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Firm Resilience and Growth during the Economics Crisis: lessons from the Greek depression

**Christos Genakos, Ioannis Kaplanis, Maria Theano Tagaraki,
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Contents

1. Introduction	5
2. Literature review.....	7
3. Data	11
4. Empirical framework	12
4.1 Modelling survival	13
4.2 Modelling firm growth	14
5. Results	14
5.1 Descriptive analysis	14
ICAP dataset.....	14
SOLE Dataset.....	30
5.2 Econometric analysis.....	37
5.2.1 Firm survival.....	37
5.2.2 Robustness	39
5.2.3 Intellectual property rights.....	39
5.2.4 Firm growth	40
5.2.5 Robustness	40
6. Discussion and policy conclusions	41
References	45

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Christos Genakos¹, Ioannis Kaplanis², Maria Theano Tagaraki³
and Aggelos Tsakanikas⁴

ABSTRACT

The global financial crisis that burst in 2008 adversely affected business performance in many countries, especially in Europe. However, the impact of the crisis on entrepreneurship and business dynamics differed amongst countries, depending on their businesses resilience, the policies implemented, but also their predominant productive structure. The magnitude and length of the Greek depression have no precedent among modern middle and high-income economies. Still, to date, there is no systematic analysis of the impact of the crisis on entrepreneurship and business dynamism. This study attempts to fill this gap by examining individual firm, sectoral and regional level characteristics that might affect existing firm resilience and new firm survival rate. We use two sources of data with the most extensive coverage of small (sole proprietorship) and large (other legal status firms) firms containing information on entry and exit in Greece. Matching data from patents and trademarks allow us to examine the interplay between entrepreneurship and innovation. Our analysis focuses on the factors that help or hinder firm survival and growth. We find that the crisis increased the exit likelihood for a firm by 5% to 16%. Larger firms, with significant fixed assets, lower financial leverage, operating in concentrated industries, but also those that are innovation and export oriented tend to have better chances of survival compared to their counterparts. These results are important for designing business policies not only in Greece but also other countries facing similar crises.

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1. Introduction

Firm entry and exit are typically understood as part of what Schumpeter (1934) described as the "creative destruction" process through which older and less efficient firms exit the market and new and more efficient firms enter the market introducing new products and processes. This Darwinian process of dynamic competition is considered an important mechanism that makes markets more efficient and results in better consumer products and services. However, in times of severe economic distress, with collapsed demand and substantial economic uncertainty, this process may push out of the market even healthy or efficient firms leading to a weaker, not stronger, economy overall. The end result might be massive layoffs, rising levels of unemployment and poverty, as well as political turbulence. Which factors make firms resilient to a deep and sustained depression? Is there a role for public policy?

In this paper, we study firm survival and growth by analysing one of the most acute downturn economic crises a country has suffered since the great depression. Greece experienced a significant boom between 1998 and 2007, with real GDP per capita growing by more than 30%, followed by a sustained depression, with real GDP per capita contracting by roughly 20% between 2007 and 2017 (Chodorow-Reich et al., 2021). The magnitude and length of the Greek depression have no precedent among modern middle and high-income economies. The severity is atypical even among economies experiencing sudden stops, sovereign defaults, or leverage cycles (Gourinchas et al., 2016). According to administrative data from the Ministry of Economy in Greece (GEMI), there were 106,000 firm closures and 38,000 openings at the crisis peak in 2011, resulting in an overall reduction of 6% of the total number of businesses in the economy.

However, to date, there is no systematic analysis of the impact of the crisis on entrepreneurship and business dynamism, that has investigated the characteristics of these firms to identify patterns and possible causal links. This study attempts to fill this gap by examining individual firm, sectoral and regional level characteristics that might affect existing firm resilience and new firm survival rate.

A significant contribution of the project is that the analysis is conducted at the firm level and utilises two valuable sources of data with the most extensive coverage of small (sole

proprietorship) and large (other legal status firms) firms containing information on entry and exit in Greece. We gathered microdata from the business registry of GEMI (*“Greek General Commercial Registry”*) for the period 2011-2019, a newly available source of information on the universe of businesses in Greece. To our knowledge, this is the first time the GEMI microdata have been processed and analysed to study individual firm resilience. Furthermore, we utilised microdata from the ICAP database, which contains financial and commercial information for all firms legally obliged to publish their economic accounts for the period 2004-2020, i.e. both before and after the crisis. We matched this microdata with information on industrial property rights, combining information on patents, industrial designs, and trademarks.

The descriptive analysis offers valuable insights on the evolution of the Greek businesses performance before, during and after the crisis, investigating firm entry and exit by size, legal type, sector and region. Furthermore, applying suitable econometric techniques, we examine which firm characteristics – based on the available data - might be crucial to firm’s resilience and growth.

Our analysis focuses on the factors that help or hinder firm survival and growth. We find that the crisis increased the exit likelihood for a firm by 5% to 16%. Larger firms, with significant fixed assets, lower financial leverage, operating in concentrated industries, but also those that are innovation and export oriented tend to have better chances of survival compared to their counterparts.

This is an important conclusion empirically supported by business demographics in Greece. Evidence on the role of such characteristics is important for policy makers not only for the Greek case and possible future policies per se but also for policymakers of other countries facing similar crises. Furthermore, it offers important business implications as it provides evidence for firms on how to strengthen their resilience and follow a strategy that can increase their chance of survival.

The remainder of the paper is organised as follows. Section 2 discusses the relevant literature. Data are presented in section 3, and the empirical framework in section 4. Section 5 presents first a descriptive analysis of the data and then the main results, alongside several robustness checks. Section 6 concludes.

2. Literature review

The ability of firms to adapt to turbulent economic conditions and survive is a key factor for the economies to maintain jobs and households to maintain their incomes. Nevertheless, it is unavoidable that a portion of the firms will not succeed in surviving, and the firm entry and exit that takes place in a period of economic turbulence might serve to restructure the economy and its industries. According to estimates from a range of industries in several countries, approximately 5-10% of the firms exit the market over a single year (Agarwal and Gort, 2002).

This paper follows and contributes to the extensive literature on business dynamics, firm entry and exit and their determinants (Geroski, 1995; Caves, 1998; Cefis and Marsili, 2006; Manjon-Antolin and Arauzo-Carod, 2008). Geroski (1995) offers an early survey of the empirical literature on firm entry and suggests that firm entry might be easier than its survival. Productivity and efficiency seem to affect the probability of survival to a great extent (Cefis and Marsili, 2006). The empirical literature on firm survival has focused on firm characteristics and industry characteristics as possible determinants for a firm's survival. The broad conclusion is that large and older firms perform better (Cressy, 2006; Dunne et al., 1989; Mata and Portugal, 1994). The better chances of larger and older firms for survival can be explained by learning models for industries such as the one developed by Jovanovic (1982), where efficient firms grow and survive. Their experience enables them to attract funding and adapt to new technologies and market needs.

Regarding size, numerous empirical studies find a positive relationship between size and the survival rate of firms (Mata and Portugal, 1994; Audretsch and Mahmood, 1995; Geroski, 1995; Sutton, 1997; Strotmann, 2007). Amongst other explanations, it has been proposed that sizeable firms have lower hazard rates as they tend to operate beyond their minimum efficient scale (Audretsch and Mahmood, 1995). Furthermore, they are also more likely to have more than one plant and thus reduce the risk of full exit in case some plants face difficulties and need restructuring (Esteve and Manez, 2008). On the other hand, there is an earlier proposition (Porter, 1979) that firms that occupy strategic niches in the market can still be successful in surviving, even if they are small. Agarwal and Audretsch (2001) reconcile this proposition with empirical evidence from the U.S. that shows that the relationship

between size and survival rates does not hold for mature or technologically intensive industries. Similarly, a number of authors find that the relationship is non-linear and either becomes insignificant beyond some level (Buehler et al., 2005) or weakens (Cefis and Marsili, 2005; Strotmann, 2007).

Although, in general, firm age is positively related to firm survival, what is called the "liability of the newness" (Stinchcombe, 1965), there have been more nuanced approaches in the literature that, amongst others, suggest a non-linear relationship (Arauzo-Carod, 2008; Rossi, 2016).

According to the proposition of the adolescence liability, the firm's hazard for exit increases and reaches its peak a few years after entry and then declines afterwards. Such a hazard increases once the firm has surpassed an initial "honeymoon period" that is fairly protected due to its initial funding and performance monitoring (Bruderl and Schussler, 1990; Fichman and Levinthal, 1991; Esteve and Manez, 2008; Rossi, 2016). But it has also been suggested that firms, as they become older, lose their ability to adapt to the changing environment and thus face increased risks for their survival, the so called "liability of senescence" (Baum, 1989; Hannah, 1998; Barron et al. 1996; Esteve and Manez, 2008).

Other firm characteristics, such as the legal structure and ownership, have also been investigated for their relationship with firm survival (Harhoff et al., 1998; Mata and Portugal, 2002; Disney et al., 2003; Helmers and Rogers, 2010). Buehler et al. 2005 find that S.A. companies have greater chances to survive due to better funding access than limited liability companies. While Harhoff et al. (1998) find that limited liability corporations tend to have higher insolvency rates than full liability ones. Foreign ownership has also been examined, and the results are mixed. Some studies find a negative effect of foreign ownership on the survival rate (e.g. Gorg and Strobl, 2003; Esteve and Manez, 2007), while others do not estimate significant results (e.g. Mata and Portugal, 2002).

Furthermore, empirical research has documented the lower hazard for exit for firms with high profitability (Audretsch and Mahmood, 1995; Esteve and Manez, 2008), high productivity (Ericson and Pakes, 1995; Melitz, 2003) and low debts (Fotopoulos and Louri, 2000a). Exporting activity has also been linked with firm survival as firms that compete in international

markets tend to be more resilient (Kimura and Fujii, 2003; Esteve et al., 2004; Buehler et al., 2005; Esteve and Manez, 2008).

There is also a growing literature on the relationship between firm survival with innovation and technology advancement (Cefis and Marsili, 2005; see literature review by Ugur and Vivarelli, 2021), as well as firm's human capital (Coleman et al., 2013; Saridakis et al. 2008; Rauch and Rijdsdijk, 2013).

The positive impact of innovation on firm survival has been empirically validated (Fontana and Nesta 2009; Cefis and Marsili 2005), but other studies find mixed results and recommend further research on the subject (Buddelmeyer et al., 2010; Børing 2015). Cefis and Marsili (2005) find an innovation premium for firms' chances of survival that arises mostly from process innovation rather than product innovation. Buddelmeyer et al. (2008) use patents and trademarks as proxies for innovation and find strong results for trademarks, while for patents, the positive relationship with survival rate applies only to incumbent firms. Firms that invest in R&D engage actively in articulating knowledge and thus face lower hazards for exit (Hall, 1987; Kimura and Fujii, 2003; Esteve and Manez, 2008).

Another interesting research stream investigates the drivers of high-quality entrepreneurship since it appears to be more resilient to economic downturns and a crucial driver for economic development (Henrekson and Johansson 2010). Giotopoulos et al. (2017) conclude that the perception of business opportunities significantly affects high-quality entrepreneurship in adverse economic conditions, and the beneficial effects of educational attainment on growth intentions strengthen in times of crisis.

There is also important literature on how institutions might affect entrepreneurship (Acs, Desai and Hessels, 2008; Acs et al., 2018). The systematic literature analysis by Urbano et al. (2018) suggests that institutions could be related to economic growth through entrepreneurship. According to Williams and Vorley (2015), that conducted a series of interviews with entrepreneurs in Greece, institutional change during the crisis has deteriorated entrepreneurial activity.

Furthermore, many researchers have investigated industry characteristics as firm survival determinants. Such elements are the technology intensity (Agarwal and Audretsch, 2001; Audretsch, 1995), the entry rate of new firms (Geroski, 1995; Segarra and Callejon, 2002) and

the life cycle of industries and businesses (Geroski, 1995; Mata et al., 1995). Some researchers have found that the level of industry concentration is related to a higher risk for firm survival due to the increased competition (Görg and Strobl, 2003; Audretsch, 1991), while others find industry concentration to be related positively to firm survival (Strotmann, 2007). Similarly, research on the innovation intensity of an industry and how it might affect firm survival, the results are mixed (Audretsch et al., 2000; Ugur and Vivarelli, 2020). For example, Audretsch and Mahmood (1995) research shows that firms entering highly innovative industries face a greater risk of exit. Still, this hazard decreases when the firm innovates as well (Audretsch, 1995).

The importance of location factors and spatial proximity for firm performance has been proposed since the seminal work of Marshall (1920) on agglomeration economies and the recent boom of research on the subject (Jacobs, 1996; Fujita, Krugman and Venables, 1999). The work of Romer (1990) and Porter (1990) suggests that the contribution of industrial geographical concentration is key for knowledge spillovers and firm growth (Glaeser et al., 1992). How knowledge spillovers influence regional new firm formation has been widely investigated (Lee et al., 2004; Acs and Armington, 2004), as well as the importance of innovation systems (Rodríguez-Pose and Crescenzi, 2008). Scholars have found that firms in urban centres have higher chances of survival (Stearns et al. 1995; Fotopoulos and Louri, 2000b;). However, other researchers have found a negative relationship for firm survival for urban areas (Keeble and Walker, 1994; Strotmann, 2007) or non-significant results (Audretsch and Vivarelli, 1995; Tsekouras et al., 2007).

Focusing on Greece, Kanellopoulos and Fotopoulos (2018) examine the effect of knowledge spillovers on new firm formation in manufacturing across Greek regions over the 2000s, finding a positive impact. Similarly, Vogiatzoglou and Tsekeris (2013) investigate the impact of knowledge spillovers on the spatial agglomeration of manufacturing. What is more, Daskalopoulou and Liargovas (2010) suggest that human capital and skilled labour are significant determinants of regional new firm establishment and stress the importance of specialisation in the manufacturing sector.

Earlier research includes Fotopoulos and Louri (2000a,b) studies on the importance of location for firm survival, examining the manufacturing sector in the 1980s and shedding light on the determinants of hazard confronting new entry. Besides the increased hazard for firms

established close to recession periods (Fotopoulos and Louri, 2000b), the role of foreign firms presence in increasing exit hazard and firm's technical efficiency in mitigating it has also been documented (Louri et al., 2006). Finally, Dimara et al. (2008) study focuses on firms in the Greek food sector finding that high technical efficiency lowers the risk of exit.

3. Data

One of the main contributions of this paper is the combination of various interrelated datasets that are used for our analysis. First, we obtained data from the business registry of GEMI, the General Electronic Commercial Registry of Greece, which consists of the universe of Greek firms from 2011 until the first half of 2019. This dataset allows us to identify the establishment and exit year of every firm in Greece, as well as the main industry that the firm operates and its geographic location. Most importantly, this dataset allows for the observation and analysis of the behaviour of sole proprietorship firms, which are not available in any other data source. The main weakness of this administrative registry is that it does not contain any additional information or characteristics for these firms.

Second, we obtain financial information for all the firms that are obliged by law to publish their yearly economic accounts in Greece from the ICAP Data Prisma firm database for 2004-2020. This is the most well-established source of firm level financial and commercial data information in Greece. It covers approximately 32,000 Greek companies⁵.

Third, we processed information on industrial property rights by combining data for patents, industrial designs (from the Hellenic Industrial Property Organization, which is the name for the Greek patent office) and trademark data (from the Secretariat for Trade and Consumer Protection). This exercise allowed us to measure the intangible capital of Greek firms for the first time and examine which of these categories of intellectual property rights contribute the most to firms' resilience.

Matching these three datasets was a challenging task, as there was no common firm identifier or unique identification code. The first step was the harmonisation and standardisation of key variables, such as the firm name, legal form and location variables, to overcome the inherent difficulties resulting from inconsistencies in spelling and

⁵ Access to the data was provided by IOBE, which is a licensed user of ICAP databases.

abbreviations, between the different datasets. The second step was based on matching these key variables by using scoring functions and setting several criteria to ensure effectiveness. After the first matching attempt, several checks were applied to control for any matching variations.

Therefore, there are two datasets that are mainly used in this paper. The first one contains basic information on all the sole proprietorship firms (2011-2019). We will refer to this as the SOLE dataset. The second and main dataset is a unique firm-level dataset for Greece that contains firm characteristics, financial information and industrial property rights (patents, trademarks and industrial designs) on all the firms that are obliged by law to publish economic information in Greece and spans the period 2004-2020, i.e. both before and after the crisis. We will refer to this as the ICAP dataset.

4. Empirical framework

Our first part of the empirical analysis includes some descriptives to understand the main trends that emerge from the datasets. In this vein, we present various illustrative graphs to show the evolution of entry and exit across sectors and geography, and complement the evaluation by utilising the Kaplan–Meier (Kaplan and Meier, 1958) non-parametric estimator of survival analysis that is defined as follows:

$$\hat{S}(t) = \prod_{i:t_i < t} \frac{n_i - d_i}{n_i}$$

where $i = 1, 2, \dots, k$ indicates the different years of the examined period and n_i is the number of businesses that are in operation for at t_i years and are at risk at the time t_i , whereas d_i indicates the number of firm exits that occur at t_i starting from the first examined year.

The second part of the analysis consists of two econometric specifications related to modelling the survival of firms and firm growth. We first elaborate on how we model survival using a variety of econometric specifications. We then explore the firm growth determinants, including the crisis' impact.

4.1 Modelling survival

To analyse firms' survival probability and its determinants, we estimate the following econometric framework:

$$pr(exit)_{it} = \alpha + \beta Crisis_t + \Omega X_{ist} + \gamma Trend_t + FE + \varepsilon_{it} \quad (1)$$

where, $exit_{it}$ is a binary indicator that takes the value of one the year t that firm i exits the market, X_{ist} is a vector of firm characteristics (size, leverage, fixed assets, industrial property rights, age, exports, industry concentration), $Trend_t$ is a linear yearly trend, and FE are various fixed effects controlling for sectoral, regional or legal status firm characteristics. $Crisis_t$ is a binary indicator that, in its most general form, takes the value of one for the years 2009-2018, i.e. for the whole duration of the crisis in Greece. In addition, we also break up this variable into two periods, the first (2009-2014) and the second (2015-2018) period of the crisis, but also into three subperiods 2009-2011, 2012-2014 and 2015-2018 to test the severity of the crisis impact. Finally, ε_{it} is the error term that captures all unobserved determinants of the firm's exit decision.

We estimate (1) using mainly a linear probability specification and calculate the standard errors based on a generalised White-like formula, allowing for firm-level clustered heteroskedasticity and autocorrelation (Bertrand et al., 2004). We also estimate a simple and a conditional fixed effects (FE) logit model. Although such a model is better suited to the binary dependent variable, it is not ideal for our purposes because the more appropriate firm FE logit model can be estimated only on the subsample of firms with variation in the exit variable, that is, those who exit from the market during the period in which we observe them. This sample is non-representative and would overestimate the actual marginal effect of the independent variables. We provide these results to show the qualitative robustness of our results.

Finally, we also use a proportional hazard model (PHM) for the duration between the time a firm enters and exits the market. We estimate (1) utilising a semiparametric estimation procedure that allows for time-varying independent variables (Cox, 1972). According to the Cox PHM, the hazard function is decomposed into two multiplicative components: $h_i(t, X_i) = h_0(t) \times \lambda_i$, where $\lambda_i \equiv \exp(\beta'X_i)$. The $h_0(t)$ is the baseline hazard function that models the dynamics of the probability of switching (hazard rate) over time; X_i is a vector of individual

characteristics, and β is a vector of regression coefficients that includes the intercept; λ_i scales the baseline hazard proportionally to reflect the effect of the covariates based on the underlying firm heterogeneity. The main advantage of the PHM is that it accounts for censoring and is flexible enough to allow for both time-invariant (e.g., indicator variables for industrial property rights or exporting) and time-varying control variables (e.g., leverage or firm age).

4.2 Modelling firm growth

To analyse firms' growth and its determinants, we estimate the following econometric specification:

$$\Delta sales_{it} = \alpha + \beta Crisis_t + \gamma \Omega X_{ist-1} + \gamma Trend_t + FE + \varepsilon_{it} \quad (2)$$

where now the left-hand side is the growth in sales, $\Delta sales_{it}$, of firm i in year t , and the only difference with specification (1) is that X_{ist-1} contains a number of firm characteristics in lagged form. We estimate (2) using OLS and cluster the standard errors again at the firm level, allowing for arbitrary heteroskedasticity and autocorrelation.

5. Results

5.1 Descriptive analysis

ICAP dataset

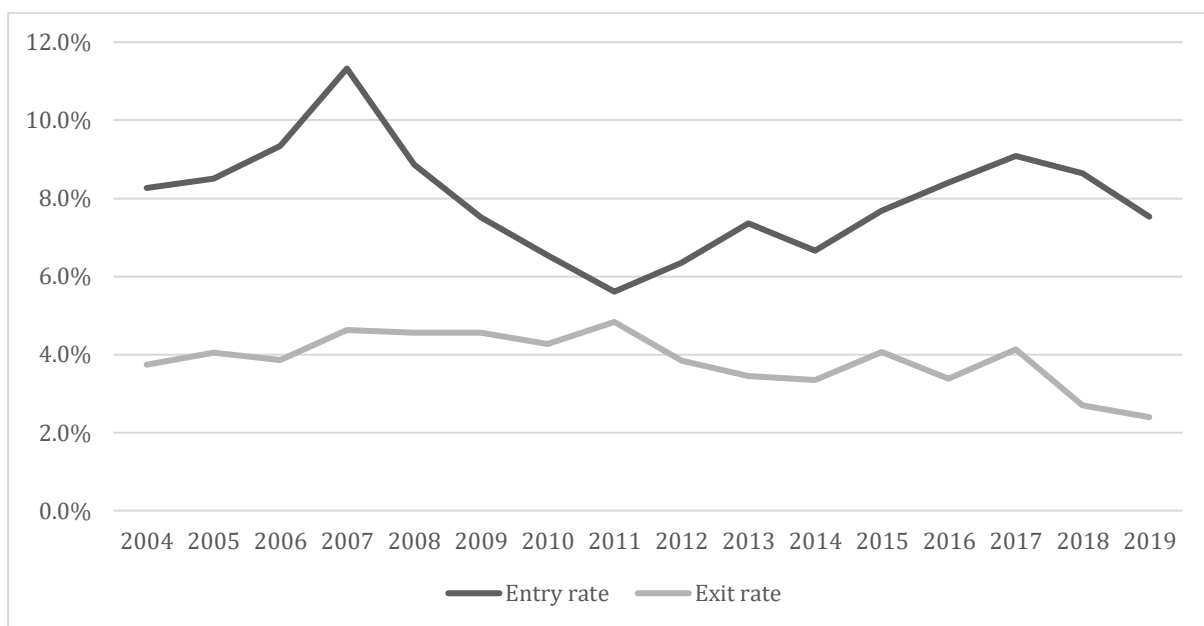
We first look at some descriptive statistics from the ICAP dataset. Following the literature, we assume that entry takes place in the first year that a firm publishes financial statements, and the entry rate compares new firms to the population of active firms in the examined year. Similarly, we assume that exit takes place the last year that the firm publishes financial statements and appears as "inactive" in the dataset.⁶ The exit rate is estimated as the ratio of the firms that exited over the total active firms in the examined year.

Although the entry and exit rates tend to be correlated over periods of boom and bust, this has not been the case during the period of the peak of the crisis (2010-2013). In 2011, the

⁶ ICAP characterizes firms as active or not on the date of the data extraction. When the firm's status is "active", we do not consider it an exit even if there are missing values from the sample for consecutive years.

entry rate reached its lowest level at 5.6%, halved compared to 2007, while the exit rate reached 4.8%, a rise of 23% compared to 2006. As we can see in Figure 1, exit and entry rates are correlated at a rate of 46.2%, and the exit rate responsiveness is relatively flatter compared to the firm entry's one. The entry rate in 2004 is equal to 8.3%, while the exit is below 4.0% (3.7%). The entry peak took place in 2007 at a rate of 11.3%, reaching its lowest value in 2011 (5.6%). Afterwards, gradual recovery began reaching its highest point in 2017 (9.1%), though it was below the percentage of 2007. On the other hand, exit rate variations were smoother than the entry ratio. In 2004 we started with a 3.7% exit ratio extending to 4.8% in 2011, while a slow decrease followed (in 2017, the exit level was 4.1%). Dropping and rising of entrepreneurial entry acts as a signal of economic downturn and growth correspondingly.

FIGURE 1 - ENTRY AND EXIT RATES, ICAP (2004-2020)



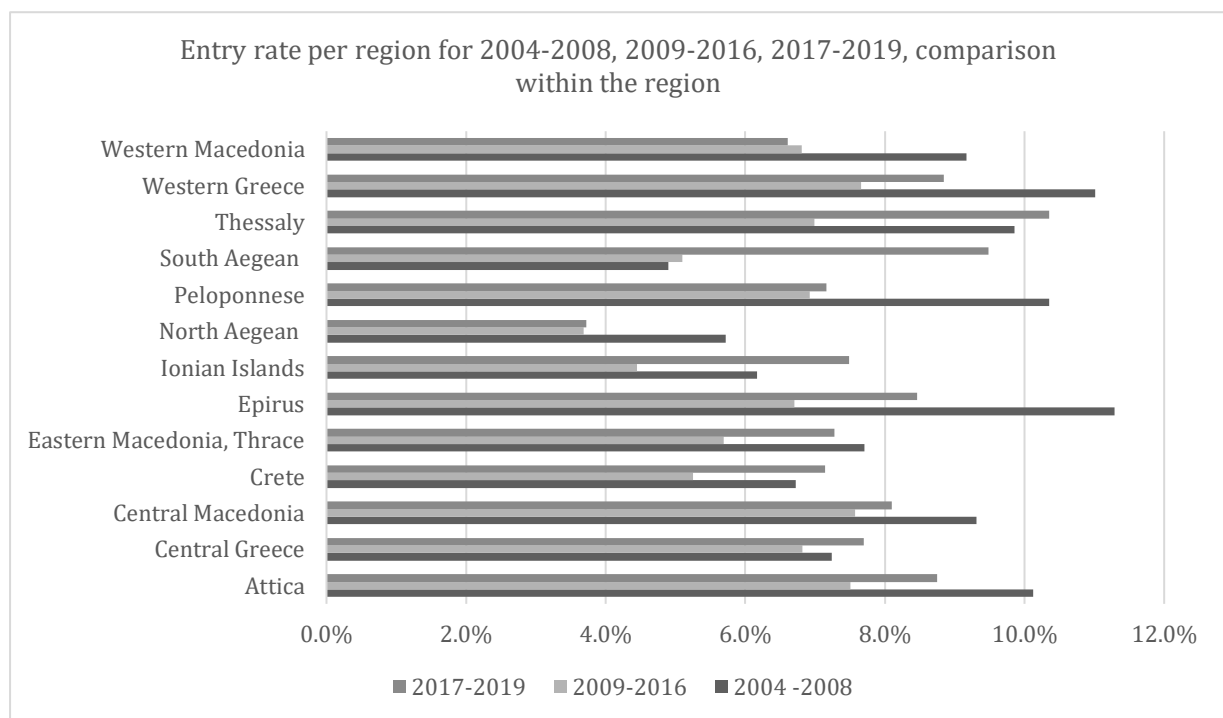
Notes: Entry (exit) rate is defined as the ratio of the number of new (closed) firms over the total number of firms in the ICAP database each respective year.

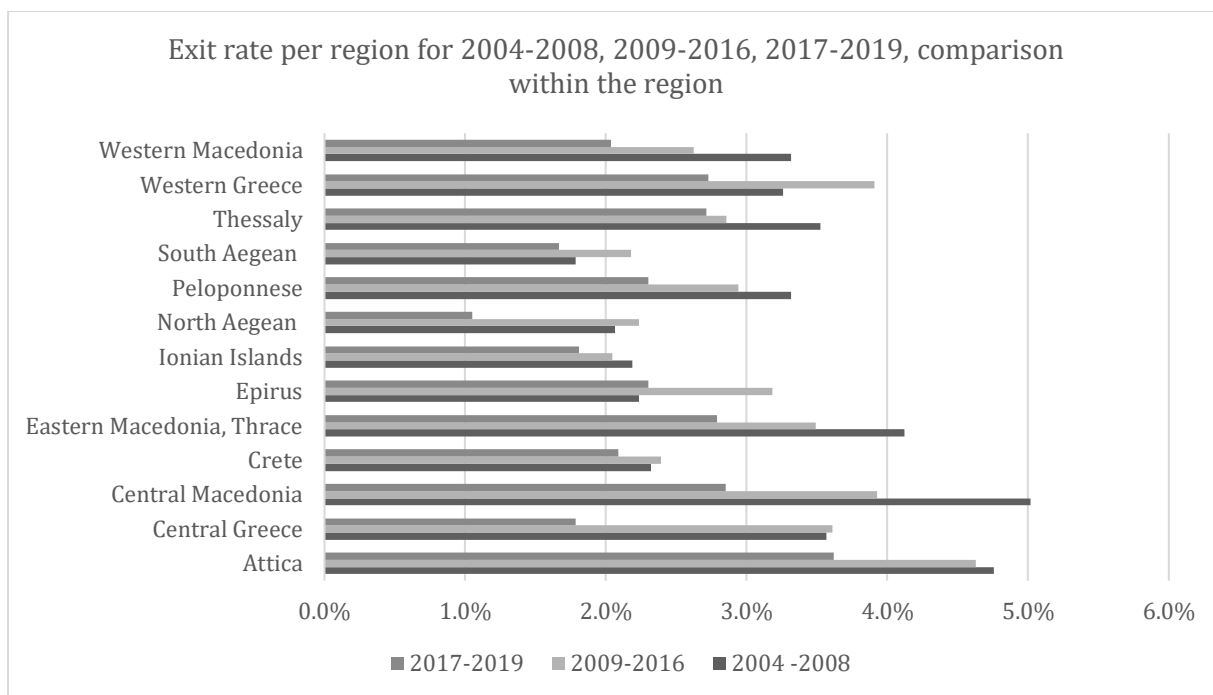
At the regional level (Figure 2), full recovery within the region is evident in only a handful of regions (Thessaly, South Aegean, Ionian Islands, Crete, Central Greece), that their post-crisis (2017-2019) entry rates exceeded their pre-crisis (2004-2008) entry rates. Furthermore, it was only the regions of Western Greece, Thessaly, Epirus, Central Macedonia and Attica that achieved more than an 8% entry rate in the 2017-2019 period. As expected in most regions during the economic depression, the entry rate reached its lowest point. The highest

entry rates were observed during 2004-2008 when Greek economic growth was at its peak. In Epirus, the entry ratio was 11.3% on average similar to Western Greece (11.0%). Peloponnese's entry percentage was equal to 10.4%, higher to the following years (6.9% and 7.2% for 2009-2016 and 2017-2019, respectively).

During the crisis, from 2009 to 2016, Attica (4.6%), Central Macedonia (3.9%), Central Greece (3.6), Eastern Macedonia and Thrace (3.5%) and Western Greece (3.9%) were hit greater concerning business exit from the market. However, the highest exit rates were observed in Attica (4.8%) and in Central Macedonia (5.0%) in the period of Greek economic bloom (2004-2008). Surprisingly, in many regions, the exit rate in the 2004-2008 period was significantly higher than in the recession years (2009-2016), such as Western Macedonia, Thessaly, Peloponnese and Eastern Macedonia and Thrace.

FIGURE 2 - ENTRY AND EXIT RATES BY REGION





Notes: Entry (exit) rate is defined as the ratio of the number of new (closed) firms over the total number of firms in the ICAP database each respective year. The presented rates are the averages of the entry (exit) rates for the periods 2004-2008, 2009-2016, and 2017-2019. The region categories refer to the NUTS2 classification regarding the location of firms.

Next, we examine the entry and exit rates concerning the firm's financial size (Figure 3). The size is defined according to sales amount in each examined year, and it is divided into four categories a) less than € 2 million, b) € 2-10 million, c) € 10-50 million, and d) more than € 50 million of sales. Both entry and exit rates are with respect to the total active firms of each year.

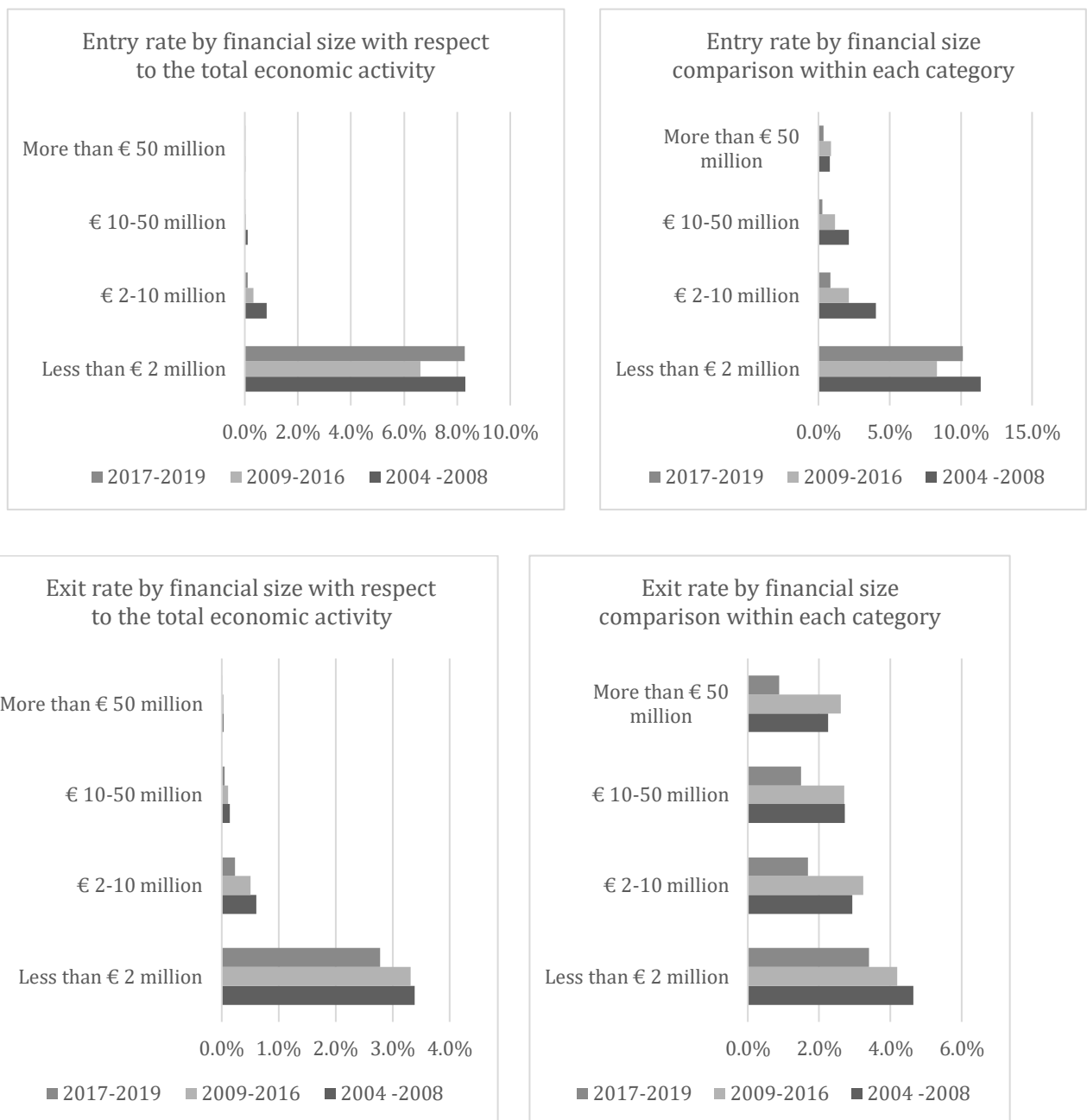
The smaller firms group dominates entry rates. The entry rate has recovered fully on average, comparing the periods of 2017-2019 and 2004-2008 (8.3% on average for both periods). Still, medium and larger firms' performance is significantly lower compared to the boom of the Greek economy. The economy of Greece consists mostly of Small and Medium Enterprises (SMEs) since their share is 99.9% (OECD, 2020). Especially, the presence of companies with turnover greater than € 50 million is almost negligible compared to the total of firms. Their entry rate during the 2017-2019 period was 0.01%, while in 2004-2008, it was 0.11%.

Smaller firms exited the market at a greater rate than the rest of the categories. The exit rate of medium and larger firms is significantly inferior compared to the first sample years.

The exit rate of smaller firms, having turnover of less than € 2 million, was higher in 2004-2008 on average (3.4%) but close to the crisis period (3.3%). Their exit rate dropped in 2017-2019, which was 2.8%. The results are quite similar for the medium-sized companies in 2004-2008 and 2009-2016 period (0.6%, 0.5% and 0.1%, 0.1% for firms with € 2-10 and € 10 – 50 million of sales correspondingly). In the 2017-2019 period, the exit ratio was even lower.

Looking at the within variation in each size category, the smallest firms exhibit the higher entry rates; while the size increases, the entry rate decreases. Their performance before the economic recession was 11.4% when during the crisis, it dropped to 8.3%, and it increased again to 10.2% during 2017-2019. For medium firms (2-10 million euros turnover), the entry rate never returned to its post-crisis performance since it dropped from 4.0% to 0.8% for the last two years examined. The behaviour of larger firms follows a similar pattern. Regarding exit rates, each size category follows a different path. For small firms with a turnover of less than two million, the exit rate is greater during the booming economic period of 2004-2008 (4.6%). During the crisis, it dropped to 4.2%, and it decreased further for the 2017-2019 period to 3.4%. Next, firms with sales of 2-10 million euros exited the market with a rate equal to 2.9%, 3.2%, and 1.7% for the three periods examined, respectively. As far as businesses with 10-50 million euros are concerned, the post and during crisis exit ratio was equal to 2.7%, and after the end of the recession, it declined to 1.5%. Lastly, 2.3% of large firms with more than 50 million euros turnover ceased operation before 2009-2016 and 2.6% of them during the aforementioned period. After the crisis, this ratio dropped to 0.9%.

FIGURE 3 – ENTRY AND EXIT RATES BY FIRM SIZE

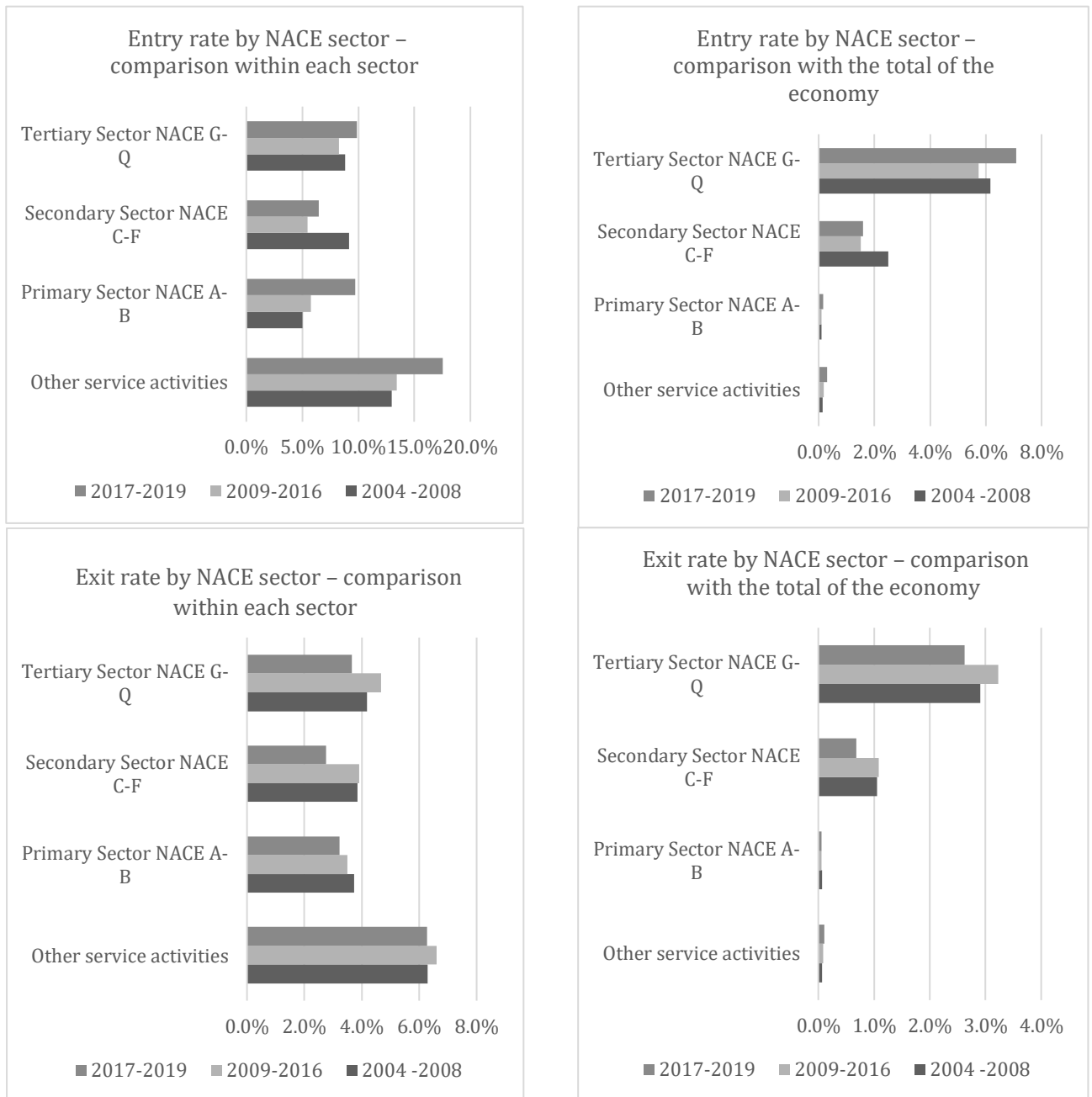


Notes: Entry (exit) rate is defined as the ratio of the number of new (closed) firms over the total number of firms in the ICAP database each respective year. Firms are divided into four categories with respect to their turnover a) “More than € 50 million” represents firms with turnover over 50 million euros, “€ 10-50 million” represents firms with turnover between the 10-50 million euros, “€ 2-10 million” represents firms with turnover between the 2-10 million euros, and “Less than € 2 million” represents firms with turnover less than two million euros. The presented rates are the averages of the entry (exit) rates for the periods 2004-2008, 2009-2016, and 2017-2019.

The entry rates in the tertiary sector during 2017-2019 (7.1%) exceeded the 2004-2008 period (6.2%) on average, and they occupy the largest share compared to the other sectors. Although the secondary sector has recovered slightly compared to 2009-2016, the entry rate is still inferior to the first four examined years. After the crisis period, the primary sector increased its share in entries (from 0.1% to 0.2%) but still is a small part of the total economy. The primary economy's within sector variation demonstrates a remarkable performance in the post-crisis period, almost doubling its entry rate, from 5.0% during 2004-2008 to 9.7% during 2017-2019. On the contrary, the secondary sector's within variation indicates an inferior entry share for the last two examined years (6.5%) compared to the initial period (9.2%).

The highest exit rate is evident in the tertiary sector during the crisis years (2009-2016) (3.2%), while for the same period, the secondary and the primary sector exited the market with a lower rate (1.1% and 0.1%, respectively). Before the crisis, the exit rate for the tertiary was lower, while for the secondary and the primary sector, it was at similar levels. Regarding the exit rate variation within the sector, the picture is quite similar to the entry rates' description with the opposite sign. The primary sector's exit rate, measured in comparison with its own shares, decreased among the examined periods on average. For the secondary sector, the rate before and during the crisis was at similar levels, and for the tertiary sector, the exit rate was higher during the crisis.

FIGURE 3 - ENTRY AND EXIT RATES BY NACE SECTOR



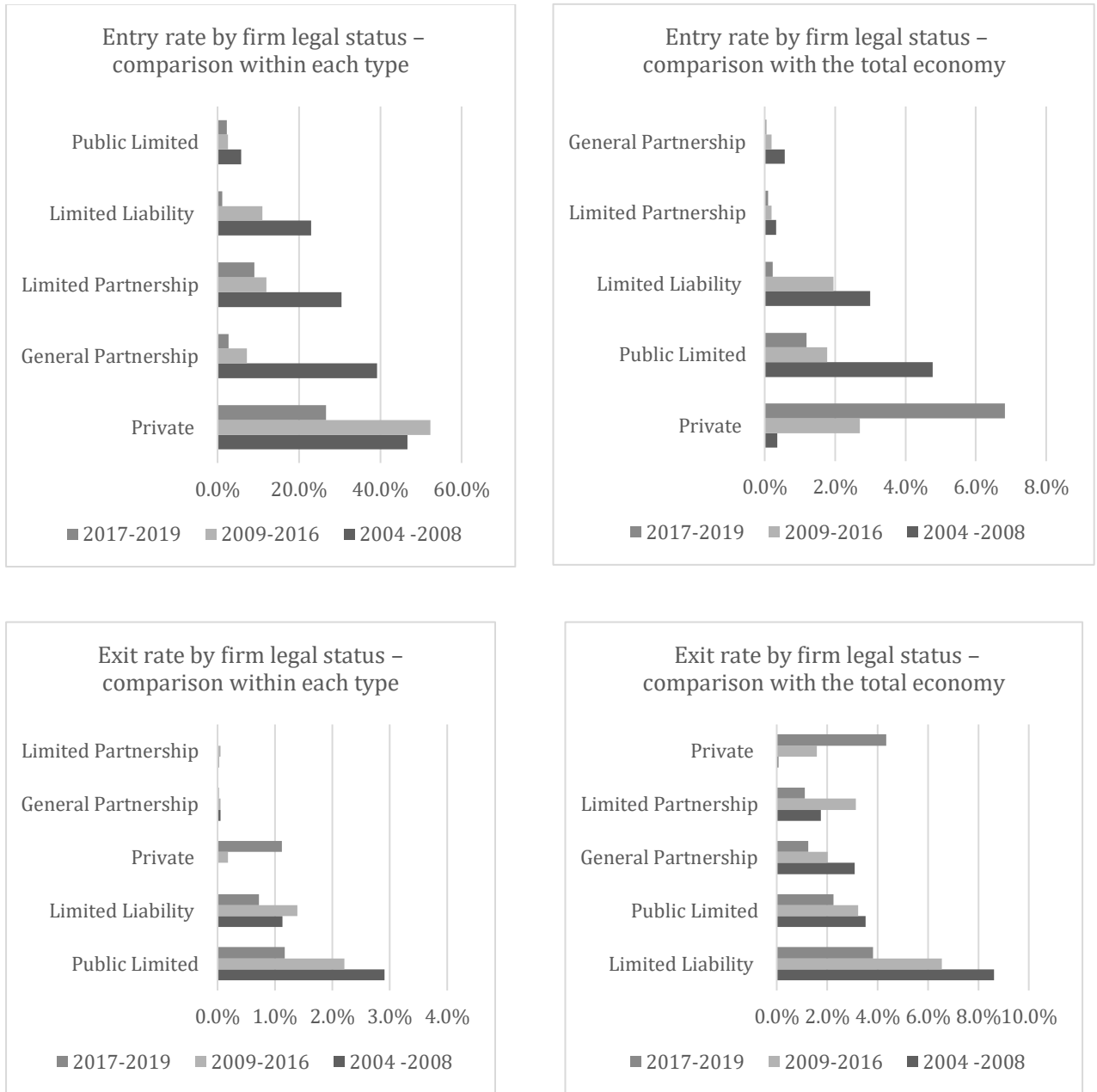
Notes: Entry (exit) rate is defined as the ratio of the number of new (closed) firms over the total number of active firms in the ICAP database each respective year. We adopt the NACE (Nomenclature of Economic Activities) standard classification. The analysis refers to the first digit NACE classification, which includes 21 sectors identified by alphabetical letters A to U. The Primary sector is defined as the A and B sections, the Secondary Sector ranges from C to F, and the Tertiary Sector is G to Q, and the rest of them belong to the category of Other Services. The presented rates are the averages of the entry (exit) rates for the periods 2004-2008, 2009-2016, and 2017-2019.

Next, we examine the entry, and exit rates by their legal status focusing on the main legal statuses appearing in the data set a) Public Limited Companies, b) Limited Liability Companies, c) Limited Partnership Companies, d) General Partnership Companies, and e) Private Companies. Private company status dominated the entry rates in the last two examined years with a rate of 6.8%, followed by Public Limited Companies with a significantly smaller ratio equal to 1.2%. The great entry share of Private companies could be attributed to the introduction of the law 4072/2012⁷. During the economic recession, again, Private Companies entered the market in a higher proportion (2.7%), with the second most popular legal type being Limited Liability Companies (2.0%). In the booming period, Public Limited Companies were the most popular ones, with a share reaching 4.8%, and Limited Liability Company status ranked again second in preference (3.0%).

The majority of the exit share, on average, belonged to the Public Limited Company legal status for all the examined years. For Limited Liability Companies, the exit percentages for the examined periods were, on average, 1.1% and 1.4%, dropping after the crisis to 0.7%. In 2017-2019 Private Companies exiting reached 1.1%. Examining the variation inside the legal categories, 8.6% of active Limited Liability Companies closed on average in 2004-2008, while the ratios for Public Limited Companies, General Partnership Companies, and Limited Partnerships Companies were inferior (3.5%, 3.1% and 1.7%). Only for Limited Partnership and Private Companies, the exit rate in 2009-2016 was greater than the booming period (3.1% and 1.6%). Whereas the exit rate for the Private Companies after the crisis was 4.4% larger than any other category.

⁷ According to the explanatory statement of law 4072/2012 and given that the majority of Greek businesses are small and medium; it was necessary to introduce a new corporate form which would disconnect the firm's capital from the entrepreneur's wealth, facilitate quick start-up and be as flexible as possible. In this context, the form of "private company".

FIGURE 4 - ENTRY AND EXIT RATES BY LEGAL STATUS



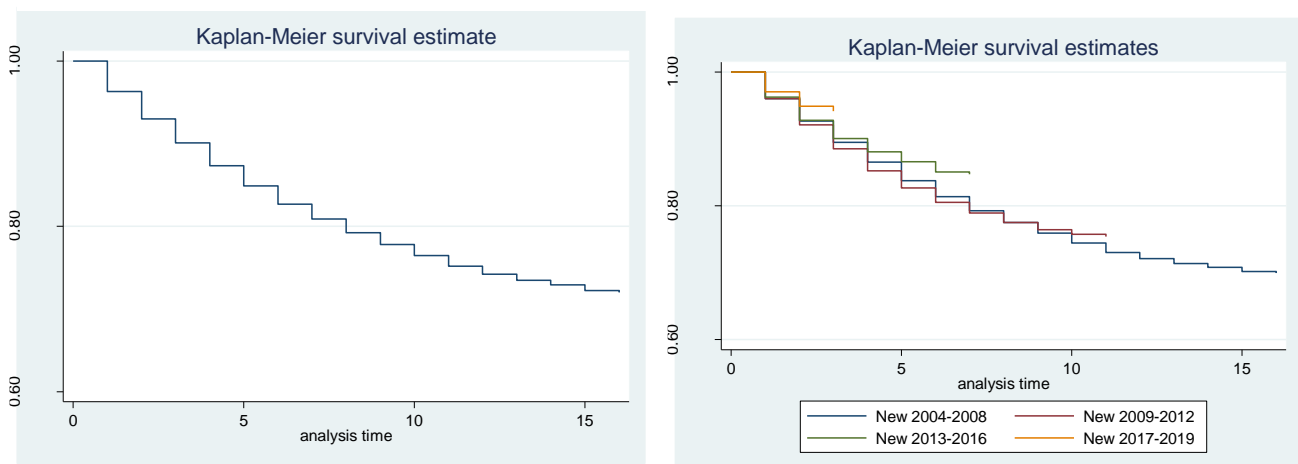
Notes: Entry (exit) rates are defined as the rate of new (closed) firms of each category towards the total of the firms in ICAP in its respective year and each respective category. The Public Limited stands for the Greek company type “Ανώνυμη Εταιρεία – ΑΕ”, Limited Partnership stands for “Ετερόρρυθμη Εταιρεία - ΕΕ”, Limited Liability is the “Εταιρεία Περιορισμένης Ευθύνης – ΕΠΕ”, Private is the “Ιδιωτική Κεφαλαιουχική Εταιρεία – ΙΚΕ”, and General Partnership is the “Ομόρρυθμη Εταιρεία - ΟΕ”. The presented rates are the averages of the entry (exit) rates for the periods 2004-2008, 2009-2016, and 2017-2019.

Survival analysis of new firms

Looking at the total of surviving new firms established in Greece during 2004-2020, approximately 19,8% of them closed by the end of 2020 (Table A7). From the sample's new firms, the interval with the highest share of failed firms was 1-2 years of operation, equalling 17.9%, while 53.8% of the failed new firms of the sample ended their operation in their first three years. After ten years of operation, the failed ratio decreases significantly to 2.8% and drops even further in the following year intervals, demonstrating the effect of age on survival rate.

First, we assess the survival rates of firms depending on the period of their market entry. We divide the examined periods in 2004-2008, the booming period before the deep recession, and the crisis into two periods 2009-2012 and 2013-2016. The last period is the three-years 2017-2019, after the crisis. The difference in survival between the different categories was statistically significant using the Log-Rank Test ($\chi^2(1) = 63722$, $Pr > \chi^2 = .000$). The period that new firms were less resilient was the first four years of the crisis. In contrast, the most resilient cohort for the first three years was those established in 2017-2019.

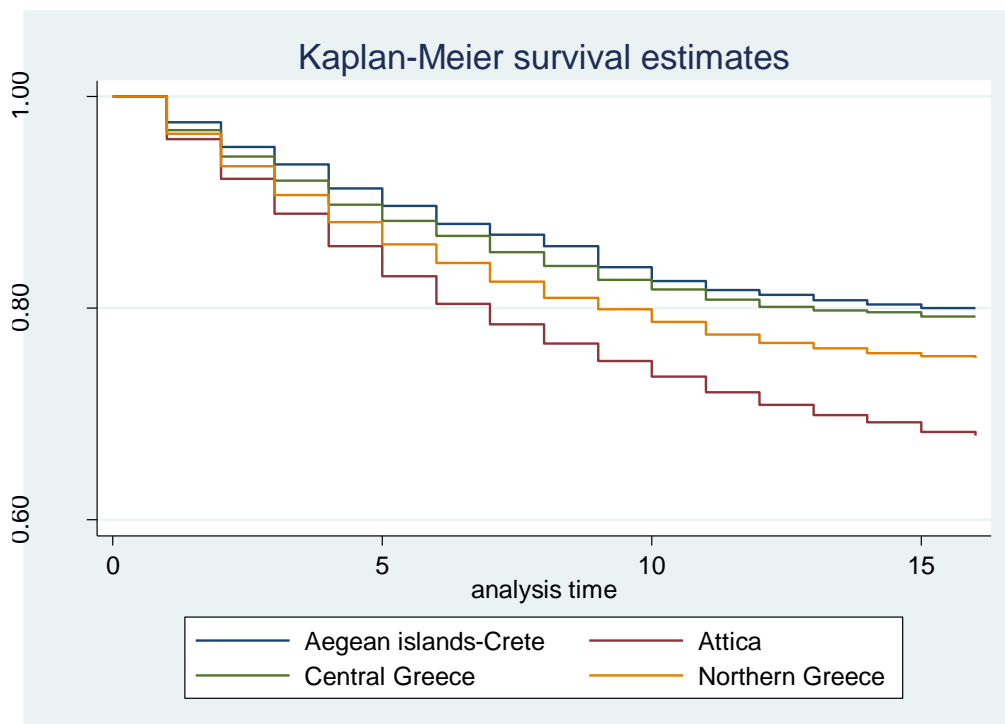
FIGURE 5 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2004-2020 IN TOTAL AND BY ECONOMIC PERIOD



Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2004. The “New 2004-2008” represents the new firms established between 2004-2008, “New 2009-2012” represents the new firms established between 2009-2012, “New 2013-2016” represents the new firms established between 2013-2016, and “New 2017-2019” represents the new firms established between 2017-2019.

Next, we examine the survival rates by looking at the NUTS1 regional categorisation. The difference in survival between the different regions was statistically significant using the Log-Rank Test ($\chi^2(1) = 62221$, $Pr>\chi^2=0.000$). The region with the highest survival rate of firms established after 2004 was the Aegean Islands and Crete, whereas the Attica region, the region with the highest share of firms, was the less resilient at the NUTS1 level.

FIGURE 6 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2004-2020 BY NUTS1 REGIONAL LEVEL

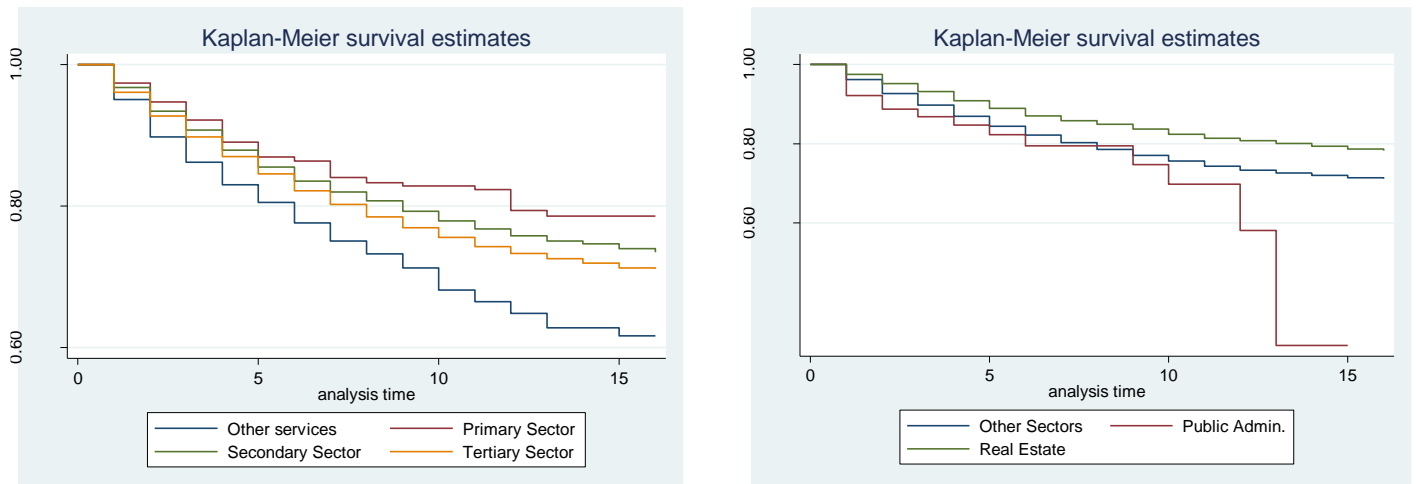


Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2004 with respect to their location. Regions are represented at the NUTS1 level.

In the sectorial level survival rates, the difference in survival between the different sectors was statistically significant using the Log-Rank Test ($\chi^2(1) = 61225.47$, $Pr>\chi^2=0,0000$). The primary sector was the most resilient during the examined period, whereas the tertiary sector demonstrated an inferior rate. The primary sector includes NACE A and B sectors, the secondary sector is the C to F NACE categories, and the tertiary is the G to Q. Other services include the R and S categories representing the arts, entertainment, and other services sectors. From the first level of NACE categories, the most resilient through the 17 years

examined was the sector of Real Estate, and the sector with the smaller survivability was the domain of Public Administration.

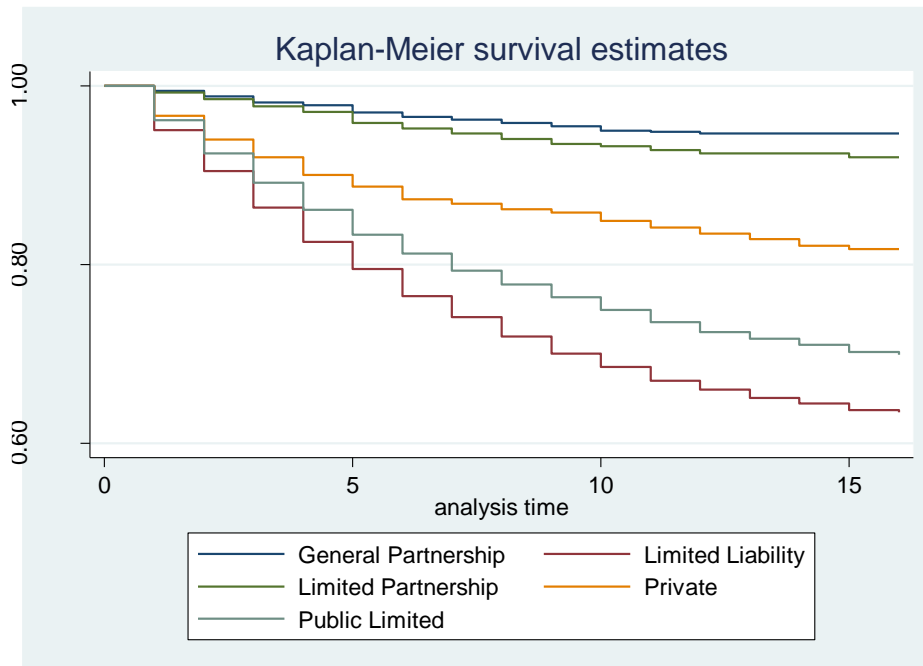
FIGURE 7 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2004 - 2020 BY NACE CATEGORISATION



Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2004 with respect to their industry. We adopt the NACE (Nomenclature of Economic Activities) standard classification. The analysis refers to the first digit NACE classification, which includes 21 sectors identified by alphabetical letters A to U. The Primary sector is defined as the A and B sections, the Secondary Sector ranges from C to F, and the Tertiary Sector is G to Q, and the rest of them belong to the category of other services. The right graph presents the most and the less resilient sector during the examined period.

From the legal status perspective, rates of the variation in endurance between the different legal statuses were statistically significant by applying the Log-Rank Test ($\chi^2(1)=57427$, $Pr>\chi^2=0.000$). The type of General Partnership Company was the top one in the Kaplan-Meier estimations, followed closely by the Limited Partnership category. On the contrary, Limited Liability Companies demonstrated the smallest-scale rate with a significant difference from the rest types. Private companies were in the middle of estimations, and Public Limited Companies ranked second last. The difference in financial size is statistically significant according to the the Log-Rank Test ($\chi^2(1) = 66335$, $Pr>\chi^2=0.000$).

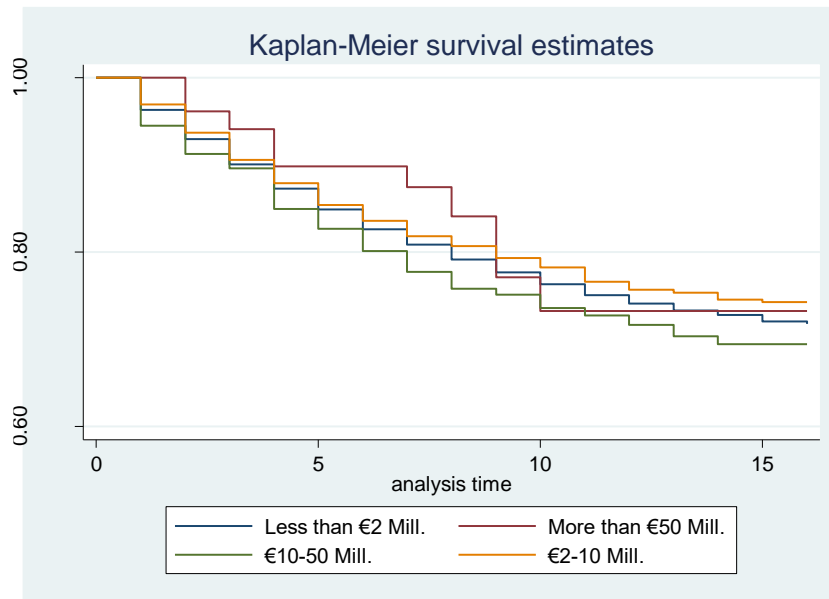
FIGURE 8 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2004-2020 BY LEGAL STATUS



Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2004 with respect to their legal status. The Public Limited stands for the Greek company type “Ανώνυμη Εταιρεία – ΑΕ”, Limited Partnership stands for “Ετερόρρυθμη Εταιρεία - ΕΕ”, Limited Liability is the “Εταιρεία Περιορισμένης Ευθύνης – ΕΠΕ”, Private is the “Ιδιωτική Κεφαλαιουχική Εταιρεία – ΙΚΕ”, and General Partnership is the “Ομόρρυθμη Εταιρεία - ΟΕ”.

Companies with greater financial size (more than € 50 million) in the first nine years seem to have a significant advantage relating to survivability, while medium firms (2-10 million) after a decade appear more resilient according to the Kaplan-Meier estimates. Through the period examined, firms with the lowest survival rates belonged to the €10-50 million category, while small firms were in the middle of the ranking approximately. The size in this category is the first year’s turnover as the firm entered the market.

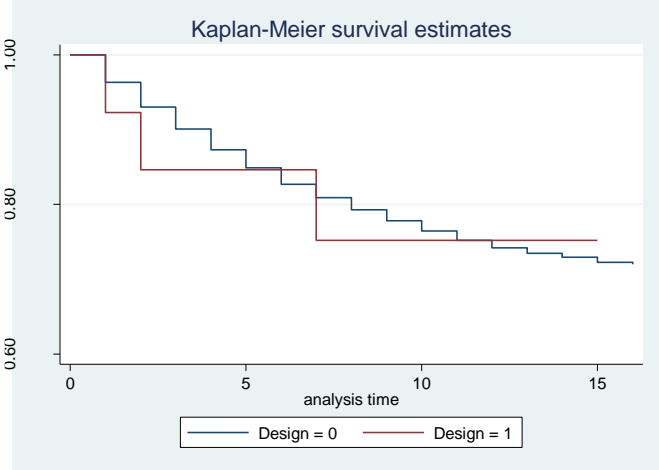
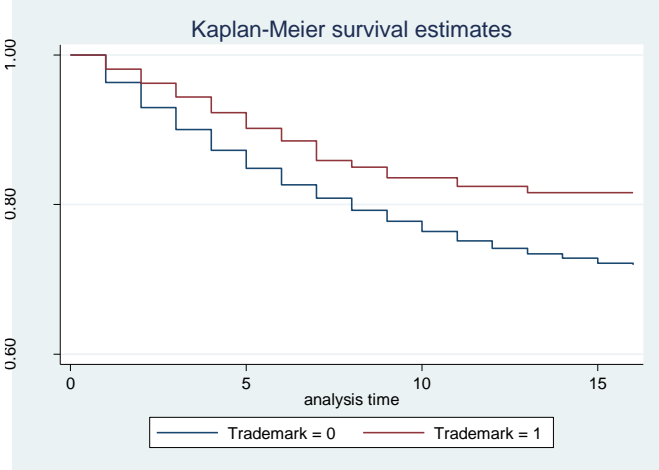
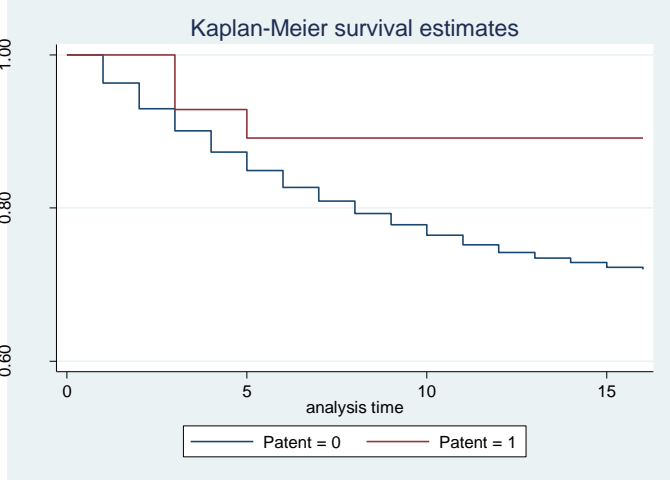
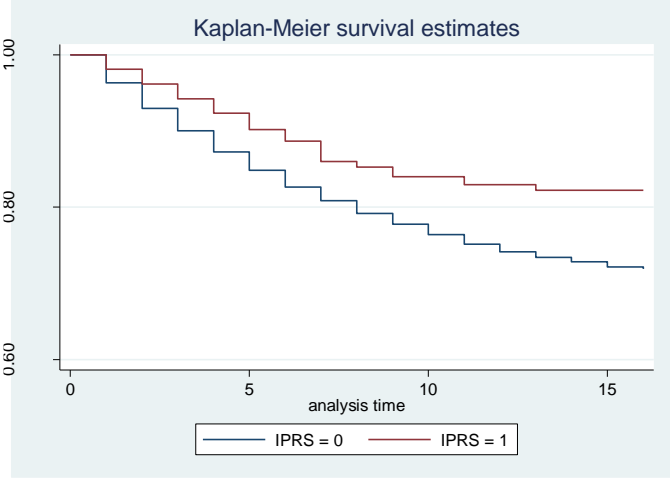
FIGURE 9 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2004-2020 BY FINANCIAL SIZE



Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2004 with respect to their financial size. Firms are divided into four categories with respect to their turnover “More than € 50 million” represents firms with turnover over 50 million euros, “€ 10-50 million” represents firms with turnover between the 10-50 million euros, “€ 2-10 million” represents firms with turnover between the 2-10 million euros, and “Less than € 2 million” represents firms with turnover less than two million euros.

The industrial property also enhances the survival probability. To examine whether having any of the examined Intellectual Property Rights (Patents, Trademarks, and Industrial Designs - IPRs) increases the resilience of firms, we estimate the survival rates using the Kaplan-Meier estimator process. Having any kind of IPRs increases the survival rate significantly, as the estimators demonstrate and by applying the Log-Rank Test ($\chi^2(1) = 66334$, $Pr > \chi^2 = 0.000$). Patents and Trademarks enhance the survival rate clearly, though the results for industrial designs are ambiguous.

FIGURE 10 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2004-2020 BY INDUSTRIAL PROPERTY TYPE



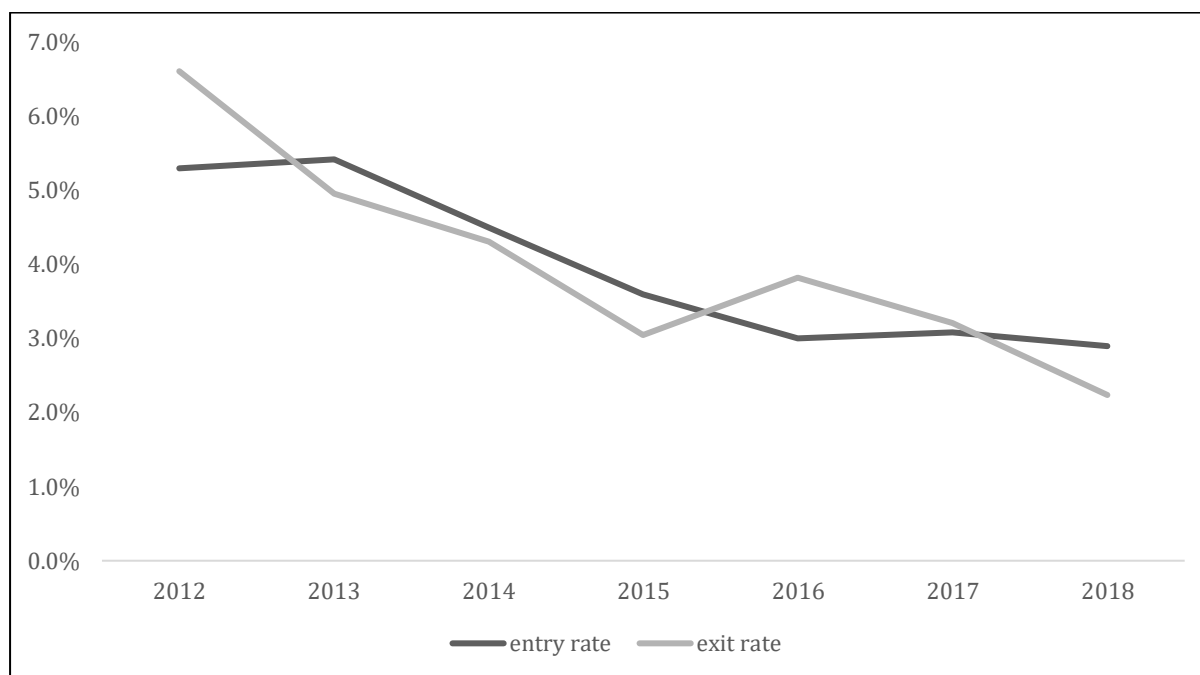
Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2004 with respect to their IP portfolio. IPRS is a dummy variable that, when equal to one, the firm has one or a bundle of IPRs. Patent, Trademark, and Design are also dummy variables that, when equal to one, the firm has one or more patents, trademarks, and Designs, respectively.

SOLE Dataset

In this section, we examine the Sole Proprietorship legal type. The only available data source for this type of ownership is the SOLE which covers their universe. The entry and exit years in this data are defined directly from the registry's data. The rate compares new/closed firms to active Sole-Proprietorship firms in the examined year. When compared, exit and entry rates are correlated during the periods of boom and bust at a rate equal to 92.9%.

The entry rate in 2012 equals 5.3% though the exit rate is at 6.6%. The year with the highest entry rate is 2013 (5.4%), while the exit percentage starts from its maximum value in 2012. From 2013 to 2015, the entry rate was greater than the exit rate, but the opposite took place from 2016-2017. In 2018 the exit rate is at its lowest value (2.2%), similarly to the entry share (2.9%).

FIGURE 11 - SOLE PROPRIETORSHIP: ENTRY AND EXIT RATES IN GREECE FOR 2012-2018

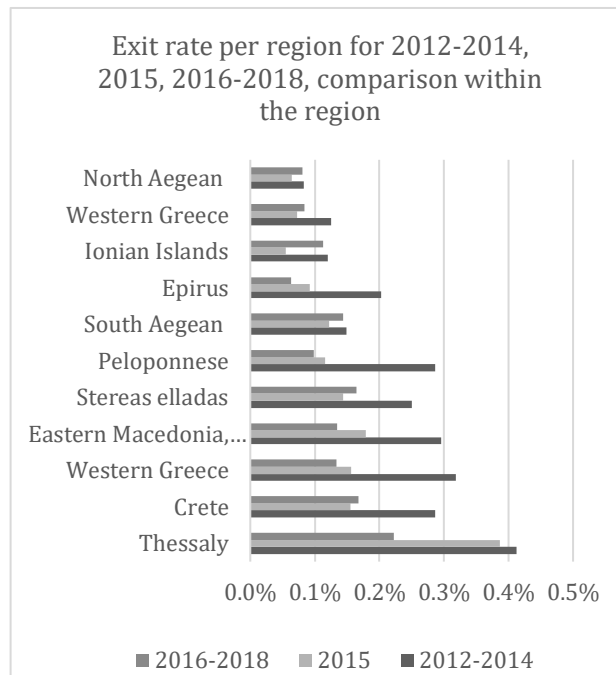
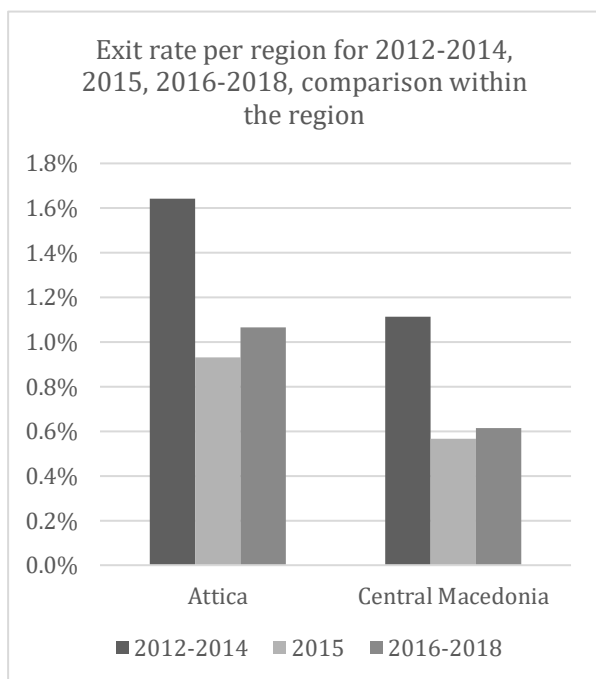
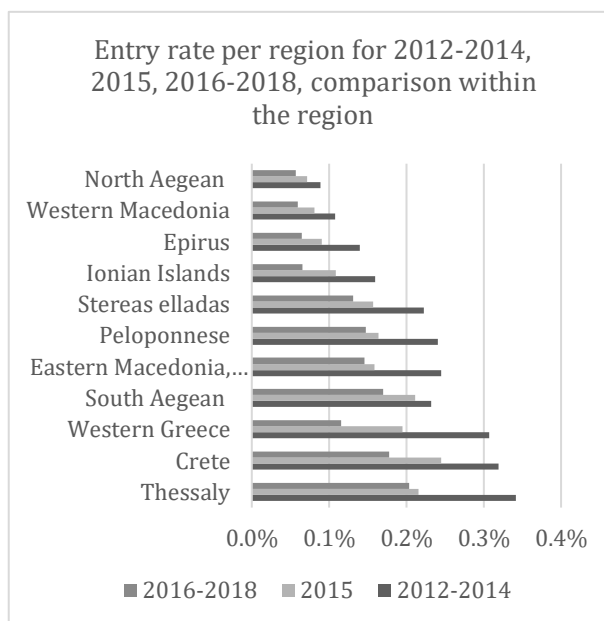
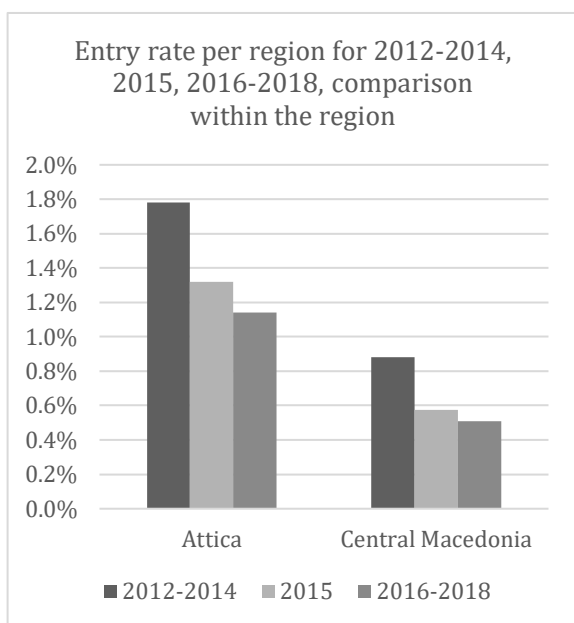


Notes: Entry (exit) rates are defined as the ratio of new (closed) firms over the total of the active firms in the SOLE database each respective year.

Attica and Central Macedonia were the leading regions regarding both entry and exit rates, and the differences to the rest of the regions were quite considerable. Entry rates decreased through 2012-2018 for all regions in Greece. In 2015 an extra shock for Greece's economy took place due to the imposition of capital controls. Therefore, we use this cut off point to analyse the regional dimension by splitting the annual rates before and after the shock using a three-year average. The highest entry rate was observed in Attica during the 2012-2014 period (1.8%), while Central Macedonia firms entered the market at a rate of 0.9% during the same period. For the rest of the regions, increased rates were observed in Thessaly, Crete and Western Greece. Before the imposition of Capital Controls, Thessaly was leading the rest of the regions with an entry rate equal to 0.3%, while in 2015, Cretan businesses entered the market with the highest share of 0.2%. The lower entry percentages for every examined period were in North Aegean, Western Macedonia and Epirus, but the largest ratio among them was the Epirus entry rate in 2012-2014, equal to 0.1%.

Regarding the market exits, the results are somehow different. Contrary to the decreasing entry rates in many regions, the exit rates increased for some regions after the 2015 shock. Attica's shares for the three examined periods were 1.6%, 0.9%, and 1.1%, correspondingly. In Central Macedonia, the exit rate before 2015 was 1.1% and remained at 0.6% for 2015 and 2016-2018. Concerning the rest of the regions, Thessaly, Crete, Western Greece, and South Aegean were the only regions after 2012-2014 that demonstrated an exit rate higher than 0.2%. At the same time, entries with the lowest values were again observed in North Aegean, Western Macedonia and Epirus, where exiting after 2012-2014 was less than 0.1%.

FIGURE 12 - ENTRY AND EXIT RATES CATEGORISED IN REGIONS BY 2012-2014, 2015, AND 2016-2018 PERIODS

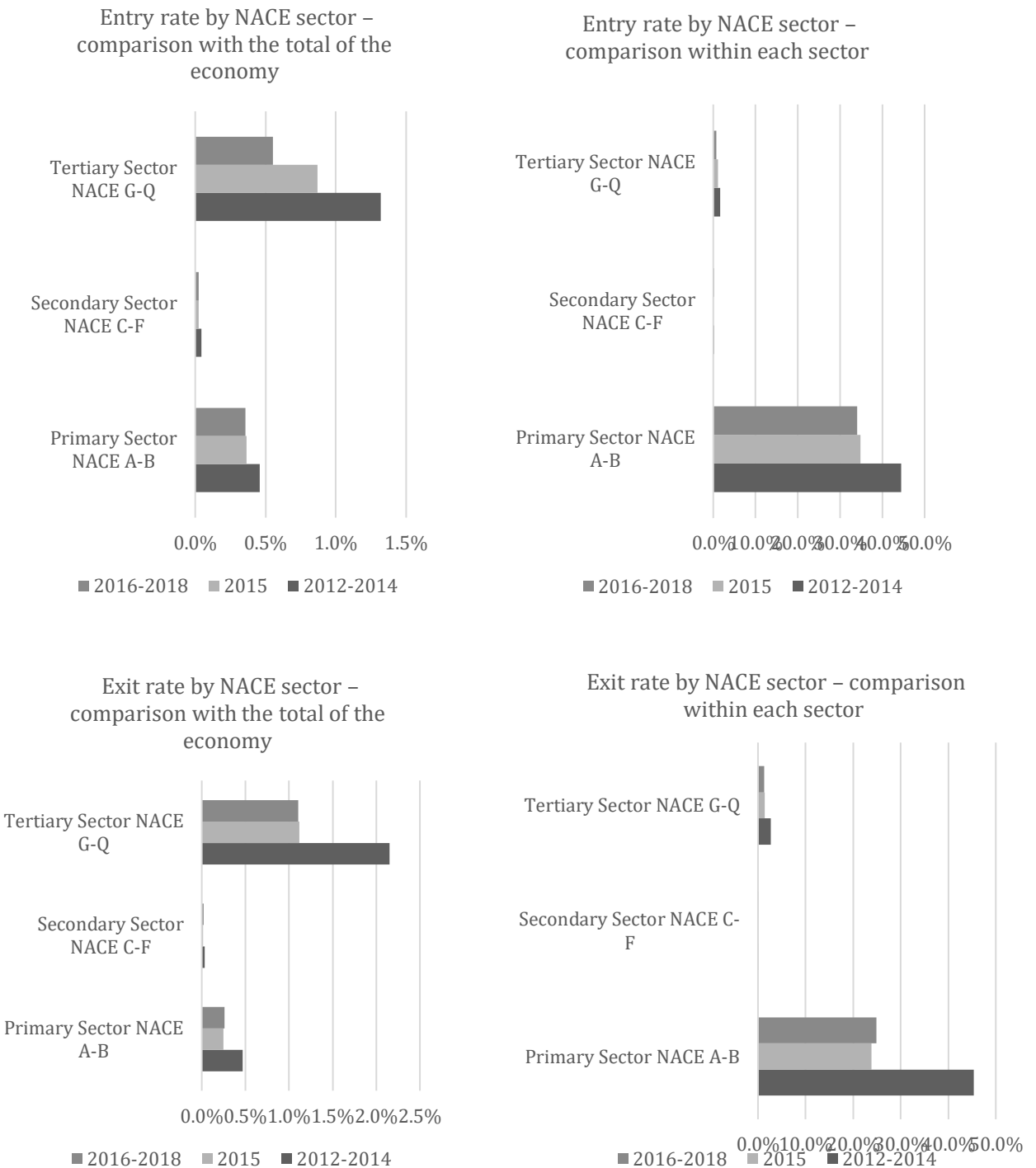


Notes: Entry (exit) rate is defined as the ratio of the number of new (closed) firms over the total number of active firms in the SOLE database each year in the respective category. The presented rates are the averages of the entry (exit) rates for the periods 2004-2008, 2009-2016, and 2017-2019. The region categories refer to the NUTS2 classification regarding the location of firms.

The tertiary sector was the leading sector with respect to entry rates when divided by the total active firms of the economy, followed by the primary sector. The higher entry rate for the tertiary sector is demonstrated in 2012-2014 (1.3%), while in 2015, it was equal to 0.9%, and in 2016-2018 it dropped further at a rate of 0.6%. The primary sector entry ratio was 0.5% in 2012-2014, while for the rest of examined periods remained constant at 0.4%. The entry of the secondary sector for the sole traders was negligible. Examining the within sector variation, the primary sector ranged from 44.4% to 34.0% for 2012-2014 and 2016-2018, correspondingly. For the tertiary sector, the entry rate before the capital controls was 2.7% for the sector's firms, which decreased further in the following years.

The average exit rate for the tertiary sector in 2012-2014 was 2.2%. During the capital controls, it fell to 1.1% and remained similar on average for the following years. For the primary sector, the exiting was 0.5%, and in 2012-2014, it declined further in the following years. Similarly, in entry years, the secondary sector's presence was negligible. Large within sector variation was evident in the primary sector, where the exit rate in 2012-2014 reached 45.4%, which dropped in 2015 to 23.8% and increased slightly in 2016-2018 to 24.9%.

FIGURE 13 - ENTRY AND EXITS RATES BY NACE SECTOR, WITHIN THE SECTOR AND THE TOTAL ECONOMY, AVERAGES 2012-2014, 2015, 2016-2018



Notes: Entry (exit) rate is defined as the ratio of the number of new (closed) firms over the total number of active firms in the SOLE database each year in the respective category. We adopt the NACE (Nomenclature of Economic Activities) standard classification. The statistics here are presented in the first level, which includes 21 sections identified by alphabetical letters A to U. The Primary sector is defined as the A and B sections, the Secondary Sector ranges from C to F, and the Tertiary Sector is G to Q, and the rest of them belong to the category of other services. The examined periods are the average of the entry (exit) rates of 2012-2014, 2015, and 2016-2018.

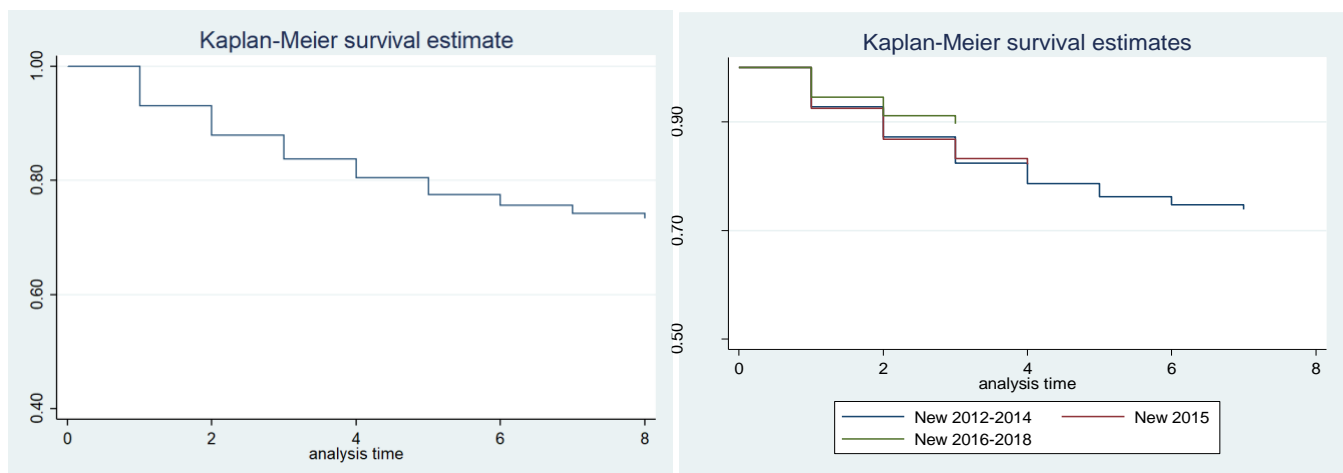
Survival analysis of new firms

The survival rates for sole traders established in 2011 are investigated in this subsection. Approximately 23.0% of Sole-Proprietorship firms introduced in the market between 2011 to half of 2019 closed until the first half of 2019 (Table A8). From the new firms of the SOLE, the interval with the highest share of failed firms was the 1-2 years of operation, equalling 27.5%, while 64.9% of the failed new firms of the sample ended their operation in the first two years of their operation. After seven years of operation, the failed ratio decreases significantly to 1.7%, indicating the impact of age on the survival rate.

The survival rates of firms depend on the period of their market entry based on the year intervals, similar to the previous section. The survival rates of new firms established in 2012-2014 and 2015 are quite similar. The most resilient period was 2016-2018. The difference in survival between the different categories was statistically significant using the Log-Rank Test ($\chi^2(1) = 210592$, $Pr > \chi^2 = 0.000$).

Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after

FIGURE 14 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2011-2019 IN TOTAL AND BY ECONOMIC PERIOD

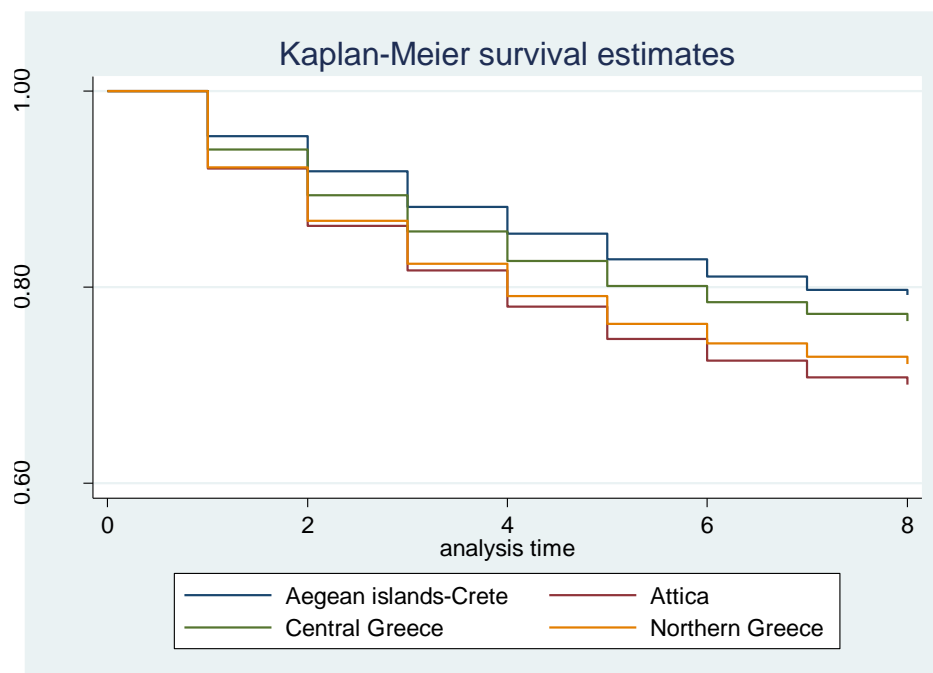


2011. The “New 2012-2014” represents the new firms established between 2012-2014, “New 2015” represents the new firms established in 2005, and “New 2016-2018” represents the new firms established between 2016-2018.

At the NUTS1 regional level, the difference in survival between the different regions was statistically significant using the Log-Rank Test ($\chi^2(1) = 257375$, $Pr > \chi^2 = 0.000$). The region with the highest survival rate of firms established after 2011 was the Aegean Islands and Crete. In

contrast, Attica, the region with the highest share of firms, performed last regarding resilience at the NUTS1 level. The results are comparable to the other legal forms examined in the ICAP dataset.

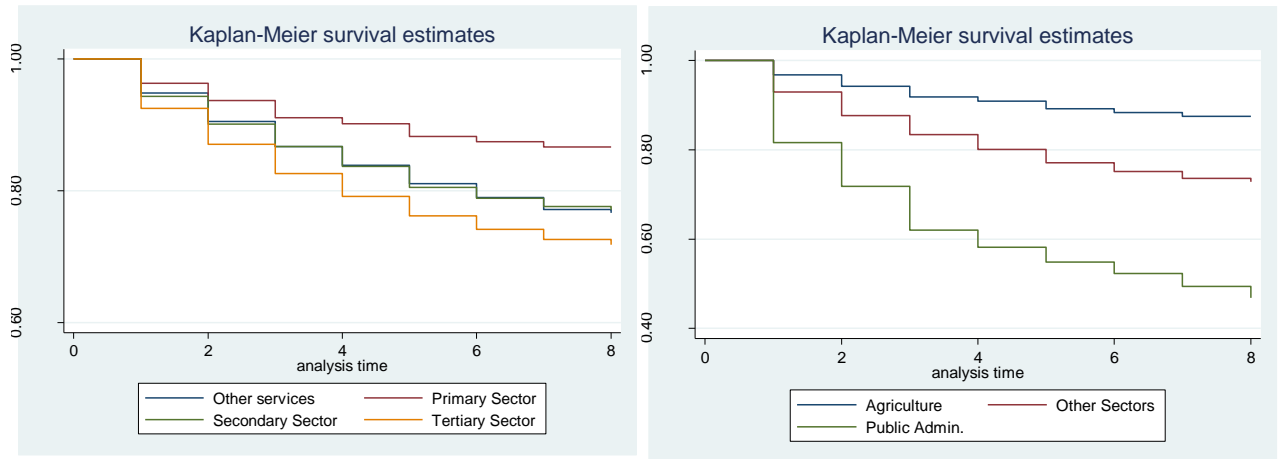
FIGURE 15 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2011 TO FIRST HALF OF 2019 BY NUTS1 REGIONAL LEVEL



Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2011 with respect to their location. Regions are represented at the NUTS1 level.

In the sectorial level survival rates, the difference in survival between the different sectors was statistically significant using the Log-Rank Test ($\chi^2(1) = 235390, Pr > \chi^2 = 0.000$). The primary sector was the most resilient during the examined period, whereas the tertiary sector demonstrated a poorer rate. From the first level of NACE categories, the most resilient through the eight years examined was the sector of Agriculture. The sector with the lesser survivability was the domain of Public Administration, similarly to the ICAP dataset.

FIGURE 16 - KAPLAN-MEIER SURVIVAL RATE FOR FIRMS ESTABLISHED BETWEEN 2011 TO THE FIRST HALF OF 2019 BY NACE CATEGORISATION



Notes: The graphs present the Kaplan – Meier survival estimates for new firms that entered the market after 2011 with respect to their industry. We adopt the NACE (Nomenclature of Economic Activities) standard classification. The statistics here are presented in the first level, which includes 21 sections identified by alphabetical letters A to U. The Primary sector is defined as the A and B sections, the Secondary Sector ranges from C to F, and the Tertiary Sector is G to Q, and the rest of them belong to the category of other services. The right graph presents the most and the less resilient sector during the examined period.

5.2 Econometric analysis

Table 1 reports summary statistics from the merged ICAP dataset. Size is measured as the natural logarithm of sales. Leverage ratio is defined as $[\text{total assets} - \text{equity}] / \text{total assets}$, whereas fixed assets ratio is defined as $[\text{total assets} - \text{current assets}] / \text{total assets}$. The industrial property rights indicator takes the value of one if the firm has any patents, trademarks or industrial designs in its management portfolio. Firm age is measured in years since the year of establishment. Exports is an indicator variable that takes the value of one if the firm has any amount of exports in that year. HHI measures the sales concentration level at the sectoral level. For our main results, we use a baseline sample of the core legal status firms (SA, Ltd etc.) that have sector information for the years 2004-2020.

5.2.1 Firm survival

Table 2 reports the main results from equation (1) using a linear probability specification. In the first seven columns, we introduce each independent variable in sequence and in column 8, we present all of them together. In columns 9-11, we add the legal status progressively, region and sector fixed effects, and in column 12, we combine all of them.

Columns 13-15 present the most restrictive specifications, where we control for firm fixed effects.

The main effect of the crisis, as we can see in columns 1-12, is to increase the probability of exit between 1.4%-1.6%, on average, whereas when we control for firm fixed effects (column 13), the effect falls to 0.5%. Given that the baseline probability of exit before 2009 was 10%, the crisis increased the exit likelihood by 5%-16%. The second interesting aspect, as we can see in column 14, is that the effect is much larger during the first period of the crisis rather than in the second one. In fact, the results from the last column indicate that it followed an inverse-U shape by first increasing and then decreasing as the crisis was phasing out.

Looking at the effect of the rest of the coefficients, we can see that larger (in assets) firms are less likely to exit, with the effect being almost linear (column 1). Higher leverage seems to increase the probability of exit (column 8). However, different firms seem to follow different strategies, and this effect becomes insignificant once we control for individual firm fixed effects. More fixed assets (column 3) seem to provide a good shelter against the probability of exit. In addition, intellectual property rights (column 4) and the ability to export (column 6) make exit less likely. Firm age plays a non-linear role (column 5), first increasing and then massively decreasing the probability of exit, but its effect is not particularly robust when we add the various FE and becomes insignificant with firm FE. Finally, the higher the sector's concentration, the less likely it is for a firm to exit (column 7). These results persist when we include the various fixed effects (columns 9-12) and retain their sign and magnitude even with firm fixed effects (columns 13-15), with the main exception of the exports indicator. It seems that this indicator is highly collinear with the firm FE, and as a result, it drops out in the estimation. This indicates that there is limited variability within each firm over time, which most likely highlights a weakness in the ICAP data and the way the information on exports is collected.⁸

Table 3 presents similar specifications using the logit model for estimation. Results look very similar to the linear probability model: the crisis massively increases the probability of exit (columns 1-12), with the effect being stronger in the early rather than the later period

⁸ The information on exports simply records the answer to the question whether the firm exports or not (without any information on quantities) and hence it seems to be too crude to capture the large change in the behavior of many firms in Greece that during the crisis massively increased their exports.

(columns 13-14), larger firms (column 1) that are in concentrated industries (column 7), that export (column 6) and have intellectual property rights (column 4) at less likely to exit. Firm age plays a smaller role (column 5), and leverage does not seem to alter the exit likelihood (column 2) significantly. Sector, region or legal status do not change results qualitatively (columns 9-11) but play a larger role quantitatively. These results are also broadly confirmed in Table 4, where we use the proportional hazard model.

5.2.2 Robustness

We do three perturbations to test the robustness of our results. First, we drop the last two years (2019-2020) both because the 2020 information is incomplete but also to make the contrast to the pre-crisis period starker. Second, we drop the variables related to sectoral information as this information was not complete for all firms. Third, we look at all legal entity forms, not just the main ones. The results from these experiments are reported in Tables 5-7 for the linear probability model. The equivalent results from the logit and proportional hazard model are reported in the Appendix (Tables A1-A6).

Table 5 shows that the crisis effect is stronger if we exclude the last two years of recovery from the dataset, whereas most of the rest of the coefficients retain their sign and magnitude. In Table 6, the pattern is similar, with the effect of crisis now stronger since our larger sample also includes the firms for which we have no sectorial information. Finally, Table 7, with the largest possible sample of firms and observations, reveals a similar picture with the effect of crisis varying between 1%-2.4%, while most of the other coefficients retain the magnitude and significance.

5.2.3 Intellectual property rights

In Table 8, we explore in more detail the role of intellectual property rights in firm survival. First, column 1 reports the effect of the aggregate indicator of intellectual property rights, which is the impact of any patents, trademarks or industrial designs that a firm has on the probability of survival, similar to Table 2, column 4. Then in columns 2-4, we break it down to each component, which reveals that the aggregate effect mainly stems from the influence of patents (column 3) and trademarks (column 4) but not designs (column 2). These results persist when we put all the variables together (column 6) and add the various fixed effects in columns 7-9. Interestingly in the last three columns where we control for firm fixed effects,

the only significant effect comes from the trademarks, which are by far the most popular tool used among the three intellectual property rights tools for Greek firms. We also repeat this exercise using the number of patents, trademarks, or industrial designs instead of the indicator, and the results are qualitatively similar.

5.2.4 Firm growth

Table 9 reports the results from (2) using ordinary least squares specification. In the first six columns, we introduce each independent variable in sequence and in column 7, we have all of them together. In columns 8-10, we add the legal status progressively, region and sector fixed effects, and in column 11, we have them all together. Columns 12-14 present the most restrictive specifications where we control for firm fixed effects.

The main effect of the crisis, as we can see in columns 1-11, is to severely hinder firm growth between 4.9% - 7.1%, on average, whereas when we control for firm fixed effects (column 13), the effect falls to 3.4%. This aggregate effect is heterogeneous over the time of the crisis as it is mainly negative during the first six years (columns 13 and 14), whereas it becomes positive during the last four years, indicating that the recovery for surviving firms starts much earlier than what aggregate economy-wide statistics would indicate.

Looking at the effect of the rest of the coefficients, we can see that older (column 5) and larger firms (column 1) grow more slowly, and the same happens to firms with higher leverage (column 2). On the contrary, a higher percentage of fixed assets (column 3), intellectual property rights (column 4) and exports (column 6) seem to increase firm growth. These results persist when we include the various fixed effects (columns 8-11) and retain their sign and magnitude even with firm fixed effects (columns 12-14), with the main exceptions of exports and leverage that are collinear with firm fixed effects.

5.2.5 Robustness

Similarly to survival, we also perform three perturbations to test the robustness of these results. First, we drop the last two years (2019-2020). Second, we drop the variables related to sectoral information. Third, we look at all legal entity forms, not just the main ones. The results from these experiments are reported in Tables 10-12.

Table 10 shows again that excluding the recovery years of 2019-2020, even if the information is incomplete, greatly impacts the estimated coefficients, particularly the one on crisis. The impact of the crisis on firm growth is ten times larger than before and varies between 28% and 33% (columns 1-11), with the effect being 22% when we look at the most restrictive specification (column 12). The rest of the coefficients do not change so fundamentally and retain their sign and significance as before. In Table 11, the main effect of the crisis is somewhat smaller than in Table 9 but very similar despite the large increase in sample size (close to 110,000 additional observations) with typically smaller and weaker firms. Finally, Table 12, with the largest possible sample of firms and observations, reveals a similar picture again, with the effect of crisis varying between 3% - 6%, while most of the other coefficients retain the magnitude and significance.

6. Discussion and policy conclusions

The analysis conducted in the context of this project provides some significant insights for policy discussion and implications for policy shaping for entrepreneurship, but also for other policies to foster innovation, performance, competitiveness and resilience of SMEs during a lasting crisis caused by exogenous shocks.

At first, we should notice that the dataset that was created combines important types of information from different sources, thus leading to a unique dataset not previously available for research. At the stage, the dataset was created to analyse the crisis's impact on entrepreneurship and firm resilience. But this dataset could be used for additional analyses in various dimensions and further widened with other firm level information, as well as sectoral information. The analysis included in the paper examines the interplay between entrepreneurship and innovation during the years of the crisis, using patent, design and trademark data. It is, to our knowledge, the first systematic examination of business demographics in Greece over such a long period of time.

Our findings have useful implications not only for Greece and its future policies but also for policymakers of other countries going through a crisis or having a similar economy structure. An overwhelming population of SMEs and especially small and middle-size firms, is similar to many EU countries, thus, our results go beyond a solely "Greek" case. In addition, Greece, due to the severe economic crisis it has been facing since 2009, represents a case

study of particular research and policy interest. But also, at the business level, we offer some insights to firms on how to strengthen their resilience and increase their chances for survival.

Furthermore, we could also pinpoint that the economic shock due to the COVID-19 crisis is partly resembling what Greece experienced during 2008-2013 in terms of some basic indicators. Both crises seem to share some common features, such as nearly double-digit GDP losses, increasing unemployment rates (if not supported by relevant measures), and a significant increase in public debt. In both cases, the regulatory and institutional set up but also the "markets" (investors) were not prepared for the magnitude and the consequences of both crises. Both crises also negatively affected business activity, resulting in business exits, supply chain disruptions, redundancies, and loss of key customers (Belitski et al., 2022). Of course, under the COVID-19 crisis, the reaction from the EU was immediate with a wide set of instruments but also significant funding for investments (EU's Recovery and Resiliency Facility (RRF)). Still, lessons can be learned that are valid for both crises.

A clear policy but also business message is that exports seem to provide a "safe" option for survival during adverse times. Of course, for the "average" Greek SME (which is actually a micro firm), this is not an easy strategy as it requires advanced human capital and efforts to innovate, which is not a typical path to follow. That is why SMEs need support for finding new alternative markets and training their workforce in that direction. An effort to grow through exports is not a defensive strategy when internal markets cannot create higher demand or absorb more volume. It is a strategy that seems not only to increase the chances of survival for firms from such economies but also a strategy to create a sustainable growth path.

Results on the importance of higher fixed assets could be closely related to investments in manufacturing firms. The recent pandemic crisis also pushed forward the policy debate on which sectors of the economy can provide a sustainable growth pattern. Tourism is important for Greece indeed, but the volatility of the relevant demand and the uncertainties around it emphasise that investments in manufacturing sectors should be at the heart of a national growth strategy. Empirical studies in Greece have indicated the significant multiplying effects of manufacturing sectors in the Greek economy, in terms of GDP but also in terms of employment and tax revenues (IOBE 2017; IOBE 2019). But our analysis supports the argument that manufacturing firms have better chances for survival compared to service firms, as well.

Finally, the focus on start-ups (that is, the flow of ventures) is also essential in an economy. But we should not downplay the fact that they represent only a marginal side of entrepreneurship. Established firms, as well as those of larger size, have a successful record of surviving various crises. They should not be "neglected" when designing policies and incentives of any type: they lie at the heart of our productive system and represent the critical "stock" of an economy. Still, our empirical research finds that although younger and smaller firms have smaller survival chances, they are the ones that demonstrated higher growth rates during the period of study. In that respect, the main policy aim of entrepreneurship should not just be an algebraic increase in the number of start-ups that are created in an economy but an effort to affect the quality characteristics of these ventures, so they can be viable and support sustainable growth (Giotopoulos et al. 2017). This is significant for designing policy strategies and tools in adverse economic conditions when, on the one hand, there are increased financial constraints and, on the other, there is a need to achieve economic recovery.

Furthermore, our empirical analysis finds strong evidence of the importance of innovation for firm performance and resilience. Firms that engage in trademark and patent activity have higher chances of survival. In that respect, it is essential to enhance the business environment to promote firm innovation and adapt to the challenges of the fourth industrial revolution. Greece has high human capital within its labour force as well as talented researchers. While it performs above average in measures of university research publications, it underperforms in most measures of innovation activity, including patenting. Greece had one of the lowest rates in GDP spending in R&D activities in the 2000s, and while subsequently it increased its efforts and managed to double it to 1.3% in 2019, it is still one of the lowest amongst OECD countries (OECD, 2020).

One of the main concerns is that the public research system is isolated from production, with few links between universities and businesses. Furthermore, the private sector is underperforming in R&D activities, amongst others, due to a lack of venture capital. It is vital to develop an ecosystem that puts knowledge production as a top strategic priority and fosters the links between the triple-helix of public research institutions, central government and the business sector. The coordinated action amongst these three pillars should aim at facilitating the produced knowledge to be transformed into entrepreneurial activity.

Our empirical findings also highlight the importance of the periphery versus the main metropolitan regions of Greece. Policies along the lines of smart specialisation become particularly useful for boosting the innovation and productive potential of all regions in Greece (EC, 2013). Regional development should not be limited to utilising the EU structural funds but also actively involve the local business sector and the public research infrastructure. Rather than a subsidy driven model, there is a need for a tailor made, bottom-up approach, that builds on local assets and amenities, the regional pool of talents, investors and institutions, in order to unlock the innovation and growth potential of each region (OECD, 2020).

To sum up, the ability of firms to adapt to turbulent economic conditions and survive is a key factor for the economies to maintain jobs and households to maintain their incomes. Our research identifies factors that enable firms to survive through crises and points to key policy recommendations for the policy makers of Greece and other countries going through similar crises. In a global environment of increased international competition with vastly changing technologies, the main policy concerns should focus on creating a business climate that enables firms to utilise their potential, innovate, produce high value-added products and successfully compete in the national and international markets.

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