Determinants of firm growth during the Great Recession: the case of the Italian automotive industry

Silvia Rocchetta
Università degli Studi di Torino
Dipartimento di Economia e Statistica "Cognetti de Martiis"
Lungo Dora Siena, 100 A, 10153 Torino
silvia.rocchetta@unito.it

Draft: preliminary version

Abstract

In this paper, we use an original firm-level dataset to explore the factors affecting firm probability to grow throughout the Great Recession. In particular, the question we want to address is whether the firms able to grow during recessionary shocks differ in terms of structural characteristics, such as their degree of innovativeness, their profitability their financial conditions and geographical location compared to the companies experiencing decline throughout the crisis. In this context, the automotive industry can be included among the Italian sectors that have been mostly hit by the Great Recession. It represents, therefore, a particularly interesting field to reflect upon the determinants of varying firm capabilities to face severe destabilizing disturbances. The empirical estimations corroborate the hypotheses that firms that invested in intangibles assets and innovated in the pre-crisis period have better chances of growing during an unexpected economic downturn. The presence of agglomeration economies does not appear to significantly influence firm probability to grow throughout recessionary phases.

JEL codes: L25, O31, R11

Keywords: Resilience Capacity, Firm Growth, Crisis, Innovation, Industrial clusters

1. Introduction

The Great Recession, started in 2008, has marked considerably the European corporate landscape. Eurostat registered that between April 2008 and April 2009 industrial production in the EU-28 dropped by more than 22 percentage points and EU unemployment rate soared by more than 2 percentage points. Not all the companies, however, have been severely affected by recessionary pressures: 'some firms prospered in recessions, while others failed very badly' (Geroski, 1996: p. 551). In this context, scholarly interest in analysing the determinants of the heterogeneity of firm performances during a recessionary shock has grown considerably.

Despite the uncertainty and idiosyncrasy that characterise the processes which are driving firm growth, the literature suggests some key determinants of companies' ability to exhibits good performance over recessionary phases. Several scholars (among others: Kroszner et al., 2007; Braun and Larrain, 2005) claim that companies with lower level of indebtedness and that invested in intangible assets (Teece et al., 1997) in the pre-crisis period have better chances of growing throughout economic downturn. Related studies (among others, Gerosky, 1996; Nelson and Winter, 1977; Coad, 2009) attribute to innovation and to the 'learning abilities' an anti-cyclical effect. Following this line of inquiry, Gerosky (1995) empirically demonstrated that innovating firms are both more profitable and grow more rapidly than non-innovators, but the major difference in term of performances turn out to be cyclical: innovators' paths of growth are much less cyclically sensitive than non-innovators. According to Nelson and Winter (1977, 1982), this is arguably due to the fact that innovation involving mechanisms of search, imitation, and implementation of internal knowledge and skills determines the amount of available opportunities and affects the firms' growth rate (Pavitt, 1984; Dosi et al., 1995).

Martin (2016) argues that the presence of agglomeration economies, as well, play a key role in protecting firm performances during destabilizing disturbances. Companies located in in spatial proximity to similar firms may benefit from growth relevant knowledge generated by competing and cooperating firms.

To the best of our knowledge, however, not many empirical studies are attempting to estimate the complex mix of firm characteristics triggering companies' ability to exhibit good performances over the crisis. In particular, the question we want to address is

whether the firms able to grow during recessionary shocks differ in terms of structural characteristics, such as their degree of innovativeness, their profitability, their financial conditions and geographical location, as compared to the companies experiencing decline over the crisis. Seeking the answer to this question involves important policy implications. Institutions, indeed, may want to understand whether firms able to cope with recessionary shocks are also those who can trigger the overall sector, region or country level of adaptability during economic downturn.

In this study, we address this gap by providing econometric evidence from a sample of 1477 companies observed over the period 2005-2012. Our dataset combines data from AIDA - a service provided by Bureau Van Dijk including detailed information about financial accounting data on Italian private and public companies - and PATSTAT database of the European Patent Office (EPO). All the firms included in the database belong to the manufacturing of motor vehicles, trailers and semi-trailer sector according to NACE Rev.2 classification. The automobile industry is, indeed, among the Italian sectors that have been hit the most by the financial crisis started in 2008 ANFIA (Associazione Nazionale Fra Industrie Automobilistiche) in 2012 registered that demand for cars fell by 9.2% from 2007. Furthermore, the automotive sector has always been particularly sensitive to exogenous shocks. This is arguably due to the fact that this industry is shaped by cyclically sensitive external factors like consumer tastes and purchasing power, labour markets regulations and public policy. The automotive industry represents, therefore, a particularly fertile ground to reflect upon the determinants of varying firms' capabilities to face destabilizing disturbances.

For the purpose of this study we use the information contained in the dataset to compute the set of explanatory variables and our categorical distributed dependent variable. We calculate the latter by analysing and comparing the evolution of firms' sales during the period 2005-2007 and the crisis period 2008-2012. Finally, by estimating a multinomial logit model, we show that the firms that invested in intangible assets and innovation in the pre-crisis period are more likely to grow during a recessionary shock. Furthermore our results suggest, that the most innovative actors of the automotive industry supply chain have better chances of exhibiting good performance despite the financial crisis while the effect of agglomeration economies is overall negligible.

The chapter is structured as follows. Section 2 analyses the main peculiarities of the Italian automotive sector. In section 3, instead, we review the literature on firm growth

during recessions and we develop a set of testable hypotheses. Section 4 introduces the data, the construction of dependent variable and the set of explanatory variables that we include in our modelling exercise. Section 5 discusses our estimation strategy and methods. This section contains also our results, which we discuss in Section 6.

2. Italian Automotive sector

The automotive industry is one of the most important sector of the Italian economy. Despite the difficulties that this sector went cyclically through, it still represents Italy's largest manufacturing industry employing 1.2 million workers and contributing for 4.4% to the national Gross Domestic Product (GDP). From a geographical point of view, the Italian automotive industry originated in Turin and nowadays it is spread all over the country: in the South (around Pomigliano d'Arco, Melfi and Termini Imerese), in the Centre (around Cassino and Chieti sites) where Fiat plants are located and in other districts of Northern Italy like Milan, Brescia, Bologna, and Modena.

Moreover, since the crisis that FIAT underwent in the 1990s, the Italian car production system experienced a progressive process of vertical disintegration by increasingly externalizing the more complex and innovative activities to specialized suppliers (Patrucco, 2011). Thus, even if few Original Equipment Manufacturers (OEMs, i.e. in this context car-makers) still dominate the industry, an increasing number of suppliers provide the more specialised components and processes.

During the global financial downturn started in 2008 the automobile industry has been among the Italian sectors that have been mostly hit. At the beginning of 2009, Fiat announced a 19% revenues drop in the last three months of 2008. ANFIA (Associazione Nazionale Fra Industrie Automobilistiche) declared that car demand fell by 9.2% from 2007 to 2012.

Automotive sector intrinsic peculiarities and the strong interdependency with the national economy contribute to make this industry particularly sensitive to exogenous shocks. Cars, in fact, are durable goods that yield utility over time rather than being completely consumed in one time- use. Moreover, Italy is already a mature market where the consumer propensity to buy vehicles is lower than in other countries. To crown it all, the sector is shaped by cyclically sensitive external factors like consumer tastes and purchasing power, labour markets regulations and public policy (incentives and taxation).

In this context, the Italian automotive industry represents a particularly fertile field to reflect upon the causes of varying firms' capabilities to face severe recessionary shocks.

3. Literature review

3.1. Firm growth

Firm growth and its possible determinants is one of the most investigated topics in the economic literature. It fosters, indeed, employment growth (Birch, 1987), gains in productivity, (Bartelsman, Scarpetta and Schivardi, 2005) product and process innovations and technological change (Pagano and Schivardi, 2003). Despite the importance of the theme, the difficulty of generalizing across the drivers of firm growth is reflected by the wide variety of theoretical and empirical studies generated by the different branches of the economic research. This is arguably due to the fact that the definition of the firm is complex and multiple (Aragon-Correa, 2003).

Classical economists (among others Viner, 1932) claim that firm growth is a process driven by variation in the market equilibrium conditions and linked to consequent mechanisms of search for the unique possible and the most efficient firm size.

Behavioural economists (among others Penrose, 1959), on the contrary, argue that the reasons of the companies' variety of performances in terms of growth have to be found into firms' different internal characteristics.

According to stochastic theorists, instead, the heterogeneous patterns of firms' growth are due to pure historical chance. This approach has been deeply influenced by the seminal study of Robert Gibrat (1931). Gibrat's law (or the 'Law of proportionate effect') states that each firm probability to grow is constant and it is independent from its initial size: 'the probability of a given proportionate change in size during a specified period is the same for all firms in a given industry regardless of their size at the beginning of the period' (Mansfield, 1962: p. 1031). Thus, following this line of inquiry, stochastic scholars (among others: Gibrat, 1931; Kalecki, 1945) argue that firm growth is the result of a non-predictable process where each firm, independently from its initial size, has exactly the same probability to grow because of a random shock. Accordingly, they claim that the market tends to be more concentrated over time because the variance of the firm growth rates is the same for every company no matter its initial dimension.

After Robert Gibrat seminal work (1931), a huge amount of studies attempted at empirically demonstrating the validity of his theory with ambiguous and controversial results. In the early 50's and 60's few empirical analyses confirmed the validity of Gibrat's Law (Hart and Prais, 1956; Simon and Bonini, 1958) by showing that there is not any relationship between firm size and firm growth. In the 80's, however, the literature on Gibrat's law experienced a new flourishing by opening new lines of research. Some empirical evidences demonstrated that, on one hand, firm probability to survive increases with firm size and age; on the other hand, firm size and age are negatively related to firm growth (Evans, 1987a; Dunne et al., 1988).

More recently, the learning theory has gained traction into this literature. In particular, evolutionary scholars identify the processes of learning by individual firms and the mechanisms of market selection among the main determinants of the industries dynamics. Following this line of inquiry, Geroski (1995a) argues that the pattern of firm growth and its survival relies on firms' capacity to learn. In this theoretical framework, the processes of learning concern the development of product and process innovations. Selection instead is the result of the interactions among the companies on the market in which the more competitive ones gain market share at the expense of the less competitive firms that shrink their weight up to their death. Mansfield (1962) provides some evidence in this direction by highlighting the fact that successful innovators grew faster than other comparable firms. Klepper (2002a; 2002b), by analysing the evolution of U.S. automobiles industry, demonstrates that the current leading auto manufacturers (General Motors, Ford and Chrysler) are the ones that acquired more competences and technological knowledge in the past.

Several scholars (among others: Penrose, 1959; Coad, 2009) argue, however, that a part from size, age, and learning capacity a wide array of others factors influences the process of firm growth. According to Storey (1994), the drivers of firm growth can be classified into three main categories: firm-specific, founder-specific, and external factors.

In the context of firm-specific determinants researchers found out that companies with tight connections with other markets (through exports) or other firms (through partnerships) are more likely to growth. These links contribute, indeed, to enhance a process of exchange of new knowledge that prompt firm productivity (Delgado et al., 2002). Several empirical analyses (among others: Coad, 2009) confirmed the key role played by innovation in prompting firm growth. Firm-level innovation, however, has

usually a positive influence on sales growth or productivity growth while its effect on employment is ambiguous. Innovation is usually measured at the firm level through the expenditure in R&D or through patenting activities. They respectively capture the input and the output side of the innovation process. In this context, the early literature (Mansfield, 1962; Mowery, 1983) supports the positive effect of innovation, especially for R&D, on sales growth. Conversely, a large number of more recent researches do not find any significant effect of R&D or patenting activity on sales growth (among others: Geroski and Mazzucato, 2002; Bottazzi et al., 2001). According to this branch of literature, innovation (both measured in term of patent or R&D) becomes a determinant of firm growth only when interplayed with size, age and other firm or sectorial characteristics.

Regarding the founder-specific characteristics Penrose (1959) highlighted that the manager ability and his level of entrepreneurial orientation play a key role in shaping firms' processes of growth.

External characteristics such as the geographical space where the firm is located, are as well fundamental determinants of firm's performance. Regarding the co-location in proximity to other firms, already Alfred Marshall in 1890 argued that firm working close to each other in related industries may benefit from three main positive externalities: the existence of a market for intermediate inputs, the presence a skilled labour force and the emergence of technology spillovers. Empirical evidence corroborates this hypothesis and suggests that the increased clustering of firms in a specific industry within the same region is positively related to firm growth (among others Smallbone and North, 1993; Almus and Nerlinger, 1999).

3.2. Firm growth during recessionary pressures

The complexity and idiosyncrasy of the process of firm growth is reflected by the ambiguous and rather controversial results emerged in the related empirical literature. Researchers found few empirical regularities and very related to the type of industry, technological regime, or region in which the firm is embedded. In this context, when economies are tested by recessionary shocks, the variance of firms' behaviours increase markedly. Despite the unevenness of the processes driving firm growth, the literature identified some factors that distinguish firms able to grow during the crises from the ones

that experience decline. Some scholars (among others: Lengnick-Hall and Beck, 2005) refer to firm's ability to cope with disturbances as resilience capacity. According to the capability- based (Dosi et al., 2001) and the resource-based theory of the firm (Penrose, 1959; Barney, 2001), resilience is defined as the unique blend of cognitive, behavioural, and contextual properties that increase firm's ability to respond to sudden environmental changes. In this context, Fort (2013) argues that large and mature businesses are less cyclically sensitive and thus less vulnerable during recessions. Conversely Moscarini and Postel-Vinay (2012) demonstrate that the downturn strengthens the performance of smaller ones. Moreover, several scholars (among others: Kroszner et al., 2007; Braun and Larrain, 2005) claim that companies with lower level of indebtedness have better chances to exhibit good performances throughout recessionary shocks.

The amount of company investments in intangible assets before the crisis may also influence its performances throughout the crisis. Gerosky (1996) underlined the prominent role played by the investments in intangible assets in the pre-crisis period in mitigating the risk of failure during a disturbance. The author (1995c), following a Schumpeterian approach, argues that innovation is another key driver of firms' resilience throughout economic crisis. Following this line of inquiry, he empirically demonstrates that innovating firms grow faster than comparable firms, and the major difference in performance emerges during destabilizing shocks: innovators growth and revenues are much less cyclically sensitive than non-innovators.

The literature does not provide any clear evidence about the role of spatial agglomeration on firm growth during the crisis. Martin (2016) suggest that firm agglomerated in cluster performed better during the Great recession. According to Cainelli (2013) instead during downturns, spatial agglomeration favours firm exit and companies decline. This arguably due to the lower market demand and subsequent increased competition between co-localised firms.

3.3. Hypotheses on the determinants of firm ability to growth during exogenous shocks

The vast literature on firm growth has developed several relevant propositions to understand what shapes firm's ability to grow during exogenous shocks. The first conjecture is that companies that invested in intangible assets in the pre-shock period are

more likely to exhibit good performances during an economic downturn. In the contemporary context of knowledge economy, several studies provided evidence of the crucial role played by intangible assets in fostering firm growth (among others Corrado et al., 2006; Bontempi and Mairesse, 2008; Marrocu et al, 2012). The Financial Accounting Standards Board defines intangibles as long-term resources of an entity, other than a financial asset, that are characterised by lack of physical substance. At firm level, they encompass all the stock of immaterial resources that enters the production process and are necessary to the creation or improvement of products and processes that drive long term value creation. More specifically, what is recorded in the companies' balance sheet under the label 'intangible' includes both endogenously created assets – e.g. research and development, blueprints, brand equity and designs - and assets procured through the external market – e.g. technology patents, licenses, and copyrights (Corrado et al., 2006).

Teece et al. (1997), argues that intangibles play a key role in shaping the path through which new capabilities are generated. Thus, firms with more abilities are more likely to create new products and technologies by recombining new and old know–how. Therefore, others things being equal, we expect that during a recessionary shock firms endowed with a greater stock of intangibles might be better prepared to orient the use of resources towards new demand pattern and thus might be more likely to grow throughout recessionary pressure.

Therefore, Hypothesis 1 can be formulated as follow:

HP 1: The amount of investments in intangible assets in the pre-crisis period positively influences firm performance during a recessionary shock.

The learning abilities theory of firm growth suggests that one of the main determinants of firm growth is innovation. Following this line of inquiry Gerosky (1995c) claims that innovation has an anti-cyclical effect during downturn. This implies that the growth rates of non-innovators fall much more than those of innovators throughout crises. There are at least two ways through which innovation may influence companies' performances during destabilizing disturbances. First of all, firms by introducing innovations acquires a temporary competitive advantage respect to their rivals. Moreover, the process of doing innovation by involving company's ability to translate endogenously generated knowledge into new goods and services, permanently transforms a firm by building up

its internal capabilities and by making it more perceptive and more adaptable to any kind of exogenous shock.

Coping with recession always requires companies to be flexible to adapt their activities to the changing market conditions and to found new opportunities not exploited yet.

This leads us to formulate the following hypothesis:

HP 2: Innovating firms are more likely to grow throughout the crisis than non-innovating ones.

In this framework, we hypothesize that among the companies that make up the Italian Automotive Industry supply chain the specialised suppliers, that provide the more complex and innovative activities, have better chances of growing throughout the crisis.

Thus, we propose the following hypothesis:

HP 3: During destabilizing disturbances, innovative suppliers are more likely to exhibit good performances than Original Equipment Manufacturers.

For a long time, firm geographical location has been considered as 'a neglected determinant of firm growth'. However scholarly interest in the topic is increasingly gaining traction in the recent economic literature. Several studies demonstrated that firms which are located within agglomerations of their industry should have higher growth potentials (Beaudry and Swann; 2009) This is arguably due to the fact that being located within agglomerations of workers in the same sector has a positive impact on firms' growth prospects. Companies located within a cluster have an easier access to more qualified human capital, to non-traded inputs and specialized goods, to venture capitalist, to the final markets and to the regional network of firms and other institutions such as universities and public research laboratories (Audretsch and Dohse, 2007). The presence of an agglomeration of firm within the same sector encourage the exchange of knowledge spillovers and the processes of intra - industry learning. Moreover, In the short-run, geographically clustered firms are able to reduce, transportation and logistic costs (Cainelli, 2014) Thus, other things being equal, we expect that firms that benefit from these type of spatial externalities are more likely to undertake processes of adaptation during financial shock. This lead us to propose the following hypothesis:

HP 4: Firms that are located within clusters are more likely to grow during a disturbance

4. Data and Variables

4.1. Dataset

The econometric analysis is based on a dataset that combines data from AIDA and PATSTAT database.

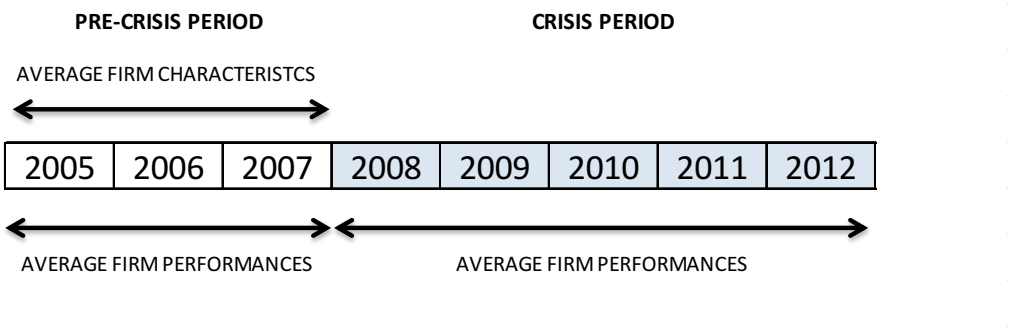
PATSTAT is a register of patent records from the European Patent Office (EPO). For the purpose of this study, it provides information about the patenting activities of the firms included in our sample.

AIDA, instead, is a service maintained by Bureau Van Dijk and contains detailed information about financial accounting data on Italian private and public companies. The edition at our disposal (2015) covers a time span of 9 years, from 2005 to 2014. We restrict our analysis to the period 2005-2012 to have a time interval with a good coverage of the variables of interest. In line with previous researches (among others: Bianchini S., 2016) we excluded those businesses that entered the market after 2008 because our main concern is to compare the behaviour of the companies before and during the financial crisis.

All the firms are classified according to their sector of principal activity disaggregated up to 4-digits of NACE Rev.2 classification. NACE, since 1970, is the acronym used by EUROSTAT to indicate the statistical classification of all the economic activities in the European Union. The present study focuses on the automotive industry therefore all the companies included in the database belong to the manufacturing of motor vehicles, trailers and semi-trailer sector according to the NACE Rev. 2 classification (code 29).

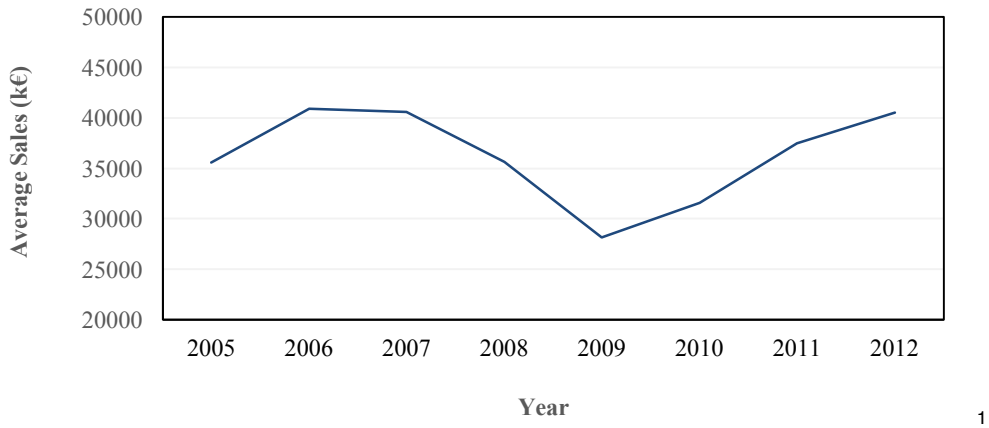
Within the constraints imposed by the available data, our general empirical strategy is to divide the available time span into two periods. Firm characteristics are measured before the crisis (2005-2007), while companies performances are evaluated before and throughout the recessionary phase. We decided to consider 2008 as the beginning of the crisis (2008-2012) by analysing the main trend (express in term of average sales) of the Italian automotive sector over the period 2005-2012 (see Figure 2).

Figure 1 - Partitioning of the sample time period



Source: AIDA-PATSTAT, own calculations.

Figure 2 - Evolution of the average firm sales in the Italian automotive sector in the period 2005-2012



[1]

Source: AIDA-PATSTAT, own calculations.

Thus, the econometric analysis is based on a cross-section of 1477 observations obtained by merging the above-mentioned two datasets using the Bvid Code.

[1] See Lotti and Marin (2013)

4.2. Variables and Measures

Dependent Variable

The econometric analysis aims to explore the factors affecting firm probability to grow throughout the Great Recession. Thus, our dependent variable aims to analyse the different performances, measured in terms of firm growth, displayed by the companies included in our sample before and throughout the financial downturn started in 2008.

A variety of proxies of firm growth have been employed in the literature. Employment and total sales, however, are among the most widely used (Delmar, 1997).

Due to the characteristics of our database, we decided to adopt as measure of firm growth the annual sales growth rate calculated for each firm i at time t as follow:

$$Gsales_{i,t} = \frac{sales_{i,t} - sales_{i,t-1}}{sales_{i,t-1}}$$

We adjusted the value of sales by using the sectorial deflator index furnished by OECD statistics. [2]

To assess the factors able to increase companies' ability to mediate the effect of the recession, we then compute a categorical distributed dependent variable ($Firmperformance_i$) by analysing and comparing the evolution of firm's sales ($Gsales_{i,t}$) during the period 2005-2007 and the crisis period 2008-2012.

Following this line of inquiry, our dependent variable is a discrete indicator that assumes the following values:

$$y_i = \begin{cases} 0 \quad if \quad \bar{g}_{i,2005-2007} \leq 0 \ \wedge \ \bar{g}_{i,2008-2012} \leq 0 \\ 1 \quad if \quad \bar{g}_{i,2005-2007} > 0 \ \wedge \ \bar{g}_{i,2008-2012} \leq 0 \\ 2 \quad if \quad \bar{g}_{i,2005-2007} \leq 0 \ \wedge \ \bar{g}_{i,2008-2012} > 0 \\ 3 \quad if \quad \bar{g}_{i,2005-2007} > 0 \ \wedge \ \bar{g}_{i,2008-2012} > 0 \end{cases}$$

[2] The OECD furnishes data on the price index implicit deflator by NACE rev.2 code 29.

This variable divides the companies of our samples in four different categories according to their average performance in term of sales growth rate before and during the recessionary shock.

In particular, the first class ($Firmperformance_i = 0$) – the one of the Worst Performers (WP) - comprehends all the firms that exhibit on average, both in the pre-crisis and in the crisis period, a negative growth rate. On the contrary, the second category ($Firmperformance_i = 1$), defined as Deteriorated Performers (DP), includes the companies whose growth rate is on average positive (greater than zero) in the pre-crisis period while is negative throughout the recession. Symmetrically, all the firms whose performances were negative in the pre-crisis period while improved up to be positive during the financial downturn are considered by the third status: Ameliorated Performers (AP) ($Firmperformance_i = 2$). Finally, the last category ($Firmperformance_i = 3$) - Best Performer (BP) - contains all the companies that registered positive growth rates both before and during the recessionary shock.

Independent Variables

In selecting the set of firm key characteristics to include in our econometric analysis, we draw from firm growth empirical literatures. As we pointed out, we want to explore what are the firm characteristics that affect companies' ability to cope with destabilizing shocks and grow.

In the previous section, we have argued, that firms that have invested more in intangible assets are better prepared to face external shocks. Therefore, to test it empirically we include in our econometric analysis a measure of the amount of investments in intangible assets made during pre-crisis period: the average value of 'intangible assets' reported by the companies' balance sheet for the years 2005-2007. normalized by each firm total assets size. We expect that this index will positively affect firm's probability to grow throughout recessionary shock, as we explained early on, we conjecture that intangibles plays a key role in prompting the generation of new capabilities.

In the third paragraph, we have also claimed that the processes of learning influences firms' ability to cope with recessionary pressures and that it mainly concerns the development of innovative products and processes. Innovation is usually measured at the firm level through the expenditure in R&D or through the patenting activities. The limits

of patent statistics are well known. As Scherer (1983) argues, the propensity to patent an invention varies with market structure, sector and firm size and not all the inventions are patentable. Nonetheless, according to Acs and Audretsch (1989), patents are a more than an adequate measure of the output side of the innovative process. In our sample few companies applied for patent to EPO before 2008 while many others not. To control for such heterogeneity, we include a dummy variable (Dummypatent) that captures whether a firm applied for a patent grant prior to 2008. It takes the value of 1 if the firm has at list one patent application before the crisis and 0 otherwise. We expect that companies that innovated in pre-crisis period will be more likely to grow during the recessionary shock. Following this line of inquiry, Nelson and Winter (1977, 1982) argues that mechanisms of search, imitation, and implementation of internal knowledge and skills determines the amount of available opportunities and positively influences firm growth rate (Pavitt, 1984; Dosi et al., 1995). Thus, we claim that innovation, as we already discussed in the previous paragraph, is among the key drivers of firm adaptability and ability to cope with unforeseen shocks and grow.

We decided to include both the number of patent and the amount of investments in intangible as a measure of firm learning abilities cause several smaller firms tend to find the process of patenting too expensive or too slow and therefore they implement alternative measures such as secrecy or copyright to protect their innovations (Archibugi, 1992; Arundel and Kabla, 1998).

We included among the key hypothesised determinants of firm resilience the presence of agglomeration of firm within the same sector. Employing the data on the number of firms located in the same province we construct the variable agglomeration economies as a proxy for the agglomeration patterns of the firms included in our sample. We expect that it positively influences firm probability to grow.

In order to evaluate where the companies of our sample are located along the automotive sector supply chain, we include in our regression sectorial dummies by using NACE Rev. 2 classification (code 29) at 4-digit level. According to EUROSTAT, the code 29.10 corresponds to OEM (Manufacture of motor vehicles) while the 29.20 to the firms that produce bodies (coachwork) for motor vehicles, manufacture of trailers and semi-trailers. Furthermore, the businesses that manufacture parts and accessories for motor vehicles are classified with the code 29.30. In particular, the code 29.31 is related to the firms that produce electrical and electronic equipment for motor vehicles and 29.32

to the ones that manufacture other parts and accessories. We expect that those businesses that produce the electronic and electrical parts (29.31), displays better performances during the crisis because, as we explained early on, we conjecture that they provide the more complex, innovative and specialised components and processes in Italian automotive supply chain.

In addition, we consider in our estimations a set of other variables that are usually employed in the firm growth literature: such as size (Size), - measured in terms of log of personnel cost - age (Age) and the amount of debts (Debts).[3] In order to take into account firm efficiency we add the variable return on assets (ROA) that measure how efficiently a company can manage its assets to produce profits during a period. Finally, we include as well regional dummies (regions) to control for regional characteristics.

In this study, following Durnev and Kim (2005), we measure all our firm level independent variables before the financial crisis to avoid possible confounding effects associated to the crisis. Thus, due to our database intrinsic characteristics, we compute the entire explanatory variable as an average between the values registered before the recessionary period in the time span 2005- 2007. On this basis, we use these variables to predict the firm probability to grow throughout the economic downturn.

4.3. Descriptive Statistics

Table 1 provides the descriptive statistics for the explanatory variables measured in the pre-crisis period, while Table presents the correlation matrix.

The descriptive statistics reported by Table 1 confirm, that both the variables Intangibles and Dummypatent present a highly skewed distribution. Furthermore, Table 2 highlights that our sample shows a high degree of heterogeneity in terms of firm size, age, debts and ROA.

[3] The variable Debts (Debts) is normalized by each firm total assets size in order to reduce bias due the heterogeneity among the companies included in our sample

Table 1 - Descriptive statistics of the explanatory variables

	Obs	Mean	Std. Dev.	Min	Max
Intagibles	1105	0,16	0,25	0	1,5
Dummypatent	1477	0,13	0,33	0	1
Size	1390	6,10	2,01	0	13,83
Age	1476	20,35	14,87	0	111
Debts	1477	351,09	7797,60	0	254878,1
ROA	1398	3,88	14,45	-248,51	51,27
Agg. economies	1477	60,79	70,48	1	219

Source: AIDA-PATSTAT, own calculations.

Table 2 - Correlation Matrix

	Firm performance	Intagibles	Dummy patent	Size	Age	Debts	Roa	Agg. economie
Firmperformance	1							
Intangibles	0.048	1						
Dummypatent	0.058	0.0568	1					
Size	0.0946	0.0029	0.4606	1				
Age	-0.0499	-0.0321	0.0339	0.0362	1			
Debts	0.0246	0.0926	0.1811	0.4082	-0.0567	1		
ROA	0.0528	0.0379	-0.0001	0.0536	-0.0076	-0.0608	1	
Agg. economies	0.0677	0.0234	0.0925	0.1665	-0.0484	0.0822	-0.0035	1

Source: AIDA-PATSTAT, own calculations.

Before moving to the econometrical estimation, it is interesting to analyse the distribution of the explanatory variables across the four distinct values assumed by our dependent variable (defined in the previous section). The descriptive statistics reported in Table 1 reveals that firm's ability to grow ($Firmperformance_i$) during a recessionary shock is very uneven across the companies included in our sample. At first glance, this table also reveal that the category of companies ($Firmperformance_i = 3$) - containing all the firms that registered a positive growth rate both before and during the crisis - is the one that present the highest amount of intangibles assets and patent applications.

Nonetheless, these descriptive statistics do not provide any clear indication of the relationship between our categorical dependent variable and the set of the hypothesized determinants.

Therefore, we are going to test what is the set of companies' characteristics that shapes the probability of a firm to grow during a recessionary shock in the econometric exercise that follow.

Table 3 - Descriptive statistics across status

	Firmperformance=0		**Firmperformance=1**		**Firmperformance=2**		**Firmperformance=3**	
Nr. of firms	168		440		280		501	
% of the sample	**12,10%**		**31,68%**		**20,16%**		**36.07%**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Intagibles	0,14	0,25	0,16	0,24	0,17	0,26	0,18	0,26
Dummypatent	0,071	0,258	0,095	0,294	0,103	0,305	0,20	0,40
Size	5,70	1,99	6,18	1,87	5,99	2,22	6,28	2,07
Age	21,38	14,51	20,43	15,75	20,37	13,54	20,0	14,5
Debts	2326,9	22600.9	1328,8	1142,2	52,6	190,0	75,9	446,1
Partnerships	0,06	0.2	0,05	0,18	0,094	0,25	0,08	0.23
ROA	.018	12,16	4,90	9,63	3,86	13,86	6,83	9,24
Agg. economies	63,07	75,16	49,12	62,39	69,37	73,12	66,78	73,74

Source: AIDA-PATSTAT, own calculations.

5. Econometric Analysis and Findings

In order to investigate the set of companies' characteristics that influences the probability for a firm to grow throughout the Great recession, we estimate the following multinomial logit model:

$$\Pr\left(Firmperformance_i = k\right) = \frac{\exp\left(XF_i' \ \beta_F^k + XC_i' \beta_C^k\right)}{1 + \ \sum_{j=0}^{3} \exp\left(XF_i' \ \beta_F^J + XC_i' \beta_C^J\right)}$$

$$for \ \ k = 0,1,2,3$$

In particular, our econometrical estimation aims at analysing how, ceteris paribus, changes in the elements of X (vectors of our explanatory variables) affect the probabilities P ($y = k|x$) for a firm to belong to $k = 0,1,2,3$ (Wooldrige, 2002). k is the set of values that our categorical dependent variable $Firmperformance$ assumes. In this specification, the probability of choosing each alternative sum up to one $\sum_{k=0}^{3} p_{i,k} = 1$.

In addition XF_i is a vector of explanatory variables that includes both our key hypothesized determinants and all the independent variables that are usually associated with firm growth during recessions. XC_i , is instead the vector of control variables. Finally, the vectors of parameters to be estimated through the econometric analysis are: β_F and β_C.

This estimation method is a natural choice since, by construction, our discrete dependent variable $Firmperformance$ is unordered and the independence from irrelevant alternatives assumption holds[4].

As discussed above, one of the key features of our dataset is that it allows us to analyse and compare the heterogeneity of determinants of firm performances throughout the crisis.

In the firm growth literature, most studies (among others: Coad and Holzl, 2009) use quantile regression techniques. These methods, however, have some drawbacks. Bianchini et al. (2016) argue that these strategies may constraint the analysis into specific notion of firm growth, based on the autocorrelation structure of the growth rates, which is inadequate to capture firm behaviour in some specific context. Starting from these considerations, maximum likelihood estimations has been increasingly used by recent researches (among others: Arrighetti et al., 2015; Bianchini et al., 2016) to track and analyse the behaviour of the firms throughout the financial downturn started in 2008 and to compare the pre and post crisis companies' performances.

Table 4 reports the results of the multinomial estimation. As far as the variable Dummypatent is concerned, the empirical evidence shows that it positively influences the probability for a firm to belong to the category Best Performer (BP) and therefore to grow during a recessionary shock. Thus, consistently with our second hypothesis and in line with previous literature, the results suggest that innovating firms are more likely to grow throughout exogenous shocks.

Our evidence also highlights that, whereas in isolation, the variable intangibles does

[4] see robustness checks

not play any role in influencing companies' probability to be in the groups of businesses that exhibit good performance during the crisis. On the contrary, the results in column 2 and 3 show that the amount of investments in intangibles assets, when interacted with the variable ROA, positively affect the probability to belong both to the category of Ameliorated Performers (AP) ($Firmperformance = 2$) and Best performer (BP) ($Firmperformance = 3$). Thus, when Intangibles are interacted with an indicator of firm relatively robust efficiency condition they positively influence the probability for a business to grow no matter the performance in terms of sales registered before the crisis. This last empirical evidence leads us to argue that, when faced with an economic recession, intangible assets increase the probability of a firm to grow, but only when they are combined with an efficient allocation of the resources inside the company. In this context, even the firms that were decreasing in sales but were not myopic and invested in intangibles before the financial downturn are more likely to grow during the crisis. Following this line of inquiry, we claim that Intangibles play a key role in influencing firm growth by shaping the path through which new capabilities are generated and therefore in prompting companies' ability to orient the use of resources towards new demand pattern even during recessionary shocks.

The relevance of the firm's degree of efficiency in affecting firm's probability to grow is confirmed by the fact that the variable ROA exhibits a positive and significant coefficient in all the categories.

On the contrary our results suggest that the variables usually associated with firm growth such as size, age and debts do not have any effect on the firm probability to grow during the Great recession. However, the variable Age, when interacted with the variable Intangibles, shows a negative and significant coefficient for both the category Ameliorated Performers and Best Performers. Thus, following Coad (2016) we can hypothesise that younger businesses are more likely to undertake riskier and more radical innovative processes that in some cases yield higher returns. This is in line with the Schumpeterian theory, according to which the level of novelty and imitation of innovations tends to change over the life course.

As far as the variable Size is concerned our evidence shows that it influences firm probability to be in Best Performers category (BP) only when it is interacted with the variable that measure the amount of investments in intangible in the pre-crisis period. Thus we can conjecture that bigger firm have more resources to invest in intangible assets

and therefore are more likely to grow both before and during recessionary shock.

Our results validate, as well, our third hypothesis. The dummy associated with the code 29.31, that refers to businesses that manufacture the most technological components and accessories for motor vehicles (electrical and electronic equipment for motor vehicles), displays indeed positive and significant coefficients both in category AP and BP. Thus, we claim that the firms that provide the more complex, innovative and specialised components and processes are better prepared to face an unexpected economic downturn and therefore are more likely to grow throughout recessionary phases.

In the empirical testing, we included as well the variable agglomeration economies. to evaluate if the clustering of firms in a specific industry have an impact of firm probability to grow throughout exogenous shocks. By contrast to previous literature and contrary to our fourth hypothesis, our evidence suggests that agglomeration economies does not have any effect on the firm probability to grow through the recessionary phase.

To explore the topic further, we need to examine the whole regional sectorial composition.

Table 4 - Results of the Multinomial Logit estimation

	Excluded category Firmperformance=0		
Categories	**DP**	**AP**	**BP**
	(1)	**(2)**	**(3)**
Intangibles	1.047	0.301	0.833
	(0.621)	(0.709)	(0.614)
Dummypatent	1.027	0.961	1.666***
	(0.630)	(0.651)	(0.618)
Size	0.0945	-0.0125	0.0165
	(0.0829)	(0.0896)	(0.0819)
Age	0.00334	-0.00171	-0.00439
	(0.0104)	(0.0100)	(0.00951)
Debts	-0.000434	-0.000184	-0.000192
	(0.000528)	(0.000422)	(0.000388)
ROA	0.0507**	0.0216**	0.0554**
	(0.0196)	(0.0276)	(0.0193)
ROA*Intangibles	0.120	0.263***	0.164**
	(0.0681)	(0.0901)	(0.0663)
Age*Intangibles	-0.00000777	-0.00000886***	-0.00000756**
	(0.00000509)	(0.00000267)	(0.00000263)
Size*Intangibles	0.00000541	0.00000882	0.0000127*
	(0.0000127)	(0.00000663)	(0.00000602)
Agglomeration economies	-0.190	-0.204	-0.522
	(0.458)	(0.476)	(0.446)
29.10.NACE	1.769*	1.484*	1295
(vehicles)	(0.716)	(0.708)	(0.694)
29.20.NACE	-1692	-29.54***	-22.79***
(vehicles and trailers)	(1.296)	(0.985)	(0.981)
29.31.NACE	0.426	15.51***	16.10***
(electrical components)	(0.457)	(0.773)	(0.680)
REGIONAL DUMMIES	YES	YES	YES
CONSTANT	-0.500	0.695	0.192
	(0.982)	(1.020)	(0.955)
Obs	900	900	900
Pseudo R2	0.251	0.251	0.251

Estimated intercept and slope coefficients for each regressor with robust standard errors in parentheses.
Asterisks denote significance: * p<0.05, ** p<0.01, *** p<0.001.
Source: AIDA-PATSTAT, own calculations

2.1.1. Robustness check

Our evidence highlighted that the firms that innovated and invested comparatively more in intangibles in the pre-crisis period have more probabilities to grow throughout exogenous shock. In order to test the robustness of these results, we decide to estimate the probability for a firm to grow throughout recessionary by using an alternative measure of firm size: the yearly variation in the number of employees. This is calculated as:

$$Gemployees_{i,t} = employees_{i,t} - employees_{i,t-1}$$

where $employees_{i,t}$ is the logarithm of firm size at time t and $employees_{i,t-1}$ is its lagged value.

In the AIDA database, however, this variable is characterised by many missing observations and thus we were forced to drop a lot of firms from our empirical analysis. To avoid problem of small sample bias[5], we estimate a simple binary choice model through which we aim to predict the probability for a firm to grow during the recessionary shock started in 2008. In this context, our dependent variable (Gemployees) take the values of one for the group of companies that increased the number of workers during the Great recession and zero otherwise.

Our evidence corroborates the hypothesis concerning the anti-cyclical effect of innovation. The coefficient of the variable Dummypatent is indeed positive and significant. Thus, our results suggest that the firms that patented in the pre-crisis period are more likely to grow during the recessionary phase.

As far as the variable intangibles assets is concerned, our empirical findings show that they positively influence the probability to grow during the crisis only when interacted with the variable concerning the degree of firm efficiency ROA. This evidence confirms the importance of intangible assets in shaping firms' adaptability to recessionary pressures.

In addition, these results corroborate the hypothesis that in the automotive supply chain the firms that produce the most advanced technological components are more likely to exhibit positive performances and that agglomeration economies does not have any effect

[5] We cannot employ the multinomial logistic model that we use in the previous paragraph cause there would be too few observations for each category.

on the firm probability to grow throughout exogenous shocks.

Table 5 - Results of the logit estimation

	Gemployees
Intangibles	0.166
	(0.362)
Dummypatent	0.621**
	(0.238)
Size	-0.111*
	(0.0501)
Age	-0.00857
	(0.00554)
Debts	-0.000134
	(0.000262)
ROA	0.0289*
	(0.0114)
ROA*Intangibles	0.0447**
	(0.0303)
Age*Intangibles	0.00000209
	(0.00000196)
Size*Intangibles	-0.00000309
	(0.00000315)
Agglomeration economies	-0.365
	(0.582)
29.1.0 .nace	-0.0407
(vehicles)	(0.272)
29.2.0.nace	-154
(vehicles and trailers)	(1.136)
29.3.1 .nace	1.036*
(electrical components)	(0.539)
REGIONAL DUMMIES	YES
CONSTANT	-0.314
	(0.578)
Obs	900
Pseudo R2	0.251

Estimated intercept and slope coefficients for each regressor with robust standard errors in parentheses. Asterisks denote significance: * p<0.05, ** p<0.01, *** p<0.001.
Source: AIDA-PATSTAT, own calculations.

In order to test if the independence from irrelevant alternatives assumption holds, we exclude from the sample the second category ($Firmperformance_i = 1$), defined as Deteriorated Performers (DP). The sign of the coefficients does not change, even though the statistical significance of the effects is weaker.

The results of this additional empirical testing are overall in line with those of our main estimations, suggesting that our findings are robust.

6. Conclusion

In this study, we have explored the factors affecting firms' probability to grow throughout the Great Recession.

This paper offers an original contribution by focusing on the role played by innovation and intangible assets in shaping the degree of firm ability to face external shocks.

We decided to focus on the Italian automotive industry because is among the sectors that have been hit the most by the crisis and therefore it constitutes a particularly interesting case to reflect upon the determinants of varying firms' capabilities to face severe recessionary downturns.

The descriptive statistics revealed that the capacity to react to the crisis and to grow was very uneven across the companies of the Italian automotive sector. We conjectured that fundamental reasons had to be found in the amount of investments in intangible assets and in the patenting activities realized in the pre-crisis period. We set out a multinomial logistic estimation to explore the companies' characteristics that affected firm probability to grow during the crisis.

The results suggested that innovators are more likely to exhibit good performances even during a recessionary shock. This is arguably due, according to Gerosky (1995b; 1995c), to the fact that the process of doing innovation, by involving company ability to translate endogenously generated knowledge into new goods and services, permanently transforms a firm, building up its internal capabilities and improving its degree of adaptability. Coping with recessions always requires increasing companies' ability to be flexible to adapt their activities to the changing market conditions and to found new opportunities not exploited yet.

Our evidence further confirmed the anti-cyclical effect of innovation by suggesting that in the automotive supply chain the suppliers that provide the more complex,

innovative and specialized components and processes were better prepared to face the crisis.

Moreover, our empirical findings highlighted that intangibles assets, when interacted with an indicator of a firm relatively robust efficiency condition, played a fundamental role in shaping firms probability to grow during the crisis even for the group of companies that were decreasing in sales before the recession (Ameliorated Performers).

The collapse in demand registered in the automotive sector during the Great Recession was translated into an increasing competition among the firms operating in this market. Thus, relatively inefficient firms were less likely to grow while more efficient ones took advantage of the changed market condition. Companies that were not myopic and invested in learning abilities before the crisis, indeed, were more prepared to face competition in the new market scenario.

We also find out that, contrary to the previous literature and to our conjecture elaborated in the fourth hypothesis, agglomerations economies do not have any impact on the firm probability to grow throughout destabilizing shock. This arguably due to the fact that various empirical investigations have shown that industrial clusters have ambiguous effect on firm growth (Buenstorf and Klepper, 2009) According to Audretsch and Feldman (1996) firms benefit from being located in industrial clusters only under specific circumstances. In particular they suggest a industry-specific perspective. Knowledge spillovers from co-localized firm matter more for companies operating in the emerging sector as well as for those pertaining to knowledge intensive industries. At a more mature stage spatial agglomeration might even hinder the process of firm growth by triggering an intensified competition among co - localized firm. This might be especially true at times of reduced demand and greater uncertainty

The generation of comparative international and inter-sectorial evidence would certainly be an interesting avenue for further research.

References

Acs, Z. J., Audretsch D. B. (1989) Patents Innovative Activity. *Eastern Economic Journal*, 14(4): 373–376.

Audretsch D. B., Dohse, D., (2007) Location: A Neglected Determinant of Firm Growth. *Review of World Economics* 143(1): 79-107.

Almus, M., Nerlinger E. A. (1999) Growth of New Technology-Based Firms: Which Factors Matter? *Small Business Economics,* 13: 141–154.

Aragon-Correa, J. A., Sharma, S. (2003) A contingent resource-based view of proactive corporate environmental strategy. *Academy of management review*, 28(1): 71-88.

Archibugi, D. (1992) Patenting as an indicator of technological innovation: a review. *Science and public policy*, 19(6): 357-368.

Arrighetti, A., Landini, F., Lasagni, A. (2015) *Economic Crisis and Firm Exit: Do Intangibles Matter?* (No. 2015/10). LUISS School of European Political Economy.

Arundel, A., Kabla, I. (1998) What percentage of innovations are patented? Empirical estimates for European firms. *Research policy*, 27(2): 127-141.

Audretsch, D., Dohse, D. (2007) *Location: A Neglected Determinant of Firm Growt*h. Springer, vol. 143(1): 79-107.

Barney, J. B. (2001) Is the resource--based 'view' a useful perspective for strategic management research? Yes. *Academy of Management* Review 26 (1): 41–56.

Bartelsman, E., Scarpetta, S., Schivardi, F. (2005) Comparative analysis of firm demographics and survival: evidence from micro-level sources in OECD countries. *Industrial and Corporate Change* 14 (3): 365-391.

Bianchini, S., Bottazzi, G., Tamagni, F. (2016) What does (not) characterise persistent corporate high-growth? *Small Business Economics*: 1-24.

Birch, D. L. (1981) Who Creates Jobs? *The Public Interest* 65: 3-14.

Birch, D. L. (1987) *Job creation in America: how our smallest companies put the most people to work. Free* Press, New York.

Beaudry, C.,Swann,.G., (2009) Firm growth in industrial clusters of the United nKingdom. *Small Business Economics*, 32(4): 409-424.

Bontempi, M. E., Mairesse J. (2008) *Intangible capital and productivity: an exploration on a panel of Italian manufacturing firms.* Technical Report No w14108, National Bureau of Economic Research.

Braun, M., Larrain, B. (2005) Finance and the business cycle: international, interindustry evidence. *The Journal of Finance*, 60(3): 1097-1128.

Cainelli, G.,Montresor, S., Vittucci Marzetti, G. (2014) Spatial agglomeration and firm exit: a spatial dynamic analysis for Italian provinces. *Small Business Economics* 43 (1): 213-228

Coad, A., Segarra, A., Teruel, M. (2016) Innovation and firm growth: Does firm age play a role? *Research Policy*, *45*(2): 387-40

Coad, A. (2009) *The growth of firms: A survey of theories and empirical evidence.* Edward Elgar: Cheltenham, UK.

Coad, A., Hölzl, W. (2009) On the autocorrelation of growth rates. *Journal of Industry, Competition and Trade*, 9(2): 139-16

Corrado, C. A., Sichel, D. E., Hulten, C. R. (2006) *Intangible Capital and Economic Growth*. FEDS WP No. 2006-24.Daley, J., 2001. The Intangible Economy.

Delgado, M. A., Farinas, J. C., Ruano, S. (2002) Firm productivity and export markets: a non-parametric approach. *Journal of international Economics*, 57(2): 397-422.

Delmar, F. (1997) *Measuring growth: Methodological considerations and empirical results*. In Entrepreneurship and SME Research: On its Way to the Next Millennium, ed. by R. Donckels, and A. Miettinen, pp. 190–216. Aldershot, VA: Avebury.

Dosi, G., Nelson, R., Winter, S. (2001) *The nature and dynamics of organizational capabilities*. OUP Oxford.

Dosi, G., Cimoli, M. (1995) Technological paradigms, patterns of learning and development: an introductory roadmap. *Journal of Evolutionary Economics*, 5(3): 243-68.

Dunne, T., Roberts, M. J., Samuelson, L. (1989) The growth and failure of US manufacturing plants. *The Quarterly Journal of Economics*: 671-698.

Durnev, A., Kim, E. (2005) To steal or not to steal: firm attributes, legal environment, and valuation. *Journal of Finance*, 60(3): 1461-1493.

Evans, D. S. (1987) The relationship between firm growth, size, and age: Estimates for 100 manufacturing industries. *The journal of industrial economics:* 567-581.

Evans, D. S. (1987) Tests of alternative theories of firm growth. *Journal of political economy*, 95(4): 657-674

Fort, T. C., Haltiwanger, J., Jarmin, R. S., Miranda, J. (2013) How firms respond to business cycles: The role of firm age and firm size. *IMF Economic Review*, *61*(3), 520-559.

Geroski, P., Mazzucato, M. (2002) Learning and the sources of corporate growth. *Industrial and corporate change*, 11(4): 623-644.

Geroski, P. A. (1995a) What Do We Know About Entry? *International Journal of Industrial Organization,* 13: 421-440.

Geroski, P., Gregg, P. (1995b) Recessionary benefits. *New Economy*, 2(3): 197-201, 09.

Geroski, P., Walters, C. F. (1995c) Innovative Activity over the Business Cycle. *Economic Journal,* 105(431): 916-28.Geroski, P., Gregg, P., (1996) What makes firms vulnerable to recessionary pressures? *European Economic Review*, 40(3): 551-557

Gibrat, R. (1931) *Les inégalités économiques: applications: aux inégalitês des richesses, à la concentration des entreprises, aux populations des villes, aux statistiques des familles, etc: d'une loi nouvelle: la loi de l'effet proportionnel*. Librairie du Recueil Sirey.

Hart, P. E., Prais, S. J. (1956) The analysis of business concentration: a statistical approach. *Journal of the Royal Statistical Society. Series A (General)*, *119*(2): 150-19.

Kalecki, M. (1945) On the Gibrat distribution. Econometrica. *Journal of the Econometric Society*: 161-170.

Klepper, S. (2002a) The evolution of the US automobile industry and Detroit as its capital. *In 9th Congress of the International Joseph A. Schumpeter Society*, Gainesville, Florida: 22-23.

Klepper, S. (2002b) The capabilities of new firms and the evolution of the US automobile industry. *Industrial and Corporate Change*, 11(4): 645–666.

Kroszner, R. S., Laeven, L., Klingebiel, D. (2007) Banking crises, financial dependence, and growth. *Journal of financial Economics,* 84(1): 187-228.

Lengnick-Hall, C. A., Beck, T. E. (2005) Adaptive fit versus robust transformation: How organizations respond to environmental change. *Journal of Management*, *31*(5): 738-757.

Lotti F., Marin G. (2013) Matching of PATSTAT applications to AIDA firms: discussion of the methodology and results. Questioni di Economia e Finanza, No 166, Banca d'Italia

Mansfield, E. (1962) Entry, Gibrat's law, innovation, and the growth of firms. *The American economic review*, *52*(5): 1023-1051.

Marrocu, E., Paci, R., Pontis, M. (2012) Intangible capital and firms' productivity. *Industrial and Corporate Change,* 21(2): 377-402

Moscarini, G., Postel-Vinay, F. (2012) The contribution of large and small employers to job creation in times of high and low unemployment. *The American Economic Review*, *102*(6): 2509-2539.

Mowery, D. C. (1983) The relationship between intrafirm and contractual forms of industrial research in American manufacturing, 1900–1940. *Explorations in Economic History*, *20*(4): 351-374.

Nelson, R. R., Winter, S. (1982) *An Evolutionary Theory of Economic Change*. Harvard University Press: Cambridge, MA.

Nelson, R. R., Winter, S. (1977) In search of useful theory of innovation. *Research policy,* 6(1): 36-76.

Pagano, P., Schivardi, F. (2003) Firm size distribution and growth. *The Scandinavian Journal of Economics*, 105(2): 255-274.

Pavitt, K. (1984) Sectoral patterns of technical change: towards a taxonomy and a theory. *Research policy*, 13(6): 343-373.

Patrucco, P. P. (2011) Changing network structure in the organization of knowledge: the innovation platform in the evidence of the automobile system in Turin. *Economics of Innovation and new Technology*, *20*(5): 477-493.

Penrose, E. (1959) *The theory of the growth of the firm*. New York: Oxford University Press.

Scherer, F. M. (1983) The Propensity to Patent. *International Journal of Industrial Organization*, 1: 107-28.

Simon, H., Bonini, C. (1958) The Size Distribution of Business Firms. American Economic Review, 48(4): 607 – 617.

Smallbone, D., North, D., Leigh, R. (1993) The growth and survival of mature manufacturing SMEs in the 1980s: an urban-rural comparison. *Small firms in urban and rural locations*: 79-131.

Storey, D. J. (1994) *Understanding the Small Business Sector*, London: Routledge.

Teece, D. J., Pisano, G., Shuen, A. (1997) Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18 (7): 509-533.

Viner, J. (1932) *Cost curves and supply curves*. Springer Berlin Heidelberg.

Wooldridge, J. M. (2002) *Econometric analysis of cross section and panel data*. Cambridge, Mass: MIT Press

ties of new firms and the evolution of the US automobile industry. *Industrial and Corporate Change*, 11(4): 645–666.

Kroszner, R. S., Laeven, L., Klingebiel, D. (2007) Banking crises, financial dependence, and growth. *Journal of financial Economics,* 84(1): 187-228.

Lengnick-Hall, C. A., Beck, T. E. (2005) Adaptive fit versus robust transformation: How organizations respond to environmental change. *Journal of Management*, *31*(5): 738-757.

Lotti F., Marin G. (2013) Matching of PATSTAT applications to AIDA firms: discussion of the methodology and results. Questioni di Economia e Finanza, No 166, Banca d'Italia

Mansfield, E. (1962) Entry, Gibrat's law, innovation, and the growth of firms. *The American economic review*, *52*(5): 1023-1051.

Marrocu, E., Paci, R., Pontis, M. (2012) Intangible capital and firms' productivity. *Industrial and Corporate Change,* 21(2): 377-402.

Martin, Philippe, Thierry Mayer, and Florian Mayneris. Are clusters more resilient in crises? Evidence from French exporters in 2008-2009. Sciences Po, 2016.

Moscarini, G., Postel-Vinay, F. (2012) The contribution of large and small employers to job creation in times of high and low unemployment. *The American Economic Review*, *102*(6): 2509-2539.

Mowery, D. C. (1983) The relationship between intrafirm and contractual forms of industrial research in American manufacturing, 1900–1940. *Explorations in Economic History*, *20*(4): 351-374.

Nelson, R. R., Winter, S. (1982) *An Evolutionary Theory of Economic Change*. Harvard University Press: Cambridge, MA.

Nelson, R. R., Winter, S. (1977) In search of useful theory of innovation. *Research policy,* 6(1): 36-76.

Pagano, P., Schivardi, F. (2003) Firm size distribution and growth. *The Scandinavian Journal of Economics*, 105(2): 255-274.

Pavitt, K. (1984) Sectoral patterns of technical change: towards a taxonomy and a theory. *Research policy*, 13(6): 343-373.

Patrucco, P. P. (2011) Changing network structure in the organization of knowledge: the innovation platform in the evidence of the automobile system in Turin. *Economics of Innovation and new Technology*, *20*(5): 477-493.

Penrose, E. (1959) *The theory of the growth of the firm*. New York: Oxford University Press.

Scherer, F. M. (1983) The Propensity to Patent. *International Journal of Industrial Organization*, 1: 107-28.

Simon, H., Bonini, C. (1958) The Size Distribution of Business Firms. American Economic Review, 48(4): 607 – 617.

Smallbone, D., North, D., Leigh, R. (1993) The growth and survival of mature manufacturing SMEs in the 1980s: an urban-rural comparison. *Small firms in urban and rural locations*: 79-131.

Storey, D. J. (1994) *Understanding the Small Business Sector*, London: Routledge.

Teece, D. J., Pisano, G., Shuen, A. (1997) Dynamic Capabilities and Strategic Management. *Strategic Management Journal*, 18 (7): 509-533.

Viner, J. (1932) *Cost curves and supply curves*. Springer Berlin Heidelberg.

Wooldridge, J. M. (2002) *Econometric analysis of cross section and panel data*. Cambridge, Mass: MIT Press