Determinants of small business survival: The impacts of capital intensity and the collateral value of fixed assets

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DETERMINANTS OF SMALL BUSINESS SURVIVAL: THE IMPACTS OF CAPITAL INTENSITY AND THE COLLATERAL VALUE OF FIXED ASSETS

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Abstract

The major claim of this article is twofold, that is, that fixed assets in small manufacturing enterprises in developing countries have to be seen with respect to two roles. The first is capital intensity. The second is the collateral value of these assets. The former is associated with the small manufacturing firms' hazard of exit in a U-shaped fashion. The latter takes up a wave-shaped relationship. Failure in the extant empirical literature to fit a binomial specification for capital intensity results in either a negative or a positive relationship, or even, lack of statistical significance. All these three outcomes are the results of a misguided attempt to fit an "artificial" monotonic specification to an actual U-shaped relationship. The trinomial specification for the collateral value of the small manufacturing enterprises' fixed assets has never been attempted. Thus, the present article proposes a new framework for the study of the impact of the small manufacturing enterprises' fixed assets investment strategy upon their hazard of exit.

Keywords: Small firms; Business survival determinants; Capital intensity; collateral value of fixed assets; Cox regression

1. INTRODUCTION

This article is a continuation of the revision of empirical research on the determinants of mortality in small and medium-sized enterprises, whose proposition was first set out in Barbosa (2016b). Before proceeding, a word has to be said in order to increase its chances of success. From the present work, empirical evidence provided by previous studies will become increasingly scarce. The reason for this is that the theme of capital intensity and the ones that will be tackled in the following working papers have been less explored by authors. As a result, achieving the goals set out by inspiration upon Low and MacMillan (1988)'s thinking will depend very much on action by the scholars whose works are being revised. This action is checking and reporting whether the arguments made in the present article are correct. This is very much necessary, if the

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Low and MacMillan (1988)'s main preoccupation, namely, to derive the maximum benefit from future research, deserves due consideration.

Doms and Others (1995) recognize the heterogeneity in capital usage in terms of two distinct concepts, both being expected to be related to survivability. The first concerns the use of advanced manufacturing technologies. According to these authors, the use of advanced manufacturing technologies may directly increase plant productivity and thus survivability. Still according to them, the use of advanced technologies may be a proxy for unobserved managerial ability. If plants with superior management are best able to fully exploit advanced production technologies, then plants with high-quality managers will be the most likely to adopt the new production methods as well as be the most likely to survive because of their efficiency advantages. The second concerns capital intensity. According to Doms and Others (1995), a basic rationale for the link of this variable with survivability is that plants with higher capital-labor ratios may have a lower ratio of variable to fixed costs. Given the basic shutdown rule that a plant will remain in operation as long as it can cover variable costs, plants with low variable-cost production techniques may be more likely to withstand negative shocks than high variable-cost producers. Another reason is that in the presence of sunk entry or exit costs and uncertain future market conditions, there is an option value to remaining in a market even if the producer is incurring losses.

Grossi and Gozzi (2005) suggest that the average industry capital intensity is a measure of the extent of scale economies in it and that, therefore, firms increasing their capital intensity are expected to have a higher chance of survival given the scale of their respective industry. López-Garcia and Puente (2006), following a viewpoint adopted by Doms and Others (1995), affirm that the share variable costs represent in relation to total cost is inversely determined by capital intensity and, consequently, if there is a negative shock by which prices go down, for example, less capital-intensive firms will exit the market first. According to Shiferaw (2009), more capital per person could enhance labor productivity and reduce the hazard of failure. Still according the same author, this is a view espoused by theories of industrial evolution that relate firm survival to investment in productivity-enhancing activities (Pakes and Ericson, 1998).

For certain, Doms and Others (1995) and other quoted authors are not specifically concerned with small and medium manufacturing enterprises in developing countries. Also, their words imply a one-direction direct relationship or no relationship between use of capital and survivability. For his part, Barbosa (2012) is concerned with the technological modernization of the small and medium manufacturing firms in Brazil. Specifically, this author is concerned with the emphasis put on this by the Brazilian small business development support that might cause so radical a change in the nature of the assisted small manufacturing enterprises that they would end up suffering from the shortcomings of bigness without getting rid of those of smallness. Barbosa (2012) pinpoints many flaws in the emphasis on technological modernization. One flaw is that the small manufacturing firms in developing countries are not able to expand their sales through new channels to an extent that would warrant the extensive and expensive use of modern equipment. Another one is that these firms are not able to obtain a regular supply of raw materials in the quantities needed to run efficiently modern machinery. Modern machinery would imply the use of expensive, processed industrial inputs, made of imported products or imported altogether, which would make the then modern small firms face the problems entailed by the big businesses' control over raw materials markets. A third flaw would stem from shortage of skilled labor and the low level of educational attainment by the developing countries' active population that would drive the small manufacturing firms into facing difficulties in competing with big businesses over recruiting workers capable of efficiently operating modern machines. Another flaw is that the small business manpower problem may become worse after technological modernization, given the unfair situation in which small firms hire workers and train them on the job only to play the role of cheap

training centers for their larger counterparts, which, by offering higher salaries, take away the best professionals. A last, but not exhaustive, flaw is that the small firm would not be protected anymore by the shield of limited, fragmented, segmented markets in regions lacking adequate infrastructure in case of being technologically modernized, since it would have to forego its original market by moving to a large industrial centre, because modern technology calls for adequate provision of technical support services to guarantee efficient operation. Moreover, standardized products would imply that custom design would be less a source of profit for the small company.

Regardless of the theoretical weight of the theories of industrial evolution, which back up the first approach above, and the fact that its field of application is that of large companies or the warmth of the "theories of domination", which permeates the second approach, and the fact that its field of studies is that of small businesses, all the three possible results of empirical investigations that seek to identify a relationship between capital intensity and business survival have come out from the analyses so far carried out. Besides, a direct, an inverse and no relationship are found irrespective of stage of development of the studied country. These conflicting results are invariably attributed to an array of causes, being different countries, different size bands, different methodologies, different samples and different numbers and nature of explored covariates some of the most cited ones. For its part, this article claims that, as long as small manufacturing enterprises are concerned, different studies find different results because of a misguided attempt to fit a linear specification when, in fact, the actual relationship between capital intensity and the hazard of exit is a U-shaped one. Thus, in developing countries the above approach by studies that defend the existence of a special context of the small firm development potential stands a step ahead. That is, some technological modernization brings benefits for these manufacturing concerns, but too much modernization reverses the effect.

Because of the foregoing, interest in this study is restricted to small firms, not only because these enterprises have been receiving particular attention by virtue of their differential nature and social and economic importance, but also because large enterprises' survival probabilities do not seem to depend so much on variations on capital intensity. There are some works that confirm this. Ferragina and Mazzotta (2015) reported a Table of Cox regressions in which capital intensity had no impact on the hazard rate in the class of multinationals, normally very large enterprises. Kimura and Fujii (2003) found mixed results for capital intensity according to size classes. Their capital/labor ratio was statistically significant in a negative association with the hazard of exit in the size classes 50-99, 300-499 and 500-599 employees but not in the classes 100-199, 200-299 and 1000 or more employees.

By using data and insights from a study that investigated the common determinants of the firm's capital structure and of business survival, it is possible to investigate in-depth the relationships between, on the one side, the small manufacturing enterprises' hazard of exit and, on the other side, capital intensity and the collateral value of fixed assets. This particular research work is uniquely suitable to such an end in view of the facts that it has dealt with a complete array of variables measured at the firm's operations level, besides including in the analyzes both industry and economy level covariates, made use of many non-linear specifications, and achieved a very high degree of explanation of the total variation in survival probability.

However, for many reasons, this reference study does not claim to have the robustness necessary to back strongly its main theses. A major reason concerns its small sample size. To overcome this weakness, the extant literature is used whatever the way it is possible to bring about evidence in support of these theses. As empirical studies on the impact of capital intensity upon the small firms' survival prospects have been accumulating for a long time now, a non-negligible amount of insights, contradictions and flaws are available for reviewing. This is the second major

source from where support for the main theses of this study is eagerly sought. With the insights made possible by the analysis in the reference study, the unexpected, "contradictory" and "awkward" results reported in the literature on capital intensity and business survival can be clarified, the better the more relevant additional information is provided by the research reports. It is understood that the better the reference study clarify these "strange" results the stronger the empirical support lent by the corresponding works to the reference study theses.

The achievements of the present study are surprisingly numberless and diversified. First statistical significance is generally very high. Capital intensity, in varying ways of measuring it, and the collateral value of fixed assets are confirmed as major determinants of the small manufacturing enterprises' hazard of exit. The findings allows the postulation of a new framework that best represents the relationship between capital intensity and small business survival, which is proposed for investigating, analyzing and interpreting such a relationship, being capital intensity either central to the study or included only as a control. Also, many predictions from the findings or from interpretations of the findings are also generated. Finally, this framework and its predictions are used to confront results in the extant literature in search for extra support for the findings and theses of the present study. This effort is successful in view of the fact that the greatest portion of the literature adjusted to the new proposed framework.

The remainder of the working paper unfolds as follows. In Section 2, a quick word is dedicated to the original reference study. Section 3 reports detailed results for capital intensity and the collateral value of fixed assets. Section 4 presents an in-depth review of the related literature in search for additional evidence that supports the findings of the analysis on the impact of capital intensity and the collateral value of fixed assets on the small manufacturing enterprises' hazard of exit. Section 5 concludes by summarizing the overall results of the research effort and by addressing main implications for theory, policy making and small business support, and for the management of the very small manufacturing enterprises. Of course, the traditional issues of limitations of the present and suggestions for future enquiries are addressed also in this last section.

2. THE REFERENCE STUDY

The reference study is described in far more details, comparisons, explanations and justifications in Barbosa (2009). However, interested readers may find that, for the purposes of this article, the version presented in Barbosa (2016a), which abbreviates the conventional analyses on the determinants of small business survival, may be sufficient as a reference. Barbosa (2016b)'s working paper on the relationships between, on the one hand, size, growth and age of the firm and, on the other hand, small business survival may be of some help, but it is not essential for the understanding of any part of this study.

It only suffices here to define the variables that are introduced in the present analyses. These are measures concerning the fixed assets of the studied small manufacturing enterprises. Then, first, there is the measure of the collateral value of the fixed assets of these companies. It is simply the reverse of the already presented machinery/fixed assets ratio, that is, 1 minus the machinery/fixed assets ratio. The selection of this measure is inspired by the statement by Binks (1979) that for a small firm a higher proportion of fixed assets does not mean higher capacity to collateralize debt, since very small firms are urged to start acquiring plant and equipment well before they are able to begin buying property, and plant and equipment are often considered unacceptable as viable security. Thus, this variable has different meanings, depending where in the scale a specific small firm is located. Being on the beginning of the scale up to some extension of

it means that most of the firm's investment in fixed assets is made in plant and equipment, what can mean that the enterprise is highly capital intensive. Towards the end of the scale, it means that all investment in fixed assets is in land and buildings. Last, being in the middle of the scale means that the small enterprise has a lot of money invested in vehicles and apparels for keeping stock or for the transportation of finished goods.

Two measures worked with in the reference study (Barbosa, 2009) but that were not presented in Barbosa (2016a) are the capital/labor ratio, the most traditional measure of capital intensity, and the plant & equipment ratio. The former is defined as plant & equipment/number of employees, averaged over the years available to each enterprise. The latter is defined as plant & equipment/total assets, also averaged over the years available to each enterprise. Theoretically, the plant & equipment ratio could not perform well as a measure of capital intensity, since it varies depending not only on the long-term investment decisions of the firm but also on its choices from alternative strategic short-term investment decisions. This is so much so because the plant & equipment ratio is a proportion of the firm's total assets.

Labor productivity, total factor productivity and type of firm also have to be defined because they are used in the revisions of previous works to be carried out in Section 4. Labor productivity corresponds to the division of annual sales turnover by the number of employees, averaged over the years available to each enterprise. The non-standardized residuals from an OLS multiple regression of logarithm of sales on the logarithm of total assets and logarithm of number of employees are taken as the values of the total factor productivity variable. Type of firm takes three values, namely, 1 for sole proprietorship, 2 for family business and 3 for partnership.

3. RESULTS WITH THE CAPITAL INTENSITY AND COLLATERAL VALUE OF ASSETS MEASURES AND POSTULATION OF A FRAMEWORK REFERENCE FOR INVESTIGATING, ANALYZING AND INTERPRETING THE RELATIONSHIPS BETWEEN THESE COVARIATES AND SMALL BUSINESS SURVIVAL

In Table I, auxiliary equations (2) to (4) report results for the fitting of the most conventional measure of capital intensity, namely, the capital/labor ratio. Main equation (1) has been brought over from the reference study (Barbosa 2009; Barbosa 2016a) for comparison purposes only. In it, the machinery/fixed assets ratio has been replaced by the measure of collateral value of fixed assets. Auxiliary equation (2) shows results for the monotonic specification employed by all researchers in the whole of the empirical literature that either investigates the impact of the capital/labor ratio on the small enterprises' survival prospects or controls for its effects. The sign of the estimated coefficient is negative, as expected, but is statistically insignificant. The fitting of the quadratic specification, which is the choice of all researchers when allowing for non-linear effects of other investigated determinants, such the size of the firm, produces a result strikingly different, that is, highly statistically significant parameter estimates of the adjustment of the specification to a U-shaped relationship between the capital/labor ratio and the small firms' failure likelihood. This is shown in auxiliary equations (3). Auxiliary equation (4) shows that results for the capital/labor ratio are greatly improved by taking out of the equation the medium- and long-term financial leverage and the market concentration covariates.

The variables capital/labor ratio, medium- and long-term financial leverage and market concentration compete with each other to explain variations in the hazard of exit because they are interrelated. Comparing the z-statistics from auxiliary equation (3) with those from the main

equation (1) it is clearly visible that these variables have their coefficients and statistical significance drastically reduced, whereas most of the other covariates experiment the opposite effects. Auxiliary equation (4) shows that the coefficient and statistical significance for the capital/labor ratio rises considerably when medium- and long-term financial leverage and market concentration are dropped out of the specification.

Table I: Determinants of Small Business Survival/Different Specifications for the Capital/labor Ratio

Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL							
	Main Equation		Auxiliary Equations					
	(1)		(2)+		(3)+		(4)+	
Capital/labor ratio	n.a.	n.a.	-0.50e-4	(1.36)	-0.59e-3	(3.37)***	-0.65e-3	(4.11)***
Capital/labor ratio^2	n.a.	n.a.	n.a.	n.a.	0.16e-7	(3.25)**	0.19e-7	(4.19)***
Net working capital	-5.68	(4.33)***	-5.89	(4.56)***	-7.65	(5.11)***	-7.86	(5.31)***
Total Financial Leverage	-10.72	(5.18)***	-11.60	(5.20)***	-13.31	(5.62)***	-10.71	(5.10)***
Medium- and Long-term Financial Leverage	11.58	(3.25)**	12.84	(3.30)**	11.32	(2.86)**	-	-
Profitability	-0.80	(4.04)***	-0.87	(4.20)***	-1.27	(4.95)***	-1.18	(5.31)***
Operational cycle$^{1/3}$	-27.25	(4.19)***	-27.41	(3.98)***	-37.23	(4.71)***	-36.79	(4.86)***
Operational cycle$^{1/2}$	9.52	(4.48)***	9.61	(4.27)***	13.13	(4.97)***	12.84	(5.07)***
Automation degree	-7.18	(5.36)***	-7.16	(5.21)***	-8.25	(5.32)***	-7.52	(5.14)***
Automation degree^2	1.35	(5.56)***	1.36	(5.42)***	1.57	(5.55)***	1.43	(5.47)***
Collateral value of fixed assets	-75.16	(5.51)***	-75.36	(5.53)***	-92.50	(5.90)***	-77.34	(5.67)***
Collateral value of fixed assets^2	150.51	(5.18)***	150.26	(5.22)***	194.70	(5.68)***	163.88	(5.45)***
Collateral value of fixed assets^3	-86.20	(4.95)***	-86.26	(4.98)***	-118.39	(5.52)***	-102.31	(5.34)***
Corporate diversification	-0.04	(3.51)***	-0.03	(2.76)**	-0.05	(3.39)***	-0.06	(3.99)***
Market concentration	-0.12	(3.68)***	-0.12	(3.52)***	-0.09	(2.50)*	-	-
Market concentration^2	1.24e-3	(3.73)***	1.22e-3	(3.61)***	1.02e-3	(2.82)**	-	-
Client concentration	0.06	(4.47)***	0.06	(4.58)***	0.09	(5.08)***	0.09	(5.54)***
Sales concentration in big clients	0.10	(5.54)***	0.10	(5.36)***	0.11	(5.47)***	0.11	(5.86)***
Sales unpredictability	0.33	(3.08)**	0.38	(3.29)**	0.38	(3.18)**	0.35	(3.40)***
Entrepreneur's Risk Tolerance	2.06	(5.87)***	2.13	(5.93)***	2.38	(6.10)***	1.99	(5.96)***
3-year lagged GDP growth rate	-0.34	(3.16)**	-0.37	(3.18)***	-0.44	(3.31)**	-0.52	(4.72)***
1998 year dummy	6.49	(5.21)***	6.75	(5.02)***	8.59	(5.31)***	8.12	(5.49)***
Market concentration X Operational cycle	-4.53e-4	(3.42)***	-4.71e-4	(3.54)***	-7.49e-4	(4.62)***	-6.13e-4	(5.11)***
Sales concentration in big clients X Machinery/fixed assets ratio	-0.11	(4.24)***	-0.11	(4.22)***	-0.11	(4.28)***	-0.12	(5.08)***
R^2_p	0.84		0.85		0.87		0.84	
LR chi2(22/23/24/21)	113.01***		113.26***		124.60***		109.42***	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute-value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) + Without case 43, which is an influential outlier; 5) Number of events/observations (firms): 46/61.

Interestingly, the auxiliary equation (3) of Table I allows the fitting of two measures of capital intensity at the same time, both reaching statistical significance and not disturbing each other. The measures are the capital/labor ratio and automation degree, which most probably are capturing the effects of different aspects of capital intensity. Doms and Others (1995) also work with two related variables, namely, the capital/labor ratio and technology usage, being the latter, like the automation degree variable of the reference study (Barbosa 2009; Barbosa 2016a), a perceptual measure. Equation (2) of Doms and Others (1995)'s table 2, in which the covariates are fitted contemporaneously, shows that both capital intensity measures are negatively related to the plants' hazard of exit and highly statistically significant.

Table II presents results for the perceptual automation degree measure of capital intensity. This variable already made part in the reference study (Barbosa 2009; Barbosa 2016a) of its final model, which is the main equation (1) in Table II. Inspection from auxiliary equation (2) over to main equation (1) shows that controlling for automation degree amazingly increases the quality of results pertaining to all the other individual effects. Auxiliary equation (3) demonstrates that the fitting of a monotonic specification of the automation degree measure generates a coefficient estimate highly statistically insignificant and with the "wrong" sign.

Table II: Determinants of Small Business Survival/The impact of the Automation Degree

Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL					
	Main Equation		Auxiliary Equations			
	(1)		(2)		(3)	
Net working capital	-5.68	(4.33)***	-4.36	(3.81)***	-4.38	(3.66)***
Total Financial Leverage	-10.72	(5.18)***	-7.43	(4.18)***	-7.79	(4.21)***
Medium- and Long-term Financial Leverage	11.58	(3.25)**	8.44	(3.08)**	7.78	(2.74)**
Profitability	-0.80	(4.04)***	-0.57	(3.39)***	-0.60	(3.46)***
Operational cycle$^{1/3}$	-27.25	(4.19)***	-12.15	(2.41)*	-11.48	(2.22)*
Operational cycle$^{1/2}$	9.52	(4.48)***	4.25	(2.64)**	4.08	(2.47)*
Automation degree	-7.18	(5.36)***	-	-	0.31	(0.93)
Automation degree^2	1.35	(5.56)***	-	-	-	-
Collateral value of fixed assets	-75.16	(5.51)***	-31.52	(3.93)***	-32.37	(3.95)***
Collateral value of fixed assets^2	150.51	(5.18)***	58.67	(3.31)**	59.85	(3.33)***
Collateral value of fixed assets^3	-86.20	(4.95)***	-30.85	(2.83)**	-31.41	(2.83)**
Corporate diversification	-0.04	(3.51)***	-0.02	(1.92)	-0.02	(1.82)
Market concentration	-0.12	(3.68)***	-0.05	(1.88)	-0.06	(2.07)*
Market concentration^2	1.24e-3	(3.73)***	7.10e-4	(2.68)**	7.75e-4	(2.83)**
Client concentration	0.06	(4.47)***	0.02	(2.20)*	0.02	(2.29)*
Sales concentration in big clients	0.10	(5.54)***	0.05	(3.67)***	0.05	(3.72)***
Sales unpredictability	0.33	(3.08)**	0.02	(0.29)	0.05	(0.62)
Entrepreneur's Risk Tolerance	2.06	(5.87)***	0.93	(4.23)***	0.97	(4.29)***
3-year lagged GDP growth rate	-0.34	(3.16)**	-0.25	(2.69)**	-0.24	(2.55)*
1998 year dummy	6.49	(5.21)***	4.41	(4.21)***	4.52	(4.23)***
Market concentration X Operational cycle	-4.53e-4	(3.42)***	-2.74e-4	(2.21)*	-2.70e-4	(2.14)*
Sales concentration in big clients X Machinery/fixed assets ratio	-0.11	(4.24)***	-0.03	(1.76)	-0.03	(1.88)
R^2_p	0.84		0.71		0.71	
LR chi2(22/20/21)	113.01***		74.62***		75.53***	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute-value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) Number of events/observations (firms): 46/61.

In Table III, auxiliary equations (2) and (4) report results for the fitting of the plant & equipment ratio. Auxiliary equation (2) shows results for the monotonic specification. The sign of the estimated coefficient is positive, against expectation, but statistically insignificant. Auxiliary equation (3) exhibits the fitting of the best U-shaped specification. In auxiliary equations (2) and (3), any covariate that is missing in relation to the main equation (1) will substantially diminish the statistical significance of the plant & equipment ratio if such missing covariate is put back into the auxiliary equations. Auxiliary equation (4) exhibits results for the quadratic specification of the plant & equipment ratio when no other covariate is specified at the same time.

Table III: Determinants of Small Business Survival/ Different Specifications for the Plant & Equipment Ratio

Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL							
	Main Equation		Auxiliary Equations					
	(1)		(2)		(3)		(4)	
Plant & equipment ratio[(na) (na) (1/2) (1)]	n.a.	n.a.	n.a.	n.a.	-15.67	(3.35)***	-4.45	(1.78)
Plant & equipment ratio[(na) (1) (1) (2)]	n.a.	n.a.	1.56	(1.23)	16.00	(3.60)***	6.94	(2.24)*
Net working capital	-5.68	(4.33)***	-	-	-	-	n.a.	n.a.
Total Financial Leverage	-10.72	(5.18)***	-	-	-	-	n.a.	n.a.
Medium- and Long-term Financial Leverage	11.58	(3.25)**	-	-	-	-	n.a.	n.a.
Profitability	-0.80	(4.04)***	-0.22	(1.82)	-0.29	(2.46)*	n.a.	n.a.
Operational cycle$^{1/3}$	-27.25	(4.19)***	-5.21	(1.02)	-5.09	(1.08)	n.a.	n.a.
Operational cycle$^{1/2}$	9.52	(4.48)***	1.96	(1.24)	2.05	(1.39)	n.a.	n.a.
Automation degree	-7.18	(5.36)***	0.16	(0.75)	0.26	(1.19)	n.a.	n.a.
Automation degree^2	1.35	(5.56)***	-	-	-	-	n.a.	n.a.
Collateral value of fixed assets	-75.16	(5.51)***	0.02	(0.04)	-0.82	(1.29)	n.a.	n.a.
Collateral value of fixed assets^2	150.51	(5.18)***	-	-	-	-	n.a.	n.a.
Collateral value of fixed assets^3	-86.20	(4.95)***	-	-	-	-	n.a.	n.a.
Corporate diversification	-0.04	(3.51)***	-0.01	(0.77)	-0.01	(0.96)	n.a.	n.a.
Market concentration	-0.12	(3.68)***	0.01	(0.23)	4.97e-3	(0.21)	n.a.	n.a.
Market concentration^2	1.24e-3	(3.73)***	1.99e-4	(0.92)	2.50e-4	(1.16)	n.a.	n.a.
Client concentration	0.06	(4.47)***	-1.29e-3	(0.22)	-5.23e-4	(0.09)	n.a.	n.a.
Sales concentration in big clients	0.10	(5.54)***	0.01	(1.74)	0.01	(1.81)	n.a.	n.a.
Sales unpredictability	0.33	(3.08)**	0.07	(1.03)	0.08	(1.24)	n.a.	n.a.
Entrepreneur's Risk Tolerance	2.06	(5.87)***	-	-	-	-	n.a.	n.a.
3-year lagged GDP growth rate	-0.34	(3.16)**	-0.07	(0.88)	-0.07	(0.88)	n.a.	n.a.
1998 year dummy	6.49	(5.21)***	-	-	-	-	n.a.	n.a.
Market concentration X Operational cycle	-4.53e-4	(3.42)***	-2.37e-4	(2.34)*	-3.02e-4	(2.78)**	n.a.	n.a.
Sales concentration in big clients X Machinery/fixed assets ratio	-0.11	(4.24)***	-	-	-	-	n.a.	n.a.
R^2_p	0.84		0.28		0.39		0.09	
LR chi2(22/14/15/2)	113.01***		20.24		30.09*		5.57	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute-value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) Number of events/observations (firms): 46/61.

Inspection from auxiliary equation (2) over to main equation (1) in Table IV shows that controlling for the collateral value of fixed assets amazingly increases the quality of results pertaining to practically all the other individual effects. Auxiliary equation (3) demonstrates that the fitting of a monotonic specification of the collateral value of fixed assets measure generates a coefficient estimate statistically insignificant, although and with the "right" sign. Chart 1 shows the adjustment of the trinomial specification of the collateral value of fixed assets measure to the martingale residuals from the auxiliary equation (2) of Table IV.

Chart 1 shows that the scattered residuals form a pattern clearly in accordance with the fitted specification for the covariate collateral value of fixed assets reported in main equation (1) of Table IV. The continuous line of dots representing the predicted log hazard values is shown only for illustrative purposes, since the correct values have been slightly altered. Interpretation might go like this: as the small manufacturing enterprises start acquiring fixed assets other than machinery, such as vehicles and apparels for accommodating and transporting perishable products,

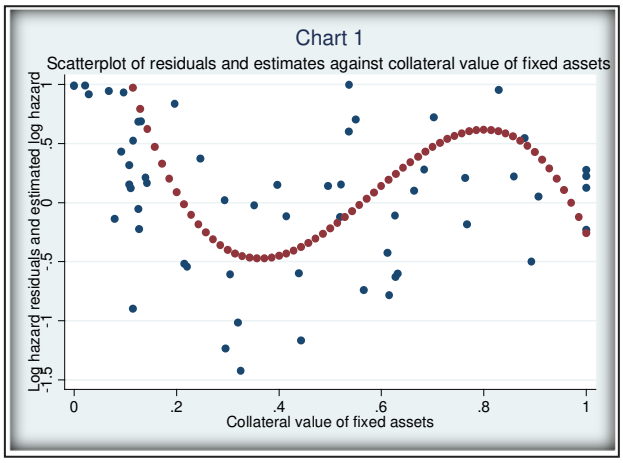
which might be more appropriate as guarantee for loans, the likelihood of exit starts to decrease. This goes on up to a certain point in the scale of the variable collateral value of fixed assets. Then the hazard of exit starts to increase until a point that coincides with the firms starting to acquire real state, such as buildings and land, which are understood to have a higher collateral capacity. From this point, the likelihood of exit starts to fall again.

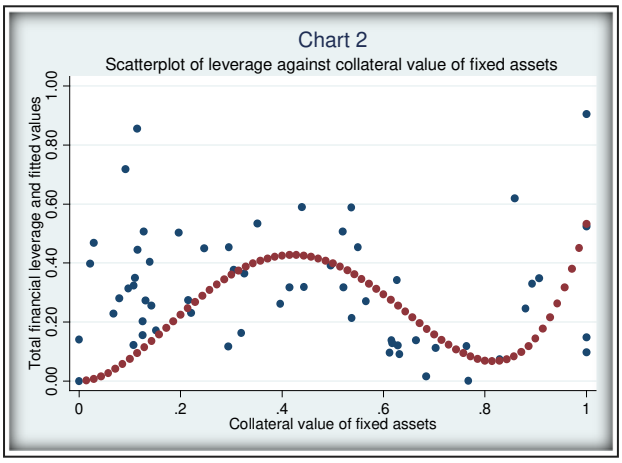
Table IV: Determinants of Small Business Survival/The impact of the Collateral Value of Fixed Assets

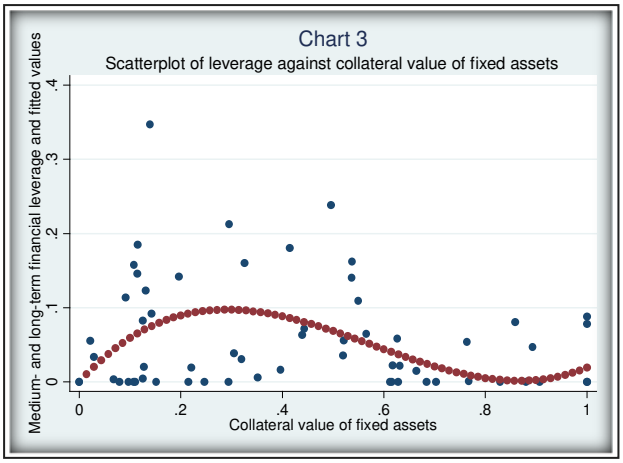
Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL					
	Main Equation		Auxiliary Equations			
	(1)		(2)		(3)	
Net working capital	-5.68	(4.33)***	-3.25	(2.82)**	-3.67	(2.95)**
Total Financial Leverage	-10.72	(5.18)***	-3.99	(2.67)**	-5.03	(2.85)**
Medium- and Long-term Financial Leverage	11.58	(3.25)**	5.80	(2.21)*	4.01	(1.44)
Profitability	-0.80	(4.04)***	-0.39	(2.53)*	-0.46	(2.81)**
Operational cycle$^{1/3}$	-27.25	(4.19)***	-12.37	(2.34)*	-11.28	(2.12)*
Operational cycle$^{1/2}$	9.52	(4.48)***	4.16	(2.51)*	3.85	(2.32)*
Automation degree	-7.18	(5.36)***	-3.08	(3.20)**	-3.20	(3.28)**
Automation degree^2	1.35	(5.56)***	0.53	(3.38)***	0.57	(3.54)***
Collateral value of fixed assets	-75.16	(5.51)***	-	-	-2.29	(1.79)
Collateral value of fixed assets^2	150.51	(5.18)***	-	-	-	-
Collateral value of fixed assets^3	-86.20	(4.95)***	-	-	-	-
Corporate diversification	-0.04	(3.51)***	-0.02	(2.03)*	-0.02	(2.13)*
Market concentration	-0.12	(3.68)***	-0.02	(0.66)	-0.03	(0.91)
Market concentration^2	1.24e-3	(3.73)***	1.89e-4	(0.68)	2.25e-4	(0.82)
Client concentration	0.06	(4.47)***	0.02	(2.76)**	0.02	(2.81)**
Sales concentration in big clients	0.10	(5.54)***	0.05	(4.28)***	0.06	(4.17)***
Sales unpredictability	0.33	(3.08)**	0.23	(2.43)*	0.23	(2.51)*
Entrepreneur's Risk Tolerance	2.06	(5.87)***	0.83	(4.04)***	0.88	(4.16)***
3-year lagged GDP growth rate	-0.34	(3.16)**	-0.35	(3.19)**	-0.36	(3.27)**
1998 year dummy	6.49	(5.21)***	2.90	(3.51)***	3.36	(3.94)***
Market concentration X Operational cycle	-4.53e-4	(3.42)***	-1.38e-4	(1.16)	-1.08e-4	(0.87)
Sales concentration in big clients X Machinery/fixed assets ratio	-0.11	(4.24)***	-0.04	(2.86)**	-0.07	(3.21)**
R^2_p	0.84		0.64		0.66	
LR chi2(22/19/20)	113.01***		63.00***		66.58***	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute-value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) Number of events/observations (firms): 46/61.

Chart 2 reinforces the above interpretation, since it shows that the covariate collateral value of fixed assets is associated with the variable total financial leverage in a way consistent with that interpretation. The case for endogeneity might be alleged, that is, that it is the loans, mainly medium- and long-term ones, that have allowed the acquiring of the respective fixed assets, and not that it is these fixed assets have made it possible to additionally finance the company. Chart 3 signalizes that this need not be the case, once, as shown by the chart, the association between the covariates collateral value of fixed assets and medium- and long-term financial leverage does not observe the same pattern as in Chart 2. So, fixed assets with higher collateral capacity help to raise financing of all maturities and also the survival prospects for the small manufacturing enterprises.







Conclusions can be drawn from the analyses so far. First, that all measures of capital intensity adjust to the hazard rate data only in a binomial, U-shaped fashion. The monotonic specification is never the best fitting. Second, that the concept of the collateral value of fixed assets is crucial to the explanation of the variations in the small manufacturing enterprises' probability of exit.

The foregoing allows the postulation of a new framework that best represents the relationship between the firm's capital intensity and small business survival, which is proposed for investigating, analyzing and interpreting such a relationship, being it either central to the study or included only as a control. Such framework is built upon two realizations. The first is that the relationship between capital intensity and the small businesses' hazard of exit is binomial, U-shaped. A linear fitting is artificial, although, as a rule, produces a negative relationship. The second realization is that a quadratic specification may not be always the best fit for the relationship. The U-shaped relationship is many times not symmetrical. It is so much so that this is the reason why the linear fitting produces, as a rule, a negative relationship. A binomial specification with a combination of powers either smaller than the unit or greater than the square may fit better the regression. Also, crucial to understanding variations in the hazard of exit is that these variations depend so much on the collateral value of the firm's fixed assets. In this case the actual relationship is wave-shaped.

Such a theoretical framework and its predictions are important in that compliance with them in studies that involve the relationship between capital intensity and small business survival promises the obtaining of more realistic overall results. The obtaining of better overall results can be attributable to 1) a more correct econometric representation of the relationship between capital

intensity and the survival of small businesses and also to 2) the fact that such more correct specification can greatly increase the quality of the results pertaining to all other studied or controlled for effects.

4. CORROBORATIVE EVIDENCE FROM THE EXTANT LITERATURE

Amazingly, empirical studies do not report attempts to fit non-linear specifications for capital intensity measures. Thus, direct evidence strictly speaking is not found in the empirical literature on small business survival. A way found to use the previous empirical studies as a source of corroborative evidence is to look at their results, mainly the disparate, awkward, embarrassing, unexpected and unacceptable ones, to see whether they are in accordance with the predictions of the frame of reference postulated in Section 3. An implication of this is that weird results signalize that correction is needed in accordance with the postulated frame of reference.

One prediction of the new postulated framework is that the negative association between the capital intensity measures and the hazard of exit is the most common outcome to be obtained by studies fitting a monotonic specification. Table V exhibits results from the previous small businesses' empirical literature according to the nature of the findings. The counting is 10 for the decreasing relationship, 6 for the increasing and 5 for no relationship. The prediction holds, but it might be seen as evidence also in favor of the prevalent conventional frame of reference. So, the analysis will proceed to look for extra evidence in all the studies listed in Table V. This task will be presented observing the chronological order of the publishing of the reviewed articles.

TABLE V - FINDINGS OF PREVIOUS STUDIES ON THE RELATIONSHIP BETWEEN CAPITAL INTENSITY AND THE SMALL BUSINESSES' HAZARD OF EXIT

	NEGATIVE RELATIONSHIP	POSITIVE RELATIONSHIP	NO RELATIONSHIP
STUDIES	Doms and Others (1995); Kimura and Fujii (2003); Audretsch (2004)§; Taymaz (2005); Grossi and Gozzi (2006)*; Bernard and Jensen (2007); Ferragina and Mazzotta (2015); Fernandes and Paunov (2015) (at first and third) and Howell (2015).	Winter (1998); Bławat and Others (2001)+; Frazer (2005); Söderbom and Others (2006); Taymaz and Ozler (2007) and Yang and Temple (2012) (at second).	Kimura and Fujii (2003); Shiferaw (2009); Yang and Temple (2012) (at first); Ha (2013) and Fernandes and Paunov (2015) (at second).
COUNT	10	6	5

Obs.: 1) + Perceptual assessment of capital intensity; 2) § Capital intensity measured as the percentage of the production costs made up by energy and depreciation costs; 3) * Capital intensity measured as asset depreciation cost divided by total assets.

Doms and Others (1995) produce extra evidence, since their Table 2 shows results that are contrary to expectation, which are predicted by the new proposed framework when the capital/labor ratio is not specified binomially. For example, in their equation (1), they specify the capital/labor ratio and labor productivity monotonically and fit them simultaneously. Results are that both variables are negatively signed, but labor productivity is not statistically significant. The explanation that is immediately prompted is that these variables are troubling one another by virtue of the fact that they are calculated by the division of two quantities, normally highly correlated with each other, into the same denominator. These quantities are, on the one hand, either sales or value added and, on the other hand, fixed assets and the denominator is number of employees, which is also highly correlated with the two quantities. All these intercorrelations signalize that the capital/labor ratio and labor productivity are bound to be highly correlated with each other. However, the proposed new framework predicts that even so the troubling need not be the case. Table VI of the present work exhibits results from an experiment with data from the

reference study. Its auxiliary equation (3) shows a pattern for the capital/labor ratio and labor productivity similar to that in Doms and Others (1995)'s work, being the only difference that in these authors' study the capital/labor ratio is the variable that exerts the stronger influence. More specifically, when these covariates enter simultaneously the regression equation, the capital/labor ratio is totally statistically insignificant. However, when, from auxiliary equation (3) to (5), a quadratic term for the capital/labor ratio is added on, significance comes back for this covariate. In fact, in auxiliary equation (5) both labor productivity and the capital/labor ratio, as well as its quadratic term, have the "right" signs and are statistically significant. Concluding, adding a quadratic term for the capital/labor ratio in equation (1) of Table 2 in Doms and Others (1995)'s work might cause similar changes, lending support to the new framework proposed by the present study.

Table VI: Determinants of Small Business Survival/The Capital/labor Ratio and Labor Productivity

Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL									
	Auxiliary Equations									
	(1)+		(2)+		(3)+		(4)+		(5)+	
Capital/labor ratio	-0.69e-4	(2.27)*	n.a.	n.a.	0.12e-4	(0.36)	-0.39e-3	(3.22)**	-0.29e-3	(2.30)*
Capital/labor ratio^2	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	0.99e-8	(2.75)**	0.88e-8	(2.45)*
Labor productivity	n.a.	n.a.	-2.33e-8	(3.65)***	-2.47e-8	(3.31)**	n.a.	n.a.	-2.34e-8	(3.01)**
R^2_p	0.68		0.74		0.74		0.72		0.76	
LR chi2(18/18/19/19/20)	68.31***		80.61***		80.74***		76.35***		86.84***	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute-value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) + Without case 43, which is an influential outlier; 5) Number of events/observations (firms): 46/61; 6) Results for 17 regressors/independent variables are omitted; 7) Medium- and Long-term Financial Leverage, Corporate diversification, Market concentration, Market concentration^2 and Sales unpredictability are missing in relation to the main equation.

Table VII: Determinants of Small Business Survival/ Capital/labor Ratio, Labor Productivity and Employment

Regressors/ Independent Variables	COX PROPORTIONAL HAZARD MODEL											
	Auxiliary Equations											
	(1)+		(2)+		(3)+		(4)+		(5)+		(6)+	
Capital/ labor ratio	-0.29e-3	(2.30)*	-0.28e-3	(2.21)*	0.34e-6	(0.01)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Capital/ labor ratio^2	0.88e-8	(2.45)*	0.84e-8	(2.28)*	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
Labor productivity	-2.34e-8	(3.01)**	-2.39e-8	(3.06)**	-2.53e-8	(3.34)**	-2.53e-8	(3.80)***	n.a.	n.a.	n.a.	n.a.
employment	n.a.	n.a.	-0.01	(0.26)	-0.01	(0.26)	-0.01	(0.26)	0.02	(0.84)	3.39e-3	(0.66)
employment^2	n.a.	n.a.	1.50e-5	(0.10)	-2.86e-6	(0.02)	-2.86e-6	(0.02)	-9.23e-5	(0.69)	n.a.	n.a.
R^2_p	0.76		0.77		0.74		0.74		0.65		0.65	
LRchi2(20/22/ 21/20/19/18)	86.84***		87.19***		81.78***		81.78***		63.09***		62.61***	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute-value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) + Without case 43, which is an influential outlier; 5) Number of events/observations (firms): 46/61; 6) Results for 17 regressors/independent variables are omitted; 7) Medium- and Long-term Financial Leverage, Corporate diversification, Market concentration, Market concentration^2 and Sales unpredictability are missing in relation to the main equation.

As important as the search for evidence supporting the proposed new framework is to consider possible arguments that might militate against it. For example, it might be alleged that the quadratic term in auxiliary equation (5) is capturing the effect of the quadratic term of size.

Barbosa (2016b) and many articles reviewed by him show that size is related to the hazard of exit in either an inverted U-shaped or a U-shaped manner. Equations (3) and (4) in Doms and Others (1995)'s Table 2 document that the introduction of employment into the regression analysis reduces the coefficients and statistical significance of the capital/labor ratio, labor productivity and total factor productivity, among other variables. Table VII of the present study shows results when employment and squared employment in various specifications enter the Cox regression analysis reported in Table VI. Results confirm that the above possible allegation makes no sense, since neither employment nor squared employment is significant in any specification. Specifying ln of employment does not bring about better results. Coming ahead in the text, there is another revision, carried out against results reported in Table IX and involving size measured as total assets, which produces additional evidence of the same kind, only that size is highly statistically significant. Concluding, discarding possible counter-supportive allegations also lends support to the appropriateness of the new framework proposed in this working paper.

Winter (1998) reports a table of probit estimates in which firm productivity and the capital/labor ratio enter the same equation. Firm productivity has the expected, negative sign, although against expectation lacks statistical significance. The capital/labor ratio is highly statistically significant, but the sign is, against expectation, positive. The fact that the capital/labor ratio is positively signed is a prediction of the new proposed framework, already discussed and confirmed by other 5 cases listed in Table V, and may happen if the actual U-shaped relationship is asymmetric. The uptrend would be either more numerous in terms of residuals, or more clearly defined as a tendency, with the residuals clustered more closely around a virtual fitting curve, or more inclined, or even all together. The adding of a quadratic term for the capital/labor ratio in Winter (1998)' specification most probably will turn the above two counter-intuitive results into results more consistent with expectations as argumented and demonstrated with respect to the findings by Doms and Others (1995). Concluding, Winter (1998)'s results may also be seen as providing extra evidence in support to the new proposed framework.

Audretsch and Others (2004) present extra evidence in favor of the proposed new framework because they work also with capital intensity measured at the industry level. This variable is at final marginally statistically significant in a positive association with the hazard of exit. The authors interpret this as being consistent with the idea that, as capital intensity is usually seen as a measure of economies of scale, their finding suggests that new-firm survival rates are lower in industries with substantial economies of scale and hence greater cost disadvantages for small firms. However, it is contended here that, although there is no denial that the industry capital intensity is an actual determinant of the small business failure rate, in fact that finding means that the variable capital intensity measured at the level of the industry is to a high extent capturing the upward trend of the actual U-shaped relationship between capital intensity measured at the firm level with the hazard of exit, whereas the variable capital intensity measured at the level of the enterprise is capturing the downward trend. This behavior by the industry capital intensity variable fulfills a prediction of the proposed new framework that the fitting of a variable that correlates with the firm's capital intensity will capture the upward trend of the actual U-shaped relationship between the capital intensity measured at the firm level with the hazard of exit in the case that a quadratic term, in addition to the linear one, for the firm's capital intensity is not specified.

Table VIII exhibits results from an experiment with data from the reference study that show that the above may really be the case for the study under review, although there are differences in the way capital intensity is measured. The variable plant & equipment measured at the level of the industry was calculated in the same way as in the Audretsch and Others (2004)'s work, that is, as the mean for the enterprise level data for each studied manufacturing sector.

Table VIII: Determinants of Small Business Survival/ Plant & Equipment Ratio

Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL									
	Auxiliary Equations									
	(1)		(2)		(3)		(4)		(5)	
Industry level plant & equipment ratio	13.76	(2.86)**	n.a.	n.a.	13.61	(2.72)**	11.41	(2.42)	n.a.	n.a.
(Firm level plant & equipment ratio)$^{(1)\ (1)\ (1)\ (na)\ (1)}$	-3.42	(1.81)	-10.39	(2.41)*	-10.79	(2.50)*	n.a.	n.a.	-2.00	(1.06)
(Firm level plant & equipment ratio)$^{(na)\ (2)\ (2)\ (na)\ (na)}$	n.a.	n.a.	10.30	(2.16)*	9.34	(1.91)	n.a.	n.a.	n.a.	n.a.
R^2_p	0.68		0.66		0.70		0.66		0.63	
LR chi2(21/21/22/20/20)	68.95***		65.31***		72.62***		65.57***		60.77***	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) Number of events/observations (firms): 46/61; 5) Results for 19 regressors/independent variables are omitted.

Auxiliary equation (1) shows a specification equivalent to that in Audretsch and Others (2004)'s work, although results differ in some respects. It is clearly visible that the industry level plant & equipment has the highest coefficient and statistical significance as compared to the other equations in Table VIII in which it is specified. So, as in auxiliary equation (1) the quadratic term for the firm level plant & equipment is not specified, the allegation made above that the industry level plant & and equipment captures much of its effect may be true. On the other hand, the quadratic term for the firm level plant & equipment has a higher coefficient and statistical significance in auxiliary equation (2), in which the industry level plant & equipment is missing. This might be seen as evidence unfavorable to the new proposed framework because it would be consistent with a possible allegation that the findings in the reference study of a U-shaped relationship might be attributable to the quadratic term capturing the effects of other factors, as, for example, the industry level capital intensity. Auxiliary equation (3) demonstrates that this need not be the case, since all three entries are at least marginally statistically significant at the 10% level. So, all the foregoing is seen as lending extra strong support to the new proposed framework.

Frazer (2005) reported many tables of probit estimates in which firm productivity, the capital/labor ratio and firm employment enter the same equation. As predicted by the new proposed framework, these variables seem to be troubling one another. Firm productivity and firm employment are always highly statistically significant and, as expected, negatively signed. The capital/labor ratio is statistically significant, but the sign is, against expectation, positive. Frazer (2005) interprets the unexpected result as supporting the trade theory prediction that capital intensive firms go out of business when exposed to international competition. However, this counter-intuitive result may be an outcome of failure to add a quadratic term for the capital/labor ratio, as argumented and demonstrated above with respect to the findings by Doms and Others (1995) and by Winter (1998). The fact that the capital/labor ratio is positively signed is a prediction of the new proposed framework, already discussed and confirmed by other five cases in Table V. This may happen if the actual U-shaped relationship is asymmetric, as explained in the revision of Winter (1998)'s article. Put in other words, the counter-intuitive result for the capital/labor ratio would be the result of a misguided attempt to fit an "artificial" monotonic, linear specification to an actual asymmetric U-shaped relationship with the firms' probability of exit. Concluding, Frazer (2005)'s results may also be seen as providing extra evidence in support to the new proposed framework.

Because Frazer (2005) makes use of total factor productivity and the previous experiments in the present paper make use of labor productivity, Table IX shows results when the former measure of firm productivity is specified. Also, ln of total assets replaces employment as the measure of size. Auxiliary equation (1) shows that the three factors need not trouble one another. All have the expected signs and are highly statistically significant. Auxiliary equation (2) demonstrates that the misguided monotonic specification of the capital/labor ratio produces a

statistically insignificant coefficient for this covariate and reduces the coefficients and significance level of the other covariates. Auxiliary equation (3) shows that similar results are obtained if it is ln of total assets that is "wrongly" monotonically specified. Conclusions are the same from inspection of auxiliary equations (4) and (5). The only exception is auxiliary equation (4), in which total factor productivity takes advantage of the total absence of the capital/labor ratio to raise its coefficient and significance level. However, all in all, results in Table IX refute possible allegations that the quadratic term of the capital/labor ratio captures the effects of the quadratic term of size and that the variables trouble each other because their measures are built upon the same or highly correlated factors, such as employment.

Table IX: Determinants of Small Business Survival/ Capital/labor Ratio, Total Factor Productivity and Ln of Total Assets

Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL									
	Auxiliary Equations									
	(1)+		(2)+		(3)+		(4)+		(5)+	
Capital/labor ratio	-0.42e-3	(2.85)**	-0.31e-4	(1.05)	-0.28e-3	(2.15)*	n.a.	n.a.	-0.36e-3	(2.81)**
Capital/labor ratio^2	0.11e-7	(2.74)**	n.a.	n.a.	0.74e-8	(2.00)*	n.a.	n.a.	0.97e-8	(2.62)**
Ln total assets	-3.18	(3.81)***	-2.79	(3.42)***	-0.43	(1.70)	-2.70	(3.44)***	n.a.	n.a.
(Ln total assets)^2	0.26	(3.40)***	0.21	(2.85)**	n.a.	n.a.	0.20	(2.85)**	n.a.	n.a.
Total factor productivity	-5.73	(4.14)***	-5.59	(4.12)***	-3.30	(2.91)**	-5.94	(4.58)***	-3.25	(2.65)**
R^2_p	0.81		0.78		0.76		0.78		0.75	
LRchi2(22/21/21/20/20/23)	98.81***		90.79***		86.27***		89.60***		83.66***	

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute-value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) + Without case 43, which is an influential outlier; 5) Number of events/observations (firms): 46/61; 6) Results for 17 regressors/independent variables are omitted; 7) Medium- and Long-term Financial Leverage, Corporate diversification, Market concentration, Market concentration^2 and Sales unpredictability are missing in relation to the main equation.

The interpretation by Frazer (2005) that the unexpected result supports the trade theory prediction that capital-intensive firms go out of business when exposed to international competition may nevertheless be conciliated with that by this article that it is due to failure to specify a quadratic term for the capital/labor ratio. The U-shaped relationship between capital intensity and the hazard of exit is explained for the case of small manufacturing enterprises in developing nations by excessive modernization in technological terms that destroys their intrinsic, internal self-beneficial characteristics without releasing them from their intrinsic, internal self-inimical characteristics, as explained with recourse to the "theories of domination" in the introduction section of this work. International competition only plays the part of revealing this reality that is covered up by customs protective policies, once these are withdrawn.

Yang and Temple (2012) for sure add extra evidence, since they fit in their second table of Cox regressions an interaction of capital intensity and a dummy variable representing years before and after reforms carried out in China, besides the monotonic specification for capital intensity that in their first table resulted in a statistically insignificant coefficient. In this second table both covariates are highly statistically significant and have opposite signs. All this is consistent with the predictions of the proposed new framework for an actual perfectly symmetric or almost perfectly symmetric U-shaped relationship between capital intensity and the hazard of exit in small enterprises in developing countries. First, lack of statistical significance in the first table of Cox regressions, where capital intensity is specified monotonically and interactions are not fitted, is the result predicted by the proposed new frame of reference and to be expected from a misguided attempt to fit a linear specification when the real relationship is a perfectly symmetric or almost perfectly symmetric U-shaped one. Second, in the second table of Cox regressions, the linear term

is capturing the uptrend of the actual U-shaped relationship and the interaction its downtrend. The corresponding prediction of the new proposed framework is that, in the absence of an additional quadratic specification for the capital intensity variable, any other covariate with some degree of correlation with capital intensity may capture one of the trends of the actual U-shaped relationship and the linear capital intensity specification the other. For sure, the Yang and Temple (2012)'s interaction has some capital intensity content and, as a consequence, is correlated with it.

Table X demonstrates that the relationships found by Yang and Temple (2012) are easily replicated with data from the reference study. Auxiliary equation (1) shows that type of firm is not related to the hazard of exit, once its estimated coefficient is totally statistically insignificant. Auxiliary equation (2) shows a predicted result for the misguided fitting of a monotonic specification of the capital/labor ratio. Auxiliary equation (3) shows results that confirm that the relationship between the capital/labor ratio and the hazard of exit is U-shaped. Auxiliary equation (4) shows results very similar to the ones obtained by Yang and Temple (2012) when the quadratic term of the correct specification for the capital/labor ratio is replaced by an interaction between the capital/labor ratio and some short-scaled covariate of the reference study data equivalent to the one used in Yang and Temple (2012)'s work. Finally, auxiliary equation (5) shows that either the specification in (3) or in (4) exhausts the capturing of the effect of the capital/labor ratio, once only two covariates are statistically significant. Further scrutiny, not reported, reveals that the interaction has a better performance than the capital/labor ratio, linearly specified, because its correlation coefficient with the quadratic term is a little lower than that between the quadratic term and the linear term of the capital/labor specification.

Table X: Determinants of Small Business Survival/ Capital/labor Ratio and Type of Firm

Regressors/ Independent Variables	COX PROPORTIONAL HAZARD MODEL										PEARSON CORRELATION	
	Auxiliary equations											
	(1)+		From Table I Equation 2 (2)+		From Table I Equation 3 (3)+		(4)+		(5)+		Capital/ labor ratio	Type of firm
Capital/labor ratio X Type of firm	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	-0.20e-3	(3.30)**	-0.16e-3	(2.55)*	0.95***	0.13
Capital/labor ratio$^{(na)(1)(1)(1)(1)}$	n.a.	n.a.	-0.50e-4	(1.36)	-0.59e-3	(3.37)***	0.24e-3	(2.61)**	-0.29e-3	(1.30)		
Capital/labor ratio$^{(na)(na)(2)(na)(2)}$	n.a.	n.a.	n.a.	n.a.	0.16e-7	(3.25)**	n.a.	n.a.	0.14e-7	(2.54)*		
Type of firm	-0.28	(0.58)	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.		
R^2_p	0.84		0.85		0.87		0.87		0.89			
LR chi2(23/23/24/24/25)	111.59***		113.26***		124.60***		124.55***		131.20***			

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) + Without case 43, which is an influential outlier; 5)Number of events/observations (firms): 46/61; 6) Results for 22 regressors/independent variables are omitted; 7) There are no regressors/independent variables missing in relation to the main equation.

Yang and Temple (2012) affirm that a significant negative effect of high capital intensity exists only after 1992, a result of economic reforms. This is an ad hoc explanation. The explanation advanced in the present study is general. According to the new proposed framework, there are two reasons why the capital intensity covariate proxies for the quadratic term of the correct specification, once it is positively signed, and the interaction for the linear term, and not the other way round, as might be expected. A reason is that in the work under review the actual U-shaped relationship is in fact a little asymmetric, as in the first table of Cox regressions all coefficients for capital intensity are positive and, out of eight, one reaches statistical significance at the 10% level. Then, the uptrend is either more numerous in terms of residuals, or more clearly

defined as a tendency, with the residuals clustered more closely around a virtual fitting curve, or more inclined, or even all together. A second, and complementary reason, is that the linear term in the second table of Cox regressions has more valid values, that is, different from zero, for the covariate capital intensity, since in the interaction term the multiplying by the dummy variable, composed of 0 and 1 values, makes many valid values for capital intensity become 0 values, meaning no variation for a great part of the independent variable.

Although there is no denying that economic reforms may have an impact on the relationship between capital intensity and the hazard of exit, as a type of them was discussed with respect to the work by Frazer (2005), the exercise carried out by Yang and Temple (2012) needs to be confronted with some aspects of the survival analysis techniques that might have unduly influenced their results. The monotonic specification for the economic reforms dummy was not kept by Yang and Temple (2012) in their second table where the interactions were fitted. Hosmer and Lemeshow (1999 p.164-5) teach that when there are statistically significant interactions, the corresponding main effect terms should be included in the model, regardless of their statistical significance. Although Yang and Temple (2012) declare their noble intention of estimating directly whether the acceleration of economic reform since 1992 had had any impact upon the firms' exit behaviors by specifying interactions of the economic reforms dummy and all their firm-level variables, keeping the dummy along with the interactions would have purged from the results the effects of variables not controlled for by the regressions. In the Yang and Temple (2012)'s first table the dummy is highly statistically significant in all equations and it is positively signed, meaning that the reforms raised the hazard of exit. This is very possible because Barbosa (2016c) showed that high economic growth produces higher mortality of incumbent small enterprises as a result of higher competition by new firms set up by opportunity entrepreneurs. And publicly available information confirms that the years after 1992 brought back very high GDP growth rates in China. Although the GDP growth rate is fitted in both tables and is statistically significant and positively signed, still much of the estimated positive impact of the interaction between the dummy with capital intensity might be in Yang and Temple (2012)'s work capturing the GDP growth rate effect, and this should be purged. Last, and perhaps most important, time is split into two parts by the reform dummy variable, which may consequently positively correlate with the follow-up years. Year can not by itself enter the Cox regression equations because it is collinear with the baseline hazard function. But, the dummy variable and also the interaction can, since they are not in econometric terms the same thing as year. However, as they carry, even if partially, the same content, it may be time, which is negatively correlated with the baseline hazard function, that is producing the negative impact of the interaction between the dummy and capital intensity. Coming ahead in the text, there is another revision, carried out against results reported in Table XI, which produces evidence of the same kind.

Fernandes and Paunov (2015) report in their Tables 3, of initial results, and 4, of main results, that capital intensity initially relates with the hazard of exit in a negative and statistically significant manner. However, as labor productivity is added on, capital intensity loses all its statistical significance. This partial analysis is enough as evidence in favor of the proposed new framework, since, as demonstrated in the revising of Doms and Others (1995)'s results, through the presentation in Table VI, the losing of statistical significance is due to failure of specifying an additional quadratic term for the capital/labor covariate. Fernandes and Paunov (2015) add then, as next step, an interaction between capital intensity and age, instead. Results from this action bring back the same analysis carried on in the revising of Yang and Temple (2012)'s article. Final results reported in auxiliary equation (4) of Table XI differ a little from those for auxiliary equation (5) of Table X because year, differently from type of firm, is linearly correlated with the hazard of exit. As a consequence, all three covariates in Table XI are predicted to and show statistically significant relationships with the hazard of exit. The interaction, in the absence of the

quadratic term for capital intensity, is capturing the uptrend of the actual U-shaped relationship between capital intensity and the hazard of exit. Fernandes and Paunov (2015) lend then a twofold support for the new proposed framework.

TABLE XI – CAPITAL/LABOR RATIO AND SMALL BUSINESS AND HAZARD OF EXIT

Regressors/Independent Variables	COX PROPORTIONAL HAZARD MODEL								PEARSON CORRELATION	
	Auxiliary equations									
	From Table I Equation 4 (1)+		(2)+		(3)+		(4)+		Capital/labor ratio	Year
Capital/labor ratio X Year	n.a.	n.a.	n.a.	n.a.	-0.36e-4	(4.33)***	-0.23e-4	(3.12)**	0.71***	0.48***
Capital/labor ratio(1)(1)(1)(1)	-0.65e-3	(4.11)***	-0.11e-4	(0.33)	0.14e-3	(3.24)**	-0.38e-3	(2.16)*		
Capital/labor ratio(2)(na)(na)(2)	0.19e-7	(4.19)***	n.a.	n.a.	n.a.	n.a.	0.15e-7	(3.02)**		
R^2_p	0.84		0.77		0.85		0.87			
LR chi2(21/20/21/22)	109.42***		89.17***		112.99***		121.26***			

Obs: 1) First values in the main body of the table are coefficient estimates; 2) numbers in parentheses are absolute value z-statistics; 3) *, **, and *** denote statistical significance at the 5%, 1%, and 0.1% levels, respectively; 4) + Without case 43, which is an influential outlier; 5) Number of events/observations (firms): 46/61; 6) Results for 19 regressors/independent variables are omitted; 7) Medium- and Long-term Financial Leverage, Market concentration and Market concentration^2 are missing in relation to the main equation.

Confronting the analyses carried out by Fernandes and Paunov (2015) with some aspects of the survival analysis techniques that might have unduly influenced their results may further produce evidence that the effect that their interaction is capturing is in fact the upward trend of the U-shaped relationship between capital intensity and the hazard of exit. Fernandes and Paunov (2015) inform that their interactions are specified with a view to correcting for the violation of the proportional hazard assumption. However, there is no information in the text about the use of the special way the interaction for correcting for the violation of the proportional hazard assumption should enter the Cox regression equation. According to Hosmer and Lemeshow (1999 p.207), the interaction term is not simply the product of the covariate and the subject's observed value of time. If Fernandes and Paunov (2015)'s age interactions are dealt with as if they were simple ones, then the impact of the age interaction with capital intensity might be in fact capturing one of the trends of the actual U-shaped relationship of capital intensity with the hazard of exit, instead of the capturing of the changing over time in the strength of the impact of capital intensity upon the hazard of exit.

5. CONCLUSIONS, STRENGHTS AND LIMITATIONS OF THE STUDY AND SUGGESTIONS FOR FUTURE RESEARCH AND SMALL BUSINESS DEVELOPMENT SUPPORT POLICIES

The present study has successfully demonstrated that its posited framework of reference for research dealing with the relationship between firm capital intensity and small business survival is highly invaluable in face of strong support lent by two sources. First, by an in-depth piece of research that has investigated a very wide range of postulated determinants of small business survival. The overall conclusion from this first source is that the binomial specification of capital intensity is the "right" one and that the finding of a statistically significant inverse relationship is one of the three possible outcomes to result from a misguided attempt to fit a monotonic specification to the actual U-shaped relationship between capital intensity and the

small manufacturing enterprises' hazard of exit. Second, by the power of the postulated framework of reference to explain a set of unexpected, embarrassing and unacceptable findings in the extant literature on small business survival. The general conclusion from this second source is that these weird findings are the result of a specification error and drive authors to misleadly attribute the effect of the quadratic term of the real U-shaped relationship between capital intensity and the exit risk to other factors.

The specific achievements of the present study are surprisingly numberless and diversified. First statistical significance is generally very high. Capital intensity and the collateral value of fixed assets are confirmed as major determinants of the small manufacturing enterprises' hazard of exit. This is robust across different ways of measuring capital intensity, including a perceptual one. Only that the relationships are U-shaped, with respect to capital intensity, and wave-shaped, concerning the collateral value of fixed assets, being these pieces of finding by far the greatest breakthroughs brought about by the study. Another striking finding concerning the collateral value of fixed assets is that controlling for it amazingly increases the quality of results pertaining to practically all the other individual effects. This is also true for automation degree, which is the perceptual measure of capital intensity. The robust findings allowed the postulation of a new framework that best represents the relationship between capital intensity and small business survival, which is proposed for investigating, analyzing and interpreting such a relationship, being it either central to the study or included only as a control. Also, many predictions from the findings or from interpretations of the findings were also developed. Finally, this framework and its predictions were used to confront results in the extant literature in search for extra support for the findings and the theses of the present study. This effort was successful in view of the fact that the greatest portion of the literature adjusted itself to the new proposed framework.

Some very specific results from this revision of the empirical literature are worth mentioning. The troubling among variables, such as capital intensity, firm productivity and size, that seems to be due to their sharing of a same base from which to be calculated, as, for instance, number of employees, is in fact due to the failure to include a quadratic term for capital intensity. Once this term is included in the analyses the troubling disappears. Interactions with capital intensity are always suspect of capturing one of the trends of the actual U-shaped relationship between capital intensity and the small manufacturing enterprises' hazard of exit when a quadratic term is not specified. Related industry level variables are also suspect to play this same role when the same misspecification error occurs. Specific experiments revealed also that it is not the case that it is the quadratic specification instead that is taking as its own effects pertaining to other factors.

Of course, it has to be acknowledged that the main limitation of this work is that it is partly based upon a piece of research that dealt with a small sample. This, in fact, has been duly done to the extent that recourse was taken to the extant related literature to search for external support to its findings and postulations. In general, other research efforts are characterized by the use of samples of huge sizes. On the other hand, it has strengths, represented by the use of a large number of covariates defined at the enterprise level, non-linear specifications and combinations of exponents for the binomial specifications other than the quadratic combination. However, the greatest strength of the research is that its methodology resulted in numerous important findings.

So, it is imperative to state that empirical research interested in understanding the same or phenomena related to the ones investigated in this study should pursue more vigorously the use of

an ampler array of covariates, mainly the ones defined at the level of the enterprise, the fitting of non-linear specifications, and, although less in this revision, the choice of binomial power combinations other than the quadratic one. Other suggestions for future research in the area have to do with the predictions made and tested in this study. Thus, one is that researchers should take care concerning use of interactions. They are new variables, but as they carry to different extents contents of the original variables, it is very possible that they still capture mostly the impact of only one of the original ones. One way of having a hint about this is to calculate the correlation coefficients of the interaction with the original variables.

Some suggestions for future research come from the revision work mainly because of technical difficulties faced in carrying out such a task. A first suggestion is that all studies dealing with either new small firms or incumbent ones, or even a mix of them, should present separate results for micro-, small-, medium- and large-sized enterprises. It is becoming clear that each of these categories of size have its own set of survivorship determinants, which in turn have individually a particular way of working, there existing cases that the determinants behave differently depending on which category of size is under consideration. Treating all categories of size alike hinders the development of meaningful theories of small business survivorship. A second suggestion is that authors should report more fully summary statistics and correlations between the variables of their studies. This eases understanding and evaluation of their results. The value of this orientation is highlighted when it is recalled that science is an endless process of accumulation of knowledge carried out bit by bit through the contribution of new researchers that add on the achievements of previous ones.

As to theory building, results from this piece of research support the “theories of domination”, which is directly applicable to the case of small manufacturing enterprises in developing countries. Once some revised pieces of research are not really concerned with small manufacturing enterprises, it remains unsettled to which extent they are also applicable to the small manufacturing enterprises in developed countries and also to the big businesses, which are the object of study of the theories of industrial evolution.

One advice for small firms is that they have to be very careful when evaluating market opportunities that imply making use of new, modern technology, which the enterprise still has to acquire and learn about its operation. Technological modernization of small enterprises in developing countries entails dangers, mainly if it is imposed. It can be excessive in such a way that the assisted small enterprise can end up suffering from the shortcomings of bigness, without getting rid of those of smallness. An example of this would be incurring the risk embodied in modern technology, namely, high operational leverage, simultaneously with that arising from markets that are unstable, unpredictable and averse to product standardization, namely, high sales volatility.

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APPENDICES:

Appendix I Survival Variables Summary Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum
Collateral value of fixed assets(28)	0.42	0.30	0.00	1.00
Capital/labor ratio(Cr$)(29)	7,776.44	8,198.30	0.00	32,930.94
Plant & equipment ratio(30)	0.33	0.21	0.01	0.88
Labor productivity(Cr$)(31)	75,029.70	53,906.47	5,497.03	241,783.17
Total factor productivity(32)	0.00	0.29	-1.18	0.76
Type of firm(33)	1.98	0.59	1.00	3.00

Variables	Fractiles			Kurtosis*	Skewness
	0.10	0.50	0.90		
Collateral value of fixed assets(28)	0.09	0.40	0.88	-1.07	0.38
Capital/labor ratio(29)+	320.26	4,753.56	21,450.96	2.10	1.68
Plant & equipment ratio(30)	0.09	0.29	0.61	0.13	0.79
Labor productivity(31)	18,549.66	62,880.38	161,485.67	-1.88	1.20
Total factor productivity(32)	-0.36	0.02	0.33	3.11	-0.90
Type of firm(33)	1.00	2.00	3.00	-0.10	0.00

Obs.: 1) Number of events/observations (firms): 46/61; 2) + Without case 43, which is an influential outlier; 3) Values in currency are in thousands and in 1992 prices, and the mean and year-end exchange rates for that year were Cr$4,516.74 and Cr$11,213.12 per US$ Dollar, respectively; 4) *According to Norušis (1992, p.167), in the SPSS the value of kurtosis for the normal distribution is, differently from many textbooks in statistics, 0 and not 3.

Appendix II Survival Variables Intercorrelation Matrix

	Collateral value of fixed assets (28)	Capital/ labor ratio (29) +	Plant & equipment ratio (30)	Labor productivity (31)	Total factor productivity (32)	Type of firm (33)
Duration(1)	0.08	0.01	-0.14	0.18	0.24	-0.04
Exit(2)	0.00	-0.01	0.08	-0.16	-0.16	0.11
Net working capital(3)	0.05	0.02	-0.22	0.02	0.03	0.09
Total financial leverage(4)	-0.09	-0.15	-0.46	0.24	0.52	-0.14
Medium- and long-term financial leverage(5)	-0.16	0.32	0.09	0.14	-0.03	0.08
Profitability(6)	-0.11	-0.08	-0.11	0.00	0.14	-0.19
Operational cycle(7)	0.07	0.09	-0.05	0.05	-0.11	0.25
Collateral value of fixed assets(28)	-	-0.18	-0.15	0.19	-0.02	-0.12
Automation degree(9)	-0.01	-0.18	-0.26	0.00	0.24	-0.05
Corporate diversification(10)	-0.13	0.45	0.12	0.30	0.21	0.06
Market concentration(11)	0.13	-0.14	0.20	-0.21	-0.28	0.13
Client concentration(12)	0.01	-0.02	-0.09	-0.02	-0.00	-0.11
Sales concentration in big clients(13)	0.06	-0.12	-0.24	0.14	0.10	0.05
Sales unpredictability(14)	0.01	0.05	0.11	-0.31	-0.36	-0.29
Entrepreneur's risk tolerance(15)	-0.18	0.08	-0.00	0.02	0.06	0.01
3-year-lagged GDP growth rate(23)	0.25	-0.15	-0.15	0.06	0.06	-0.20
1998 year dummy(26)	0.20	-0.12	-0.19	0.15	0.26	-0.08
Capital/labor ratio(29)+	-0.12	-	0.34	0.42	0.13	-0.06
Plant & equipment ratio(30)	-0.15	0.40	-	-0.26	-0.49	0.11
Labor productivity(31)	0.19	0.24	-0.26	-	0.72	0.00
Total factor productivity(32)	-0.02	0.04	-0.49	0.72	-	-0.15
Type of firm(33)	-0.12	-0.08	0.11	0.00	-0.15	-

Obs.:1) Number of events/observations (firms): 46/61; 2) + Without case 43, which is an influential outlier; 3) Coefficients in absolute values higher than 0.20 are statistically significant at the 5% level, higher than 0.30 at the 1%, and higher than 0.40 at the 0.1%, in one-tail test.