Exit and Entry Dynamics of UK Firms in the Wake of the Global Financial Crisis

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Abstract

This paper investigates the dynamics of entering and exiting firms in determining the long-lasting drop in aggregate Total Factor Productivity (TFP) following the Great Recession in the UK. We decompose the growth rate of UK industry productivity over the 2006-2014 period into four components; the within, the between, the entry, and the exit effect employing the Diewert and Fox (2010) method using the FAME micro-level dataset. The main factor driving the aggregate TFP decline is the within effect, which is the productivity decline within surviving firms. However, the entry and exit effects also significantly contribute to the long-lasting drop in aggregate TFP. First, exiting firms tend to have higher than average TFP. Second, newly entering firms tend to have lower than average TFP. And third, newly entering firms fail to increase their TFP levels over time, thereby depressing the within effect.

Keywords: Great Recession, Firm Dynamics, United Kingdom, Total Factor Productivity, Credit Rationing

JEL Code: D24, E13, E32

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1 Introduction

At least since Robert Solow's contribution to the theory of economic growth in 1956, economists have argued the only factor facilitating sustainable long-run economic prosperity is Total Factor Productivity (TFP). Consequently, during times of economic distress, researchers assign a high degree of urgency in understanding productivity dynamics, and why policymakers try to find solutions that would improve the business environment. Notably, even after almost 15 years since the end of the Great Recession in the United Kingdom, productivity dynamics from that period are still somewhat unclear. The so called *Productivity Puzzle* remains to be an elusive concept which stands to be fully understood and explained. It is therefore this paper's aim to extend the analysis by Gerth et al. (2025), who analyzed the Great Recession experience of the United Kingdom in terms of resource allocation. The analysis finds that static resource misallocation could only marginally account for the devastating downturn in TFP during that period. Moreover, preliminary evidence suggests that entry and exit dynamics of firms might play a key role in allocating resources from productivity rich towards productivity poor firms.[1, 2]

A number of researchers have been attempted to analyze Britain's financial crisis experience from a productivity perspective. Using a structural model that allows for the heterogeneous distribution of firms and wages, Dacic and Melolinna (2022) discuss the importance of allocation of real wages during the Global Financial Crisis (GFC) in the United Kingdom. The authors find that rigidities in the wage-adjustment process led to drops in TFP for British firms. Martin and Riley (2024) find that the post-crisis performance in the UK was worse compared to a sample of advanced economies. However, the pattern of stagnation was similar. Using the MULAMA model, Jacob and Mion (2022) argue that demand factors, instead of supply factors, were responsible for the sharp contraction and later stagnation in TFP in the UK. Focusing on labor productivity, Mason et al. (2018) focus on the dynamics between labor productivity and the UK's skill base. The authors conclude that a lack of capital investment and a deterioration in the human skill set were responsible for the slowdown in UK productivity potential compared to a sample of its peers.

Contrary to that, Bryson and Forth (2015) find that increased labor market rigidities, in response to increased unionization, actually improved productivity allocation. With the help of a discrete search model, Audoly (2024) strengthens the argument that the allocation of labor is fundamental for the productivity level of an economy. He argues that the productivity level of firms should determine the productivity level of the worker. However, labor market frictions might distort this matching process during adverse economic shocks. A drop of UK productivity of almost 20% can be accounted for by credit market imperfections, according to Besley et al. (2022). The authors argue that this led TFP away from its long-term trend, not recovering until the end of their sample period. Kierzenkowski et al. (2018)'s findings coincide with the aforementioned analysis in that they argue that structural, instead of cyclical factors, caused the UK's productivity shortfall. Interestingly, the authors broke down the UK economy into its diverse sectors and found a productivity slowdown in the financial sector even before the onset of the GFC. Using a production function approach, Wronski (2019) concludes that productivity dynamics have been negative since the late 1970s. However, with the wake of the GFC, a lack of capital deepening, financial frictions, and a slowdown of international trade were the most important legacies affecting productivity growth.

An obvious shortcoming of the above literature is the lack of attention given to the idea of *Creative Destruction*. This is somewhat surprising since Schumpeter almost a century ago conceptualized the relationship between competition, productivity endowments, and firm survival. Ever since, economists all around the world have been applying his ideas to understand productivity dynamics and business cycle fluctuations. Nickell et al. (1992) analyzes TFP for a panel of manufacturing firms in the UK. They find that as firms compete with each other for a limited amount of resources, only those with a technological advantage are going to survive and prosper. Nishimura et al. (2005) developed the Natural Selection Mechanism of Economic Darwinism which, for Japanese firms in the 1990s, emphasized the relevance of efficient resource allocation of entering and exiting firms on the overall productivity potential of an economy. While Baily et al. (1992) began to decompose economy-wide productivity into firm-level endowments during normal recessions, Foster et al. (2016) examined whether the same dynamics held true for recessions that were defined by financial and credit market frictions. For the US economy, the authors found that the speed of reallocation of production factors was closely linked to productivity. Further, financial frictions can lead to bottlenecks in credit allocation, as well as bank forbearance and the creation of zombie firms.

In line with the findings of the latter authors, Fukao and Kwon (2006) also document the breakdown of the creative destruction hypothesis. Analyzing the lost decade in Japan, they found that the economic metabolism, or the allocation of production factors towards more productive firms, was low, leading to a severe and long-lasting drop in aggregate TFP for the Japanese economy. Using a structural model of credit demand for the UK, Anderson et al. (2019) elicit the importance of credit constraints and the creation of Zombie firms for the UK economy during and after the GFC. Similarly, while analyzing the UK economy with the help of the albeit static Olley-Pakes covariance measure, Riley and Bondibene (2016) found that cleansing and reallocation worked well for normal recessions, but broke down after the Great Recession. Further, using a

[1] For an empirical and structural analysis of the importance of TFP during financial crises see Gerth and Otsu (2015, 2018).

[2] Another paper analyzing how the Global Financial Crisis created havoc is Gerth and Temnov (2021). The authors empirically showcase how misaligned monetary policy can lead to instabilities in the real estate market of an economy.

difference-in-difference approach for the Australian economy, Zeng (2021) finds that incumbent firms play a bigger role towards aggregate TFP than entering and exiting ones.[3] Lastly, in terms of policy implications, Crafts (2019), Andrews and Cingano (2014), and Claessens et al. (2010) emphasize that the factors and dynamics that govern firm productivity are vital for effective government and financial resource allocation. With combined uncertainties over critical factors in both the Great Recession and later Brexit, optimal policy decisions require evidence-based analyses of how best to foster economic growth and firm productivity in the UK. Governments otherwise risk repeating similar mistakes in allocating scarce resources to failing or zombie firms, while allowing high-performing enterprises to leave the market.

Given the findings and limitations of Gerth et al. (2025), the theoretical and empirical insights on the importance of creative destruction, and the concern of economic policy emphasized in previous literature, this paper documents the quantitative effects entering and exiting firms have on aggregate TFP. In this respect, we decompose industry productivity levels into four components: the within, the between, the entry, and the exit effect.

In the first step, we find that the main factor driving the aggregate TFP decline is the within effect, which is the productivity decline within surviving firms. However, the entry and exit effects also significantly contribute to the long-lasting drop in aggregate TFP. First, exiting firms tend to have higher than average TFP. Second, newly entering firms tend to have lower than average TFP. And third, newly entering firms fail to increase their TFP levels over time, thereby depressing the within effect.

In a second step, TFP evolution of entering firms and the probability of exit for incumbent firms is regressed on time and firm age for the former and on three different financial variables for the latter. The variables that are intended to capture financial distress in the economy are i) turnover, ii) operating income, and iii) asset cover. This is done in order to shed light on the mechanism that allowed low-productivity firms to enter and survive, and forced high-productivity firms to leave the economy.

The regression analysis shows that, first, even if accounting for age and time, newly entering firms do not keep up with the positive productivity growth of incumbents. Second, firms with a higher availability of internal finance have a lower probability of exit and firms with a higher debt-to-asset ratio have a higher probability of survival.

These findings support two theoretical arguments that may explain the crisis and post-crisis experience of the UK economy in terms of aggregate TFP. The first one is the *credit constraints* argument that discusses the lack of funds for highly productive small and young firms in favor of already established less productive firms. The second is the *zombie-lending* issue which claims that during financial turmoil highly-indebted low-productivity firms have their loans rolled over in order for banks to maintain a clean balance sheet, thereby restricting the flow of funds towards their most productive use. These findings fit well with the theoretical contributions by Midrigan and Xu (2014) and Caballero et al. (2008) that model severe crisis episodes through the lens of heterogeneous agent DSGE models with adjustment frictions.

Our study contributes to the literature on financial crises in at least two distinct ways. First, it is the first to measure the effect of firm turnover (exit and entry) during the financial crisis on the UK economy to assess its importance in the recession starting at the end of 2007. And second, its analysis is not restricted towards a subset of sectors in the economy, but considers each and every single one in the examination of the UK economic experience during the Great Recession.

The work by Riley et al. (2015) is closely related to this study. However, both differ in scope. First, Riley et al. (2015) use the *Annual Respondents Database (ARD)*, which is a survey for firms smaller than 250 employees, whereas our work uses the *FAME* database, see section 2.1. Second, the former authors omit several sectors from the sample, among them the financial sector. As discussed by Kierzenkowski et al. (2018), the financial sector carries crucial information regarding firm dynamics and their connection to aggregate TFP, and hence must not be omitted. Third, Riley et al. focus on the behavior of labor productivity whereas our study's focus lies on multifactor productivity. This is preferred in times of economic unrest since labor productivity is a biased indicator when resource-substitution effects exist, (Nishimura et al., 2005).[4] Last, while their dataset contains establishment-level data, the current dataset covers firm-level data. Nakajima et al. (2000) and Nishimura et al. (2005) argue that, compared to firms, establishments do not account for indirect non-productive activities and therefore are a biased measure in determining firm survival.

The paper proceeds as follows. Section 2 introduces the dataset and discusses the decomposition technique used to analyze firm dynamics. The following section implements the quantitative exercise, decomposes the *within* effect into its components, thereby leading closer to a detailed understanding of the crisis period, and regresses the probability of exit on several financial variables that support theories of a decline in aggregate TFP during financial crises. Section 4 discusses the results and leads towards structural models that potentially explain the crisis and post-crisis experience of the UK economy. The last section concludes.

[3] Other empirical studies that analyze the breakdown of the creative destruction hypothesis on a micro-level basis with macroeconomic consequences are, among others, the articles by Griffin and Odaki (2009), Hallward-Driemeier and Rijkers (2013), and Foster et al. (2016).

[4] Also see Geroski and Gregg (1997) regarding increased capital and labor reallocation during recessions, and Field and Franklin (2014) and Harris and Moffat (2016) for the importance of TFP as driver of labor productivity.

2 Methodology

2.1 Data

The *FAME* (Financial Analysis Made Easy) database is a firm-level census commercialized through the Bureau Van Dijk, an information and business intelligence company that specializes in firm-level data around the world. The available version of the data set consists almost 10 million firms from the years 2006 to 2015. Its coverage ranges from the United Kingdom (England, Wales, Scotland, Northern Ireland), the Republic of Ireland to several crown dependencies. The analysis in this paper focuses on the United Kingdom because after cleaning the dataset, too few observations are left for the Republic of Ireland or for any of the crown dependencies.

The information provided in the dataset covers intelligence on firms' financial and productive activities obtained through their respective balance sheets and income statements. It ranges from the name, address, identification numbers of firms to information about stocks, merger and acquisition details, and intelligence about mortgages held by each individual firm. According to Kalemli-Ozcan and Sorensen (2016), the economic activity reported in this micro-dataset covers 70 to 80 percent of the economic activity reported by the national consensus in *Eurostat*. It contains large and small firms from all sectors in the economy (agricultural, manufacturing, service, mining and quarrying, utility, construction, wholesale and retail, public sector), as well as, publicly-traded and privately-owned companies. All of the almost 99 2-digit industries are represented in this database, including the finance industry.

In order to prevent downloading the entire dataset, a preselection is done. That is, only firms that are located in the UK are selected. Moreover, for at least one year between 2006 and 2014 the individual firm is required to have a value for each of the variables used in this study. This decreases the sample size from almost 10 million to about 104,000 observations. Variables that are downloaded are the company name, primary UK SIC code, firm's location, date of incorporation, number of employees, fixed assets[5], profit (loss) per period[6], the interest paid[7], depreciation[8], remuneration[9], directors' remuneration[10], whether having consolidated or unconsolidated accounts, and taxation per firm per period respectively.

Value Added for firm i in time t is constructed as follows:

$$\begin{aligned} VA_{it} = {} & \textit{Profit (Loss) for Period}_{it} + \textit{Interest Paid}_{it} + \textit{Taxation}_{it} \\ & + \textit{Depreciation}_{it} + \textit{Remuneration}_{it} + \textit{Directors' Remuneration}_{it}. \end{aligned}$$

And the total wage bill for firm i in time t is:

$$\textit{Total Wage Bill}_{it} = \textit{Remuneration}_{it} + \textit{Directors' Remuneration}_{it}.$$

To prevent nonsensical results and outliers in the data set, several cleaning steps are performed. Firms which are not resident in the UK, with no SIC code or with missing information, that is not due to exit, are erased. Firms with consolidated accounts are kept and with unconsolidated accounts are left out. This is done to prevent double counting. To be consistent, the same is done for firms that change their accounts from being unconsolidated to consolidated during the 2006-2014 period. To deal with potential outliers in the data, the sample is trimmed at the top and bottom 1% for fixed assets, value added and TFP. To prevent the firm that is cut off from reappearing, each observation that is erased in any year is taken out for the remaining years. Firms with a negative VA for any of the years are also deleted for the whole sample period. Moreover, industries consisting of only 1 firm and industries with a labor share of bigger than 1 are also dropped. The result is an unbalanced panel of more than 40,000 observations within the 2006 to 2014 period.

Aggregate TFP is computed by consolidating the firm-level variables with the following aggregator; $\widehat{TFP}_t = \frac{\sum_{i=1}^{M} \widehat{Y_{i,t}}}{(\sum_{i=1}^{M} \widehat{K_{i,t}})^{\alpha}(\sum_{i=1}^{M} L_{i,t})^{1-\alpha}}$. Where $\widehat{Y}$ is detrended firm value added, $\widehat{K}$ is detrended firm capital stock, and L firm labor input. From firm i to the total amount of firms in the sample M.

Figure 1 shows that aggregate TFP in the UK drops by almost 7% with the onset of the Global Financial Crisis. It slightly recovers in 2010 to drop again to more than negative 10% compared to its pre-crisis trend level.[11] The black line is aggregate TFP computed with aggregate *Eurostat* data. Even though the firm-level dataset exhibits a slightly bigger drop in TFP at the beginning of the crisis period and a slightly smaller thereafter, its pattern is similar and therefore arguably the firm-level analysis will give unbiased results. Figure (2) shows TFP decomposed into the two main sector of the British economy, manufacturing and services. The analysis shows that it is important to distinguish productivity measures.

Since the aim of this paper is to document the quantitative importance of entry and exit dynamics during the Great Recession, Figure (3) shows the *Churn Rate* and Figure (4) shows the relative productivity endowments of entering and exiting firms. The former displays the change in entry, blue line, and exit, black line, as fraction

[5]Fixed assets contain tangible assets like land, buildings, plants, and vehicles; intangible assets; and investments. By incorporating intangible assets this study is in line with the Eurostat definition of fixed assets.

[6]Profit (loss) for period consists of profit (loss) after tax plus extraordinary items plus minority interest.

[7]Interest paid to bank, on hire purchase, on leasing, and other interest paid.

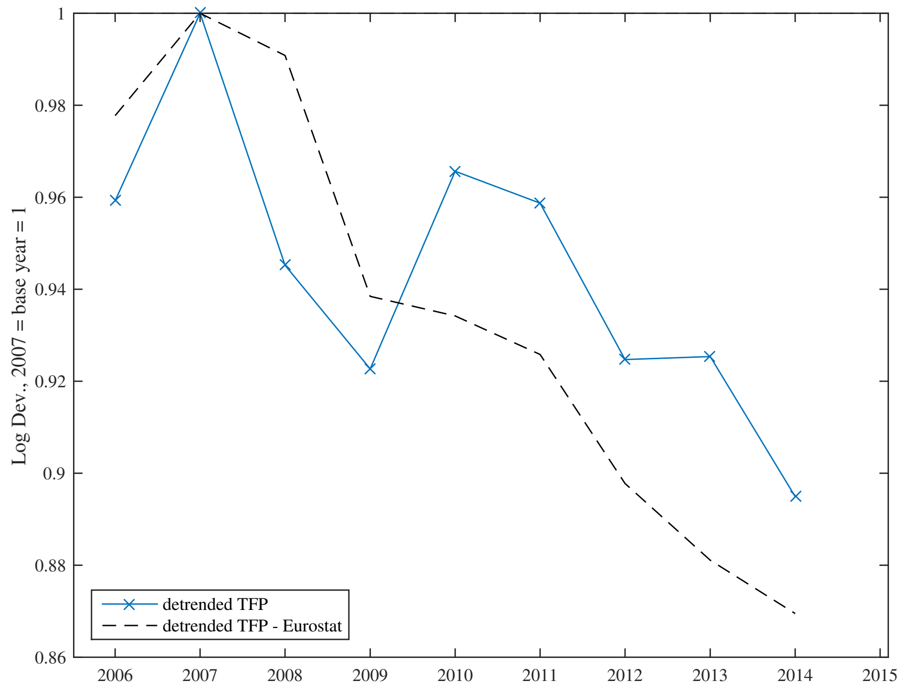
[8]Depreciation on owned assets, on other assets, and impairment on tangibles.

[9]Remuneration consists of wages and sales, social security costs, pension costs, and other staff costs.

[10]Directors' remuneration consists of directors' fees, pension contribution, and other emoluments.

[11]The annual trend growth rate was taken to be 2.23%. It is derived via computations through aggregate data obtained from *Eurostat*. See Gerth and Otsu (2018) for more detail.

Figure 1: Aggregate TFP for the UK between 2006 and 2014 period



Note: aggregate $\widehat{TFP}_t = \frac{\sum_{i=1}^{M} \widehat{Y_{i,t}}}{(\sum_{i=1}^{M} \widehat{K_{i,t}})^{\alpha} (\sum_{i=1}^{M} L_{i,t})^{1-\alpha}}$. *Where M is the number of firms in the entire economy.*

of total firms. The number of entering firms increases from 2008/09 until 2013/14. The exit rate, on the other hand, decreases over the same time period. Therefore, *net entry*, the red line, keeps steadily rising until 2012/13 and only slightly drops thereafter. Figure (4) features the absolute productivity endowment for entering, blue line, and exiting firms, black line. What can be recognized is that with the exception of 2010, weighted firm-level productivity of exiting firms is far above that of entering firms. This may be an indication of a slowdown in the metabolism of the UK economy, or a worsening in the allocation of resources from productivity high-towards productivity-low firms, (Fukao and Kwon, 2006).

2.2 Productivity Decomposition Technique

The Diewert and Fox (2010) technique is shown in Equation (1):

$$\Delta P_t = \sum_{i\epsilon S} \bar{\theta}_{S,i} \Delta p_{i,t} + \sum_{i\epsilon S} \Delta\theta_{S,i,t}(\bar{p}_i - \bar{P}_S) + \sum_{i\epsilon N} \theta_{i,t}(p_{i,t} - P_{S,t}) - \sum_{i\epsilon X} \theta_{i,t-k}(p_{i,t-k} - P_{S,t-k}). \quad (1)$$

Where P_t is log of industry-level productivity, $\theta_{i,t}$ is the firm-industry share for firm i and sums up to 1, and $p_{i,t}$, is log of firm-level productivity. S are the surviving firms, or the firms that are present in $t-1$ and t, N are the entering firms, or the firms that enter in t, and X are the exiting firms, or the firms that exit in $t-1$ and are therefore not present in t. A bar over the variable signifies the time average over the base and end year, i.e. $\bar{\theta} = \frac{\theta_1+\theta_2}{2}$.[12]

Equation (1) decomposes the growth rate of industry productivity into four different factors; first, $\sum_{i\epsilon S} \bar{\theta}_{S,i} \Delta p_{i,t}$, which is the share weighted *within effect*, or the effect of productivity growth within surviving firms. Using a share-weighted mean leads to a more representative average productivity in the sense that it does not overemphasize the effect small firms have on the productivity distribution. Second, $\sum_{i\epsilon S} \Delta\theta_{S,i,t}(\bar{p}_i - \bar{P}_S)$, which is the *reallocation* or *between existing firms* effect and explains how the market share is reallocated between surviving firms with different productivity levels. Third, $\sum_{i\epsilon N} \theta_{i,t}(p_{i,t} - P_{S,t})$, which is the entry effect, or the effect entering firms have on the growth in industry-level productivity. And fourth, $\sum_{i\epsilon X} \theta_{i,t-k}(p_{i,t-k} - P_{S,t-k})$, which is the exit effect, or the effect exiting firms have on the change in productivity. It is important to note for the entry and exit effects, the former is compared to surviving firms at the time of entry and the latter with surviving firms at the time of exit. Disregarding this, as other decomposition techniques do, would introduce a bias that overestimates net entry if industry-wide productivity is decreasing.[13]

[12] The averaging of output shares and productivity levels over the beginning and end periods is done to remove random measurement errors in output and inputs.

[13] Some frequently used decomposition techniques that introduce that bias into their algorithm are Baily et al. (1992), Griliches and Regev (1995), and Foster et al. (2001).

Figure 2: Sectoral TFP for the UK between 2006 and 2014 period

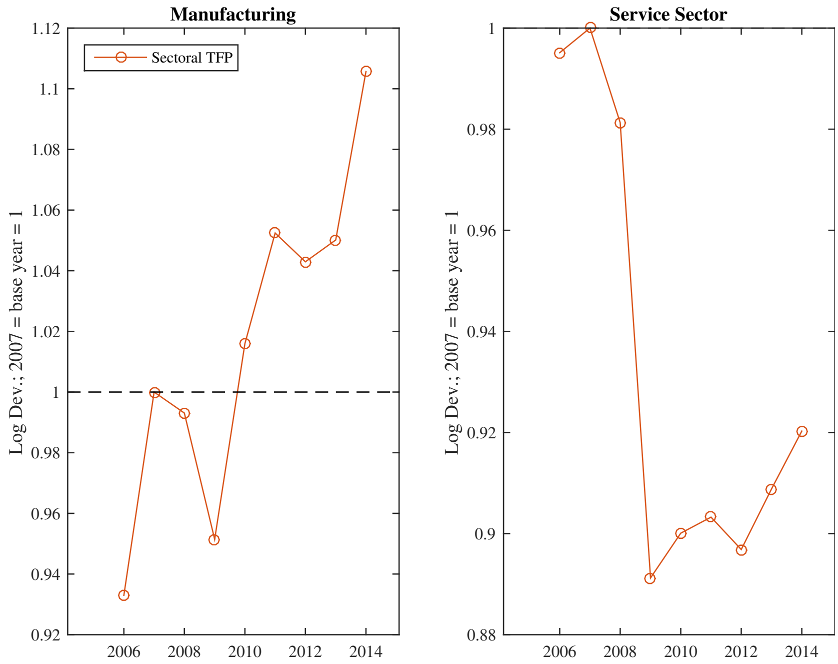


Table 1: DF (2010) decomposition table - Economy

Time	TFP gain (in %)	Effects (in %)			
		Within	Between	Entry	Exit
2006-2007	4.12	4.67	0.03	-1.54	0.95
2007-2008	-4.80	-3.58	0.25	-0.94	-0.52
2008-2009	-3.35	-3.78	-1.26	1.97	-0.28
2009-2010	5.26	6.09	-1.17	1.52	-1.18
2010-2011	0.73	2.38	-0.15	-0.51	-0.99
2011-2012	-0.93	1.07	-0.11	-1.06	-0.83
2012-2013	0.97	1.24	-0.32	0.50	-0.46
2013-2014	0.31	3.03	0.07	-1.70	-1.09

3 Firm dynamics, aggregate TFP, and the Global Financial Crisis

3.1 Decomposition Results

Economy Table 1 shows the results for the whole economy. Several things are of importance: i.) The *within* effect is the most dominant effect and leads overall productivity. ii.) While initiating the initial drop and subsequent recovery, the *within* effect drops and remains depressed until the end of the sample period. iii.) The *between* effect only plays a minor role.[14] iv.) Exiting firms permanently dampen productivity growth and v.) entering firms work with and against the productivity cycle. Finally and surprisingly, vi.) *exit* and *entry* seem only to have small effects towards the productivity evolution.

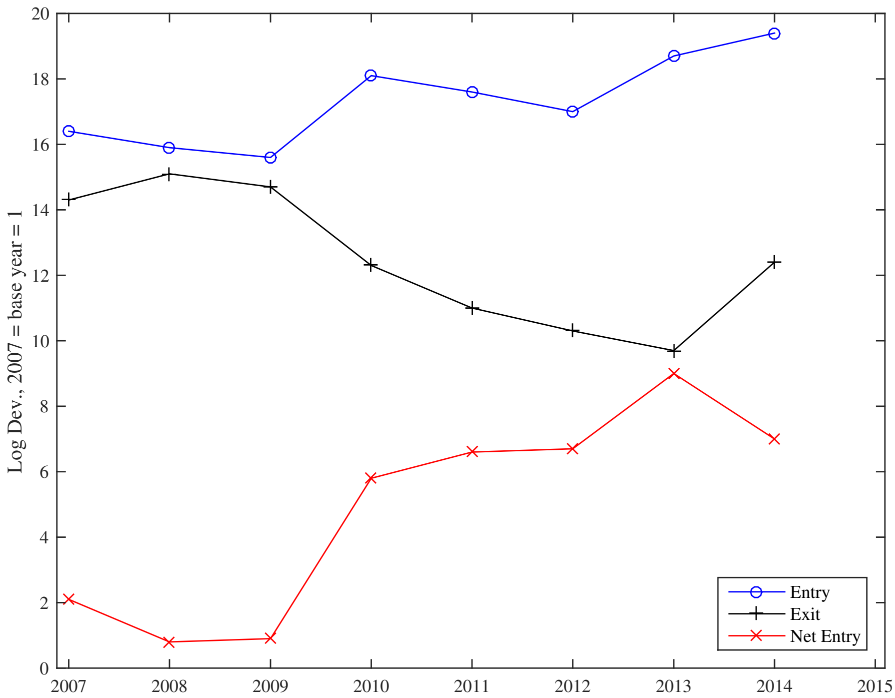
Sectoral Analysis - Manufacturing and Service Sector Table 2 shows the DF decomposition results for the manufacturing sector. In case the *within* effect is much more volatile than for the entire economy, ultimately leading to a more volatile *between* effect. *Exit* and *entry*, fifth and sixth columns, show a working with and against the leading *within* effect. However, their values are small and most of the time oscillate around zero.

The analysis of the service sector, Table 3, is similar to the analysis for the entire economy. That is, the productivity drop is much more severe and occurs without substantial recovery. Also, the *within* effect is smaller than for the MP technique, implying that the influence of small firms is more dominant in the service than in the manufacturing sector. Regarding *exit* and *entry*, in all but one cases do exiting firms contribute to a worsening in productivity growth, whereas entering firms do, depending on the time period, contribute positively and negatively towards TFP. The effect of *net entry*, however, is stronger than for the economy as a whole.

Sectoral Analysis - Service Sector decomposed

[14]The *between* effect only being marginally negative implies that resources where only minimally channeled from relatively high-productivity firms towards relatively low-productivity firms. Therefore, static misallocation only plays a minor role, see Gerth et al. (2025) for a closer discussion on that subject.

Figure 3: Churn Rate



Note: The years t on the horizontal axis are the change from year t-1 to t.

Table 2: DF (2010) decomposition table - Manufacturing Sector

Time	TFP gain (in %)	Effects (in %)			
		Within	Between	Entry	Exit
2006-2007	8.39	6.60	-0.11	0.05	1.85
2007-2008	-1.57	-4.16	1.74	-0.04	0.89
2008-2009	-2.63	-0.52	-0.83	-1.20	-0.07
2009-2010	8.91	8.08	-0.40	0.00	1.23
2010-2011	1.48	1.42	0.49	-0.32	-0.10
2011-2012	1.29	3.32	-0.80	-0.11	-1.12
2012-2013	-6.12	-1.83	-0.81	-0.96	-2.52
2013-2014	2.25	0.04	0.23	2.20	-0.22

Financial Sector The second column in Table 4 shows the massive productivity rise in the build up of the crisis in the financial sector and its deep and prolonged downturn. It is notable to see that the *within* effect initiates the slump in 2007-2008 and 2008-2009, together with the *between* effect in the latter year, but becomes positively depressed for the remaining crisis years. *Net entry*, on the other hand, kicks in a year after the onset and continues to considerably dampen productivity growth until the end of the sample period.

Services without Finance Table 5 shows the same analysis as above for the service sector not including financial services. It shows that TFP drops much less for non-financial services and even recovers over and above its pre-crisis level. The reason for the downturn has less to do with the *within* effect, but more with the *between* and *net entry* effect.

3.2 Decomposing the *Within* Effect

By extending the static misallocation exercise, Gerth et al. (2025) suggests that the dynamic behavior of firms must be taken into account to explain UK productivity dynamics during the Great Recession. Furthermore, the author argues that it is the entry of low-productivity firms that not only prevents aggregate TFP to recover, but also drags production efficiency down until the end of the sample period. Those findings, however, initially seem to contradict the contemporary results in section 3.1, where the *within* effect dominates the behavior of aggregate productivity and where *entry* only plays a minor role.[15] Since the dataset and the data manipulations used in both studies are the same, a solution has to be found that brings harmony to both empirical findings.

Figure 5, therefore, shows the decomposition of the *within* effect. The orange line shows the effect for firms that survive throughout the crisis period, and the blue line shows the effect for firms that enter the sample at

[15]Even though the *exit* effect is permanently negative, see Table 1, it is not big enough, in absolute value, to explain the long-lasting slump in productivity.

Table 3: DF (2010) decomposition table - Service Sector

Time	TFP gain (in %)	Effects (in %)			
		Within	Between	Entry	Exit
2006-2007	3.08	4.15	0.47	-2.97	1.43
2007-2008	-3.11	-1.41	-0.19	-1.20	-0.31
2008-2009	-3.31	-4.11	-2.18	4.12	-1.14
2009-2010	2.67	5.66	-1.91	1.08	-2.16
2010-2011	0.56	3.28	-0.44	-0.96	-1.33
2011-2012	-2.63	2.02	-1.03	-2.45	-1.17
2012-2013	5.16	2.06	0.00	1.82	1.28
2013-2014	-2.18	4.45	-0.70	-4.24	-1.70

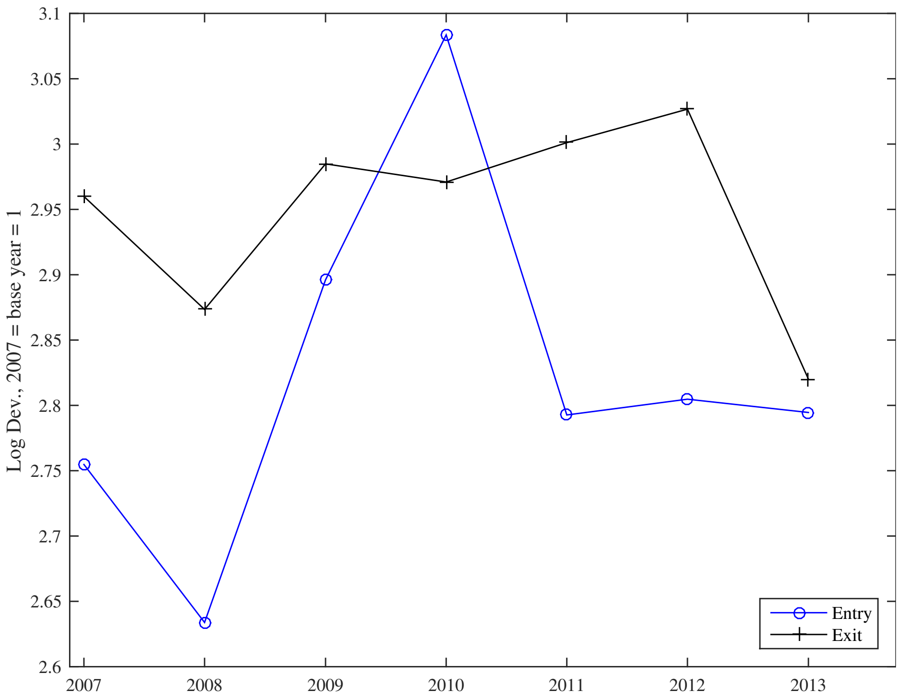
Table 4: DF (2010) decomposition table - Service Sector - Financial Sector

Time	TFP gain (in %)	Effects (in %)			
		Within	Between	Entry	Exit
2006-2007	16.43	10.80	5.51	-4.36	4.48
2007-2008	-9.69	-9.15	-0.91	-0.49	0.86
2008-2009	-21.91	-7.95	-10.59	2.13	-5.50
2009-2010	-0.30	4.65	-3.35	4.10	-5.69
2010-2011	-15.68	1.92	-0.64	-9.81	-7.14
2011-2012	-8.97	1.21	-3.05	-6.05	-1.09
2012-2013	5.96	3.79	0.28	0.98	0.92
2013-2014	-7.81	3.57	-5.79	-5.97	0.38

Table 5: DF (2010) decomposition table - Service Sector - Services without Finance

Time	TFP gain (in %)	Effects (in %)			
		Within	Between	Entry	Exit
2006-2007	-1.08	2.08	-1.11	-2.54	-0.48
2007-2008	-1.17	0.88	0.02	-1.41	0.66
2008-2009	1.58	-3.11	0.03	4.65	-0.01
2009-2010	3.43	5.92	-1.54	0.30	1.25
2010-2011	4.29	3.60	-0.39	1.07	-0.01
2011-2012	-1.18	2.21	-0.57	-1.62	1.19
2012-2013	4.97	1.65	-0.06	2.02	-1.37
2013-2014	-0.64	4.69	0.70	-3.76	2.27

Figure 4: Entry and Exit Productivity Endowments



time t. It is obvious that for firms that enter sometime after the onset of the crisis, the corresponding *within* effect declines throughout the sample period. For surviving firms, on the other hand, productivity initially drops but thereafter recovers and even keeps on growing until the end of the sample period. This analysis shows that by controlling for the age of a firm, entering firms cannot keep up with the productivity growth of surviving firms, but rather lead to a downwards trend in the *within*-firm effect by remaining in the economy without exiting.

There is an obvious caveat with the just discussed analysis, that is, firms may exit again one or more periods after their entry, and this may therefore drive the conclusions stated above. Due to this reason Table 6 shows the regression model in equation (2) that not only controls for age, but also for time and firm size.

$$\Delta TFP_{i,t} = \alpha + \beta_1 * year_{i,t} + \beta_2 * age_{i,t} + \beta_3 * size_{i,t} + \beta_4 * (year * age)_{i,t} + \epsilon_{i,t}. \quad (2)$$

Where *year* captures the time of entry for firm i, *age* the age of the firm conditional on entry, and *size* is the amount of employees the firm has.[16]

The results in Table 6 confirm that conditional survival, conditional on recent entry, and a slowdown in productivity are statistically related to each other. The variable *age* is significant at a 1% level and has a value of -0.025. This means that firms conditional on entry experience a yearly average TFP drop of 2.5%. This reconciles the findings in section 3.1 about the importance of the *within* effect and the findings of Gerth et al. (2025) about the importance of *exit* and *entry*. The variable *size*, albeit very small, also is statistically significant, however only at a 10% level. Accordingly, firm size only marginally contributes towards TFP growth. Controlling for the year, at the top of Table 6, shows us that the date of entry does not play a role in TFP growth of entering firms. Except for the first interaction term, *2009*age*, all other interaction terms are insignificant. Implying that firms entering in 2009 had an additional TFP deficit of 7.8% if they survived for an additional period.

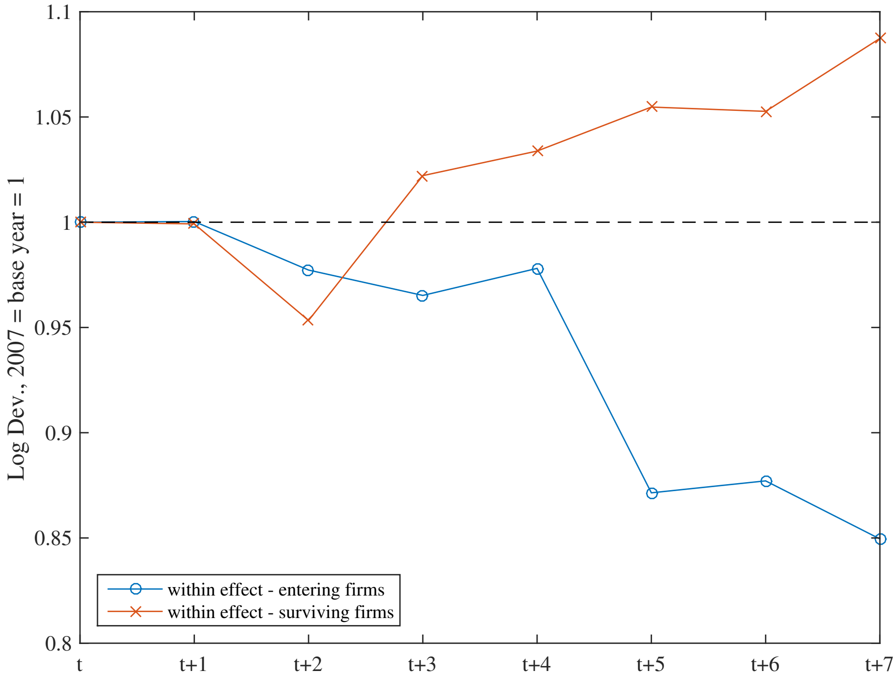
3.3 Firm exit and financial constraints

Table 3 shows that with the beginning of the Great Recession, productivity endowments of exiting firms were permanently higher than for surviving firms. This, however, is contrary to established economic theory which suggests that only low-productivity, low-profitability firms should exit in times of economic unrest while high-productivity, high-profitability firms should grow and gain market share.[17] The current section therefore tries to explore whether financial variables are responsible for the reversal of the *creative destruction* effect.

Due to *right censoring* of the data, conventional econometric techniques will lead to inconsistent and biased parameter values, (Esteve-Perez et al., 2004).[18] It is therefore that a *survival model* is used to determine the

[16] To define firm size with the amount of employees is in the spirit of Haltiwanger et al. (2013).
[17] See section 1 for detailed discussion.
[18] Right censoring exists because two different types of firms exist; firms that exit sometime during the sample period and firms that will remain in the economy even though the sample reached its last observation point. Conventional econometric techniques see the end of the sample period as a point where all firms are forced to exit, and therefore lead to inconsistent and biased results.

Figure 5: Within Effect decomposed - Entry vs. Survivors



Note: total $\widehat{TFP}_t = \frac{1}{N}\sum_{i=1}^{N} TFP_{i,t}$. *Where* TFP *is firm-level productivity and* N *is the amount of firms within the particular sample, either surviving or entering firms.*

Table 6: *Within* effect decomposed

Independent variable:	Coefficient Values:
2009	0.049
	(0.055)
2010	0.003
	(0.043)
2011	0.020
	(0.036)
2012	-0.026
	(0.031)
2013	0.001
	(0.029)
2014	0.021
	(0.027)
age	-0.025***
	(0.004)
size	-1.85e-06*
	(1.02e-06)
years*age	
2009	-0.078*
	(0.029)
2010	-0.015
	(0.016)
2011	-0.016
	(0.01)
2012	0.002
	(0.007)
2013	-0.002
	(0.006)
2014	omitted because of collinearity
Constant	0.129***
	(0.024)
Observations (firms)	10,666

*Notes: Robust standard errors clustered at the firm level are displayed in round brackets. *statistical significant at 10 per cent; **statistical significant at 5 per cent; ***statistical significant at 1 per cent.*

effects of financial variables on the probability of exit.[19] The model chosen is the Cox Proportional Hazard (CPH) model, (Cox, 1972).[20] CPH is a semi-parametric approach in that it is non-parametric in respect to time, but parametric in the effects of the covariates on the probability of exit. Hence, it is less restrictive than a fully-parameterized model, (Carreira and Teixeira, 2011). Its purpose is to determine the probability of exit over time, conditional on exogenous variables and the aforementioned data restrictions.

$$\begin{aligned} h(t|x_{i,t}) = h_0(t) * \\ exp(\beta_1 * size_i + \beta_2 * TFP_i + \beta_3 * assetcover_i + \beta_4 * turnover_i \\ + \beta_5 * operatingprofit_i + \beta_6 * z_{j,t} + u_{i,t}). \end{aligned} \tag{3}$$

The left-hand side in equation (3) shows the *hazard* or *failure rate*, $h(t|x_{i,t})$. This is the firm's instantaneous escape rate from operation conditional it has survived until today, t, and conditional on exogenous covariates, x_i.[21] $h_0(t)$ is the baseline hazard function and equals the hazard rate if all covariates are equal to zero. It captures the conditional probability of having survived until t.[22] $exp(.)$ is the exponential of the parameters β_{x_i} times the covariates $x_{i,t}$. Three sets of covariates are included in the model. First, firm-control variables; $size$ and TFP capture firm size and TFP endowments, respectively. Second, industry-control variables; $z_{j,t}$ takes account of non-observed differences across industries j. This is done by including random effects which capture within-group correlations that are not observed and may affect the conditional probability of exit. Last, financial variables that may influence firm survival; i) *turnover*, ii) *operating profit*, and iii) *asset cover*. Where i) is a proxy of the firm's sales and ii) is a proxy for its operating cash-flow. Both variables are meant to measure a company's potential independence from formal lending channels by approximating the amount of internal funds available. Therefore, economic theory suggests that the higher *turnover* or *operating profit*, ceteris paribus, the lower the risk of exit. iii) is a proxy for the *leverage* of a firm. That is, the higher the asset cover -debt over assets- the higher a firm's leverage, or the higher its need to finance its operations externally. For the *creative destruction* hypothesis to hold, the coefficient for the variable *leverage* needs to be positive. That is, everything else equal, firms with a higher debt-to-asset ratio should be more financially constrained during financial crisis and therefore more probable to exit. A negative coefficient value, however, would indicate that firms which are relatively more indebted are kept alive by supplying them with external funds. $u_{i,t}$ is a standard error term.

Table 7 presents the results for equation (3).[23] On first sight, all variables are statistically significant at a 1% level. The variable *employees* is barely bigger than 1 and therefore implies that bigger firms are only marginally more probable to exit the sample. The variables *turnover* and *operating profit* are smaller than one, 0.857 and 0.894 respectively, and therefore suggest that firms with more internal financial capital are 14.3% and 10.6% less likely to exit the economy. The same applies for the variable *asset cover*, which indicates that firms with a higher debt-to-asset ratio will exit the sample 12.4% less often than firms with less debt relative to internal assets. This is contrary to the *cleansing effect* discussed at the beginning of this article and will be an important lead in finding the right structural model in section 4. TFP, on the other hand, has a value of 1.481, which implies that firms that are relatively more productive also exit the sample 48.1% more frequently. The variable *Theta* shows the significance of the random effects. Since its p-value is 0.00 it can be concluded that the random effects model is justified.

4 Discussion

4.1 Entry Margin

Many economists argue that if market outcomes are efficient, entering firms will always be more productive than incumbents. Others reason that since young firms are small they will end up with less capital per worker, (Van Biesebroeck, 2005), and therefore lower TFP, but will quickly reach the same productivity levels since productivity growth is higher for newly entered firms than for settled incumbents.[24] The previous section has not only contradicted the former argument by showing that the TFP level of entering firms sometimes contributes to the growth of aggregate TFP in the economy and sometimes to its contraction, but also the latter argument. That is, by decomposing the *within effect* it shows that young firms cannot match TFP

[19]For a discussion about the appropriateness of survival models see Mata and Portugal (1994) and Esteve-Perez et al. (2004).

[20]CPH is the most widely used model in duration/survival analysis, (Manjón-Antolín and Arauzo-Carod, 2008).

[21]The focus on *conditional* probability taking place over *unconditional* probability is essential in survival analysis, (Kiefer, 1988). That is, the model answers the question of what the probability of exit will be at time t, given the firm has survived until now, and not what the unconditional probability of leaving at time t will be.

[22]The model does not make any assumptions about the shape of the baseline hazard function. This comes at the cost of a loss in efficiency. However, misspecifying $h_0(t)$ can produce unreliable and unstable estimates for β_{x_i}, (Heckman et al., 1984; Dolton and Von Der Klaauw, 1995), and therefore a non-parametric approach is preferred.

[23]Note: A coefficient value bigger than 1 means that the probability of exit increases, whereas a value smaller than one means that the probability of exit decreases. This comes from the exponential function in equation (3). That is, if a coefficient value is equal to 0, the exponent must be 1. Therefore, any positive coefficient value becomes bigger than 1 and any negative coefficient value becomes smaller than 1.

[24]See Tybout (1996), Aw et al. (2001), Huergo and Jaumandreu (2004), and Van Biesebroeck (2005).

Table 7: Firm exit and financial constraints

Variable	Hazard Ratio
employees	1.000047***
	(6.90e-06)
TFP	1.481***
	(0.075)
assetcover	0.876***
	(0.018)
turnover	0.857***
	(0.029)
operatingprofit	0.894***
	(0.023)
Theta	0.083***
	(0.033)
LR test of theta=0: chibar=31.56, Prob>=chibar=0.00	

*Notes: Cox proportional hazard model, with 'ties' handled with the method proposed by Efron (1977). Robust standard errors clustered at the firm level are displayed in round brackets. *statistical significant at 10 per cent; **statistical significant at 5 per cent; ***statistical significant at 1 per cent.*

growth of incumbents, see Figure 5. We therefore suggest that this is due to *binding borrowing constraints* for young firms.

Entering firms are small and initially depend on the formal lending channel in order to finance their operations, (Gertler and Gilchrist, 1994; Robb and Robinson, 2012).[25,26] That implies that the functioning of liquid capital markets are fundamental for the healthy and successful growth in new firms.[27,28] During the financial crisis however, UK bank lending dropped considerably and stayed depressed longer after the initial shock, (Riley et al., 2015). Bell and Young (2010) argue that this was due to a contraction on the supply side of credit instead of a lack in demand, meaning that the cost of available funds considerably rose and the availability of these decreased.[29] According to Iyer et al. (2013), young and small non-financial corporations were especially hit by the freeze in capital in the UK interbank market.[30] In addition to that, young firms that mainly rely on collateralized debt were affected by the drop in house prices, which therefore additionally constrained their lending behavior, (Fort et al., 2013).[31] Both of these occurrences, the dry-up of credit supply and the loss in collateral values, are thought to have contributed to a tightening of credit conditions for young and small firms. This lack of funds may have impaired the TFP level and growth of young firms in two ways. First, potential high-productivity firms were not able to enter the economy and therefore never had the chance to grow in the first place.[32] Second, firms that could enter were hindered from growing and reaching their optimal size. By not being able to grow, average costs did not drop and therefore TFP stayed below its potential level, (Robb and Robinson, 2012).[33]

A structural model that matches our empirical findings on the entry margin is the one by Midrigan and Xu (2014). In their work, the authors estimate a two-sector model to explain aggregate TFP dynamics during productivity and financial shocks. Especially, collateral borrowing constraints lead to a drop in aggregate TFP for two reasons; first, factors of production are allocated towards incumbent firms that have more collateral independent of their productivity endowments. Second, financial frictions impede entry of small and young firms into the economy and prevent them from being able to adopt more productive technologies. Their latter finding matches our empirical finding on the severe and long-lasting drop of UK productivity. As represented in the above sections, empirical results show that it is not always the most productive firms that enter the economy, rather firms that may be big enough in order to pay the sunk cost up front. Furthermore, instead of catching up with the productivity frontier of the incumbent firms, newly entered firms keep on performing

[25] Kochar (1997) argues that the biggest stumbling block for small firms to grow is the availability of credit.

[26] In addition, Lemmon et al. (2008) show that firms maintain a certain persistence in their capital structures and therefore keep on depending on the formal lending channel.

[27] Bond et al. (2003) argue that investment decisions taken by UK firms are more sensitive to their current cash-flow than the ones on the continent.

[28] That is because small firms cannot finance themselves in commercial paper corporate bond or equity markets, (Gertler and Gilchrist, 1994). Furthermore, young firms do not have an established credit record, (Fort et al., 2013), which may help them to overcome the asymmetric information problem. Evans and Jovanovic (1989) build up a model where firms have to gain reputation in credit markets.

[29] Broadbent (2012) and Pessoa and Van Renen (2014) argue that even though central banks lowered base rates, the cost of capital rose during the crisis, owing to the reluctance of banks to lend to the economic sector.

[30] Also see Fort et al. (2013) who argue that it was the small firms that suffered most during the Global Financial Crisis.

[31] Mishkin (2008) emphasizes the importance of the collateral channel and home-equity finance for newly established and young firms.

[32] Riley et al. (2015) note that during financial upheaval capital-intensive firms are less probable to enter and therefore do not have a chance to contribute on aggregate TFP growth.

[33] That the small and the young are the most hit during financial crises is not a novel finding, see Gertler and Gilchrist (1994), Sharpe (1994), and Fort et al. (2013).

badly in terms of their inherent productivity endowments, which may have to do with the fact that young firms are small and cannot pay the sunk cost connected to adopting more productive technologies.

4.2 Exit Margin

A number of empirical studies show that during normal recessions, the productivity level of exiting firms is lower than for surviving firms. They argue for a negative correlation between firm exit and productivity endowments. Contrary to that, the analysis in section 3.1 demonstrates that this was not the case for the UK economy during the Global Financial Crisis. The last column in Table 1 shows that from 2007 onward the productivity level of exiting firms has been higher than for survivors. Nishimura et al. (2005) and Fukao and Kwon (2006) present empirical evidence of the same finding for Japan's lost decade and argue that during severe financial crises highly productive firms are forced to exit the economy due to *zombie lending*.

Zombie lending, or bank forbearance, occurs if financial institutions supply funds to otherwise unsustainable firms. The reason why lenders may engage in evergreening under normal circumstances insolvent borrowers is that, to avert illiquidity, they want to prevent non-performing loans from showing up on their balance sheets. In times of a credit crunch zombie lending leads to a diversion of credit away from firms that should grow and prosper towards firms which should rather scale down and/or exit the market, and therefore ultimately to the obstruction of competition. The result is that companies which are more productive and capable of repaying their outstanding loans do not have their debt rolled over and are forced to exit whereas highly indebted firms are artificially kept alive.

Empirical evidence on the presence of zombie lending for the UK economy is scarce and, if it exists, contradictory. For one, Bryson and Forth (2016) theoretically argue that forbearance of lending may have played a dominant role in the productivity slowdown of the British economy with the start of the Global Financial Crisis. The authors argue that not only has the fraction of loss-making firms risen with the start of the crisis, (Barnett et al., 2014), but also it was the more productive workplaces that shut down from operations in the five years following its onset, (Harris and Moffat, 2014). In addition to that, Pessoa and Van Renen (2014) argue that political pressures within the UK economy may have led to allocation of loans that was not driven by economic fundamentals, but rather by political interests after the government took over the Royal Bank of Scotland. Using a quasi-experimental approach, Anderson et al. (2019) find that distressed UK banks protected highly leveraged, low productivity businesses from failure. Arrowsmith and Griffiths (2013), on the other hand, find that even though forbearance of lending was present during the most severe crisis years, it only accounted for very little in terms of productivity shortages. Their research, however, is founded on a qualitative questionnaire given to bank managers about the health of their loan portfolios, and therefore is not supported by ex post facto observed data.

The statistical analysis above confirms the notion that zombie lending has played a role during the Great Recession in the UK, resulting in relatively more productive firms exiting the market economy. That is, first, Table 7 shows that firms with a higher debt-to-asset ratio are less likely to exit the economy, and therefore were favoured when the amount of credit available contracted. This is contrary to economic theory, in that, firms with higher debt-to-asset ratios are more dependent on external financing and are therefore more threatened if credit conditions in the economy tighten. Second, firms with relatively higher TFP endowments were more likely to exit the economy. The latter contradicting the idea that more productive firms can produce the same amount of output with less inputs, therefore having lower production costs and a higher margin, leading to a decreasing probability of exit. Both findings are contrary to *cleansing effects* and hint towards forbearance of lending to more indebted and less productive firms.

Caballero et al. (2008) have built a model where negative technology, demand, or financial shocks affect the composition of firms on the exit margin.[34] That is, while more productive firms are forced to exit, less productive firms are subsidised and therefore can remain in the economy. This increased presence of zombie firms congests the affected industries and lowers productivity. Even if the credit shock is only temporary, the model's response to the initial drop in job destruction is to only slowly readjust due to the congestion of low-productivity firms. Therefore, temporary shocks can have long-lasting effects.

5 Conclusion

Even in the early 20th century, the importance of low-productivity firms exiting and high-productivity firms entering in the economy and their connection to a beneficial resource allocation was recognized to be fundamental in understanding business cycles. This theory suggested that during economic contractions low-productivity firms should contract and exit thereby freeing factors of production in favor of high-productivity firms that would enter and expand. Admittedly, it was not until about 60 years later that this theory was proven to be empirically true. However, economists argue that during severe recessions -among them financial crises- these so called *cleansing effects* are reversed to favor firms that are not necessarily the most competitive ones.

Understanding the entry and exit dynamics of firms is crucial for policymakers because these dynamics significantly impact Total Factor Productivity (TFP), and economic growth. The entry of new firms can

[34] The model by Caballero et al. (2008) also allows for changes on the entry margin. This section, however, focuses on firm exit.

stimulate competition, encouraging existing firms to innovate and improve their productivity. Conversely, the exit of low-productivity firms can raise the average productivity of the remaining firms. Understanding these effects helps policymakers identify ways to enhance productivity growth. Furthermore, firm entry and exit dynamics can influence how an economy responds to shocks, such as financial crises. As we have empirically shown, for the Great Recession the UK experienced a significant decline in TFP partly due to the exit of high-productivity firms and the entry of low-productivity firms. Understanding these dynamics can help policymakers design interventions to stabilize the economy during downturns. The phenomenon of zombie firms can distort the economy, because unproductive firms continue to operate due to bank forbearance or government support. These firms tie up resources that could be better used by more productive enterprises. Policymakers need to understand and address the factors that allow zombie firms to survive to ensure a healthier economic environment.

It has been the purpose of this paper to analyze whether these *creative destruction* effects have broken down during the Global Financial Crisis and which could explain the long-lasting recession in the UK. The reason why this question seems important lies in the work by Gerth and Otsu (2015, 2018). The authors find that the Global Financial Crisis' severity is unprecedented up to the Great Depression, and that the financial shock has been propagated through the productivity channel into the drop and slump in output, employment, consumption, and investment. An initial investigation has been done in Gerth et al. (2025). There, however, only static misallocation measures were used and ultimately indicated that composition effects have to be taken into account in order to make a qualified judgment about the flow of resources towards or away from their most efficient use.

By using the Diewert and Fox (2010) productivity decomposition technique, four important discoveries have been made; first, the main factor driving the aggregate TFP decline is the within effect, which is the productivity decline within surviving firms. However, the net entry effect also significantly contributes to the long-lasting drop in aggregate TFP. Exiting firms tend to have higher than average TFP. Newly entering firms tend to have lower than average TFP. And, newly entering firms fail to increase their TFP levels over time, thereby ultimately depressing the within effect.

Regression analyses lead towards the direction of *credit rationing* and *zombie lending* as the main mechanism why cleansing effects were reversed until the end of 2014. Future research should focus on models that allow for heterogeneity on dimensions like productivity, net worth, debt-to-asset ratios, and cash-flow. Midrigan and Xu (2014) and Caballero et al. (2008)'s models are examples that theoretically demonstrate our empirical findings. Both emphasize the importance of heterogeneity in firms wanting to enter and expand or being forced to contract and exit. Furthermore, it would be of interest to see whether the recent COVID-19 crisis follows the same pattern or whether strong fiscal support between 2019 and 2022 changed financial and credit dynamics within the UK economy.

The findings are fundamentally important for policymakers to understand business dynamics during financial crises. They shed light on resource misallocation and ultimately long-term economic prosperity, the latter facilitating rising living standards and economic progress. Should credit rationing break down, as was the case during the GFC in the UK, it is in the policy makers' interest to act swiftly in re-establishing frictionless financial markets. Therefore, future research should focus on specific policies that allow more fair and efficient credit allocation during times of an adverse financial cycle. Additionally, the mechanisms upon which credit markets allocate funds to less-productive firms need to be understood in greater detail, as well as the microeconomic mechanisms that restrict systematically efficient credit. Furthermore, it would be of interest to see whether past financial crises follow the same pattern. Lastly, country-difference and -patterns are of great interest to understand and compare. We leave these considerations to future research.

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