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Scale, Scope and Survival: A Comparison of Cooperative and Capitalist Modes of Production

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Abstract This paper draws on a comprehensive data set from Portugal to investigate the activities, internal characteristics and survival prospects of cooperatives and capitalist enterprises. Consistent with theory, high levels of market concentration and low entry costs were shown to be conducive to cooperatives. Cooperatives were found to be, on average, older and to operate with a larger, more highly educated and more productive labour force than do their capitalist counterparts. Finally, we show that cooperatives have a markedly higher probability of survival than do capitalist enterprises due, in part, to differences in industry of operation and internal characteristics.

Keywords Cooperatives · Capitalist firms · Firm ownership

JEL Classification J54 · P12

1 Introduction

A long-standing and fundamental question in economics is why firms in market economies are typically owned by the suppliers of capital. In this paper we focus on cooperatives as an alternative to investor ownership.

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Cooperatives, as Hansmann (1999) points out, are a relatively new form of organization—having emerged as recently as the latter half of the nineteenth century—but now have a significant economic presence in many countries. Notable contemporary examples include Associated Press, which is owned by consumers (media organizations); the worker-owned cooperatives that are clustered around the town of Mondragon in the Basque region of Spain, which accounted for 8 % of Basque industrial gross value added in 2008; and the farmer-owned cooperatives, which are responsible for the marketing of substantial portions of agricultural output in many countries.

The behaviour and performance of cooperatives has attracted the attention of theorists, but econometric evidence is limited; and there is a scarcity even of basic comparative information on the characteristics and performance of the two types of organization.[1] In this paper we draw on a comprehensive data set from Portugal to compare the patterns of activity, internal characteristics and survival prospects of cooperatives and investor-owned ("capitalist") firms.

The main findings of the paper are: First, there are significant differences in the industrial distribution of cooperatives and capitalist enterprises; cooperatives are attracted to industries that are characterized by low entry costs and—except in the case of agriculture, forestry and fishing—high demand volatility. Second, cooperatives tend to be older and have a larger, more highly educated workforce than do their capitalist counterparts. Third, cooperatives experience lower failure rates than do capitalist firms (CFs)—a difference that is, in part, accounted for by the differences in industry of operation and internal characteristics.

The remainder of the paper is organized as follows: The next section provides a definition of both cooperatives and capitalist modes of production, and describes the data. Section 3 investigates the industry distribution and internal characteristics of each type of firm. Our findings on survival are presented in Sect. 4, and a concluding section then completes the paper.

2 Definitions and Data

A satisfactory comparative analysis of cooperative and capitalist production requires: first, a precise theoretical distinction between the two organizational forms; and, second, a close correspondence between these theoretical entities and the types of enterprises that are identifiable in the data.

Following a framework that has been suggested by Grossman and Hart (1986), Hart (1995), and Hart and Moore (1990, 1996), we define the organizational form of an enterprise in terms of the ownership of—and thereby the residual rights of control over—its non-human assets.

[1] For informal analyses see Hansmann (2012) on electricity distribution cooperatives in the US and Hart and Moore (1996) on securities exchange cooperatives. With the exception of Jones and Kalmi's (2009) analysis of the implications of geographical variations in the level of trust, econometric evidence is confined to a small number of studies that focus specifically on worker cooperatives. Recent comparative studies that involve worker cooperatives include Arando et al. (2012), Pérotin (2006) and Podivinsky and Stewart (2012).

Whilst, in principle, a particular firm might be owned by anyone, in practice, as Hansmann (1996) points out, ownership is generally assigned to parties that have a transactional relationship with the firm, either as suppliers of an input or as consumers of its output. The former category can usefully be divided into three groups: suppliers of financial capital; suppliers of labour; and suppliers of any other inputs such as raw materials.

A CF can then be defined as an enterprise in which the rights to residual control are assigned to the suppliers of financial capital, and in proportion to the amount of capital supplied. These control rights would typically cover matters such as the choice of products and prices, and decisions on employment and investment. In practice, such rights might be exercised directly or indirectly through the appointment of specialist managers. In the latter case, the owners retain ultimate control through their right to dismiss the management.

In this framework, a cooperative can be defined as an enterprise in which the rights to residual control are assigned to one of the other (i.e., other than capital suppliers) contracting parties, and in which these "members" exercise control on the basis of one-member, one-vote. Once again, decision-making might be delegated to specialist managers.

Our primary source of data is the Quadros de Pessoal (QP): an annual survey that is produced by the Portuguese Ministry of Labour and Social Security.[2] All firms that have one or more wage earners are included in the survey with the exception of firms engaged in certain aspects of public administration and domestic work. The QP classifies firms according to their legal form, which enables us to identify both capitalist and cooperative firms.

We include both private limited liability companies (Sociedade por Quotas) and public limited liability companies (Sociedade anónima) in the category of CFs. Sole proprietorships, on the other hand, are excluded on grounds that, in practice, many such enterprises are operated only on a part-time basis.

The legal rules that govern the operation of cooperatives in Portugal are set out in Article 3 of the "Código Cooperativo" , which draws on principles that are set down by the International Co-operative Alliance. Two of these principles—concerning "democratic management" and "autonomy and independence"—indicate a close correspondence with the above theoretical definition of a cooperative.

On the issue of democratic management, the Código states: "The co-operatives are democratic organizations managed by their members, which actively participate in the formularization of policies and in making decisions. The men and women who exert their functions as representatives are responsible to the members who elected them. In the cooperatives of the first degree, the members have equal rights to vote (one member, one vote), and co-operatives of other degrees are also organized in a democratic form."

On the matter of autonomy and independence, the Código requires that if a cooperative were to seek external capital then it must do so in a manner that maintains its autonomy as a cooperative.

[2] The QP has been used extensively for the analysis of firms in aggregate but not, as far as we are aware, for the analysis of cooperatives.

Unfortunately the QP does not distinguish between cooperatives that are owned by consumers, those that are owned by workers, and those that are owned by the suppliers of other inputs. However, a separate cooperative dataset (CASES) constructed by the Confederação Cooperativa Portuguesa employs a classification system that allows the ownership type of a subset of cooperatives to be determined. Whilst individual enterprises cannot be matched across the two datasets, we have used the CASES data to impute ownership types to a subset of the QP cooperatives.

The CASES classification system assigns cooperatives to one of twelve categories, based on the type of activity and/or ownership structure. We identified those enterprises that fell into one of our three ownership categories—consumer, producer or other input supplier (henceforth abbreviated to "supplier")—and designated the remainder as "undefined".[3]

Ownership types were then imputed to the QP data using the following rule: if all of the CASES cooperatives in a particular CAE 5 digit industry are of the same ownership type, and there are no undefined cooperatives, then that type is imputed to all of the QP cooperatives in that industry.[4] If, on the other hand, there exists more than one type and/or undefined firms, then all are designated as undefined.

This conservative approach generates a considerable number of undefined cooperatives at the sectoral and industry group levels but provides sufficient observations for the analysis of characteristics and survival at the CAE 5 digit level.

The QP excludes any organization that does not employ at least one worker. To clean the data, we removed any firm (whether cooperative or CF) that reported zero revenue in all periods. We paid careful attention to a firm's legal status. In some instances a firm was present in the data at dates t and $t + k$ but absent in between. Such firms were retained, provided that their status at t and $t + k$ was the same. All other firms were checked for consistency of status. If a firm's status was missing in one or more years, then—provided it was constant in the other years—the missing entries were imputed.[5]

3 Industry Distributions and Firm Characteristics

In this section we investigate the types of activities that are undertaken by cooperatives and CFs, and examine their internal characteristics. We test for differences across the two types of firm in these dimensions and investigate whether

[3] To carry out this assignment we consulted the specific legislation of each of the 12 types of cooperatives which is available at http://www.cases.pt/cooperativas/legislacao/legislacao-setorial.

[4] Firms are classified according to the Portuguese CAE (rev.2.1) system of industrial classification which is equivalent to NACE (rev.1.1). CAE 5 digit is equivalent to NACE 4 digit.

[5] A number of firms changed their legal status more than once. It is possible that this might indicate a classification error and thus all results were checked for robustness to the exclusion of these firms.

If one firm were to acquire another, either both firms would disappear from the data and a new firm (with a new identification code) would be created; or only the acquired firm would disappear. Thus, it is not possible to distinguish mergers from exits. However in an earlier analysis of survival using the same data set, Mata and Portugal (2002) argued that, in Portugal, only a small proportion of exits are accounted for by mergers and thus "... our inability to trace mergers in our data set is not likely to have an impact upon our results." (p. 331).

the industrial distribution of cooperatives is consistent with theoretical arguments in the literature. We begin with a brief review of these arguments.

3.1 Theoretical Background: Implications of Ownership Structure

The theoretical literature has identified a number of potential links between a firm's ownership structure and its behaviour and performance.[6] Here we restrict attention to arguments that can be addressed using our data set.

One long-standing argument is that due to the inherent divisibility of financial capital, investors in a capitalist enterprise are more able to spread risks than are the members of a cooperative. Thus, in the specific context of worker cooperatives, Meade (1972) wrote: " while property owners can spread their risks by putting small bits of their property into a large number of concerns, a worker cannot put small bits of effort into a large number of different jobs" and thus "we are likely to find cooperative structures in lines of activity in which the risk is not too great" (p. 426).[7]

Meade's argument can be applied to cooperatives more generally since, as Hansmann (1999, 2012) points out, cooperative members frequently have a greater proportion of transactions, relative to their wealth, tied to a single firm than do investors in CFs. However, Hansmann also points to situations where ownership enables individuals to hedge risks. In such circumstances, cooperatives might have comparable risk-spreading properties to capitalist enterprises. Housing cooperatives, Hansmann (2012) suggests, are a case in point.

Two further arguments that have frequently been advanced to explain why cooperatives are far less numerous than CFs are first, that they are more susceptible to the problems that are associated with collective governance and second, that they face particular difficulties in raising external finance. On the former, Dow and Skillman (2007) and Hart and Moore (1996) present models in which cooperative members exhibit a greater degree of preference heterogeneity than do investors in CFs and, as a result, experience inefficiencies in decision-taking. Hansmann (2012) similarly emphasizes this issue and, as an illustration, points out that agricultural marketing cooperatives typically deal with just one type of crop.

One reason to suppose that cooperatives might face a higher cost of external finance than CFs concerns the position of an investor in the event of a negative shock to the firm.[8] To the extent that members' generalized claims on a cooperative's assets are vague, the firm is likely to operate with a relatively low level of net worth. This in turn means that capital suppliers may be reluctant to lend, since net worth provides the buffer for the lender against shocks that might decrease the value of the firm's assets to a level that is below the borrower's claim.

[6] See Hansmann (1996), the contributions by Grossman, Hart, and Moore that were cited above, and (for the specific case of worker cooperatives) Dow (2003).

[7] Podivinsky and Stewart (2007 and 2012) found that risk, measured by the variance of industry profit, acted as a barrier to worker cooperative entry into UK manufacturing industries. Dong and Bowles (2002) found that risk played an important role in workers' decisions as to whether to buy shares in privatized Chinese enterprises.

[8] We are grateful to the editor for the following arguments.

Furthermore, if a lender faces particular legal difficulties in forcing bankruptcy and taking possession of the firm's assets in the case of a cooperative, then, once again, external finance is less likely to be forthcoming.

In the specific case of worker cooperatives Vanek (1977) has argued that the problems associated with finance are so serious that " they offer an ample explanation of the comparative failure of these forms in history, ever since they were first conceived of by the writers of the eighteenth and nineteenth centuries" (1977, p. 187). [9]

The final potential determinant of the pattern of cooperative activity that we consider is market power. Hansmann (2012) argues that many producer and consumer cooperatives have been established in situations where their members would otherwise have been exposed to monopsony or monopoly power. As examples, he cites the agricultural marketing and electricity distribution cooperatives in the US. Hart and Moore (1996) present a formal model in which the efficiency of cooperatives relative to investor-ownership is shown to be inversely related to the degree of competition. In line with the model, they suggest that increasing competition is one of the factors behind proposals to reform the structure of some securities exchanges in the direction of outside ownership.[10]

3.2 Basic Data on Industry Distributions

We begin by examining the activities that were undertaken by cooperatives and CFs between 1995 and 2007.[11] Table 1 presents data on the total number of firms *averaged* over the period 1995–2007 and their distributions across sectors and industries. In the case of cooperatives, the overall figures are disaggregated by ownership type (consumer, worker, and supplier). As explained in Sect. 2, these latter figures are imputed rather than drawn directly from the QP dataset and, as such, should be treated with caution. The imputation procedure generates a substantial number of undefined cases, which are indicated in the table.

[9] Podivinsky and Stewart (2007, 2012) found that high levels of capital intensity acted as a barrier to worker cooperative entry into UK manufacturing industries.

[10] To illustrate their model, Hart and Moore consider a golf club that could be owned by an outside investor or by the members themselves, organized as a consumer cooperative. Both organizations are susceptible to investment inefficiencies, but for different reasons. In the former case, the owner maximizes profit by tailoring investment to the preferences of those members with the highest willingness to pay and then setting a correspondingly high membership fee. The preferences of the remaining members are not taken into account, resulting in a loss of efficiency. In the consumer cooperative, by contrast, it is the preference of the median voter that dictates the decisions. The key point is that whilst an increase in competition would reduce the inefficiency of outside ownership (since the ability to set a high membership fee would thereby be constrained), it would not affect the decisions taken by a consumer cooperative (since the membership fee would have been at a lower level than that of an outside investor and would not be sensitive to market competition).

[11] The period was chosen on grounds of consistency of the industrial classification (CAE Rev. 2.1). For some historical background of the cooperative sector in Portugal, see Fernandes (2006).

Table 1 Distribution of firms by industry (averaged over period 1995–2007)

	Cooperatives					CFs
	Total	Imputed type				Total
		Consumer	Worker	Supplier	Undefined	
Panel A: distribution across sectors						
Agriculture, forestry and fishing	126	0	1	100	25	3855
Mining and quarrying	1	0	1	0	0	682
Manufacturing	215	0	40	159	16	29,881
Electricity, gas and water	7	0	0	0	7	101
Construction	64	4	3	0	56	22,093
Services	862	227	17	176	442	115,938
Average number of firms 1995–2007	1275	231	62	435	546	172,551
Panel B: distribution within agriculture, forestry and fishing						
Agriculture, animal production and other	1	0	1	94	24	3287
Forestry and logging	0	0	0	3	1	419
Fishing and aquaculture	0	0	0	2	0	149
Average number of firms 1995–2007	126	0	1	100	25	3855
Panel C: distribution within manufacturing						
Food, beverages and tobacco	151	0	3	148	0	3455
Clothing, textiles and leather	12	0	10	0	2	7346
Wood and furniture	2	0	2	0	0	2576
Printing and publishing	22	0	4	11	8	2478
Chemical and pharmaceuticals	3	0	3	0	0	1345
Glass and ceramics	3	0	3	0	0	2334
Mechanical and metal products	9	0	7	0	2	6415
Electric and electronics	4	0	0	0	3	1296
Other	8	0	8	0	0	2635
Average number of firms 1995–2007	215	0	40	159	16	29,881
Panel D: distribution within services						
Wholesale, retail and repairs	327	87	1	153	87	55,798
Hotels and restaurants	13	0	1	0	12	16,989
Transport and communications	40	0	5	0	35	9437
Finance	99	99	0	0	0	1077
Real estate	92	41	6	0	45	19,800
Public administration and defence	6	0	0	0	6	8
Education	101	0	2	0	99	1936
Health and social work	52	0	0	0	52	6121
Other	132	0	2	23	107	4772
Average number of firms 1995–2007	862	227	17	176	442	115,938

Panel A reveals that over the period in question the average number of cooperatives was 1275 and that of CFs, 172,551.[12] Cooperatives thus accounted for approximately 0.7 % of the total number of enterprises.

Just over two-thirds of the cooperatives were engaged in the services sector and a further 17 % in manufacturing. Whilst the proportions of CFs active in these two sectors were almost identical, the remaining firms were distributed somewhat differently: Cooperatives were overrepresented in agriculture, forestry, and fishing and were correspondingly underrepresented in construction. Very few enterprises of either type were involved in mining and quarrying or in the supply of electricity, gas, and water.

Panels B, C, and D provide more detailed information on the three main sectors. In each case there are marked differences in the distributions of the two types of enterprise across industries. In the cases of agriculture, forestry, and fishing and of manufacturing the distribution of cooperatives is more highly concentrated than that of CFs. This is particularly evident in manufacturing where 71 % of cooperatives were engaged in the production of food, beverages, or tobacco compared with just 12 % of CFs.[13] For CFs the main manufacturing industry, accounting for a quarter of the firms, was clothing, textiles, and leather.

Within services, cooperatives were active in all subsectors, with the main concentrations being in wholesale, retail and repairs (38 %), education (12 %), finance (11 %), and real estate (11 %). The distribution of CFs is, once again, quite different with wholesale, retail and repairs (48 %), real estate (17 %), and hotels and restaurants (15 %) being the main areas of activity.[14]

Turning now to the ownership of cooperatives, we note that more than 40 % of the cooperatives have been designated as undefined. Thus it is not possible to comment on the overall distribution of ownership types beyond saying that, according to our estimates, at least 34 % were supplier owned, at least 18 % were consumer owned, and at least 5 % were worker owned.

For some of the individual sectors and industries, however, it is possible to be more precise. Thus it can be seen in Panel A that, according to our estimates, the vast majority of cooperatives that were engaged agriculture, forestry and fishing were supplier owned. Similarly, the figures in Panel C suggest that supply cooperatives account for almost all of the cooperatives in food, beverages, and tobacco.

The estimates also point to the presence of worker cooperatives in at least eight of the nine manufacturing industry groups. These groups include both clothing, textiles, and leather and printing and publishing: two industries that have previously been identified as important areas of activity for worker cooperatives (see, for example, Ben-Ner 1988a).

Whilst we found no positive evidence of consumer-owned cooperatives in either agriculture, forestry and fishing or in manufacturing, such enterprises were active within services. Indeed, the evidence suggests that all of the cooperatives in finance

[12] In Table 2, these figures correspond to 16,570/13 $\approx$ 1275 and 2,243,169/13 $\approx$ 172,551.

[13] A more detailed breakdown revealed that no cooperatives were engaged in the production of tobacco products.

[14] The "other" category includes, among other activities: arts, entertainment, and recreation; repair of household goods, and various personal services.

were consumer owned and that there were substantial numbers in wholesale, retail, and repairs and in real estate.[15,16]

3.3 Industry Characteristics and Firm Attributes

Our brief review of the theoretical literature pointed to market power, risk, and the costs of external finance and collective governance as potential determinants of the pattern of cooperative activity. In this section we discuss the selection and construction of the industry variables that will be used to address these arguments and present summary data on both industry and firm characteristics.

To capture variations in market power we employ the Herfindahl-Hirschman Index of market concentration, defined—as with the other industry variables below—at the 5 digit CAE (4 digit NACE) level for each year.

We consider two measures of the risk associated with entering a particular line of activity. First, we construct a measure of demand volatility that has recently been proposed by Cuñat and Merlitz (2012) in their analysis of the implications of volatility and labour market flexibility for comparative advantage. The variable is constructed by first determining, for each firm, the standard deviation of the annual growth rate of its sales, with the latter measured by the year-difference in sales. The volatility measure, *Volatility*, is then calculated as the employment-weighted average of these standard deviations across all firms in the industry. This measure, as Cuñat and Merlitz point out, is unaffected by any trend growth in firms' sales.[17]

Second, we employ a proxy for the sunk costs of entry and exit, based on observed industry entry and exit rates. This approach has been used in the literature on entry and survival by, for example, Mata and Machado (1996) and more recently, Bernard and Jensen (2007). The premise is that, in steady state, entry and exit rates will covary with the level of sunk costs. Following Bernard and Jensen (2007), we utilize the following proxy, which allows for the fact that industries might not be in equilibrium:

$$Entry\,costs_{s,t} = 1 - \left\{\min\left(Entry_{s,t}, Exit_{s,t}\right)\right\} \tag{1}$$

where $Entry_{s,t}$ is the industry entry rate defined as the number of firms entering the industry during the period $t-1$ to t divided by the total stock of firms at time t. Similarly, $Exit_{s,t}$ is the industry exit rate defined as the number of firms exiting the industry during the period t to $t+1$ divided by the total stock of firms at time t.

We are not able to address the governance or finance arguments directly, nor do we have data on industry capital requirements. However, both arguments carry the suggestion that cooperatives might be more constrained in their scale of operation than are capitalist firms, and we are able to examine the size distribution of each type

[15] The legal framework that govern education cooperatives allows for ownership by either users (students and/or parents and guardians), providers (teachers and/or other employees), or a mixture of users and providers.

[16] These differences in the patterns of activity between cooperatives and CFs within each of the sectors are, as was the case with the broad sectoral distributions, statistically significant at the 1 % level.

[17] In line with the procedure adopted by Cuñat and Merlitz, we excluded any observation for which the absolute value of the growth rate exceeded 300 %.

Table 2 Summary statistics, 1995–2007

Variables	Cooperatives					Capitalist firms				
	Obs.	Mean	SD	Min.	Max.	Obs.	Mean	SD	Min.	Max.
Industry characteristics										
Volatility	16,570	0.5491	0.1892	0.0259	2.0305	2,243,169	0.4801	0.1430	0.0148	2.8768
Entry costs	16,570	0.7699	0.2217	0.0000	1	2,243,169	0.7929	0.1847	0.0000	1
Concentration (HHI)	16,570	0.0885	0.1270	0.0006	1	2,243,169	0.0363	0.0768	0.0006	1
Median firm size (MFS)[a]	16,570	597,641	931,521	3514	1.86e+07	2,243,169	307,045	3,414,619	3514	2.07e+09
Firm characteristics										
Employment	16,570	22	53	1	1373	2,243,169	12	863	1	19,337
Firm age	16,570	25.1711	20.4221	0	172	2,243,169	11.6751	12.5102	0	305
Labour productivity[a]	14,472	190,078	1,392,035	51	1.31e+08	2,011,392	101,290	1,053,463	7	1.06e+09
Average schooling (years)	14,147	7.5233	3.0601	0	16	1,830,036	6.8211	3.0760	0	16
Proportion of men	14,147	49 %	0.3435	0	1	1,830,036	60 %	0.3804	0	1
Location (%)										
North	16,570	26 %	0.4389	0	1	2,243,169	33 %	0.4692	0	1
Algarve	16,570	5 %	0.2099	0	1	2,243,169	5 %	0.2099	0	1
Center	16,570	23 %	0.4237	0	1	2,243,169	22 %	0.4132	0	1
Lisbon	16,570	20 %	0.3963	0	1	2,243,169	32 %	0.4647	0	1
Alentejo	16,570	20 %	0.3982	0	1	2,243,169	6 %	0.2366	0	1
Azores	16,570	5 %	0.2220	0	1	2,243,169	1 %	0.1069	0	1
Madeira	16,570	1 %	0.1185	0	1	2,243,169	2 %	0.1449	0	1

[a] Firm size is measured by firm revenues, and labour productivity is measured by revenues divided by employment. Both figures are converted to real terms using the GDP deflator—Prices = 2009

Table 3 Firm size, 1995–2007

	Cooperatives				Capitalist firms
	All	Imputed type			All
		Consumer	Worker	Supplier	
Employment					
Mean	22	16	23	22	12
Median	8	8	11	9	4
Categories of employment size					
1–9 (%)	54	55	46	52	78
10–49 (%)	36	39	47	38	19
50–99 (%)	6	5	3	6	2
100+ (%)	4	1	4	4	1
Total number of observations	16,570	3008	806	5652	2,243,169
Annual revenue (10 ^{6}euros)[a]					
Mean	3.7890	4.0590	0.7009	6.0970	1.4460
Median	0.4800	1.0770	0.1925	0.9012	0.1983
Total number of observations	14,472	2577	740	5282	2,011,392

[a] Converted to real terms using the GDP deflator—Prices = 2009

of firm and to test whether the pattern of cooperative activity is sensitive to industry scale of operation as measured by the size (revenue) of the median firm, MFS.

Table 2 presents summary statistics for each of these industry variables, and for a set of internal firm attributes.

The table reveals first of all that, on average, cooperatives operate in markets that are characterized by higher levels of concentration, higher demand volatility, lower entry costs, and higher median firm size than those that are populated by capitalist enterprises.[18] These differences are all significant at the 1 % level; but, given that collinearity is to be expected, we defer any comments on the predictions from theory to the following section.

Second, it can be seen that there are significant differences in the internal attributes of the two types of firm: Cooperatives are, on average, older than are capitalist enterprises and operate with a larger, more highly educated and more productive workforce.[19] The average age of a cooperative is just over 25 years, compared with <12 years for the average CF, and workers in the former have undergone, on average, one additional year of schooling.

It can also be seen that there is a marked difference in the gender composition of the workforces: females form the majority in cooperatives (51 %) but a minority (40 %) in capitalist enterprises.

Further details on the scale of operation of cooperative and capitalist enterprises are set out in Table 3.

[18] Firm size is measured by inflation-adjusted sales revenue.

[19] Labour productivity is measured by inflation-adjusted revenue divided by employment. Variations in the number of observations in this table are due to missing observations for some variables.

Table 4 Bivariate logit of Cooperative/CF on characteristics (average marginal effects)

	All sectors	By economic sector				By employment size		
		Agriculture	Manufacturing	Construction	Services	1–9	10–49	50+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Industry characteristics								
Volatility	0.0138***	−0.1086***	0.0013	0.0118**	0.0119***	0.0095***	0.0224***	0.0224***
	(0.0008)	(0.0262)	(0.0020)	(0.0046)	(0.0010)	(0.0008)	(0.0021)	(0.0056)
Entry costs	−0.0061***	−0.0504***	−0.0041***	−0.0015***	−0.0045***	−0.0042***	−0.0091***	−0.0057*
	(0.0003)	(0.0050)	(0.0006)	(0.0006)	(0.0004)	(0.0003)	(0.0008)	(0.0021)
Concentration (HHI)	0.0096***	−0.0056	−0.0036	−0.0217**	0.0219***	0.0157***	0.0146***	−0.0025
	(0.0013)	(0.0179)	(0.0034)	(0.0121)	(0.0015)	(0.0010)	(0.0031)	(0.0110)
Log of median firm size (MFS)	0.0009***	−0.0337***	0.0036***	−0.00003	0.0006**	−0.0007***	0.0034***	0.0015
	(0.0002)	(0.0039)	(0.0004)	(0.0009)	(0.0003)	(0.0002)	(0.0006)	(0.0013)
Firm characteristics								
Log of employment	0.0078***	0.0099***	−0.0022***	0.0004	0.0025***	0.0001	0.0020**	−0.0050**
	(0.0003)	(0.0025)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0010)	(0.0019)
Log of firm age	0.0078***	0.0431***	0.0094***	0.0042***	0.0071***	0.0056***	0.0156***	0.0117***
	(0.0003)	(0.0046)	(0.0008)	(0.0007)	(0.0004)	(0.0003)	(0.0009)	(0.0022)
Log of labour productivity	0.0002	0.0051**	0.0022***	−0.0005***	−0.0010***	0.0007***	−0.0024***	−0.0036***
	(0.0002)	(0.0022)	(0.0004)	(0.0002)	(0.0002)	(0.0002)	(0.0005)	(0.0011)
Average schooling	0.0003***	0.0029***	0.0006***	0.0002***	0.0007***	0.0003***	0.0020***	0.0052***
	(0.0001)	(0.0008)	(0.0002)	(0.0001)	(0.0001)	(0.0000)	(0.0002)	(0.0007)
Proportion of males	−0.0052***	0.0095	−0.0109***	−0.0072***	−0.0060***	−0.0035***	−0.0193***	−0.0195***
	(0.0005)	(0.0081)	(0.0012)	(0.0010)	(0.0006)	(0.0004)	(0.0017)	(0.0044)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4 continued

	All sectors	By economic sector				By employment size		
	(1)	Agriculture (2)	Manufacturing (3)	Construction (4)	Services (5)	1–9 (6)	10–49 (7)	50+ (8)
Industry fixed effects	Yes	No	No	No	No	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,679,220	38,237	317,548	211,824	1,101,795	1,242,554	368,520	68,146
ll	−58,730	−4600	−10,643	−2744	−40,715	−33,774	−21,520	−5631

Standard errors (in parentheses) are clustered at firm level; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 5 Multinomial logit of type of firm: imputed type of cooperative versus capitalist firms (CF) on characteristics (average marginal effects)

Imputed type of cooperative versus CF	Consumer	Worker	Supplier	Undefined
Industry characteristics				
Volatility	0.0032***	−0.0001	0.0034***	0.0031***
	(0.0003)	(0.0002)	(0.0005)	(0.0004)
Entry costs	−0.0015***	−0.0004***	−0.0029***	−0.0012***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
Concentration (HHI)	−0.0056***	0.0005**	0.0020**	0.0103***
	(0.0006)	(0.0002)	(0.0009)	(0.0007)
Log of median firm size (MFS)	0.0001**	−0.0002**	0.0007***	−0.0002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)
Firm characteristics				
Log of employment	−0.0001**	0.0001	−0.0000	0.0009***
	(0.0001)	(0.0000)	(0.0001)	(0.0001)
Log of firm age	0.0015***	0.0003***	0.0035***	0.0025***
	(0.0001)	(0.0001)	(0.0002)	(0.0002)
log of labour productivity	0.0003***	−0.0002***	0.0010***	−0.0007***
	(0.0001)	(0.0000)	(0.0001)	(0.0001)
Average schooling	−0.0001***	0.0000	−0.0001**	0.0002***
	(0.000)	(0.0000)	(0.0000)	(0.0000)
Proportion of male	−0.0017***	−0.0003*	−0.0001***	−0.0027***
	(0.0002)	(0.0001)	(0.0003)	(0.0004)
Observations		1,679,220		
Year fixed effects		Yes		
Industry fixed effects		Yes		
Regional fixed effects		Yes		
F-test column, industry characteristics	387	54	560	810
F-test column, firm characteristics	496	205	205	561

Standard errors (in parentheses) are clustered at firm level; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

We see from the table that cooperatives employed, on average, 22 workers, compared with an average of just 12 in capitalist enterprises. The data also reveal the presence of a significant number of large cooperatives: 6 % of cooperatives employed between 50 and 99 workers, and a further 4 % employed 100 or more. The corresponding proportions for CFs can be seen to be appreciably lower. Table 3 also shows that if size were to be measured by revenue rather than employment the differential is even more marked: The average mean annual revenue in cooperatives is more than two-and-a-half times the CF figure.

Variations across the types of cooperative are also evident from the data: Measured by mean employment, worker cooperatives (23) are the largest of the three categories, closely followed by supplier cooperatives (22) and then consumer

cooperatives (16). On the other hand, it is the supplier cooperatives that, on average, generate the most revenue and worker cooperatives—by some margin—the least.

The finding that cooperatives are capable of operating on a large scale is not new. Even in the case of worker cooperatives, which one might expect to face the most severe constraints on size, Dow (2003, p. 47) reports the existence of construction firms in Italy that employed about 3000 workers and enterprises in the Mondragon group that employed 200–300 workers. Indeed, Ben-Ner (1988a) reports that, in the 1980s, the mean employment level among Mondragon worker cooperatives exceeded 200 workers.

We should note, however, that elsewhere the typical worker cooperative was considerably smaller: 27 workers, on average, in France and 40 in Italy, according to Ben-Ner (1988a). More recently, Burdín and Dean (2009) report that in Uruguay in 2005, the average worker cooperative employed 26 workers, which was almost twice the CF average.

3.4 Econometric Evidence

We now provide some descriptive evidence on attributes and industry characteristics of cooperatives and capitalist enterprises within a multivariate framework. Specifically, we estimate in Table 4 the following binary outcome model:

$$\Pr(y_{i,t} = 1 \mid x) = G\left(\beta^s x^s_{i,t}, \beta^f x^f_{i,t}, D_s, D_r, D_t\right) \tag{2}$$

where $y_{i,t}$ takes the value 1 if a firm$_i$ is a cooperative and 0 if it is a CF, $x^s_{i,t}$ is a set of industry characteristics, $x^f_{i,t}$ is a vector of firm characteristics, and D_s, D_r, D_t are sector, region, and year dummy variables respectively.[20,21] Furthermore, in order to explore if the (firm or industry) attributes differ across different types of cooperatives, we also estimate in Table 5 a multinomial model, similar to the binary model presented above, where the dependent variable now takes five mutually exclusive categories (the four previously defined cooperative types in addition to the CF category).

Table 4 reports the estimates from the bivariate model, using pooled data for the years 1995–2007. Aggregate findings are presented in column (1), with the remaining columns showing separate estimates for four main sectors and for all firm size categories. Chow tests reject the equality of coefficients across both sectors and size groups; but, in the absence of theoretical explanations for the differences, the aggregate findings remain of interest.[22]

If we look first at the industry-level variables, the most clear-cut finding is the negative and significant coefficient on entry costs both in aggregate and for all of the

[20] The sector dummy variables are defined at the CAE 1-letter level (NACE 2-digit level).

[21] Exploration of differences in the regional distributions of the two types of firm is beyond the scope of the present paper. For recent work in this area see Arando et al. (2012), Jones and Kalmi (2009), and Kalmi (2013).

[22] The total number of nonmissing observations for all variables is 12,424 and 1,666,796 for cooperatives and CFs, respectively.

individual sectors and size categories. This is consistent with the hypothesis that cooperatives offer less protection against risk than do capitalist enterprises. However, taken together with the predominantly positive coefficient on volatility—which suggests that cooperatives perform relatively well in markets that are characterized by high levels of demand variability—the situation with regard to risk would appear to be complex.

One possible explanation for these apparently contradictory findings is that entry costs might be picking up the effect of the hypothesized difference in the cost of raising finance for the two types of firm as well as in their risk-spreading properties.

The findings on market concentration and median firm size point to important differences between sectors. In the case of concentration, the estimates indicate a negative association between cooperative presence and HHI in the construction sector, a positive association in services and the absence of a significant relationship in either agriculture, forestry and fishing or manufacturing. In the case of median firm size (MFS), significant relationships, but of opposing signs, were detected in agriculture, manufacturing, and services, whilst no significant relationship was found in construction. Furthermore, the estimates in columns (6)–(8) suggest that any association between firm organization and either HHI or MFS applies only to micro and small-sized firms (employment below 50 employees).

The picture is a little clearer when we consider the individual firm attributes: The probability that a random firm is organized as a cooperative was found to be increasing in age and in education level in all specifications. The estimates also point to a negative association with the proportion of males in the labour force, except in the case of agriculture where no significant relationship was detected.

On the other hand, the findings with respect to the simple measure of labour productivity were mixed, with positive associations detected in agriculture and manufacturing and in micro firms (employment below 10 employees), and negative relationships in construction and services and in larger firms (employment above 9 employees).[23]

It is important to bear in mind that the estimates in Table 4 are derived from data that do not distinguish among consumer, worker and supplier cooperatives and, as was seen earlier, the proportion of cooperatives of each type varies across sectors. This naturally leads to the question of whether the three types exhibit different industry characteristics and internal attributes. This is explored in Table 5.

The table reveals, first of all, that low entry costs are conducive to cooperatives of whatever type and that all forms of cooperative tend to be older and have a lower proportion of males than is true of their CF counterparts.

However, the findings also point to differences between the three types.[24] In particular, the positive association between the incidence of cooperatives in aggregate and market volatility was found not to apply to worker cooperatives, whilst for consumer cooperatives the estimates point to a negative, rather than positive, association with market concentration.

[23] For further discussion and analysis of productivity in cooperatives see Dow (2003) and Maietta and Sena (2010).

[24] F-tests reject the equality of the effects across the different types of cooperative.

With regard to firm attributes, it can be seen that it is the cooperatives whose type we have been unable to identify that are significantly larger than CFs, whilst consumer cooperatives are smaller than their CF counterparts. It can also be seen that whilst consumer and supplier cooperatives exhibit higher labour productivity but lower education levels than do CFs, the opposite is true for the undefined cooperatives.

One clear message to emerge from Tables 4 and 5 is that, even in the presence of the full set of controls, the probability of a randomly selected firm being organized as a cooperative is increasing in age. This raises the question of whether the propensity for survival differs across enterprise types. It is to this issue that we now turn.

4 Firm Survival

We begin with a review of the literature on firm survival, focusing on aspects that can be addressed using our data set. Kaplan–Meier survival functions for cooperatives and CFs are presented in Sect. 4.2, which reveal that, at all age points, cooperatives are cumulatively more likely to have survived than are CFs. We also undertake a detailed investigation of the probability of survival using a complementary log–log proportional hazard model.

4.1 Literature Review

As far as we are aware, the only theoretical arguments that explicitly address the survival prospects of cooperatives relative to CFs relate to the survival of the particular organizational structure that is adopted by the enterprise rather than that of the production unit itself.

One line of argument is that by setting up a CF an entrepreneur is able to secure a larger share of the surplus than would be the case with a cooperative (see, for example, Ben-Ner 1988b). In certain circumstances, the establishment and entry of the firm will, in itself, serve to consolidate the entrepreneur's position such that the future profit stream could then be realized by the sale of the firm. At this stage, the ownership structure might change to reflect relative efficiency and thus some CFs might become transformed into cooperatives.[25]

On the other hand, a prominent theme in the literature on worker cooperatives concerns the possibility that such firms might display a tendency to "degenerate" into CFs over time. The explanation is that there may be an incentive for a successful cooperative—in which income per worker exceeds the market wage—to replace any departing members with hired workers (Ben-Ner 1984, 1988b; Miyazaki 1984).[26]

[25] See Stewart (1984) for a model in which an entrepreneur uses capital precommitment as a device for appropriating surplus and Hansmann (1996) for a discussion of owneship changes following entry. Hansmann recognizes that, in practice, there may be impediments to changes in ownership structure.

[26] See Dow (2003) for further theoretical discussion of transformations and Abramitzky (2008) for an analysis of membership levels in the specific case of Israeli kibbutzim.

The theoretical literature on firm survival more generally has focused on the implications of age and size. Jovanovic (1982) presents a model in which firms are uncertain about their own efficiency, but learn through experience in the market. A high level of output signals a high level of relative efficiency, with the implication of a positive association between firm size and the probability of survival.

The age of the firm influences survival in two ways: First, the fact that experience enables the firm to estimate its cost of production with greater precision serves, other things being equal, to raise the probability of survival. However, due to an assumed convex relationship between expected future profit and expected relative efficiency, a firm's expected future profit, for a given efficiency level, declines with the increased precision with which efficiency is estimated as the firm ages. This effect on expected future profit thereby generates a negative relationship between experience and survival, and so the overall effect of age on survival cannot be signed a priori.[27]

Theoretical ambiguity also arises with regard to size once allowance is made for possible changes in the external environment. Thus, using an entirely different theoretical framework, Ghemawat and Nalebuff (1985) demonstrate that a large firm may have a greater incentive than does a small firm to exit from a declining industry.

There is a large empirical literature on firm survival, which includes two papers—Ben-Ner (1988a) and Pérotin (2004)—with a specific focus on worker cooperatives. Ben-Ner estimated hazard rates, conditioned on age, for worker cooperatives and CFs in the UK over the period 1974–1986, and found that, at all age points, the cooperatives had a substantially lower probability of demise than did CFs.[28]

Pérotin (2004) examined the fortunes of a cohort of French enterprises over a period of up to five years from their formation in 1987. She found that, except at age 3 where the probabilities of failure were broadly similar, the hazard rates of worker cooperatives were, once again, markedly below those of CFs: after four years, nearly 75 % of the cooperatives remained in operation, compared with fewer than 60 % of capitalist firms.

Both papers also reveal a tendency for failure rates to decline over time, although for worker cooperatives, the evidence suggests there may be an initial phase of rising failure rates.

Notwithstanding the theoretical ambiguities noted above, the wider literature on firm survival strongly suggests that both age and size have a negative impact on the probability of failure [see, for example, Agarwal and Gort (2002), Disney et al. (2003), Mata and Portugal (2002), and Tsoukas (2011)].[29]

[27] See Dunne et al. (1989) and Pakes and Ericson (1998) for further discussion.

[28] CF rates were based on data from 1974 to 1982. Ben-Ner noted that the result was not sensitive to whether or not sole proprietorships were included in the set of CFs.

[29] Studies of establishment or plant survival similarly find that age and size increase the chance of survival [see, for example, Bernard and Jensen 2007 and Bandick and Görg 2010]. Disney et al. (2003) present results both for independent establishments and for those that form part of a group under common ownership.

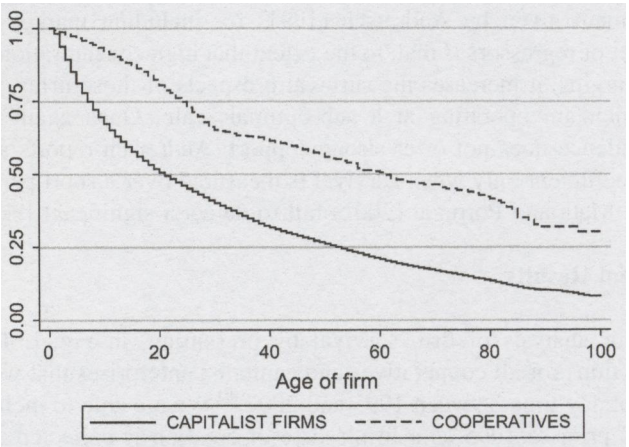

Fig. 1 Kaplan–Meier survival estimates

Two other firm attributes that are frequently included among the explanatory variables, and for which we have measures, are productivity and the skill or educational level of the workforce. These variables have similarly been found to have a negative effect on firm and plant exit (Bandick and Görg 2010; Bernard and Jensen 2007; Mata and Portugal 2002).

A number of empirical studies investigate the role that is played by industry characteristics and, in fact, each of the industry attributes that we considered above in the context of the distribution of cooperative activity has been considered as a potential determinant of the likelihood of failure. Drawing on the work of Dunne et al. (1988, 1989), Bernard and Jensen (2007) emphasize the role of sunk entry costs and find, as expected, a significant negative relationship between their proxy measure and the probability of plant closure.

By contrast, no such clear-cut evidence has emerged with regard to demand volatility, industry scale of operation, or market concentration. Agarwal and Gort (2002) argue that demand volatility should increase failure rates; but, in the absence of a direct measure of volatility, they rely on the distinction between consumer and producer industries as a simple proxy. This proxy proved to be statistically insignificant.

Audretsch and Mahmood (1995) argue that the greater the extent to which a firm is operating below minimum efficient scale, the greater will be its cost disadvantage and thus the higher the probability of failure. This hypothesis receives support from Mata and Portugal (2002) who utilized a proxy for minimum efficient scale that was suggested by Lyons (1980); but the findings of Audretsch and Mahmood, using an alternative proxy suggested by Comanor and Wilson (1967), were inconclusive, with the coefficient changing sign depending on the period of survival under consideration. Median firm size was employed by Tsoukas (2011) as a (very rough) proxy for minimum efficient scale, and was found not to have a significant effect on the probability of failure.

The argument given by Audretsch (1991) for including market concentration among the set of regressors is that, to the extent that high concentration leads to high price-cost margins, it increases the survival prospects of those firms, typically new entrants, which are operating at a sub-optimal scale. Once again however, the available evidence does not offer strong support. Audretsch reports a positive and significant coefficient only when survival is measured over a short period following entry, whilst Mata and Portugal (2002) fail to detect a significant relationship.

4.2 Empirical Results

We begin our analysis of firm survival by presenting, in Fig. 1, Kaplan–Meier survival functions for all cooperatives and capitalist enterprises that were present in the data set at any time between 1995 and 2007.[30] We are able to include firms that were created prior to 1995 as a firm's date of creation is collected as part of the census.

The lifespan of each firm was computed as the difference between the last year that the firm was observed in the data set and the year the firm was constituted as reported in the data. Our interest here is in the survival of a production unit with a specific organizational form. All firms that changed legal status were therefore excluded from the survival analysis. In practice, almost all exits were due to dissolution; conversions accounted for only 6 % of total cooperative failures and for a negligibly small proportion of CF failures.[31,32]

The survival functions show the percentage of firms of each type in the sample that had survived to, or beyond, the specified ages.

The figure reveals a clear difference in the lifespans of the two types of firms, which comes as no surprise given the earlier finding on the average age of the firms. It can be seen that, at every age point, cooperatives have a higher cumulative probability of survival. Approximately 97 % of cooperatives in the sample had survived for five years or more, 84 % had survived for 20 years or more, and 63 % had existed for 50 years or more. For capitalist enterprises the respective figures are approximately 80, 45, and 20 %.

It should be noted that the, perhaps surprisingly, long lifespans for enterprises of both types reflects the fact that the Kaplan–Meier methodology corrects for right censoring but not left censoring within the data; long-lived firms are over-represented.

[30] The Kaplan–Meier estimate is a nonparametric estimate of the survivor function. It shows the probability of failing (closing down) after period t, given by the product of conditional survival to each time at which an event occurs. It takes account of the right-censored property of the data (not all firms fail during the sample period).

[31] Our interest lies in the distinction between cooperatives and CFs and so a change in status from private to public limited liability company, or vice-versa, is not regarded as a transformation.

[32] After excluding conversions, the total number of nonmissing observations for (all variables) is 9970 for cooperatives and for CFs is 1,393,543.

Table 6 Determinants of firm exit

Variables	All sectors	By economic sector				By employment size		
	(1)	Agriculture (2)	Manufacturing (3)	Construction (4)	Services (5)	1–9 (6)	10–49 (7)	50+ (8)
Cooperative	−0.1031**	0.3204**	−0.4253***	−0.2634	−0.0792	−0.0712	−0.1730	−1.733***
	(0.0523)	(0.1570)	(0.1226)	(0.2397)	(0.0657)	(0.0612)	(0.1097)	(0.5175)
Industry characteristics								
Volatility	0.7894***	−0.1277	0.6186***	1.1717***	0.6488***	0.670***	0.9093***	0.9268***
	(0.0258)	(0.3734)	(0.0682)	(0.1035)	(0.0305)	(0.0287)	(0.0700)	(0.1394)
Entry costs	−0.7812***	−0.2099	−0.2188*	−0.5538***	−1.0260***	−0.8603***	−0.0136	0.2167
	(0.0406)	(0.3321)	(0.1241)	(0.2102)	(0.0448)	(0.0435)	(0.1378)	(0.3409)
Concentration (HHI)	−0.0766	0.5405*	−0.1810**	−0.2841	0.0964	−0.1102**	−0.2606**	−0.1791
	(0.0495)	(0.2756)	(0.0821)	(0.3602)	(0.0660)	(0.0563)	(0.1282)	(0.2217)
log of median firm size (MFS)	0.1346***	0.3074***	0.1468***	0.01	0.1923***	0.1281***	0.1547***	0.0775***
	(0.0058)	(0.0573)	(0.0133)	(0.0343)	(0.0058)	(0.0063)	(0.0149)	(0.0275)
Firm characteristics								
Log of employment	−0.6113***	−0.7116***	−0.4954***	−0.5990***	−0.6929***	−0.8599***	−0.0818***	−0.1559***
	(0.0050)	(0.0360)	(0.0097)	(0.0128)	(0.0066)	(0.0062)	(0.0234)	(0.0385)
Log of firm age	−0.1400***	−0.0547	−0.0009	−0.1896***	−0.1667***	−0.1320***	−0.2415***	−0.2348***
	(0.0045)	(0.0352)	(0.0111)	(0.0145)	(0.0054)	(0.0048)	(0.0139)	(0.0343)
Log of labour productivity	−0.1436***	−0.1245***	−0.1465***	−0.0494***	−0.1540***	−0.1457***	−0.1816***	−0.2630***
	(0.0040)	(0.0252)	(0.0110)	(0.0096)	(0.0050)	(0.0042)	(0.0125)	(0.0205)
Average schooling	0.0300***	0.0376***	0.0332***	0.0445***	0.0243***	0.0291***	0.0146***	−0.0063
	(0.0011)	(0.0084)	(0.0037)	(0.0035)	(0.0012)	(0.0011)	(0.0050)	(0.0143)
Proportion of males	−0.1295***	−0.1633**	−0.5147***	0.1418***	−0.0106	−0.0795***	−0.4140***	−0.4229***
	(0.0094)	(0.0721)	(0.0230)	(0.0416)	(0.0105)	(0.0097)	(0.0361)	(0.0948)

Table 6 continued

Variables	All sectors	By economic sector				By employment size		
		Agriculture	Manufacturing	Construction	Services	1–9	10–49	50+
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	No	No	No	No	Yes	Yes	Yes
Regional fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,403,513	31,785	266,266	178,855	919,734	1,038,214	308,662	56,637
ll	−3.1e+05	−5986	−5.5e+04	−4.3e+04	−2.0e+05	−253,308	−44,247	−6875

Standard errors (in parentheses) are clustered at firm level; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Table 7 Exit hazards with imputed cooperative type

	(1)	(2)	(3)
Imputed cooperative type			
Consumer	−0.2287**	−0.2152**	0.1860*
	(0.0909)	(0.0916)	(0.1092)
Worker	−0.1301	−0.1178	0.1928
	(0.1696)	(0.1718)	(0.1972)
Supplier	−0.4149***	−0.3427***	−0.1708*
	(0.0717)	(0.0715)	(0.0889)
Undefined	−0.5877***	−0.5751***	−0.2443***
	(0.0689)	(0.0692)	(0.0867)
Industry characteristics			
Volatility		0.6927***	0.7881***
		(0.0200)	(0.0258)
Entry costs		−0.8682***	−0.7798***
		(0.0330)	(0.0406)
Concentration		−0.0280	−0.0736
		(0.0388)	(0.0496)
Log of median firm size		−0.1123***	0.1344***
		(0.0042)	(0.0058)
Firm characteristics			
Log of employment			−0.6113***
			(0.0050)
Log of firm age			−0.1402***
			(0.0045)
Log of labour productivity			−0.1436***
			(0.0040)
Average schooling			0.0297***
			(0.0011)
Proportion of males			−0.1293***
			(0.0094)
Year fixed effects	Yes	Yes	Yes
Industry fixed effects	No	Yes	Yes
Regional fixed effects	No	Yes	Yes
Observations	1,935,646	1,935,646	1,403,513
ll	−4.8e+05	−4.8e+05	−3.1e+05

Standard errors (in parentheses) are clustered at firm level; * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

To determine the factors underlying these differences, we estimated the following complementary log–log hazard model:[33]

[33] The cloglog model has been used by Bandick and Görg (2010) and Tsoukas (2011) and, as a discrete time version of the Cox proportional hazards model, is appropriate for the analysis of annual data. The

$$h_{i,t} = h_0(t)\exp(\beta' Z(t)) \tag{3}$$

where $h_{i,t}$ is the probability that firm i exits between dates t and $t+1$, t is the time since entry, $h_0(t)$ is the baseline hazard, and Z is a vector of explanatory variables.

The model was estimated using the full sample as above, and the results are reported in Table 6. Note that the dependent variable takes a value of 1 if the firm exits and 0 otherwise.

In column (1) we report the estimated effect of cooperative ownership (of any kind) on the probability of failure, controlling for the full set of industry and firm attributes, and also year, sector and region.[34] As we would expect from the survival probabilities depicted in Fig. 1, the coefficient on Cooperative is negative and significant at the 5 % level, and indicates a qualitatively important difference between the two types of firm: At each survival time, the hazard rate for cooperatives is about 90 % of that of capitalist enterprises.[35] As we will see below, the presence of the industry and firm-level controls serves to attenuate the difference in hazard rates of the two enterprise types.

The findings on the industry and firm variables are generally in line with a priori expectations and previous research. Thus the probability of exit was found to be positively associated with Volatility and MFS and, consistent with Bernard and Jensen (2007), negatively related to entry costs. For instance, moving from the 25th percentile of the distribution of entry costs (0.7839) to the 50th percentile (0.8282) would increase a firm's survival chances by 4.3 percentage points.[36]

In terms of the firm-level variables, the estimates suggest that larger and older firms have a significantly lower probability of failure. We also found a negative association between probability of failure and the proportion of males in the labour force and—surprisingly—a positive relationship with the educational level of the workforce.

Columns (2)–(5) present estimates for each of the main industry sectors and columns (6)–(8) for each firm size category. These estimates point to a more complex picture since only in the case of manufacturing is the coefficient on Cooperative negative and significant. Indeed in agriculture, forestry and fishing the estimates suggest that cooperatives have a higher probability of exit than do CFs (for given industry and firm characteristics). Furthermore, only in the case of firms with 50 or more employees was a significant effect identified.

To throw further light on the determinants of cooperative survival, we estimated exit hazards with dummy variables to capture the possible effect of the different types of cooperative structure. These estimates are reported in Table 7.

Footnote 33 continued
underlying assumption of proportional hazard models is that the hazard depends only on the time at risk—the baseline hazard—and on explanatory variables affecting the hazard independently of time.

[34] Bernard and Jensen (2007) similarly include regional fixed effects in their examination of manufacturing plant closures.

[35] Since $exp(-0.1031) = 0.902$.

[36] This is calculated as follows: ln(0.8282)−ln(0.7839) = 0.0550 and 0.0550 (−0.7812) = −0.043. Note that the values of percentiles here are not consistent with the figures in Table 2 due to differences in the samples.

The findings for a basic specification without industry, region, or firm controls are presented in column (1). These suggest, first, that whilst consumer, producer, and undefined cooperatives have a lower probability of exit than do capitalist enterprises, there is no significant difference in the case of worker cooperatives. Second, among the imputed cooperative types it is undefined firms that have the lowest probability of exit (a hazard that is 56 % of that of CFs) followed by supplier cooperatives (66 %), consumer cooperatives (80 %), and then worker cooperatives.

The addition of industry and region controls in column (2) causes a slight lowering of the coefficients on cooperative type, but it is the incorporation of the firm attributes in column (3) that has the most marked effect, causing the coefficient on the consumer cooperative dummy variable to change sign and those on supplier and undefined cooperatives to fall substantially in magnitude. In the case of supplier cooperatives, the introduction of controls has the effect of increasing the relative hazard from 66 to 84 % of that of capitalist enterprises.

The suggestion that the probability of failure of worker cooperatives is not significantly different from that of capitalist enterprises is somewhat surprising, given the earlier findings of Ben-Ner (1988a) and Pérotin (2004). However, our estimates for worker cooperatives should be viewed with particular caution since not only is ownership type imputed, but also the number of resulting worker cooperatives is small.

Taken together these results tentatively suggest first: that cooperatives typically exhibit higher survival rates than those of capitalist enterprises; second, that there are differences across the types of cooperatives; and third, that the longer survival relative to capitalist enterprises can to some extent be explained by differences in industry of operation and internal characteristics.

5 Conclusions

In this paper we have drawn on a comprehensive data set from Portugal—the Quadros de Pessoal—to provide a detailed comparison of cooperative and capitalist modes of production. More specifically, we investigated the patterns of activity that are undertaken by cooperatives and CFs, their scale of activity and internal characteristics, and their ability to survive in the market.

One limitation of the QP survey is that it does not identify whether the cooperatives are owned by consumers, workers, or other input suppliers. Drawing on a separate data set, we imputed ownership types to a subset of the cooperatives in order to generate some tentative indications of variations in characteristics and survival prospects across the three types of cooperative.

The main findings of the paper are: First, there are significant differences in the industrial distribution of cooperatives and capitalist enterprises. Cooperatives are attracted to industries that are characterized by low entry costs and—except in the case of the agriculture, forestry and fishing sector—by high volatility. The evidence for the argument that cooperatives are attracted to markets with high levels of market power is somewhat mixed: The estimates are sensitive to both the sector of operation and the type of cooperative.

These industry-level findings complement the work of Jones and Kalmi (2009), who focused on the geographic distribution of cooperatives and found, at a country level, a positive relationship between the level of interpersonal trust and the presence of cooperatives.

Second, there are marked differences in the internal characteristics of cooperatives and capitalist enterprises, with the former typically being older and having a larger, more highly educated workforce.

Thirdly, we found that cooperatives exhibit a lower probability of failure than do CFs and that this could, in part, be explained by differences in industry of operation and internal characteristics.

Supplementary analysis that uses the imputed data on ownership types tentatively suggests that it is the lower exit probabilities of supplier and consumer cooperatives that account for the superior survival rates of cooperatives; worker cooperatives were found to have exit probabilities that did not differ significantly from those of capitalist enterprises.

It is important to emphasize that this latter finding for worker cooperatives is based on a small sample and that this caveat should be considered alongside the general note of caution that pertains to the results based on the imputed data.

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