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ESSAYS ON WORKER-MANAGED FIRMS

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Introduction

Worker-managed firms (WMFs) are defined as enterprises in which the workforce has ultimate control rights (Dow, 2003).[1] WMFs are democratic in the sense that members have equal political influence on economic decisions regardless of their capital contribution to the firm ("one person, one vote"). This type of firm captured the attention of renowned economists such as Karl Marx, John Stuart Mill, Leon Walras, and Alfred Marshall. Since the late 1950s, an extensive theoretical literature has been developed to help understand the behavior of WMFs and explain why they are dominated by capitalist firms (CFs), even in labor-intensive industries.[2]

In the early 90s, there was a consensus among scholars regarding the unbalanced growth of the economic theory on WMFs compared with the very few empirical attempts to test it against the data. For instance, Craig and Pencavel (1992) pointed out

> "....what needs to be done in the research on labor-managed firms is to shift the focus of effort away from more speculation on the way cooperatives behave and toward work that investigates their actual behavior. Our impression is that most economics research on these issues currently takes the form of variations on a number of theoretical themes while the empirical investigation of these issues is relatively neglected" (Craig and Pencavel, 1992 p. 1103)

Over the last two decades, several empirical contributions to the literature have substantially modified that picture. Our understanding of the way in which workers´control actually affects firm behavior has notably improved, particularly in areas such as employment and wages adjustments and productive efficiency. (Pencavel, 2013). However, economists remain silent with respect to the empirical plausibility of many important theoretical claims on the effects of workers´control.

[1] Other terms for WMFs that are used in the literature include worker cooperatives, producer cooperatives, and democratic firms.

[2] For a review of the literature see Bonin, Jones, and Putterman (1993), Dow and Putterman (2000), Dow (2003), and Putterman (2008). The most updated evaluation of the empirical literature is provided by Pencavel (2013).

This thesis provides novel evidence on three relatively underexplored dimensions: firm survival, the interplay between pay compression and workers´ mobility, and monitoring. From a methodological point of view, the thesis adopts a *comparative economics* approach as conventional firms are used as a benchmark to evaluate the characteristic and behavior of worker-managed firms. The empirical analysis combines different data sources from Uruguay, including firm-level and linked employer-employee panel data - based on work history data from social security- and recently collected survey data. To my knowledge, this is one of the richest data that have ever been assembled to study worker-managed firms in actual economies.

The fact that this study relies on observational data may cast doubts on the internal validity of the results. Many unobserved confounding factors both at the firm and individual-level are difficult to control for using real-world data. For instance, individuals self-select into organizational forms according to their preferences and unobservable traits that might also affect firm-level outcomes. Despite this potential limitation, it is worth noting that most of the empirical analysis presented in this thesis has been carried out using a monthly panel of workers and firms that allows to study the entire population of Uruguayan worker-managed firms and their workers over more than 13 years. This notably mitigates identification threats associated with time-constant unobserved factors. By providing controlled exogenous variation in the assignment of control rights, alternative experimental methods may allow to make stronger causal claims but at substantial costs in terms of external validity. Interestingly, the evidence presented in the next chapters is broadly consistent with the results obtained by the few existing attempts to study workplace democracy using laboratory experiments (Frohlich et al., 1998; Mellizo et al., 2011).

The thesis is composed of three chapters, corresponding to three independent essays with the following titles:

I. Does workers' control affect firm survival: Evidence from Uruguay
II. Equality under threat by the talented: Evidence from worker-managed firms
III. Equality as a discipline device in worker-managed firms

The first chapter of the thesis analyzes whether worker-managed firms are prone to failure in competitive environments as suggested by different theoretical explanations. The analysis is based on a long panel of Uruguayan firms and exploits a broad range of survival analysis techniques. Excluding micro-enterprises and controlling for differences in the effective tax burden faced by the two types of firms, the hazard of dissolution is 29% lower for WMFs than for conventional firms. This result is robust to alternative estimation strategies based on semi-parametric and parametric frailty duration models that impose different distributional assumptions about the shape of the baseline hazard and allow to consider unobserved firm-level heterogeneity. WMFs outperform CFs under both recessionary and expansionary macroeconomic conditions, suggesting that the greater survivability of WMFs cannot be explained merely by the fact that members exercise their control rights over the dissolution decision when outside job opportunities are scarce. Compensation flexibility does not in itself explain the higher survival chances of WMFs as firm survival is generally correlated with lower wage variability. The greater survivability of WMFs seems to be associated with the greater employment stability achieved by this type of firms.

In the second chapter, I study the interplay between compensation structure and quit behavior in worker-managed firms. In particular, I analyze whether pay compression entails brain drain problems for WMFs. The study exploits two novel administrative data sources: a panel of Uruguayan workers employed in both worker-managed and conventional firms; and a linked employer–employee panel data set covering the population of Uruguayan worker-managed firms and their workers from January 1997 to April 2010. A key advantage of the data is that it enables one to rank workers in terms of ability using as a proxy their relative positions in the intrafirm wage distribution. The paper's four main findings are that (1) the wage policies of worker-managed firms are more egalitarian than those of conventional firms; (2) in worker-managed firms, high-ability members are more likely than other members to exit; (3) the hazard ratio of high-ability members is lower for founding members and for those employed by worker-managed firms in which there is less pay compression; and (4) high-ability members are less likely to quit when labor market

conditions in the capitalist sector are less attractive. At a more general level, this chapter contributes to the study of the interplay between equality and incentives that permeates many debates in public finance, comparative economic systems, personnel and organizational economics. The chapter also adds to the literature on collective choice and democractic governance in worker-managed firms and other nonconventional organizational settings (Hansmann, 1996; Kremer, 1997; Abramitzky, 2011)

Finally, the third chapter presents new comparative evidence on pay inequality and monitoring in WMFs and conventional firms. The data comes from a recent survey conducted in Uruguay to 193 worker cooperatives and a comparison group of 172 conventional firms. The fieldwork was carried out during 2011 in the context of a broader ongoing research project on employment, wages and investment in Uruguayan worker-managed firms. The main findings are that: (1) WMFs have a more compressed wage structure than conventional firms (which is consistent with results provided in chapter II using individual-level administrative records), mainly because the managerial compensation is significantly lower in this type of firms; (2) WMFs exhibit a significantly lower supervision ratio than conventional firms; (3) WMFs rely more frequently on peer monitoring as a labor effort regulation device, particularly when the comparison is restricted to small firms; (4) egalitarian WMFs exhibit lower supervision ratios and tend to rely more frequently on peer monitoring than their non-egalitarian counterparts. The idea that equality serves as a discipline device in worker-managed firms is rationalized in a simple team production model augmented by group effort norms in which the sharing rule is endogenously determined (Encinosa et al., 2007).

Overall, the evidence presented in this thesis suggests that the marginal presence of WMFs in actual market economies can hardly be explained by the fact that these firms exhibit lower survival chances than conventional firms. Future research should be focused on both the obstacles faced by workers at the formation stage of a WMF and the growth constraints faced by incumbent WMFs. While the evidence presented in chapter II indicates that egalitarian WMFs pay a "brain drain cost", the analysis performed in chapter III, based on survey data, suggests positive labor discipline effects associated with egalitarian

compensation policies in this type of firms. WMFs may face a dilemma in deciding the degree of internal inequality. On one hand, greater wage dispersion reduces the incentives to quit of high-ability workers, mitigating the brain drain effect. On the other, inequality seems to erode the conditions that support peer monitoring and allow WMFs to save on nonproductive monitoring inputs, which is one important comparative organizational advantages of this type of organizations vis-à-vis capitalist firms.

Workplace democracy has been justified on different normative grounds.[3] By studying the actual economic behavior and organizational design of worker-managed firms, I hope this thesis provides useful insights into the potentials, problems and prospects faced by democratic organizational alternatives to the capitalist firm in modern market economies.

[3] Dow (2003) also provides an insighful normative discussion on workers' control.

I. DOES WORKERS' CONTROL AFFECT FIRM SURVIVAL? EVIDENCE FROM URUGUAY

I.1 Introduction

Samuelson (1957) claims that in a perfectly competitive market it does not really matter who hires whom. In other words, it is irrelevant whether entrepreneurial functions are carried out either by capital or labor. This famous statement seems to be at odds with the fact that most firms in actual market economies are ultimately controlled by capital suppliers and not by their workforce.

Recent developments in economic theory have provided several competing explanations to account for this fact. One important concern in this debate is to determine whether the low proportion of worker-managed firms (WMFs) is explained by structural obstacles impeding their formation or by internal inefficiencies leading to a higher rate of failure of this type of firms compared with conventional enterprises.

I provide an empirical assessment of the comparative survivability of WMFs and conventional firms (CFs) based on a long panel of Uruguayan firms. In it I exploit social security administrative records containing monthly information on the total population of WMFs and CFs in 112 3-digit sectors over the period January 1997-July 2009. The empirical strategy is based on semi-parametric and parametric frailty survival models that impose different distributional assumptions about the shape of the baseline hazard and allow to consider unobserved firm-level heterogeneity.

This study adds to the literature on labor-managed firms because empirical work on the effect of workers' control on firm survival is scarce. Previous studies comparing worker-managed firms and conventional firms have been mainly concerned with employment and wage adjustments, productivity, and business cycle determinants of entry and exit.[4] While some evidence exists on the effect of unions and employee stock ownership plans (ESOPs)

4 Craig and Pencavel (1992; 1995), Doucouliagos (1995), Pencavel et al. (2006), Pérotin (2006), Burdín and Dean (2009), and Fakhfakh et al. (2012).

on firm survivability, this is, to my knowledge, one of the first studies on firm survival, comparing conventional firms and firms fully controlled by their workforce. In contrast to previous descriptive research on worker-managed firms' survivability, I rely on appropriate micro-data for both types of firms and apply a broad range of survival analysis techniques. The analysis of worker-managed firms, the most radical implementation of workplace democracy and profit-sharing, should also shed light on the potential effects of more limited participatory initiatives at the firm level. Thus, this study contributes as well to the growing body of recent literature on shared capitalism.[5]

The rest of this chapter is organized as follows. Section I.2 briefly discusses the related literature, and Section II.3 provides background information on the operation of WMFs in Uruguay. Section I.4 describes the data, and Section I.5 explains the basic econometric framework. Section I.6 presents the main results, and Section I.7 provides several robustness checks. Section I.8 analyzes possible explanations for the main results. Section I.9 concludes.

I.2 Theoretical literature and previous evidence

According to Dow (2003), any theoretical explanation concerning the paucity of WMFs' actual economies should rely on the identification of relevant physical and institutional asymmetries between capital and labor. The author points out that differences in alienability may determine why ultimate control rights over firms are usually assigned to capital suppliers. He argues that while human capital is not alienable, the ownership of nonhuman assets can be transferred from one person to another. Dow identifies three types of asymmetries that may be important in accounting for different survival prospects of WMFs compared with CFs.

First, there are *commodification asymmetries* involving the ability of members to trade control positions in markets (Dow, 2003, p.236). In a conventional firm, shares of stock conferring voting rights can be transferred from one person to another without changing the firm's physical assets. By contrast, it is impossible to transfer control rights in a WMF

[5] See, e.g., Kruse et al. (2010).

without replacing one person by another in the labor process. In this context, an adverse selection problem may arise because a departing member might benefit by selling her position to an undesirable replacement, inflicting losses on stayers (Dow and Putterman, 2000). This is one potential explanation of why membership markets are rare and, hence, why assets in WMFs are usually owned by their workforce collectively. Under collective ownership, WMFs would make inefficient employment and investment decisions which, in turn, may negatively affect their survival chances compared with conventional firms (Ward, 1958; Furubotn, 1976).

In relation to employment decisions, the basic neoclassical model predicts that WMFs would not respond in the usual way to changes in the product price; instead, they would reduce the level of employment and output when the market price increases (Ward, 1958). The model assumes that WMFs maximize revenue per worker rather than total profits. The theoretical foundations of this seminal model have been harshly criticized in the literature, and the backward supply response of WMFs has not been empirically confirmed.[6] However, there is ample evidence that employment responses to demand shocks are less elastic in WMFs compared with conventional firms (Craig and Pencavel, 1992; Pencavel et al., 2006; Burdín and Dean, 2009). Employment smoothing may be costly for WMFs, especially in industries where employment variability is high, even though it may also provide incentives for investments in training and firm-specific human capital (Levine and Parkin, 1994). Regarding investment decisions, WMFs would suffer from the so-called horizon problem (Furubotn, 1976). As worker-members have no claim on future investment returns after separation from their firm, the evaluation of investment projects will be truncated to the members' expected employment horizon. Workers would prefer to distribute income in the current period instead of financing investments, unless the expected rate of return exceeds workers' opportunity cost of the funds by an amount that depends inversely on their expected tenure within the firm (Gui, 1984). Therefore, WMFs would underinvest and only carry out projects with short-run returns. Moreover, members

[6] This result does not necessarily hold in the case of multiproduct WMFs or when the production process involves other variable inputs apart from labor. It has also been argued that worker-members will be reluctant to vote for layoffs because in a WMF in which members are equally treated everybody faces similar probabilities of being selected for dismissal (Moene, 1989).

of a WMF must supply financial resources as well as labor and, hence, would invest their savings in an asset whose returns are highly correlated with the returns on their human capital. But this would be incompatible with the desire of risk-averse workers to maintain a diversified financial portfolio (Dow and Putterman, 2000).

It is worth noting that the underinvestment critique was originally directed at labor-managed firms in which, as in the old Yugoslav system, worker-members receive a share of current profits but have no ownership stake.[7] The applicability of the theory to WMFs operating in Western market economies depends on the structure of property rights (Bonin et al., 1993). Physical assets of WMFs can be owned by their members collectively or individually. Under collective ownership, members do not own tradable shares and enjoy the right to usufruct as long as they work in the firm. Under individual ownership, members own capital shares that vary with the value of the firm (Ben-Ner, 1988a). The underinvestment critique applies to collectively owned WMFs, as is the case with most Uruguayan WMFs, but not to those owned through individual shares. In the latter case, departing members are able to capture the expected value of future profits based on current investments and recoup their contributions toward such investments by selling their shares (Dow, 1986). However, as mentioned, membership markets are rarely observed in practice.[8]

Second, there are *commitment asymmetries* concerning the capacity of firm controllers to extend credible commitments to the suppliers of non-controlling factors. Dow argues that while giving control rights to the workforce facilitates the alignment of workers' incentives in the firm, this also makes it more difficult to offer credible guarantees of repayment to investors (see also Bowles and Gintis, 1994). As the conflict of interest between managers and workers is virtually eliminated in WMFs, this type of firms would reduce supervision costs and elicit higher levels of effort through the combination of profit sharing and mutual monitoring among coworkers, overcoming the standard free-rider problem associated with

[7] Estrin and Uvalic (2008) discuss the underinvestment critique in the context of the Yugoslav system.
[8] There is also evidence that existing membership markets operate imperfectly as share prices seem to be systematically undervalued (Craig and Pencavel, 1992).

team production (Alchian and Demsetz, 1972).[9] However, WMFs would face a disadvantage in attracting capital as members may not act in the interest of the lender. They may decide to pay high wages, misuse the capital equipment, or engage in risky projects. According to Dow, the net effect of these commitment problems is to bias the allocation of control rights over firms against labor. While capitalist firms develop social conventions that would make the workplace conflict tolerable, WMFs -- mainly composed of wealth-constrained workers -- would have limited access to capital markets.

Third and last, there are *composition asymmetries* involving disparities in the characteristics of control groups such as their size or the degree of heterogeneity in members' preferences. The problems faced by WMFs with a heterogeneous workforce have been pointed out, notably by Hansmann (1996). WMFs may face higher costs of collective decision making associated with democratic governance compared with conventional organizations. While capital suppliers unanimously support the maximization of profit, workers may have widely different attitudes toward effort, investment decisions, wage levels, job security, and other workplace amenities.[10] For instance, it has been argued that WMFs may suffer from excessive egalitarianism which, in turn, may cause the outflow of high ability workers (Gui, 1987; Kremer, 1997; Abramitzky, 2008).[11] There is empirical support for the idea that the presence of skilled labor has a positive and significant effect on firm survival (Gimeno et al., 1997; Mata and Portugal, 2002; Geroski et al., 2010). Hence, the inability of WMFs to retain skilled labor may negatively affect their survival chances compared with conventional firms.[12]

Compared with the extensive theoretical literature, empirical work studying the relationship between workers' control and firm survival is rather uncommon. Previous studies on

[9] Available empirical evidence generally indicates that worker cooperatives do not underperform conventional firms in terms of productivity (Craig and Pencavel, 1995; Jones, 2007; Fakhfakh et al., 2012; Pencavel, 2012). For experimental evidence on team production see, e.g., Carpenter et al. (2009) and Grosse et al (2011).

[10] Conventional investors may have different time horizons and time preference rates, and these may also result in collective choice problems regarding investment decisions in capitalist firms (Pencavel, 2012).

[11] Indeed, survey evidence indicates that WMFs usually have a more compressed wage structure than conventional firms (see, e.g., Bartlett et al., 1992).

[12] Inequality may be detrimental for firm performance if it increases perceptions of unfairness among workers and deters cooperation in the workplace (Akerlof and Yellen, 1990; Levine, 1991; Baron and Pfeffer, 1994).

WMFs' survival have usually lacked appropriate micro-data for both types of firms and relied on aggregate descriptive comparisons (Pérotin, 1987; Ben-Ner, 1988b; Staber, 1989; Pérotin, 2004).[13] Close to the empirical approach adopted in this study, Park et al. (2004) studied the effect of employee ownership plans (ESOPs) on firm survival, relying on data from U.S. public companies and estimating a Weibull model. They found that employee ownership increases the probability of firm survival and suggested that the higher survival rate may be explained by the greater employment stability exhibited by these companies.[14]

I.3 Worker-managed firms in Uruguay

In Uruguay, WMFs are those firms that are legally registered as producer cooperatives (PCs) in which the employee-to-member does not exceed 20%. Worker-managed firms are allowed to hire temporary employees in response to seasonal demand changes, but they must still comply with the legislated maximum level of hired workers in order to receive certain tax advantages—in particular, the exemption from paying the employer payroll tax to social security. The law also requires a minimum of six members to register a new cooperative firm.

Although their key organizational features are predetermined by law, WMFs have discretion over a broad range of associational rules. With respect to governance structure, WMFs must have a general workers' assembly that selects a council to supervise the daily operations (the council, in turn, usually selects the managers). Each member has only one vote, regardless of her capital contribution to the firm.

Physical assets of WMFs can be owned by their members either collectively or individually. Under collective ownership, members do not own tradable shares but enjoy the right to usufruct as long as they work in the firm. Under individual ownership, members own capital shares that vary with the firm's value. Most Uruguayan WMFs operate under a collective ownership regime. As in other countries, membership markets are extremely rare

[13] A related strand of research analyzes the relationship between unionization and closures (Freeman and Kleiner, 1999; Bryson, 2004; DiNardo and Lee, 2004).
[14] Park et al. (2004) identified employee-owned firms as those in which workers own 5% or more stock of the company. This raises the concern about the limited scope of workers' control in most of these companies.

in Uruguay.[15] A recent survey indicates that less than 10% of Uruguayan WMFs are owned by their workforce through individual shares (Alves et al., 2012). The activities of WMFs are financed via bank loans and/or retained earnings.[16]

Previous studies have shown that Uruguayan WMFs exhibit a different adjustment process of wage and employment levels compared with conventional firms. The employment responses to idiosyncratic and macroeconomic shocks seem to be less elastic in WMFs than in conventional firms (Burdín and Dean, 2009; 2012).

I.4 Data and descriptive statistics

This study is conducted using an unbalanced panel of Uruguayan firms, consisting of monthly firm-level observations over the period January 1997 - July 2009. The data set is based on social security administrative records provided by *Banco de Previsión Social* (BPS), which is the public agency in charge of social security affairs in Uruguay. The data set covers the entire population of firms registered as Producer Cooperatives (PCs) and conventional firms in 112 3-digit sectors in which at least one PC was registered during that period. The available firm-level information includes firms' industry class (5 digits, ISIC, fourth revision), employment, and average wage, distinguishing members and nonmembers in the case of PCs. The analysis is based on all cohorts of newly formed firms since February 1997 onwards. I do not consider firms that were already active at the beginning of the observation period (January 1997) as their spells are left censored, i.e., there is no information on their starting dates.[17]

Previous studies on Uruguayan WMFs have pointed out that not all firms registered as PCs should be considered as WMFs. Specifically, in many firms legally registered as PCs the majority of the workforce has no control over firm decisions (Burdín and Dean, 2009,

[15] There is evidence that existing membership markets operate imperfectly, since share prices seem to be systematically undervalued (Craig and Pencavel, 1992). The role of membership markets has been extensively discussed in the literature (Sertel, 1982; Dow, 1986; Fehr, 1993).

[16] It is worth noting that capital markets play a minimal role in the financing and capitalization of conventional firms in Uruguay.

[17] Left-censored firms have already been exposed to the risk of failure for an unknown amount of time before coming under observation. It is a common practice in survival analysis to exclude left-censored spells (see, e.g. Giuliano et al., 2011).

2012). I distinguish WMFs from the total population of producer cooperatives using information on the employee-to- member ratio. I define WMFs as those firms registered as PCs where this ratio is no greater than 20% (measured at the time of entry) and exclude observations on PCs the computed ratio is greater than 20%.

As for the identification of firm failures, I proceed as follows. All private Uruguayan firms must transfer employees' social security contributions; when a new firm is registered as active in BPS files, a corresponding entry can be identified in the data, while a firm cancellation indicates it is no longer active as such (i.e., a "failure"). Hence, the date of entry and exit of each firm can be determined accurately.[18] "Failure" is a dummy variable which takes value 1 (at the exit date) if the firm exits during the period and 0 otherwise.

The way in which failures are identified in the data requires two further clarifications. First, information on the reason for dissolution is not available. This is a potential limitation as cases of successful firms which dissolved from being bought out by another firm may be counted as failures. Specifically, it is not possible to identify mergers and acquisitions. However, anecdotal evidence suggests that a negligible fraction of dissolutions can be explained by these reasons.[19]

Second, a broader definition of organizational failure may not only include dissolutions but also transformations of one organizational type into another (Ben-Ner, 1988a). For instance, workers may buy out a CF in financial distress and convert it into a WMF in order to prevent the firm from shutting down, but conversions of CFs into WMFs cannot be identified in the data. However, survey evidence indicates that most Uruguayan WMFs were created from scratch. Only 11% of total PCs that were active in 2009 had been formed through conversions of conventional firms (Alves et al., 2012). In addition, it has been argued that successful WMFs may degenerate into CFs, increasing the employee-to-

[18] Audretsch et al. (1999) investigated the relationship between start up size and firm survival, also using social security records from Italy.

[19] There are no official statistics on mergers and acquisitions in Uruguay. The firms are obliged to report mergers and acquisitions to the Commission for the Promotion and Defense of Competition (Ministry of Economy and Finance) only in cases in which such operations involve substantial changes in the market structure. For instance, the commission received only eleven notifications of mergers and acquisitions during the period 2009-2011.

member ratio over time (Ben-Ner, 1984). Considering the impossibility of providing a unified treatment of conversions into both CFs and WMFs, the cases of WMFs that increase their employee-to-member ratio, surpassing the initial threshold of 20% over the course of their life, were not computed as failures.[20] Hence, the definition of "failure" used in the analysis refers only to dissolutions.

The basic information on the firm-level panel for the final sample is reported in Appendix Table I.A1. There are 29,125 different firms, including 223 WMFs (i.e., 1% of total firms in the sample and 74% of total firms registered as PCs). As the average number of monthly records per firm is 43.21, the total number of firm-month observations in the data is 1,258,606. There are approximately 15% of firms with time gaps (interval truncation), and the median gap length is 5 months. A gap in a firm's spell may be due to a temporary interruption of operations or to the fact that the firm exits and restarts with the same identification number. The social security agency keeps the original identification in both cases. Temporary exits from the panel are not computed as failures. The number of firm failures is 15,308, including 90 failures of WMFs. The average failure rate is lower in WMFs (40.4%) than in CFs (53%).

Table I.1 reports information on the characteristics of both types of firms. Firm start-up size is larger in WMFs than in CFs. While most CFs (84%) are classified as micro-enterprises (less than 6 workers), WMFs (63%) are typically small firms (between 6 and 19 workers).[21] This is due to the fact that Uruguayan law determines that WMFs cannot be formed with less than six members. WMFs are highly concentrated in Services (49%) while CFs are more frequently located in Manufacturing, Transport, and Other Sectors (Construction, Electricity, and Retail Trade). The average firm wage at the entry date is higher in CFs than in WMFs.

[20] Below, I analyze the sensitivity of the results to the inclusion of this group of WMFs.

[21] This right-skewed size distribution is characteristic of Uruguayan firms. For instance, data from the National Statistical Institute indicate that 83% of Uruguayan firms employed less than 5 workers in 2010 (www.ine.gub.uy).

Table I.1. Descriptive statistics of firm-level variables

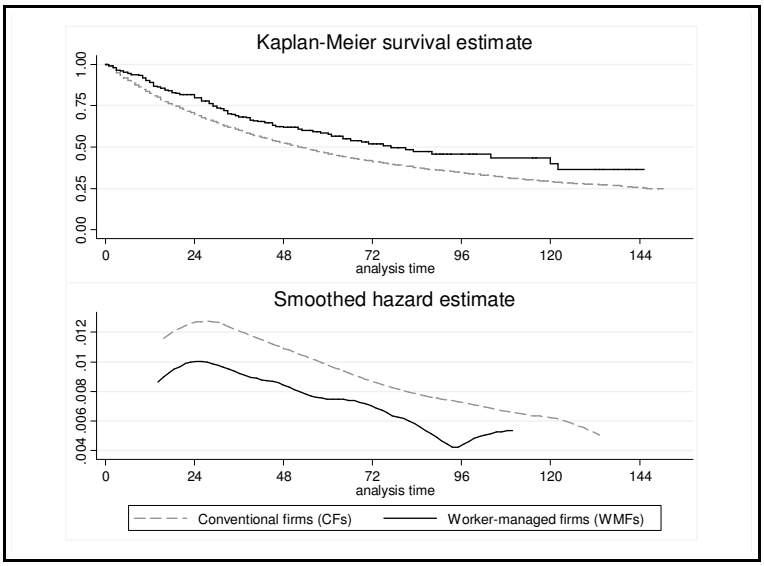
	1997-1999		*2000-2002*		*2003-2005*		*2006-2009*		*Total*	
	CFs	WMFs	CFs	WMFs	CFs	WMFs	CFs	WMFs	CFs	WMFs
Firm start-up size (in logs)	0.72	2.42	0.81	2.24	0.78	2.13	0.76	2.02	0.76	2.22
	(0.90)	(0.74)	(0.95)	(1.19)	(0.91)	(0.90)	(0.93)	(0.84)	(0.92)	(0.95)
Start-up average wage (in logs)	8.34	7.44	8.24	7.62	7.96	7.46	8.29	7.55	8.21	7.51
	(0.92)	(1.35)	(0.96)	(1.31)	(0.93)	(1.16)	(0.90)	(1.39)	(0.94)	(1.29)
Effective tax burden	0.086	0.023	0.081	0.014	0.075	0.006	0.075	0.005	0.081	0.013
	(0.049)	(0.042)	(0.053)	(0.031)	(0.049)	(0.014)	(0.028)	(0.016)	(0.049)	(0.030)
Sectoral composition (%)										
Manufacturing	27.85	13.52	25.43	27.19	27.44	16.70	23.98	25.05	26.69	19.76
Transport	13.52	9.06	10.48	11.04	13.80	8.00	13.67	5.57	12.82	8.78
Services	25.72	54.07	28.94	50.88	26.72	44.16	33.88	45.57	27.71	48.90
Other Sectors	32.91	23.35	35.14	10.89	32.04	31.15	28.47	23.81	32.78	22.56
Size composition (%)										
Micro-firms	85.35	3.5	82.53	24.31	84.2	25.09	84.64	25.64	84.26	18.96
Small firms	12.1	80.5	14.56	50.69	13.23	59.47	12.2	58.1	13.03	62.77
Medium firms	2.5	11.68	2.74	21.64	2.43	15.44	2.98	16.26	2.6	16.17
Large firms	0.05	4.32	0.17	3.36	0.15	0	0.19	0	0.12	2.1

Notes: Wages are defined as the firm wage bill divided by total employment and measured as pesos uruguayos deflated by the official Consumer Price Index (CPI). Start-up size is defined as the log of employment at the time of entry. Start-up wage is defined as the log of average firm wage measured at the time of entry. Tax burden is the effective employer payroll tax rate. Firms are classified in four categories according to their start-up size: micro (less than 6 workers), small (between 6 and 19), medium (between 20 and 99), and large (100 or more workers). The category ''Other Sectors" includes Construction, Electricity, and Retail Trade. Standard deviations are in parentheses. Source: Author's calculation using data from the Banco de Previsión Social

As expected, the comparison between dying and surviving firms indicates that survival is positively associated with employment and wage growth in both WMFs and CFs (see Appendix Table I.A2). This suggests that firm survival is associated with better firm performance no matter whether the dissolution decision is controlled by the workforce or by conventional investors. Interestingly, firm survival seems to be negatively correlated with both wage and employment variability. WMFs exhibit significantly less employment variability and more wage volatility and experience higher wage growth and lower employment growth rates than CFs. A similar pattern arises when micro-enterprises are excluded except that the differences in terms of employment growth reverse in favor of WMFs. As mentioned, Uruguayan law requires a minimum of six members in order to start

up a WMF. Hence, when the whole sample is considered the higher employment growth rates of CFs compared to WMFs may simply reflect a composition effect associated with the fact that firm growth is inversely related to start-up size (see, e.g., Audretsch et al., 1999). However, among those firms that do not fail employment grows faster in CFs than in WMFs.

Figure I.1. Survivor and hazard functions. Non-parametric estimates



Notes: The Kaplan-Meier survivor function is defined as $\hat{S}(t_j) = \prod_{j|t_j<t}\left(1-\frac{d_j}{n_j}\right)$, where d_j is the number of failures occurring at time t_j and n_j is the number at risk at t_j before the occurrence of the failures. The hazard function is calculated as a weighted kernel-density using the estimated hazard contributions, $\Delta\hat{H}(t_j) = \hat{H}(t_j) - \hat{H}(t_{j-1})$, where t_j is the current failure time and $\hat{H}(t_j)$ is the estimated cumulative hazard. The Nelson-Aalen estimator of $\hat{H}(t_j)$ is defined as $\hat{H}(t_j) = \sum_{j|t_j\le t}\left(\frac{d_j}{n_j}\right)$, i.e., the sum of the expected number of failures at each observed time. See Jenkins (2005) and Cleves et al. (2008) for further details on non-parametric survival analysis.

Figure I.1 reports non-parametric estimates of the survivor and hazard function, pooling all cohorts of newly formed firms during the period 1997-2009. At first glance, WMFs seem to have a lower hazard rate than CFs.[22] According to the log-rank test, I reject the null

[22] Entry and exit rates of WMFs and CFs are presented in the Appendix Figures A1 and A2.

hypothesis of equality of the survivor functions ($\chi_{(1)} = 10.1$).[23] The hazard exhibits an inverted U-shape for both WMFs and CFs, reaching a maximum around the second year of the firm's life span and then decreasing with firm age. The pattern of greater vulnerability of young firms observed in the data seems consistent with the "liability of newness" argument developed in the organizational ecology and industrial organizational literature on firm survival (Jovanovic, 1982; Freeman et al., 1983; Geroski, 1995).[24]

Figure I.A.3 (Appendix 1) provides a further exploratory analysis of the data, reporting the survivor functions by cohorts of firms and sectors. WMFs exhibit better performance than CFs in most cohorts, particularly when the comparison is restricted to retail trade and service firms. However, caution should be exercised before drawing definitive conclusions from these graphs for two reasons. First, non-parametric estimates do not account for other factors that may also affect firm survival. Second, given the small number of total WMFs, cohort-sector-specific survivor functions are imprecisely estimated. For these reasons, I provide a more rigorous econometric test of the differences in survivability between WMFs and CFs in the next sections, estimating semi-parametric and parametric duration models.

I.5 Econometric framework

The variable of interest in the analysis of firm survival is the time elapsed between entry and exit.[25] Firms' spells are either complete or right censored. Right censoring occurs for those firms whose entry date is known but who still do not fail when the observation period ends. The length of a spell for a firm $t > 0$ is the realization of a random variable T with a cumulative distribution function (cdf) and probability distribution function (pdf) given by $F(t)$ and $f(t)$, respectively. $F(t)$ is also known as the failure function. The survivor function is defined as $S(t) \equiv 1 - F(t)$ and represents the probability of surviving beyond

[23] Burdín and Dean (2010) obtained similar results comparing non-parametric estimates of the hazard of exit for Uruguayan WMFs and CFs over the period 1996-2005.
[24] The "liability of newness" refers to the higher risk of failure faced by younger firms (Stinchcombe, 1965).
[25] This section draws on Jenkins (2005).

time t.[26] The pdf is the slope of the failure function such that $f(t)=\lim_{\Delta t\to 0}\frac{P(t\le T\le t+\Delta t)}{\Delta t}=\frac{\partial F(t)}{\partial t}=-\frac{\partial S(t)}{\partial t}$.

The survivor function $S(t)$ and the failure function $F(t)$ both satisfy the properties of probabilities. $S(t)$ is bounded between zero and one and is strictly decreasing in t, $S(t)$ is equal to one at the beginning of the spell and zero at infinity. The hazard rate, $h(t)$, is defined as the instantaneous chance of failure at time t. More precisely, it is the conditional probability that the firm exits the market at time t, conditional on the fact that the firm has been active until t such that $h(t)=\frac{f(t)}{1-F(t)}=\frac{f(t)}{S(t)}$. Finally, the cumulative hazard rate, $H(t)$, is defined as the integral of the hazard rates over (0, t) such that $H(t)\equiv\int_0^t h(u)du$.[27]

The shape of the hazard function is, in principle, unknown, making it necessary to impose distributional assumptions on the data. To avoid misspecification errors, I estimate a Cox proportional hazard model. This model, originally proposed by Cox (1972), has been widely used in the literature on firm survival (for a review, see Manjón and Arauzo, 2008). The main advantage of this model lies in the fact that it enables to estimate the relationship between the hazard rate and the covariates without making assumptions about the functional form of the baseline hazard. The Cox model is specified as follows:

$$h(t\,|\,.)=h_0(t)\exp(\beta_1 COOP_i+\beta_2 X_i) \qquad \text{(I.1)}$$

where $h_0(t)$ is the baseline hazard function, COOP is a dummy variable that takes value equal to one if the firm is a WMF, and X is a vector of control variables. The coefficient of interest is β_1. The effect of a unit change in a covariate is to produce a constant proportional change in the hazard rate, i.e., the proportional hazard assumption.

[26] More precisely, $P(T\le t)=F(t)$, which implies for the survivor function that $P(T>t)=1-F(t)\equiv S(t)$.

[27] The only restriction on the hazard rate is that $h(t)\ge 0$. Note that $H(t)\ge 0$ and $\partial H(t)/\partial t=h(t)$.

I.6 Results

Table I.2 reports the estimates of the baseline Cox model. In Column (1), the estimates only control for firm's start-up size and average wage. More precisely, estimates include the log of employment at the entry date.[28] The average firm wage at the entry date is included as a rough proxy of the starting firm's quality. For instance, the average wage may reflect the initial endowment of human capital in the firm. In Column (2), the estimates include industry dummies in order to control for time-constant industry characteristics.

It has been argued that the environment at the time of entry largely determines the strategic choices of firms. Organizations founded in economically unfavorable times are unlikely to be close to their optimal structural configuration and may not be able to find the right kind of resources, make the correct organization-specific investments, or design appropriate organizational routines (Geroski et al., 2010). Furthermore, entrepreneurs who have entered self-employment after being unemployed exhibit higher exit rates than those who have entered subsequent to paid employment (Pfeiffer and Reize, 2000). Indeed, there is evidence pointing out that if the underlying motivation to start a new firm is linked to innovative projects, a better post-entry performance may be expected than if a new firm is started on the basis of a purely "defensive" motivation such as the fear of becoming unemployed (Vivarelli and Audretsch, 1998; Santarelli and Vivarelli, 2007). The effect of founding conditions may be important in this setting as it is well known that WMFs exhibit higher formation rates in recessions (Pérotin, 2006). Therefore, in Column (3) estimates also include cohort dummies in order to control for macroeconomic conditions at the time of entry.[29]

Results indicate that WMFs have higher survival chances than capitalist firms and the difference is highly significant in all specifications. According to estimates reported in

[28] Small firms may operate at a suboptimal scale level of output and face a cost disadvantage with respect to larger firms (Caves, 1998; Geroski, 1995; Audretsch and Mahmood 1995;Mata and Portugal 1994; Esteve et al., 2004).

[29] The inclusion of cohort dummies also ensures that the assumption that the true duration is independent of the starting and censoring time holds (Wooldridge, 2001: p. 696).

Column (3) of Table I.2, the hazard of dissolution is about 25% lower for WMFs than for CFs. [30] The included control variables have the expected effect. In line with the large IO literature on firm survival, there is a negative and significant relationship between initial firm size and the hazard of exit. Moreover, survival prospects are positively associated with the average firm wage at the time of entry. The estimated hazard function -- obtained from the Cox regression -- is plotted in the Appendix Figure I.A4.

Table I.2. Cox model estimates

	(1)	(2)	(3)
Coop	-0.326***	-0.298***	-0.293***
	(0.107)	(0.109)	(0.110)
Firm start-up size	-0.058***	-0.076***	-0.071***
	(0.01)	(0.01)	(0.01)
Firm start-up wage	-0.156***	-0.148***	-0.170***
	(0.009)	(0.009)	(0.009)
Hazard ratio	**0.722**	**0.742**	**0.746**
Industry fixed effects	No	Yes	Yes
Cohort fixed effects	No	No	Yes
Observations	1,245,207	1,245,207	1,245,207

Notes: Start-up size is defined as the log of employment at the time of entry. Start-up wage is defined as the log of average firm wage measured at the time of entry. In Columns (2)-(3), estimates include 4 industry dummies (distinguishing Manufacturing, Transport, Services, and Other Sectors). In column (3), estimates include 13 cohort dummies. The hazard ratio is obtained computing $\exp(\beta^{coop})$. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. * Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

To check the sensitivity of the results, alternative estimates were performed including year fixed effects to control for current macroeconomic conditions. I also estimated the model including four start-up size categories (distinguishing micro-, small, medium, and large firms) and 66 2-digit industry dummies and analyzed whether the results were affected by the exclusion of firms with time gaps in their records. Finally, to check whether the result was driven by the way in which I identified WMFs, I estimated the model by comparing

[30] I check the empirical plausibility of the proportional hazard assumption by means of graphical methods (Cleves et al., 2008). This assumption seems to be satisfied by the data (see Appendix Fig. A3). According to the test based on the Schoenfeld residuals for the variable *Coop*, I do not reject the proportional hazard (PH) assumption. However, the PH assumption is rejected when the global test of the model is considered (Appendix Table I.A3). In the next section I therefore analyze the sensitivity of the results to alternative parametric specifications that do not rely on the PH assumption.

conventional firms with all firms registered as PCs. Neither of these modifications altered the results.[31]

Table I.3. Cox model estimates by sectors

	(1)	(2)	(3)	(4)
	All firms (excluding Construction and Retail Trade)	Manufacturing	Transport	Services
Coop	-0.272**	0.173	0.014	-0.619***
	(0.118)	(0.190)	(0.288)	(0.189)
Firm start-up size	-0.082***	-0.079***	0.009	-0.094***
	(0.012)	(0.020)	(0.040)	(0.017)
Firm start-up wage	-0.165***	-0.164***	-0.238***	-0.148***
	(0.011)	(0.020)	(0.030)	(0.016)
Industry fixed effects	Yes	-.-	-.-	-.-
Cohort fixed effects	Yes	Yes	Yes	Yes
Observations	853,911	329,009	159,560	347,972

Notes: Start-up size is defined as the log of employment at the time of entry. Start-up wage is defined as the log of average firm wage measured at the time of entry. In column (1), estimates include 4 industry dummies (distinguishing Manufacturing, Transport, Services, and Other Sectors). All estimates include 13 cohort dummies. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. * Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

The observed difference between WMFs and CFs may reflect industry differences in demand volatility. To rule out this possibility, Column (1) of Table I.3 presents the results of additional estimates of the baseline Cox model, excluding Construction and Retail Trade firms.[32] I exclude these sectors because the presence of WMFs is comparatively low. The results are quite similar compared with baseline estimates. Even excluding firms located in sectors characterized by high firm turnover, the hazard of exit is 24% lower for WMFs than for CFs (exp(-0.272)-1). In Columns (2)-(4) of Table I.3, I report the results of separate estimates for Manufacturing, Transport, and Services. While in Manufacturing and Transport the hazard of exit is not significantly different, in the Services sector the hazard of exit of WMFs is 46% lower compared with CFs (exp(-0.619)-1). Thus, the better

[31] All of these additional estimates are available from the author upon request.
[32] It is worth mentioning that during this period the Uruguayan law forbade the formation of WMFs in the Retail Trade.

performance of WMFs in the Services sector explains the aggregate results obtained in the baseline estimates. This is consistent with the fact that firms in the Services sector have lower physical capital requirements compared with other sectors. According to some theoretical explanations previously discussed, this is precisely the kind of economic environment in which one would expect WMFs to outperform conventional firms (see, e.g., Bowles and Gintis, 1994; Dow, 2003).

I.7 Robustness checks

I performed a large number of robustness checks, addressing the following issues: i) differences in the size composition of both types of firms, ii) conversions of WMFs into CFs, iii) differences in tax regimes, iv) unobserved heterogeneity and alternative parametric specifications of the hazard function. All of these estimates are presented in Columns (1)-(6) of Table I.4.

I.7.1 Size composition

It is a stylized fact in the literature on firm survival that survival chances positively depend on firm size (Caves, 1998; Audretsch and Mahmood, 1994; Bartelsman et al., 2005). As explained, Uruguayan law prescribes that for their formation WMFs must have at least six members. This formal rule seems to be enforced reasonably well: on average, only 18% of WMFs can be defined as micro-enterprises. By contrast, 85% of CFs start up with less than six workers (see Table I.1). Even if previous estimates control for firm size, one may still be concerned that the results are an artifact of the different size composition of both types of firms. To rule out this possibility, Column (1) of Table I.4 reports the estimates of the Cox model excluding micro-enterprises.[33] It is worth noting that in this case estimates are performed with 201,877 observations (i.e., 16% of the original sample). Despite this dramatic loss of information, results remain qualitatively unchanged. WMFs exhibit higher survival chances than CFs, even excluding micro-enterprises. I continue restricting estimates to firms employing at least six workers at the time of entry throughout the rest of the analysis.

[33] As reported in Table I.1, the size composition of WMFs and CFs becomes rather similar after the exclusion of micro-enterprises.

I.7.2 Degeneration

I identified WMFs as those firms registered as PCs with an employee-to member ratio no greater than 20% at the time of entry. This implies that previous estimates may have pooled WMFs in which the employee-to-member ratio evolved rather differently, including cases of WMFs where the ratio surpassed the initial threshold of 20% at some point in time. It is worth noting that hired workers in WMFs, similar to workers employed in CFs, do not have formal control rights, which means that the higher the fraction of employees, the lower the proportion of the workforce involved in the firm's decision making. One could argue that in such cases WMFs have survived longer, though at the expense of degenerating into CFs (Ben-Ner, 1984).[34] However, it is doubtful whether a WMF that surpasses the 20% threshold in a given month should be considered a case of organizational transformation as the law allows WMFs to exceed the threshold temporarily to cope with seasonal demand increases. A better approximation is to identify WMFs that have been converted into CFs as those WMFs whose employee-to-member ratio averaged during their entire spells exceeds 20%. Column (2) of Table I.4 reports additional estimates excluding those cases. Results remain qualitatively unchanged. Workers' control is positively associated with firm survival, even excluding that group of WMFs.

I.7.3 Differences in tax regimes

As in most countries, WMFs in Uruguay benefit from a favorable tax treatment. Specifically, they are exempted from paying the employer payroll tax (i.e., employer contributions to the pension system) for the fraction of the wage bill corresponding to members (this exemption does not apply to hired workers in WMFs).[35] In fact, as reported in Table I.1, this implies that WMFs face a lower effective tax burden than CFs. One may argue that the superior performance of WMFs in terms of survivability is simply a by-product of this favorable tax regime. Interestingly, during the period of analysis there was considerable variability in payroll tax rates applied to CFs across industries and over time,

[34] Burdín and Dean (2009) did not find support for the degeneration hypothesis in the Uruguayan case.
[35] Uruguayan WMFs are also fully exempted from the corporate income tax (IRAE). However, the corporate tax rate is quite low in Uruguay (25%). Available estimates indicate that the corporate income tax, on average, represents 1% of firm revenue in Uruguay (Gonzalez and Montero, 2008).

including subperiods of a zero tax rate in specific sectors (Manufacturing, Transport). In addition, the Uruguayan constitution provides for further tax exemptions in sectors where WMFs and CFs compete such as the provision of educational services. Hence, CFs also enjoy full or partial tax exemptions in many sectors during the period of analysis (Bucheli and Vigna, 2006).[36]

Using the information on the 5-digit industry classification and the wage bill of each firm (distinguishing members and employees of WMFs), I construct a measure of the *effective tax burden* faced by each firm over time. I define the effective tax rate faced by firm *i* at time *t* as the total payroll tax bill divided by the total wage bill and, hence, given by $T_{it} = \frac{Taxbill_{it}}{W_{it}}$. This variable is intended to control for differences in non-wage labor costs incurred by both types of firms. Results are presented in Column (3) of Table I.4. The effect of the *effective tax burden* on the hazard of exit is significantly positive, though rather small.[37] A one percentage point increase in the tax burden increases the hazard rate by 3%. Being a WMF still has a negative effect on the hazard rate compared with CFs. The magnitude of the effect is smaller compared with estimates reported in Column (1) of Table I.4: the hazard rate is about 29% lower for WMFs than for CFs.

I.7.4 Unobserved heterogeneity and parametric hazard specifications

The Cox model allows to estimate the effect of covariates without making assumptions about the pattern of duration dependence of the hazard. Although this procedure minimizes specification errors, it produces less efficient estimates compared with the "correct" parametric model. Moreover, previous estimates have assumed that all differences between firms are captured by observed explanatory variables. This may bias coefficient estimates and overestimate the negative duration dependence of the hazard function, i.e., the duration dependence of the hazard may be less negative when unobserved heterogeneity is present (Jenkins, 2005). A frailty model defines the hazard to be: [38]

[36] Table I.A4 (Appendix) provides a detailed description of the evolution of tax rates by sectors between 1997 and 2009.
[37] To avoid potential feedback effects, the effective tax burden is lagged three months.
[38] The formal exposition draws heavily on Cleves et al. (2008).

$$h(t_i \mid x_i, \alpha_i) = \alpha_i h(t_i \mid x_i) \tag{I.2}$$

where α_i is some unobserved observation-specific effect ("frailty"). Effect α_i is known as frailty and indicates that firms are heterogeneous due to factors that remain unobserved. It is assumed that α_i has mean one and variance θ, where θ is estimated from the data. The relationship between hazard and survivor function is such that

$$S(t_i \mid x_i, \alpha_i) = \{S(t_i \mid x_i)\}^{\alpha_i} \tag{I.3}$$

where $S(t_i \mid x_i)$ is the survival function for a standard parametric model. The unconditional survival function is obtained by integrating the unobservable α_i. Assuming that α_i follows a gamma distribution and has a pdf $g(\alpha_i)$, the unconditional survivor function is such that

$$S_\theta(t_i \mid x_i) = \int_0^\infty \{S(t_i \mid x_i)\}^{\alpha_i} g(\alpha_i) d\alpha_i \tag{I.4}$$

where
$$g(\alpha_i) = \frac{\alpha_i^{1/\theta - 1} \exp(-\alpha_i / \theta)}{\Gamma(1/\theta)\theta^{1/\theta}} \tag{I.5}$$

Finally, combining (4) and (5), the following expression is obtained:

$$S_\theta(t_i \mid x_i) = \left[1 - \theta \ln\{S(t_i \mid x_i)\}\right]^{-1/\theta} \tag{I.6}$$

The frailty model is the standard parametric model with the addition of one new parameter, θ.[39] Assuming a Weibull distribution of the hazard with gamma-distributed heterogeneity, the survivor function can be written as follows:

[39] It is worth noting that $S_\theta(t_i \mid x_i)$ reduces to $S(t_i \mid x_i)$ as θ goes to zero.

$$S_\theta(t_i \mid x_i) = \left[1 + \theta \exp(\beta_0 + x_i\beta_x) t_i^p)\right]^{-1/\theta} \quad \text{(I.7)}$$

Estimates of this model are reported in Column (4) of Table I.4. Results remain unchanged: WMFs exhibit a lower hazard than CFs.[40] The estimated parameter $1 < \hat{p} < 2$ in the Weibull model indicates that the hazard is increasing over time at a decreasing rate.[41] This pattern of duration dependence is not consistent with the shape of the hazard reported in Figure I.1. Considering the potential misspecification of the hazard, Column (5) reports the estimates of the frailty model, assuming a log-logistic distribution of the hazard. Results are qualitatively similar. The status of WMF is positively associated with longer survival times.[42] As the estimated parameter $\hat{\gamma} < 1$, the log-logistic hazard increases and then decreases, which, in turn, is consistent with the inverted U-shaped pattern described in Figure I.1.

Finally, Column (6) of Table I.4 presents the estimates of a generalized gamma model.[43] Apart from the coefficient β, this model involves the estimation of two additional parameters, κ and σ. The gamma model presents two main advantages. First, it possesses a highly flexible hazard function, allowing for a large number of possible shapes. Second, this distribution includes, as special cases, the Weibull model ($\kappa = 1$), the exponential model ($\kappa = 1, \sigma = 1$), and the log-normal model ($\kappa = 0$). The fact that these parametric models are nested allows the use of the gamma model to search the appropriate parametric specification for the data. The estimate indicates that the status of WMF has a positive effect on survival time. The estimate of the coefficient of interest $\hat{\beta}^{COOP} = 0.545$ indicates

[40] The Wald test for $H_0 : \ln(p) = 0$ for which the test statistic is 8.98 leads to rejection of the null hypothesis of constant hazard.

[41] The 95% confidence interval for $\hat{p}$ is (1.239 1.397).

[42] The log-logistic model has no proportional hazard interpretation as it is defined in the Accelerated Failure Time (AFT) metric. The effect of the covariates must be interpreted in terms of survival time and not in terms of the hazard. Therefore, the magnitude of the effect cannot be compared with Cox model estimates.

[43] The gamma model is also defined in the AFT metric.

that the status of the WMF increases the expected value of $\ln(t)$ by 0.545, i.e. being a WMF is expected to increase survival time by approximately 72.5%, or roughly 2.74 years.[44]

Table I.4. Robustness checks

	Semi-parametric models			Parametric models			
	Proportional hazard			Accelerated failure time			
	Cox-model			Weibull	Log-logistic	Gamma	Log-normal
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Coop	-0.502***	-0.476***	-0.338**	-0.705***	0.533***	0.545***	0.543***
	(0.138)	(0.151)	(0.168)	(0.209)	(0.160)	(0.156)	(0.156)
Firm start-up size	-0.009	-0.010	-0.039	-0.009	0.005	0.023	0.0232
	(0.033)	(0.033)	(0.038)	(0.049)	(0.037)	(0.038)	(0.0377)
Firm start-up wage	-0.243***	-0.245***	-0.239***	-0.430***	0.327***	0.318***	0.319***
	(0.025)	(0.025)	(0.026)	(0.042)	(0.030)	(0.03)	(0.0296)
Tax burden			0.032***				
			(0.008)				
Hazard ratio	**0.605**	**0.621**	**0.713**	**0.494**	**-.-**	**-.-**	**-.-**
κ						0.029	
						(0.071)	
σ						1.481	1.491
						(0.036)	(0.024)
P				1.316			
				(0.040)			
γ					0.783		
					(0.02)		
θ				1.589	0.281		4.69e-06
				(0.165)	(0.079)		(0.0004)
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	201,877	200,139	185,671	201,877	201,877	201,877	201,877

Notes: All estimates are restricted to firms employing at least six workers at the time of entry. Start-up size is defined as the log of employment at the time of entry. Start-up wage is defined as the log of average firm wage measured at the time of entry. In Column (2), WMFs in which the average value of the employee-to-member ratio during their spells is greater than 20% are excluded. In Column (3), the tax burden variable is lagged three months. All estimates include 4 industry dummies (distinguishing Manufacturing, Transport, Services, and Other Sectors) and 13 cohort dummies. The hazard ratio is obtained computing $\exp(\beta^{coop})$. Columns (1)-(3) report Cox model estimates. Columns (4)-(5) report estimates of parametric frailty models that control for unobserved observation-specific effects and assume a Weibull and log-logistic distribution of the baseline hazard, respectively. The frailty term is assumed to follow a gamma distribution with mean 1 and variance θ. Column (6) reports the estimate of a Generalized Gamma model. In Columns (5)-(6), the effect of the covariates must be interpreted in terms of survival time (Accelerated Failure Time metric) and not in terms of the hazard. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. * Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

[44] This effect is computed as exp(0.545)=1.725. The mean firm duration in the sample (excluding microenterprises) is 45.3 months. Hence, (45.3*0.725)/12=2.73.

The Wald test for $H_0 : \kappa = 1$ leads to a strong rejection of the Weibull model ($\chi_{(1)} = 185.59$). The result of the Wald test for $H_0 : \kappa = 1, \sigma = 1$ also allows to discard the exponential model ($\chi_{(1)} = 260.35$), suggesting that the hazard is not constant over time. The 95% confidence interval for $\hat{\kappa}$ is (-0.111 0.169), which indicates that the log-normal model is not rejected $(H_0 : \kappa = 0)$. In fact, Column (7) of Table I.4 reports estimates of a log-normal model which are similar to the gamma model.[45]

I.8 Disentangling possible explanations

The results presented in the previous sections are surprising, considering several theoretical predictions which suggest that WMFs have lower survival chances than conventional firms. In this section, I evaluate the relevance of different explanations that may account for the previous findings. [46]

The higher survival chances of WMFs may simply reflect the fact that worker-members exert control over the dissolution decision, particularly when outside job opportunities are scarce. Members may be more reluctant to close the firm than conventional investors and decide to continue running it just in order to secure their jobs. It is doubtful whether the lower hazard of dissolution of WMFs can be interpreted as a measure of firm performance in this case. From a social point of view, it might be better to dissolve the firm and reallocate labor and physical assets to more productive firms. In fact, the period analyzed in this paper includes four years (1999-2002) in which Uruguay faced a deep economic crisis. This may partly explain the large difference in survival prospects in favor of WMFs found in the previous sections.

To rule out this explanation, I split the analysis in two four-year subperiods characterized by notably different macroeconomic conditions and perform separate survival estimates for each period. During the period 1999-2002, Uruguay experienced a severe economic crisis.

[45] In fact, the log-normal model gives the lowest Akaike Information Criterion (AIC) index, which suggests its selection from among several parametric models (Appendix Table I.A5).
[46] This section draws on helpful comments and suggestions provided by an anonymous referee.

The average GDP growth rate was -3.7%, and the unemployment rate rose to 17% in 2002. By contrast, between 2004 and 2007 the Uruguayan economy performed extremely well, the GDP grew on average 5.8%, and the unemployment rate decreased to 9.6% in 2007. The average unemployment rate was 2.7 percentage points lower compared with the period 1999-2002 (see Appendix Table I.A6).

Table I.5 reports the results of separate estimates for the two periods of a parametric survival model that assumes an exponential distribution of the baseline hazard.[47] If the higher survival chances of WMFs are mainly driven by the lack of alternative jobs, one should note that WMFs outperformed CFs mainly during the period 1999-2002. The estimates do not seem to support this hypothesis. The status of WMFs significantly reduces the hazard of dissolution under both expansionary and recessionary macroeconomic conditions. Indeed, the comparison of point estimates suggests that the magnitude of the effect is slightly larger for the economic boom than for the recession.[48] The greater survivability of WMFs is not merely the outcome of defensive strategies implemented by insiders during economically unfavorable times.

A more straightforward explanation is that WMFs survive longer because they are more productive than CFs, as some studies have shown (Craig and Pencavel, 1995; Perotin et al., 2012). As reported in Appendix Table I.A2, firm survival is positively associated with wage growth, and WMFs exhibit higher wage growth -- a crude proxy of productivity growth -- than their conventional counterparts, even excluding micro-enterprises. Unfortunately, the lack of information on output and non-labor inputs in social security records precludes constructing appropriate productivity indicators at the firm level.

[47]The crucial assumption of this model is that the firm faces the same hazard at any age (constant hazard), which allows the inclusion of left-censored firms, i.e., firms that are already active at the beginning of each subperiod (1999 and 2004, respectively). Cox model estimates, also reported in Table I.5, provide similar results.

[48] The effect of WMFs on the hazard of exit for the subperiod 1999-2002 is statistically significant only at 10%.

Table I.5. Survival estimates under different macroeconomic conditions

	Cox model		Exponential model	
	Period 1999-2002	Period 2004-2007	Period 1999-2002	Period 2004-2007
Coop	-0.435	-0.518***	-0.437*	-0.523***
	(0.265)	(0.195)	(0.265)	(0.197)
Firm start-up size	-0.102*	0.064	-0.100	0.065
	(0.062)	(0.050)	(0.062)	(0.051)
Firm start-up wage	-0.183***	-0.285***	-0.183***	-0.288***
	(0.041)	(0.036)	(0.041)	(0.036)
Hazard ratio	**0.647**	**0.596**	**0.646**	**0.593**
Industry fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
Observations	49,762	86,301	49,762	86,301

Notes: All estimates are restricted to firms employing at least six workers at the time of entry. Start-up size is defined as the log of employment at the time of entry. Start-up wage is defined as the log of average firm wage measured at the time of entry. All estimates include 4 industry dummies (distinguishing Manufacturing, Transport, Services, and Other Sectors) and 13 cohort dummies. The hazard ratio is obtained computing $\exp(\beta^{coop})$. Robust standard errors are in parentheses. Standard errors are clustered at the firm level.
* Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

Compensation flexibility and employment stability may be other possible mechanisms accounting for the lower risk of dissolution of WMFs. Compensation flexibility may enable firms to weather negative demand shocks, enhancing survival prospects. It has also been argued that employment stability may affect firm survival through labor productivity. Long-term employment relations may create better incentives to invest in training and firm-specific human capital. Workers may also be more willing to share productive information with managers as productivity improvements will not jeopardize their jobs (Levine and Parkin, 1994). Indeed, there is extensive evidence suggesting that WMFs exhibit greater employment stability and wage variability than conventional firms (Craig and Pencavel, 1992; Pencavel et al., 2006; Pencavel, 2012). This empirical regularity has also been proved to hold for the Uruguayan case (Burdín and Dean, 2009).

Table I.A2 also reports that WMFs exhibit significantly greater compensation flexibility and employment stability than CFs. In addition, somewhat surprisingly, information provided in Table I.A2 shows that compensation flexibility is not a good candidate to

explain the higher survival chances of WMFs as surviving firms generally exhibit lower wage variability than dying firms. By contrast, firm survival seems to be positively correlated with employment stability.

To provide additional evidence on the role played by these mechanisms, I estimate the Cox model, adding wage variability and employment variability as control variables. As pointed out, WMFs significantly differ from CFs in terms of these variables. Hence, if some of these factors mediate the relationship between workers' control and firm survival, one would expect that their inclusion will partly absorb the effect associated with the WMF variable.[49] Results are reported in Table I.6. For simplicity, Column (1) of Table I.6 reproduces the baseline results excluding micro-enterprises.[50] Column (2) presents the estimates of the Cox model including an indicator of wage variability. Consistent with the descriptive analysis presented in Table I.A2, there is a significantly positive association between wage variability and the hazard of dissolution. The estimated WMF coefficient remains unchanged compared with the baseline estimates, suggesting that compensation flexibility in itself does not explain the positive relationship between workers' control and firm survival. Column (3) reports the results of the Cox model in which differences in employment variability between firms are controlled for. There is a positive correlation between employment instability and the hazard of exit. Interestingly, the negative effect of WMFs on the hazard decreases considerably and remains statistically significant only at 10%, suggesting that employment variability is partly picking up the effect of workers' control on firm survival. Differences in employment variability roughly explain 34% of the difference in the hazard of dissolution between WMFs and CFs reported in Column (1) of Table I.6.[51]

Considering the potential endogeneity of these variables, I perform additional estimates, measuring these variables just over the pre-2004 period and studying their effect on the

[49] This approach is similar to the one adopted by Park et al. (2004).
[50] Firms with short spells (less than 12 months) are excluded by construction as it is not possible to compute the annual change in employment and wages for those firms. This explains the slight variation in the estimates and the number of observations compared to Column (1) of Table I.7.
[51] This is computed as (0.734-0.6)/(1-0.6)=0.34.

post-2003 likelihood of survival. In this case, the analysis is restricted to pre-2004 cohorts of firms. It is reasonable to assume that the pre-2004 values of these variables are exogenous with respect to the post-2003 firm survival. Results remain qualitatively unchanged. The effect of workers' control on firm survival is lower and no longer significant after controlling for the pre-2004 employment variability (see Appendix Table I.A7). Therefore, the higher survival rate of WMFs appears to be partly linked with lower employment variability, implying that employment stability may be a potential mediator between workers' control and firm survival. This result is in line with previous evidence on the effect of employee stock ownership plans (ESOPs) on firm survival (Park et al., 2004)

Table I.6. Employment stability, wage flexibility, wage growth, and firm survival. Cox model estimates

	(1)	(2)	(3)	(4)
Coop	-0.511***	-0.518***	-0.309*	-0.369**
	(0.166)	(0.164)	(0.161)	(0.161)
Firm start-up size	0.046	-0.023	-0.035	-0.065
	(0.04)	(0.042)	(0.041)	(0.041)
Firm start-up wage	-0.200***	-0.137***	-0.147***	-0.115***
	(0.028)	(0.030)	(0.028)	(0.028)
Wage variability		0.781***		0.628***
		(0.103)		(0.099)
Employment variability			0.817***	0.628***
			(0.072)	(0.074)
Hazard ratio	**0.600**	**0.596**	**0.734**	**0.691**
Industry fixed effects	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes
Observations	194,894	194,894	194,894	194,894

Notes: All estimates are restricted to firms having at least 12 monthly records and employing at least six workers at the time of entry. Start-up size is defined as the log of employment at the time of entry. Start-up wage is defined as the log of average firm wage measured at the time of entry. Wage growth is defined as the annual change in the log of average firm wage. Employment and wage variability are measured as the standard deviation of annual changes in the log of employment and wages, respectively. All estimates include 4 industry dummies (distinguishing Manufacturing, Transport, Services, and Other Sectors) and 13 cohort dummies. The hazard ratio is obtained computing $\exp(\beta^{coop})$. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. *Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

I.9 Conclusions

Based on a long micro-panel of Uruguayan firms, I conducted a survival analysis comparing WMFs and CFs. In contrast to the theoretical "pessimism" regarding the viability of workers' control in market economies, I find that WMFs exhibit lower hazard rates (longer survival times) than CFs. This finding remains robust to the exclusion of micro-enterprises, to the exclusion of sectors with high firm turnover, in which WMFs are less frequently observed, and to alternative estimation strategies based on semi-parametric and parametric frailty models. Moreover, the results do not seem to be driven by the differential tax regime applied to WMFs. The hazard of dissolution is 29% lower for WMFs than for CFs after controlling for differences in the tax burden faced by the two types of firms and excluding micro-enterprises.

This finding seems to contradict several theoretical predictions that WMFs will have performance problems and a higher risk of dissolution, related, for instance, to poor work incentives, inefficient investment and risk taking decisions, and costly collective choice problems (for a review, see Dow and Putterman, 2000; Dow, 2003). I do not specifically address whether or not WMFs are affected by some of these problems. Nevertheless, the evidence suggests that potential internal inefficiencies are counterbalanced by other comparative organizational advantages.

I examined several possible explanations for the results. WMFs outperform CFs under both recessionary and expansionary macroeconomic conditions, suggesting that the greater survivability of WMFs cannot be explained merely by the fact that members exercise their control rights over the dissolution decision when outside job opportunities are scarce. Compensation flexibility does not in itself explain the higher survival chances of WMFs as firm survival is generally correlated with lower wage variability. The positive effect of workers' control on firm survival seems to be associated with the greater employment stability exhibited by WMFs. Long-term employment relationships may encourage worker-members to make firm-specific investments and facilitate organizational changes which, in turn, may increase productivity and survival prospects. In addition, workers with job security have a longer time horizon, and this would make group-based rewards and peer

pressure more effective, sustaining cooperation in work teams (Levine, 1992; Levine and Parkin, 1994). Consistently with this argument, survey evidence comparing WMFs and CFs in Uruguay indicates that WMFs employ fewer supervisors compared with CFs, rely more on mutual monitoring among co-workers, and are more likely to introduce organizational innovations such as team work, quality groups, job rotation, and consultation mechanisms (Alves et al., 2012).

This study has some caveats that deserve further analysis. First, direct measures of firm productivity were not available. The evidence indicates that the greater survivability of WMFs is coupled with higher wage growth compared with CFs. However, wage growth is at best a crude proxy of productivity growth at the firm level. This suggests the importance of conducting further longitudinal studies, comparing performance measures other than firm survival.[52] Second, the fact that WMFs survive longer may partially reflect self-selection of both WMFs into industries and workers into organizational forms. It may be the case that WMFs are not randomly sorted into industries or, in other words, enter industries where they might have better survival prospects. Moreover, workers may be self-selected into organizational forms according to unobservable characteristics that might also affect firm survival. As Chiappori and Salanié (2003) point out, the combination of unobserved heterogeneity and endogenous matching of agents to contracts is bound to create selection biases toward the parameters of interest. For instance, cooperatives may be able to attract highly motivated workers (Elster, 1989). This selection problem is a potential identification threat common to all studies on WMFs based on observational data (Kremer, 1997: p.13). Interestingly, recent experiments on team production in which subjects are randomly assigned to "democratic" and conventional workplaces also suggest positive incentive effects associated with workers' control (Mellizo et al., 2011). However, the sorting process of workers into organizational forms is another important issue requiring further research.

[52] Recent evidence from 2009 cross-section data indicates that Uruguayan WMFs are less capital intensive and exhibit lower value-added per worker and investment rates than conventional firms (Alves et al., 2012).

Notwithstanding these issues, the evidence presented in this paper suggests that the marginal share of WMFs in the population of firms and employment in Uruguay can hardly be explained by the fact that these organizations exhibit a higher hazard of failure than conventional firms. The analysis indicates the importance of focusing on both the obstacles faced by workers at the formation stage of a WMF and the growth constraints faced by incumbent WMFs.

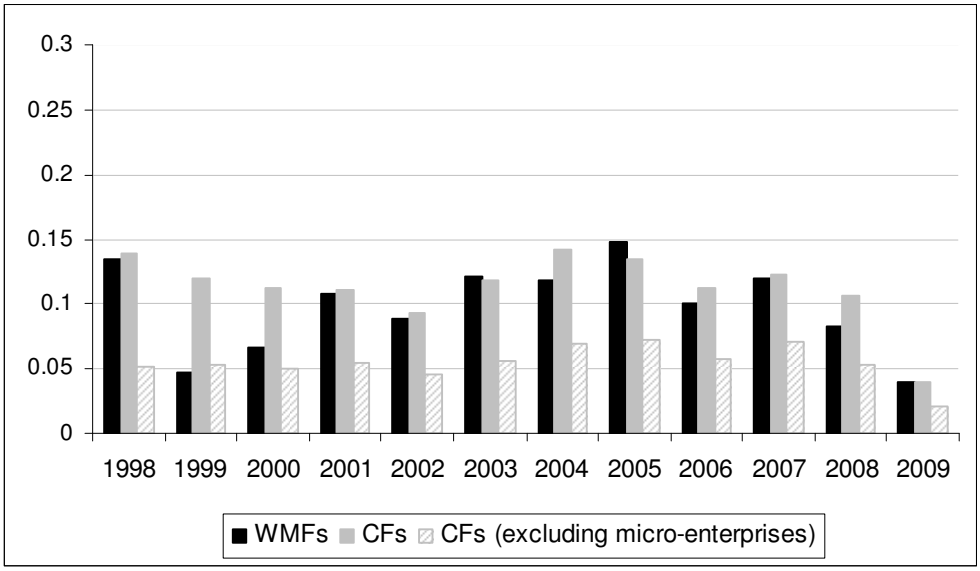
Appendix I

Table I.A1. Descriptive survival statistics

		Per firm			
	Total	Mean	Min	Median	Max
All firms					
No. of firms	29,125				
No. of records	1,258,606				
(Final) Exit time		45.63	1	35	150
Firms with gap	4,546				
No. of gaps	6,497				
Time on gap if gap	70,974	10.92	1	5	138
Time at risk	1,258,606	43.21	1	32	150
Failures	15,308	0.53	0	1	1
CFs					
No. of firms	28,821				
No. of records	1,244,542				
(Final) Exit time		45.63	1	35	150
Firms with gap	4,520				
No. of gaps	6,466				
Time on gap if gap	70,668	10.93	1	5	138
Time at risk	1,244,542	43.18	1	32	150
Failures	15,177	0.53	0	1	1
All PCs					
No. of firms	304				
No. of records	14,064				
(Final) Exit time		47.27	1	37	147
Firms with gap	26				
No. of gaps	31				
Time on gap if gap	306	9.87	1	6	51
Time at risk	14,064	46.26	1	35	147
Failures	131	0.43	0	0	1
WMFs					
No. of firms	223				
No. of records	10,179				
(Final) Exit time		46.18	1	38	145
Firms with gap	14				
No. of gaps	17				
Time on gap if gap	118	6.94	1	6	26
Time at risk	10,179	45.65	1	38	145
Failures	90	0.40	0	0	1

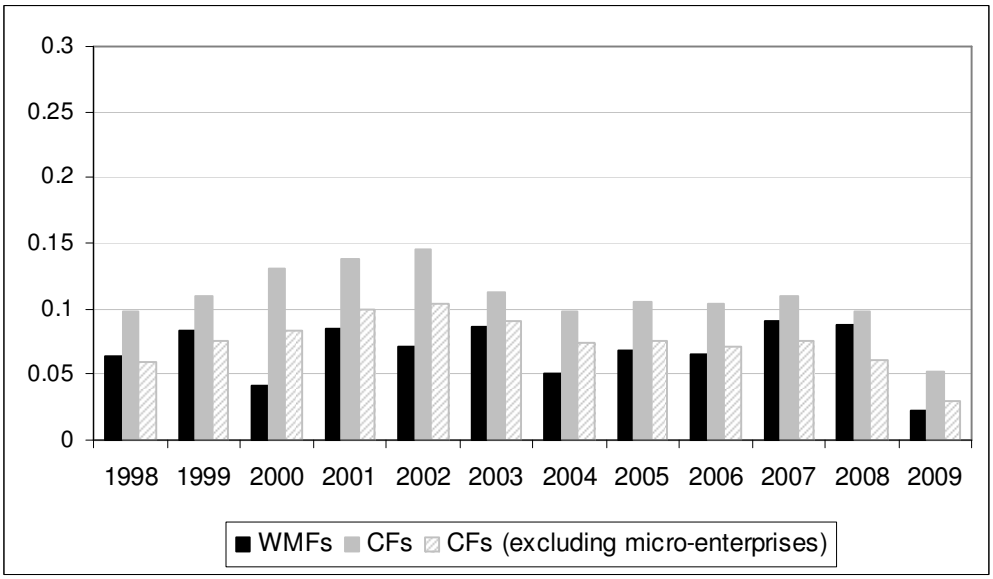
Notes: The total number of records divided by the number of firms gives the mean number of monthly records (mean time at risk) per firm (43.18 months). The difference between the final exit time and the number of records (or time at risk) is due to firms with gap. Time on gap if gap refers to the length of the gap. The median gap lasts 5 months. The total Time on gap if gap is computed as the mean Time on gap if gap times the number of gaps (there are firm spells with multiple gaps). Failure is a dummy variable which takes value 1 (at the exit date) if the firm exits during the period and 0 otherwise. Source: Author's calculation using data from the Banco de Previsión Social

Figure I.A1. Entry rates of WMFs and CFs. Period 1998-2009



Notes: Annual entry rates calculated as the number of entering firms divided by the total number of firms in the previous year. In 2009, only the period January-July is considered. Source: Author's calculation using data from the Banco de Previsión Social

***Figure I.A2*.** Exit rates of WMFs and CFs. Period 1998-2009



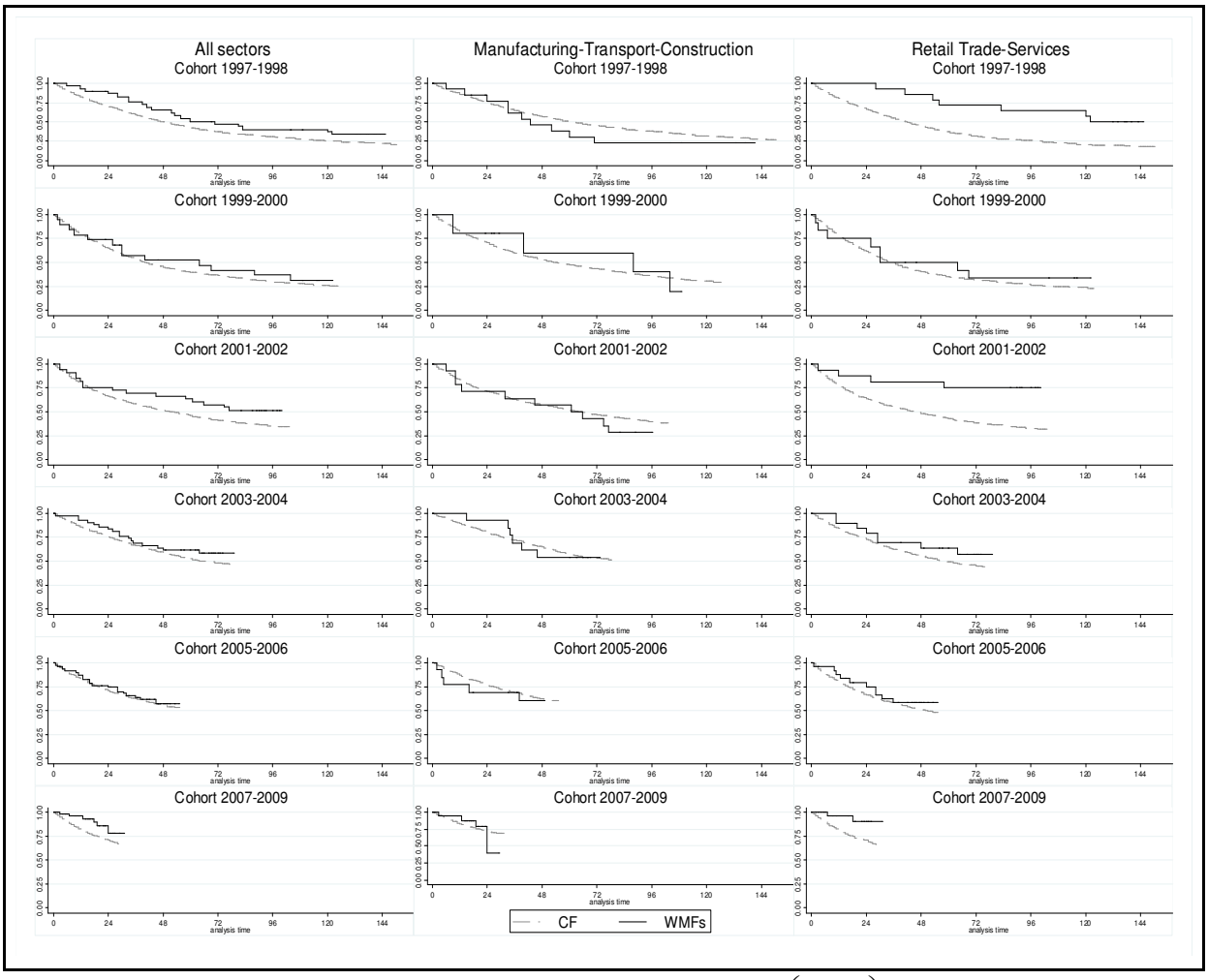
Notes: Annual exit rates calculated as the number of exiting firms divided by the total number of firms in the previous year. In 2009, only the period January-July is considered. Source: Author's calculation using data from the Banco de Previsión Social

Table I.A2. Employment and wage dynamic

	Total	Dying firms	Surviving firms	t-stat (i)
All firms				
Employment growth				
WMFs	0.022	-0.064	0.050	(8.47)***
CFs	0.072	-0.008	0.107	(94.80)***
t-stat (ii)	(10.31)***	(4.46)***	(11.87)***	
Wage growth				
WMFs	0.071	-0.006	0.093	(4.67)***
CFs	0.048	-0.01	0.073	(77.21)***
t-stat (ii)	3.28***	0.21	2.94***	
Employment variability				
WMFs	0.267	0.329	0.244	11.17***
CFs	0.370	0.395	0.358	64.82***
t-stat (ii)	(37.26)***	(9.27)***	(41.54)***	
Wage variability				
WMFs	0.460	0.605	0.409	22.46***
CFs	0.353	0.392	0.333	120.44***
t-stat (ii)	30.79***	26.61***	21.22***	
Excluding micro-enterprises				
Employment growth				
WMFs	-0.007	-0.010	0.021	(8.31)***
CFs	-0.018	-0.166	0.047	(58.40)***
t-stat (ii)	2.19**	4.66***	(5.34)***	
Wage growth				
WMFs	0.054	-0.059	0.084	(6.12)***
CFs	0.031	-0.039	0.059	(31.97)***
t-stat (ii)	3.09***	(0.89)	3.33***	
Employment variability				
WMFs	0.232	0.296	0.211	9.89***
CFs	0.377	0.510	0.311	112.87***
t-stat (ii)	(47.41)***	(25.73)***	(34.62)***	
Wage variability				
WMFs	0.434	0.576	0.387	18.48***
CFs	0.352	0.452	0.303	93.10***
t-stat (ii)	(21.33)***	12.90***	22.21***	

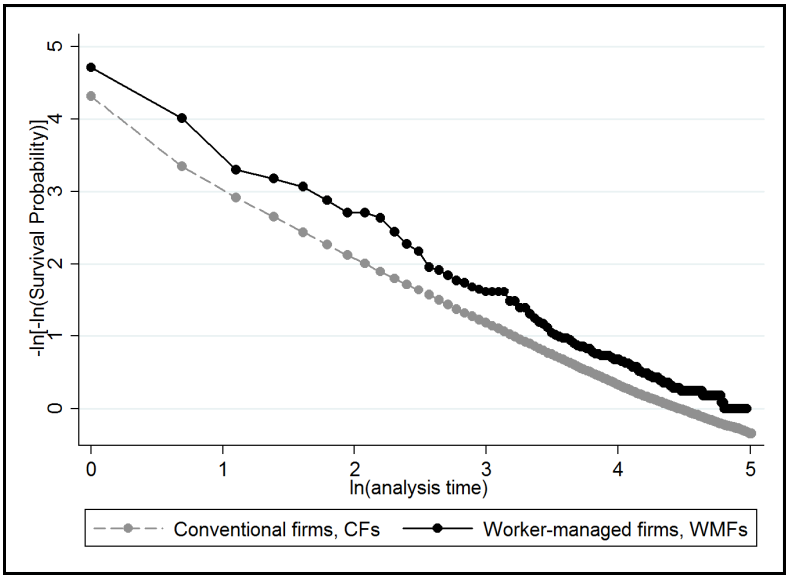
Notes: **E**mployment and wage growth rates defined as the annual change in employment and wages, respectively (in log form), such that $\Delta \ln E_{it} = \ln E_{it} - \ln E_{it-k}$ and $\Delta \ln w_{it} = \ln w_{it} - \ln w_{it-k}$.Employment and wage variability are measured as the standard deviation of annual changes in the log of employment and wages, respectively. (i) Test for differences between dying and surviving firms. (ii) Test for difference between WMFs and CFs. Source: Author's calculation using data from the Banco de Previsión Social

Figure I.A3. Survivor function of WMFs and CFs by firm cohorts and sectors



Notes: Plots of the Kaplan-Meier survivor function, defined as $\hat{S}(t_j) = \prod_{j|t_j<t}\left(1-\frac{d_j}{n_j}\right)$, where d_j is the number of failures occurring at time t_j and n_j is the number at risk at t_j before the occurrence of the failures. The left-hand side panels plot the survivor function estimated, pooling all sectors. The right-hand side panels plot the survivor function, considering retail trade and services firms. The center panels consider manufacturing, construction, and transport firms.

Figure I.A3. Graphical check of the proportional hazard assumption



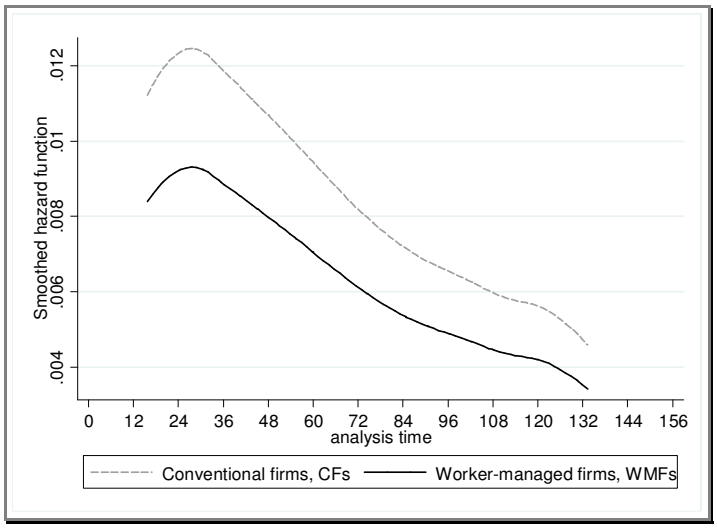
Notes: This figure depicts the plot of the transformation $-\ln\left[-\ln\left\{\hat{S}(t)\right\}\right]$ versus $\ln(t)$ for CFs and WMFs, where $\hat{S}(t)$ is the Kaplan-Meier estimate of the survivor function. Under the proportional hazard assumption, the curves should be parallel.

Table I.A3. Test of proportional hazard assumption

	Chi-square	p-value
Coop	0.11	0.7420
Firm start-up size	5.49	0.0192
Firm start-up wage	31.8	0.0000
Sectoral dummies		
(Manufacturing)		
Transport	0.81	0.3695
Services	5.8	0.0161
Other Sectors	50.02	0.0000
Cohort dummies		
(1997)		
1998	30.42	0.0000
1999	39.76	0.0000
2000	52.58	0.0000
2001	62.85	0.0000
2002	26.93	0.0000
2003	7.13	0.0076
2004	17.34	0.0000
2005	25.17	0.0000
2006	27.43	0.0000
2007	19.36	0.0000
2008	14.42	0.0001
2009	2.77	0.0962
Global test	218.31	0.0000

Notes: Test is based on Schoenfeld residuals. Rejection of the null hypothesis indicates a deviation from the proportional hazard assumption.

Figure I.A4. Hazard function of WMFs and CFs



Notes: Cox model post estimation

Table I.A4. Employer payroll tax rate by sector

Period	General tax rate	Total and partial tax exemptions
1997	12.5%	0% - Education 6.25%- Manufacturing
1998	12.5%	0%- Education 6.25%- Manufacturing
1999	12.5%	0%- Education 6.25%- Manufacturing
2000	12.5%	0%- Education 6.25%- Manufacturing, Freight transport by road (from October 2000)
2001	12.5%	0%- Education 6.25%- Manufacturing, Freight transport by road (until May 2001) 0%- Urban and suburban passenger land transport, Manufacturing, Freight transport by road (from June 2001)
2002	12.5%	0%- Education, Taxicabs (from May 2002), Urban and suburban passenger land transport , Manufacturing, Freight transport by road
2003	12.5%	0%- Education, Taxicabs, Urban and suburban passenger land transport, Manufacturing, Freight transport by road
2004	12.5%	0%- Education, Taxicabs, Urban and suburban passenger land transport , Manufacturing, Freight transport by road
2005	12.5%	0%- Education, Taxicabs, Urban and suburban passenger land transport , Manufacturing, Freight transport by road
2006	12.5%	0%- Education, Taxicabs, Urban and suburban passenger land transport , Manufacturing, Freight transport by road
2007	7.5% (from July 2007)	0%- Education, Taxicabs, Manufacturing, Freight transport by road (until June 2007), Urban and suburban passenger land transport
2008	7.5%	0%- Education, Taxicabs, Urban and suburban passenger land transport
2009	7.5%	0%- Education, Taxicabs, Urban and suburban passenger land transport

Source: Bucheli and Vigna (2006)

Table I.A5. Comparison of AIC values for several parametric models

	Log Likelihood	K	C	AIC
Exponential	-5427.0172	20	1	10896.0344
Weibull	-5418.7098	20	2	10881.4196
Gompertz	-5378.1049	20	2	10800.2098
Log-normal	-5335.0687	20	2	10714.1374
Log-logistic	-5349.2146	20	2	10742.4292
Generalized Gamma	-5334.9943	20	3	10715.9886

Notes: k is the number of model covariates and c the number of model-specific distributional parameters. $AIC = -2\ln L + 2(k + c)$. All estimates are restricted to firms employing at least six workers at the time of entry.

Table I.A6. Macroeconomic performance of the Uruguayan economy. Period 1999-2007

	1999	2000	2001	2002	2003	2004	2005	2006	2007
GDP growth rate	-1.94%	-1.93%	-3.84%	-7.73%	0.81%	5.00%	7.46%	4.10%	6.54%
Inflation	4.17%	5.05%	3.59%	25.94%	10.19%	7.59%	4.9%	6.38%	8.5%
Unemployment rate	11.3%	13.6%	15.3%	17%	16.9%	13.1%	12.2%	11.4%	9.6%
Real wage growth rate	0.90%	-1.19%	-0.85%	-10.89%	-12.79%	-1.45%	4.02%	4.99%	4.55%

Notes: Real wage growth rate is only computed for workers employed in the private sector. The unemployment rate is the urban unemployment rate. Source: INE, BCU

Table I.A7. Employment stability, wage flexibility, wage growth, and post-2003 firm survival

	Cox model				Exponential model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Coop	-0.643**	-0.594*	-0.473	-0.476	-0.652*	-0.602*	-0.476	-0.479
	(0.327)	(0.326)	(0.326)	(0.326)	(0.335)	(0.334)	(0.334)	(0.335)
Firm start-up size	0.0053	-0.008	-0.035	-0.033	0.011	-0.002	-0.026	-0.025
	(0.078)	(0.075)	(0.077)	(0.076)	(0.081)	(0.078)	(0.079)	(0.078)
Firm start-up wage	-0.228***	-0.177***	-0.203***	-0.193***	-0.236***	-0.184***	-0.212***	-0.203***
	(0.052)	(0.052)	(0.052)	(0.053)	(0.054)	(0.054)	(0.053)	(0.054)
Wage variability		0.512***		0.144		0.515***		0.129
		(0.145)		(0.163)		(0.148)		(0.167)
Employment variability			0.949***	0.882***			0.986***	0.924***
			(0.128)	(0.146)			(0.133)	(0.154)
Hazard ratio	**0.526**	**0.552**	**0.623**	**0.621**	**0.521**	**0.548**	**0.621**	**0.619**
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	55,601	55,601	55,601	55,601	55,601	55,601	55,601	55,601

Notes: The analysis is restricted to the post-2003 firm survival. All estimates are restricted to firms having at least 12 monthly records in the pre-2004 period and employing at least six workers at the time of entry. Start-up size is defined as the log of employment at the time of entry. Start-up wage is defined as the log of average firm wage measured at the time of entry. Wage growth rates are defined as the annual change in the log of average firm wage (measured in the pre-2004 period). Employment and wage variability are measured as the standard deviation of annual changes in the log of employment and wages, respectively (measured in the pre-2004 period). All estimates include 4 industry dummies (distinguishing Manufacturing, Transport, Services, and Other Sectors) and 13 cohort dummies. The hazard ratio is obtained computing $\exp(\beta^{coop})$. Robust standard errors are in parentheses. Standard errors are clustered at the firm level. * Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

II. EQUALITY UNDER THREAT BY THE TALENTED: EVIDENCE FROM WORKER-MANAGED FIRMS

II.1 Introduction

The potential conflict between equality and the need for incentives is a major debate in economics and political philosophy.[53] Are high-ability individuals more likely to quit from egalitarian regimes? Is the redistributive capacity of democratic organizations restricted by the possibility that talented agents may exit? I revisit this long-standing debate by analyzing the relationship between compensation structure and quit behavior in a unique and underexplored institutional setting: worker-managed firms (WMFs).

Most economic activities in actual market economies are carried out by conventional firms (CFs) controlled by capital suppliers. In contrast, WMFs are defined as enterprises in which the workforce has ultimate control rights (Dow, 2003).[54] Worker-managed firms are democratic in the sense that members have equal political influence on economic decisions regardless of their capital contribution to the firm ("one person, one vote"). This type of firm captured the attention of such renowned economists Karl Marx, John Stuart Mill, Leon Walras, and Alfred Marshall. Since the late 1950s, an extensive theoretical literature has developed that seeks to understand the behavior of WMFs and to explain why they are relatively rare.[55]

One prominent explanation for the paucity of WMFs is that workplace democracy may result in substantial redistribution at the expense of high-ability workers. Median voter models suggest that, to the extent the median member is less productive than the average, most cooperative members can gain by reducing wage differences relative to differences in

[53] The Rawlsian difference principle states that "social and economic inequalities, for example inequalities of wealth and authority, are just only if they result in compensating benefits for everyone, and in particular for the least advantaged members of society" (Rawls, 1971: 14–15). For a critique, see Cohen (1992).
[54] Other terms for WMFs that are used in the literature include worker cooperatives, producer cooperatives, and democratic firms.
[55] For a review of the literature see Bonin, Jones, and Putterman (1993), Dow and Putterman (2000), Dow (2003), and Putterman (2008). The most updated evaluation of the empirical literature is provided by Pencavel (2013).

productivity (Kremer, 1997). Another explanation is that equality may provide insurance against unfavorable realizations of ability (Abramitzky, 2008). Irrespective of the precise mechanism behind egalitarian compensation policies in WMFs, both models predict that equality discourages the participation of high-ability members. However, the actual extent and effects of redistribution in WMFs have not been systematically studied.

This paper contributes to filling this gap by examining three interrelated questions. Do WMFs actually engage in redistributive compensation policies? Are high-ability members in WMFs more likely (than other members) to exit? Does the degree of equality affect the severity of brain drain? The empirical analysis is based on novel work history data from Uruguayan social security administrative records. To answer the first question, I use a panel of workers employed in both worker-managed and conventional firms. To address the second and third questions, I use a matched employer–employee panel data set that includes information on the total population of firms legally registered as producer cooperatives (PCs)—from which WMFs can be identified—and all their workers, both members and nonmembers. One major advantage of the latter data set is that I can observe the entire wage distribution (and other characteristics of the workforce) at each firm for any moment in time. This makes it possible to rank the ability of workers, including quitters, according to their position in the intrafirm wage distribution. Both panels are unusually long and extend over the period from January 1997 to April 2010.

The analysis yields four main results. First, I find a small wage premium associated with being employed in WMFs. Because there is mobility between worker-managed and conventional firms, identification rests on the variability provided by workers who switch between organizational types during the period—under the assumption that sorting is based on time-invariant characteristics. It is noteworthy that this wage gap decreases across the wage distribution and becomes significantly negative for top wage earners. Quantile regression estimates confirm that WMFs do implement redistributive compensation policies. Second, estimates derived from duration models indicate that the high-ability members of WMFs exhibit a higher hazard rate of voluntary separation. Third, in WMFs that are more egalitarian, high-ability members are more likely to exit; in other words, the

brain drain's severity depends on how compressed the pay scale is. I also find that the hazard ratio of high-ability members is lower in the case of founding members; this suggests that ideological commitment—which may be stronger for first-generation members—enables greater redistribution within WMFs. Fourth, the quit decisions of high-ability WMF members seem especially sensitive to labor market conditions in the capitalist sector. Higher unemployment rates and lower wages paid in the conventional sector (relative to WMF members' compensation) significantly reduce the exit rate of high-ability members.

At a more general level, this paper contributes to the study of the interplay between equality and incentives that permeates many debates in public finance, development, comparative economic systems, human resources and organizational economics. First, it is related to a series of recent studies on equal-sharing rules and migration in communes, particularly in Israeli kibbutzim (Abramitzky, 2008, 2009, 2011). The paper adds to this literature in several ways. Kibbutzim studies have relied on self-reported measures of the degree of internal equality and have tested brain drain by comparing quitters to stayers in terms of education and skill levels, not in terms of their wages. Moreover, they have not investigated whether kibbutzim that shift away from equal-sharing rules do in fact reduce their brain drain. By contrast, I use matched organization–worker panel data that gives the entire wage distribution of each WMF and exploit within-firm variation in intrafirm wage dispersion to analyze how organizations use compensation policies to cope with brain drain. The interest in worker-managed firms is motivated by the fact that these organizations have existed (alongside investor-controlled firms) in most Western economies since the Industrial Revolution. Yet even though WMFs are thus a realistic organizational alternative to capitalist firms, they are usually found only in certain sectors (e.g., professional partnerships, taxis) and regions.[56] The paucity of WMFs, especially in labor-intensive sectors, remains a puzzle.

[56] According to Arando et al. (2012), worker-managed firms account for 13% of economic activity in the northern Italian province of Emilia Romagna and 8% of industrial gross value added (and 4% of overall gross value) in the Basque Country, Spain, where the Mondragon Cooperative Corporation is located.

Second, the choice of a compensation structure and its effect on the retention of valuable employees is a core topic in personnel economics (Lazear and Shaw, 2007; Lazear and Oyer, 2013). Third, the paper is also related to the public economics literature on how mobility constrains redistributive taxation (Simula and Trannoy, 2010; Kleven, Landais, and Saez, 2013; Rothschild and Scheuer, 2013). The case of WMFs illustrates how egalitarian schemes are threatened when some individuals have attractive exit options and so can "vote with their feet".

Fourth, this paper contributes directly to the literature on WMFs. In contrast to early neoclassical models, more recent theoretical approaches emphasize the role of labor discipline, credit market imperfections, and collective choice problems associated with determining distributional rules in heterogeneous WMFs (Bowles and Gintis, 1993, 1994; Kremer, 1997).[57] That being said, hardly any attention has been given to how members' heterogeneity and democratic governance actually interact in such firms (Pencavel, 2013). There is some extant research comparing worker-managed and conventional firms in terms of productivity, wage and employment adjustments, and firm demography; however, this study is one of the first to assess the extent and effects of redistribution in WMFs.[58] Participatory workplaces may use pay compression to enhance cohesiveness and teamwork, but the evidence presented here suggests that such greater equality has the negative side effect of brain drain (Levine, 1991). The role played by members' heterogeneity and distributional conflicts in organizations has received attention in development economics (Banerjee et al., 2001). In contrast to this literature, which investigates whether land inequality triggers distributional conflicts and inefficiencies in the context of agricultural cooperatives, I study WMFs that operate in nonagricultural sectors and in which political conflict is likely to be structured by differences in members' ability (Kremer, 1997).

The rest of this chapter is organized as follows. Section II.2 briefly discusses the related literature, and Section II.3. describes the data, and Section II.4 presents the main results.

[57] This theoretical literature will be discussed in Section II.

[58] See, for example, Craig and Pencavel (1992), Pencavel and Craig (1994), Craig and Pencavel (1995), Pérotin (2006), Burdin and Dean (2009), Fakhfakh, Pérotin, and Gago (2012), and Burdin (2013).

Section II.5 concludes and discusses the implications of these results in terms of the organizational performance of WMFs.

II.2 Democratic governance, compensation structure, and incentives under workers' control

There are few theoretical contributions that address the relationship between redistribution and incentives in worker-managed firms. Early neoclassical models assumed that the objective of a WMF is to maximize net income per worker, and they ruled out problems associated with democratic governance (see e.g. Ward, 1958). More recently, theoretical models have departed from the standard "complete contracting" assumptions in labor and credit markets. The main implication of these models is that WMFs should have a competitive advantage in regulating labor effort but should be credit constrained owing to the lack of workers' wealth for use as collateral (Bowles and Gintis, 1994). By assuming a homogeneous workforce, these models also eliminate the possibility of collective choice problems within WMFs and hence fail to account for the predominance of conventional firms even in labor-intensive industries (Kremer, 1997).

The problems faced by WMFs with an heterogeneous workforce have been discussed at length by Hansmann (1988, 1996). The author points out that the costs of collective decision making constitute the main disadvantage of this organization type vis-à-vis conventional enterprises. These costs are increasing in the members' heterogeneity. Whereas capital suppliers unanimously support the objective of maximizing profit, workers may have different attitudes regarding effort, investment decisions, wage levels, job security, and the provision of other workplace amenities. In a democratically controlled firm, workers must rely on some mechanism—typically, a majority voting rule—to aggregate their preferences. Unless the preferences of the median voter coincide with those of the mean voter (which is seldom the case), the resulting decisions may be inefficient in the sense of not maximizing organizational surplus (Hansmann, 1996). Organizational design in worker-managed firms may limit the diversity of preferences to ensure workforce homogeneity. Large inequalities among members may destabilize a cooperative governance

structure even as internal rules adopted to minimize the costs of collective governance may also result in efficiency problems (Benham and Keefer, 1991).

The determination of the compensation structure is probably the most important collective choice problem faced by WMFs.[59] Kremer (1997) proposes a median voter model with heterogeneously productive members. He shows that, to the extent the median member is less productive than the average member, the majority of a cooperative's members are better-off if wage differences are reduced with respect to productivity differences. A WMF will therefore set an egalitarian wage structure and then will have problems retaining high-ability members.[60]

Abramitzky (2008) develops a theoretical framework to study the effect of equal-sharing rules in Israeli kibbutzim.[61] In the first period, ex ante identical individuals make a sunk contribution to the kibbutz and set a sharing rule (the degree of equality). In the second period, individuals learn about their own productivity and decide whether or not to remain in the kibbutz. Equality provides insurance but discourages high-ability individuals from remaining in the organization (the brain drain effect). The model also predicts that, the higher the value of total assets, the greater the ability of the kibbutz to maintain an equal-sharing rule. Common property operates as a lock-in device because, as in collectively owned WMFs, members who leave the kibbutz have no claims on its assets.[62]

Unfortunately, there is little evidence on the extent and effects of redistribution in WMFs. There is some anecdotal evidence supporting the view that worker-managed firms implement more egalitarian wage distributions than do conventional firms. For instance,

[59] Earlier theoretical analyses of how distribution rules affect WMFs include Sen (1966) and Gui (1987).
[60] Transferable membership rights may mitigate inefficient redistribution in WMFs. But membership markets are rare in practice, and most WMFs operate under collective ownership (Kremer, 1997).
[61] Kibbutzim resemble WMFs in many respects; for instance, both are managed by democratic principles (one person, one vote) and assets are held as common property. Of course, there are also important institutional differences: only the kibbutzim are communes, in which members share both production and consumption activities while working and living in one place.
[62] In this regard there is an important difference worth noting. Under Kremer's (1997) model, members vote on a wage schedule *after* their abilities are known (ex post redistribution); in Abramitzky (2008), however, contracts are written from a Rawlsian "original position": kibbutzim members choose the sharing rule behind a "veil of ignorance"—that is, *before* knowing their type (ex ante redistribution).

US plywood cooperatives have generally relied on equal-pay schedules regardless of seniority or tasks performed (Pencavel, 2001). Mondragon cooperatives located in the Basque Country, Spain, have strict regulations concerning maximum wage differentials (Dow, 2003), which is in line with survey evidence on WMFs located in the Italian province of Emilia Romagna (Estrin and Holmes, 1991; Bartlett et al., 1992). Most of the evidence on the incentive effects of egalitarian arrangements comes from the recent literature on kibbutzim. Abramitzky (2008) presents evidence supporting the basic implications of his model: more educated individuals and those employed in high-skilled occupations have a greater propensity to exit equal-sharing kibbutzim. Consistently with that model's prediction, wealth and ideological commitment is associated with greater redistribution within kibbutzim. Abramitzky (2009) also documents adverse selection effects: equal-sharing kibbutzim attract individuals of lower ability.

II.3 Data

II.3.1 Worker-level panel data

To test whether redistribution actually takes place within WMFs, I use a random sample of Uruguayan workers who were registered in social security at least one month during the period from January 1997 to April 2010. The data were provided by Banco de Prevision Social, the agency in charge of social security affairs in Uruguay. Employers are obliged to deliver monthly information on their employees to the agency, which uses that information to calculate pension and social benefits.

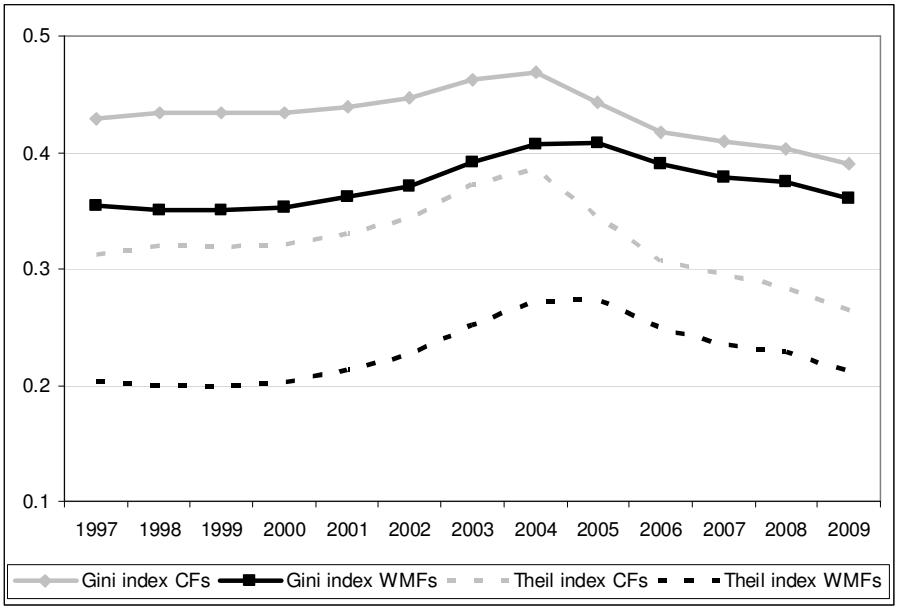
The structure of the data is an unbalanced panel of workers extending from January 1997 to April 2010. The data contains information on daily wages, personal characteristics of the worker (gender, age, tenure), and attributes of the firm in which she works (firm size, industry). Each worker-month observation is tagged with a firm identification number so that job changes (and any other work history discontinuity) can be observed.[63] Most importantly, the data identifies the legal form of the firm for each worker's employment

[63] The data contain information on both blue- and white-collar workers, including managers, but do not enable identification of workers' occupations. Survey evidence indicates that WMFs employ significantly fewer managers and supervisors irrespective of the sector in which they operate (Alves et al., 2012).

spell. Thus, workers employed by WMFs are identified as those working in a firm registered as a PC.[64] I restrict the sample to workers employed by nonagricultural private firms; public and rural workers are also excluded. Finally, I trim the data by excluding observations with daily wages corresponding to the top and bottom 1% of the wage distribution.

The descriptive statistics are presented in Appendix Table II.A.1. The resulting sample includes, on average, about 40,000 workers in each month. Those employed in WMFs amount to only some 3% of all workers. Average wages are higher in worker-managed than in conventional firms. However, the composition of the two groups is different: workers employed by WMFs are older than those employed by CFs, and in the latter case the average firm size is smaller. Proportionately fewer women are employed by WMFs than by CFs, although female participation in the former has increased over the period. That change is driven, in part, by the change in the industry composition of Uruguayan WMFs: highly concentrated in the transport sector as recently as 1997, they have expanded into services and other sectors during the last decade.

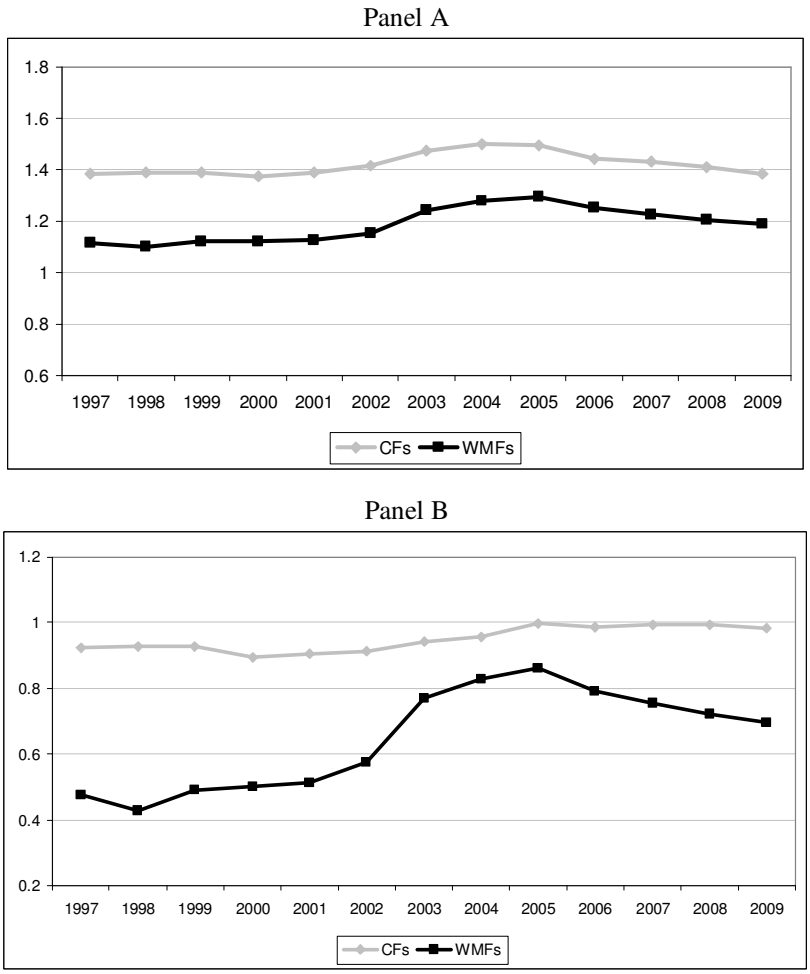
Figure II.1. Wage Inequality in WMFs and CFs (daily wages), 1997–2009



[64] In this data set, it is not possible to exclude PCs for which the employee-to member ratio is greater than 20%.

To give a preliminary picture of the extent of redistribution within WMFs, I compute two standard inequality measures for workers employed by WMFs versus CFs.[65] Figure II.1 plots the evolution of the Gini and Theil indexes of daily wages among the workers employed in each type of firms. As expected, wage inequality is systematically lower in WMFs. The Gini index is, on average, 9.3 percentage points (p.p) lower for workers employed by worker-managed than by conventional firms. It is interesting that this difference is even greater (14 p.p.) when wage inequality is measured by the Theil index, which is more sensitive to differences at the top of the wage distribution (Cowell, 2000).

Figuure II.2. Mean-to-Median Ratio and Wage Skewness in WMFs and CFs, 1997–2009



Notes: Panel A reports the mean-to-median ratio of daily wages. Panel B reports the Pearson's coefficient of wage skewness, computed as [3 × (mean − median)] ÷ (standard deviation).

[65] In each year, only workers between the ages of 20 and 55 are considered.

Figure II.2 provides further information that characterizes the wage distribution in WMFs and CFs. Worker-managed firms seem to reduce not only pay dispersion but also pay skewness, thus improving the median worker's compensation relative to the mean. Both the mean-to median wage ratio (Panel A) and the coefficient of wage skewness (Panel B) are systematically lower among workers employed by WMFs versus CFs. This is precisely the pattern one would expect from a WMF median voter model (Kremer, 1997).

II.3.2 Matched organization–worker panel data

To investigate whether WMFs suffer from brain drain and whether this problem is related with the extent of internal redistribution, I exploit a matched employer–employee monthly panel data set. The data covers the entire population of Uruguayan firms registered as producer cooperatives and all their workers (members and nonmembers) during the period from January 1997 to April 2010. This data set, too, was provided by the Banco de Previsión Social and is based on the individual work histories used to calculate social benefits.

Previous studies have pointed out that not all Uruguayan firms legally registered as PCs should be considered as WMFs (Burdin and Dean, 2009). Specifically, many PCs rely extensively on hired labor to carry out productive activities, which implies that—as in conventional firms—most of the workforce has no control over firm decisions. I therefore distinguish WMFs from the total population of PCs by using information of the employee-to-member ratio. I define WMFs as those PCs in which this ratio is lower than 20% at the time of entry. As mentioned previously, this is the maximum percentage allowed by the legal framework regulating the operation of WMFs in Uruguay. Estimates are performed using the subsample of WMFs just described.[66]

The main advantage of the data is that it is possible, for each WMF, to match the information on all its workers in each month with a unique identification number. Hence the structure of the data is that of a linked employer–employee panel data set. Firm-level

[66] Results remain unchanged when the whole sample of workers employed in PCs is considered.

information includes firm size (measured as total employment) and industry (5-digit SIC code). Worker-level information includes age, gender, job tenure, gross monthly wages, and number of days worked. Gross monthly wages are deflated by the Consumer Price Index and divided by the number of days worked in order to obtain the real daily wage for each worker. I also exclude workers whose daily wages are outside the 1%–99% range.

This ability to link firm and workers' information allows me to calculate different measures of workforce composition by firm (e.g., fraction of female workers, average age, age dispersion). Key to this study is that I can observe the entire wage distribution at any time and compute intrafirm pay dispersion indicators. The data enable me to observe each individual employment spell within WMFs and to locate workers' position in the firm's wage distribution. Among those workers who exit from WMFs during the period, I can also distinguish between voluntary quits and separation for other reasons (such as layoff, retirement, or death). Descriptive statistics on workers and firms are reported in Appendix Table II.A.2 and Table II.A.3, respectively. The resulting sample includes, on average, roughly 10,500 workers and 270 producer cooperatives in each month. Information on the subsample of WMFs is also presented. It is worth noting that average wages in the individual-based data (Table II.A.2) are always higher than the average firm wage (Table II.A.3). This difference simply reflects the fact that larger PCs, which account for more workers, have higher average wages than smaller PCs; that is, the (unweighted) average firm wage is disproportionately influenced by small, low-wage PCs.

II.4 Results

II.4.1 Worker-managed firms redistribute in favor of low-wage workers

Section II.3 gives prima facie evidence that inequality is lower among workers employed by WMFs than among those employed by CFs. Of course, that naïve comparison may be affected by the different workforce and sectoral composition of each firm type. To provide more systematic evidence on redistributive policies in WMFs, I use the worker-level panel described in Section II.3.1 and proceed as follows. First, in order to determine the sign and

magnitude of the wage differential between workers employed in worker-managed and conventional firms, I estimate a standard Mincerian equation as follows:

$$\ln w_{ijt} = x_{ijt}\alpha + z_{jt}\beta + C_{ijt}\delta + \lambda_t + \eta_i + u_{ijt}, \qquad \text{(II.1)}$$

where ln *w* denotes the logarithm of real daily wages, the *x* are observed characteristics (gender, age, and tenure as well as quadratics in age and tenure) of the individual worker, the *z* are observed features (size, industry) of the enterprise *j* by which the individual is employed, and *C* is a dummy indicator variable that is set to 1 when worker *i* is employed by a WMF (and set to 0 otherwise); the λ_t are year fixed effects.[67] Unobserved factors affecting wages are represented by the terms *u* and η, where the latter denotes unobserved factors that vary across individuals but are fixed for a given individual over time. The wage differential is captured by the coefficient δ.[68]

I estimate equation (1) via pooled ordinary least-squares (OLS) and fixed-effect (FE) regressions. The latter strategy is feasible because there is mobility of workers between WMFs and conventional firms. Under the assumption that selection into the WMF status is based on unobserved but time-invariant individual characteristics, fixed-effect regressions yield an unbiased estimate of the wage gap. The fraction of workers who switch between WMFs and CFs is roughly 4%. It is well known (e.g., from the literature on unions) that FE estimates of a relatively persistent status—as when there are only a small number of switchers—are more susceptible to attenuation bias due to measurement errors (Freeman, 1984; Card, 1996). However, measurement errors are of less concern in this study because the estimates rely on administrative data that are extremely unlikely to reflect either misreporting or miscoding. The WMF status is measured by the legal form of the firm and hence is not likely to be misreported. Moreover, any change in a worker's WMF status corresponds to a change in the identification number of the firm employing that worker, which virtually eliminates miscoding.

[67] One drawback to using social security data is the lack of information on workers' education level.

[68] There is no clear theoretical prediction regarding the sign of the wage differential. Pencavel, Pistaferri, and Schivardi (2006) adopt a similar empirical approach and find that, in Italy, being employed by a WMF is associated with a negative wage gap.

Estimates are reported in Table II.1. Column 1 reports the results of the pooled OLS estimate, according to which a worker employed by a WMF earns 5.5% more than one employed by a CF; this difference is highly significant. However, an OLS estimate of equation (1) may be biased if C and η are correlated—that is, if unobservable factors affecting the choice between working for a WMF or a CF are correlated with the determinants of earnings (Pencavel, Pistaferri, and Schivardi, 2006). Column 2 reports the results from a fixed-effect regression that yields consistent estimates for δ under arbitrary correlation between C and η. The wage gap is still positive (2.7%) and significant at the 10% level.[69]

In Uruguay, there is a legal restriction on the minimum size of WMFs. More precisely, WMFs cannot be formed with fewer than six members—which helps explain why the average firm size is greater in worker-managed than in conventional firms (see Table II.A.1). For this reason I perform an additional FE estimate that excludes workers employed in micro-enterprises (i.e., firms employing fewer than six workers). The results, which are reported in Column 3 of Table II.1, remain unchanged.

The estimates so far have compared all workers employed in WMFs (members and nonmembers) with those employed in CFs. Results are qualitatively similar when considering only WMF members. The wage gap is slightly higher (9%) and highly significant (see Column 4 of Table II.1). This is plausible given that WMF members' compensation includes distributed dividends. Finally, to account for heterogeneous time effects across sectors, Column 5 reports estimates that include sectoral-specific year fixed effects. Results are robust also to this modification.[70]

[69] The Hausman test leads to a strong rejection of the null hypothesis that random effects yield consistent estimates ($p = 0.000$).

[70] I replicate the estimates reported in Column 4 when including both month and year fixed effects. Alternatively, I try adding a linear time trend. I also perform estimates using the log of hourly wages (instead of the daily wage) as the dependent variable. Results are robust to all these modifications. Estimates using daily wages are preferred because information on working hours is missing for nearly a fifth of the sample.

Table II.1. Wage gap between workers employed in WMFs and CFs

	OLS	FE	FE	FE	FE
	(1)	(2)	(3)	(4)	(5)
Coop	0.055**	0.027*	0.028*	0.092**	0.091**
	(0.011)	(0.015)	(0.016)	(0.038)	(0.038)
Female	–0.230***				
	(0.005)				
Age	0.060***	0.210***	0.212***	0.212***	0.211***
	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
Age squared	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Tenure	0.047***	0.032***	0.030***	0.030***	0.030***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tenure squared	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size (in logs)	0.153***	0.122***	0.099***	0.100***	0.099***
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)
Year fixed effects	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes
Observations	5,264,811	5,264,811	3,533,031	3,445,097	3,445,097

Notes: The dependent variable is the log of daily wage. Column 1 reports pooled OLS estimates; Columns 2–5 report panel data fixed-effect estimates. The estimates reported in Columns 3–5 exclude workers employed in firms with fewer than six workers. Estimates in Columns 4 and 5 compare employees in CFs with members in WMFs (i.e., nonmembers are excluded). All estimates include a set of thirteen year dummies and six industry dummies. The estimates in Column 5 also include sectoral-specific year fixed effects. Standard errors (reported in parentheses) are clustered at the individual level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Having documented a positive wage premium associated with being employed in a WMF, I then ask whether this wage gap varies across the wage distribution. If WMFs actually implement redistributive policies, then we should expect the magnitude of the wage differential to be greater at the bottom of the wage distribution. In other words, the gain experienced by a worker who moves from a conventional firm to a worker-managed firm should be greater for low-wage than for high-wage workers. To perform this analysis, I use quantile regression to estimate the wag gap associated with being employed in a WMF at each quantile $\theta \in [0,1]$ of the distribution of the log of daily wages of worker *i* in firm *j* during month *t*:

$$Quant_{\theta}(w_{ijt} \mid \cdot) = Coop_{ijt}\gamma_{\theta} + X_{it}\beta_{\theta} + Z_{jt}\delta_{\theta}, \qquad \text{(II.2)}$$

where $Quant_{\theta}(w_{ijt} \mid \cdot)$ refers to the conditional quantile of the log of daily wages, X_{it} captures personal characteristics (gender, age, age squared, tenure, tenure squared), and Z_{jt} stands for firm attributes (firm size, industry); $Coop_{ijt}$ is a dummy variable set equal to 1 only if individual *i* is employed by a WMF. I perform separate quantile regression estimates by year, pooling monthly workers' records in each year.

In Appendix Table II.A.4, I report the results of quantile regressions for selected years during the 1997–2009 period. I present estimates for the 0.2, 0.4, 0.6, and 0.8 quantiles. As expected, the wage gap declines along the wage distribution and becomes negative at the top. Results indicate that there is a significant wage penalty associated with being employed in a WMF at the 0.8 quantile. Interquantile differences appear to be quite stable over the period. For example: in 1997, the wage premium for the 0.2 quantile was 18% as compared with a wage penalty of 3% for the 0.8 quantile; in 2009, the respective figures were 16% and 4%.[71] Compensation policies within Uruguayan WMFs seem to strongly favor workers at the bottom of the distribution.[72]

II.4.2 High-ability WMF members are more likely to quit

In this section I test whether redistributive policies implemented by WMFs affect workers' flows. Specifically, I analyze whether the hazard of voluntary separation is greater for high-ability workers.

To perform this analysis, I use the linked organization–worker panel described in Section II.3.2. Because the study focuses on voluntary quits, I restrict the sample in several ways. First, I exclude workers older than 55 because they are probably considering retirement. Second, I do not consider separations caused by firm closures. Third, separations due to

[71] Statistical tests of interquantile differences in the wage premium are presented in Appendix Table I.A.4. The null hypothesis of no interquantile differences is rejected in all cases.

[72] Studies based on survey data comparing WMFs and CFs do not find significant wage differences for low-wage occupations (unskilled workers) but confirm a significant wage penalty for managerial occupations (Estrin and Holmes, 1991; Alves et al., 2012). These studies rely on mean comparisons of firm-level data on wages grouped by occupation.

other reasons (e.g., layoffs, death) are treated as censored.[73] Finally, I drop left-censored spells—that is, individuals who were already working in a given firm at the beginning of the study period (January 1997). The problem of right-censored observations is handled by using duration analysis techniques.

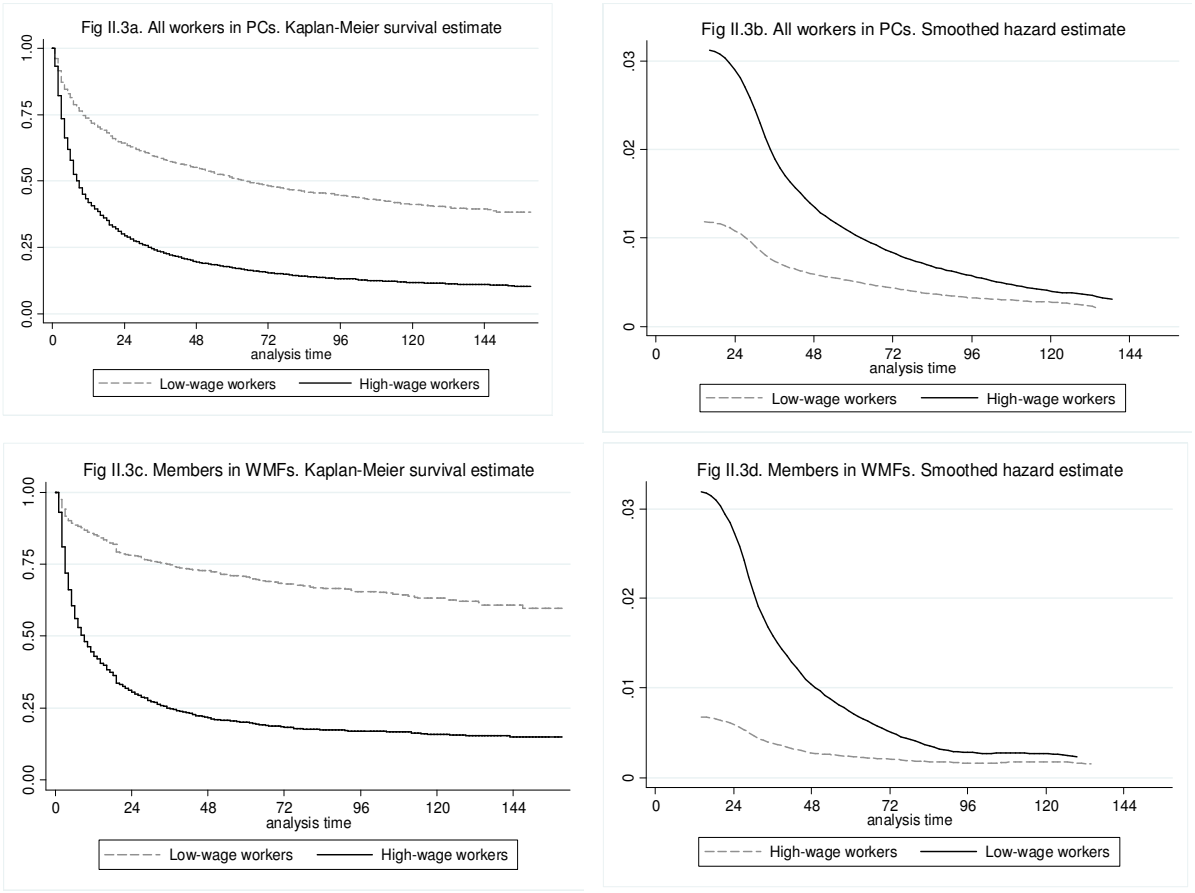
In order to identify high-ability workers, I divide the workforce of each firm (at any moment in time) into two groups: those with wages above and those with wages below the firm's median wage. The intuition behind this procedure is to use the within-firm wage variation to rank workers according to their ability types. Controlling for other characteristics of the worker and the firm, I assume that the position of the worker in the internal wage scale is a reasonable proxy for her position in the ability distribution. This approach has been adopted in the literature on assortative matching between workers and firms, but it requires one to assume that workers' payoffs are increasing in their own types (Bartolucci and Devicienti, 2012).

Figure II.3 plots nonparametric estimates of the survival funtion and the hazard function for job separations while distinguishing between high- and low-wage workers. These functions are calculated for both the whole sample of workers employed in PCs (Figures II.3a and II.3b) and the subsample of WMF members (Figures II.3c and II.3d).[74] The hazard of job separation is systematically higher for high-wage workers in both cases. The log-rank test clearly rejects the null hypothesis that the survivor functions of the two types of workers are equal ($\chi_{(1)} = 2410$).

[73] Voluntary quits constitute 72% of total worker separations. As expected, the fraction of voluntary quits increases (to 82%) when the analysis is restricted to members.

[74] The Kaplan–Meier survivor function is defined as $\hat{S}(t_j) = \prod_{j|t_j<t}(1-d_j/n_j)$, where d_j is the number of failures occurring at time t_j and where n_j is the number at risk at time t_j (before any failures occur). The hazard function is calculated as a weighted kernel density using the estimated hazard contributions: $\Delta\hat{H}(t_j) = \hat{H}(t_j) - \hat{H}(t_{j-1})$, where t_j is the current failure time and $\hat{H}(t_j)$ is the estimated cumulative hazard. The Nelson–Aalen estimator of $\hat{H}(t_j)$ is defined as $\hat{H}(t_j) = \sum_{j|t_j\leq t}(d_j/n_j)$; this is the sum of expected failures at each observed time. For further details on nonparametric survival analysis, see Jenkins (2005) and Cleves et al. (2008).

Figure II.3. Worker's Position in the Within-firm Wage Distribution and Job Duration



Notes: The *High-wage worker* indicator variable is set equal to 1 only for a worker whose daily wage is above the median daily wage in the firm that employs her. Figures II.3a and II.3b consider the full sample—that is, all workers (members and nonmembers) employed by PCs; in Figures II.3c and II.3d the estimates are restricted to members of WMFs.

In order to analyze the determinants of employment duration in WMFs (i.e., the time elapsed between workers' enrollment and voluntary separation), I estimate a proportional hazard model (Cox, 1972):

$$h_{ij}(t) = h_j(t)\exp(HighW_{it}\beta_1 + X_{it}\beta_2 + Z_{jt}\beta_3)\,, \qquad \text{(II.3)}$$

where $h_j(t)$ is the baseline hazard for firm *j* and where *t* is the number of months that individual *i* has been employed at firm *j*; the dummy variable $HighW_{it}$ is set equal to 1 for workers whose daily wage is above the firm's median daily wage, *X* is a vector of personal characteristics (gender, age, age squared), and *Z* is a vector of firm characteristics (firm

size, proportion of female workers, workforce average age and its dispersion). The effect of a unit change in any covariate is to produce a constant proportional change in the hazard rate. The coefficient of interest is β_1.[75]

To rule out potential unobserved firm-level confounding factors, I estimate stratified Cox models in which each firm has its own flexible baseline hazard function. This approach allows one to control for all time-invariant firm-level characteristics (Giuliano, Levine, and Leonard, 2011). Cox model estimates stratified by firm eliminate unobserved heterogeneity across firms but not across individuals within a firm. I account for unobserved individual-level heterogeneity by also estimating a parametric model in which each individual's duration depends on a random effect ("frailty") and the baseline hazard is assumed to have a log-normal distribution (Jenkins, 2005).[76]

Table II.2 reports the results. All estimates are restricted to the subsample of members of WMFs. Column 1 reports the results of estimating equation (3) while controlling only for personal characteristics. In Column 2 the estimates control also for firm-level characteristics and include cohort fixed effects to account for common shocks (at the time of entry) that may affect subsequent job duration. Column 3 reports estimates of the parametric frailty model. Results are qualitatively similar across specifications. The hazard of job separation is systematically greater for high-ability workers. The results reported in Column 2 indicate that high-wage members are 3.7 times more likely than are low-wage members to exit.[77] Estimates reported in Column 3, which account for individual unobserved heterogeneity, indicate that the time ratio associated with being a high-ability worker is 0.23; this means that the status of high-ability worker reduces employment

[75] The Breslow method is used for handling ties. I check the empirical plausibility of the proportional hazard (PH) assumption by means of graphical methods (Jenkins, 2005; Cleves et al., 2008). This assumption seems to be satisfied by the data; see Figure A.1 in the Appendix. I also perform the test based on the Schoenfeld residuals for the variable *HighW* and do not reject the PH assumption ($p = 0.218$). The PH assumption is not rejected (at 5%) when the global test of the model is considered ($p = 0.0774$).

[76] The log-normal distribution is consistent with the nonmonotonic pattern of duration dependence of the hazard observed in Figure III. Unlike the Cox model, the log-normal model does not rely on the PH assumption.

[77] If I express the model in terms of the log of the hazard ratios, this effect is computed as exp(1.32).

duration (survival time) within a WMF by 77%, or roughly 20 months.[78] That the high-ability are more likely to exit provides further support for the idea that pay compression in WMFs is a deliberate policy. As Lazear and Shaw (2009) point out, there would be no reason for top workers to leave disproportionately (nor for bottom workers to stay disproportionately) if all workers were paid their competitive wage.[79]

II.4.3 High-ability workers are less likely to quit when redistribution within WMFs is less intense; founding members are also less prone to exit

One can certainly argue that high-ability workers are more mobile in any organizational setting and so not simply because of redistributive policies implemented by WMFs. Yet because matched organization–worker data is available only for WMFs, I am unfortunately not able to assess whether the brain drain is greater in worker-managed than in conventional firms. However, I can exploit the observed within-firm variation in intrafirm wage dispersion among WMFs to assess whether the degree of equality within WMFs affects the outflow of high-ability members. As already mentioned, this procedure allows me to estimate models that control for unobserved differences across firms. The expectation is that a less compressed wage structure mitigates brain drain. To test this hypothesis, I estimate equation (3) while including a measure of intrafirm inequality and its interaction with the variable identifying high-wage members. Because measures of intrafirm inequality are not meaningful for small firms, I restrict the sample to WMFs employing at least ten workers.

[78] This effect is computed as $[1 - \exp(-1.484)] \times 100 = 77..32$. The mean employment duration for the subsample of WMF members is 27 months; thus, $(27 \times 0.77)/12 = 1.73$. Observe that, in Column 3, the covariate effects must be interpreted in terms of survival time ("accelerated failure time" metric) and not in terms of the hazard as in Cox model estimates ("proportional hazard" metric).

[79] I perform additional robustness checks as well. First, I estimate the Cox model considering all workers (members and nonmembers) in WMFs. Second, I consider the whole sample of workers employed in all PCs. Third, I exclude employment spells with time gaps. Fourth, I redefine high-ability workers as those whose wage is above the 80th percentile of the within-firm wage distribution. Finally, I estimate the Cox model defining covariates and the worker's position in the within-firm wage distribution at the time of entry. None of the described modifications alters the basic results. Estimates for these alternative regressions are available from the author upon request.

Table II.2. Worker's position in the within-firm wage distribution and hazard of exit in WMFs. Results from duration models estimates.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
(A) *HighW*	1.320***	1.307***	−1.484***	1.895***	2.398***	2.453***	1.375***
	(0.0529)	(0.0529)	(0.0614)	(0.123)	(0.190)	(0.254)	(0.0690)
(B) *HighW* × *Coef. of variation*				−1.610***			
				(0.254)			
Coef. of variation				1.606***			
				(0.258)			
(C) *HighW* × *Mean-to-median ratio*					−0.995***		
					(0.149)		
Mean-to-median ratio					1.855***		
					(0.164)		
(D) *HighW* × *Sigma*						−4.184***	
						(0.809)	
Sigma						−4.064*	
						(2.230)	
(E) *HighW* × *Founding member*							−0.428***
							(0.119)
Founding member							−0.251**
							(0.119)
Hazard ratio/ Time ratio							
(A)	3.743***	3.695***	0.227***				3.955***
	(0.198)	(0.196)	(0.014)				(0.273)
Post-estimation: (A) + σ*(B)				2.482***			
				(0.177)			
Post-estimation: (A) − σ*(B)				5.054***			
				(0.434)			
Post-estimation: (A) + σ*(C)					3.274***		
					(0.177)		
Post-estimation: (A) − σ*(C)					4.129***		
					(0.268)		
Post-estimation: (A) + σ*(D)						1.491***	
						(0.278)	
Post-estimation: (A) − σ*(D)						6.386***	
						(0.975)	
Post-estimation: (A) + (E)							2.579***
							(0.254)
Worker-level controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm-level controls	No	Yes	Yes	Yes	Yes	Yes	Yes
Cohort fixed effects	No	Yes	Yes	Yes	Yes	Yes	Yes
Observations	183,523	183,514	183,514	163,151	163,151	112,235	96,722

Notes: Cox proportional hazard models stratified by firm—except for Column 3, which reports estimates from a shared "frailty" model in which the baseline hazard assumes a log-normal distribution. The *HighW* dummy variable is set equal to 1 for those workers whose daily wage is above the firm's median daily wage (and to 0 for other workers). All estimates control for worker-level characteristics (gender, age, age squared) and are restricted to WMF members. Estimates presented in Columns 2–6 also control for firm-level characteristics (firm size, average age of the workforce and its dispersion, fraction of female) and cohort fixed effects. The estimates presented in Column 3 include industry fixed effects; in Columns 4 and 5, the estimates are restricted to WMFs employing at least ten workers. In Column 7, estimates are restricted to WMFs (formed after January 1997) for which founding members can be identified. Robust standard errors (reported in parentheses) are adjusted for clustering at the individual level. * significant at 10%; ** significant at 5%; *** significant at 1%

In order to characterize the wage distribution within each WMF, I consider two measures: the coefficient of variation and the mean-to-median ratio of wages within the firm.[80] I expect the coefficient for the interaction term to be negative. If brain drain is driven by egalitarian wage policies implemented by WMFs then, ceteris paribus, high-wage workers should be less likely to exit WMFs in which redistribution is less pronounced.

The results reported in Columns 4 and 5 of Table II.2 support this hypothesis. The interaction term is negative and statistically significant in both specifications, and the magnitude of the effect is sizable. I report the post-estimation of the hazard ratio (using a linear combination of parameter estimates) when the within-firm coefficient of variation in daily wages is one standard deviation above or below the mean. According to the values in Column 4 of the table, the hazard ratio of high-ability members is twice as high in a WMF for which the within-firm coefficient of variation in wages is one standard deviation (0.221) below the sample mean (0.392)

Results are qualitatively similar in estimates that include the mean-to-median firm wage ratio (see Column 5 of Table II.2). The hazard ratio of high-ability members is 1.26 times higher in a WMF for which the mean-to-median wage ratio is one standard deviation (0.117) below the sample mean (1.101). It should be emphasized that the mean-to-median wage ratio has a direct interpretation in terms of a WMF median voter model (Kremer, 1997). Higher values of the mean-to-median ratio indicate that the median voter commits *not* to engage in redistribution while taking into account participation constraints of the most productive members. A consistent feature of the findings reported here is that the brain drain effect is mitigated in those WMFs whose median member is less prone to leverage her pivotal position in the organizational political process to redistribute away from high-ability members.

Neither the coefficient of variation nor the mean-to median wage ratio take into account the observed heterogeneity among workers within firms. This is an important limitation when

[80] I compute the average of these variables over each individual employment spell. Hence, whereas the averages vary both between and within firms, they vary only between (not within) individuals. In this way I can estimate the Cox model stratified by firm.

one considers that most theoretical predictions about the effect of egalitarian wage policies in WMFs are derived from models in which members have different abilities but are observationally equivalent (Kremer, 1997). To provide further evidence on the interplay between intrafirm pay dispersion and brain drain in WMFs, I repeat the previous empirical exercise while using a conditional measure of intrafirm inequality. In order to compute a conditional measure of inequality at the firm level, I run the following standard wage equation separately for each firm in each month:

$$\ln w_{ijt} = \alpha + X_{ijt}\beta + \varepsilon_{ijt} . \qquad \text{(II.4)}$$

Here i indexes individuals, j firms, and t time; $\ln w$ is the log of real daily wage of individual i; and X is a vector of worker characteristics (gender, age, job tenure, quadratics in age and tenure, and a dummy variable distinguishing between members and nonmembers). The standard errors of these wage regressions are viewed as a conditional measure of intrafirm wage inequality, $Sigma_{jt}$; this variable captures the wage inequality (among workers employed by firm j at time t) that remains after controlling for observable personal characteristics.[81]

I next estimate equation (3) while including among the regressors both $Sigma_{jt}$ and its interaction with the variable identifying high-wage members. Results are reported in Column 6 of Table II.2. The hazard ratio of high-ability members is 4.3 times higher in a WMF whose intrafirm residual wage dispersion is one standard deviation below the mean. As expected, the more the wage structure of a WMF recognizes differences in workers' ability, the less the incentive of members in the upper tail of the internal wage distribution to exit the firm and migrate to the capitalist sector. The higher hazard rate of exit for top members in more egalitarian WMFs supports the argument that wage compression is a deliberate policy in this type of firm.

Finally, I analyze whether the hazard ratio of high-ability members varies with their status in the organization. Previous evidence from Israeli kibbutzim indicates a positive

[81] This procedure was suggested by Lazear (1989) and originally implemented by Winter-Ebmer and Zweimüller (1999).

association between the degree of equality and the degree of members' ideology (Abramitzky, 2008). Ideology seems to play the role of relaxing the participation constraint by increasing the nonpecuniary value of staying in the kibbutz. It is unfortunate that I have no direct measure of a member's ideology. Nonetheless, it is possible to identify the founding members of WMFs formed after January 1997. It is reasonable to assume that the ideological commitment of first-generation members is stronger than that in subsequent members. I estimate equation (3) while including an indicator variable for founding member and its interaction with the variable identifying high-wage members. These results are reported in Column 6 of Table II.2. On average, founding members are less likely to quit WMFs. A finding of particular interest is that the hazard ratio of high-ability members is 1.4 times lower in the case of founding members. This result confirms the intuitive notion that a WMF's redistribution policies are less constrained by the threat of brain drain when members are intrinsically motivated to join the firm.[82]

II.4.4 High-ability members are less likely to quit when outside options are less attractive

Finally, I analyze whether the hazard of exit of high-ability members varies according to changes in labor market conditions in the capitalist sector. To characterize the external labor market, I use three-month lagged values of both the monthly urban unemployment rate ($Unemp_{t-3}$) and the ratio of the median daily wage paid in the capitalist sector—computed for the specific 2-digit sector of the WMF in which the individual is employed—to the member's daily wage ($Ratiow_{it-3}$).[83] I then estimate equation (3) while including these variables and their interaction with the variable identifying high-wage members within WMFs.

[82] First-generation members may also have greater sunk investments in their firms. Therefore, I cannot rule out that a founding member's lower hazard of exit is due to lock-in effects associated with the collective ownership of a WMF's physical assets. Indeed, Abramitzky (2008) finds that the degree of equality is higher in wealthy kibbutzim and that higher wealth reduces the brain drain in equal-sharing kibbutzim.

[83] The monthly urban unemployment rate is based on official statistics published by the Uruguayan National Statistical Institute (www.ine.gub.uy). The 2-digit sector median daily wage in the capitalist sector is computed using the data set described in Section IV.A. Results remain unchanged when the values of both variables are lagged by six months.

Table II.3. Labor market conditions and hazard of exit in WMFs.
Results from duration models estimates

	(1)	(2)	(3)	(4)
HighW	1.468***	1.531***	1.530***	1.709***
	(0.061)	(0.070)	(0.070)	(0.067)
Ratiow		0.207**	0.210***	0.095
		(0.083)	(0.082)	(0.066)
Unemp	−0.039***		−0.039***	−0.012
	(0.014)		(0.014)	(0.014)
HighW × *Unemp*				−0.089***
				(0.011)
HighW × *Ratiow*				0.256***
				(0.094)
Worker-level controls	Yes	Yes	Yes	Yes
Firm-level controls	Yes	Yes	Yes	Yes
Observations	163,949	159,628	159,628	158,917

Notes: Cox proportional hazard models stratified by firm. The *HighW* dummy variable is set equal to 1 for those workers whose daily wage is above the firm's median daily wage (and to 0 for other workers); *Ratiow* is the ratio of the member's daily wage to the median daily wage corresponding 2-digit sector of the WMF in which the individual is employed; and *Unemp* is the monthly urban unemployment rate. All estimates include *Ratiow* and *Unemp* (lagged three months) and are restricted to WMF members. In addition, all estimates control for worker-level characteristics (gender, age, age squared) and firm-level characteristics (firm size, average age of the workforce and its dispersion, fraction of female). Robust standard errors (reported in parentheses) are adjusted for clustering at the individual level.
* significant at 10%; ** significant at 5%; *** significant at 1%

Results are reported in Table II.3. As expected, the more (less) attractive are the external labor market conditions, the higher (lower) is the hazard of exit in WMFs. More precisely, estimates reported in Column 1–3 indicate that both an increase in the unemployment rate and a reduction in the 2-digit, sector-specific reference wage (relative to the member's current wage) significantly reduces the hazard of exit from WMFs. Column 4 of the table reports estimates that include labor market conditions interacted with the variable $HighW_{it}$, which identifies high-wage members within WMFs. Both interaction terms have the expected sign and are highly significant. It is worth noting that the sensitivity of quit decisions to external labor market conditions also varies according to the member's position in the intrafirm wage distribution. When outside options in the capitalist sector become more attractive, the exit hazard increases more for high-ability than for low-ability members.

II.5 Conclusion and discussion

In this paper I study the extent and effects of redistribution in WMFs. The analysis is based on a panel of Uruguayan workers and a linked employer–employee panel data set covering the country's entire population of WMFs and their workers. The analysis supports four basic findings. First, workplace democracy is associated with substantial redistribution among workers. There is only a small wage premium associated with being employed in a WMF, and this gap declines significantly (and is then reversed) with increasing wage. Whereas the wage premium is systematically higher for low-wage workers, top earners actually incur a wage penalty for being employed by a WMF. During the period of analysis, the wage premium at the 0.2 percentile ranged between 14% and 19% while the wage penalty at the 0.8 percentile ranged between −3% and −11%. Second, WMFs suffer from brain drain: the separation hazard of high-ability members is more than 3 times higher than that of low-ability members. Third, in WMFs there is a relationship between the extent of pay compression and the severity of brain drain: I find that high-ability workers are less likely to exit a WMF whose wage structure is less compressed. I also find that the status of founding member is generally associated with a lower hazard of exit and significantly reduces the hazard of high-ability members, suggesting that the presence of intrinsically motivated workers enables greater redistribution. Finally, I find that the quit behavior of high-ability members varies as a function of labor market conditions in the capitalist sector.

It is beyond the scope of this paper to analyze the relationship between pay compression and organizational performance in WMFs. The brain drain effects documented here suggest a plausible mechanism to account for a potential negative relationship between pay compression and performance. Another possible explanation, which is suggested by tournament theory, is that a compressed wage structure reduces the expected gains from internal promotions and hence does not provide enough incentive to increase workers' efforts (Lazear and Rosen, 1981). Nevertheless, panel data evidence on the relative efficiency of WMFs indicates that they perform as well as (or even bettter than) conventional firms in terms of productivity (Craig and Pencavel, 1995; Fakhfakh, Pérotin, and Gago, 2012; Pencavel, 2013). Burdin (2013) also shows that Uruguayan WMFs are less likely to dissolve than are conventional firms. Note that experiments on team

production in which selection plays no role—because random assignment guarantees that the allocation of subjects to organizational types is fully exogenous—also find positive performance effects associated with workplace democracy (Frohlich et al., 1998; Mellizo, Carpenter, and Matthews, 2011).

Those experimental and nonexperimental studies suggest that other beneficial effects associated with pay compression are at work in WMFs. First, a greater degree of equality may result in higher productivity through greater teamwork (Lazear and Shaw, 2007). Conversely, competition for promotions within firms may erode workplace cooperation and cohesiveness (Lazear, 1989; Levine, 1991). Third, pay dispersion may exacerbate rent-seeking behavior within firms: workers may withhold information to increase their influence and persuade managers, wasting time and organizational resources rather than producing (Milgrom and Roberts, 1990). Fourth, pay comparisons within organizations reduce the job satisfaction for workers at the bottom of the wage distribution (Card et al., 2012). Finally, pay dispersion may reduce the effectiveness of peer pressure as a mechanism for overcoming free-rider problems in team production (Kandel and Lazear, 1992). For instance, pay differences may increase social distance between members and reduce the psychological costs (guilt, shame) incurred by those who deviate from group effort norms.

Because group sociology may influence team pay practices (Encinosa, Gaynor, and Rebitzer, 2007), it is possible for pay equality—and other policies that increase the degree of empathy among members—to facilitate mutual monitoring within WMFs. The costs of equality associated with brain drain and inferior management quality may be outweighed by other labor discipline benefits, such as higher motivation of shop-floor workers and lower supervision costs.[84] Further research is needed to investigate the efficiency-enhancing effects of pay compression in democratically controlled workplaces.

[84]Survey evidence indicates that Uruguayan WMFs exhibit lower pay dispersion and less supervision intensity than do conventional firms and also rely more on mutual monitoring among co-workers to ensure workplace discipline (see chapter III in this volume). Additional regression results (not reported in this paper) suggest an inverted U–shaped relationship between pay dispersion and employment growth in WMFs but no significant relationship between pay dispersion and WMF survival. It is difficult to give a causal interpretation of these results because each WMF determines its compensation structure and employment levels simultaneously.

Appendix II

Table II.A1. Descriptive statistics. panel of workers

	1997		2001		2005		2009	
	CF	WMF	CF	WMF	CF	WMF	CF	WMF
Number of workers	36,117	1,305	33,944	1,092	38,148	1,138	46,667	1,220
Fraction female	0.43	0.36	0.45	0.38	0.45	0.42	0.45	0.44
Age	36.34	41.21	37.32	42.66	37.59	43.51	38.07	43.09
	(12.63)	(10.57)	(12.27)	(10.75)	(12.16)	(10.80)	(12.18)	(11.13)
Tenure	5.26	9.12	5.80	10.33	5.39	10.81	4.87	10.15
	(6.67)	(8.12)	(6.82)	(8.64)	(6.97)	(9.28)	(6.62)	(9.76)
Monthly wage	13,829	25,138	13,118	22,632	10,779	17,880	13,376	21,210
	(13,260)	(17,546)	(13,398)	(15,693)	(11,181)	(15,551)	(12,428)	(16,028)
Daily wage	523.55	922.90	497.15	911.43	416.68	668.41	519.10	804.54
	(469.08)	(592.96)	(469.11)	(620.86)	(394.11)	(520.80)	(434.06)	(543.61)
Hourly wage	89.60	156.81	87.65	143.53	71.99	115.60	89.60	131.68
	(84.72)	(103.06)	(86.34)	(90.87)	(75.82)	(92.15)	(85.70)	(95.99)
Firm size	3.74	5.78	3.81	5.68	3.81	5.45	3.94	5.69
	(1.96)	(1.77)	(2.02)	(1.76)	(2.01)	(1.74)	(2.03)	(1.76)
Fraction in Manufacturing	0.29	0.29	0.23	0.26	0.24	0.29	0.22	0.22
Fraction in Transport	0.07	0.30	0.08	0.31	0.08	0.27	0.08	0.25
Fraction in Services	0.32	0.40	0.36	0.41	0.36	0.41	0.35	0.49

Notes: Summary statistics reported in October of each year. Wages are measured as pesos uruguayos deflated by the official Consumer Price Index (CPI). Firm size is measured as the log of total employment in each firm.

Table II.A2. Descriptive statistics: linked employer-employee panel data.
Worker-level information

	1997	2001	2005	2009
All workers employed in PCs				
Observations	9,634	9,533	10,265	12,706
Fraction female	0.31	0.36	0.41	0.45
Fraction members	0.40	0.42	0.45	0.41
Average age	41.08	42.59	42.83	41.88
Average job tenure	9.20	9.85	9.81	8.75
Gross monthly wage	25,538	23,675	17,154	19,355
Daily wage	982	1,004	679	805
Fraction in Manufacturing	0.37	0.29	0.30	0.26
Fraction in Transport	0.31	0.30	0.25	0.21
Fraction in Services	0.30	0.39	0.42	0.48
Only those workers in WMFs				
Observations	3,270	3,202	3,898	4,417
Fraction female	0.15	0.14	0.24	0.27
Average age	42.23	44.02	44.61	43.94
Average job tenure	7.46	8.77	8.22	8.11
Gross monthly wage	23,757	22,594	16,243	17,629
Daily wage	944	890	666	811
Fraction in Manufacturing	0.17	0.08	0.15	0.13
Fraction in Transport	0.79	0.76	0.57	0.50
Fraction in Services	0.04	0.13	0.22	0.28

Notes: Summary statistics are reported in October of each year. Wages are measured as pesos uruguayos deflated by the official Consumer Price Index (IPC).

Table II.A3. Descriptive statistics: linked employer-employee panel data.
Firm-level information

	1997	2001	2005	2009
All PCs				
Number of firms	241	262	285	309
Firm size (log of employment)	2.69	2.57	2.63	2.63
Firm average wage	11,027	9,785	7,153	9,259
Coef. of variation (daily wages)	0.25	0.27	0.32	0.32
Fraction female	0.23	0.28	0.35	0.39
Average age	42.10	43.11	43.35	43.77
Age dispersion (S.D.)	9.63	9.47	9.57	9.84
Average job tenure	4.33	5.18	5.22	5.45
Job tenure dispersion	2.33	2.90	3.26	3.69
Fraction in Manufacturing	0.25	0.18	0.19	0.18
Fraction in Transport	0.44	0.40	0.33	0.26
Fraction in Services	0.26	0.34	0.38	0.42
WMFs				
Number of firms	145	160	187	203
Firm size (log of employment)	2.50	2.37	2.52	2.54
Firm average wage	10,257	8,922	6,671	8,844
Coef. of variation (daily wages)	0.15	0.18	0.24	0.26
Fraction female	0.19	0.22	0.30	0.33
Average age	43.11	44.50	44.11	44.18
Age dispersion (S.D.)	9.50	9.44	9.53	9.74
Average job tenure	4.00	5.12	4.79	5.21
Job tenure dispersion	1.90	2.70	2.90	3.37
Fraction in Manufacturing	0.25	0.19	0.19	0.20
Fraction in Transport	0.59	0.53	0.40	0.31
Fraction in Services	0.14	0.20	0.27	0.33

Notes: Summary statistics are reported in October of each year. Wages are measured as pesos uruguayos deflated by the official Consumer Price Index (IPC). S.D. = standard deviation.

Table II.A.4. Wage gap across the wage distribution. results of quantile regressions.
Period 1997-2009

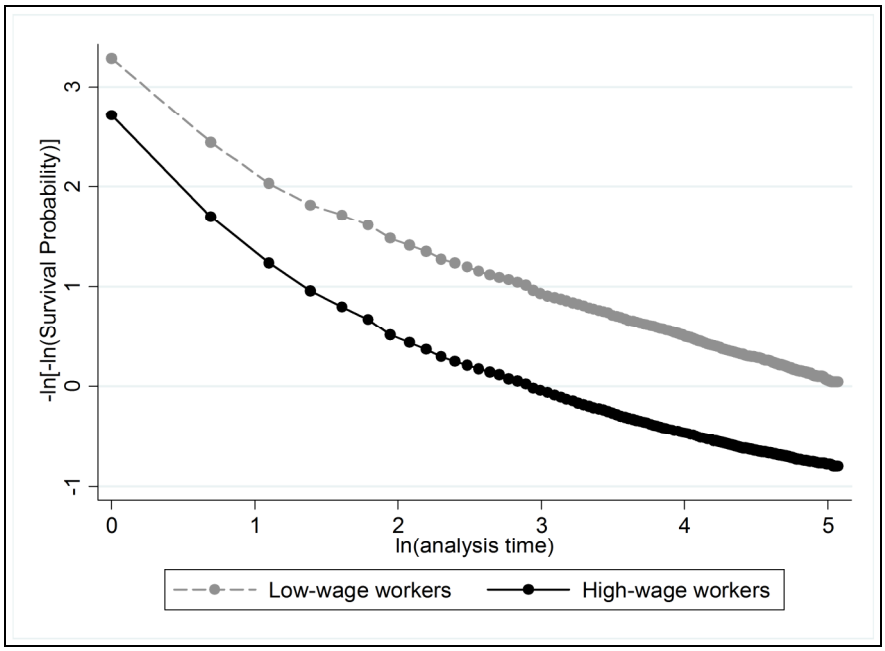
	1997				2000			
	q20	q40	q60	q80	q20	q40	q60	q80
Coop	0.175***	0.095***	0.021***	−0.033***	0.192***	0.107***	0.037***	−0.028***
	(0.006)	(0.005)	(0.006)	(0.007)	(0.007)	(0.005)	(0.006)	(0.007)
Age	0.037***	0.055***	0.066***	0.081***	0.044***	0.059***	0.068***	0.088***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	−0.213***	−0.251***	−0.288***	−0.319***	−0.182***	−0.222***	−0.253***	−0.271***
	(0.003)	(0.002)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Tenure	0.056***	0.049***	0.045***	0.043***	0.063***	0.054***	0.0485***	0.045***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Tenure squared	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.205***	0.183***	0.171***	0.166***	0.194***	0.173***	0.158***	0.149***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Test of interquantile Differences								
20th = 40th	[.000]				[.000]			
20th = 80th	[.000]				[.000]			
40th = 80th		[.000]				[.000]		
Observations	389,190	389,190	389,190	389,190	389,055	389,055	389,055	389,055

Table II.A4 (continued). Wage gap across the wage distribution. results of quantile regressions. Period 1997-2009

	2003				2006				2009			
	q20	q40	q60	q80	q20	q40	q60	q80	q20	q40	q60	q80
Coop	0.142***	0.053***	–0.023***	–0.107***	0.159***	0.110***	0.040***	–0.040***	0.160***	0.114***	0.059***	–0.039***
	(0.006)	(0.006)	(0.006)	(0.009)	(0.007)	(0.005)	(0.007)	(0.009)	(0.008)	(0.005)	(0.005)	(0.006)
Age	0.039***	0.053***	0.064***	0.081***	0.039***	0.044***	0.054***	0.072***	0.031***	0.038***	0.045***	0.065***
	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Age squared	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Female	–0.153***	–0.195***	–0.239***	–0.277***	–0.167***	–0.185***	–0.226***	–0.264***	–0.202***	–0.211***	–0.240***	–0.263***
	(0.003)	(0.003)	(0.003)	(0.004)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.003)
Tenure	0.061***	0.060***	0.053***	0.050***	0.039***	0.042***	0.044***	0.043***	0.038***	0.044***	0.048***	0.049***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.005)	(0.005)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Tenure squared	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***	–0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Firm size	0.188***	0.170***	0.159***	0.156***	0.125***	0.125***	0.129***	0.141***	0.106***	0.107***	0.112***	0.122***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Test of interquantile Differences												
20th = 40th	[.000]				[.000]				[.000]			
20th = 80th	[.000]				[.000]				[.000]			
40th = 80th		[.000]				[.000]				[.000]		
Observations	340,130	340,130	340,130	340,130	429,504	429,504	429,504	429,504	492,771	492,771	492,771	492,771

Notes: The dependent variable is the log of daily wages. The *Coop* dummy variable is set equal to 1 only for workers employed in a PC. Firm size is measured as the log of total employment in each firm. All estimates include six industry dummies. Bootstrapped standard errors (reported in parentheses) are based on 200 replications. *** significant at 1%.

Figure II.A1. Graphical Check of the Proportional Hazard assumption



Notes: This graph plots the transformation $-\ln[-\ln\{\hat{S}(t)\}]$ versus $\ln(t)$ for high- and low-wage members employed by WMFs, where $\hat{S}(t)$ is the Kaplan–Meier estimate of the survivor function. The proportional hazard assumption is not violated when the curves are parallel.

III. EQUALITY AS A DISCIPLINE DEVICE IN WORKER-MANAGED FIRMS

III.1 Introduction

A worker-managed firm (WMF) is an enterprise in which economic decisions are ultimately controlled by the workforce using a democratic political process. There is nothing in this definition that precludes WMFs to mimic the compensation structure and organizational design adopted by capitalist firms. However, economic models generally predict that workers' control should be associated with more egalitarian compensation policies and less hierarchical organizational structures. Existing theoretical accounts of egalitarian compensation policies in kibbutzim and worker coops have relied either on insurance motives (Abramitzky, 2008) or median voter arguments (Kremer, 1997).

These explanations are not entirely satisfactory for several reasons. First, the insurance motive provides a plausible explanation for equal-sharing rules decided among kibbutzim founders that came to a new country and dealt with uncertainty in a context in which insurance markets did not exist. However, this explanation does not seem to fully account for egalitarian compensation policies adopted by WMFs in actual economies in which social security systems provide insurance against the most common shocks to individual ability (unemployment, workplace injuries and sickness).[85] Second, while the environment faced by kibbutzim founders at the beginning of the 20th century clearly resembles the Rawlsian original position, there are other settings in which members may be fully aware of their ex-ante productivity differences.[86] Third, some WMFs strictly regulate maximum compensation differences between members, even when direct democracy is rarely exercised and managers have ample discretion to decide over a broad range of organizational issues.[87]

[85] There is evidence that WMFs provide additional insurance against shocks that are common to all members by relying on labor hoarding and smoothing employment levels over the business cycle.
[86] This is particularly true in the case of WMFs formed through transformation of a conventional firm as a large fraction of current members were employed in the preexisting firm.
[87] For instance, differences in salaries between the highest and lowest paid in Mondragón cooperatives in the Basque Country cannot exceed 1:8, even though interviews with managers reveal that in practice wage differentials are only 1:5 (Arando et al, 2010).

According to existing empirical evidence, WMFs perform as well or even better than conventional firms in terms of productivity and survival (Craig and Pencavel, 1995; Fathi et al 2012; Pencavel, 2013; Burdin, 2013), even if pay compression entails brain drain costs (Abramitzky, 2008; see also chapter II in this volume). It is also interesting that work ethics do not decline monotonically with the degree of equality in Israeli kibbutzim (Abramitzky, 2011: 14). To reconcile these apparently conflicting facts, this paper suggests that pay compression enhances the effectiveness of peer monitoring in WMFs. Based on recently collected survey evidence from Uruguayan firms, I study the interplay between compensation structure and monitoring in both WMFs and CFs. The data is particularly suitable for the present study because, apart from standard financial and employment firm-level information, the survey collected both qualitative and quantitative information on several dimensions of organizational design (hiring policies, promotions, wage structure, monitoring, human resources management practices).[88]

The main finding is that WMFs and CFs significantly differ in two important dimensions of organizational design: the structure of rewards and monitoring. WMFs exhibit significantly lower pay dispersion and supervision intensity than conventional firms. WMFs are able to reduce vertical supervision by relying more frequently on coworkers' mutual monitoring. The substitution of vertical supervision by mutual monitoring is more salient in egalitarian than in non-egalitarian WMFs, suggesting that pay compression serves as a discipline device. Following the theoretical framework proposed by Encinosa et al (2007), I rationalize the results in terms of a simple team production model augmented by team-effort norms in which the sharing rule is endogenously determined.

I report further differences between WMFs and CFs in terms of labor adjustments to shocks, recruitment channels and human resource management. These differences suggest thar WMFs adopt a coherent package of organizational policies to enhance the

[88] The survey was conducted as part of a research project on employment and investment decisions in WMFs funded by the Research and Innovation National Agency (www.anii.org.uy). This project involves a research team of the Instituto de Economía, Universidad de la República. Further information about the survey design and a more general presentations of the most important results is discussed in Alves, Burdín, Carrasco, Dean and Rius (2012).

effectiveness of peer monitoring and mitigate adverse selection effects associated with egalitarian compensation policies.

The paper adds to the literature on worker-managed firms. The results broadly support the idea that worker participation need to be coupled with employment stability and pay compression (Levine, 1991; Levine and Parkin, 1994). Several theoretical contributions have emphasized the potential labor effort regulation advantages associated with worker participation.[89] However, there are few studies comparing the monitoring technology employed by WMFs and CFs.[90] One major advantage of this study is that a very precise measure of supervision intensity is employed. Interviewers were instructed to give a definition of supervision tasks to respondents who reported the number of workers performing this kind of tasks within their firm. This measure of supervision intensity seems to be more accurate than the nonproduction-to-production employees ratio commonly used in the literature (Acemoglu and Newman. 2002; Fafchamps and Soderbom, 2006) because it allows to distinguish supervision tasks from other productive managerial and administrative tasks. The problem of labor discipline in capitalist firms and democratically-controlled firms is also at the core of the radical approach to labor markets and the theory of the firm (Reich and Devine, 1981; Bowles, 1985; Rebitzer, 1993). Issues related with authority, monitoring and workers´ participation at the workplace have been recently revisited by experimental and behavioral approaches to the theory of the firm (Falk and Kosfeld, 2006; Carpenter et al, 2011; Grosse et al, 2011, Fehr et al, 2012, Bartling et al, 2012).

The rest of this chapter is organized as follows. Section III.2 discusses the survey design and provides the descriptive statistics. Section III.3 presents the main results from descriptive analysis and provides further econometric estimates. Section III.4 provides a theoretical interpretation of the results in terms of a team production model. Section III.5

[89] Bowles and Gintis (1993; 1994) analyze the advantages and disadvantages of WMFs vis-a-vis conventional firms in a post-walrasian microeconomic framework.

[90] A partial exception comes from US plywood coops case studies (see, e.g., Greenberg, 1986; see also Pencavel, 2002).

provides further survey evidence on peer-monitoring enhancing policies in WMFs. Section III.6 concludes and discusses the limitations of the analysis.

III.2 Survey design and descriptive statistics

The empirical analysis is based on recently collected firm-level survey data from Uruguay. The survey design has the following features. The sample frame was constructed using information from the national firm directory in December 2009 (*Registro Permanente de Actividades Económicas*).[91] To construct the sample frame of PCs, this information was complemented using registers of active PCs provided by the National Federation of Producer Cooperatives in Uruguay (*Federación de Cooperativas de Producción del Uruguay*).

In the case of PCs, the objective was to conducted a census, except in two sectors -taxi services and dental clinics- in which a random sample was extracted. In order to have a comparable group of conventional firms, a random sample of conventional firms was also extracted. The sample of conventional firms was stratified by sector and firm size in order to match the sectoral and size distribution of PCs. This procedure resulted in a sample of 280 PCs and a similar number of conventional firms. The fieldwork period ran from November 2010 to July 2011 and the reference period of the survey was 2009. Firms were contacted by telephone in order to schedule face-to-face interviews. Respondents were generally managers, professionals or members of the work council in the case of PCs. Interviews were carried out by undergraduate students in economics that received a specific training course. Because of classification errors or cases of inactive firms discovered during the contact phase of the survey, the sample of PCs reduced to 252.[92]

The final sample of firms includes 193 PCs and 172 conventional firms. Compared to the original sample, this implies a very high response rates for PCs (77%). The response rate

[91] This is the sample frame of the official Economic Activity Survey regularly carried out by the National Statistics Institute in Uruguay. The information comes from update registers used for purposes of tax collection by government agencies.

[92] As the objective was to conduct a census of PCs in most sectors, there were no available replacements for these firms.

for conventional firms (61%) is in line with response rates obtained in similar firm-level surveys.[93] To identify the subgroup of WMFs, I apply the same identification criterion used with social security data, defining WMFs as those firms adopting the legal form "Producer Cooperative" in which the employee-to-member ratio does not exceed 20%. I denote those remaining PCs not classified as WMFs as "Other Producer Cooperatives" (OPCs)

Table III.1 presents the basic information on the final sample, distinguishing CFs, WMFs and all PCs. The size and sectoral distribution of the final sample of CFs approximately mimic the one exhibit by PCs and WMFs.[94] This ensures that any comparison of WMFs and CFs is not affected by the different size and industry composition of both types of firms.

Table III.1. Descriptive statistics by firm type

	CFs	WMFs	All PCs
Manufacturing	19.19	25.89	23.04
Transport	12.21	20.54	17.28
Services	53.49	43.75	50.26
Other sectors	15.12	9.82	9.42
Small	67.27	66.07	63.87
Medium-Large	32.73	33.93	36.13
% firms located in Montevideo	58.14	56.25	53.4
Firm age	24.012	15.896	14.703
	(21.76)	(13.17)	(11.75)
% female	0.399	0.481	0.499
	(.344)	(.398)	(.374)
% <35 years old	0.392	0.203	0.178
	(.305)	(.242)	(.227)
% firms employing temporary workers	25.58	26.79	35.6

Notes: Standard deviations are in parentheses. The category "Other sectors" includes retail trade, construction and electricity. Small firms defined as firms employing less than 20 workers.

[93] For instance, the average response rate to the European Company Survey (ECS-2009) ran in 30 European countries was 31% (the maximum response rate for a single country was 65%). The response rate to the Workplace Employment Relation Survey (WERS-2004) in UK was 64%.

[94] This indicates that the replacement of non-respondent units in the original sample of CFs does not bias the size and sectoral distribution of the final sample.

III.3 Results

First, I provide descriptive results on the compensation structure and monitoring, relying on simple difference in means tests (null hypothesis of no differences between CFs and WMFs). Then, I present a more rigorous econometric analysis.

III.3.1 Compensation structure

The survey collects information on the annual wage bill of the firm (including dividends distributed among members in PCs) and the monthly average wage received by workers grouped by occupations. The questionnaire specifies five main occupations: managers, professionals and technicians, administrative, skilled and unskilled workers.

Table III.2 presents the information regarding average wages and intra-firm inequality by firm type. While there are no significant differences between WMFs and CFs in the average firm wage, their wage structure differs markedly. Managers earn significantly less in WMFs than in CFs. On average, managers' compensation in a CF more than double the one paid by a WMF. I use the manager/unskilled wage ratio as a measure of intra-firm inequality.[95] The wage ratio is lower in WMFs than in CFs regardless firm size and sectoral location (the difference is not significant in Transport). Overall, the survey indicates that Uruguayan WMFs have a more compressed wage structure than CFs. This is consistent with previous evidence based on worker-level data from social security records (see chapter II in this volume).

[95] It was not possible to construct the wage ratio for 38 firms (10% of sample) because of missing data. I exclude firms with missing values of the wage ratio throughout the rest of the analysis. It is worth noticing that the wage ratio does not capture wage dispersion within occupations. The result remain unchanged if the wage ratio is computed using hourly wages instead of gross monthly wages.

Table III.2 Compensation structure by firm type

	CFs	WMFs	t-stat (i)	OPCs	t-stat (ii)
Average firm wage	9548	9109	0.34	9214	0.25
Average wage by occupation					
Managers	38082	17065	4.33***	21129	3.36***
Profesionals and tecnichians	21645	16316	1.16	18106	0.68
Administrative workers	12343	12694	-0.15	12109	0.14
Skilled workers	12609	9741	2.33**	11777	0.56
Unskilled workers	8389	7238	1.16	7702	0.51
Intra-firm inequality					
Managers/Unskilled wage ratio	2.80	1.55	2.35**	2.42	0.67
Intra-firm inequality by sector					
Manufacturing	2.88	1.08	3.04***	2.47	0.47
Transport	1.44	1.15	1.12	1.30	0.45
Services	3.62	1.80	1.71*	2.83	0.72
Intra-firm inequality by firm size					
Small	2.33	1.24	1.78*	2.20	0.19
Medium-Large	4.64	2.51	2.43**	2.85	2.41**
Intra-firm inequality by firm origin					
Created de novo	-.-	1.45	-0.87	2.62	1.29
Transformation of CF	-.-	1.93		1.91	

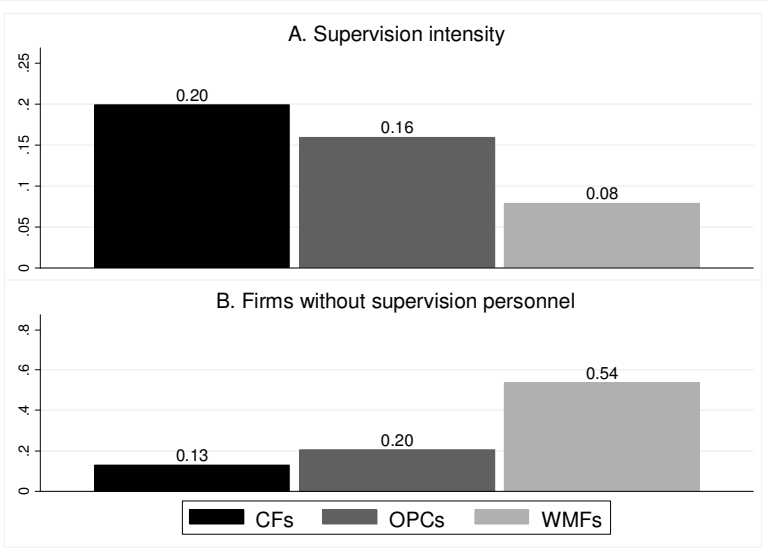
Notes: The average firm wage is calculated as the wage bill divided by total employment. In the case of WMFs and PCs, dividends distributed to members are also included. Wages are measured in pesos uruguayos. Intra-firm inequality is computed as the ratio between the maximum wage occupation and the minimum wage occupation. Small firm are defined as those employing less than 20 workers. (i) t-statistic for a difference in mean test between WMFs and CFs. (ii) t-statistic for a difference in mean test between PCs and CFs.

III.3.2 Monitoring

The survey also provides detailed information on the number of supervisors and further qualitative information regarding workplace disciplinary devices employed by WMFs and CFs. To have a measure of supervision intensity within each firm, I define the supervision ratio as the number of supervisors divided by total employment. The questionnaire specifically ask managers to report the number of workers performing supervision tasks. Following Wright (1995), supervisors are defined as workers that have more than one subordinate and can make decisions regarding the tasks, the tools or procedures to be used, and the pace of work of their subordinates. They can also sanction (or cause to be

sanctioned) with respect to pay, promotions or job termination.[96] This measure of supervision intensity seems to be more accurate than the nonproduction-to-production employees ratio commonly used in the literature (see, for instance, Fafchamps and Soderbom, 2006) because it allows to distinguish supervision tasks from other managerial and administrative tasks.

Figure III.1. Supervision intensity by firm type



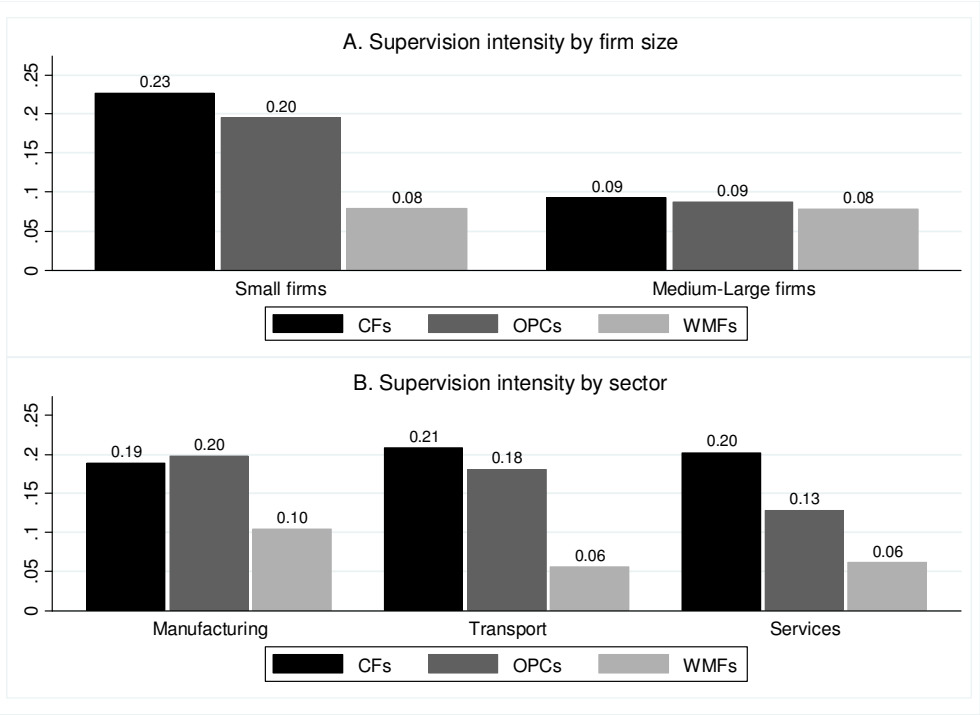
Notes: Supervision intensity is measured as the ratio between supervisors and total employment. Supervisors are defined as workers that have more than one subordinate and can make decisions regarding the tasks, the tools or procedures to be used, and the pace of work of their subordinates. They can also sanction (or cause to be sanctioned) with respect to pay, promotions or job termination. (Wright, 1985).

Figure III.1 (Panel A) plots the supervision intensity by type of firms. As expected, WMFs exhibit lower supervision intensity than CFs. The supervision ratio is on average 12 p.p. lower in WMFs compared with CFs. This difference, according to a *t-test,* is significant at the 1 percent level (t-stat=4.30). Figure III.1 (Panel B) shows that the fraction of firms without supervision personnel is significantly higher in WMFs than in CFs (t-stat=5.23). Figure III.2 reports the supervision ratio by firm size and sector. The difference between CFs and WMFs is significant in all economic sectors suggesting that the negative association between workers´ control and supervision intensity does not depend on specific technological conditions. Supervision intensity is lower in WMFs than in CFs for all size

[96] Measurement issues regarding supervision work are also discussed in Gordon (1990; 1994) and Jayadev and Bowles (2004).

categories, even though the difference is highly significant only in the case of small firms (t-stat=4.25). This suggests that WMFs face restrictions to replace vertical supervision with alternative monitoring schemes as firm size increases.[97]

Figure III.2. Supervision intensity by firm size and sector



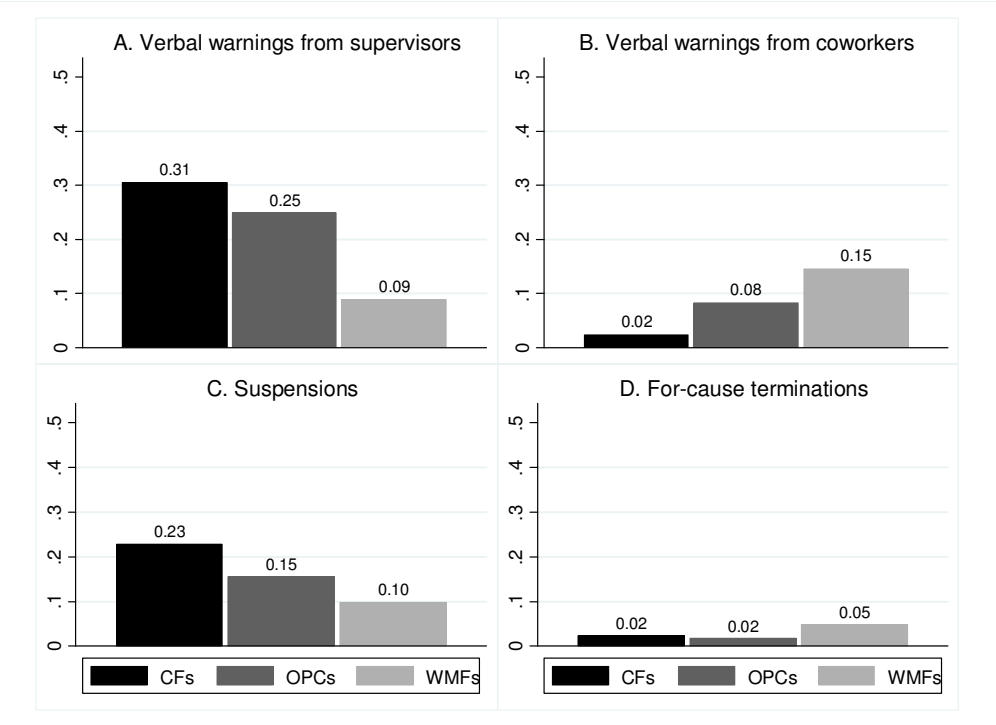
Notes: Supervision intensity is measured as the ratio between supervisors and total employment. Supervisors are defined as workers that have more than one subordinate and can make decisions regarding the tasks, the tools or procedures to be used, and the pace of work of their subordinates. They can also sanction (or cause to be sanctioned) with respect to pay, promotions or job termination. (Wright, 1985). Small firms defined as firms employing less than 20 workers.

There are significant differences between WMFs and CFs in terms of the most frequent disciplinary mechanism used within the firm. Results are reported in Figure III.3. While 31% of CFs rely on "*verbal warnings from supervisors*" to discipline workers, only 9% of WMFs declare to utilize this mechanism (t-stat=3.51). CFs also employ "*suspensions*" more frequently than WMFs (t-stat=2.1). By contrast, "*verbal warnings from co-workers*" is the most frequent mechanism exploited by WMFs (15%). This mechanism is rarely employed

[97] Figure 2 shows that supervision intensity in CFs is decreasing in firm size. This may suggest that there are economies of scale in supervision. Fafchamp and Söderbom (2006) found a negative relationship between firm size and supervision ratios using data from African firms and provided an explanation in terms of an efficiency wage model.

among CFs (2%). The difference is again highly significant (t-stat=2.76). Interestingly, there are no difference in the utilization of *"disciplinary layoffs*" (for-cause termination).

Figure III.3 Workplace disciplinary mechanisms by type of firms

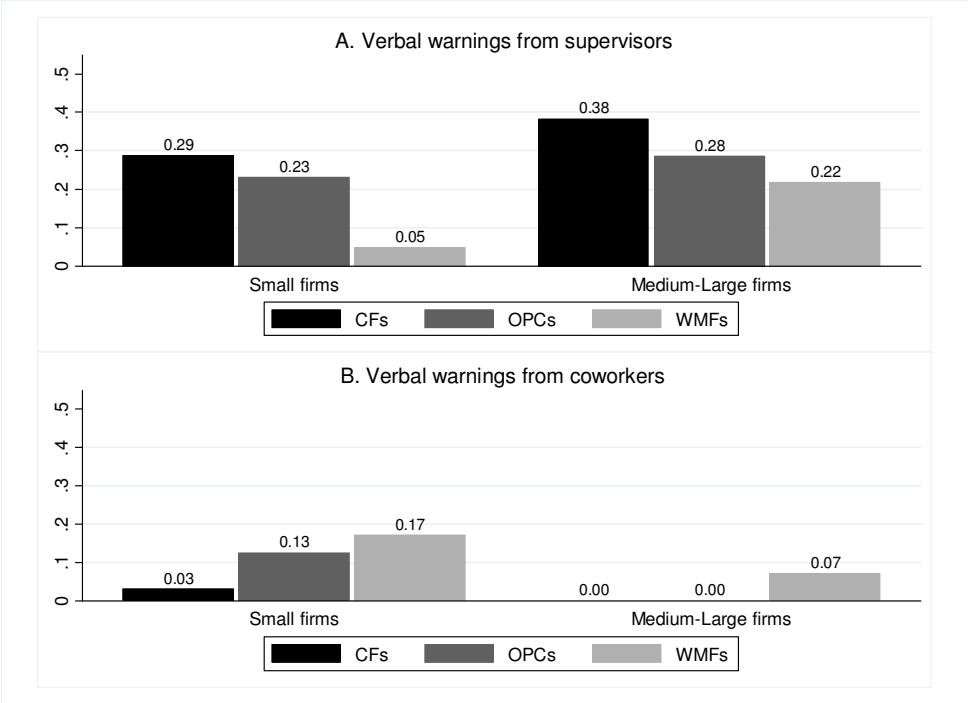


Notes: Fraction of firms declaring "X" as the main disciplinary mechanism employed by the firm. Small firms defined as firms employing less than 20 workers.

Not surprisingly, differences in monitoring technologies between WMFs and CFs vary with firm size (Figure III.4). Regarding the most frequent disciplinary mechanism employed at the firm-level, there are no significant differences between WMFs and CFs in the case of medium-large firms. As long as the comparison is restricted to small firms, WMFs declare more frequently to use "*verbal warnings from coworkers*" than CFs (t-stat=2.5) and less frequently to employ *"verbal warnings from supervisors"* (t-stat=3.44) as the main disciplinary device. The evidence suggests that the substitution of hierarchical supervision by mutual monitoring in WMFs operates mainly in small firms.[98]

[98] This is consistent with the fact that peer pressure becomes feasible when there is physical proximity of workers in the production process (see, for instance, Kandel y Lazear, 1992) and with experimental evidence on team production indicating that the level of punishment directed toward shrinking members is decreasing in team size (Carpenter et al, 2009).

Figure III.4 Workplace disciplinary mechanisms by firm size



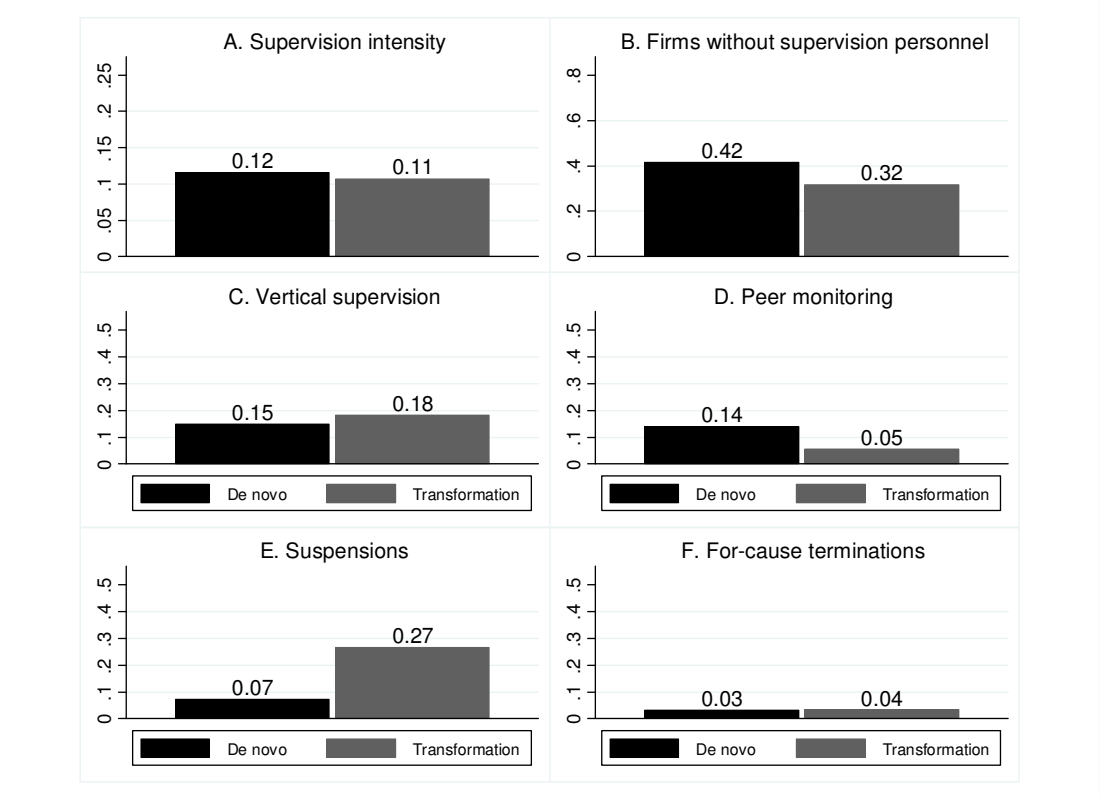
Notes: Fraction of firms declaring "X" as the main disciplinary mechanism employed by the firm. Small firms defined as firms employing less than 20 workers.

The lower supervision intensity exhibited by WMFs may not only reflect a pure incentive effect associated with workers' control but also a selection effect. For instance, it may be the case that control averse workers are sorted into WMFs to reduce their exposure to vertical supervision.[99] Unfortunately, it is difficult to disentangle incentives effects from self-selection in a non-experimental cross-section study.[100] However, the comparison between WMFs created *de novo* and those created through *transformation of conventional firms* in financial distress ("*empresas recuperadas*") may provide useful insights. This comparison is interesting because one could argue that sorting is more likely to occur in WMFs *created de novo* as members deliberately choice to start-up this particular type of organization. While it is not possible to rule out sorting effects also in the case of WMFs created from the *transformation* of a pre-existing conventional firm, as workers´choices

[99] For experimental evidence on control aversion in principal-agent relationships see Falk and Kosfeld (2006).
[100] Experimental evidence shows that managers in employee-owned firms spend less time on monitoring and supervision than do managers in conventional firms (Frohlich et al., 1998). Workplace democracy in the lab is also associated with greater effort provision (Carpenter et al, 2011).

still play a role, it is plausible to expect that the formation of a WMF in this situation is more likely to be driven by an exogenous shock (firm bankruptcy) than by workers' preferences.

Figure III.5. Labor discipline in WMFs by creation mode

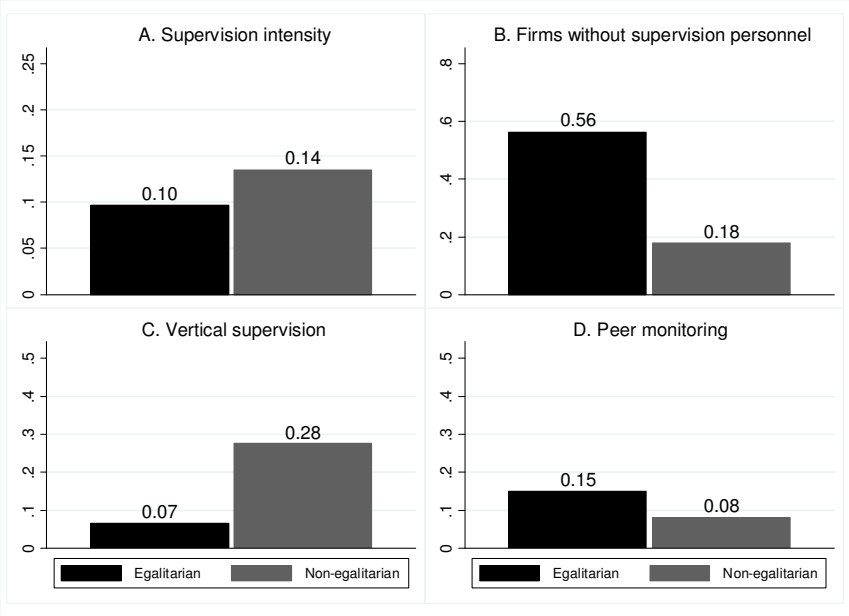


Notes: Panel A plots supervision intensity in WMFs by creation mode. The two creation models are the following: WMFs created from the *transformation* of a pre-existing conventional firm and WMFs created from scratch (*de novo*). Supervision intensity measured as the ratio between supervisors and total employment (see Fig 2). Panels C-F plot the fraction of firms declaring "X" as the main disciplinary mechanism employed by the firm.

Figure III.5 reports the supervision ratio and workplace disciplinary mechanisms employed by WMFs, distinguishing their creation mode. Interestingly, Figure III.5 (Panel A) reports no significant differences in supervision intensity between creation modes (t-stat=0.41). Regarding workplace disciplinary mechanisms, there are no significant differences between creation modes (at the 5 percent level). The only exception is that WMFs created through *transformation* rely more heavily on *"suspensions"* than WMFs created de novo (t-stat=2.68). Finally, Figure III.6 reports the supervision ratio and workplace disciplinary

mechanisms in WMFs, distinguishing perfectly egalitarian and non-egalitarian WMFs. Figure III.6 (Panel A) shows that egalitarian WMFs exhibit a lower supervision ratio compared with non-egalitarian WMFs.

Figure III.6. Labor discipline in egalitarian and non-egalitarian WMFs

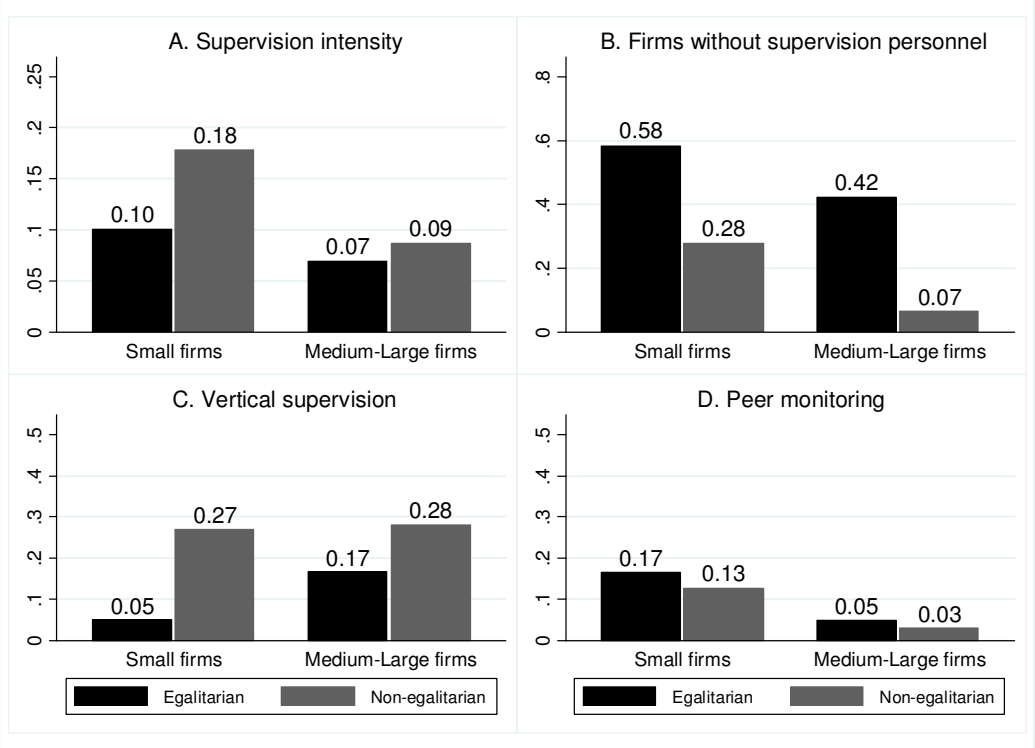


Notes: Panel A plots supervision intensity in WMFs by the degree of internal equality. The two distributive regimes are the following: perfectly egalitarian and non-egalitarian WMFs. Supervision intensity measured as the ratio between supervisors and total employment (see Fig 2). Panels C-D plot the fraction of firms declaring "X" as the main disciplinary mechanism employed by the firm.

The difference is significant at the 10 percent level (t-stat=1.79). The fraction of firms without supervision personnel is also significantly higher among egalitarian WMFs (t-stat=5.24). Egalitarian WMFs use more frequently mutual monitoring and less vertical supervision than their non-egalitarian counterparts.[101] In line with the evidence reported in the previous section, these differences become more salient when the comparison is restricted to small firms (Figure III.7).

[101] The difference is only significant when the whole sample of PCs is considered.

Figure III.7 Labor discipline in egalitarian and non-egalitarian WMFs by firm size



Notes: Panel A plots supervision intensity in WMFs by the degree of internal equality. The two distributive regimes are the following: perfectly egalitarian and non-egalitarian WMFs. Supervision intensity measured as the ratio between supervisors and total employment (see Fig 2). Panels C-D plot the fraction of firms declaring "X" as the main disciplinary mechanism employed by the firm. Small firms defined as firms employing less than 20 workers.

III.3.3 Econometric results

Table III.3 presents estimates of the firm-level determinants of the supervision ratio. The coefficient of interest is the one attached to the variable *Coop* which takes value of 1 for PCs and 0 for CFs. Due to the small sample size, estimates are performed pooling observations of all PCs. Estimates control for firm size, composition of the workforce (% female, % workers younger than 35 years old), region and industry fixed effects. I also include a dummy variable taking value of 1 if the firm is a multi-establishment firm. OLS estimates reported in Column (1) of Table III.3 indicate that after controlling for observable characteristics, the status of PC is associated with a reduction in supervision intensity of 4 p.p.

Considering that linear regression model does not provide accurate estimates in the case of fractional dependent variables, I perform additional estimates using a Tobit model that accounts for the censored nature of the dependent variable.[102] The status of PC is also associated with a reduction in supervision intensity (Column 2). Following Papke and Wooldridge (1996) , I also estimate a fractional logit model. The dependent variable is the supervision ratio, $y_i = S/L$. Let $\{(x_i, y_i); i = 1,2,...,N\}$ denote the sequence of y_i observations with $0 \leq y_i \leq 1$ and N the number of firms. For all *i*, it is assumed that,

$$E[y_i \mid x_i] = G(x_i\beta) \tag{III.1}$$

where $G(.)$ is known function satisfying $0 < G(z) < 1$ for all $z \in \Re$. This ensures that the predicted values of *y* lie in the interval (0,1). $G(.)$ can be approximated using the logistic function $G(z) \equiv \Lambda(z) \equiv \exp(z)/[1+\exp(z)]$. The estimation procedure is a particular quasi-maximum likelihood estimator (QLME) which maximizes the following Bernoulli log-likelihood function, given by[103],

$$l_i(\beta) = y_i \log[G(x_i\beta)] + (1-y_i)\log[1-G(x_i\beta)] \tag{III.2}$$

Column (3) reports the results from fractional logit estimates, which remain qualitatively unchanged.[104] Column (4) and (5) present additional estimates of the factional logit model. Estimates reported in Column (4) control for respondents´ beliefs regarding firm´s competitive position. More precisely, I add two dummy variables taking value of 1 if the respondent answer that the firm has an advantage over competitors in terms technology and workforce training respectively. I also control on whether the firm declare to face credit constraints and demand problems in the previous year and add a dummy variable indicating whether the firm employs teamwork. Estimates reported in Column (5) also control for

[102] The supervision ratio is bounded between 0 and 1. The linear model may predict values of the dependent variable out of the interval (0,1) (Papke and Wooldridge, 1996).

[103] The QLME $\hat{\beta}$ is consistent and efficient under the assumption that $Var(y_i \mid x_i)$ is proportional to $G(x_i\beta)[1-G(x_i\beta)]$

[104] In Columns (3)-(7) of Table III.3, I report average marginal effects.

difference in the capital-labor ratio across firms and indicate that workers´control reduces supervision intensity by 3.4 p.p.[105]

Table III.3. Firm-level determinants of the supervision ratio

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
				All firms: CFs and PCs			Only PCs
	OLS	Tobit			Fractional Logit Model		
Coop	-0.0385**	-0.0632***	-0.0344**	-0.0375***	-0.0338***	-0.1360***	-.-
	(0.0168)	(0.0205)	(0.0136)	(0.0127)	(0.0122)	(.0270)	
Egalitarian Coop							-0.0269**
							(0.0098)
Firm size	-0.0381***	-0.0303***	-0.0413***	-0.0460***	-0.0520***	-0.0627***	-0.0082
	(0.00808)	(0.00940)	(0.00838)	(0.00864)	(0.00585)	(0.0071)	(0.0073)
*Coop*Firm size*						0.0366***	
						(0.0105)	
% female	-0.0633**	-0.0708**	-0.0590***	-0.0322	-0.0422**	-0.0429**	-0.0594***
	(0.0274)	(0.0332)	(0.0229)	(0.0196)	(0.0184)	(0.0189)	(0.0163)
% <35 years old	0.0211	0.0340	0.0265	0.00691	0.00291	0.0061	0.0538***
	(0.0288)	(0.0343)	(0.0219)	(0.0194)	(0.0157)	(0.0155)	(0.0176)
Multi-establishment firm	0.0141	0.0198	0.0149	0.0107	0.00517	-0.001	-0.0207
	(0.0160)	(0.0189)	(0.0172)	(0.0167)	(0.0131)	(0.0152)	(0.0167)
Better technology than competitors				-0.00343	-0.0132	-0.0148	
				(0.0146)	(0.0128)	(0.0147)	
Better workforce training than competitors				-0.0260**	-0.0197*	-0.0265**	
				(0.0120)	(0.0106)	(0.0124)	
Demand problems				-0.0582***	-0.0610***	-0.0711***	
				(0.0163)	(0.0155)	(0.0182)	
Teamwork				0.000760	0.00269	0.0060	
				(0.0149)	(0.0124)	(0.0141)	
Lack of credit				0.0665***	0.0571***	0.0640*	
				(0.0227)	(0.0171)	(0.0179)	
Capital-to-labor ratio					0.00725***	0.0075***	
					(0.00249)	(0.0024)	
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	282	282	282	238	166	166	147

Notes: Coop is a dummy variable equal to one when the firm is a PC. Firm size defined as the log of employment lagged one period (total employment in 2008). All estimates include industry dummies (distinguishing Manufacturing, Transport, Services and other sectors) and region dummies. Columns (3)-(7) report average marginal effects. Estimates reported in Column (5) control for the capital-to-labor ratio (missing values in this variable reduce the number of observations). Estimates reported in Column (7) are restricted to the subsample of PCs and control for the employee-to-member ratio.. Egalitarian coop is a dummy variable equal to one for those PCs in which the wage ratio is equal to one.Robust standard errors are in parentheses. Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

[105] The substantial decrease in the number of observations in this estimate is due to firms with missing data on physical assets.

To test whether differences in supervision intensity vary with firm size, estimates reported in Column (6) include an interaction term *Coop*Firm size*. As expected, the interaction term is significantly positive, indicating that the difference in the supervision ratio tend to vanish as firm size increases. Finally, to provide evidence on the relationship between supervision and pay compression under workers' control, I estimate the same model restricting the analysis to PCs. I add a dummy variable that takes value 1 for Egalitarian PCs and 0 otherwise. Results are reported in Column (7) of Table III.3. Consistently with descriptive evidence provided in Figure III.5 and III.6, there is a positive association between pay inequality and supervision intensity in PCs. Controlling for other observable characteristics, the supervision ratio in Egalitarian PCs is 2.7 p.p. lower compared with non-egalitarian PCs. Worker-managed firms that deviate from equal-sharing use more supervisors per worker.

To study the determinants of the probability of using different disciplinary mechanisms within the firm, I perform additional probit estimates. Average marginal effects are reported in Table III.4. Results are generally consistent with the descriptive analysis presented in the previous section. The probability of using *"verbal warnings from supervisors"* as a disciplinary device, holding constant other factors, is 14.6% lower in PCs compared with CFs (Column 1). By contrast, the probability of relying on *"verbal warnings from coworkers"*, is 12% higher in PCs compared to CFs (Column 2). PCs are also less likely to rely on suspensions than CFs (Column 3). There are no significant differences between PCs and CFs in the use for-cause layoffs (Column 4). As expected, PCs are significantly less likely to rely on mutual monitoring as firm size increases.

In column (5) and (6) estimates are restricted to PCs and control for the employee-to member ratio. Results indicate that the probability of relying on vertical supervision (mutual monitoring) is significantly lower (higher) in Egalitarian PCs. More precisely, the probability of using *"verbal warnings from supervisors"* as a disciplinary device is 18% lower in Egalitarian PCs. By contrast, the probability of using mutual monitoring is 9.8% higher compared to perfectly egalitarian PCs. Interestingly, pay compression seems to be

associated with lower supervision intensity and a higher propensity to rely on mutual monitoring in PCs.

Table III.4. Probit estimates of different disciplinary mechanisms within firms
(Average marginal effects)

	(1)	(2)	(3)	(4)	(5)	(6)
	All firms: CFs and PCs				Only PCs	
	Verbal warnings from supervisors	Verbal warnings from coworkers	Layoffs	Suspensions	Verbal warnings from supervisors	Verbal warnings from coworkers
Coop	-0.146	0.122**	-0.0738***	0.0300		
	(0.0676)	(0.0537)	(0.0227)	(0.0215)		
Egalitarian Coop					-0.181***	0.0983**
					(0.0306)	(0.0441)
Firm size	0.0318	-0.0316***	0.0715***	0.00419	0.0250**	-0.0702***
	(0.0221)	(0.0105)	(0.0171)	(0.00574)	(0.0116)	(0.0139)
% female	-0.00647	-0.0254	-0.136*	0.0231	0.108***	-0.0727**
	(0.0935)	(0.0429)	(0.0756)	(0.0209)	(0.0391)	(0.0355)
% <35 years old	0.0715	0.0785	0.0412	0.0862**	0.256***	0.0773
	(0.0912)	(0.0574)	(0.0756)	(0.0392)	(0.0568)	(0.0652)
Region fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	286	286	286	286	148	148

Notes: Coop is a dummy variable equal to one when the firm is a PC. Egalitarian coop is a dummy variable equal to one for those PCs in which the wage ratio is equal to one. Firm size defined as the log of employment lagged one period (total employment in 2008). All estimates include industry dummies (distinguishing Manufacturing, Transport, Services and other sectors) and region dummies. In Column (5)-(6) estimates are restricted to the subsample of PCs and control for the employee-to-member ratio. Average marginal effects are reported in all cases. Robust standard errors are in parentheses. Statistically significant at .10 level; ** at the .05 level; *** at the .01 level

III.4 Rationalization

In this section, I provide a rationalization for the idea that equality serves as a discipline device in worker-controlled firms. I present a very simple model of team production augmented by group-effort norms proposed by Encinosa et al (2007). The distinct feature of the model is that the team's sharing rule is determined endogenously. [106]

[106]Other models of team production with mutual monitoring assumed equal sharing (see, e.g., Kandel and Lazear, 1992: Bowles et al, 2009)

A WMF is modeled as a partnership. A group of *n* members form a WMF in order to share fixed costs (e.g., space, equipment, common administrative structure, accounting system). Each member generate an individual revenue R such that:

$$R(e_i) = e_i + \varepsilon_i, \qquad \text{with} \quad R(0) = 0, R' > 0, R'' < 0 \tag{III.3}$$

where e_i is the effort provided by member i and ε_i is a mean zero random variable having variance σ_ε^2. WMF members are identical and ε_i is independently distributed across members.

Taking group size *n* as given, the expected individual income is defined as:

$$E(y_i) = \alpha e_i + (1-\alpha)\frac{\sum_{i \neq j} e_j}{n-1}, \qquad 1/n \leq \alpha \leq 1 \tag{III.4}$$

Each member is allowed to keep a fraction α of her revenue -decided by the group- and puts $(1-\alpha)$ into a common pool that is equally distributed among the remaining WMF members. The sharing rule $\alpha = 1/n$ corresponds to a perfectly egalitarian WMF. By contrast, $\alpha = 1$ corresponds to a situation in which there is no internal redistribution and each member receives her individual revenue.

Members' preferences are represented by following utility function:

$$U_i = E(y_i) - c\frac{e_i^2}{2} - \gamma\left(e^F - e_i\right), \tag{III.5}$$

where $e^F = \dfrac{\sum_{i \neq j} e_j}{n-1}$ is the group effort norm and $\gamma > 0$ indicates the size of the penalty that sub-norm performers receive. The last term of the RHS of equation (III.5) captures the idea that the work environment in a WMF provides sanctions (rewards) for those who work

below (above) the group norm. γ is interpreted as representing sub-performers' feelings of shame and guilt as well as informal monitoring and sanctions among group members. (Kandel and Lazear, 1992; Encinosa et al, 2007; Carpenter et al, 2008).[107] Changes in γ and *c* affect the equilibrium work effort by altering the marginal cost of effort.

The problem of the group is to choose the sharing rule that maximize the utility of the representative partner subject to the effort supply function. First, consider the standard case in which the utility function does not take into account social norms regarding effort provision. In this case, there is no internal redistribution and the optimal sharing rule is $\alpha = 1$. First-best effort levels are selected, equating the marginal benefit and the marginal cost of effort such that:

$$\frac{\partial U_i}{\partial e_i} = \alpha - ce_i = 0 \Rightarrow e_i^* = 1/c \qquad \text{(III.6)}$$

However, when sub-norm performers experience a penalty $\gamma > 0$, the problem is such that,

$$\underset{\alpha}{Max} U = Y(e) - c\frac{e_i^2}{2} - \gamma\left(e^F - e_i\right) \qquad \text{(III.7)}$$

$$\text{s.t.} \quad e = e(\alpha)$$

Differentiating (5) leads to the following first-order condition for effort provision in the presence of norms:

$$\frac{\partial U_i}{\partial e_i} = \alpha - ce_i + \gamma = 0 \qquad \text{(III.8)}$$

According to equation (6), the first-best effort level $e_i^* = 1/c$ is achieved when $\alpha + \gamma = 1$. As long as $\gamma > 0$, this implies that the group will set $\alpha < 1$. *In the presence of effort norms,*

[107] The model assumes that mutual monitoring is costless.

a WMF incur in internal redistribution, operating with $\alpha < 1$. *This is line with survey evidence indicating that peer monitoring is coupled with pay compression in WMFs.*

Under equal sharing $\alpha = 1/n$, which implies that as team size increase α decreases. It is less likely that large groups will have norms γ strict enough to sustain first-best effort levels with equal sharing. Formally,

$$\left.\begin{array}{l}\alpha+\gamma=1\\ 1/n+\gamma=1\end{array}\right\} \Rightarrow \gamma^{*}=1-1/n \Rightarrow \partial\gamma^{*}/\partial n=1/n^{2}>0 \qquad \text{(III.9)}$$

Hence, internal redistribution is more likely to be implemented in small WMFs. This is in line with the fact that peer monitoring is significantly more frequent in small WMFs.

III.5 Other peer-monitoring enhancing policies: further survey evidence

In this final section, I provide evidence on further differences in organizational design and practices between WMFs and CFs. I focus on three specific problems associated with the employment relationship: labor adjustments to shocks, matching firms with workers (hiring policies and screening among entrants), and the organization of work (human resource practices).

III.5.1 Labor adjustments to shocks

The survey provides some additional qualitative information on labor adjustment strategies in WMFs and CFs. Results are reported in Appendix Figure III.A1. The fraction of firms that faced adverse demand conditions during 2009 is very similar across organizational forms.[108] However, there are significant difference in the way WMFs and CFs response to negative demand shocks. The fraction of firms responding *"No action taken affecting the workforce"* is significantly higher in WMFs (28%) than in CFs (10%). CFs seem to adjust quantities (working hours and employment) more frequently than WMFs. In turn, wage

[108] The questionnaire asks whether the firm faced demand problems lasting at least one month during 2009.

cuts are more common in WMFs than in CFs. These qualitative results are in line with existing panel data evidence on wage and employment adjustments in WMFs and CFs (Craig and Pencavel, 1992, Pencavel et al, 2006; Burdin and Dean, 2009).[109]

The rationale of labor hoarding in WMFs may be also related with their specific labor discipline strategy based on mutual monitoring. Greater employment stability provide members longer with time horizons. This is crucial to support a *tit-for-tat* type of cooperation through repeated interactions in work teams in which members are residual claimants (Levine and Parkin. 1994, Bowles, 2004).

III.5.2 Recruitment channels and screening

Economic theory suggests that low-ability types may be overrepresented among job applicants in egalitarian organizational settings (Abramitzky, 2011).[110] To mitigate adverse selection effects, WMFs may rely on different recruitment channels than CFs. The survey provides evidence on the recruitment channels employed by WMFs and CFs to fill vacancies. Figure III.A3 (Appendix) shows that WMFs rely less frequently on public calls, newspapers and recommendations from outsiders than CFs. By contrast, recommendations from incumbent members and promotions are more often used in WMFs than in CFs. Overall, the evidence suggests that WMFs develop specific screening devices to exclude low-ability entrants. In Appendix Figure A4, I report the same information but distinguishing egalitarian and non-egalitarian WMFs. Interestingly, egalitarian WMFs rely more frequently on internal channels (recommendation from insiders and promotions) than non-egalitarian WMFs. The use of "trial periods" to make the final hiring decision is also more frequent among egalitarian WMFs. These recruitment policies may also reduce social distance and increase empathy between new and incumbent members and, hence, their susceptibility to peer pressure and group effort norms (shame, guilt). In terms of the model presented in the previous section, recruitment and screening policies contribute to enforce labor discipline by affecting the parameter γ in members´ utility function.

[109] See also chapter I in this volume (Table I.A2).
[110] In fact, problems of retention-recruitment of skilled workers are more frequently reported in egalitarian WMFs than in non-egalitarian WMFs (see Appendix Figure A2).

III.5.3 Human resources practices

Finally, the survey provides information on the use of different human resource (HR) practices in WMFs and CFs. In Appendix Figure III.A5, I report the fraction of firms using certain HR practices. Teamwork, worker involvement initiatives and quality circles are more commonly employed in WMFs than in CFs. Interestingly, task rotation is also significantly more frequent in WMFs than in CFs. The fact that WMFs rely more intensively on these practices may also be interpreted as a way of enhancing social interactions at the workplace, favoring the conditions that support mutual monitoring.

III.6. Conclusions

This paper present novel survey evidence comparing the compensation structure and monitoring in worker-managed firms and conventional firms. I find evidence that workers' control is associated with pay compression and lower hierarchical supervision intensity. Differences in labor discipline strategies are more salient in small firms in which mutual monitoring becomes a feasible substitute for vertical supervision in WMFs. These findings can be rationalized in a simple team production model augmented by group-effort norms. In the presence of social norms, a WMF can achieve first-best effort levels by weakening individual monetary incentives (Encinosa et al., 2007).

While previous evidence suggests that egalitarian WMFs pay a "brain drain cost" (see chapter II in this volume), this paper suggests a positive labor discipline effect associated with egalitarian compensation policies in this type of firms. WMFs may face a dilemma in deciding the degree of internal inequality. On one hand, greater wage dispersion reduces the incentives to quit of high-ability workers, mitigating the brain drain effect. On the other, inequality seems to erode the conditions that support peer monitoring and allow WMFs to save on nonproductive monitoring inputs, eroding an important competitive advantage of this type of organziations.

However, the evidence presented in this paper should be taken cautiously. The cross-section nature of the data and the small sample size impede to handle obvious identification problems (e.g. omitted variables and measurement errors) and make strong causal claims. Forthcoming data from an ongoing firm-level panel survey will allow to overcome some of the limitations of this preliminary analysis. Moreover, further research is needed to provide a unified labor discipline model that makes explicit the trade-off between the positive and negative side effects associated with pay compression in WMFs.

Appendix III

Figure III.A1. Labor costs adjustment strategies in WMFs and CFs

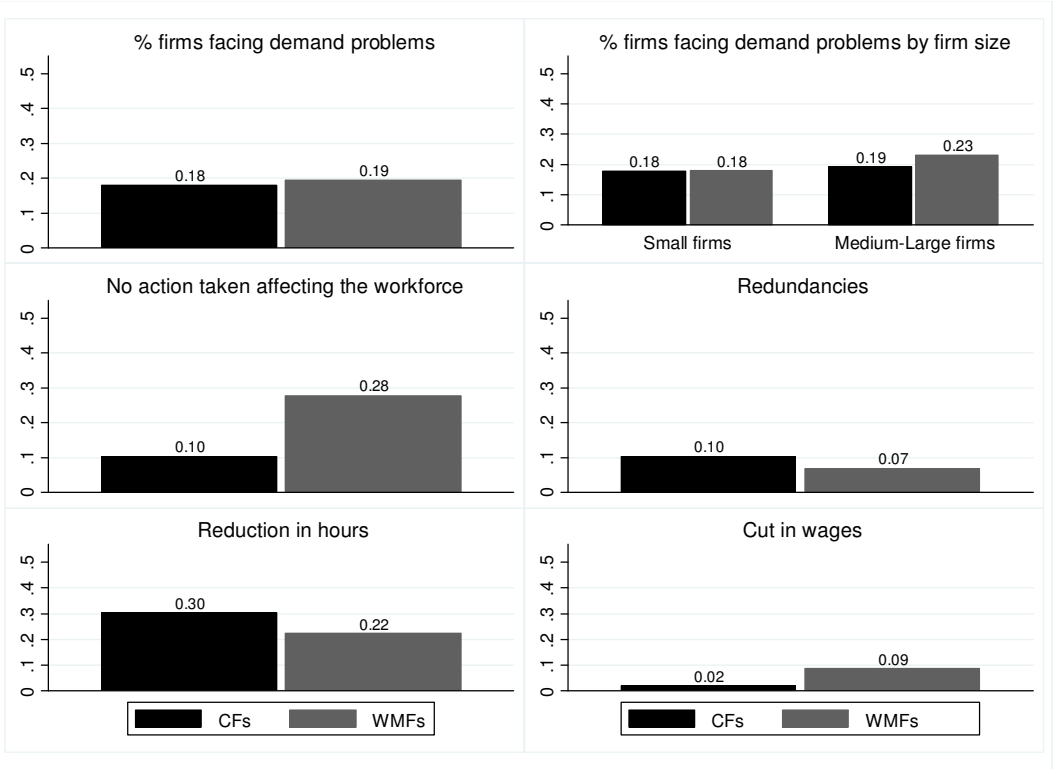


Figure III.A2. Perceived HRM problems in egalitarian and non-egalitarian WMFs

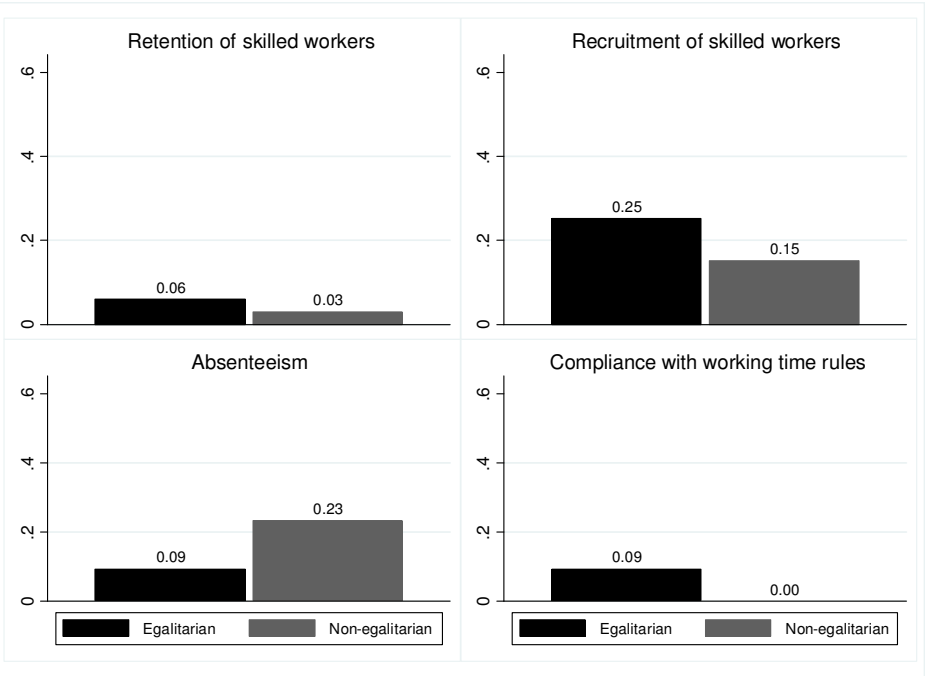


Figure III.A3. Recruitment channels in CFs and WMFs

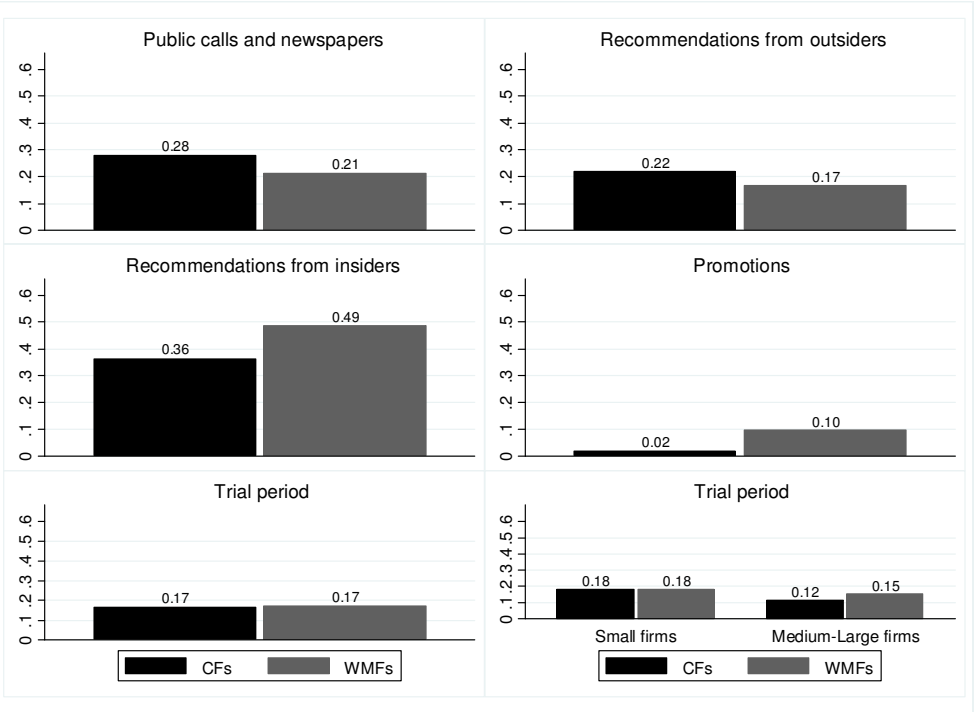


Figure III.A4. Recruitment channels in egalitarian WMFs and CFs

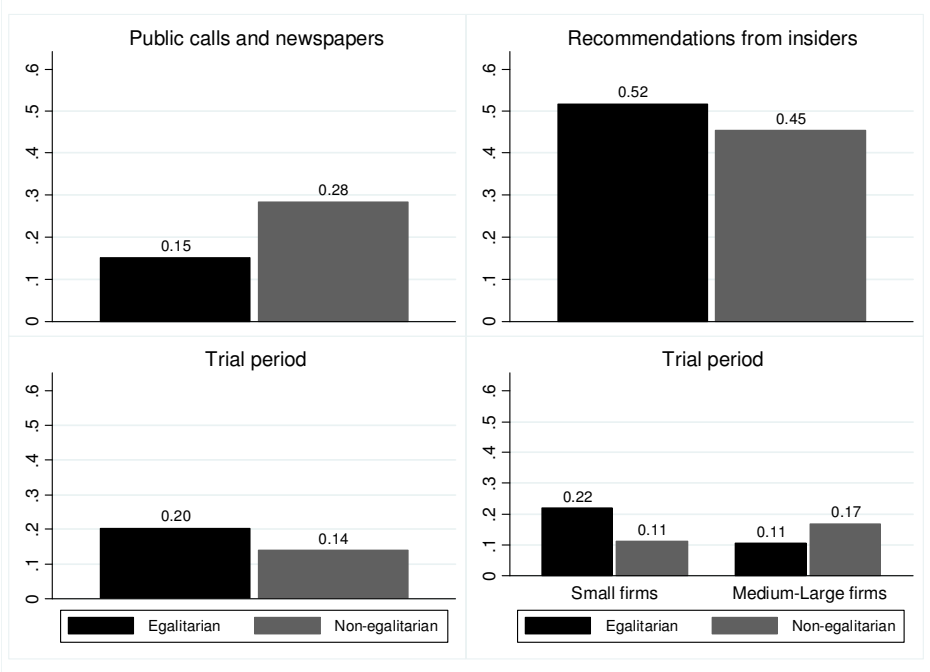


Figure III.A5. Human Resource practices in CFs and WMFs

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