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Survival Advantage of Worker Buyouts over Newly Created Worker-Owned Firms

Thibault Mirabel

BEST PHD PAPER AWARD

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Contents

SURVIVAL ADVANTAGE OF WORKER BUYOUTS OVER NEWLY CREATED WORKER-OWNED FIRMS

Abstract

Purpose – Various theories predict that firm buyouts survive longer than newly created firms. This study seeks to know whether it is the case for worker-owned firms, i.e., firms owned and controlled mostly by their workers.

Design/methodology/approach – I conduct a comparative survival analysis of French worker-owned firms distinguished by their entry mode (i.e., newly created, worker buyouts of sound conventional firms, worker buyouts of conventional firms in difficulty, or worker buyouts of nonprofit organizations).

Findings –The hazard of exit is 32% lower for worker buyouts of sound conventional firms than newly created worker-owned firms, 18% for worker buyouts of conventional firms in difficulty, and 64% for worker buyouts of nonprofit organizations. This study confirms that worker buyouts, even of conventional firms in difficulty, have on average a survival advantage over newly created worker-owned firms. Surprisingly, I also show that this survival advantage is similar across sectors with different knowledge intensity but is lower in high capital-intensive sectors than in low capital-intensive ones.

Originality/value – This study offers the first survival analysis distinguishing four modes of entry among worker-owned firms.

Research limitations/implications – Endogeneity issues limit the scope of the results and should be tackled in future research. Overall, these findings show that worker-owned firms are composed of groups with

different survival likelihoods that are obscured if one only looks at the aggregate population.

Practical implications – With caution, support agencies could foster worker buyouts of firms in difficulty and of nonprofit organizations as viable forms of entrepreneurship.

Paper type – Research paper

JEL codes – J54, P13, D22, C41

1. Introduction

In France, the share of firm owners aged 50 or older has steadily increased during the last decades (from 42% in 1982 to 46% in 2012). In 2019, almost half of the firms employing at least 10 employees are owned by baby boomers aged 50 or older (Charond *et al.*, 2021). These firms will either change owners or disappear in the near future. This so-called "silver tsunami" that is common across western developed countries offers a window of opportunity for employee ownership that will not be seen again for many decades. Moreover, the current economic crisis due to the Covid-19 pandemic has dramatically increased the number of "zombie firms," i.e., firms that should have exited during the year but are kept alive by safeguard measures implemented by states. In France, the number of firm failures was 29% lower in 2020 than in 2019 for small businesses (Cros *et al.*, 2020). When those state protections cease, the number of firms to be bought out must increase.

The worker-owned firm movement could benefit from this twofold increase in demand of firm buyouts. Worker-owned firms are small business enterprises (e.g., the biggest French worker-owned firm counts 963 worker-members in 2019) representing a minute proportion of firms in any country (e.g., 1 for 10,000 in France). In the case of buyouts, worker-owned firms have the advantage over conventional firms of ensuring to the entrepreneur-seller of the firm that the firm's legacy and activity will continue and to the worker-members that their job will be secured. Even if various theories have put into question the viability of worker-owned firms, empirical evidence accumulated in the last decades shows that worker-owned firms are viable entrepreneurial forms that present high survival rates. A better understanding of the survival of worker-owned firms, distinguishing those that are newly created and those that are converted, would bring valuable insights on the role that worker-owned firms could play in the next years and decades.

Various theories predict that firm buyouts survive longer than newly created firms. This study seeks to know whether it is the case for worker-owned firms, i.e., firms owned and controlled mostly by their workers (Dow, 2018). Worker-owned firms are often referred to as labor-managed firms, worker cooperatives, producer cooperatives, or self-managed firms. Worker-owned firms are an alternative structure of ownership to conventional or investor-owned firms where control and return rights are distributed mostly to investors (Ellerman, 2007; Hansmann, 1996). French legislation defines the operations and status of worker-owned firms in accordance with the principles of the International Cooperative Alliance which defines cooperative identity. Hence, in French worker-owned firms (called SCOPs), worker-members own at least 65% of votes at the shareholders' meeting (i.e., control rights). The votes at the shareholders' meeting are not proportional to the number of shares owned but follow the principle of "one person equals one vote." Therefore, each shareholder has one vote whatever their capital invested in the firm. Worker-members also own at least 51% of the equity (i.e., profit rights). The value of each shareholder's capital is fixed at its acquisition value. No capital gain is possible when the shares are redeemed in the event of the departure of the employee shareholder. In the event of net profits on liquidation (fund surplus, liquidation bonus), French law prohibits the distribution of these profits to worker-members. The surplus must be transferred to cooperative organizations or support agencies. These features of French worker-owned firms are common among

countries with legislation devoted to worker-owned firms based on the principles of the International Cooperative Alliance, which ensures a certain degree of generality of the results of this article.

There are multiple ways to create a worker-owned firm. I refer to "newly created firms" as worker-owned firms (WOFs) created from scratch, and to "worker buyouts" (WBOs) as worker-owned firms created from an existing firm. Worker buyouts form a heterogeneous category. Following the operational categorization of worker-owned firms' support agencies and previous studies (e.g., Pérotin, 2004; Olsen, 2013), I distinguish three types of WBOs by their mode of entry: WBOs of sound conventional firms, WBOs of ailing conventional firms, and WBOs of nonprofit organizations (mostly volunteer organizations and other types of cooperatives such as consumer cooperatives). Following CGSCOP (2015), I define an ailing firm as a firm that faces important economic difficulties and that is subject or not to legal proceedings (i.e., conciliation, safeguard, rehabilitation, or liquidation proceedings). I do not consider family-owned firms as a mode of entry since, to the best of my knowledge, no worker-owned firms are family-owned in France.

This article offers a comparative survival analysis of French worker-owned firms distinguished by their entry mode. I use the records of the CGSCOP (the national support agency of French WOFs) which contains yearly information on the total population of worker-owned firms over the period of 1989 to 2018. My empirical strategy is based on a semiparametric complementary log-log survival model.

This study confirms that worker buyouts, even of conventional firms in difficulty, have on average a survival advantage over newly created worker-owned firms. After controlling for firm's entry size and industrial, regional, and yearly fixed effects, the hazard of exit is 32% lower for WBOs of sound conventional firms than newly created WOFs, 18% for WBOs of conventional firms in difficulty, and 64% for WBOs of nonprofit organizations. Surprisingly, I also show that this survival advantage is similar across sectors with different knowledge intensity but is lower in high capital-intensive sectors than in low capital-intensive ones.

While some evidence exists on the effect of entrepreneurial characteristics of firm takeovers and newly created firms' survival patterns (Xi et al., 2020; Manjón-Antolín and Arauzo-Carod, 2008), this article is, to the best of my knowledge, the first survival analysis distinguishing four modes of entry among worker-owned firms. Previous studies comparing worker-owned firms of different entry modes have provided hazard rates without regressing them on any covariates (Pérotin, 2004; Pérotin, 1987). Previous studies on worker-owned firms' survival have also relied on aggregate descriptive comparisons (Olsen, 2013; Ben- Ner, 1988b) or have not distinguished between their different modes of entry (Batstone, 1983; Staber, 1989; Estrin and Jones, 1992; Arando et al., 2009; Burdín, 2014). Contrary to previous studies, this article relies on appropriate microdata for four modes of entry and applies semiparametric survival analysis techniques.

The findings of this paper are important for policy makers and support agencies of worker-owned firms. Fostering worker buyouts, even of conventional firms in difficulty,

might be a sustainable way to develop the worker-owned firm movement. This paper also helps to inform nonprofit organizations that becoming a worker-owned firm is a viable entrepreneurial form.

The rest of this article is organized as follows. Section 2 reviews the theoretical and empirical literature on the factors of firm survival. Section 3 describes the data. Section 4 discusses the methodology. The main results are discussed in section 5. Robustness checks are displayed throughout the presentation of results. Section 6 concludes.

2. Firm Survival Factors: Theoretical Framework and Previous Evidence

I review the rationale and previous evidence of the negative effect of firms' characteristics at entry or buyout (i.e., size and age) over their hazard rates and their life cycles. I also stress the expected differences in firm survival between entry modes due to sectoral characteristics.[1]

2.1. Firm Life Cycle

Previous evidence shows that worker-owned firms suffer from a "liability of adolescence" (Olsen, 2013) rather than a "liability of newness" (Stinchcombe, 1965). In this case, the risk of exit does not monotonically decrease with the firm's age. Rather, worker-owned firms face one or two years of low-risk honeymoon after birth before their risk of exit peaks at 3-5 years and then declines steadily over time. This honeymoon period might be due to a greater commitment and solidarity among the workers following the firm's entry. Burdín (2014) finds that the risk of exit of Uruguayan worker-owned firms peaks in year 2. Pérotin (2004) finds that it peaks in year 3 in France. Staber (1989) finds that it peaks in year 5 in Canada. Pérotin (2004) and Staber (1989) also find that the risk of failure of worker-owned firms increases again around year 15, suggesting that they face a "mid-life crisis." This crisis might be due to the departure of the firm's founders or an increase in the heterogeneity of workers (Batstone, 1983).

The non-monotonic age dependency of failure risk is common to newly created WOFs and WBOs, but there still might be differences in the level of hazard rates they face. Pérotin (2004) provides evidence that hazard rates of newly created WOFs are 2 times higher than those of WBOs of sound firms and 1.5 times higher than those of WBOs of ailing firms. Nevertheless, many theoretical arguments defend that the age dependency of firm survival reduces and even vanishes over firm life cycle. For instance, financial constraints are more pronounced for young firms than for mature firms with an established track record (Honjo, 2000). Young firms are more vulnerable to selection pressures than existing firms due to a "lack of formal goals, clear boundaries, and unambiguous technologies" (Amburgey and Rao, 1996). In line with the organizational ecology approach, Pérotin (2004) and Staber (1989) stress that WBOs might have organizational inertia that hinders adaptation when the environment changes, which newly created WOFs do not share. Thus, WBOs would exit earlier than newly created WOFs, counterbalancing their survival advantage.

Whatever their mode of entry, the hazard rates of worker-owned firms are expected to have an inverted U-shaped form. Newly created WOFs are expected to suffer more from liability of adolescence than WBOs, entailing a survival advantage of the latter. However, this advantage is expected to reduce over the firm life cycle. Hence, my first hypothesis:

1 Because I investigate the effect of the economic environment on the survival of worker- owned firms, personal characteristics of the entrepreneur(s) are not considered in this study, though several studies show that they may be rather decisive for a firm's post- entry development (Xi et al., 2020, Vivarelli, 2004). In addition to these characteristics at stake in different entry modes of conventional firms, there might be specific entrepreneur characteristics or workers' motives that differ between entry modes of worker-owned firms such as democratic skills or psychological commitment (Pérotin, 2004).

- **H1:** The survival advantage of worker buyouts over newly created worker-owned firms is expected to reduce over firm life cycle.

2.2 Firm Characteristics at Entry

Greater access to resources at firm's entry entails a survival advantage. Industrial organization literature shows that firm's entry size monotonically increases firm survival and post-entry performance (Agarwal and Audretsch, 2001; Mata and Portugal, 1994). Larger firms should be able to survive longer because, if they find themselves to be less efficient than they had expected, they may get smaller before they exit. Besides, in the case of large size at entry, more periods with bad results will be needed to eliminate the *a priori* positive profit expectation because entry size signals the priors of entrepreneurs (larger size at entry indicating greater **a priori** expectations of success). Small firms employ less capital-intensive methods (Acs and Audretsch, 1990) and, therefore, variable costs represent a greater proportion of total costs. If output prices go down, these differences in the composition of cost implies that smaller firms would exit first. WBOs are typically larger than newly created WOFs at entry. The survival advantage resulting from size might be balanced by higher organizational and informational costs. Conversion of existing firms (whether conventional or nonprofit) into worker-owned firms requires organizational changes and modifications of workers' psychological commitment to the firm that are more easily satisfied in small worker teams. Nevertheless, the effect of entry size on the survival of worker-owned firms is expected to be positive whatever their mode of entry. Hence, my second hypothesis.

- **H2:** Firm entry size is expected to increase worker-owned firms' survival regardless of their entry mode.

By definition, firm buyouts are older and more experienced than newly created firms, thus ensuring more resources to the former that is likely to result in a survival advantage. However, it is not obvious that the pre-conversion lifespan of WBOs significantly impacts their hazards of exit. Different types of buyouts must be distinguished here. According to numerous case studies, WBOs of ailing firms represent a radical and substantial change – a crisis that shrinks the number of workers, modifies the investment strategy, renews the networks of buyers, changes the process of production, and incites workers and managers to participate in democratic governance (Bassi and Fabbri, 2019; Monni et al. 2017; Azzelini, 2016; Garcia and Beltramini, 2014; Grégoire and Delalieux, 2015). Conventional firms are in difficulty precisely because their capabilities accumulated over their lifespan are inefficient, and thus, do not imply a competitive advantage once the conventional firms are bought out by their workers. In fact, almost all WBOs of ailing firms in my sample are born with a different identification number than the firm they rescued, while such a change of identification number is not legally mandatory. For WBOs of nonprofit organizations, the change is expected to be less radical than for WBOs of ailing firms, but still entails a substantial change of the firm's goals and technology (Billaudeau and Moysan, 2019). Conversion of nonprofit organizations into worker-owned firms implies entering into competitive markets and employing mostly wage workers instead of mostly volunteers (Salamon and Sokolowski, 2018). The pre-conversion age effect might significantly increase the survival of only WBOs of sound firms because their conversion entails continuing with the same workforce and investment strategy. In this

case, converting into worker-owned firms is more a formal than a substantive change (Barbot-Grizzo, 2019; Murphy, 2017). Workers and managers are accompanied by the regional support agencies for several years to ensure the smoothest conversion possible (Charmettant and Renou, 2021). Therefore, the pre-conversion lifespan is expected to increase converted worker-owned firms' survival, especially of WBOs of sound conventional firms. Hence, my third hypothesis:

- **H3:** Pre-conversion lifespan is expected to increase worker buyouts' survival.

2.3 Sectoral Characteristics

Debt and equity are the two means through which conventional firms can raise capital beyond auto-investment. But the equity leverage in worker-owned firms is very limited since they do not allow investors to have an important voice in decision-making.[2] Therefore worker-owned firms rely mainly on debt to raise capital. In addition, worker-owned firms might suffer from the so-called "horizon problem" (Pejovich and Furubotn, 1972). Because of the lack of recoupable claims on the firm's shares, workers in worker-owned firms can only recover their investment while they are present in the firm, thus leading to an adverse selection of short-term investments over long-term investments. Worker-owned firms would then underinvest in the long term. The increase in capital requirements should hamper the survival of worker-owned firms (Mikami and Tanaka, 2010). Evidence shows that capital intensity has a negative effect on the entries of worker-owned firms (Podivinsky and Stewart, 2012; Ben-Ner, 1988b). This effect is expected to be stronger for newly created WOFs than WBOs, leading us to predict that, everything else being equal, newly created WOFs will concentrate in low capital-intensive sectors while WBOs will be evenly spread in low and high capital-intensive sectors (Ben-Ner, 1988a). WBOs are expected to enjoy better access to financial resources than newly created WOFs because they offer an existing track record of credit history and can use their immobilizations as collateral (Olsen, 2013). Also, sunk costs might have already been made in WBOs. However, the conversion into worker-owned firm implies that the workers buy the shares of the existing firm and provide capital from their own earnings to make necessary investment, which might lower the incentive for creation, especially for WBOs of firms in difficulty where the necessary investments might be higher than in other forms of WBOs. Despite this caveat, the negative effect of capital intensity on the survival rate of worker-owned firms is expected to be higher for newly created WOFs than WBOs. Hence, my fourth hypothesis:

- **H4:** The survival advantage of worker buyouts is expected to be higher in high capital-intensive sectors than in low capital-intensive sectors.

The pre-conversion lifespan of WBOs provides them with resources, especially human capital, lacking in newly created WOFs. Workers in WBOs have acquired experience in

2 In France, for instance, external investors that are not worker-owned firms cannot legally own more than 35% of votes at the annual shareholder meeting. In virtue of the principle "one person equals one vote," external investors have one vote regardless of the number of shares they own in the firm. Exceptions can be decided by each worker- owned firm to distribute a number of votes proportional to the shares owned by external investors. But even in that case, the external investors can only have a minor share of profit since the dividends due to members, whether workers or not, cannot exceed 33% of the total profit of the firm. The remuneration of the dividend is fixed to the average remuneration of bonds of the last three years.

their market such as the volatility of demand, or they might have developed specific knowledge tied to the firm's technology. On the contrary, newly created WOFs must face informational costs on market structure and demand. This informational asymmetry between WBOs and newly created WOFs is likely to provide a survival advantage to the former, which is also likely to get stronger in high knowledge-intensive sectors. These sectors are indeed characterized by high skill-activities requiring a high investment in labor or human capital. However, the effect of pre-conversion lifespan might not be significant for WBOs of ailing or nonprofit firms as already discussed in section 2.2. Moreover, the workers creating a worker-owned firm from scratch in a given sector might have past experience in this sector, thus counterweighting the survival advantage of WBOs. Despite these caveats, my fifth hypothesis is as follows:

- **H5:** The survival advantage of worker buyouts is expected to be higher in high knowledge-intensive sectors than in low knowledge-intensive sectorss.

3. Data and Descriptive Statistics

The dataset covers the entire population of French worker-owned firms from 1989 to 2018 (4,416 firms). The lifespan of worker-owned firms is measured in years. The available firm-level information includes the worker-owned firms' year of entry, year of exit, industry class (European NACE classification), region of creation (NUTS-2), number of worker-members at entry (i.e., workers that are associates to the worker-owned firm in which they work), and mode of entry (i.e., newly created WOFs, WBOs of sound conventional firms, WBOs of ailing conventional firms, WBOs of nonprofit organizations). The analysis is based on all cohorts of worker-owned firms beginning with 1989. I did not consider firms that were already active at the beginning of the observation period, as their spells are left censored, that is, there is no information on their birth dates.

The dataset is based on the monitoring records of the national confederation of worker-owned firms (CGSCOP). The CGSCOP is a nonprofit organization charged by the French Government to provide the official list of existing worker-owned firms every year. Only the firms registered on this list must conform to obligations listed in special laws and can benefit from fiscal advantages attached to them. Therefore, the entry date, mode of entry, and exit date of each worker-owned firm is monitored by the CGSCOP. Exit comprises failure, degeneration, and closure of sound worker-owned firms, but information on the reason for exit is not available. This is a potential limitation as cases of successful firms being bought out by another firm are counted as exits. It is also not possible to identify mergers and acquisitions. However, a negligible fraction of worker-owned firm exits can be explained by degeneration or mergers. For instance, Magne (2016: 49) counts only 29 French worker-owned firms degenerating into conventional firms over a four-year period. French law also limits the possibilities for the conversions of worker-owned firms into conventional firms without closing the worker-owned firm and opening a new conventional firm.

The categorization of the worker-owned firm entries into four modes of entry has been used by the CGSCOP since the beginning of its monitoring of French worker-owned firms and is made for operational purposes. CGSCOP's regional agencies provide support to worker-owned firms adapted to their mode of entry. They are particularly important in supporting the workers in the creation or buyouts processes. For instance, the WBOs of sound conventional firms usually take a few years during which workers are informed of the legal and organizational specificities of worker-owned firms. The founder-entrepreneur often becomes an external member in the WBO to ensure that the transition goes well and that the firm's activities continue.

To assess my hypothesis on the effects of the firm characteristics at entry, I measure the firm entry size by the logarithm of the number of worker-members at the creation or conversion of the firm. This is a proxy of the total number of workers since the worker-members represent on average 61% of total workers in French worker-owned firms, and this percentage increases over the firm's lifespan (Magne, 2016). To calculate the pre-conversion lifespan, I use the 'first' date of creation of WBOs recorded in the FICUS-FARE database. The FICUS-FARE database is an administrative file containing annual firm-level accounting data of all French firms. Data are collected through annual profit declarations made by the firms to the tax authorities, from annual social data providing information on employees, and from a sample of enterprises surveyed using a specific questionnaire.

The FICUS file is available for the period of 1994 to 2007. Since 2008, the FARE file has replaced the FICUS file. The FARE database is available for the period of 2008 to 2018. The access to the FICUS-FARE database is granted by the Committee on Statistical Confidentiality. I use the reports of the French National Office of the Statistics on the State of Sectors (INSEE, 2017) to distinguish between low and high capital-intensive sectors. For distinguishing between low and high knowledge-intensive sectors, I use the classification established by Eurostat on the Knowledge-Intensive Activities (see table A.4 in the Annex for more details).

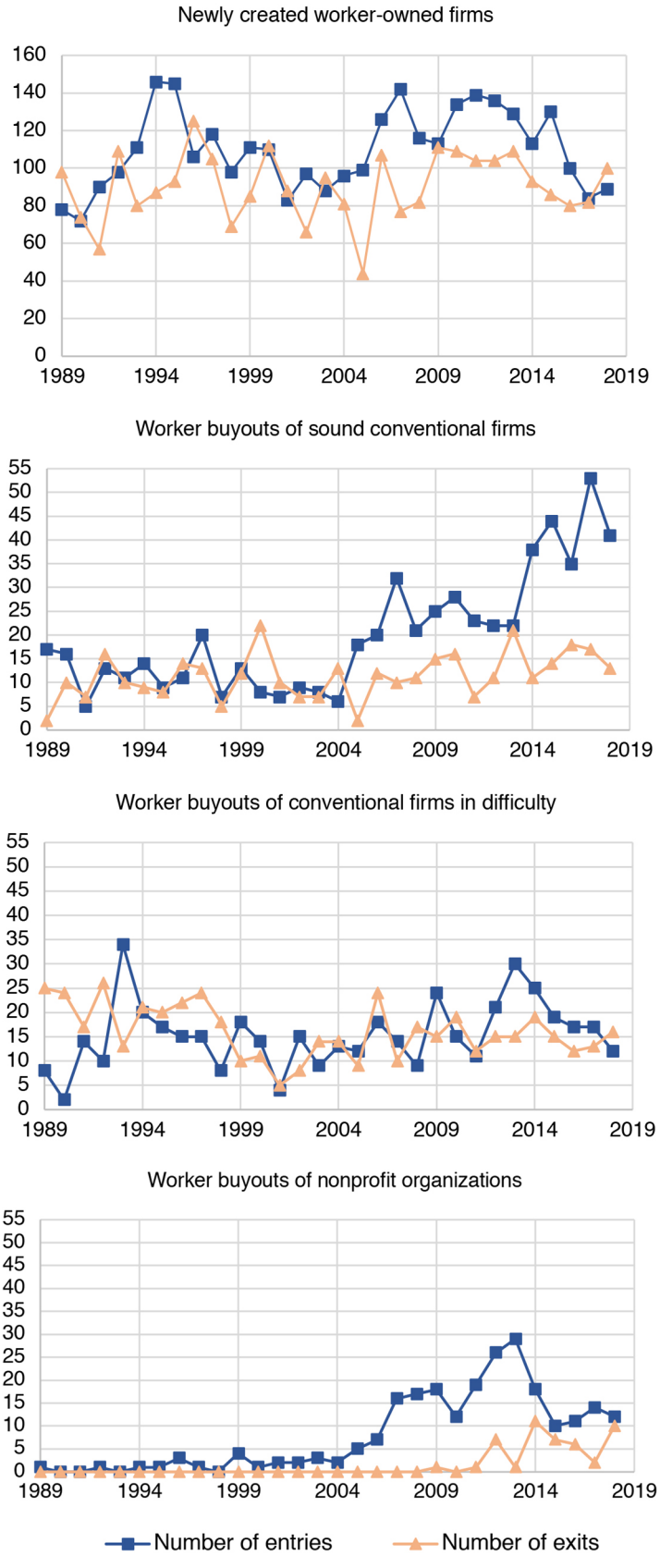
The basic information on the firm-level panel for the final sample is reported in table A.1 in the Annex. There are 4,416 different firms, including 1,292 WBOs (29% of total worker-owned firms). As the average number of yearly records per firm is 7.07, the total number of firm-year observations in the data is 31,211, including 9,239 observations of WBOs. The average failure rate is lower for WBOs (41%) than for newly created WOFs (63%). There are no firms with time gaps and all firms exit only once.

In 2018, the population of worker-owned firms was comprised of 58% newly created WOFs, 27% WBOs of sound firms, 8% WBOs of firms in difficulty, and 8% WBOs of nonprofit organizations. This ratio of 60/40 between newly created WOFs and WBOs is not specific to France. Similar ratios are found in Spain, Italy, and the USA. In all countries where data is available, newly created WOFs always represent a large majority share of worker-owned firm population (Olsen, 2013).

Figure 1 plots the number of entries and exits of newly created WOFs and different types of WBOs for the period of 1989 to 2018. Figure 1 shows that worker-owned firms' entries have temporal patterns specific to their mode of entry. Newly created WOFs reveal a cyclic pattern with no trend, while WBOs present no clear cyclical patterns. The Pearson correlation coefficients between entry and exit series are 31% for newly created WOFs, 34% for WBOs of sound firms, -8% for WBOs of ailing firms, and 48% for WBOs of nonprofit organizations. These numbers suggest that factors impacting the survival of WBOs of ailing firms might significantly differ from the factors impacting the other entry modes of worker-owned firms.

WBO entries of sound conventional firms or nonprofit organizations present a slight positive trend over the period of 1989 to 2018. The distribution between the four entry modes has known a cyclical evolution in France. Ben-Ner (1988b) reports that WBOs stood for 40% of worker-owned firms in the late 1970s. Pérotin (1987) also reports that in 1984, WBOs of ailing firms stood for 39% of worker-owned firm entries, and WBOs of sound firms for 9%. This proportion of WBOs is mainly due to a wave of creations following the political left-wing protest of May 1968 and highly mediatized cases of workers striking and then taking over the production against the will of the managers and investors such as the firm LIP (Gourgues, 2020; Demoustier, 1984: 32-34). The proportion of WBOs slightly decreased during the 1980s and 1990s to reach 20% of all WOFs, before slightly increasing in the 2000s to finally get back to 40% of worker-owned firms today. The recent increase is due to a steady slight increase of WBOs of sound conventional firms and nonprofit organizations rather than the wave that explains the proportion of 40% in the late 1970s, and is also due to the decrease in the number of newly created WOFs in the 2010s. The trend of worker-owned firm exits is null with about 75% of exits concerning only newly created WOFs within the period.

Figure 1: Time Series of Worker-Owned Firms' Entries and Exits by Mode of Entry



4. Methodology

The OLS approach is not suited for survival analysis because 1) OLS estimators provide the probability that the firm exits in year t unconditionally on having survived until year t, 2) OLS estimators ignore the right-censoring of observations (i.e., some firms are still in operation at the end of my sample period) resulting in biased estimates, 3) the resulting predicted probabilities of firm exits are not always meaningful as they may lie outside the [0,1] interval and the corresponding estimated variances can be negative.

The continuous-time proportional hazards model of Cox (1972) is popular in firm survival studies and used by Burdín (2014) on worker-owned firms. However, the Cox model is not suited for my survival analysis. First, it requires survival time to be a continuous variable and firms to be ordered exactly regarding their exit time. In my dataset, these requirements are not verified, as firm survival times are grouped into discrete one-year intervals, resulting in ''ties.'' In the presence of tied survival times, the coefficients and standard errors of the Cox model are biased (Cox and Oakes, 1984), even when corrected by the Breslow's or Efron's method. Second, the Cox model does not allow controlling for unobserved firm heterogeneity due to computational difficulties. A failure to account for that heterogeneity leads to biases in the estimated effects of firm characteristics on the hazard of exit and to a frailty effect, i.e., a spurious negative duration dependence of the estimated Cox hazard function (Heckman and Singer, 1984).

Due to the incomplete and discrete nature of the duration data, discrete-time hazard models are the more appropriate and preferred choice for my comparative analysis of firm survival (Lancaster, 1990).

Let a firm-survival spell j be complete $(cj = 1)$ or right-censored/incomplete $(cj = 0)$ and the number of years a firm survives (i.e., the time to a failure event) T be used in the definition of the discrete time survival function which is the probability of firm survival at least t years:

$$S_j(t) = \Pr(T_j > t) = \prod_{k=1}^{t}(1 - h_{jk}) \quad (1)$$

where $T_j = \min\{T_j^*, C_j^*\}$, T_j^* is a latent failure time, C_j^* is a latent censoring time for the firm survival spell j, and h is the discrete time hazard rate of ending the survival spell, that is, exiting, in t years, conditional on survival for $t - 1$ years which is defined as:

$$h_j(t) = \Pr(t - 1 < T_j \leq t) / \Pr(T_j > t - 1) \quad (2)$$

When a binary dependent variable y_{jk} is defined to take a value of 1 if firm-survival spell j ends in year t and 0 otherwise, its log-likelihood function is given by:

$$logL = \sum_{j=1}^{J}\sum_{k=1}^{t}[y_{jk} log h_{jk} + (1 - y_{jk}) \log(1 - h_{jk})] \quad (3)$$

where the contribution to the log-likelihood of a right-censored firm survival spell j is the discrete-time survival function, equation (1), and of a completed firm survival spell j

in interval t is the discrete time density function (the probability of ending the spell in t years).

Equation (3) implies that discrete time hazard models for grouped duration times can be estimated using standard regression models for binary choice panel data (Jenkins, 1995). To be fully estimable, the log-likelihood function requires the specification of a functional form for the discrete time hazard rate that links exit probabilities to explanatory variables. Following Fernandez and Paunov (2015), I consider three functional forms: the complementary log-log (cloglog) as my preferred functional form, and the probit and logit forms as robustness checks. For the probit and logit models, the discrete time hazard rate is distributed, respectively, as an inverse cumulative gaussian (normal) and a logistic function (the log of the odds ratio). A stacked binary choice model using a cloglog link function with time-specific intercepts is the exact discrete-time analogue of the continuous-time Cox proportional hazards model while the probit and logit models do not impose this proportionality assumption (Hess and Persson, 2011). Thus, the cloglog model assumes that the impact of a regressor on survival is the same regardless of firm age and proportional shift of the baseline hazard function common to all survival spells. In addition to the year fixed effects (i.e., firm lifespan), the baseline hazard is estimated with sector and region fixed effects that allow for unrestricted changes in the hazard rates by sectors and regions. The models are estimated by maximum likelihood.

According to Prentice and Gloeckler (1978), if we consider that the discrete hazard follows a cloglog distribution, the discrete representation of a continuous time proportional hazard can be written as:

$$h_t(X_{jt}) = 1 - \exp\left[-\exp(\alpha_t + \beta' X_{jt} + \varepsilon_j)\right] \quad (4)$$

where α_t is the baseline hazard, X_{jt} is a vector summarizing the characteristics of a firm survival spell, and $\varepsilon_j = log\ (v)$ is the unobserved individual heterogeneity (frailty term) which is a random variable with a mean of zero. The vector of firm characteristics X_{jt} in equation (4) includes firm's mode of entry, size at entry, dummies for years (i.e., firm lifespan), sectors (i.e., 18 NACE 1-digit sectors), and regions (i.e., 27 NUTS-2 regions). The occurrence of specific differences in the survival advantage of WBOs are tested through Chow tests for equality of coefficients in different types of sectors.

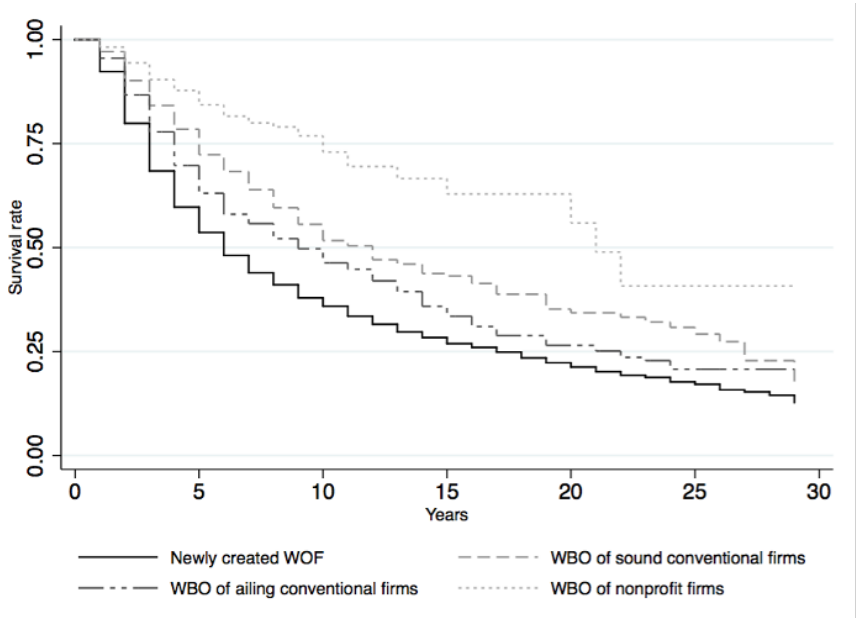
While the identification of entry modes is straightforward, it forbids the use of firm fixed effects. Failing to account for significant unobserved individual heterogeneity leads one to underestimate the magnitude of the coefficients and to misinterpret them, since the proportionate effect of a given covariate on the hazard rate is no longer constant and independent of survival time (Jenkins, 2004). While I display, in section 5, the estimates of a non-frailty PH cloglog model, table A.6 in the Annex provides cloglog estimates with Normal and Gamma distributions of the frailty term.

5. Survival Advantage of Worker Buyouts over Newly Created Worker-Owned Firms

5.1 Nonparametric Estimates

Figures 2 and 3 report nonparametric estimates of the survival and the hazard functions, respectively, for four entry modes of worker-owned firms, pooling all cohorts of created worker-owned firms during the period of 1989 to 2018

Figure 2: Nonparametric Estimates of Survival Functions



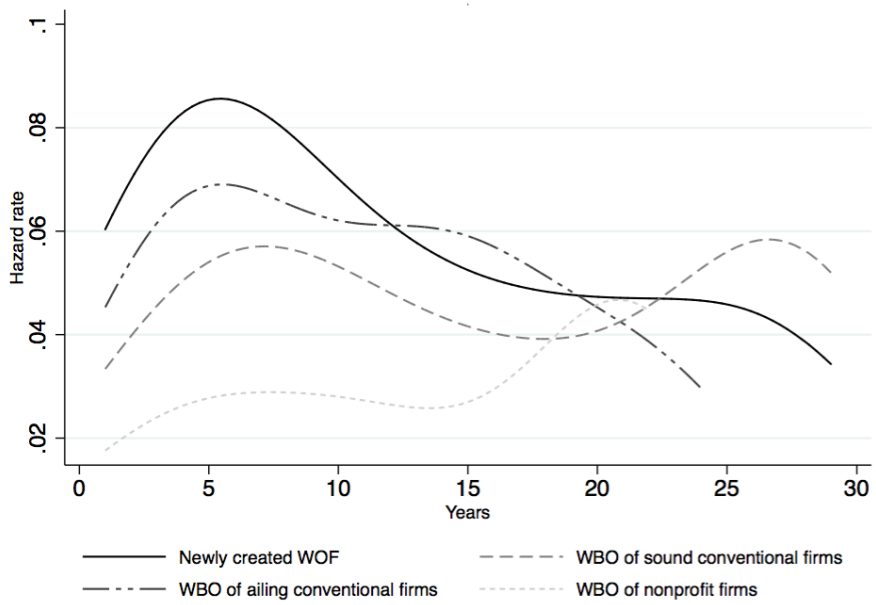
Source: Author's calculations using CGSCOP's records.

Note: Kaplan-Meier survival estimates of worker-owned firms according to their mode of entry, 1989-2018. WOF: worker-owned firms. WBO: worker buyouts.

Figure 2 shows that newly created WOFs have lower survival odds: after five years, 54% of them survive, compared to 72% of WBOs of sound firms, 63% of WBOs of firms in difficulty, and 84% WBOs of nonprofit organizations. Based on the log-rank test results (Chi2=14.74, P=0.0001), I reject the null hypothesis of the survival function equality between newly created WOFs and WBOs of firms in difficulty and, *a fortiori,* any other worker buyout entry mode. WBOs benefit from a survival advantage relative to newly created WOFs. Indeed, 50% of the newly created WOFs survive until year 7, whereas 50% of the WBOs of sound firms survive until year 12, 50% of the WBOs of ailing firms survive until year 10, and 50% of the WBOs of nonprofit organizations survive until year 21. Studying the Israeli kibbutzim from 1924 to 1992, Russell and Hanneman (1995) report that 50% of the worker-owed firms survive until year 4. This low value of the survival median might be explained by the high proportion of newly created WOFs in Israel. Using Spanish data, Thomas and Cornforth (1989) observe that 50% of worker-owned

firms survive until year 5 in the 1975-1981 period, while 50% worker-owned firms survive until year 3 in the 1982-1983 period. This decrease in survival median might be due to an increase in the share of newly created firms in the Spanish worker-owned firm population in 1982 and 1983.

Figure 3: Nonparametric Estimates of Hazard Functions



Source: Author's calculations using CGSCOP's records.

Note: smoothed hazard estimates (gaussian kernel) of worker-owned firms according to their mode of entry, 1989-2018. WOF: worker-owned firms. WBO: worker buyouts.

According to Figure 3, the hazard functions of newly created firms and worker buyouts of firms in difficulty exhibit an inverted U-shape and cross at year 12. Hazard functions of WBOs of sound firms and nonprofit organizations have a wave form but, up to year 15, present an inverted-U shape. All entry types of WOFs experience a honeymoon period during the first years of their lifespan before reaching a peak at years 5-6. The pattern of greater vulnerability of adolescent WOFs observed in the data is consistent with the "liability of adolescence" observed by Pérotin (2004). The dissimilarity observed by Pérotin (2004) that after year 10, the newly created WOFs have lower hazard ratios than WBOs of sound or ailing firms is confirmed here around year 12 for the latter and year 23 for the former. Note that before year 5 and after year 20, the confidence intervals of hazard ratios grow extensively, necessitating a cautious interpretation of the order and forms of the hazard ratios curves. In line with the findings of Pérotin (2004), I conclude from Figure 3 that the higher early exit risks of newly created worker-owned firms compared to those of worker buyouts is consistent with higher barriers to entry for the former compared to the latter. The hazard curve for newly created WOFs has the highest peak and the greatest drop thereafter. Contrary to the observations of Pérotin (2004) the hazard rates of newly created WOFs do not grow again after year 12 but they decrease

slower. Overall, worker buyouts have a survival advantage over newly created worker-owned firms that reduces over the firm's lifespan. This result confirms my hypothesis 1. The dissimilarities both in the general shape and in the level of hazard curves of different entry modes show that WOFs form a heterogeneous population comprising groups with different survival likelihoods that are obscured if one only looks at the aggregate survival curve of WOFs.

Table A.2. in the Annex provides a further exploratory analysis of the data, reporting the results of log-rank tests by 5-year cohorts, sectors, and entry sizes. WBOs of ailing firms exhibit relatively better performance than newly created WOFs in all cohorts, especially at the beginning of the period studied (1989-1998), and in all sectors, especially in manufacturing and construction. WBOs also exhibit better survival performance than newly created WOFs for all classes of entry size, except beyond 20 worker-members. The crossing of the survival functions of WBOs and newly created WOFs with at least 20 worker-members might be due to the low number of newly created WOFs (i.e., 12) relative to WBOs (i.e., 69). The higher performance of newly created WOFs over WBOs might also be due to higher barriers to entry.

Caution should be exercised before drawing definitive conclusions from table A.2. and figures 2 and 3 because nonparametric estimates do not account for other factors that may also affect firm survival and also because, given the small number of total worker-owned firms, 5-year cohorts or sector specific survival functions are imprecisely estimated. For these reasons, I provide a more precise econometric test of the differences in survival between WBOs and newly created WOFs, estimating semiparametric models in the next sub-sections.

5.2 Semiparametric Estimates of Firm Characteristics at Entry

Table 1 presents the cloglog estimates of the effect of the firm entry mode on the hazard of firm exit. Table 1 shows that WBOs of any type have higher survival chances than newly created WOFs. Expressed in terms of hazard ratios (computed as the exponential of the coefficients), the marginal effects of firm entry modes in column (2) imply that the hazard of exit is 32% lower for WBOs of sound conventional firms than newly created WOFs, 18% for WBOs created from rescuing conventional firms in difficulty, and 64% for WBOs of nonprofit organizations.

Table 1. Cloglog Estimates on Mode of Entry and Firm Exit, 1989-2018

	(1)	(2)	(3)
Firm Entry Mode (default: Newly created WOFs)			
WBOs of sound conventional firms	-0.515*** (0.068)	-0.389*** (0.076)	-0.695*** (0.164)
WBOs of ailing conventional firms	-0.318*** (0.069)	-0.200** (0.082)	-0.317** (0.146)
WBOs of nonprofit organizations	-1.091*** (0.143)	-1.029*** (0.153)	-0.989*** (0.310)
Firm Entry Size (log)		-0.174*** (0.038)	-0.109 (0.091)
1-digit industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Log pseudolikelihood	-8,617.087	-7,634.317	-1,313.224
Observations	31,166	28,298	5,975
Standard errors clustered at the firm level are in parentheses. Significant at ** 5%, *** 1% confidence levels. Column (3) displays estimates for worker-owned firms with at least 6 worker-members at the firm entry.			

Table 1 shows that there is a negative and significant relationship between firm entry size and the hazard of firm exit. In column (2), the increase of one point in the log of firm entry size entails a 16% decrease in hazard of firm exit. This result confirms my hypothesis 2 and implies that the bigger the firm at entry, the longer the firm survives.

On average, WBOs are bigger at entry than newly created WOFs. With 2.9 worker-members on average at entry, newly created WOFs are smaller than WBOs of sound firms (i.e., 7 worker-members at entry), WBOs of ailing firms (i.e., 11 worker-members at entry), and WBOs of nonprofit organizations (i.e., 6.5 worker-members at entry). Even if the estimates of column (2) control for the logarithm of firm size at entry, one may still be concerned that the results may be an artifact of the different size composition of worker-owned firms according to their mode of entry. To rule out this possibility, column (3) of table 1 reports the cloglog estimates excluding worker-owned firms with less than 6 worker-members at entry. It is worth noting that in this case estimates were performed

with 750 firms (i.e., 17% of the original sample). Despite this loss of information, results remain qualitatively unchanged. WBOs exhibit higher survival chances than newly created WOFs, even excluding very small firms, and firm entry size has the expected negative effect on hazard exits. I have run estimations with a quadratic term (not significant at usual thresholds) of firm entry size or with firm entry size as a categorical variable distinguishing very small (<6), small (6-10), medium (11-20), and large firms (>20). I have also estimated column (2) with NACE 2-digits sector fixed effects. None of these modifications altered the results. I also estimated probit, logit, and Cox PH models (cf. table A.5. in the Annex). The results remain unchanged.

Table 2 reports the cloglog estimates of the pre-conversion of lifespan on hazard rates for each type of worker buyout over the period 1994-2018. A quadratic term of pre-conversion lifespan is included to catch a potential non-linear effect. The number of observations for WBOs of ailing firms are too low (i.e., 10) to estimate any effect. The estimates of table 2 show that pre-conversion lifespan has an inverted U-shaped effect on the hazard of exit of WBOs of sound conventional firms and of nonprofit organizations. A one-year increase of pre-conversion lifespan decreases on average the exit hazard of WBOs of sound firms by 8%. The effect of pre-conversion lifespan becomes positive (0.1%) on exit hazard at year 27.3 Until year 27[3], as expected, the pre-conversion lifespan has a strong positive effect only on the survival of WBOs of sound conventional firms. This result confirms my hypothesis 3 and suggests that a share of the survival advantage of WBOs over newly created WOFs is due to pre-conversion lifespan.

3 The threshold of year 27 is calculated as follows: $-\beta_1/(2 \times \beta_2)$ where β_1 and β_2 are the coefficients of pre-conversion lifespan and pre-conversion lifespan^2, respectively.

Table 2. Cloglog Estimates of Pre-conversion Lifespan and Firm Exit, 1994-2018.

	WBOs of sound firms (1)	WBOs of nonprofit organizations (2)	All WBOs 3)
Pre-conversion Lifespan	-0,079*** (0.029)	-0.060 (0.055)	-0.030 (0.021)
Pre-conversion Lifespan^2	0.001*** (0.000)	0.0004 (0.0005)	0.0003*** (0.0002)
Firm Entry Size (log)	-0.299* (0.162)	-0.409 (0.455)	-0.188 (0.136)
1-digit industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
Log pseudolikelihood	-249.576	-96.413	-396-706
Number. of observations	1,245	703	2,319
Number. of firms	218	113	376
Sampling (%)	39.3	50.4	30.6
Standard errors clustered at the firm level are in parentheses. Significant at, * 10%, *** 1% confidence levels. Sampling refers to the percentage of sampled firms in the population of worker buyouts by entry mode. WBOs: worker buyouts.			

5.3 Semiparametric Estimates by Sectors

Columns (1) and (2) of table 3 present the cloglog estimates for low and high capital-intensive sectors. The Chow test statistic for parameter equality of the firm entry mode variable between models (1) and (2) is equal to 8.41 (p=0.015) and allows us to reject the null hypothesis of parameter equality at the 5% threshold. Therefore, I conclude that the survival advantage of WBOs over newly created WOFs is stronger in low capital-intensive sectors than in high capital-intensive sectors. This result is contrary to my hypothesis 4 and might be due to a problem of endogeneity. The newly created WOFs in high capital-intensive sectors could be more able to survive because they have overcome the barrier to entry of capital requirements. Thus, the newly created WOFs in low and high capital-intensive sectors are not strictly comparable, the latter being more likely to survive than the former. The number of firms in these sectors sustains this interpretation. Indeed, there are more newly created WOFs in low capital-intensive sectors (i.e., 1,058) than in high capital-intensive sectors (i.e., 784), whereas it is the contrary for WBOs, with 368 and 444 firms in low and high capital-intensive sectors, respectively. The high number of worker buyouts in high capital-intensive sectors is due to the overrepresentation of WBOs of ailing firms in those sectors. In low capital-intensive sectors, the estimates of table 3 comprehend 204 WBOs of sound firms, 135 WBOs of ailing firms, and 29 WBOs of nonprofit organizations. In high capital-intensive sectors, the estimates of table 3 comprehend 169 WBOs of sound firms, 246 WBOs of ailing firms, and 29 WBOs

of nonprofit organizations. It is noteworthy that the coefficient for the WBOs of ailing firms is only significant at the 10% level in low capital-intensive sectors, suggesting that these firms do not entail on average a survival advantage in high capital-intensive sectors because of their high capital requirement costs. The traumatic episode during the 1980s, when worker-owned firms flourished as a response to the economic crisis, has led to a very high number of failures of these recoveries (e.g., the emblematic company of Manufrance). This episode tarnished the image of WOFs in France (Charmettant and Renou, 2021). In response, and to avoid bad publicity, the strategy of support agencies might have changed and now select more carefully which WBOs of ailing firms to support.

Table 3. Cloglog Estimates by Types of Sectors, 1989-2018.

	Capital-intensity		Knowlledge-intensity	
	Low (1)	High (2)	Low (3)	High (4)
Firm Entry Mode (default: Newly created WOFs)				
WBOs of sound conventional firms	-0.334** (0.133)	-0.293** (0.122)	-0.378*** (0.085)-	-0.322* (0.191)
WBOs of of ailing conventional firms	-0.272* (0.143)	-0.204 (0.125)	-0.161* (0.093)	-0.382* (0.201)
WBOs of nonprofit organizations	-1.357*** (0.473)	-0.687* (0.372)	-0.929*** (0.217)	-1.050*** (0.239)
Firm Entry Size (log)	-0.208*** (0.068)	0.026 (0.057)	-0.151*** (0.043)	-0.304*** (0.091)
2-digit industry fixed effects	No	No	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
Log pseudolikelihood	-2,482.357	-2,144.338	-6,097.222	-1,441.026
Observations	8,610	7,559	22,425	5,804

Standard errors clustered at the firm level are in parentheses. Significant at *10%, ** 5%, *** 1% confidence levels. Low Capital-Intensive sectors (column 1) refer to Construction and Wholesale and retail trade. High capital-intensive sectors (column 2) refer to Manufacturing, Transportation and storage, and Information and communication. Knowledge-intemsive sectors are defined at the NACE 2-digit level and listed in table A4 in the Annex.

Columns (3) and (4) of table 3 present the cloglog estimates for low and high knowledge-intensive sectors with 2-digit sectoral fixed effects. The Chow test statistic for parameter equality of the firm entry mode variable between models (3) and (4) is equal to 2.10 (p=0.350) and does not allow us to reject the null hypothesis of parameter equality at the usual thresholds. Therefore, I conclude that the survival advantage of WBOs over newly created WOFs is similar in low and high knowledge-intensive sectors. This result is

contrary to my hypothesis 5, suggesting that investment in labor is independent of the entry mode of WOFs.

The effect of sectoral characteristics of knowledge- and capital-intensity are assumed to be constant over time. However, the period studied (1989-2018) includes a major economic crisis in 2008-2009 that might have structurally altered the effect of sectoral characteristics. According to log-rank tests, the survival functions of newly created WOFs and WBOs of sound firms are significatively higher in the 2010-2018 period than in the 1989-2007 period, suggesting that the economic environment, and especially the 2008-2009 economic crisis, has positively impacted the survival rates of WOFs. Therefore, I estimate a cloglog model for the time periods before and after 2008-2009. The results are presented in table A.3. in the Annex. The results are roughly similar before and after the 2008-2009 economic crisis, suggesting that the survival advantage of WBOs over newly created WOFs depends more on firm and sectoral characteristics than on the business cycle characteristics.

6. Conclusion

The findings of this article show that worker-owned firms are composed of groups with different survival likelihoods that are obscured if one only looks at the aggregate population. Worker buyouts survive on average longer than newly created worker-owned firms, both unconditionally and conditionally on firm entry size. The hazard of exit is 32% lower for worker buyouts of sound conventional firms than newly created worker-owned firms, 18% for worker buyouts of conventional firms in difficulty, and 64% for worker buyouts of nonprofit organizations. With caution, support agencies could foster worker buyouts of firms in difficulty and of nonprofit organizations as viable forms of entrepreneurship. Contrary to my hypotheses, the survival advantage of worker buyouts over newly created worker-owned firms is stronger in low capital-intensive sectors than in high capital-intensive sectors. This result suggests that high barriers to entry (i.e., capital requirements) positively impact the survival likelihood of newly created worker-owned firms. No significant difference in survival advantage is found between low and high knowledge-intensive sectors.

One limitation of this paper is that I am unable to assess the effect of entry mode over firm survival because of endogeneity. The firms that are converted into worker-owned firms, especially worker buyouts of ailing firms, might be selected by the CGSCOP in such way that they are more likely to survive to avoid bad publicity. Similarly, the choice of organizational structure (worker-owned or investor-owned) is hardly exogeneous. Organizational structure should be carefully chosen by the workers and investors by trading off returns and risk of investment. The choice of entry mode is not exogeneous and might be correlated with omitted variables. This endogeneity issue tempers the aforementioned practical implications and should be tackled in further research. Another limit concerns the identification of entry modes. Depending on the legislation and the monitoring ability of support agencies, the mode of entry of worker-owned firms might be defined differently in other countries. For instance, Vieta (2015) uses another typology of Italian worker buyouts: “labor conflict,” “employee stock ownership plan,” and “negotiated.” Future research comparing survival of worker-owned firms with different modes of entry in other countries and periods would test the robustness of my results.

Concerning the differences of survival rates between worker-owned firms and conventional firms, the survival differences across entry modes of conventional firms decrease over a 5-year period whereas it takes more than 20 years for the survival rates of worker buyouts of ailing firms and of nonprofit organizations to equal those of newly created worker-owned firms. Conventional buyouts have a survival rate of 70-80% at year 5 while the survival rate of newly created conventional firms is 50% (Xi et al., 2020). Worker buyouts have roughly similar survival rates to converted conventional firms, while newly created worker-owned firms have higher survival rates than newly created conventional firms. A proper comparative survival analysis between worker-owned firms and conventional firms, taking into account their mode of entry, could provide valuable insights into the question of whether worker-owned firms survive longer than conventional firms.

The findings of this paper are important for policy makers, especially worker-owned firm support agencies. With the ageing trend of entrepreneurs born during the baby-boom, the number of small businesses to be reprised is increasing. The pool of potential conversion into worker-owned firms is therefore also increasing. Similarly, the devastating economic effects of the Covid-19 pandemic will lead to an surge of firm failures in the next years, thus increasing the opportunities of creating rescue worker buyouts, especially in deprived sectors such as hosteling and restauration in order to save jobs. This paper also helps to inform nonprofit firms that becoming a worker-owned firms is a perennial entrepreneurial form.

Concerning the differences of survival rates between worker-owned firms and conventional firms, the survival between different modes of entry of conventional firms tend to reduce in a 5-year window whereas it takes more than 20 years for the survival rates of rescue and transmitted worker buyouts to equal those of newly created worker-owned firms. Conventional reprisals have a survival rate of 70-80% at 5-year lifespan while the survival rate of newly created conventional firms are 50% (Xi et al., 2020). Worker buyouts have roughly similar survival rates than converted conventional firms, while newly created worker-owned firms have higher survival rates than newly created conventional firms. A proper comparative survival analysis between converted worker-owned firms and converted conventional firms could provide some insights into this question.

A limit of this paper is that I am not able to assess the effect of mode of entry over the firm's survival because of endogeneity. The firms that are converted as worker-owned firms, one may think specially to rescue worker buyouts, might be selected by the CGSCOP in such way that they are firms that are more likely to survive to avoid bad publicity. The choice of mode of entry is not strictly speaking exogeneous and might be correlated with omitted variables. Further research should try to tackle this endogeneity issue. To do so, it would be needed to have firm-level data during the preconversion lifespan of firms. Unfortunately, such data are difficult to get, at least in France, where most of the worker buyouts, especially WBOs recuing firms in difficulty, have a different identification firm number than the converted firm, making impossible to track them with their identification number. Another limit that could be investigated for future research is comparing survival of worker-owned firms with different modes of entry in other countries and periods. Depending on the legislation and the monitoring ability of support agencies, the mode of entry of worker-owned firms might be defined differently in other countries. For instance, Vieta (2015) uses another typology of worker buyouts between "labor conflict," "employee stock ownership plan," and "negotiated."

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Annex

Table A.1. Descriptive Survival Statistics

		Per firm			
Variable	Total	Mean	Minimum	Median	Maximum
All worker-owned firms					
No. of firms	4,416				
Times at risk	31,211	7.07	1	5	29
Failures	2,591	0.59	0	1	1
Worker-owned firms newly created					
No. of firms	3,189				
Times at risk	22,037	6.91	1	5	29
Failures	2,062	0.65	0	1	1
Worker buyouts of sound conventional firms					
No. of firms	555				
Times at risk	4,021	7.25	1	5	29
Failures	226	0.41	0	0	1
Worker buyouts of ailing conventional firms					
No. of firms	448				
Times at risk	3,544	7.91	1	5	29
Failures	253	0.56	0	1	1
Worker buyouts of nonprofit organizations					
No. of firms	224				
Times at risk	1,609	7.18	1	6	29
Failures	50	0.22	0	0	1

Source: Author's calculations using data from CGSCOP

Table A.2. Log-rank tests of survival functions equality between newly created worker-owned firms and worker buyouts of firms in difficulty

Variable	Graphically lowest survival function	Chi2	P-value	Newly created WOFs		WBOs of firms in difficulty	
				Firms (total)	Exits	Firms (total)	Exits
5-year cohorts							
1989-1993	Newly created WOFs	3.95	0.047	448	87%	68	79%
1994-1998	Newly created WOFs	10.61	0.001	613	83%	75	73%
1999-2003	Newly created WOFs	0.22	0.640	490	72%	61	72%
2004-2008	Newly created WOFs	1.13	0.288	578	67%	66	65%
2009-2013	Newly created WOFs	2.98	0.084	651	50%	101	39%
2014-2018	Newly created WOFs	0.02	0.879	516	20%	90	20%
Total	Newly created WOFs	15.21	0.000	3,296	63%	461	55%
Sectors (NACE 1-digit)							
Manufacturing	Newly created WOFs	6.98	0.008	388	69%	209	55%
Construction	Newly created WOFs	7.73	0.005	714	71%	113	59%
Wholesale and retail trade	Newly created WOFs	2.25	0.134	344	66%	22	50%
PST* Activities	Newly created WOFs (crossing at t=13)	0.83	0.336	689	54%	27	41%
Information and communication	Newly created WOFs (crossing at t=3)	0.19	0.661	316	56%	18	50%
Total	Newly created WOFs	13.49	0.000	2,451	63%	389	55%
Entry size (number of worker-members at birth)							
<6	Newly created WOFs	4.95	0.026	3,042	62%	218	51%
6-10	Newly created WOFs	3.18	0.074	186	68%	105	56%
11-20	Newly created WOFs (crossing at t=16)	0.38	0.536	56	63%	69	64%
>20	Rescue WOFs	6.66	0.001	12	17%	69	57%
Total	Newly created WOFs	5.49	0.019	3,296	63%	461	55%

Note: *PST Activities means Professional, Scientific, and Technical Activities

Table A.3. Cloglog Estimates Before and After the 2008-2009 Economic Crisis

	All Sectors		Low Capital-Intensive Sectors		High Capital-Intensive Sectors		Low Knowledge-Intensive Sectors		High Knowledge-Intensive Sectors	
Variable	1989-2007 (1)	2010-2018 (2)	1989-2007 (3)	2010-2018 (4)	1989-2007 (5)	2010-2018 (6)	1989-2007 (7)	2010-2018 (8)	1989-2007 (9)	2010-2018 (10)
Firm Entry Mode(base: newly created WOFs)										
WBOs of sound conventional firms	-0.335***	-0.337***	-0.516**	-0.121	-0.289	-0.063	-0.292**	-0.352***	-0.424	-0.274
	(0.117)	(0.115)	(0.211)	(0.214)	(0.180)	(0.214)	(0.125)	(0.132)	(0.340)	(0.266)
WBOs of ailing conventional firms	-0.274**	-0.069	-0.440**	-0.005	-0.349*	-0.065	-0.224*	-0.027	-0.292	-0.275
	(0.117)	(0.133)	(0.203)	(0.236)	(0.179)	(0.229)	(0.130)	(0.155)	(0.314)	(0.330)
WBOs of nonprofit orga-nizations	N/A	-0.611***	N/A	-1.022**	N/A	-0.102	N/A	-0.511**	N/A	-0.640**
		(0.167)		(0.480)		(0.392)		(0.230)		(0.282)
Firm Entry Size (log)	-0.154***	-0.259***	-0.177**	-0.247**	-0.013	-0.142	-0.119**	-0.257***	-0.418***	-0.287*
	(0.051)	(0.065)	(0.085)	(0.118)	(0.076)	(0.114)	(0.058)	(0.078)	(0.150)	(0.147)
Sector fixed effects	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Log pseudolikelihood	-3,811.376	-3,018.37	-1,339.258	-854.878	-1,121.463	-744.796	-3,047.994	-2,400.294	-686.838	-546.190
Observations	12,577	12,944	4,299	3,451	3,587	3,089	10,070	10,117	2,393	2,519

Standard errors are clustered at the firm level. Significant at * 10%, ** 5%, *** 1% confidence levels. Sector fixed effects are at the 1-digit level (NACE rev.2) for columns (1)-(2) and at the 2-digits level (NACE rev.2) for columns (7)-(10).

Table A.4. Typology of the Sectors according to their Knowledge Intensity

High knowledge-intensive sectors	Low knowledge-intensive sectors
Manufacture of basic pharmaceutical products Manufacture of computer, electronic and optical products Air transport Publishing activities Motion picture, video and television program production Programming and broadcasting activities Telecommunications Computer programming, consultancy and related activities Information service activities Financial service activities Insurance, reinsurance and pension funding, except compulsory social security Activities auxiliary to financial services and insurance activities Legal and accounting activities Activities of head offices; management consultancy activities Architectural and engineering activities Scientific research and development Advertising and market research Other professional, scientific and technical activities Veterinary activities Employment activities Travel agency, tour operator reservation service and related activities Public administration and defense; compulsory social security Education Human health activities Creative, arts and entertainment activities Libraries, archives, museums and other cultural activities Activities of membership organizations	Crop and animal production, hunting and related service activities Forestry and logging Fishing and aquaculture Other mining and quarrying Manufacture of food products Manufacture of beverages Manufacture of textiles Manufacture of wearing apparel Manufacture of leather and related products Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials Manufacture of paper and paper products Printing and reproduction of recorded media Manufacture of chemicals and chemical products Manufacture of rubber and plastic products Manufacture of other non-metallic mineral products Manufacture of basic metals Manufacture of fabricated metal products Manufacture of electrical equipment Manufacture of machinery and equipment n.e.c. Manufacture of motor vehicles, trailers and semi-trailers Manufacture of other transport equipment Manufacture of furniture Other manufacturing Repair and installation of machinery and equipment Electricity, gas, steam and air conditioning supply Sewerage Waste collection, treatment and disposal activities; materials recovery Remediation activities and other waste management services Construction of buildings Civil engineering Specialized construction activities Wholesale and retail trade and repair of motor vehicles and motorcycles Wholesale trade, except of motor vehicles and motorcycles Retail trade, except of motor vehicles and motorcycles Land transport and transport via pipelines Water transport Warehousing and support activities for transportation Postal and courier activities Accommodation Food and beverage service activities Real estate activities Activities of head offices; management consultancy activities Rental and leasing activities Security and investigation activities Services to buildings and landscape activities Office administrative, office support and other business support activities Social work activities without accommodation Sports activities and amusement and recreation activities Repair of computers and personal and household goods Other personal service activities

Source: Metadata of Eurostat, Annex 8 – Knowledge Intensive Activities by NACE rev.2, available at https://ec.europa.eu/eurostat/cache/metadata/en/htec_esms.htm#data_rev1580829488131. I list only the sectors that are available in my dataset of worker-owned firms. The classification of sectors as knowledge intensive is based on the share of tertiary educated people in each sector of industries and services according to NACE at 2-digit level and for all EU Member States.

Table A.5. Semiparametric estimates with or without proportional hazards (PH) assumption

	PH-assumption		*Non-PH assumption*	
	Cloglog	*Cox*	*Probit*	*Logit*
	(1)	*(2)*	*(3)*	*(4)*
Firm Entry Mode (default: Newly created WOFs)				
WBOs of sound conventional firms	-0.389***	-0.372***	-0.199***	-0.406***
	(0.076)	(0.073)	(0.038)	(0.079)
WBOs of ailing conventional firms	-0.200**	-0.188**	-0.099**	-0.208**
	(0.082)	(0.078)	(0.042)	(0.086)
WBOs of nonprofit organizations	-1.029***	-0.995***	-0.493***	-1.062***
	(0.153)	(0.150)	(0.068)	(0.157)
Firm Entry Size (log)	-0.174***	-0.166***	-0.090***	-0.182***
	(0.038)	(0.036)	(0.019)	(0.039)
1-digit industry fixed effects	Yes	Yes	Yes	Yes
Region fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	No	Yes	Yes
Log pseudolikelihood	-7,634.317	-17,190.906	-7,637.175	-7,634.811
Observations	28,298	28,342	28,298	28,298

Standard errors clustered at the firm level are in parentheses. Significant at ** 5%, *** 1% confidence levels. Colum (1) is similar to column (2) of table 1. Column (2) reports the estimates of the Cox PH model with Breslow correction for ties. Columns (3) and (4) report the estimates of the probit and logit link functions.

Table A.6. Cloglog Estimates of Frailty Effects

	No frailty	*Normally distributed frailty*	*Gamma distributed frailty*
	(1)	*(2)*	*(3)*
Firm Entry Mode (default: Newly created WOFs)			
WBOs of sound conventional firms	-0.389***	-0.684***	-0.710***
	(0.076)	(0.188)	(0.131)
WBOs of ailing conventional firms	-0.200**	-0.363**	-0.386***
	(0.082)	(0.155)	(0.137)
WBOs of nonprofit organizations	-1.029***	-1.523***	-1.450***
	(0.153)	(0.348)	(0.221)
Firm Entry Size (log)	-0.174***	-0.277***	-0.269***
	(0.038)	(0.080)	(0.060)
α_ε		1.420	
		(0.483)	
ρ		0.551	
		(0.168)	
γ *variance*			1.454***
			(0.356)
1-digit industry fixed effects	Yes	Yes	Yes
Region fixed effects	Yes	Yes	No
Year fixed effects	Yes	Yes	Yes
Log pseudolikelihood	-7,634.317	-7,626.659	-7,643.742
Observations	28,298	28,342	28,342

Significant at ** 5%, *** 1% confidence levels. Column (1) is similar to column (2) of table 1. For the column (2), the likelihood ratio test for ρ displays Chi2(1)=15.31, P=0.000. For the column (3), the likelihood ratio test of the γ *variance* displays Chi2(1)=27.27, P=0.000. These LR tests indicate the significant presence of unobserved individual heterogeneity and lead to interpret cautiously the estimates provided in column (1). Results remain unchanged: worker buyouts keep surviving longer than newly created worker-owned firms.

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