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Profitability and size of newly established firms

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Abstract

Does size matter for new firms and do they need to be large to be profitable? From small to large firms, a wide range of arguments have explored the possible strengths and liabilities associated with size. Despite the long interest in the relation between size and profitability, the empirical evidence is mixed and inconclusive. To date, studies focus mainly on established firms. In order to advance the knowledge on the relation, we examine the effects of size on the profitability of newly established firms in their first years of business. Overall, the results show that size has a positive impact on the profitability of new firms. In particular, increases in the number of employees have a positive effect on the return on assets that indicates that being small is a liability for new firms. Further, this finding indicates the need for a certain critical mass of employees when firms start out. By starting out with a higher number of employees, new firms may invest in the development of their performance by stimulating learning and motivation and, in this way, increase their profitability and their chances of survival. In addition to the liability of smallness, we also investigate the moderator effect of age. Our conclusions support the liabilities of obsolescence and senescence arguments that state that as firms age, they have difficulties in adapting to the external environment and face internal inertia.

Keywords Liability of size · Size · Profitability · Liability of age · New ventures

JEL classification L25 · L26 · M13 · C33 · D22

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Introduction

The discussion on whether profitability contributes to economic growth has been of considerable importance. Understanding the determinants of profitability is pivotal to firms. First, understanding the difference between profit and profitability is important. While profit is the difference between revenues and costs, profitability is a relative measure that reflects both the efficiency and the performance of a firm (Ilaboya and Ohiokha 2016). However, according to Tulsian (2014), the level of profits cannot be used to compare the efficiency between firms, since a higher level of profits is not necessarily associated with better efficiency and a low level of profits might not always indicate a deterioration in the firms' activity. In this way, profitability can be the most adequate measure to analyse whether or not the firm is operating in an efficient way.

Further, understanding what affects a firm's profitability is of utmost importance. One factor that can influence profitability is size. But, does size matter for firms and do they need to be large to be profitable? From small to large firms, a wide range of arguments over the years has explored the strengths and weaknesses associated with their size (Kipesha 2013). On the one hand, small firms may not be able to access resources, may have limited integration of marketing and innovation capabilities, and have difficulty accessing funding and markets as they lack the critical mass to do so (e.g., Arend 2014; Jeng and Pak 2016; Sheppard 2020). These constraints reflect what is known of as the liability of smallness that translates into the hazards that smaller firms face and that may threaten their survival (Kale and Arditi 1998). On the other hand, larger firms have greater production capacity or variety of services, have different management strategies, are more visible, and may benefit from economies of scale and scope that represent a reduction in firms' costs due to an increase in the production scale (e.g., Zenger 1994; Becker-Blease et al. 2010; Leal-Rodríguez et al. 2015; Ambrose et al. 2019).

However, with size come liabilities. For example, some firms face agency problems that occur when managers make decisions that will ultimately benefit them, such as in terms of reputation and wealth or "empire building", and not necessarily the firm (Jensen and Meckling 1976). Growing "too big" is a concern that firms need to avoid as it represents a reduction in the firms' value, a misappropriation of the assets and, ultimately, the threat of failure (Jensen and Meckling 1976). In addition, larger firms may face additional costs that are associated with diseconomies of scale. These diseconomies translate into a larger need for control layers due to the complexity of the organization process, the lack of understanding and motivation in employees, and the losses in efficiency that may arise from performance bonuses that may encourage employees to perform under their most efficient level (Williamson 1975; Phillips et al. 2018).

To date, the studies on the determinants of profitability have focused mainly on established, large, and listed firms (e.g., Hall and Weiss 1967; Dhawan 2001; Lee 2009). More recently, they have also focused on small and medium-sized enterprises (SMEs) (e.g., Serrasqueiro and Nunes 2008; Yazdanfar 2013; Fernández et al. 2019) but very rarely on new firms (e.g., Chrisman et al. 1998). To that end, the knowledge on the determinants of profitability for new firms is imperfect. In order to advance this knowledge, the present study focuses on newly established firms as they are key contributors to economic growth and job creation (Anyadike-Danes et al. 2015a,b)

and, therefore, their success or failure is a concern that must addressed by policymakers (Patel et al. 2017; Patel 2019). In fact, in Portugal, the employment share of firm births, that is, the number of people employed by new firms as a share of the total people employed among the total number of firms, was near 5% in the last decade (Eurostat 2020). This value is one of the highest in Europe (second only to Turkey and quite above the average of 2.8 for the European countries). Thus, new firms contribute the dynamism that exists in the country. Portugal has one of the highest birth rates of firms—about 14% of the total of firms active in each year over the last decade (Eurostat 2020). However, Portuguese new firms have one of the lowest survival rates of only about 50% (Eurostat 2020), although this rate has increased in the last few years. Thus, these young and small firms create many jobs but have a very high rate of churn (Anyadike-Danes et al. 2015a, b).

An understanding of the determinants of profitability in new firms may help to explain their high rate of churn. As such, one may question if the new firms face the liability of smallness due to their newly established status. One way of overcoming such a liability may be by improving their profitability through the investment in incentives to their employees through further learning and motivation that in turn increase their performance and productivity (Patel et al. 2017). Additionally, new firms might start out already larger that might also contribute to the need to understand the effects of size on their profitability levels.

The present study makes two important contributions. First, it examines new and recently established Portuguese firms that are small and listed. The dimension, resources, capabilities and challenges of new and non-listed firms are quite different from those that are listed in the stock market. For example, the access to capital and means of financing, the challenges of investor protection or the ownership type constitute a completely different setting. Second, studies have rarely examined new firms separately. Our study covers a very large sample of new firms with several dimensions: from micro firms to large firms. This range enables a decent understanding of the Portuguese business sector and the role of size in the profitability of new firms in their first years of business.

This paper is organized as follows: The next section presents the theoretical framework and hypotheses, namely the theoretical background regarding the positive and the negative relations between size and profitability. Then, we present the sample, the variable descriptions and the empirical methods. That is followed by the results and robustness checks. Finally, we present the conclusions, limitations and future research avenues.

Theoretical framework and hypotheses

Does size matter for firms, and do they need to be large to be profitable? In particular, what are the effects that size has on firms' profitability? The discussion on the relation between size and profitability has long attracted the attention of scholars and is rooted in two main theoretical lenses: the industrial organization theory (IO), and the resource-based theory (RBV) (Fernández et al. 2019). According to the IO theory, the goal is to determine if there are differences in the structures of firms in order to compare the average profitability of different industries. (e.g., attractiveness, position within the industry, and other factors that affect the competitive position of the firm) (Porter 1979;

Porter 1980; Amato 1995; McGahan and Porter 2002; Amato and Amato 2004). The studies in line with the RBV aim to find the mechanisms underlying the profitability, in particular, the resources that are at the disposal of each firm that can explain the differences in profitability (Barney 1991; Penrose 1995; Bamiatzi and Hall 2009; Barney et al. 2011; Bamiatzi et al. 2016). Despite the long interest and the mounting number of studies, the relation between size and profitability is mixed and inconclusive.

Positive relation between size and profitability

Size matters when it comes to the access to resources and funds. The most commonly known factor that one can use to endorse the positive relation between size and profitability is the concept of economies of scale. It can be defined as a reduction in costs through an increase in the level of production, since the fixed costs that a firm faces are dissipated through higher volumes of production, hence increasing its efficiency (Becker-Blease et al. 2010). Economies of scale can be translated into financial, organizational, and technical frameworks. Regarding the first, as firms grow bigger, the interest and the discount rates at which they are subject are more beneficial, since the amounts of products and loans acquired are also higher. As for the second, larger firms can more easily generate specialized tasks and improved mechanisms that lead to mass production and an increase in the levels of productivity. Additionally, firms that display higher volumes of production benefit from discounts from their suppliers, since they establish regular and trustworthy relationships accompanied by large volumes of orders. Third, in what respects the technical aspect, bigger organizations have the ability to disperse their fixed costs as their size increases and even use more innovative methods of production to develop more R&D and to decrease their overall costs (Pervan and Višić 2012).

In addition, larger firms also benefit from economies of scope, that is, the saving in costs that arise from the joint production of two different products instead of manufacturing them separately. When firms reach a certain size, they may find that internalizing the production of, for example, a primary good, is more advantageous instead of paying another firm to do so. When the increase in the costs that arise from the joint production of the goods is less than the cost that was originally assumed by buying one of them from another firm, then economies of scope exist (Marques and Witte 2011).

Notwithstanding, there are other factors beyond the economies of scale and scope that also corroborate the positive relation between size and profitability. As such, the lack of a *certain* size may cause firms to face difficulties, known as the *liability of smallness*. Usually, smaller businesses suffer from weaknesses in both management and organizational decisions. The latter can be rigid and discriminatory, while the former can translate into the reluctance to transfer responsibilities, inadequate reporting, and an insufficient view of the market (Kale and Arditi 1998). Moreover, larger firms have the advantage of enjoying a higher market power that allows them to offer superior prices and, thereby, collect higher profits. In addition, the probability of larger firms having better control over market fluctuations is higher that thus gives them more ability to overcome or tone down possible losses (Pervan and Višić 2012). Furthermore, these firms also benefit from a larger scope of qualified resources as well

as a reduced price relative to the capital they use in their production, since they have a lower risk premium when compared to smaller firms (Yang and Chen 2009).

Firms' size is also an advantage from the point of view of entry barriers (Paul 2020), since it allows larger firms to benefit from entry constraints that incoming firms will have to face. New entrants may suffer from major fixed costs in order to enter the business sector that can go from obtaining and preserving machineries and tools to the construction or rental of buildings, which are fundamental to expand their activity in order to achieve and keep up with the level of production in the market. The higher these fixed costs, the higher the entry barriers that larger firm can benefit from, and as a consequence less competition and more profits will exist (Ramasamy et al. 2005).

The scarcity of wherewithal and financial support from investors are part of the difficulties that smaller firms face and may jeopardize their continuity in the market. Firms with lower levels of financial support may find themselves "stuck" in their daily activity because they cannot invest further. This is true whether they need new products or to improve operational process. Therefore, they find themselves unable to increase their efficiency and effectiveness and, as a result, their profitability. Additionally, smaller firms lack the ability to protect themselves against market restrictions and usually suffer from managerial weakness (Kale and Arditi 1998; Laurell et al. 2017). In this manner, smaller firms have to deal with more constraints to their activity. These constraints confine the amount and quality of the tactics that they can endorse to remain competitive in terms of effectiveness that directly translate into lower levels of profitability as compared to firms that can overcome these constraints.

Regarding new firms, they need to deal with a great number of competitive adversities because they face high levels of uncertainty due to lower recognition and acceptability. A way in which these firms may overcome the liability of smallness is to employ a higher number of qualified workers that contribute to increases in the firms' efficiency and profitability (Moser et al. 2017). In this way, these workers may bring know-how to the firm that it benefits from by starting out at a bigger size, since the size allows for increases in its productivity and efficiency, and therefore positively affecting its profitability.

Negative relation between size and profitability

Notwithstanding the arguments on size, another question is why firms do not expand to new businesses or why do most large firms only employ a few employees rather than thousands or hundreds of them. If size represents such an advantage, then why is there not just one big firm that conducts all the production in the market? As the quantity produced increases, the average costs decrease as a consequence of economies of scale. Nevertheless, at a certain point, these economies of scale are exhausted, and after a stable period, diseconomies of scale appear that lead to increases in costs as a consequence of increases in the output level (Canbäck et al. 2006). According to Williamson (1975) there are four categories of diseconomies of scale: atmospheric, bureaucratic, incentive limits and communication distortion. The first is related to the lack of commitment by the employees, since they have difficulty in comprehending the intent of the business activities of the firm and begin to question the extent to which they are a positive contribution to the larger picture. As for the second, as firms increase in size, senior managers become less accountable to the lower echelons and to the

shareholders and thus begin to pursue their own interests. This is mostly known as the principal-agent concept. It can be defined as a situation in which one individual, the principal, attributes some authority to another individual, the agent, to accomplish some service on their behalf. Since both agents seek to maximize their own utility, the agent should act according to their own interest and not to that of the principal (Jensen and Meckling 1976). So, the segregation between the firm's ownership and control might generate management decisions that are not made in the best interest of the firm but, instead, the interest of the managers themselves with the goals to generate higher incomes and reputations. (Pervan and Višić 2012). Regarding the third category presented, Williamson (1975) argues that the incentives that the firms give to their employees are limited by some factors. As firms pay higher bonus to their employees, senior managers may begin to feel threatened. Additionally, if firms pay bonuses based on the employees' performance, then it may result in an underperformance, since workers only have to reach the performance level that grants them the bonus, which may be under their most efficient capacity. For the fourth category, the, Williamson (1975) proposes that as firms increase in size, more bureaucratic and hierarchical layers are required, since the original number of managers cannot conduct the increased activity. With this increase in the number of layers, the information flows that exist between them may contain distortions that constrain the capacity of managers to take actions based on reality.

As firms get larger, they also accumulate more costs (e.g., You 1995; Becker-Blease et al. 2010) such as transaction (costs of preparing, adjusting and controlling the conclusion of the tasks), agency (such as those arising from the pursuit of self-interest and from asymmetric information), and organizational costs (such as accumulation of management layers and bureaucracies). The increase in costs will overtake the gains from the economies of scale and scope and will lead to a decrease in the firms' profitability.

For new firms, even if they have more resources, such as tangible and intangible assets, that allow them to choose from a higher number of reasonable strategies and shield itself from more capable rivals, they do not inevitably lead a higher profitability. Although the survival chances of a new firm are directly related to its resources, they are not directly connected with its effective growth. These resources do not deliver a mechanism for generating competitive benefits because they are easy to commercialise, copy, or replace. So, even though starting with a larger number of resources, and therefore with a larger size, may increase their survival chances, new firms' profitability may not benefit from them in the future (Chrisman et al. 1998).

Hypothesis

As shown, the underlying theories regarding the relation between size and profitability are inconclusive and, to that end, the empirical evidence is also mixed. Some studies provide evidence of a positive relation (e.g., Papadogonas 2007; Ilaboya and Ohiokha 2016; Pervan and Višić 2012), a negative relation (e.g., Kipesha 2013; Ramasamy et al. 2005), or even an insignificant one (e.g., Jónsson 2007; Becker-Blease et al. 2010). Further, the empirical evidence only focuses on established firms.

In light of the mixed evidence and the lack of studies for new firms in particular, the proposed hypothesis is exploratory and aligns with the arguments that new firms may

benefit from owning more initial resources. Thus, we propose an initial hypothesis of a positive relation between size and profitability.

H1: There is a positive relation between size and profitability.

Sample, variables and empirical methods

The data was retrieved from the IES form (*Informação Empresarial Simplificada* (IES)) that contains financial and performance information available from the INFORMA D&B database.

The data cover the firms that started their activity between 2010 and 2018, and cover 19 industries (CAE [*Código das Atividades Empresariais*] letter), which allows the coverage of a wide range of new firms from multiple sectors. Initially, we identified 32,718 new firms. To avoid any inconsistencies, we eliminated the observations with errors such as negative values for assets or cash. Moreover, and according to Patel et al. (2019), we also eliminated firms that were acquired, reported no activity (firms that had no sales), and those with suspended activity. The final sample only accounted for firms with an active status. Furthermore, firms with zero employees were also withdrawn from this study, because they could provide an inappropriate insight into the firms' size and performance (Pervan and Višić 2012) or reflect self-employed entrepreneurs. After these adjustments, the final sample of this study consisted of 13,750 observations, with a total of 3818 new firms.

Amongst the total number of observations, the industry with the highest number of observations was the real estate industry (CAE letter L) at 22% of the total sample. This industry was followed by the wholesale and retail trade, repair of motor vehicles, and motorcycles industry (CAE letter G) that accounted for 13% of the sample; and by the professional, scientific, and technical activities (CAE letter M) that also accounted for 13% of the total sample. The industry with the lowest share was public administration, defence, and compulsory social security (CAE letter O) at 0.06% of the total sample.

Variables

The return on assets (ROA) measures the level of a firm's profitability. It is calculated as the ratio of the net income to total assets. It is the measure of how the firm is able to create profits as a consequence of the efficient use of resources and of proper management (Burja 2011). A higher ROA ratio means that the firm is more effective in the generation of net income through its assets. One of the advantages of ROA is that it is less sensitive to leverage than the return on equity (ROE), which is calculated by comparing the firms' return to the investment that it has made over the years (Berk and DeMarzo 2014). If a firms' financial statements contain negative equity and also a negative net income, then the ROE assumes a positive value that therefore indicates the firm is performing satisfactorily. However, negative net income and equity values show that the firm is underperforming, that is, not profitable. In this situation, the interpretation from observing the ROE values do not reflect the real circumstances of the firm. Size is defined as the natural logarithm of the number of employees.

The study uses several control variables. Age is the natural logarithm of the difference in months between the final day of the most recent year with available

information (2018) or when the firm was out of business and the day on which the firms was created. The fixed assets ratio (FAR) is the ratio of the fixed assets to total assets. This ratio measures the proportion of assets that the firm holds on a long-term basis in relation to its activities and details the amount of capital allocated to technical and productive infrastructures. A high FAR denotes a strong investment state; notwithstanding, if it has higher values, it could restrict the firm's capacity to invest in further activities (Burja 2011). The debt ratio (DR) is defined as the ratio of the total debt to total assets, and it indicates the level at which a firm's total assets are financed through debt, which usually is reflected by loans. An increasing indebtedness grants the firms a higher sum of financing resources; however, it is most likely to also compromise firms' independence and creditworthiness that increases the inherent risk. Thus, this risk is what creditors consider before lending funds to the firm (Burja 2011). The financial leverage ratio (FLR) is calculated as the ratio between total debt and total equity. Both debt and equity can be described as the firms' two main funding sources with the ratio giving an idea of how much capital is financed through debt, in contrast to equity. The higher the ratio, the greater the share of debt in the firms' financing structure. Obtaining a sound and efficient financing structure can increase the prospect of financial developments in the long run for the firm's investors. The asset turnover ratio (ATR) is the ratio between sales and the total assets of a firm. It accounts for the firms' capacity to produce sales in an efficient way from its assets (Berk and DeMarzo 2014). A variation in the asset turnover reflects an alteration in the efficiency of the firms' assets and as a consequence should be used to forecast possible changes in the profitability levels (Fairfield and Yohn 2001). Age is the number of months the firm has been in business. According to the liability of smallness, younger firms face a greater likelihood of failure as they need to establish a sound reputation and trustworthy relationships with other agents. For a new firm, these relationships are still incipient, and the learning by doing occurs as it ages (Stinchcombe 1965). Last, we use year and industry dummies to account for the effects of different years and different industries in the final results.

Table 1 presents the summary statistics and the correlations.

Table 1 Sample description. Mean, SD, and pairwise correlations

		Mean	S.D.	1	2	3	4	5	6
1	ROA	−1.59	111.98	1					
2	Size	1.27	1.41	0.009	1				
3	Age	4.21	0.39	0.0169**	0.123***	1			
4	FAR	0.17	0.27	0.001	0.1191***	0.0411***	1		
5	DR	1.58	43.40	−0.393***	−0.004	−0.009	−0.012	1	
6	FLR	4.00	113.38	0.001	0.005	0.013	0.012	−0.001	1
7	ATR	0.95	9.00	−0.116***	0.044***	0.004	−0.0185**	0.2863***	0.001

Notes: $N = 13{,}750$ observations

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

Results

To test our hypothesis, we use the following model:

$$ROA_{it} = \beta_0 + \beta_1 Size_{it} + \beta_C \sum_{i=0}^{C} Controls_c(t) + \beta_{Ind} \sum_{i=0}^{Ind} Industry_{ind} + \beta_y \sum_{i=0}^{y} Year_{ind} + \varepsilon_{residual1,it} \quad (1)$$

Linear and nonlinear effects

Table 2 presents the results of the estimations using the ordinary least squares (OLS). In order to test for possible multicollinearity of the data, we analyse the variance inflation factor (VIF). The analysis produces evidence that there are no multicollinearity problems in the variables of the model. Additionally, to deal with possible heteroscedasticity, the models are estimated using the robust option for the standard errors.

Table 2 presents the regression results. Model 1 shows the effect of size, and models 2 and 3 add the control variables. According to the models, size is positive and statistically significant; thus, the hypothesis is validated. The results are in line with the liability of smallness that posits larger firms are more likely to achieve higher levels of profitability. This profitability occurs through the scale and scope economies and

Table 2 Linear OLS results

Variables	(1)	(2)	(3)
Size	0.1679*	0.0822***	0.0692***
	(1.6849)	(7.8804)	(5.4560)
Age		0.1896***	0.2726***
		(5.0863)	(7.1778)
FAR		−0.0456	−0.0474
		(−1.1590)	(−1.5361)
DR		−0.9944***	−0.9944***
		(−353.0108)	(−349.1674)
FLR		0.0001	0.0001
		(1.5602)	(1.3977)
ATR		−0.0851***	−0.0853***
		(−9.3055)	(−9.5807)
Constant	−0.8666**	−0.1800	−0.8283***
	(0.4266)	(0.1519)	(0.1761)
R-squared	0.00	0.99	0.99
Time dummies	No	No	Yes
Industry dummies	No	No	Yes

Notes: N = 13,750 observations; Robust t-statistics in parentheses

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

through a sound and stable market position that benefits larger firms (Pervan and Višić 2012). As such, considering that the sample are new firms, the results show that new firms with more employees are associated with higher levels of profitability.

Table 3 shows the results of the model that accounts for nonlinear effects to investigate at what point the number of employees goes from producing increases in profitability to becoming negative. Or in other words, we examined if there is an inverted u-shape relation that can explain the constraints that firms start to experience after reaching a certain size, such as the principal-agent problem and the diseconomies of scale (Jensen and Meckling 1976). According to the table, size maintains its positive and statistical significance but there is no evidence of nonlinear effects, as the squared value of size is not significant.

Age as a moderator effect

For most firms, the first challenges they face when starting out are exterior to the organization itself, like managing to create positive and trustworthy relationships in their core business or developing mechanisms and tasks to operate in the market. If a firm is at the beginning of its life, then these challenges might be more complex for it than for a firm that has already established itself in the market for a considerable period of time (Kale and Arditi 1998; Coad et al. 2016, 2018; Rossi 2016).

Table 3 Nonlinear OLS results

Variables	(1)	(2)
Size	0.1078***	0.0805**
	(3.6456)	(2.2142)
Squared Size	−0.0061	−0.0026
	(−1.0392)	(−0.3788)
Age	0.1876***	0.2714***
	(4.9024)	(6.9099)
FAR	−0.0480	−0.0483
	(−1.2168)	(−1.5703)
DR	−0.9944***	−0.9944***
	(−352.6362)	(−349.1103)
FLR	0.0001	0.0001
	(1.5098)	(1.3843)
ATR	−0.0851***	−0.0853***
	(−9.3240)	(−9.5827)
Constant	−0.1813	−0.8176***
	(0.1514)	(0.1767)
R-squared	0.997	0.997
Time dummies	No	Yes
Industry dummies	No	Yes

Notes: N = 13,750 observations; Robust t-statistics in parentheses

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

By aging, a new firm is able to gain external acceptance through the establishment and development of trustworthy relationships with its clients, creditors, and suppliers that comes from fulfilling their expectations. As firms grow older, their ability to accumulate knowledge also increases based on their experience (Coad et al. 2013). Older firms can accumulate more "organizational learning" (Burgelman 1991), that is, the ability to sustain or expand their profitability based on the experience gathered over the years.

However, as firms grow older, they may lack the ability to adapt their internal organization procedures to the developments in the environment in which they operate, which is known as the liability of obsolescence. This mismatch increases over time, especially if the technological progresses involve greater capital, knowledge, and skills than the firm has (Sørensen and Stuart 2000). The loss in flexible and adaptive capacity may translate into the loss of their place in the market to younger and more innovative firms, which now can adapt better to the new market environment and conditions (Barron et al. 1994). In a related line, with age firms may start to experience internal inefficiency, which is known as the liability of senescence. If inertial forces influence the structure of a firm, then it becomes stuck with the tactics and procedures implemented at its inception. As firms accumulate persistent characteristics, such as patterns, customers, partners, political alliances, and presupposed perceptions, they became more likely to suffer from impregnated internal frictions that prevent them from increasing efficiency in collective actions and that as a consequence, lead to a decline in competence (Hannan 1998; Shane and Stuart 2002). By failing to unchain themselves from habits and from the inertia accumulated over the years, firms fail to devote their time to investing in new projects that might generate positive outcomes, such as new physical and technological infrastructures. Or they fail to enhance the ones that are already part of their activity, like the diversification of their products and services. To that end, firms that suffer from both the liability of obsolescence and the liability of senescence face decreases in productivity and profitability (Coad et al. 2013).

Table 4 presents the results of Eq. 1 that now includes age as a moderator variable. According to the table, size is still positive and significant that is thus still in line with the previous results. When using the moderator effect of age, we observe that additional increases in the number of employees produce negative effects when firms reach a certain age, since the coefficient presented is negative and has a strong statistical significance. This result indicates that, after a certain amount of time in business, firms may start to face diseconomies of scale. By adding an additional employee and with similar capacities as existing employees, the level of costs associated with this decision may overshadow the benefits arising from the increase in output, as the inertial forces that the firm is facing do not allow for an increase in the efficient generation of profits. So, even though new firms experience positive effects in their profitability through increases in size, they reach an age at which these positive effects shift. If firms do not develop technical progress and more efficient procedures and rules, further increases in the number of their employees only contribute to increases in complexity. This complexity results from adding an additional layer in an already complex structure that constrains the increases in the profitability that once occurred.

Robustness estimations

In order to check the robustness of the results, we use alternative ways to measure size and profitability. Thus, size, is now represented by total sales. According, to the technological theories of the firms, the sales level is more appropriate for measuring the effect of size (Becker-Blease et al. 2010).

The results are presented in Table 5. Regarding the effect of size on profitability, the results are in line with the previous ones with a positive and significant coefficient.

Further, we consider the distinction between manufacturing and non-manufacturing firms as it provides an additional understanding regarding the effects of size on profitability. According to Scallan (2003), manufacturing firms are those that produce products from raw resources by using multiple procedures, equipment, processes, and manpower that follow a previously designed and detailed plan. This activity includes the production of consumer, intermediate, and investment goods. On the other hand, non-manufacturing firms focus on activities that do not produce a physical product, such as health, or financial activities.

To distinguish between manufacturing and non-manufacturing firms, we use the NACE statistical classification that as defined by Eurostat (2008), is used to designate the multiple statistical classifications of economic activities developed since 1970 in the

Table 4 OLS results for age moderator effect

Variables	(1)	(2)
Size	0.2923***	0.3183***
	(3.9401)	(4.5346)
Age	0.2466***	0.3407***
	(4.9830)	(7.9988)
Size * Age	−0.0492***	−0.0585***
	(−2.7196)	(−3.5690)
FAR	−0.0451	−0.0478
	(−1.1473)	(−1.5471)
DR	−0.9944***	−0.9944***
	(−353.1543)	(−349.2232)
FLR	0.0001	0.0001
	(1.6375)	(1.4948)
ATR	−0.0851***	−0.0853***
	(−9.3050)	(−9.5866)
Constant	−0.4204**	−1.1108***
	(0.1982)	(0.1980)
R-squared	0.997	0.997
Time dummies	No	Yes
Industry dummies	No	Yes
Observations	13,750	13,750

Notes: N = 13,750 observations; Robust t-statistics in parentheses

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

European Union. Nevertheless, each country may submit a direct equivalent to the NACE classification that in the Portuguese scenario, is designated as CAE (*Classificação Portuguesa das Atividades Económicas*). According to the CAE classification, the manufacturing firms are labelled as C, while the non-manufacturing are labelled either A or E. In the sample considered in this study, the manufacturing firms account for approximately 11% of the total number of observations.

Table 6 shows the results. Once more, the coefficient for size is positive and statistically significant. Thus, the results show that the type of activity does not play a pivotal role in terms of profitability. Nevertheless, the coefficient is larger for non-manufacturing firms that may be because manufacturing firms are usually characterized as having routine processes that are normally performed by machinery that means the production process needs little in human resources. In the case of non-manufacturing firms, their activity is more related with services that are usually personalized and adapted to each situation that usually involves the firms' employees rather than machines.

Conclusion

This study examines the relation between size and profitability through the liability of smallness for new Portuguese firms. The results align with past evidence that shows that as new firms grow, they become stronger competitors and benefit from this

Table 5 Linear OLS results for sales

Variables	(1)	(2)	(3)
Size as Sales	0.2967	0.1208**	0.1138**
	(1.1725)	(2.4586)	(2.5537)
Age		0.0641*	0.0129
		(1.7268)	(0.2289)
FAR		−0.2523*	−0.2379*
		(−1.7841)	(−1.8628)
DR		−0.8686***	−0.8657***
		(−7.7531)	(−7.5076)
FLR		0.0001*	0.0001**
		(1.8945)	(2.1153)
ATR		−0.2910	−0.2962
		(−1.5133)	(−1.4940)
Constant	−4.0119	−0.8195**	−0.6310**
	(3.3788)	(0.4067)	(0.2824)
R-squared	0.002	0.991	0.991
Time dummies	No	No	Yes
Industry dummies	No	No	Yes

Notes: N = 13,750 observations; Robust t-statistics in parentheses

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

increasing market power. This power allows them to collect a higher market share and to offer higher prices that lead to higher amount of profits (Papadogonas 2007; Pervan and Višić 2012). Furthermore, as new firms increase their size, they also benefit from economies of scale and scope that result from the efficiency that arises as they become better at making decisions. In this way, new firms develop their production capacity in such an efficient way that allows them to sell more quantities at a higher price at the same time as they benefit from a reduction in their costs.

The results indicate the need for a certain critical mass of employees when firms start out. Thus, new firms may invest in the development of the employees' performance by stimulating learning and motivation and, in this way, increase the firms' survival chances. Even though firms may need to increase their costs due to additional staff expenses, they also benefit from being more attractive to employees that allows firms to "hold" them and therefore reduce turnover. For new firms, this reduction in employee turnover allows for higher initial learning and a preservation of the firms' particular know-how, at the same time that it ensures the continuity of the service. Additionally, a higher salary may incentivize employees to be more focused on striving to create strong relationships with customers and being more oriented towards their needs and demands. This strong and positive relationship with customers leads to new firms

Table 6 Comparison between estimation results for manufacturing and non-manufacturing firms

	Manufacturing		Non-Manufacturing	
Variables	(1)	(2)	(3)	(4)
Size	0.0363***	0.0250***	0.0873***	0.0731***
	(4.8972)	(2.9886)	(7.1262)	(4.9340)
Age	0.0439	0.1282***	0.1985***	0.2826***
	(1.4434)	(3.2128)	(4.8615)	(6.8381)
FAR	0.2582***	0.2610***	−0.0492	−0.0660*
	(4.6182)	(4.4493)	(−1.1724)	(−1.9322)
DR	−0.4828***	−0.4888***	−0.9944***	−0.9944***
	(−2.8475)	(−2.9350)	(−352.0935)	(−348.8044)
FLR	0.0001	0.0001*	0.0001	0.0000
	(1.4312)	(1.8206)	(1.3434)	(1.1411)
ATR	0.0830***	0.0809***	−0.0854***	−0.0855***
	(5.6908)	(5.3252)	(−9.5011)	(−9.7642)
Constant	−0.1571	−0.4602*	−0.2183	−0.8751***
	(0.1802)	(−1.9353)	(−1.3118)	(−4.5853)
R-squared	0.338	0.4595	0.997	0.997
Time dummies	No	Yes	No	Yes
Industry dummies	No	Yes	No	Yes

Notes: N = 13,750 observations; Robust t-statistics in parentheses

N (manufacturing) = 1509 observations; N (non-manufacturing) = 12,2419

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

distinguishing themselves from their competitors because of customer' loyalty that allows the firms to create a sound reputation early on (Patel et al. 2017).

In addition to the liability of smallness, we investigate the moderator effect of age. The conclusions indicate that firms start to face diseconomies of scale after a certain amount of years in the business. Considering that this study focuses on new firms, this may even occur in the earlier years of their activity. This outcome is supported by the liability of obsolescence and senescence arguments that state that, as firms age, they have difficulty in adapting to the external environment and face internal inertia forces. This difficulty eventually generates additional costs that further reduce firms' profitability. So, even though new firms benefit from starting out with more employees, they reach a point in their age in which additional increases in employees do not produce benefits to the firms' profitability.

Limitations and future research

The present study has some limitations. First, it uses only new firms that are active during the period of analysis. Future studies can look to the possible differences for those that failed in the first years of existence and see whether size was a determining factor for the failure. Second, although the panel includes nine years, it may fall short in truly assessing the presence of liability of age. Thus, we use this variable as a moderator and encourage future studies to use a larger panel of years to dig deeper into the effect of age on profitability. Third, future studies can try to assess when new firms stop being that new and if the liability of smallness and newness are present in different ways. Fourth, the growth pattern of firms may vary accordingly to the economic reality that is faced by specific countries that could also lead to profitability shifts independent from whether the firm size has varied. Moreover, this study does not account for market imperfections, such as the existence of monopolies or oligopolies, that may constrain new firms from succeeding and prospering, or even stop them from existing at all. These monopolies and oligopolies benefit from an extremely large profitability, mainly due to their market power and not necessarily to their size variations. In order to account for both these situations, future studies may want to include a cross-country analysis as well as an additional variable that accounts for the existence of monopolies and oligopolies in the market that allows the separation of markets that are "perfect" from markets in which imperfections exist. Lastly, the study of the relation between the liability of size, age and volatility may be of great interest for the analysis of the success and profitability of new firms. The liability of volatility may increase the exit probability of new firms due to the difficulty in planning forward that increases the risk premium associated with uncertainty and the costs that are needed to constantly adapt to the changes produced by volatility (Lundmark et al. 2020). In this way, considering all of these liabilities in the same study and analysing the differences and the similarities between them would obtain a much more detailed perspective on the reasons behind profitability shifts and new firms' success.

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Compliance with ethical standards

Conflict of interest The authors declare that they have no conflict of interest.

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