of time during which new products and business practises are adapted to consumer preferences. As such, knowledge of the link between firm dynamics and productivity and how it evolves is of great importance to further the understanding of how to best design policies that foster growth.

The purpose of this paper is to extend the knowledge of how entrepreneurship affects productivity growth. This is done by employing a panel dataset of individual Swedish firms separated by industry as well as region of business for the period 2008-2017. The model used is based on a traditional Cobb-Douglas production function where the impact of the technology available is assumed to be dependent on, amongst other factors, firm dynamics. In an attempt to determine differences in how the changing composition of firms affects productivity growth for firms identified as either service providers or goods producers the model is estimated separately using firm entry, exit or a composite measure of firm turbulence as one of the independent variables. Using a panel data set and identifying firms by the region in which they are active allows controlling for how business legislation and business culture is interpreted across different regions. The study benefits from the ever increasing availability of data, allowing for a more comprehensive analysis than before. Focusing on a timespan yet to have been the subject of extensive study the empirical results are at odds with those of previous research, raising questions regarding the long-term viability of Swedish start-up firms and their role as contributors to productivity growth.

The following two research questions are formulated in an effort to narrow the scope of the paper, where the first refers to the causal relationship as suggested by economic theory and the second refers to the channels through which the causal relationship is observed:

Does firm dynamics affect productivity growth in Swedish firms?
How does firm dynamics affect productivity growth in Swedish firms?

The paper is organized as follows. Chapter two will present a survey of previous research, highlighting some of the different strands of research in the field. Chapter three will go in depth showing the theoretical framework underpinning the analysis. Chapter four will introduce important definitions along with the variables used in the empirical analysis. In chapter five the econometric approach is discussed, the model of estimation is introduced and the empirical results are discussed. Finally, chapter six provides a conclusion of the results and their interpretation in relation to the research questions.

2 Literature review

Ever since the concept of creative destruction was introduced by Schumpeterian economic theory economists have been interested in and tried to determine the impact of competition on economic growth. However, it is only relatively recently that researchers have focused on the potential impact of new firms entering the market and old ones exiting it, previously focusing heavily on the interactions between incumbent firms (Aghion and Howitt, 2009, p. 274).

As in many fields of economics the increased availability of data has been the main driving force, allowing researchers to conduct empirical analyses previously not possible (Andersson, Braunerhjelm and Thulin, 2012, p. 128). Stemming from research done in the 1970s that emphasised new enterprises as an important source for employment growth, and had great policy impacts in the US, the field has developed into different strands with some looking at the determinants of firm dynamics themselves, such as Nyström (2007) who examines the determinants of firm entry and exit for Swedish industrial sectors, while others attempt to determine how entry and exit rates affect economic performance (Fritsch, 2008, p 2). The latter focus has grown in popularity over the years and resulted in multiple papers on different countries with varied results.

In terms of method the field can readily be divided into those studies that employ total factor productivity models (TFP), such as Callejón and Segarra (1999), and those that choose to express economic development in terms of variables such as employment growth or value added and fit some production function, such as (Andersson et al., 2012).

In many of his papers Michael Fritsch examines the link between various aspects of entrepreneurship and job creation in Germany. Perhaps his most important contribution is the evidence of firm dynamics having a staggered impact on employment growth (Fritsch and Mueller, 2004). In a study from 2008, extending on previous findings alongside Pamela Mueller, the effects of new business formation on employment changes are examined for German regions with a special focus on the developments over time. Introducing lagged variables extends the analysis to the short-, medium- and long-term and shows that it follows a wave-like pattern with an initial boost in employment, a subsequent slump followed by a strictly positive effect albeit much less pronounced in rural areas. The authors accredit the negative impact in the mid-term to the crowding out of incumbent firms, creating a short-term vacuum as the market adapts and the markets shares previously held by exiting firms are absorbed by the surviving firms. The long-term positive impact on the other hand is described as being the result of an overall increasing level of competitiveness. These characteristics have been confirmed in similar studies where economic development is expressed as employment growth. One such example is a paper from 2008 by Carree and Thurik that examines the link between firm dynamics and employment using a dataset on country level for 21 OECD members.

Bosma and Nieuwenhuijsen (2002) use a TFP model to determine the impact of a composite measure of firm turbulence, made up by data on both firm entry and exit, on productivity growth for companies in forty different Dutch regions over the period 1988-1996. Distinguishing industries by manufacturing and service providers they find that firm dynamics has a positive impact on the service industry but not in the manufacturing sector and rationalize the results by arguing that big firms serve a greater role in manufacturing, leaving less room for new innovators to drastically change the economic landscape. Introducing lagged variables for firm turbulence they find a similarly delayed positive impact on TFP growth as found by Fritsch and Mueller (2008) for employment growth where the initial effect is negative followed by positive results.

An interesting contribution that stands out in the literature is a paper by Callejón and Segarra (1999) in which the effects of firm entry and exit on TFP growth are examined separately for Spanish manufacturing firms during 1981-1992. They find that while firm exit has a strictly positive and significant effect firm entry starts out as a positive effect before turning negative in subsequent lags, the results in stark contrast to those for studies on similar countries at the time. Offering a possible explanation to this phenomenon they argue that the stress new entrants place on incumbent firms, who are forced to adapt to the new landscape, reduce the scale of production and increases costs. They postulate that it is evidence of excessive entry and that incumbent Spanish firms suffer from insufficient protection from new entrants.

Another feature that has received attention is how the net effect of firm dynamics has changed over time. In a paper from 2004, researchers van Stel and Storey examine the link between firm start-ups and job creation in 60 different British regions through the 1980s and 1990s. While finding no significant impact of firm dynamics during the initial 10-year period the latter half of the dataset reveals a significant and strictly positive effect. The results are curious in the sense that they contradict the predictions made at the time. British government policy was heavily skewed in favour of entrepreneurship and new businesses during the 80s when performance was poor and shifted towards favouring already established employers during the 90s when there is actual evidence of start-ups being the main contributor of new jobs. Similar findings have been shown to be true for Germany during the same period (Audretsch and Fritsch, 2003). Furthermore, there is evidence that suggests the impact of firm dynamics is dependent on the stage of development in which the target economy is situated (van Stel et al, 2005). Using data on 36 different countries the authors examine if entrepreneurship activity influences GDP-growth. Finding that firm dynamics has a negative impact on growth in developing countries they argue that such countries suffer from a lack of larger companies for whom start-ups can act as suppliers. Additionally, they point towards a potentially lacking level of human capital that stifles the contributions of new firms.

3 Theoretical framework

3.1 Direct and indirect effects of firm dynamics

The way in which new firms' impact productivity is often separated into direct and indirect effects. As stated by Fritsch (2008, p. 2), firms that enter the market are ultimately representations of the entry of new production capacities into the market. How these new production capacities develop and end up affecting the economy thus represent the direct effect of firm dynamics. Additionally, new firms entering the market will undoubtedly also force already active firms that face the threat of increased competition to adapt. The way in which incumbent firms end up reacting to the changing landscape in which they turn out to be operating in will be the indirect effect of firm dynamics (Fritsch, 2008, p. 2).

Firms operating in an industry sector compete for an ultimately finite market. Different barriers of entry, such as necessary fixed costs or institutional limitations, in one way or another limit the number of customers any given firm can expect to reach. As such new entrants will hope to claim the market shares of already active firms and the selection effect implied means that inefficient firms or poor performers will be forced out of business. Consequently, it is no surprise that any attempt at starting a new business involves a significant amount of risk-taking and that an overwhelming share of new firms survive only for a few years (Fritsch and Weyh, 2006, p. 253). The way in which to survive and thrive in a cutthroat, evolution of the fittest, business environment is to introduce some product or business practice that improves on those employed by already active businesses, thus improving the overall productivity of all firms in business. This direct effect of firm dynamics is the key aspect of entrepreneurship by which new firms have been accredited the role of being the main contributor to productivity growth (Andersson et al., 2012, p. 126).

The influx of new entrants also induces a competition process in which the possibility of losing market shares or being forced out of business will encourage incumbent firms to innovate themselves, raising the level of productivity amongst those already in business.

Furthermore, any exiting firms will contribute further to overall productivity as resources and means of production are made available to more efficient firms who may be able to make use or improve upon them (Bosma et al., 2011, p. 403) In effect the indirect influence of new firms will help improve the overall productivity of already active producers (Aghion and Howitt, 2012, p. 275-276).

3.2 The Schumpeterian growth model

In a Schumpeterian context, as opposed to endogenous growth models, it is readily shown how firm dynamics have positive impacts on productivity growth within firms as well as on the national level (Aghion and Howitt, 2009, p. 275). Adopting the following assumptions where each agent lives for just one period and final goods Y_t are produced using intermediate goods x_{it} and the productivity parameter A_{it} with $\alpha \in (0,1)$ results in the following production function that allows for a simple representation of the process

$$Y_t = \int_0^1 A_{it}^{1-\alpha} x_{it}^{\alpha} di \qquad (1)$$

The final good is assumed to be used for further research as well as in the production of intermediate goods. Producers of intermediate goods choose their level of production according to what amount will maximize their profits when intermediate goods are sold to the final goods sector at prices equal to the marginal productivity of the good. As shown by Aghion and Howitt (2009) the equilibrium profits are

$$\pi_{it} = \pi A_{it} \qquad (2)$$

where

$$\pi = \left(\frac{1-\alpha}{\alpha}\right) \alpha^{\frac{2}{1-\alpha}} \qquad (3)$$

Assuming $\overline{A_t}$ represent the productivity frontier at period t and that

$$\overline{A_t} = (1+g)\overline{A_{t-1}} \qquad (4)$$

with

$$(1+g) = \gamma > 1 \quad (5)$$

The level of technology is thus a function of previous periods. An important distinction between incumbent firms becomes the level of technology available to them relative the production frontier. Firms can either be close to the frontier, "neck-and-neck", or further below it. Those being close to the frontier are assumed to have access to the productivity level $A_{it-1} = \overline{A_{t-1}}$ while others use $A_{it-1} = \overline{A_{t-2}}$ (Aghion and Howitt, 2009, p. 277).

Whether a firm choose to innovate or not as a means of increasing productivity becomes an important decision prior to any production taking place. Innovating will increase productivity by γ units and is successful with probability z at the cost $c_{it} = cz^2\overline{A_{it-j}}/2$. At the same time firms face the threat of entry from outside or new firms with the probability p, all of whom are assumed to operate with the latest available technology $\overline{A_t}$. If the new entrant is successful and ends up competing with a firm with a lower productivity they are assumed to force the previous incumbent out of the market and take its place. However, if they end up competing with a firm of a similar technological level competition will ensure that profits of both firms are forced to zero. If the potential entrant is able to observe the productivity level of the incumbent it will never choose to enter into a market where it will not end up competing with a less effective firm. As such, the threat of entry is only present in sectors in which the incumbent has chosen either not to innovate or where innovation has been unsuccessful (Ibid, p. 277).

If firms far below the productivity frontier choose to innovate, avoid entry from new firms and are successful the profits earned will be $\pi_{it} = \pi\overline{A_{t-1}}$ with probability $(1-p)z$. However, if the firm is unable to successfully innovate profits will be $\pi_{it} = \pi\overline{A_{t-2}}$ with probability $(1-p)(1-z)$. If a new firm enters, the incumbent firm will obtain zero profits (Ibid, p.278). As such, the expected profits can be expressed as

$$(1-p)z\pi\overline{A_{t-1}} + (1-p)(1-z)\pi\overline{A_{t-2}} - \frac{cz^2\overline{A_{t-2}}}{2} \quad (6)$$

Firms will then choose the value of z that maximizes the previous expression. The first-order condition (FOC) that follows is

$$z_2 = (1-p)(\gamma-1)(\frac{\pi}{c}) \quad (7)$$

If, on the other hand, the incumbent firm is initially close to the technological leaders they will maximize

$$z\pi\overline{A_t} + (1-p)(1-z)\pi\overline{A_{t-1}} - \frac{cz^2\overline{A_{t-1}}}{2} \quad (8)$$

with the first order condition

$$z_1 = (\gamma-1+p)(\frac{\pi}{c}) \quad (9)$$

By taking the derivative with respect to the probability of firm entry, p, firm response can be analysed

$$\frac{\partial z_1}{\partial p} = \frac{\pi}{c} > 0 \quad (10)$$

$$\frac{\partial z_2}{\partial p} = -\frac{\pi(\gamma-1)}{c} < 0 \quad (11)$$

The equations (10) and (11) show that incumbent firms will respond markedly different to the threat of new firms depending on how close they are to the leaders in terms of productivity. Those close to the frontier are incentivized to make investments in innovations in order to keep control of their market shares while those with little hope of catching up with the leaders are discouraged from making investments. As such it is clear in this theoretical set-up that firm dynamics will positively impact productivity both by promoting investment and by forcing less efficient firms out of the market.

4 Data and restrictions

4.1 Sources of data

This paper uses multiple datasets consisting of panels for firms in separate Swedish regions and industries distinguished from one another by the classification formats NUTS2 and NAICS 2017 respectively. Eight different variables have been collected for each company over the ten-year period 2008-2017 using the Orbis database, maintained by Bureau van Dijk. Orbis is a statistical database on individual companies across the world, providing information on 280 million different companies. Additionally, the rates of entry and exit for different regions are collected from the Swedish agency for growth policy analysis (Tillväxtanalys).

4.2 Disaggregation and distinctions

NUTS2 is used in the EU when reporting statistics and separates Sweden into eight different national areas; Stockholm (SE11), East Middle Sweden (SE12), Småland and the islands (SE21), South Sweden (SE22), West Sweden (SE23), North Middle Sweden (SE31), Middle Norrland (SE32) and Upper Norrland (SE33) (Eurostat, p. 125). Parsing the economy by these regions makes it possible to control for possible differences in business climate and technologies available to the companies in the different Swedish regions (Callejon & Segarra, 1998, p. 267). The datasets contain yearly observations for eight different variables from 2008 until 2017 for twenty-three different industries in eight different geographical regions. The different industry classifications are agriculture, forestry, fishing and hunting (NAICS 11), mining, quarrying and gas extraction (NAICS 21), utilities (NAICS 22), construction (NAICS 23), manufacturing (NAICS 31-33), wholesale trade (NAICS 42), retail trade (NAICS 44-45), transportation and warehousing (NAICS 48-49), information (NAICS 51), finance and insurance (NAICS 52), real estate and rental and leasing (NAICS 53), professional, scientific and technical services (NAICS 54), management of companies and enterprises (NAICS 55), administrative and support and waste management and remediation services (NAICS 56), educational services (NAICS 61), health care and social assistance (NAICS 62), arts, entertainment and recreation (NAICS 71) accommodation and food services (NAICS 72) and finally other services (except public administration) (NAICS 81).

Industries are grouped in two supersets, manufacturing and goods producing industries and service providers, according to the NAICS 2017 method under which economic units that share the same production processes are classified to be within the same industry (Office of management and budget, 2017, p. 3). The following table summarizes which industries are included in in the respective supersets.

Manufacturing and goods producing industries	Service providers
NAICS 11	NAICS 22
NAICS 21	NAICS 42
NAICS 23	NAICS 44-45
NAICS 31-33	NAICS 48-49
	NAICS 51
	NAICS 52
	NAICS 53
	NAICS 54
	NAICS 55
	NAICS 56
	NAICS 61
	NAICS 62
	NAICS 71
	NAICS 72
	NAICS 81

Important to note is that the service industry in Sweden is significantly larger than the manufacturing industry in terms of the number of firms in business. The table below provides the relative shares of the economy that the respective industries hold as of 2017.

	% share of the total number of firms
Manufacturing and goods producing industries	24
Service providers	76

4.3 Variables

The eight different variables, of which the two datasets used in the econometric analysis consists of, are described below with variable shorthand in parenthesis. The variables can be described as part of one of three groups, dependent-, independent or control variables.

Value added (VA) is the dependent variable of the analysis, reported as firm value added in thousands of US dollars. It describes the process by which a company is able to increase the value of the goods used in its production. As such it should serve as a useful measure of firm productivity and how it develops over time, see Bosma, et al. (2011). The first independent variable is the total number of employees for each firm and year (EMP). Representing human capital it is expected to have a positive impact on productivity. Additionally, the amount of tangible fixed assets (TFA), reported in thousands of US dollars, represents means of production such as land, machinery or buildings and as such is expected to contribute positively to productivity growth. Furthermore, intangible fixed assets (IFA) is included to capture held assets such as patents, trademarks and the like also used in the production of goods and services. Included as a measure of technology it is expected to contribute positively to productivity.

To capture the impact of firm dynamics themselves firm entry (ENTRY), measured as the total number of start-up companies per year in each of the eight regions, is included as well as firm exit (EXIT), captured as the number of bankruptcies that are filed every year in each region. By including both measures the ambition is to discern the relative importance of the direct and indirect aspects of firm dynamics, as described in the previous chapter. Additionally, a composite measure of firm turbulence (FT) is calculated by scaling the sum of all firm entries and exits on the total number of firms active in each region[1]. The process is an example of Principal Component Analysis (PCA) as used by Bosma and Nieuwenhuijsen (2002) in their study of Dutch firms. PCA makes it possible to reduce dimensionality while preserving as much information as possible (Jolliffe and Cadima, 2016, p 2). As will be

[1] $FT = \frac{Entry+Exit}{Total\ number\ of\ firms}$

explained further in subsequent sections the impact and sign of firm dynamics is expected to change with time.

Finally, a control variable for population density (POP_density) is included, reported as the number of inhabitants per square kilometre in each of the eight regions with the purpose of capturing any externalities related to distance (Ciccone and Hall, 1995, p 1). If the cost of production increases with distance, then production within one single region will have additional benefits. Furthermore, close proximity to a larger base of customers as well as employees will likely carry with it positive externalities. Population density is included as a control variable for any such effects. As such it is expected to have a positive coefficient in the final estimations.

4.4 Restrictions

As in any empirical study the restrictions placed by the available data is something that must be taken into consideration. While Orbis provides an excellent source data is only available for the most recent ten years and there are still many companies for whom very little information is available. As such the datasets have been adapted to account for the missing variables by excluding companies for whom data is not available.

5 Results and discussion

5.1 Econometric approach

As has become common practice in the literature a panel data model is used in order to estimate the effects of firm dynamics on productivity growth. One important reason why panel data analysis has become popular is the prospect of being able to control for omitted factors. This is done by inclusion of a fixed- (FE) or random effects (RE) estimator. Fixed effect estimators are most commonly used when dealing with datasets where the individuals being distinguished between are distinctly different from one another, such as countries, industries or firms, while random effects are appropriate when the cross-sections themselves are of little interest in favour of the underlying characteristics of the sample (Verbeek, 2012, p.384-385).

Choosing which method to apply is not always straightforward. However, one important feature of the random effects estimator is that it requires the explanatory variables to be uncorrelated with the error-term. Making the mistake of including a random effects estimator in such a case would result in inconsistent estimates. The fixed effects estimator on the other hand makes no such assumption. Essentially, each cross-section receives its own intercept thus ridding the resulting estimation from any issues with endogeneity that could arise from variables being correlated with the error term (Verbeek, 2012, p 385). As it is improbable that the explanatory variables are solely responsible for explaining productivity growth and that none are correlated with any omitted variable the final estimations will be done using fixed effects estimators, thus avoiding the issue of endogeneity. An additional benefit of working with panel data is that the assumption of normal errors is satisfied as the large amount of observations in the sample effectively means that normality follows (Lumley et al. 2002). Additionally, in order to control for heteroscedasticity all estimations are done using robust standard errors.

Another important aspect is the rate at which firm dynamics is expected to impact productivity, and thus how it enters into the estimated model. Evidence from previous studies suggests that the effect is bicameral as well as staggered. Perhaps the most important result to consider was shown by Fritsch and Meuller (2004). In their study of entrepreneurship and its impact on employment growth in Germany they found it was not until the long-run that significant gains were observed (Fritsch and Meuller, 2004, p. 19). Following these results the custom approach when conducting productivity analysis has been to include lagged variables for firm entry and exit in order to capture any such effects (see Carre and Thurik (2008), Bosma, Stam and Schutjens (2011) amongst others). Consequently, lagged variables for entry, exit and firm turbulence is included in the different estimations.

Working with time series it is of importance to be aware of the underlying processes by which economic variables evolve. It is not uncommon that such measures depend on their past, that is they are autocorrelated. In choosing the correct way to describe such a model there are several ways to go about it. The most common one is to examine the autocorrelation (ACF) and partial autocorrelation coefficients (PACF) (Verbeek, 2012, p. 306). These describe the “memory” of the process, in other words how persistent shocks are (Verbeek, 2012, p. 282). Examining the ACF and PACF for the different variables, available in the appendix) it becomes clear that they closely describe typical AR(1) processes. An additional hurdle is the possible presence of unit-roots. Including variables that exhibit general upward, or downwards, trending behaviours might result in spurious regressions with inconsistent estimates (Enders, 2014, p 195). To test for the possibility of nonstationarity LLC and IPS tests are run for all variables, available in the appendix, which conclusively reject the presence of any unit roots. However, the tests are not without fault. With the null hypothesis being that all firms have a unit root it can be rejected if true for just one cross-section (Verbeek, 2012, p. 414). As such it is necessary to be cautious when confronted with results as one-sided as these and as robustness checks of sorts all estimations will be run including a lagged dependent variable along with lagged explanatory variables in addition to the benchmark estimations.

5.2 Model

In constructing a model that allows measuring of the impact of entry and exit on firm productivity growth inspiration is drawn from the traditional Cobb-Douglas production function used by, amongst others, Bosma and Nieuwenhuijsen (2002) and Andersson, Braunerhjelm and Thulin (2012). Value added (Y) for each firm is assumed to be the function of capital formation (K), the amount of people employed (L) and the impact of the technology that is available (A), where the index i denotes firm and t denotes years

$$Y_{it} = F(L_{it}, K_{it}, A_{it}) \tag{12}$$

The relationship between the dependent variable and the explanatory ones can be expressed more distinctly as

$$Y_{it} = L_{it}^{1-\alpha} K_{it}^{\alpha} A_{it} \tag{13}$$

where α is the return to capital. Taking logs

$$\ln(Y_{it}) = (1-\alpha)\ln(L_{it}) + \alpha \ln(K_{it}) + \ln(A_{it}) \tag{14}$$

The variable of interest is the representation of the technology available and used by the firm, A. Drawing upon the theoretical arguments presented earlier it is defined as a function of, amongst other things, firm entry and exit in each region which in turn will make it possible to estimate the impact the effects have on productivity growth. As such, technology is assumed to be the function of intangible fixed assets (IA) along with firm dynamics (FD), a control variable (x) and a stochastic error term (ϵ). Firm dynamics is used as a general description of either one of the three measures that describe how firm composition changes. It is modelled as follows

$$A_{it} = \exp(\omega IFA_{it} + \gamma FD_{it} + x_{it} + \epsilon_{it}) \tag{15}$$

By combining equation (14) and (15) the model stands as follows

$$\ln(Y_{it}) = (1-\alpha)\ln(L_{it}) + \alpha\ln(K_{it}) + \omega IFA_{it} + \gamma FD_{it} + x_{it} + \epsilon_{it} \qquad (16)$$

When applying the fixed effects estimator and introducing the lagged expressions for firm dynamics the final model of estimation becomes

$$\ln(Y_{it}) = \alpha_i + \beta_1\ln(EMP_{it}) + \beta_2\ln(TFA_{it}) + \beta_3 IFA_{it} +$$
$$\beta_4\sum_{\lambda=0}^{3} FD_{it-\lambda} + \beta_5 x_{it} + \epsilon_{it} \qquad (17)$$

5.3 Results

As such several versions of equation (17) will be estimated. Both the datasets for manufacturing firms and those in the services sector will be run using the equation as described above with variables for firm entry, exit and firm turbulence in place of firm dynamics. Furthermore, the same equations will be run including a lagged dependent variable as well as lagged explanatory variables as explained above. In total, twelve different estimations are made.

Table 1 presents the benchmark results for manufacturing firms using the three separate specifications for firm dynamics. As expected the variable representing human capital is positive and significant for all three specifications. Similarly, the impact of fixed assets is both positive and significant across the board. The next variable however, representing intangible assets and included as part of the measure of available technology, is not significant for any of the three specifications although it shows the expected sign. Finally, the control variable for population density that was included to capture positive externalities otherwise not accounted for shows some interesting traits. While positive and significant for the first two specifications it, surprisingly, turns negative when the aggregate measure for firm turbulence is included in the estimation.

Looking at the variables for firm dynamics themselves it becomes clear even at a glance that the results are at odds with those of previous research. While the value of the coefficients themselves are small the results are generally significant and with unexpected signs. When including firm entry in the estimation the initial values are positive while the latter ones are negative, directly opposed to the idea of crowding-out of incumbent firms as presented by Fritsch and Meuller (2004). Similar results are obtained from the third estimation, including firm turbulence as the measure of firm dynamics, while firm exit appears the have a consistently positive impact. Additionally, it appears as if the positive impact decreases over time. Altering the model by the number of lags included did not alter the pattern observed. An explanation to these results more likely than there being no selection effect is that the positive effect new firms bring, direct as well as indirect, is greater than the initially negative impact of firms being forced out of business as the market adapts. Thus, the new business practices and varieties new firms bring to the market and force incumbent firms to adopt seems, at least initially, to be able to more than compensate for firms being forced into bankruptcy. Still somewhat odd is that the latter lags of firm entry as well as firm turbulence are negative which would point towards an inability of new firms to induce the long-term, indirect, positive effects suggested by theory such as boosting the productivity of already established firms in the face of increased competition. Overall it appears the impact on productivity is greater when including the composite measure for firm turbulence while the net impact of firm entry and exit is relatively small, with firm entry having a slightly greater impact.

Table 2 presents the benchmark results for service providing firms using the three separate specifications for firm dynamics. Similarly to those for manufacturing firms the results for variables representing human- and fixed capital are both significant and positive. However, the results for intangible assets differ in that they are significant with the expected sign in all three cases. The control variable for population density is positive for all three specifications but not significant when the model is fitted using firm entry to describe firm dynamics.

Turning to the variables for firm dynamics it appears as if the same patterns observed in table 1 repeats themselves. The initial effect is consistently positive with the sign shifting in later lags. As for manufacturing firms the size of the impact is greater when fitting the model using firm turbulence while the impact of firm entry slightly exceeds that of firm exit.

Table 1. Manufacturing and goods producing industries

VARIABLES	(1) Entry	(2) Exit	(3) FT
lnEMP	0.798***	0.930***	0.924***
	(0.00508)	(0.00257)	(0.00256)
lnTFA	0.0668***	0.0817***	0.0826***
	(0.00156)	(0.00113)	(0.00112)
IFA	2.40e-11	5.98e-11	6.37e-11
	(5.92e-11)	(4.45e-11)	(4.72e-11)
Entry	3.88e-05***		
	(1.09e-06)		
Entry_lag1	7.05e-06***		
	(4.09e-07)		
Entry_lag2	-3.77e-07		
	(3.94e-07)		
Entry_lag3	-6.10e-06***		
	(3.28e-07)		
POP_density	0.000460**	7.39e-05**	-0.000854***
	(0.000203)	(3.60e-05)	(3.39e-05)
Exit		1.80e-06	
		(5.36e-06)	
Exit_lag1		3.11e-05***	
		(3.75e-06)	
Exit_lag2		8.46e-06**	
		(3.68e-06)	
Exit_lag3		2.93e-07	
		(3.03e-06)	
FT			0.350***
			(0.0101)
FT_lag1			0.189***
			(0.00738)
FT_lag2			0.0288***
			(0.00726)
FT_lag3			-0.154***
			(0.00580)
Constant	10.33***	10.32***	10.07***
	(0.0328)	(0.0127)	(0.0150)
Observations	248,253	248,253	248,253
R-squared	0.377	0.367	0.379

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 2. Service providers

VARIABLES	(1) Entry	(2) Exit	(3) FT
lnEMP	0.744***	0.896***	0.886***
	(0.00418)	(0.00211)	(0.00209)
lnTFA	0.0497***	0.0781***	0.0789***
	(0.00114)	(0.000881)	(0.000868)
UFA	5.14e-11*	1.00e-10***	1.09e-10***
	(2.84e-11)	(2.74e-11)	(3.12e-11)
Entry	4.23e-05***		
	(8.06e-07)		
Entry_lag1	4.73e-06***		
	(3.10e-07)		
Entry_lag2	-1.62e-07		
	(2.91e-07)		
Entry_lag3	-5.65e-06***		
	(2.50e-07)		
POP_density	0.000185	0.000309***	0.000780***
	(0.000149)	(3.17e-05)	(1.83e-05)
Exit		3.93e-05***	
		(4.32e-06)	
Exit_lag1		2.93e-05***	
		(2.75e-06)	
Exit_lag2		9.01e-06***	
		(2.64e-06)	
Exit_lag3		-1.95e-07	
		(2.26e-06)	
FT			1.575***
			(0.0317)
FT_lag1			0.771***
			(0.0316)
FT_lag2			0.408***
			(0.0308)
FT_lag3			-0.999***
			(0.0260)
Constant	10.60***	10.35***	9.766***
	(0.0267)	(0.00957)	(0.0189)
Observations	522,368	522,368	522,368
R-squared	0.285	0.271	0.291

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

The results from the adapted models, adopting an AR(1) structure and correcting for potential non-stationarity, are presented in table 3 and 4, available in the appendix. While the coefficient values differ somewhat the general structure remains, giving credit to the benchmark model.

Overall it appears the impact on productivity is greatest when including the composite measure for firm turbulence. As for firm entry and exit the net impact is small with new firm entering the market slightly edging exiting firms in terms of importance, suggesting that the direct effects of firm dynamics is more important for productivity growth than the indirect ones. Contrasting the two sectors from one another the impact of firm dynamics is overall greater for firms acting as service providers. As suggested by Andersson, Braunerhjelm and Thulin (2012) it could be a result of service providers being more reliant on transaction and delivery costs and as such be more influenced by changes in the local firm composition or that larger firms are more prevalent in the manufacturing sectors, allowing less room for innovators to impact. Attempting to summarize the findings it becomes clear that the generally expected results, given previous research by Fritsch and Meuller (2004), are not present. Rather than firm dynamics having a positive effect over time the opposite is true. Possible explanations as to why the results for the estimated period differ from previously observed results would seem to depend on quirks present in the Swedish economy during the period of observation. Instead of increasing competition forcing established firms out of the market causing a temporary dip in productivity growth it appears as if innovating firms are able to generate value upon entry that compensates for any crowding-out taking place.. Potentially worrying however is the inability to capitalize in the long-run on the benefits generated as the positive impact steadily deteriorates which could point towards a weakness in the viability of new enterprises or that already active enterprises are so entrenched that the threat posed by new firms is not grave enough to bring about the indirect effect of widespread innovation.

6 Conclusion

With the purpose of this study being to examine the connection between changes in the composition of firms in business and productivity growth in Swedish firms recalling the research questions first stated in chapter one is necessary. The first question, "Does firm dynamics impact productivity growth in Sweden", is readily answered by the empirical results obtained in the paper. As both economic theory and previous research has alerted to both the formation of new firms as well as the process of incumbent firms exiting the market turns out to affect productivity growth during the period of study. Using a panel data set and production function set-up estimations for both manufacturing firms as well as service providers make clear the causal relationship between changes in regional firm composition and productivity growth. Moving on to the second question posed, "How does firm dynamics impact the productivity growth in Swedish firms", perhaps more interesting facts reveal themselves. The empirical results indicate that firm entry and exit has a staggered impact on firm productivity, affecting service providers to a greater degree than manufacturing firms. Additionally, the effect is greater for new firms entering the economy than it is for firms entering bankruptcy.

Curiously, the impact is positive and at its strongest immediately as it takes effect to then dissipate over time until it finally turns negative. The results are at odds with the general understanding of the relationship between firm dynamics and productivity growth, beckoning further research into the period in question to determine what has triggered the departure from historical patterns. Additionally, the question beckons whether the results are unique to Sweden or if similar patterns are more widespread.

As in any empirical study, effort should be spent addressing the limitations faced and their potential impact on the final results. First and foremost the comparability between studies is somewhat strained as methods of estimations differs along with distinctions between industries. Furthermore, the availability of data exerts a natural limit to the scope of generalizability of the paper. While the datasets employed provide a great foundation for an attempt to determine the causal relationship between firm dynamics and productivity growth there are many firms for whom very little, if any, information is available during the observed timespan. As such, any result should be accepted with some caution and as the availability of data increases further attempts should be made in order to create a better understanding of the true relationship between firm dynamics and productivity growth.

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8 Appendix

8.1 ACF and PACF Correlograms

Graph 1. Value added, manufacturing

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.870	0.870	335124	0.000
		2	0.743	-0.058	579605	0.000
		3	0.623	-0.045	751388	0.000
		4	0.516	-0.018	869337	0.000
		5	0.412	-0.059	944448	0.000
		6	0.316	-0.036	988708	0.000
		7	0.223	-0.061	1.E+06	0.000
		8	0.141	-0.026	1.E+06	0.000
		9	0.067	-0.040	1.E+06	0.000

Graph 2. Intangible fixed assets, manufacturing

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.740	0.740	18650.	0.000
		2	0.551	0.008	29003.	0.000
		3	0.406	-0.011	34607.	0.000
		4	0.293	-0.012	37532.	0.000
		5	0.213	0.004	39080.	0.000
		6	0.152	-0.007	39868.	0.000
		7	0.100	-0.019	40206.	0.000
		8	0.055	-0.020	40311.	0.000
		9	0.017	-0.023	40320.	0.000

Graph 3. Tangible fixed assets

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.773	0.773	260692	0.000
		2	0.608	0.026	421960	0.000
		3	0.478	-0.000	521534	0.000
		4	0.371	-0.010	581687	0.000
		5	0.283	-0.015	616620	0.000
		6	0.205	-0.027	634980	0.000
		7	0.136	-0.030	643087	0.000
		8	0.075	-0.034	645528	0.000
		9	0.020	-0.036	645699	0.000

Graph 4. Employment, manufacturing

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.823	0.823	317730	0.000
		2	0.683	0.017	536609	0.000
		3	0.562	-0.016	684608	0.000
		4	0.452	-0.033	780251	0.000
		5	0.351	-0.038	837958	0.000
		6	0.259	-0.040	869355	0.000
		7	0.175	-0.040	883733	0.000
		8	0.098	-0.047	888194	0.000
		9	0.023	-0.056	888450	0.000

Graph 5. Value added, services

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.689	0.689	70410.	0.000
		2	0.494	0.037	106592	0.000
		3	0.348	-0.010	124538	0.000
		4	0.237	-0.016	132857	0.000
		5	0.162	0.000	136736	0.000
		6	0.107	-0.006	138424	0.000
		7	0.063	-0.013	139019	0.000
		8	0.029	-0.015	139143	0.000
		9	0.001	-0.016	139143	0.000

Graph 6. Intangible fixed assets, services

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.711	0.711	75058.	0.000
		2	0.511	0.010	113809	0.000
		3	0.360	-0.014	133080	0.000
		4	0.246	-0.016	142084	0.000
		5	0.169	0.002	146324	0.000
		6	0.113	-0.006	148211	0.000
		7	0.068	-0.013	148904	0.000
		8	0.033	-0.014	149069	0.000
		9	0.005	-0.016	149072	0.000

Graph 7. Tangible fixed assets, services

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.772	0.772	660152	0.000
		2	0.604	0.020	1.E+06	0.000
		3	0.471	-0.005	1.E+06	0.000
		4	0.362	-0.012	1.E+06	0.000
		5	0.273	-0.012	2.E+06	0.000
		6	0.196	-0.026	2.E+06	0.000
		7	0.128	-0.031	2.E+06	0.000
		8	0.068	-0.031	2.E+06	0.000
		9	0.015	-0.034	2.E+06	0.000

Graph 8. Employment, services

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.816	0.816	890702	0.000
		2	0.672	0.015	1.E+06	0.000
		3	0.546	-0.019	2.E+06	0.000
		4	0.434	-0.030	2.E+06	0.000
		5	0.333	-0.036	2.E+06	0.000
		6	0.242	-0.038	2.E+06	0.000
		7	0.159	-0.039	2.E+06	0.000
		8	0.085	-0.041	2.E+06	0.000
		9	0.018	-0.044	2.E+06	0.000

8.2 Alternative specifications

Table 3. Manufacturing and goods producing industries

VARIABLES	(1) Entry	(2) Exit	(3) FT
lnVA_lag1	0.0421**	0.0651***	0.0359*
	(0.0205)	(0.0207)	(0.0205)
lnEMP_lag1	0.238***	0.245***	0.238***
	(0.0252)	(0.0262)	(0.0252)
lnTFA_lag1	0.0256***	0.0243***	0.0259***
	(0.00779)	(0.00794)	(0.00775)
lnUFA_lag1	0.000901	-0.00877*	0.00420
	(0.00440)	(0.00450)	(0.00434)
Entry_lag1	6.73e-05***		
	(4.55e-06)		
Entry_lag2	-4.25e-06***		
	(1.54e-06)		
Entry_lag3	-4.60e-06***		
	(1.29e-06)		
POP_density_lag1	-0.00224***	0.00121*	-0.00123**
	(0.000686)	(0.000685)	(0.000609)
Exit_lag1		0.000168***	
		(3.24e-05)	
Exit_lag2		-2.52e-05*	
		(1.43e-05)	
Exit_lag3		8.13e-06	
		(1.34e-05)	
FT_lag1			0.910***
			(0.0568)
FT_lag2			-0.0716***
			(0.0273)
FT_lag3			-0.0508**
			(0.0242)
Constant	12.18***	11.87***	11.85***
	(0.297)	(0.309)	(0.286)
Observations	14,858	14,858	14,858
R-squared	0.110	0.080	0.119

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 4. Service providers

VARIABLES	(1) Entry	(2) Exit	(3) FT
lnVA_lag1	0.119***	0.137***	0.109***
	(0.0126)	(0.0125)	(0.0129)
lnEMP_lag1	0.245***	0.248***	0.243***
	(0.0165)	(0.0171)	(0.0162)
lnTFA_lag1	0.0256***	0.0232***	0.0267***
	(0.00412)	(0.00422)	(0.00407)
lnUFA_lag1	0.00949***	0.00465	0.0132***
	(0.00282)	(0.00289)	(0.00271)
Entry_lag1	4.33e-05***		
	(2.43e-06)		
Entry_lag2	8.19e-07		
	(8.12e-07)		
Entry_lag3	-3.63e-06***		
	(7.13e-07)		
POP_density_lag1	-0.00205***	0.000254	-0.000489
	(0.000588)	(0.000524)	(0.000523)
Exit_lag1		0.000169***	
		(1.72e-05)	
Exit_lag2		-6.57e-06	
		(7.21e-06)	
Exit_lag3		3.02e-05***	
		(7.22e-06)	
FT_lag1			2.470***
			(0.151)
FT_lag2			-0.220***
			(0.0750)
FT_lag3			-0.0550
			(0.0914)
Constant	11.22***	10.86***	10.80***
	(0.202)	(0.212)	(0.178)
Observations	52,279	52,279	52,279
R-squared	0.152	0.141	0.160

Robust standard errors in parentheses
*** p<0.01, ** p<0.05, * p<0.1

8.1 Unit-root tests

Table 5. Unit-root tests, manufacturing firms

Variable	LLC	IPS
Value added	-427.276***	-225.558***
Tangible fixed assets	-249.277***	-440.248***
Intangible fixed assets	-143.473***	-198.448***
Employment	-247.153***	-763.346***

Table 6.Unit-root tests, service providers

Variable	LLC	IPS
Value added	-318.741***	-500.396***
Tangible fixed assets	-465.982***	-376.107***
Intangible fixed assets	-472.581***	-219.752***
Employment	-293.314***	-523.491***