



The financial structure of Technology-Based Firms

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ABSTRACT

This study aims to analyze the evolution of financial structure in Technology-Based Micro, Small and Medium-Sized Enterprises (MSMEs) throughout their business cycle. The papers analyzing financial structure in Technology-Based MSMEs focus on developed countries, with strong institutional environments, economic stability, and developed financial markets. This study contributes to bridging the literature gap in knowledge regarding financial structure in Technology-Based MSMEs in economies with small and underdeveloped financial markets and those with recurring economic crises. These issues intensify the limitations of access to financing for these companies and their potential growth. The importance of Technology-Based companies not only lies on their contribution to economic growth, but they are regarded as channels through which scientific knowledge is applied to products, processes, and services, improving the quality of life of society as a whole. The results evidenced in this study indicate the need to devise policies focused on encouraging access to funding in the various stages of the business cycle of Technology-Based MSMEs. A database with 89 Argentine Technology-Based MSMEs is used, applying an Ordered Logit model to analyze the variables affecting financial diversification in these companies. The results confirm the predictions of the financial growth cycle of small business theory, which argues that company size and age affect the probability of diversifying the financial structure. At the same time, this work found that these variables have a different effect depending on the stage in life cycle that a company is going through.

Keywords: Micro, Small and Medium-Sized Enterprises (MSMEs), access to funding, financial diversification, emerging economies, innovation.

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1. INTRODUCTION

The growing importance of Technology-Based Firms (TBFs) in the economy has encouraged the study of their characteristics, particularities, and problems. Storey and Tether (1998) define these companies as those that develop and commercially exploit a technological innovation that implies high uncertainty. Such uncertainty is one of the main obstacles they face to fund their investment projects.

This study is framed within the problem of Technology-Based Micro, Small and Medium-Sized Enterprises (MSMEs) in relation to access to funding, in order to provide knowledge about the limitations that these companies face to access funds. An extensive literature claims that SMEs have greater restrictions to access funding than large companies (Berger & Udell, 1998; Carpenter & Petersen, 2002; Coleman & Robb, 2012; Myers & Majluf, 1984; Stiglitz & Weiss, 1981), therefore, the financial restrictions of Technology-Based SMEs, due to their innovative nature, are even more severe.

The problems of Technology-Based MSMEs to access funds are analyzed by means of theories designed for Small and Medium-Sized Enterprises (SMEs) in general, i.e. the Financial Pecking Order Theory (PO), proposed by Myers and Majluf (1984), the Financial Growth Cycle of Small Business Theory, proposed by Berger and Udell (1998), among others.

Myers and Majluf (1984) state that SMEs choose the sources of funding in relation to information that the borrower must provide to the lender, that is why entrepreneurs prefer to finance themselves with their own funds when they begin to pursue their business, being at that time young and small. As they grow up, they are willing to share more information, thereby accessing bank funding first, and then the capital market.

On the other hand, Berger and Udell (1998), claim that the choice of various sources of funding evolves with the company lifecycle. When businesses are young and/or small, information asymmetries and adverse selection problems lead them to be financed with internal funds or family and friends' money, with commercial credits, or through business angels. As they go through their life cycle, they access funds from risk capitals, and then from the debt market and/or the capital increase. Therefore, as businesses grow, the availability or access to various funding sources is greater, making it possible to diversify them.

In Argentina, the sources of private external funding that can be accessed by MSMEs are limited to commercial funding and the banking sector. This last fund provider, although having a strong presence within the financial system, does not meet the financial needs of the productive sector, mainly to finance TBFs. On the other hand, there are no alternative sources of funding, mainly due to the low presence of capital markets and the lack of legislation to govern funding mechanisms through venture capital or business angels.

The depth of the problem in emerging countries in general, and in Argentina in particular, has given rise to numerous public initiatives in this country to directly finance these types of companies, and/or improve access to funding from private sources. However, there are scarce publications about the impact of such policies on the permanence and growth of TBFs.

The objective of this study is to evaluate whether, as technology-based SMEs move through their business cycle, the funding source diversification increases, as indicated in the approach taken by Berger and Udell (1998).

The main contribution of this study to the literature regarding the sources of funding used by TBFs in emerging economies where, as mentioned above, access to external sources of funding is a much deeper problem than in developed economies. The papers published to address the financial structure of TBFs in Latin America are scarce, and virtually non-existent in Argentina.

Expanding knowledge about the sources of funding used by TBFs, their relationship with company's characteristics and their evolution throughout the life cycle provides a better understanding of the issue of access to funding in this segment of companies and allows promoting public policies aimed at its growth. Also, improving access to funding for Technology-Based MSMEs is of paramount importance for developing these types of companies, given the strong impact they have on the economy as a whole.

This study is structured as follows. The second section describes the main theories about the choice of capital structure in Technology-Based SMEs and the third section presents the data and methodology. The results of empirical analysis are shown in section four, and finally, there are the main conclusions of this study.

2. CAPITAL STRUCTURE AND FUNDING DECISIONS OF SMES

Among the theories that explain capital structure and funding decisions of SMEs there is the Financial Pecking Order Theory, proposed by Myers and Majluf (1984). These authors state that the asymmetric information between lenders and companies increases the agency costs, since the latter, in general, have more information than the former, encouraging companies, in this case, the SMEs, to finance themselves with internal funds in the first place, then with bank debt, and finally with capital increase in the stock market (Myers, 1984).

As the company moves through its business cycle, decreased information asymmetries improve access to external financial sources, with longer terms and reduced costs. Hierarchical order is the result of lower transaction costs and greater flexibility that allows the owners to use internal resources instead of external resources.

Berger and Udell (1998) state that funding decisions are explained through the Financial Growth Cycle of Small Business Theory. This theory predicts that funding sources evolve with the company lifecycle. Thus, when companies are young and/or small, they are less transparent in terms of financial information, which leads them to be funded with internal sources (internal funds, family and friends' money), with trade credits, or to business angels. When the company enters the growth stage, it can access various external sources; first, those from risk capital institutions and then from the debt market and/or the capital equity. For Argentina, Briozzo and Vigier (2006) find a positive relationship between funding source diversification and company size measured by the number of employees. The authors also find the legal form adopted by the company as a proxy for its informality degree, but they do not find such a relationship when considering firm age.

On the other hand, Zeidan, Galil and Shapir (2018), using a sample of Brazilian SMEs, find that entrepreneurs prefer to use retained earnings and that such a preference increases when company profits rise, something which indicate that, despite company growth, entrepreneurs do not diversify their financial structure. These findings are linked to the fact that a SME owner fears losing control of the company if she/he decides to use other sources of funding.

Several authors agree that the problems of access to external funding in Technology-Based SMEs are more significant than in traditional SMEs, and this affects their financial structure.

First, information asymmetries are deeper for Technology-Based SMEs, due to their short life, the

innovation process uncertainty, and the difficulty of controlling and grasping the projects that are usually complex in technological terms for investors and financial institutions (Berger & Udell, 1998; Carpenter & Petersen, 2002; Coleman & Robb, 2012). Another feature that aggravates information problems is that Technology-Based SMEs are reluctant to provide information about their innovations, due to competition in this sector (Bank of England, 2001; Cassar, 2004). Second, high-tech companies have lengthy delivery of products, so they require a longer term for funding than traditional SMEs (Bank of England, 2001; Oakey, 2003). Third, Technology-Based SMEs are companies whose tangible assets are scarce, and this prevents funding from being guaranteed with these types of assets. The value of Technology-Based SMEs is based on the present value of their growth possibility, which is named as growth options, and in general, banks are reluctant to accept this type of guarantee (Rajan & Zingales, 1995). Also, the reproduction difficulty and intangibility of assets in Technology-Based SMEs intensify the company's value drop in case of bankruptcy (Bozkaya & Van Pottelsberghe De La Potterie, 2008; Revest & Sapio, 2012).

Other authors partially corroborate the Financial Pecking Order Theory, for TBFs. This is the case of Cassia and Minola (2012), who observed that these companies in the USA follow such a theory during their early years of life, but then they prioritize capital increase instead of bank indebtedness. The same results are found by Minola, Cassia and Criaco (2013), for U.S. companies, and by Hogan and Hutson (2005) for Irish companies. The latter authors analyze the Software and Information Services (SIS) sector, and find that most of the external resources come from venture capital funds or business angels, and that bank participation is small. Finally, they emphasize that this financial structure not only comes from financial restrictions (on the supply side), but this is a consequence of the preferences of Technology-Based SMEs' owners, who unlike traditional SMEs, do not have a rooted desire for independence, as a consequence, they prefer to share company ownership, rather than borrowing from the financial system.

Hogan, Hutson and Drnevich (2017) also observe, for a set of Irish SMEs, that venture capitalists and business angels take second place, after internal funding, thus concluding that such order is a consequence of private investors having more company information than financial institutions, a finding consistent with the Financial

Pecking Order Theory. Guercio, Vigier, Briozzo and Martínez (2016) show that SIS companies, for a group of Argentine SMEs, fund both their working capital and the purchase of fixed assets with internal resources. So, there are current liabilities, mainly provision, and finally, loans from financial institutions.

Ullah and Taylor (2007) carry out a comparative study between Technology-Based SMEs operating in the SIS and biotechnology subsectors in the UK, and find out a higher rate of rejection in the funding request among companies in the SIS subsector than among biotechnology companies. As for the financial structure, funds from personal savings are listed as the main source of funding. Second, there is risk capital, and third, mortgage loans. In turn, Guercio, Martínez and Vigier (2017) find that the technological intensity for a group of Argentine companies negatively impacts the probability of receiving funding from the banking sector.

Other authors say that capital structure is influenced by the financial system's structure of the economies. For instance, Khan, He, Akram, Zulfqar and Usman (2018)

claim that economies with rather developed capital markets support innovation activities more efficiently than bank-based economies.

Through literature review, it is observed that authors who test the Financial Pecking Order Theory for TBFs, find coincidences with the predictions of this theory, mainly in the relationships existing between company size and age, as some discrepancies, such as the order of sources used by companies, a consequence of the particularities of TBFs in relation to traditional SMEs. However, most of the conclusions originate in developed countries, with stable and consolidated financial markets.

Based on literature review and the objectives of this study, the following research hypotheses are proposed:

H1: Company size is positively related to funding source diversification.

H2: Company age is positively related to funding source diversification.

H3: The degree of public disclosure of accounting information is positively related to funding source diversification.

3. DATA AND METHODOLOGY

The data used in this study come from a survey carried out in 2016 in Argentina, whose purpose was detecting the problems of access to funding in Technology-Based SMEs.

The survey's unit of analysis is Technology-Based SMEs, distinguishing the following sectors: software and engineering companies that have made or carry out a technological innovation and whose main activity is exploiting this innovation, Biotechnology and Nanotechnology companies.

One of the limitations found during fieldwork was the impossibility of knowing the TBFs' population, even due to the difficulty to define a TBC. Therefore, a non-probabilistic sampling is carried out, taking into account its characteristics in terms of generalization of results.

To select the companies to be surveyed, we contacted Technology-Based SMEs, through technological linking institutions of the Universities and the CONICET, Company Incubators and Accelerators, Clusters, Parks and Technology Poles, business associations, and other institutions that combine Technology-Based SMEs. Hereinafter, we resorted to a sampling chain, networks, or snowball. In this type of sampling, key study participants are identified to provide information and contacts with

a view to identifying the remaining participants who are hard to contact (Hernández Sampieri, Fernández Collado, & Baptista Lucio, 2014). In addition to contacting key participants in the production network, like Technology Poles, Parks, and Chambers, among other institutions that combine these company types, each company surveyed was asked to provide information on other companies that fall into the definition of TBC.

The tool to gather information was a structured survey conducted through *Skype* or by phone. The units of analysis consist of Technology-Based SMEs that are less than 20 years old. The survey was answered by company owners and/or partners and/or managers. In total, 123 surveys were registered, but due to lack of data for all surveys conducted, the sample was reduced to 85 companies.

3.1 Building the Dependent Variable and Working Hypothesis

Going on with the objective of this study, the dependent variable is built through the financial sources used by companies with the lowest or highest diversification, taking value 1 (group 1) if the company only uses internal funds, 2 (group 2) if, in addition to funds of its own,

it uses trade credit and short-term bank funding, and 3 (group 3) if, in addition to the sources mentioned above, the company uses loans from medium and long-term financial institutions.

Figure 1 shows the problem statement and statistical assumptions schematically, where IF are internal finance, STF is short-term commercial and bank funding, and LTF is long-term funding.

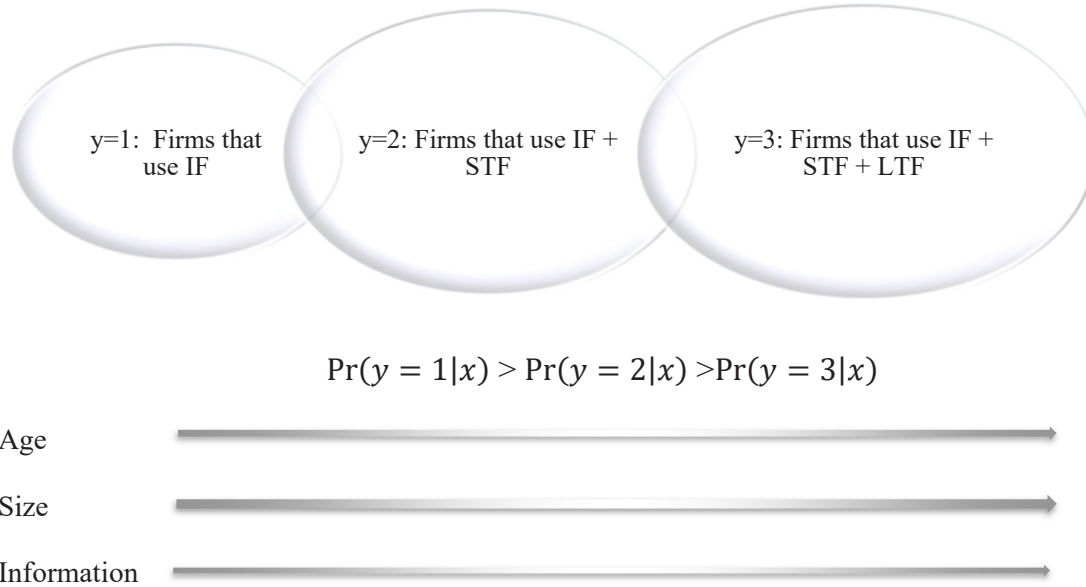


Figure 1 Definition of the dependent variable
Source: Adapted from Berger and Udell (1998, p. 623).

3.2 Methodology

The model that adjusts to the characteristics of the problem posed is the ordered logit model, since it is applied to qualitative categorical variable models, taking values ordered by companies from least to greatest financial structure diversification.

This relationship may be expressed like this:

- y=1 ↔ the company uses IF
- y=2 ↔ the company uses IF and STF
- y=3 ↔ the company uses IF, STF and LTF

To evaluate the relationship between the probability of belonging to one of the 3 groups based on the independent variables incorporated into the model (x_i), we start from the Ordinal Logit model:

$$y^*_i = x_i \beta + \mu \tag{1}$$

where y^* is a latent variable indicating the probability that the company has a diversified financial structure. The higher the value of y^*_i , the higher the event likelihood,

in this case, diversified financial structure. Therefore, y is defined as that ordered response variable divided into J categories:

$$y_i = m \text{ if } \tau_{m-1} \leq y_i^* < \tau_m \text{ for } m=1 \text{ a } J, \tag{2}$$

where cutting points are estimated from τ_1 to τ_{J-1} . For instance, if y takes a value 0, 1 and 2, there are two cutting points, τ_1 and τ_2 . For this reason, formulation (1) does not contain the constant value (for a more detailed description of the Ordinal Logit Model, see Wooldridge, 2002, p. 504-508).

In our model $y_i = 3$ if $\tau_2 \leq y_i^* < \tau_3$ for $m=1$ to 3.

The probability that y is equal to the value of category m for a given x value may be written as:

$$\Pr (y_i = m/x_i) = \Pr (T_0 \leq y_i^* < T_1/x_i) \tag{3}$$

replacing $x\beta + \mu$ by y^* :

$$\begin{aligned} \Pr (y_i = m/x_i) &= \Pr (T_0 \leq x_i\beta + \mu < T_1/x_i) \\ &= \Pr (T_0 - x_i\beta \leq \mu < T_1 - x_i\beta/x_i) \\ &= F (T_1 - x_i\beta/x_i) - F (T_0 - x_i\beta) \end{aligned} \tag{4}$$

the formula for probability of occurrence is reached:

$$\Pr (y_i = m/x_i) = F (T_m - x_i\beta) - F (T_{m-1} - x_i\beta) \quad 5$$

where F is the cumulative distribution function, so that the F Ordered Logit is a logistic function with $\text{Var}(\mu) = \pi^2/3$ (Long and Freese, 2001; Wooldridge, 2002).

The ordered Logit results do not allow interpreting the coefficients associated with each variable. Given that in the model the independent variables are mostly qualitative, the results will be analyzed according to the creation of company profiles and the predicted probabilities for various levels of financial structure diversification are calculated.

3.3 Explanatory Variables and Control Variables

In this study, the explanatory variables are defined as size, age, and legal form of the company. To analyze whether company size is related to funding source diversification, two variables are analyzed: number of employees and turnover (InfoLEG, 2016).

Company age is shown in two types of variables. *Age*, the number of years the company is in the market, and three dummy variables to group companies by age: *young*, *adolescent*, and *adult*, adapting the categorization made by Berger and Udell (1998) to the distribution by sample ages.

Table 1

Definition of variables

Indicator	Variable	Definition
Explanatory variables		
Company age	<i>Age</i>	Quantitative variable indicating company age from the moment it was formally registered.
	<i>Young</i>	Dichotomous variable that takes value 1 if the company is less than 5 years old.
	<i>Adolescent</i>	Dichotomous variable that takes value 1 if the company is between 5 and 10 years old.
	<i>Adult</i>	Dichotomous variable that takes value 1 if the company is more than 10 years old.
Size	<i>Employees</i>	Quantitative variable that indicates the number of employees working in the company with employee status.
	<i>Micro</i>	Dichotomous variable that takes value 1 if the company makes less than US\$ 23,681 a year*.
	<i>Small</i>	Dichotomous variable that takes value 1 if the company makes between US\$ 23,681 and US\$ 1,014,885 a year*.
	<i>Medium-sized</i>	Dichotomous variable that takes value 1 if the company makes between US\$ 1,014,885 and US\$ 12,175,620 a year*.
Legal form	<i>Limit</i>	Dichotomous variable that takes value 1 if the legal form adopted by the company limits entrepreneurs' ownership liability for company debts, and 0 otherwise.
Control variables		
Internationalization	<i>Export</i>	Dichotomous variable that takes value 1 if the company is an exporter, and 0 otherwise.
Sector	<i>ICT</i>	Dichotomous variable that takes value 1 if the company belongs to the ICT sector.
	<i>Bio_Nano</i>	Dichotomous variable that takes value 1 if the company belongs to the Biotechnology and Nanotechnology sectors.
	<i>Eng</i>	Dichotomous variable that takes value 1 if the company belongs to other technological sectors such as engineering, renewable energy, and agrochemicals.

*In US dollars, exchange rate corresponding to the average seller's closing price for the year 2016 published by the Central Bank of the Argentine Republic.

Source: Prepared by the authors.

Following Briozzo and Vigier (2006), the legal form adopted by the company may be regarded as a proxy for the informality degree, since legal forms that do not limit ownership liability have fewer requirements in terms of providing book information than those that do limit entrepreneurs' ownership liability for company debts. In this sense, a company registered with legal forms that limit ownership liability, such as corporations or limited liability companies, positively affects access to external funding, in comparison to those companies that do not limit ownership liability as autonomous or

de facto partnerships.

Also, a dummy *export* variable is incorporated, since several authors find out a positive relationship between company's export capacity and access to funding (Kumar and Francisco, 2005; Pasquini and De Giovanni, 2010). Finally, a sector variable is incorporated, distinguishing the TBFs between companies into the Information and Communication Technologies (ICTs) and Biotechnology and Nanotechnology (Bio/Nano) sectors, in addition to other technological sectors such as engineering, renewable energy, and agrochemicals (Eng).

4. EMPIRICAL ANALYSIS

To contrast the research hypotheses, first, the sample's descriptive statistics are shown through bivariate analysis, and second, a multivariate analysis is performed by means of an Ordinal Logit model.

4.1 Descriptive Statistics

Table 2 shows the descriptive statistics of explanatory variables and control variables for the total sample and for each of the groups in which the dependent variable is defined. In addition, hypothesis tests (differences in mean values and proportions) were performed, to assess whether there are significant differences in size, age, and legal form between groups of companies.

In turn, the description of variables according to financial structure diversification is presented (groups 1, 2, and 3). Through the information provided, we may conclude that older companies have greater financial diversification than younger companies. When separating companies by age, it is observed that there is a greater participation of young and adolescent

companies in group 1, and in group 3 there is a greater participation of adult companies in comparison to that of adolescent and young companies. In relation to size, both variables indicate that when the company is larger in terms of employees and turnover, it has greater funding alternatives available.

The results for the relationship between age and size and the company's financial structure provide clues about whether the relationships shown in the working hypotheses are true.

As for the legal form adopted by companies, it is worth noticing that companies with greater financial source diversification adopt legal forms that limit ownership liability. Besides, there is a greater proportion of exporting companies in the group with the greatest source diversification (group 3), and that the Biotechnology and Nanotechnology (Bio_Nano) sector has greater financial source diversification in comparison to the ICT sector and the other sectors in the sample (Eng). The variable indicating the CEO's gender is not significant for this survey.

Table 2

Descriptive statistics and hypothesis testing

	Total	Group 1	Group 2	Group 3	P value
N	89	45 (50%)	13 (14%)	31 (35%)	
Explanatory variables					
Age ^a	10	6	10	15	0.0001
Young ^b	27%	40%	31%	6%	0.005
Adolescent ^b	33%	40%	38%	19%	0.150
Adult ^b	40%	20%	31%	74%	0.000
Employees ^a	15	6	6	42	0.0001
Micro ^b	62%	90%	83%	16%	0.0001
Small ^b	23%	7%	8%	48%	0.0000
Medium-sized ^b	15%	2%	8%	35%	0.003
Limit ^b	77%	64%	85%	94%	0.008

Table 2

Cont.

	Total	Group 1	Group 2	Group 3	P value
Control variables					
Export ^b	47%	43%	23%	62%	0.053
ICT ^b	66%	76%	62%	55%	0.159
Bio_Nano ^b	22%	11%	31%	35%	0.032
Eng ^b	11%	13%	8%	10%	0.803

Note: ^a Since the variables do not follow a normal distribution, the difference in mean values is assessed through the Kruskal-Wallis test, ^b Pearson's test χ^2 .

Source: Prepared by the authors based on the Technology-Based Survey.

4.2 Multivariate Analysis

To analyze the relationship between financial diversification and company characteristics, three models are estimated. The differences between the models arise from considering alternative ways to include the variables that indicate size and age. Therefore, in Model 1, company size is expressed through qualitative variables that group companies by turnover segments into Micro, Small, and Medium-Sized. Model 2 excludes these last variables and includes as a measure for size a quantitative variable that indicates the number of employees a company has. In relation to age, model 3 replaces the qualitative variables that distinguish companies by groups in relation to the life cycle (youth, adolescent, and adult), and includes a quantitative variable that indicates a company's years of experience in the market.

Table 3 shows the results for the Ordered Logit estimate. Model 1 shows that a company's size (measured as turnover volume) and age are variables that turned out to be significant in explaining a company's financial structure diversification, as in bivariate analysis. The negative sign of the variable Micro indicates that if the company is in the micro-business segment, the propensity to have diversified financial structure decreases, something which contributes to accepting H1. The positive sign of the variable Age that brings together companies that are more than 10 years old indicates that the propensity to diversify the financial structure is greater for companies that are in this segment than for companies under 5 years old, contributing to accept the H2 in this study. The variable that divides companies in relation to the possibility of providing information is not significant, so H3 is rejected. This finding does not agree with bivariate analysis, indicating that when significant variables such as size and age are incorporated, the legal form's effect on the probability to diversify the sources of funding disappears. Exports are negatively related, unlike what theories show. Finally, the fact of belonging to the biotechnology and nanotechnology sector is positively related to the propensity to diversify

the sources of funding, in comparison to belonging to the ICT sector (base category).

In Model 2, the positive sign of the variable Employees provides evidence to accept the positive relationship between company size and financial source diversification (H1). Age was as significant as in Model 1, providing evidence in favor of H2, and the legal form adopted by the company was not significant. The Bio/Nano sector behaves in the same way as in Model 1 and Export is not significant in this model.

The results of Model 3 indicate that if a company is older, the greater the propensity to diversify the sources of funding, contributing to accept H2. The remaining variables behave in the same way as in Model 1.

Regarding the goodness-of-fit measures in both models, it is observed that the likelihood of the complete model (ll) is significantly greater than that of the model only with the constant (ll_0), something which indicates that the independent model variables affect the dependent variable. The *p* value for LR test (df = 8) indicates that H0, i.e. all coefficients are zero, is rejected, and the alternative hypothesis, i.e. at least one of the coefficients for the estimated model is significantly different from zero, is accepted.

The McFadden R2 (r2_p) indicates the goodness-of-fit for the model in relation to data. In this case, it is used to compare the two-model explanatory capacity, meaning that model 1 has greater explanatory capacity than model 2. The Count (Aj) is the proportion of cases that the prediction derived from the model is correct. In both models, this proportion is high (Mercado, Macías & Bernardi, 2012).

To test the assumption of parallel regressions, the Brand test (results in Annex 1) was performed, not rejecting the null hypothesis for each of the models, indicating that the assumption of parallel regressions has not been violated. Therefore, we may claim that the relationship between the various categories of the dependent variable and the independent variables is the same.

Table 3
Ordered Logit results

Variable	Model 1	Model 2	Model 3
Age			
Age			0.072*
Adolescent	0.588	0.727	
Adult	1.519 *	2.22***	
Size			
Small	-3.63***		-3.798***
Medium-sized	-3.63***		3.198***
Employees		0.036**	
Limit	0.9860	1.122	0.78
Export	-1.490**	-0.8749	-1.28*
Bio/Nano	1.53**	1.259**	1.62**
Eng	-0.741	0.412	-0.56
cut1	-1.232	2.34	-1.18
cut2	0.0303	3.38	0.071
Statistics			
N	81	85	81
ll_0	-80.92	-84	-80
ll	-51.5	-62	-52
LR (df = 8)	58.84	44.81	57.7
P value	0.0	0.0	0.0
r2_p	0.36	0.2623	0.24
aic	125	144	122
bic	151	169	143
Count (Aj)	0.537	0.429	0.537

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

Source: Prepared by the authors based on data from the Technology-Based Survey MSMEs.

As it is not a linear model, the coefficients associated with each variable cannot be interpreted. In order to perform a deeper analysis, it is possible to understand the results through the ratios or through the predicted probability.

Given that in the model the independent variables are mostly qualitative, the results are analyzed according to the preparation of company profiles, and the predicted probabilities for the various diversification levels of their financial structure are calculated. To perform the analysis, we consider the model with the greatest adjustment (greater McFadden R2), in this case, to be Model 1.

We calculate the probabilities of belonging to group 1, 2, or 3 based on company age and size, keeping the

rest of the variables constant. In this case, we assess the probabilities for exporting companies (Export = 1) of the ICT sector (ICT = 1), which are registered with legal forms that do not limit ownership liability (Limit = 1). Annex 2 of this study contains estimates for Bio/Nano companies, whose results are similar to companies in the ICT sector.

The results of predicted probabilities are shown in Table 4 and their graphical representation, in Figure 2. Only the combinations of results for young and adult companies are presented, since the category adolescent did not turn out to be significant in relation to the base category young.

Table 4
Predicted probabilities of financial source diversification for ICT companies

Company typology		Null pr (y = 1)	Medium pr (y = 2)	High pr (y = 3)
Micro young business	YMi	97%	2%	1%
Micro adult business	AMi	88%	8%	4%
Small young business	YSm	84%	10%	6%
Small adult business	ASm	50%	25%	25%
Medium-sized young business	YMe	42%	27%	31%
Medium-sized adult business	AMe	12%	18%	70%

Source: Prepared by the authors based on data from the Technology-Based Survey MSMEs.

We observe that the probability of belonging to group 1, that is, the probability that a company funds itself only with internal funds, is very high for micro businesses. This probability decreases as age increases. In contrast, the probability that a micro business has a highly diversified financial structure (Pr (y=3)) is low in comparison to larger companies. Although the relationship between size and diversification likelihood is observed in the negative sign of the coefficient for the variable Micro in Model 1 (Table 3), the results of predicted probabilities allow us to quantify the effect size and affirm that the probability of belonging to group 3 is very low if the business is micro, and that its age does not have a significant effect on changing the said probability. That is, the probability of having a highly diversified financial structure for a young micro business is only 3% less than that probability for an adult micro business (1% vs. 4%). However, the probability of belonging to the high diversification group increases by 5% (1% vs. 6%) if a young business goes from micro to small sized. These findings show that size effect is greater than age effect.

While the same thing happens in small and medium-sized business segments, age increases the likelihood that small and medium-sized businesses are in group 3. In this sense, if small businesses are young, the probability of belonging to group 3 is 6%, and 25% if these businesses are adult, that is, the probability of belonging to the group of businesses with highly diversified financial sources increases by 19%. For the medium-sized business segment, if these companies are young, the probability of belonging to group 3 increases by 39% (31% vs. 70%).

The representation of predicted probabilities in Figure 2 allows us to visualize the results obtained as a whole. We observe how smaller and younger companies show a higher probability of having a non-diversified structure, and that as the company grows, both in size and age, the probability of belonging to group 1 decreases, and the probability of belonging to group 3 increases. In relation to group 2, we observe that when the company grows, the probability of belonging to this group increases, however, when the companies are medium-sized, the probability of belonging to group 2 begins to decrease.

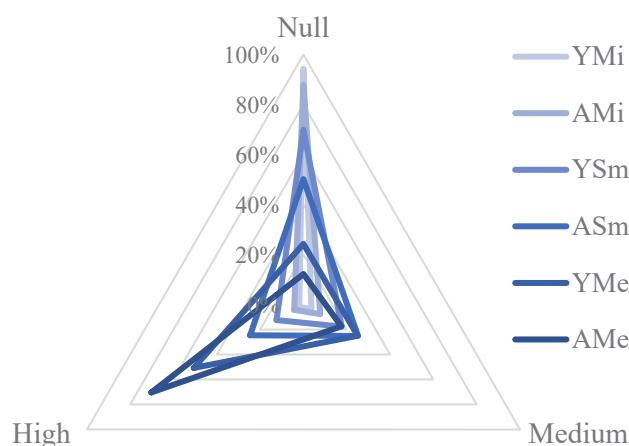


Figure 2 *Probability of diversifying the sources of funding*

Note: YMi: Micro young business, AMi: Micro adult business, YSm: Small young business, ASm: Small adult business, YMe: Medium-sized young business, AMe: Medium-sized adult business.

Source: Prepared by the authors based on data from the Technology-Based Survey MSMEs.

The results obtained by the study show that company size and age are variables affecting the probability to expand its financial structure diversification. Also, it was found that for micro businesses, age has a lesser effect on the probability of having a highly diversified structure than in the case of small and medium-sized businesses.

These findings partly agree with the results provided by the analysis performed on traditional SMEs in Argentina (Briozzo and Vigier, 2006, 2009), which found that company size and legal form proved to be significant variables to explain the greater financial structure diversification, providing evidence on the hypotheses raised by the Enterprise Financial Cycle Theory for this country.

Nevertheless, these authors find that only the variable indicating size calculated by number of employees is significant. In this study, we demonstrated that company size turned out to be a significant variable measured both

in terms of sales and number of employees. This result may be indicating that, in the case of Technology-Based MSMEs, there is a link between number of employees and company sales that allows us to match the classifications of companies by size, regardless of the variable used for such a classification.

On the other hand, unlike the results found for traditional MSMEs, in this study we found that for technology-based MSMEs, age turns out to be a significant variable in all models executed, mainly when the business is small and medium-sized. This finding could be indicating that, unlike what the authors point out for traditional SMEs, the fact of belonging to a technology-based MSME creates the need to engage in investment projects on an ongoing basis, which require external funding, regardless of the stage in life cycle where it is located.

Finally, for Technology-Based MSMEs, the legal form did not turn out to be a significant variable.

5. CONCLUSIONS

The objective of this study was evaluating if Technology-Based MSMEs follow the predictions of the Financial Growth Cycle of Small Business Theory. The results show the relevance of the relationship between size and use of the various sources of funding, demonstrating that the smaller the business, the greater the probability of being financed only with funds of its own, and the lower the probability of using a rather diversified financial structure, in relation to the largest and oldest companies.

In this sense, younger businesses use short and long-term funding to a lesser extent, and the impact of the relationship between company age and greater financial structure diversification grows along with its size. So, we may say that access to funding in the micro businesses segment depends more on size than on age. On the other hand, when companies grow, age begins to be a major determinant for accessing foreign funds, especially in the long term.

Although the empirical evidence resulting from assessment of the Financial Life Cycle Theory in Technology-Based MSMEs in developed economies partly agrees with the results obtained in relation to how size and age affect financial structure diversification, the main contribution of this study is demonstrating that the deepest limitations lie on the segment of micro and small businesses, regardless of their age. These findings indicate that policymakers' efforts should be aimed at this company segment.

But the testing of theories cannot be carried out in its entirety, given that the poor development of the Argentine capital market does not allow us to incorporate funding alternatives to the issuance of shares, or the issuance of corporate debt, as they do, indeed, in developed countries. On the other hand, the shortage of incentives to foster the incursion into the financial system of participants like venture capitalists or business angels prevents funding from these sources to be among the financial alternatives available for TBFs. These players constitute one of the main sources of funding that various authors observe in developed economies, above all in the early stage of Technology-Based MSMEs.

The need to have a developed and active capital market for this type of company becomes clear with the existence of Argentine companies trading stocks on Wall Street, or those based in the USA or Chile to benefit from how quickly a company can be established and from the access to various sources of funding, such as public support and/or a dynamic private funding market. The fact that companies with Argentine resources grow outside this country has a direct impact on the economy, not only in gross domestic product (GDP) loss, but also in the invaluable loss of the spill effect that innovation activities generate for the rest of the economy.

Among the limitations of this study, we think that there is a need to rely on panel data, that is, financial information at various times in the life cycle of the same

company, in order to obtain more robust conclusions, which are consistent with the theory. However, we believe that the results obtained herein contribute to increase knowledge on the funding decisions of Technology-Based SMEs in emerging economies such as Argentina, which

has numerous limitations for channeling investments into the productive sectors.

As further lines of research, we propose investigating the use of funds from public policies aimed to encourage the emergence, growth, and expansion of TBFs.

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ANNEX 1

Table A1

Brand test

Variable	chi2	p>chi2	df
Model 1			
All	6.09	0.529	7
medium-sized	0.12	0.732	1
adult	0.16	0.688	1
fsmall	1.35	0.245	1
fmid	0.12	0.731	1
limit	0.41	0.523	1
sector	0.6	0.439	1
p1	0.9	0.343	1
Model 2			
All	-6.69	1	6
medium-sized	0.02	0.885	1
adult	0.04	0.846	1
h13	-39.9	-999	1
limit	0.43	0.512	1
sector	0.44	0.505	1
p1	2.23	0.135	1
Model 3			
All	8.91	0.179	6
antiq	2.05	0.152	1
fsmall	2.33	0.127	1
fmid	0.58	0.448	1
limit	0.43	0.513	1
sector	0.65	0.422	1
p1	0.96	0.327	1

Source: Prepared by the authors based on data from the Technology-Based Survey MSMEs.

ANNEX 2

Table A2

Predicted probabilities of diversification of financial sources for ICT companies

Firm profile		Null	Medium	High
Micro young firm	YMi	93%	5%	2%
Micro adult firm	AMi	85%	9%	5%
Small young firm	YSm	65%	20%	15%
Small adult firm	ASm	45%	26%	29%
Young medium-sized firm	YMe	20%	23%	56%
Adult medium-sized firm	AMe	10%	15%	75%

Source: Prepared by the authors based on data from the Technology-Based Survey MSMEs.

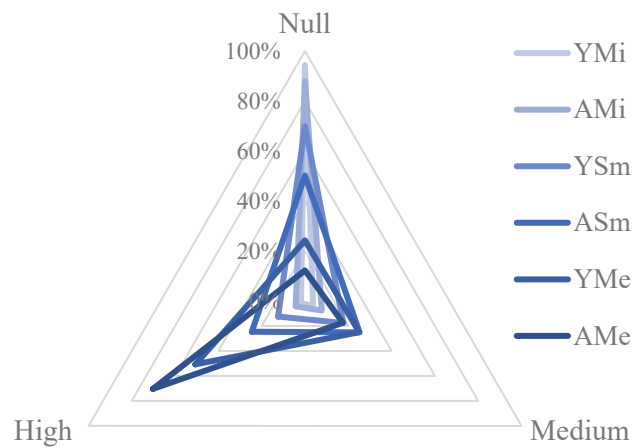


Figure A Probability of diversifying funding sources

Note: YMi: Micro young business, AMi: Micro adult business, YSm: Small young business, ASm: Small adult business, YMe: Medium-sized young business, AMe: Medium-sized adult business.

Source: Prepared by the authors based on data from the Technology-Based Survey MSMEs.