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The contribution of business dynamics to productivity growth in the Netherlands

Firm dynamism in the Netherlands has been steadily declining since at least 2006 and productivity growth rates have been sluggish at best. We find that in services, productive young firms raise productivity by replacing less productive old firms according to the creative destruction mechanism. By contrast, in manufacturing incumbent young firms contribute more to productivity growth.

We find that a decline in firm dynamics in services, observed between 2006 and 2016, accounts for reduced productivity growth at the national level of around 0.2%-point annually.

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The contribution of business dynamics to productivity growth in the Netherlands

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Abstract
This paper analyses the declining firm dynamism in the Netherlands, which may explain part of the slowdown in productivity growth. We use a rich microdata set including nearly all corporations in the Netherlands during 2006-2016, which enables us to evaluate the TFP growth contributions of exiting firms, start-ups and new firms resulting from mergers & acquisitions in different industries. We use a Melitz and Polanec (2015) decomposition to assess TFP growth contributions. We find that in service industries, start-ups, new firms created by M&As and exiting firms all contribute to overall TFP growth, in line with the creative destruction hypothesis. In manufacturing industries, TFP growth is driven mostly by incumbent firms. Here, entry and exit dynamics contribute relatively little or even negatively to TFP growth. In addition, young firms in the manufacturing industries tend to have higher TFP growth than older firms, while in service industries this is not the case. Finally, in general, relatively low productivity entrants are more likely to exit in the first five years after entry, which is in line with an 'up-or-out' dynamic.

Keywords: productivity slowdown, firm dynamics, TFP

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1 Introduction

Business dynamism, including firm birth, growth, decline and exit, is important for overall productivity growth and reallocation, and therefore for economic growth (Decker et al., 2018). High dynamism enables resources to be reallocated from low-productivity to high-productivity firms in the economy (Bartelsman and Doms, 2000). Foster et al. (2018) find that periods of rapid innovation are accompanied by high rates of entry. Successful innovators and adopters grow while unsuccessful innovators contract and exit, yielding productivity growth. A lack of business dynamics is associated with misallocation of production resources. In turn, this lack of dynamics and the misallocation can be explained by market distortions, often policy induced (Restuccia and Rogerson, 2013), stifling aggregate productivity growth (Hsieh and Klenow, 2009; Syverson, 2011; Bartelsman et al., 2013).

Despite the importance of small and young firms[1] in the firm growth distribution (Decker et al., 2014; Capasso et al., 2013), relatively little is known about the contribution of the dynamics of these firms to aggregate productivity growth. This gap is partly due to the lack of widely available, sufficiently detailed firm-level data (Guillamón et al., 2017). Large firms are usually overrepresented in datasets used in many productivity studies, such as KLEMS or Orbis, which obscures much of the dynamics of young and small firms.

The international literature has long been biased by concentrating on particular industries, i.e. manufacturing (Foster et al., 2002), due to data constraints as well as methodological difficulties in measuring service sector productivity (Ahn, 2001). But the manufacturing and services industries have been found to show different dynamics (Audretsch et al., 1998) and small firms are much more important in the latter.[2] Hurst and Pugsley (2011) point out diverse entry dynamics in different industries. This is illustrated by van der Wiel (2000), who uses Dutch firm-level data and finds that despite increasing firm dynamics during 1987-1995, productivity growth rates in the business services industry were sluggish at best. Likewise, Bosma et al. (2011) find that firm entry and exit are important for regional competitiveness in services, but not in manufacturing in the Netherlands.

We contribute to the literature by highlighting the contribution of small and young firm dynamics to aggregate and industry total factor productivity (TFP) growth. We

[1] Bartelsman (2004) notes that a distinction should be made between small and young firms; we therefore make this distinction explicitly in the paper.

[2] Around 65% of manufacturing firms in our data are small firms (fewer than 10 employees), in most services industries this share is over 80%. If non-corporations are included too, this difference would likely be larger still.

use a panel of firm data covering 52 industries for the period 2006-2016 featuring annual data on nearly all corporations in the Netherlands.[3] Additionally, our data allows us to distinguish between different modes of firm entry and exit. This enables us to evaluate the productivity growth contributions of young firms that we know to be start-ups, or those resulting from mergers & acquisitions (M&As). The data also allows us to examine various reasons for the exit of firms. Furthermore, we distinguish between various manufacturing and services industries, evaluating the dynamics relevant for productivity growth in each.

First, we find that the churn, the sum of entry and exit, has declined, mostly driven by a declining entry rate from 2006. The churn rate has declined more strongly in manufacturing than in services. In services industries, declining entry rates have driven lower churn rates, whereas in manufacturing, both entry and exit rates have declined.

Second, using a Melitz and Polanec (2015) decomposition, we find that firm dynamics contribute differently to TFP growth across industries. In services, entry of new firms, including entries through M&As, contribute most to overall TFP growth. In line with the creative destruction hypothesis, entrants in service industries tend to have a higher than average TFP, while exiters have a lower than average TFP. This is less so in manufacturing, where TFP growth is driven mostly by incumbent firms. In manufacturing, entry and exit dynamics contribute relatively little or negatively to TFP growth.

Third, we analyse survival and growth of new firms. For manufacturing, we find that TFP growth of new firms tends to be higher than that of incumbents, contributing positively to aggregate TFP growth. In services industries, this is not the case. In both industries, relatively low productivity entrants are more likely to exit in the first five years after entry. These results, particularly for manufacturing, are in line with an 'up-or-out' dynamic of new firms, which is an important source of productivity growth: exiting new firms have low productivity while the surviving new firms exhibit rapid growth with above average productivity (Haltiwanger, 2012; Decker et al., 2014).

This paper builds on the literature on firm dynamics. In general, business dynamism appears to be declining in many countries (Decker et al., 2018; Akcigit and Ates, 2021; Pugsley and Sahin, 2019). However, there are differences between countries. Bravo-Biosca (2011) finds both fewer growing and shrinking firms in European countries than in the US; Europe has a much larger share of firms that do not grow much after entry, which is found across all industries (Bartelsman et al., 2005). Bijnens and Konings (2018) find declining dynamism in Belgium over a longer period of time, starting their analysis in the mid-1980s. They suggest that the dynamism slowdown could be driven by increasing

[3] In this paper, we equate corporations with firms. NFO covers 80% of the large firms and 90% to 95% of the small firms (in terms of the balance sheet total).

prevalence of information technologies.

The relationship between firm dynamics and productivity growth has been a topic of much research. Ahn (2001) provides a comprehensive literature overview. The causal relationship is not a priori clear. Foster et al. (2008) note that while the working hypothesis is that firm dynamism and the related reallocation processes are related to productivity, both the magnitude and the causality of the effect of this relationship are empirical issues. Market imperfections in product, capital, or labour markets may distort the reallocation process so that the timing, magnitude, and/or nature of reallocation is not productivity enhancing. For instance, capital markets may be imperfect for small and young businesses.

However, most studies that link productivity to firm growth, find that productivity is the key determinant of firm growth (Du and Temouri, 2015; Moral-Benito, 2016; Guillamón et al., 2017). Productive small young firms tend to grow more often into large firms and are less likely to exit (Foster et al., 2016). As a consequence, large firms tend to be more productive than small firms (Lucas, 1978; Bartelsman et al., 2013; Moral-Benito, 2016; Medrano-Adán et al., 2018). Baumol (2004) suggests that small young firms generate the major breakthroughs to fuel new industries, while large firms adopt and implement novel ideas. See also Haltiwanger et al. (2013) and Foster et al. (2006) for overviews of this literature.

Schumpeter (1934) linked firm dynamics and economic growth in his "creative destruction" model, in which a new firm enters the market with new technologies or innovations. Successful innovations lead to increased competition and ultimately the replacement of existing firms. This process of creative destruction widens the gap between the productivity levels of entering and exiting firms. Productivity growth is enhanced through this process of entry and exit and the associated reallocation of resources. Versions of this model include the models of Aghion and Howitt (1994) and Caballero and Hammour (1991). Following this model, we would expect that both entry and exit contribute positively to productivity growth. Also in this model, business cycles represent waves of creative destruction and recessions have a cleansing effect, although the empirical evidence for this is not clear (Caballero and Hammour, 1991; Foster et al., 2016).

Later models are extended with uncertainty, learning, and diffusion effects. Uncertainty arises from the fact that firms do not know the demand for new products or which new technologies will be successful. Firms learn by trying out different technologies, passively or actively. Passively learning firms learn about the success of their technologies only after entry. This explains why many entrants exit soon after entering and why growth rates of small and young firms are more variable (Jovanovic, 1982). In the active learning model a firm analyses the market before entering and selects successful investments (Ericson and Pakes, 1995). These models would give rise to an 'up-or-out' dynamic where new firms must grow, or exit the market (Decker et al., 2014; Haltiwanger, 2012).

Other models suggest that successful technologies lead to a growing market and many new firms will enter. As the market matures, it becomes more difficult to survive; fewer new firms will enter and more firms will exit. Contributions to this product life cycle model include Agarwal and Gort (1996) and Gort and Klepper (1982). In this model, entering firms are not necessarily more productive than incumbents.

More recent literature examines firm dynamics in the context of rising industry concentration rates, which are a measure of firm industry dominance (De Loecker et al., 2020; Autor et al., 2019). This literature points to increasingly dominant (large and productive) superstar firms being responsible for rising concentration ratios which is an additional deterrent for entry of small firms. The most successful and productive young firms will be bought out by large superstar competitors, thus limiting their growth potential (Decker et al., 2016).

The paper continues as follows: in the next sections we discuss the dataset and the methodologies used to derive productivity and to decompose productivity growth. Subsequently, we present the results, starting with the decomposition results and followed by the regression results that assess the TFP dynamics of firms post-entry. Two final sections discuss and conclude.

2 Data

We merge three datasets to obtain a large representative sample of Dutch firms for which we estimate productivity. The merged dataset contains a total of 401,403 incorporated enterprises, including enterprises that consist of multiple firms.[4] From hereafter we will use the term 'firms' to designate both firms and enterprises. Throughout the paper, we consider three firm size classes: micro firms[5] (<10 employees), small firms (10-49 employees), and large firms (50 or more employees). We distinguish three main industries: manufacturing, services and other (construction and agriculture).

The three datasets are obtained from Statistics Netherlands. Firstly, the ABR (business registry) dataset contains information on important events in the life cycle of the firms and some basic background statistics such as birth date, industry and size. Secondly, the

[4] In the dataset used in this study, 95.5% of the enterprises consist of only one firm. The majority (77.2%) of the observations where an enterprise consists of multiple firms appear in the 2006-2009 subsample.

[5] Note that, due to data constraints, our data excludes non-employer firms. These firms are therefore not included in our analysis and their contributions to firm dynamics are not considered. Fortunately this is, in terms of value added (¡5%), a relatively small group.

NFO (non-financial firms) dataset contains book value data for the population of firms. Thirdly, we match the Polisbus dataset, which contains employee-level data, to the firm data. Due to changes in definitions in the ABR, we can only consider data in the period 2006 to 2016, yielding an unbalanced panel of 11 years.[6] We calculate productivity for around 144,000 firms per year. Data are available for 52 industries, covering the whole economy excluding public and financial industries (see the list in Table 3 in the appendix).

We measure labour input by summing employee labour hours for each firm, using the matched firm-employee data. We obtain a good match between the NFO and Polisbus; on average, 82.4% of the firms observations match each year. However, we drop firm-observations when employees are insufficiently matched. For firms with fewer than 20 fte, 10.5% of the observations are lost, while the loss is minimal (3.5%) for other firms.[7]

The events data is a feature that sets our dataset apart from many other micro datasets. This information in this dataset lists the reasons for the entry and exit of firms. We can distinguish between three types of entry and exit: pure, M&A, and restructuring. In addition, when we observe entry and exit unlabelled in the events database, we label this "other" entry or exit. Pure entry consists of new firms that have not been previously observed in another form and pure exit consists of firms that leave the dataset completely. This is contrasted by entry and exit through mergers and acquisition (M&A).[8] Entry and exit through restructuring contains firms that are disconnected from the parent firm or that are restructured to such an extent they are registered as a new firm.[9]

Finally, we reduce the effects of outliers (i.e. implausibly small or large TFP values) by trimming the top and bottom 3% of the industry-year TFP distribution. We choose the 3% level because it gives us the best match between aggregated micro data and official productivity growth figures.

3 Methodology

In this section we outline how we derive TFP at the firm level using industry-specific production functions. Following this, we outline the Melitz and Polanec (2015) decomposition

[6] According to the documentation, NFO covers 80% of the large firms and 90% to 95% of the small firms (in terms of the balance sheet total).

[7] The results are robust to the sample selection caused by the merge. A detailed discussion of merging outcomes is found in van Heuvelen et al. (2018).

[8] Unfortunately, the data does not allow tracing of the parties involved in M&A's or restructuring all the way through. This means we can observe firm exit for these reasons, as well as firm entry. But not exactly which individual firms merge/restructure into which new individual firms.

[9] We refer the reader to Eurostat for the technical definitions of the entry and exit types.

method to decompose industry-level productivity growth into different contributors, using the firm-level TFP estimations.

3.1 Measuring TFP

To estimate TFP, we use a Cobb-Douglas production function with Hicks-neutral productivity (lower case denoting logged variables):

$$y_{it} = \beta_k k_{it} + \beta_l l_{it} + \omega_{it} + \epsilon_{it} \tag{1}$$

where value added y is produced with capital k and labour l, productivity ω_{it} (known to the firm) and an unanticipated output shock (ϵ). Since ω_{it} is known to the firm when choosing inputs k_{it} and l_{it} there is an endogeneity problem, resulting in biased OLS estimates.

Several solutions have been proposed to this endogeneity problem, such as using instrumental variables. Olley and Pakes (1996) (OP) have proposed a two stage approach that has been widely taken up and further refined (e.g. Levinsohn and Petrin (2003) (LP) and Ackerberg et al. (2006)). OP derive a valid proxy for ω_{it} entailing investments. LP have adapted this approach using intermediate inputs, such as materials. We follow the approach of LP and use firms' material inputs m_{it}. The approach assumes that a firm chooses its inputs in different periods: capital is chosen at $t-1$ and labour in period t; capital is thus a state variable. Under this timing assumption, the demand for materials inputs can be formulated as a function of productivity ω_{it}, capital k_{it}:

$$m_{it} = f_t(k_{it}, \omega_{it}) \tag{2}$$

with the firm's demand for materials strictly increasing in ω_{it}. To use this approach, several assumptions must be made: (i) the firm's information set at t, I_{it}, includes current and past productivity shocks but does not include future productivity shocks; (ii) productivity ω_{it} evolves according to an endogenous first-order Markov process:

$$\omega_{it} = h(\omega_{it-1}) + \xi_{it} \tag{3}$$

where ξ can be seen as a firm's innovation to its productivity.

Inverting equation (2) and plugging it into the original equation we obtain the following equation:

$$\begin{aligned} y_{it} &= \beta_0 + \beta_k k_{it} + \beta_l l_{it} + f^{-1}(m_{it}, k_{it}) + \varepsilon_{it} \\ &= \beta_l l_{it} + \phi(m_{it}, k_{it}) + \varepsilon_{it} \end{aligned} \tag{4}$$

Because l_{it} and m_{it} are uncorrelated with ε_{it}, β_l and ϕ can be identified; this is the first stage.

The second stage involves the estimation of all coefficients of the production function. As $\omega_{it} \equiv \phi(k_{it}, m_{it})$ - β_0 -$\beta_k k_{it}$, we can obtain the following equation:

$$y_{it} - \hat{\beta}_l l_{it} = \beta_0 + \beta_k k_{it} + h(\hat{\phi}_{it-1} - \beta_0 - \beta_k k_{it-1}) + \xi_{it} + \varepsilon_{it} \tag{5}$$

The estimation of the second stage uses the moment conditions $E\left[(\varepsilon_{it} + \xi_{it})\mathbf{I_{it}}\right] = 0$. The matrix $\mathbf{I_{it}}$ is defined as follows:

$$\mathbf{I_{it}} = \begin{bmatrix} k_{it-1} \\ k_{it} \end{bmatrix} \tag{6}$$

In the first stage, $\hat{\beta}_l$ and $\hat{\phi}$ were estimated, in the second stage, β_0 β_k and f are estimated.[10]

For our estimation we apply the one-step GMM estimator based on Wooldridge (2009) shown below.

$$y_{it} = \beta_0 + \beta_k k_{it} + \beta_l l_{it} + h(f^{-1}(.)) + \xi_{it} + \varepsilon_{it} \tag{7}$$

We approximate $h(f^{-1}(.))$ with a third order polynomial in all of its elements, except for the year dummies that enter linearly. Finally, using the estimated output elasticities β_l and β_k we back out productivity as a residual.

3.2 Decomposition

Many studies on dynamics and productivity consider some form of decomposition of industry-level productivity index (Foster et al., 2001; Griliches and Regev, 1995; Melitz and Polanec, 2015).[11]

The specific decomposition we apply is the Dynamic Olley-Pakes Decomposition (DOPD) developed by Melitz and Polanec (2015). Using this decomposition, we split aggregate productivity growth into the contributions of firm productivity growth and changing shares of firms' value added. The method explicitly separates the contributions of entering and exiting firms. Equation (8) shows the productivity growth decomposition from a period 1 to period 2 (industry subscripts suppressed).

$$\Delta P_{1,2} = \Delta \bar{P}_{S1,2} + \Delta COV_{S1,2} + s_{E2}(P_{E2} - P_{S2}) + s_{X1}(P_{S1} - P_{X1}) \tag{8}$$

[10] See Olley and Pakes (1996); Levinsohn and Petrin (2003) for a more thorough discussion of the derivations and the assumptions required for this method.

[11] Griliches and Regev and Foster et al., use different methodologies, leading to different outcomes (Baldwin and Gu, 2006).

where aggregate productivity change that stems from incumbent (S), entering (E), and exiting (X) firms is decomposed into four terms.

The first term of equation (8) is the change of the unweighted industry average productivity for incumbent firms ($\Delta\bar{P}_{S1,2}$).[12] The second term (ΔCOV_S) is induced by market share reallocations between incumbents (i.e. the covariance change between firm-level productivity and value added share). The third and fourth terms of equation (8) are the productivity growth contributions of respectively entrants ($s_{E2}(P_{E2} - P_{S2})$) and exiters ($s_{X1}(P_{S1} - P_{X1})$ with s being the share of value added).

Because there are no observations for the productivity of entrants in period 1 and productivity of exiters in period 2, the method uses the set of incumbent firms as a benchmark to analyse how adding the group of entrants (or exiters) affects the aggregate productivity change. The term for entrants thus compares the weighted average productivity of entrants (P_{E2}) with the weighted average productivity of incumbents in period 2 (P_{S2}). If entrants are more (less) productive than incumbent firms, their entry contributes positively (negatively) to productivity growth. In addition, the degree to which entrants contribute to aggregate productivity growth depends on their share in total industry value added (s_{E2}). The contribution of exiting firms is analogous but uses period 1 as base period. The key feature of this decomposition is that the productivity contributions of entry and exit are defined relative to period 2 and 1, respectively. This is an improvement on many other decompositions, which compare all terms to the same base period and therefore either entry, exit, or both are biased (Melitz and Polanec, 2015).

Our data allows us to observe the reasons for entry and exit, for example mergers & acquisitions or 'pure' entry or exit. Using this information we observe groups of firms that entered or exited in specific ways. We can evaluate the productivity contribution of each of these groups by adding additional entry and exit terms in equation (8).

The next section presents the results of the decomposition and examines the survival and growth of new firms.

4 Results

In this section, we first show the developments of entry, exit and churn ratio's since 2006. Secondly, we present our decomposition results using the Melitz and Polanec (2015) decomposition and explore how new firms contribute to productivity growth of industries. We expect that new firms will be, on average, more productive than incumbents and

[12] This is equal to the average firm-level productivity change ($\Delta\Sigma_{P_{et}}$) for all incumbent firms.

thereby contribute to productivity growth. Finally, we examine how new firms' productivity growth develops after they have entered the market.

4.1 Mobility of firms

We use the churn ratio as a simple indicator of an industry's dynamism, which is defined as the sum of entering and exiting firms divided by the total number of active firms in a year.[13] The left panel of figure 1 shows that the churn ratio has declined since 2009, driven by a decreasing trend in the entry rate that dominates the slightly increasing trend in the exit rate.

The right panel shows the churn rate per firm size.[14] The rate has fallen for all types, with the churn rate for large firms falling much earlier. Given its large share in number of firms (81.5% in 2016), micro firms drive the total churn rate.

Figure 1: The churn rates of micro, small and medium-large firms, 2006-2015

(a) All firms

(b) Firm size types

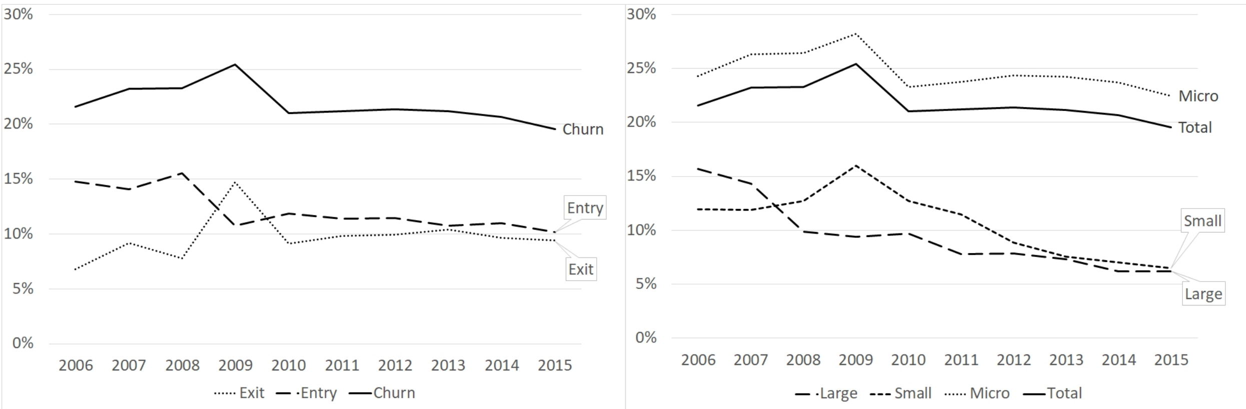


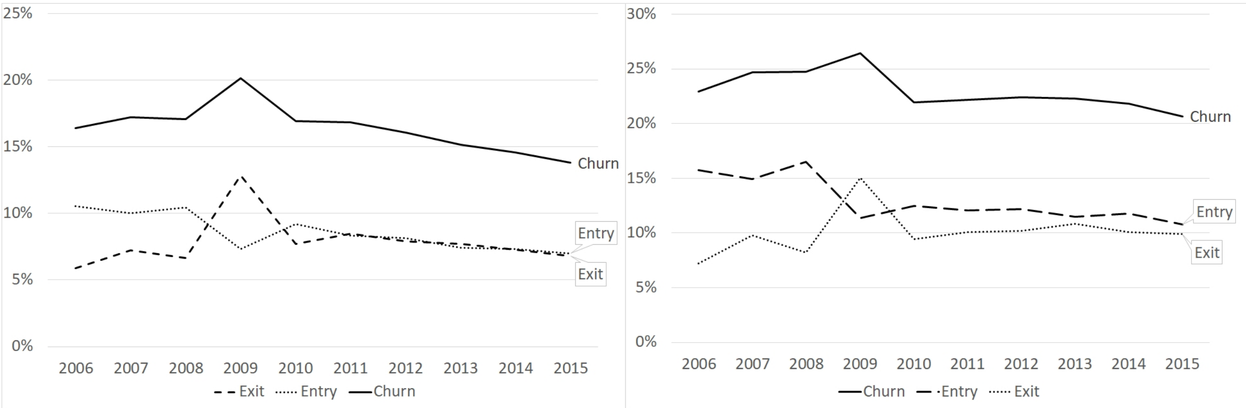
Figure 2 distinguishes between manufacturing and services industries. It shows that in both manufacturing and services, dynamism has declined. The churn rate is higher in services than in manufacturing (20.7% versus 13.8% in 2015). From a peak in 2009, the churn rate has declined more for manufacturing (32%) than for services (22%).

[13]The entry and exit rates include all types of entry and exit: pure entry, mergers & acquisitions, split-offs and restructures.

[14]The total rate is a weighted average of the three components. To facilitate comparison with the total rate, we abstract from firms shifting to another size type. The size types are defined as: micro, with less than 10 FTEs, small, between 10 and 50 FTEs, and medium to large, with more than 50 FTEs.

Figure 2: The entry, exit and churn rates of manufacturing and services industries, 2006-2015

(a) Manufacturing (b) Services



These results show that firm dynamism has declined between 2006 and 2015.[15] Due to the many structural breaks in the database, it is almost impossible to establish a longer, continuous trend over time. For the Netherlands, Calvino et al. (2020), report a declining trend since 2000 for firm entries.

4.2 Productivity Decomposition

In line with the creative destruction model, we expect entry and exit dynamics to contribute positively to productivity growth because firms that enter are expected to be more productive than incumbents, while relatively unproductive incumbent firms are more likely to exit.

We show a decomposition of the average productivity growth (year on year). First, figure 3 displays the contribution of incumbent firms to productivity growth (y-axis), sorted on the x-axis according to industry (the manufacturing industries on the left and the various service industries on the right). The size of the bubble denotes the size of the industry (natural logarithm of its total value added averaged over time).

The contributions of incumbent firms are given by the first two right-hand terms of equation (8). The first term, the unweighted average, indicates how much the average productivity growth within firms contributes to overall productivity growth. The second

[15] It is important to note here that we only include corporations, and not self-employed without employees or sole proprietorship, which have increased in number.

term is the covariance, which indicates how much the reallocation of market share to incumbent firms has contributed to overall productivity growth.

The manufacturing industries show mixed results for unweighted average firm productivity, with some negative and some positive values. However, in almost all service industries, average productivity of incumbents has declined and contributed negatively to productivity growth. For the covariance term (reallocation), the slight positive results for most industries indicate small increases in allocative efficiency, with corresponding positive contribution to industry productivity growth.

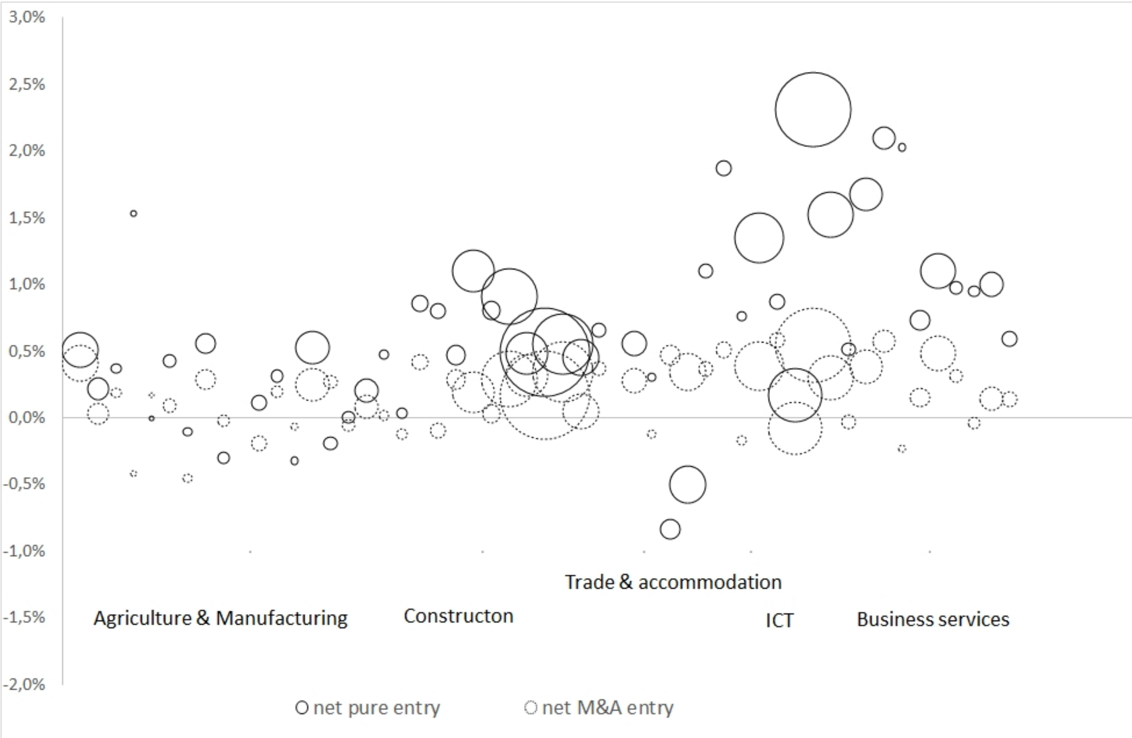
Figure 3: Contribution of incumbent firms to average annual productivity growth (in %-points), 2006-2015, per industry

The bubble size reflects the size of the industry measured by value added.

The negative values in figure 3 may be explained by the 2008-2010 and 2012-2013 crisis periods when productivity growth turned negative. When we exclude these downturns, the unweighted average across all industries is pushed up, but the differences between manufacturing and services industries are maintained.

Figure 4 shows the combined contribution of entry and exit to productivity growth,

Figure 4: Contribution of net entry (pure and M&A) to average annual productivity growth (in %-points), 2006-2015, per industry



The bubble size reflects the size of the industry measured by value added.

i.e. net entry, which is the sum of the final two terms of equation (8). Both pure and M&A[16] tend to contribute positively to productivity growth, in line with expectations from theory. We also observe differences between industries: the contribution of pure net entry is clearly more positive in service industries than in manufacturing. Figures 10 and 11 in the appendix show the contributions to productivity growth of pure net entry and net entry through M&A between 2006 and 2015. In contrast the contribution of incumbent firms to productivity growth, the economic downturns have had little impact, if any, on productivity growth contribution of net entry.

The contribution of net entry due to M&A is more positive in service industries, especially business services. This is despite the share of M&As (in total number of firms) is higher in the manufacturing industry than in services and has increased more strongly.

[16]Entry and exit due to other dynamics, such as firm restructuring, contribute less across the board. The appendix provides the results for these entry types.

Around 90% of all M&As involve firms with fewer than 50 employees. In the manufacturing industry, the distribution is skewed towards larger companies (40% of M&A involve firms with 10-50 employees) while in the service industries, the distribution is skewed towards smaller firms (M&As in 50-70% of service industries involve firms with fewer than 10 employees).

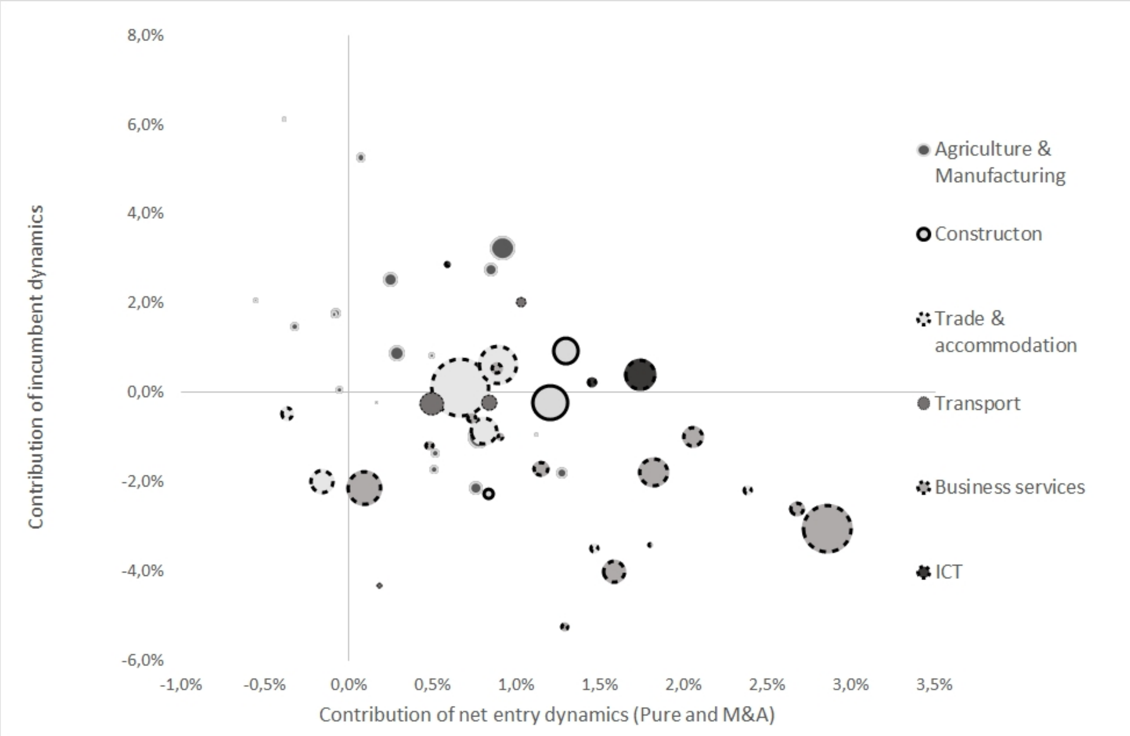
Because the growth in value added shares rather than contributions to productivity growth may drive the results in figure 4, we perform a counterfactual decomposition. In this counterfactual, we keep the value added shares of entry and exit constant across industries so that the contributions only show the productivity of entrants and exiters compared to incumbent firms.

Figure 12 in the appendix shows that keeping the value added shares of entry and exit constant across industries results in less variance between industries. For many of the manufacturing industries, we see fewer negative contributions. Entrants in the manufacturing industry thus contribute to productivity growth, and therefore the lower entry rates we have seen in figure 2(a) can be linked to the slowdown of productivity growth. For many services industries, however, the contributions are less positive in the counterfactual of figure 12. In these services industries, the average value added of entrants has therefore increased.

These results indicate entry and exit dynamics generate more productivity growth in services than in manufacturing industries. At the same time, incumbent firms constitute a drag on productivity growth in service industries. In manufacturing industries, incumbent firms generate productivity growth while net entry dynamics contribute relatively little. To illustrate these findings, figure 5 combines the figures 3 and 4 to relate the contributions of incumbent firms to the combined contribution of pure and M&A net entry. The overall image shows a negative relation; in industries where net entry dynamics contribute more to productivity growth, the contribution of incumbent firms tends to be lower. This negative relation is based on industry differences: the bottom right is mostly populated by business service firms, while the top left features mostly manufacturing industries.

In conclusion, there is a clear industry difference in the productivity growth contributions from 2006 to 2016. For manufacturing, incumbent firm dynamics contribute most to productivity growth, and net entry dynamics tend to be small. In services, the opposite is true, the contribution of entry and exit dynamics is mostly positive while incumbent firms on average reduce productivity growth. Other industries (agriculture and construction) fall somewhere in the middle, with positive contributions of net entry and ambiguous contributions of incumbents.

Figure 5: Average annual productivity growth contributions of incumbent firms and net entry (in %-points), 2006-2015, per industry



4.3 Productivity growth over the lifespan of firms

In this section we focus the analysis by examining the productivity growth of entrants in the first years of their lifespan. Following an 'up-or-out' dynamic, new firms either become more productive in the years after entry or leave the market when their productivity remains low. At the same time, it is possible that high productivity entrants exit the market because they are bought by larger incumbent firms. In this case, we would observe a high correlation between productivity and exit through mergers or acquisitions for entrants.

Table 1 shows information for the first six years of entering firms across industries. We compare the dynamics of firms entering through pure entry and M&A (i.e newly combined firms). It shows for each age cohort their average sales, productivity growth, and the total hours worked by employees. Pure entrants are smaller but tend to have higher TFP and output growth than firms that entered through M&As. Post-entry productivity growth across years is higher for manufacturing firms than those in the business services industry (not shown in the table). This difference holds for pure entry firms, but not for firms that

Table 1: Average characteristics of entrants as they age, 2006-2015

Age	N	Gross output (euro)	Hours worked	Annual TFP Growth
	(a) Pure entry			
1	62995	1125	8500	
2	61858	1286	9523	15%
3	50637	1361	10385	15%
4	40505	1566	11234	14%
5	32227	1586	12080	14%
6	24723	1570	13178	13%
older		1811	15206	12%
	(b) M&A Entry			
1	18196	6818	38204	
2	17425	6815	52943	10%
3	15125	6470	53595	8%
4	12763	6892	56729	9%
5	11049	7661	64394	8%
6	9687	7823	68385	9%
older		10746	97390	10%

entered through M&A.

We continue by exploring for each industry how productivity levels of young firms compare to older firms. To explore this, we relate firm age to firm productivity-levels: for each industry we run the following regression.

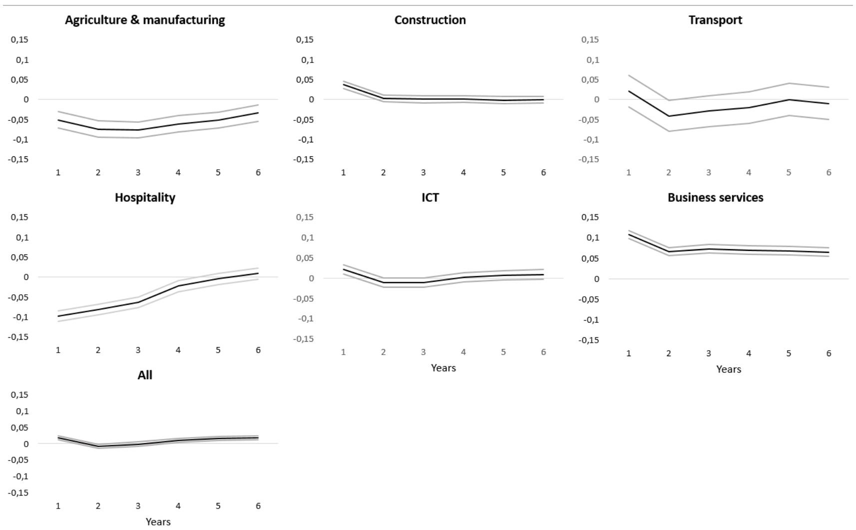
$$TFP_i = \beta_0 + \sum_y \beta_y(age_y) + \delta_t + \eta_s + \epsilon_i \tag{9}$$

where age_y is a set of dummies indicating firms of ages 1 through 6, making firms older than 6 the reference group in these regressions. δ_t and η_s are time and industry-fixed effects. In figure 6 we show the results of this regression. The figure shows how productivity levels of young firms, under six years compare to average productivity of older firms.[17]

The results show that across the board, the productivity of young firms converges to that of older firms in the same industry. However, some differences between industries stand out. Young firms in business services tend to have a *higher* productivity than older incumbents. This productivity advantage appears to decline only very slowly over time. In contrast, young firms in agriculture, manufacturing and certain services industries tend

[17]The cut-off age of six years is chosen, given the length of our sample. The age of firms is defined independent of the mode of entry.

Figure 6: Productivity development of entrants compared to incumbents of over six years old, per broad industry category



Results of regression in equation 9, with 95% confidence interval. Table 5 in the appendix shows the numerical regression results.

to have a much lower productivity, on average, than older incumbents. However, this gap is made up for by faster average productivity growth, i.e. catching-up. To find out whether this is due to faster productivity growth of young firms, or due to unproductive young firms dropping out, we explore both possibilities.

First, to analyse the productivity growth of young firms, we compare the average productivity growth of individual entrants and incumbents over the entire period they are observed. We now define entrants as firms that enter during the period 2006-2016, and define incumbents as firms already present in 2006. We focus on the same industries used in the decomposition. We use the following regression equation for pure net entry and M&A net entry separately:

$$\Delta averageTFPgrowth_i = \beta_0 + \sum_s \beta_s (Entry_{iq} * Industry_s) + startyear_t + \eta_s + \epsilon_i \quad (10)$$

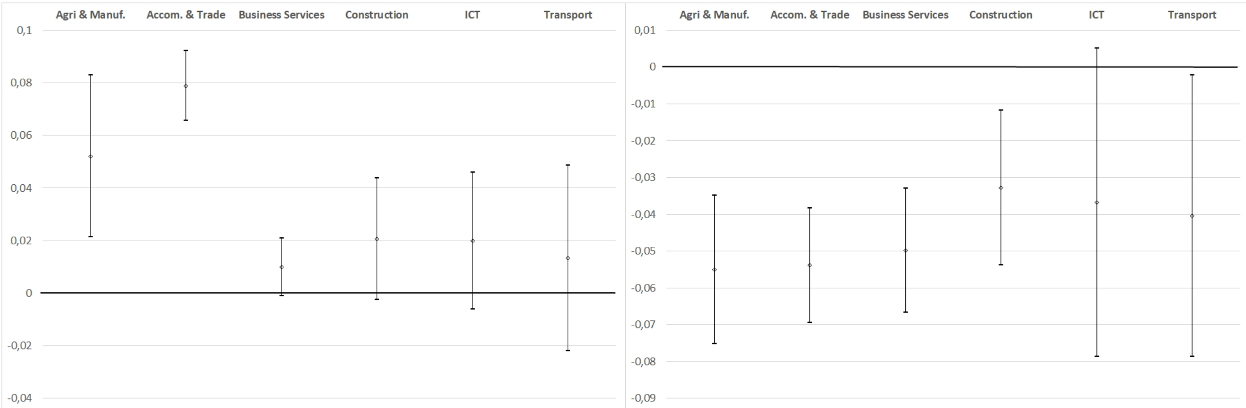
where q indicates different entry types: pure and M&A. The regression uses industry fixed effects and controls for entry-year of entrants (which is set at 2006 for existing firms).[18] Dummy variable $Entry_{iq}$ equals one when firm i enters the market through mode q at any

[18]In this and the next regressions, the fixed effects are specified to be industry-specific.

point during 2006-2016. This is interacted with an industry indicator $industry_s$. Panel (a) of figure 7 shows the results of this regression and compares average TFP growth performance of pure entrants and older firms per industry. Panel (b) of figure 7 shows the same for M&A entrants. The full regression results are shown in appendix table 4.

Figure 7: Difference between TFP growth of entering firms (post entry) and other firms, across industries, 2006-2015

(a) Pure entry (b) M&A net entry



95% confidence interval.

We find that overall, pure entrants have higher productivity growth than older firms, but especially the two categories of industries 'Agriculture & Manufacturing' and 'Accommodation & trade'. In the other industries (business services, construction and ICT), the growth difference between entrants and older firms is much smaller, and insignificant.

M&A entrants tend to experience lower productivity growth than older firms, on average. This is perhaps unsurprising, given the high number of M&As that are unsuccessful, for various reasons (Schenk, 2007). Interestingly, this finding seems to hold for all industries in roughly equal measure, though it is not significant in the last two industries.

Second, we explore the possibility that faster average productivity growth of young firms is due to unproductive young firms dropping out, which is in line with the up-or-out dynamic. To explore this, we use a logit regression for the following log-odds equation.

$$log\frac{P(exit_{iq}=1)}{1-P(exit_{iq}=1)} = \beta_0 + \sum_s \beta_s(AverageTFP_i * Industry_s) + startyear_t + \eta_s + \epsilon_i \quad (11)$$

where the likelihood of exit of type q for firm i occurring sometime between entry and the

Table 2: Post-entry probability of exit and firm productivity for pure entrants, marginal effects (2006-2015)

	Pure Exit	M&A Exit
Agri & Manuf.	−0.053**	−0.006
Accom. & Trade	−0.089***	−0.004*
Business Services	−0.008**	0.004*
Construction	−0.177***	−0.008
ICT	−0.092***	0.006
Transport	−0.035*	0.015***
Observations	77 054	64 337

***;**;*: significant at 1,5,10% level. This table shows the average marginal effects of the logit results. In the appendix, table 6 the coefficients and number of exits in each industry are displayed.

end of the sample is predicted by the average firm productivity, for each broad industry. We include both industry and time fixed effects. Table 2 shows the results.

In every industry, less productive entrants are more likely to leave the market through pure exit in the years after entering, indicated by the negative coefficients in column 1 in table 2. There is some variation across industries; for example, the coefficient for the business service industry is small, which suggests an 'up-or-out' dynamic for entrants. We can therefore conclude that faster average productivity growth of young firms is both due to faster productivity growth and to unproductive young firms dropping out.

The relation between productivity and exit due to M&A is different. For most industries, the results are insignificant. For Business services and Transport, there is a positive and statistically significant relationship, which indicates that higher than average productivity entrants are more likely to be acquired, or to engage in mergers.

Incumbents might be acquiring high productivity entrants for different reasons: to prevent future competitors or to benefit from their productivity. This is in line with the superstar-firm idea that powerful incumbents defend their market positions by preventing competition, rather than competing (Shapiro, 2019). While we observe that these firms are exiting due to M&A activity, we do not know which new firms are created through M&A.

The reason that Business Service and Transport industries show these dynamics might be related to the structure of innovation which goes beyond technical innovations (den Butter et al., 2008). In business services, ICT, and to some extent transportation, firms may enter the market with new trade innovations or unique intangible capital, which could be interesting for incumbent firms to acquire. In other industries, intangibles might be less important and innovation might be structured differently. For example, in some industries, incremental innovations may be more important (Crouzet and Eberly, 2019).

4.4 Discussion

We explored how firm dynamics and productivity growth are related across industries. We tested the hypothesis that new firms are on average more productive than incumbents and thereby contribute to productivity growth. If they are not, they exit the market. In addition to this, we expected that more productive entrants are more likely to exit the market through M&As. These hypotheses are in line with the creative destruction and 'up-or-out' theories.

Reflecting a general slowdown in firm dynamism in the Netherlands, entry rates have steadily declined since 2006, more strongly in manufacturing than in services. We find that firm dynamics contribute differently to TFP growth across industries. In services, the entry of firms contributes most to overall TFP growth. In line with the creative destruction hypothesis, entrants in service industries tend to have a higher than average TFP, while exiting firms have a lower than average TFP. The declining rate of entries in services therefore may explain some of the slowdown in TFP growth.

To illustrate this, net entry contributes on average 1%-point to the TFP growth rate across all services industries. A decline in entry and exit of 5%-points, not far off from what we observe since 2006, reduces the productivity growth rate in services with almost 0.25%-points.[19] Since the service sector constitutes over 75% of GDP, this would indicate almost a 0.2%-points lower economy-wide productivity growth.

In manufacturing, TFP growth is driven mostly by incumbent firms while entry and exit dynamics contribute relatively little or even negatively to TFP growth. However, once manufacturing firms have entered the market, their TFP growth tends to be higher than that of incumbents, contributing positively to the aggregate TFP growth, but with small weights. Thus, the declining rate of entries in manufacturing may also explain some of the slowdown in TFP growth. However, this is less straightforward than in services and the impact takes longer to materialise. In both industries, relatively low productivity entrants are more likely to exit in the years after entry. These results are in line with an 'up-or-out' dynamic, particularly in manufacturing.

[19] A decline in entry and exit of 5%-points is equivalent to a decline in the churn ratio of around 25% (see figure 2, panel b), if the distribution of entrants and exiters remains the same, this decline translates to a decline in the contribution to productivity growth.

These results raise the question: why are there such differences between industries in how entrants contribute to productivity growth? An obvious candidate is economies of scale. In services, returns to scale are smaller, and larger firms have less of an inherent productivity advantage (Audretsch et al., 1998). Small service firms may therefore enter the market with a high productivity, while small manufacturing firms become more productive as they grow, showing catching-up.

This is related to specific capital that needs to be invested. In some industries, firms are required to make significant up-front investment, such as in manufacturing industries and service industries like wholesaling and trade that depend on the physical capital and infrastructure that support their business. In business services, computer capital and digital infrastructure are more important. It is easier to set up shop and be productive right after entry when relatively low levels of investments are needed.

The time required to build expertise and raise productivity might also contribute to the differences. This is particularly related to Jovanovic (1982), who suggests firms engage in learning after entry and actively pursue productivity enhancing investments. Such investments might on average be more abundant or relevant in manufacturing industries than in many services industries. Iacovone and Crespi (2010) suggest that building firm-level technological capabilities is important for catching up.

A further possibility comes from Melitz and Redding (2021), who argue that international trade might affect firm dynamics, particularly in open economies like the Netherlands. The manufacturing sector is inherently more trade-able than most services industries. Firms in manufacturing therefore compete with a larger set of (international) competitors. It is possible therefore that manufacturing firms require more scale and learning to be able to compete with the set of incumbent firms at the international frontier. This frontier might be less relevant for new firms and incumbents in services.

Other potential explanations for industry differences include: intensity of intangible capital use (De Ridder, 2019) and the IT-intensity (Aghion et al., 2019). The issue of what leads to the differences in firm dynamics between industries is an open issue to which many factors might contribute. We leave this question to future work.

Mergers and acquisitions contribute positively to TFP growth, more so for services than for manufacturing, although the difference is small. In the service industry, mostly very small firms are involved in M&As, 95% of all mergers involve firms with fewer than 20 employees. In contrast, in manufacturing 95% of mergers involve firms with up to 80 employees. This makes sense when we consider that on the one hand, most service firms are smaller to begin with, and on the other hand, manufacturing firms become more productive as they grow. Why there are relatively more M&As in manufacturing than in the services industry when the productivity gain of those M&As is less seems somewhat paradoxical. Firms engage in M&As for a number of reasons (we will not go into these here, see Junni and Teerikangas (2019) for an overview). One important reason is to reach scale, which is more important in manufacturing industries than services.

An interesting avenue for future research is to explore the dynamics that we document here for other countries. Andrews et al. (2015) show for a wide set of developed countries that firms at the productivity frontier (i.e. with the highest productivity growth), are slightly younger on average than those that lag behind. van Heuvelen et al. (2018) document the same for the Netherlands but only for service industries, not for manufacturing. This is in line with our findings that young firms in services tend to be more productive than incumbents on average. This might indicate that the creative destruction dynamics we find for services is more widely applicable in other countries.

Related, compared to other OECD countries, young firms in the Netherlands grow relatively slowly (in terms of jobs) (Calvino et al., 2016). This might be because manufacturing makes up a larger part of the economies of other countries, and we find that young manufacturing firms experience more rapid growth (in terms of productivity, at least). To our knowledge, no previous work has explored the heterogeneity between industries in terms of firm dynamics and productivity in a cross-country setting. Further research in this area will shed more light on whether our results hold more generally, or if these dynamics are specific for the Netherlands.

Finally, our results are highly relevant for the recent developments in business dynamics due to the lock-downs and government support measures related to the Covid-19 pandemic. These developments have possibly led to further reductions in firm dynamics as support measures have kept firms afloat. This might have implications for productivity growth, particularly in the services sector. Additionally, measures such as lockdowns and social distancing have had very different effects across sectors, again likely significantly altering the firm dynamics with associated productivity growth effects. How these and other developments related to the Covid-19 pandemic (like increased working from home) affect firm productivity and the link between productivity and firm dynamics, remains an open question. This and other questions are for future work.

5 Conclusion

Our results show that firms in different industries contribute differently to TFP growth. Generalising, we find that service firms contribute to productivity growth when entering the market, and manufacturing firms after entering the market. In manufacturing, entrants tend to be less productive than incumbent firms but show catch-up behaviour, increasing their productivity much faster than incumbent firms, which contributes to productivity growth. In services, the gap in productivity growth between entrants and incumbents is much smaller, and only marginally significant.

These differences in how firm dynamics contribute to productivity growth can be explained by economies of scale, how industries are structured, and their production technologies. More research is needed to identify explanations for these differences, such as technology (ICT-intensity) or human capital investments. We leave these for future work.

However, some policy recommendations do emerge from our findings. Facilitating firm learning and investing in technical capabilities are important building blocks. Encouraging start-ups to adopt and make use of innovations will be an important building block. Investing in skills, especially ICT, will be important in this regard. Furthermore, our results are highly relevant for policies aimed at keeping firms alive, like the recent Covid-19 related firms support measures. A downside of this type of policies is the disturbance of creative destruction, which remains an important source for productivity growth, particularly in services.

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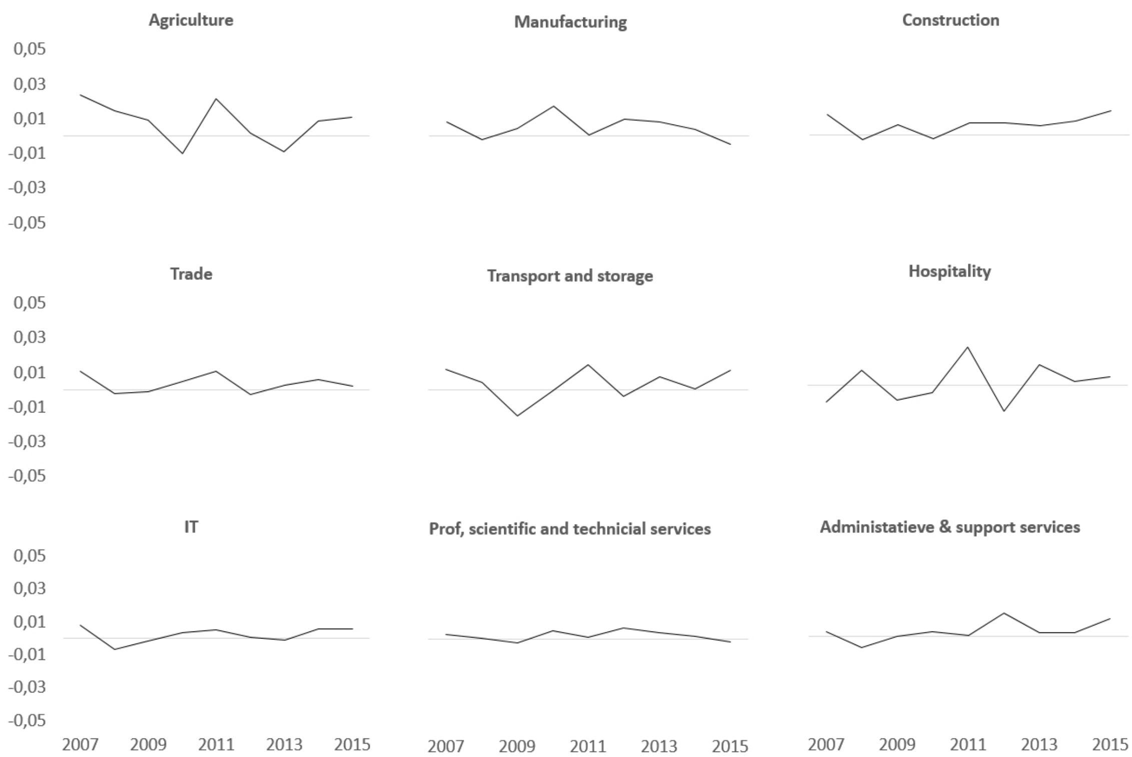
Appendix Tables & Figures

Figure 8: Changes in unweighted average firm productivity, 2006-2015 for nine broad industries

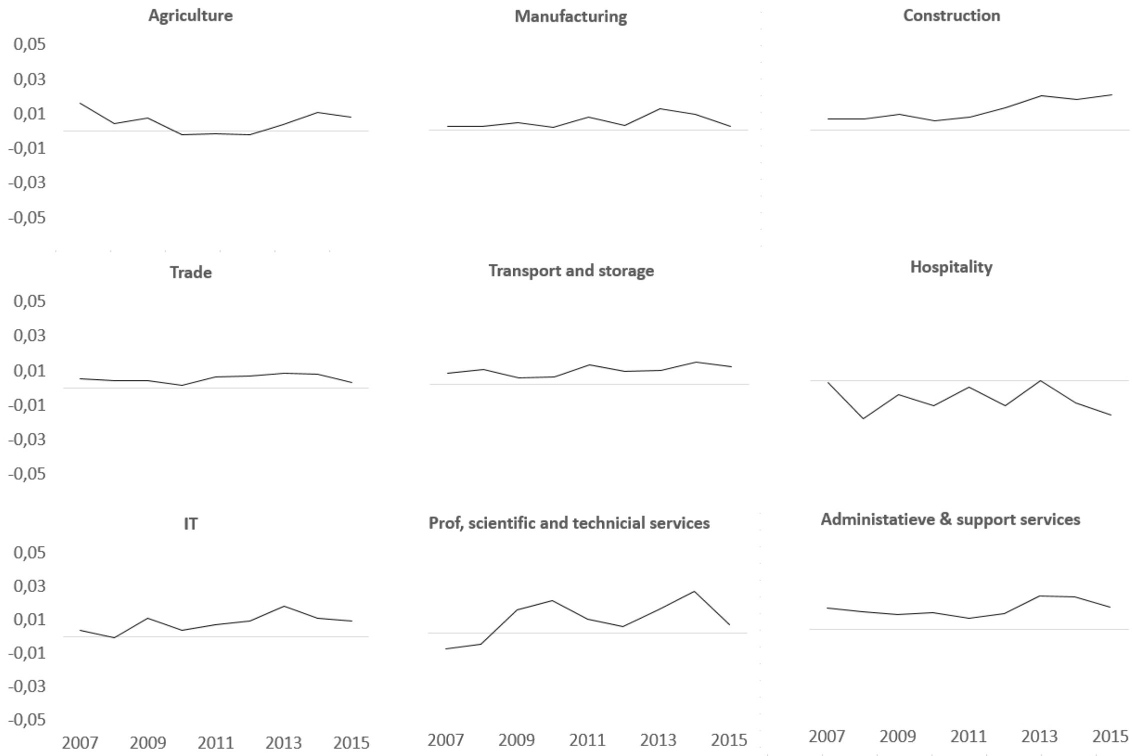
Note that the y-axis ranges from 0.15 to -0.15

Figure 9: Changes in productivity growth contribution of reallocation, 2006-2015 for nine broad industries



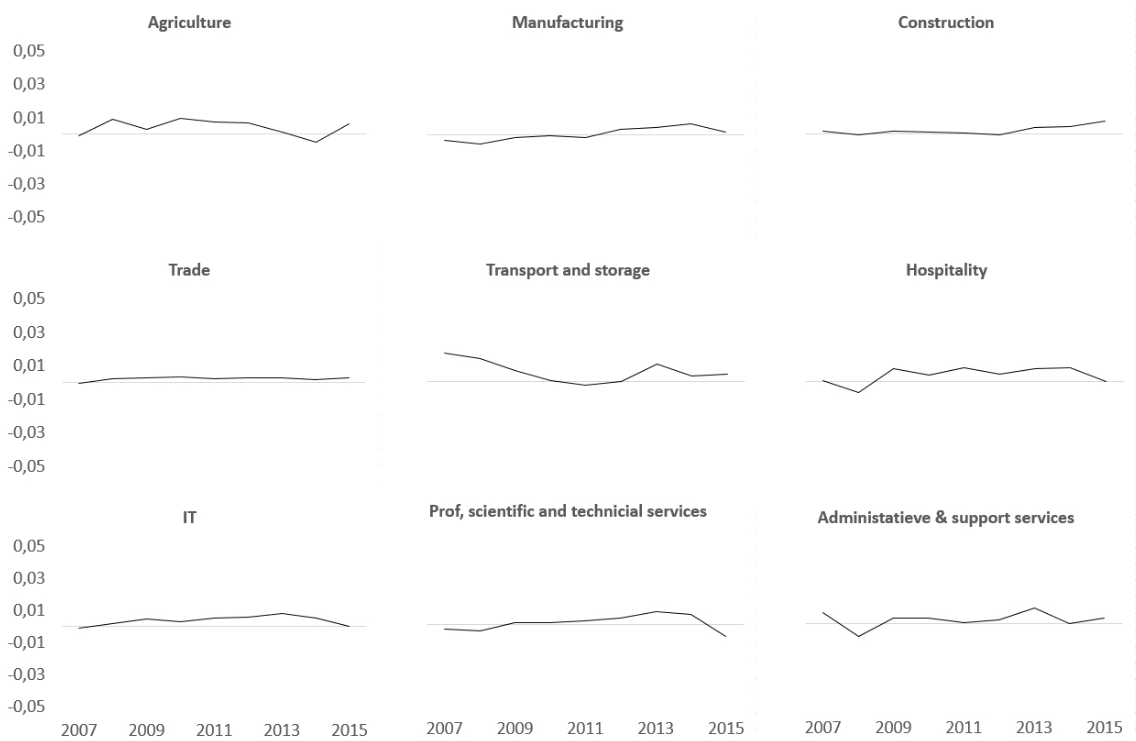
Note that the y-axis ranges from 0.05 to -0.05

Figure 10: Changes in productivity growth contribution of pure net entry, 2006-2015 for nine broad industries



Note that the y-axis ranges from 0.05 to -0.05

Figure 11: Changes in productivity growth contribution of M&A net entry, 2006-2015 for nine broad industries



Note that the y-axis ranges from 0.05 to -0.05

Figure 12: Contribution of incumbent firm dynamics to average annual productivity growth, 2006-2015, per industry (constant value added shares)

Table 3: List of 2-digit SBI industries

SBI / ISIC	Description
1	Crop and animal production, hunting and related service activities
10	Manufacture of food products
13	Manufacture of textiles
14	Manufacture of wearing apparel
15	Manufacture of leather and related products
16	Manufacture of wood and of products of wood and cork, except furniture; articles of straw and plaiting
17	Manufacture of paper and paper products
18	Printing and reproduction of recorded media
20	Manufacture of chemicals and chemical products
21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	Manufacture of rubber and plastic products
23	Manufacture of other non-metallic mineral products
24	Manufacture of basic metals
25	Manufacture of fabricated metal products, except machinery and equipment
26	Manufacture of computer, electronic and optical products
27	Manufacture of electrical equipment
28	Manufacture of machinery and equipment n.e.c.
29	Manufacture of motor vehicles, trailers and semi-trailers
30	Manufacture of other transport equipment
31	Manufacture of furniture
32	Other manufacturing
33	Repair and installation of machinery and equipment
41	Construction of buildings
42	Civil engineering
43	Specialised construction activities
45	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	Wholesale trade, except of motor vehicles and motorcycles
47	Retail trade, except of motor vehicles and motorcycles
49	Land transport and transport via pipelines
50	Water transport
51	Air transport
52	Warehousing and support activities for transportation
53	Postal and courier activities
55	Accommodation
56	Food and beverage service activities
58	Publishing activities
59	Motion picture, video and television programme production, sound recording and music publishing
61	Telecommunications
62	Computer programming, consultancy and related activities
63	Information service activities
69	Legal and accounting activities
70	Activities of head offices; management consultancy activities
71	Architectural and engineering activities; technical testing and analysis
72	Scientific research and development
73	Advertising and market research
74	Other professional, scientific and technical activities
75	Veterinary activities
77	Rental and leasing activities
78	Employment activities
79	Travel agency, tour operator and other reservation service and related activities
80	Security and investigation activities
81	Services to buildings and landscape activities
82	Office administrative, office support and other business support activities

Table 4: Average productivity growth rates of Entrants compared to other firms, by entry, industries

	(1)	(2)	(3)	(4)
	Pure Entry	M&A Entry	Restructure Entry	Other Entry
Agri & Manuf.	0.0521***	−0.0550***	−0.00727	−0.0384
	(0.0157)	(0.0103)	(0.0153)	(0.0419)
Accom. & Trade	0.0789***	−0.053***	−0.0327***	−0.0390
	(0.00675)	(0.00790)	(0.0107)	(0.0306)
Business Services	0.0100*	−0.0498***	−0.0345***	0.0921**
	(0.00557)	(0.00859)	(0.0119)	(0.0456)
Construction	0.0206*	−0.0327***	0.0168	0.0547
	(0.0118)	(0.0107)	(0.0194)	(0.0601)
ICT	0.0199	−0.0368*	0.0121	0.225
	(0.0133)	(0.0213)	(0.0248)	(0.161)
Transport	0.0134	−0.0404**	−0.0727***	0.0918
	(0.0180)	(0.0195)	(0.0260)	(0.115)
Constant	0.131***	0.138***	0.134***	0.134***
	(0.0184)	(0.0191)	(0.0189)	(0.0189)
Observations	236,358	236,358	236,358	236,358
R-squared	0.006	0.005	0.005	0.005

Regressions include entry-year-FE and industry-FE. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Average TFP of firms ages 1-6 compared to older incumbents

Age	All Firms Coefficient	All Firms SE	Agriculture & Manufacturing Coefficient	Agriculture & Manufacturing SE	Construction Coefficient	Construction SE	Transport Coefficient	Transport SE
1	0.0182***	(0.0031)	−0.0512***	(0.0104)	0.0364***	(0.0043)	0.0207	(0.0194)
2	−0.00855***	(0.0030)	−0.0743***	(0.0101)	0.00307	(0.0042)	−0.0414**	(0.0194)
3	−0.00144	(0.0031)	−0.0769***	(0.0101)	0.000105	(0.0042)	−0.0294	(0.0196)
4	0.00963***	(0.0032)	−0.0609***	(0.0101)	0.000434	(0.0043)	−0.0201	(0.0199)
5	0.0152***	(0.0032)	−0.0521***	(0.0100)	−0.00176	(0.0043)	−0.000576	(0.0201)
6	0.0182***	(0.0033)	−0.0343***	(0.0101)	−0.000787	(0.0043)	−0.00990	(0.0203)
Observations	1,425,943		148,273		153,643		62,152	
R-squared	0.405		0.349		0.279		0.378	

Age	Hospitality/Trade Coefficient	Hospitality/Trade SE	ICT Coefficient	ICT SE	Business Services Coefficient	Business Services SE
1	−0.0983***	(0.0067)	0.0205***	(0.0057)	0.108***	(0.0048)
2	−0.0817***	(0.0066)	−0.0112**	(0.0056)	0.0663***	(0.0048)
3	−0.0628***	(0.0066)	−0.0108*	(0.0057)	0.0729***	(0.0049)
4	−0.0227***	(0.0068)	0.00124	(0.0059)	0.0697***	(0.0051)
5	−0.00452	(0.0068)	0.00635	(0.0060)	0.0680***	(0.0053)
6	0.00832	(0.0069)	0.00891	(0.0062)	0.0648***	(0.0055)
Observations	458,742		103,710		499,423	
R-squared	0.416		0.288		0.381	

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 6: Post-entry probability of exit and firm productivity for pure entrants (2006-2015)

	(1) Pure Exit	Exitshare (%)	(2) M&A Exit	Exitshare (%)
Agri & Manuf.	$-0.355**$	57	-0.0202	12
	(0.148)		(0.0773)	
Accom. & Trade	$-0.562***$	66	0.0247	11
	(0.0522)		(0.0317)	
Business Services	$-0.0448**$	68	$0.0704***$	14
	(0.0188)		(0.0266)	
Construction	$-1.034***$	66	0.041	12
	(0.135)		(0.119)	
ICT	$-0.622***$	66	0.178	12
	(0.105)		(0.118)	
Transport	$-0.248*$	64	$0.216***$	12
	(0.138)		(0.064)	
Constant	$-0.314*$		$-2.636***$	
	(0.176)		(0.285)	
# Observations	82428		82393	
# Exit	17197		4509	

Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Exit through restructuring and other entry are rather rare at around 0.5%, those results are therefore excluded here.