Are Workers' Enterprises entry policies conventional?*

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Abstract

One of the main reasons why workers' enterprises (*WE*) still represent a relevant chunk of the economy may lay in some affinities with conventional profit maximizing firms. To prove this, we compare the entry policies of *WEs* and conventional firms when they can decide size at entry while having to stick to it afterwards. Even though short run differences remain, a long run coincidence appears besides that under certainty. Endogenizing size and time of entry in an uncertain dynamic environment we see that *WEs* enter at the same trigger and size of conventional firms. Both of them wait less and choose a dimension larger than the minimum efficient scale. This may be another way to explain why *WE* are still an important share of the economy (Hesse and Cihàk, 2007) despite the ongoing mantra of their imminent demise.

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1 Prologue

In Labour Managed firms (*LMFs*) workers own and govern the enterprise on an equal foot. *LMFs* exist in most countries and industries (Craig and Pencavel, 1992, 1995; Moretto and Rossini, 2003). For instance, *LM* banks are quite common in both developed and emerging countries and seem to contribute to equity and financial stability (Hesse and Cihàk, 2007). Last but not least, *LMFs* are quite close to firms belonging to the broad *US Census* category dubbed *Nonemployer* (Moretto and Rossini, 2005) and, in particular, to the large subset corresponding to *Partnerships,* very popular among infant firms in high tech sectors.

Whenever we compare a *LMF* with a conventional profit maximizing firm (*PMF*) we come across some fundamental differences in short run behavior, while a kind of long run coincidence holds.

In the short run the supply of the *LMF* reacts in a negative manner to higher market prices. The same occurs to the amount of labour required. Moreover, an increase in fixed costs generates a larger membership as the *LMF* needs fresh employee-members to bear larger overheads[1]. These reactions, deemed as "perverse", have been cast within the original modelling of the *LMF* (Ward, 1958; Vanek, 1970) and are still quite popular even though they lack realism since they are based on the assumption that, in the short term, an *LMF* changes, as a result of market signals, the membership size decided at the foundation. This weakness has been amended by the proponents of the new theory of Workers' Enterprises (*WE*) (Sertel, 1987; 1991; 1993; Fehr and Sertel, 1993). *WE*s, based on the evolution of the traditional *LMF* underpinning, are quite similar to *LMFs,* but for membership, that can follow two alternative arrangements. In the first, size is chosen at the time of entry in the market and is not liable to vary in the short run. In the second, there exists a competitive market for memberships and, thanks to it, the number of members can change in the short run. In both cases "perversities" of the *LMF* shy away[2].

In the long run *LMFs*, *WEs* and *PMFs* are indistinguishable. This has given rise to the paradox stating that, in the long run, it is immaterial whether capital hires labour or the other way round (Samuelson, 1957; Dow, 1993). However, this result should be taken with great care, since the long run comparison between *PMF* and *WE* is confined to a static framework where the entry process is not explicitly modeled.

Here comes our main purpose, i.e. to model the entry decision and to test the long run convergence of *WE* and *PMF* with market uncertainty and investment irreversibility. After all, one of the main reasons why *WEs* still represent a significant chunk of the economy may lay in some affinities with respect to

[1] We may consider hiring labor that will not become member of the *LMF*. This possibility is considered in the literature (Bonin and Putterman, 1987). The resulting *LMF* is a sort of hybrid closer to a *PMF,* or, in other words, an intermediate arrangement between the *LMF* and the *PMF*.

[2] A further confirm of the non-perversities of *WEs* come in a differential game framework from Cellini and Lambertini (2006).

conventional firms. In this sense we shall provide a further interpretation of the persistence of *WE* in most economies (Hesse and Cihàk, 2007) despite the ongoing mantra of their imminent demise. To interpret this unexpected survival (and flourishing) we show fresh similarities between *WE* and *PMF,* with market uncertainty in a dynamic setting when firms can delay entry, which is thought of as an option that firms possess to enter a market. In this option - like scenario, firms observe the quantity that market demands. Then, they choose size and set the price, that triggers entry, in an optimal way. This occurs in the same way regardless of the market structure (Leahy, 1993, Grenadier 2002). With no uncertainty in a dynamic setting the trigger prices of *WE*s and *PMF*s are the same (Moretto and Rossini, 2005): the two enterprises follow parallel patterns and in equilibrium cannot be distinguished. This happens if both firms do not change, after entry, the amount of labour chosen even when market incentives require it. The assumption closely mirrors the internal organization of human capital intensive industries. Here labor has a high specific value and firms are reluctant either to reduce it or to increase it due to large adjustment costs. This rigidity makes the *PMF* quite close to a *WE* constrained by a fixed membership after entry. Without this constraint affinities would shrink sharply.

The paper goes on as follows: In the next section we are concerned with the *WE* textbook case in a static environment; in section 3 we model entry, size and trigger prices under uncertainty. Conclusions are drawn in the epilogue.

2 The textbook case

We shortly present the *WE* static short run model drawn from current literature.[3]

We consider a *WE* producing a homogenous good with the short run Marshallian technology $Q(L)$, with $Q(0) = 0$, $Q'(L) > 0$, $Q''(L) < 0$ and $L \in \left[\underline{L}, \bar{L}\right]$, where Q is the quantity manufactured and L is the labor input. The good is sold at price p.

The *WE* sets optimal membership maximizing the surplus per worker (value added ($y(p; L)$) minus market wage (w)):

$$y(p; L) - w = \frac{pQ(L) - I}{L} - w \tag{1}$$

where I indicates the sunk - fixed cost.

The short run (sr) first order condition (FOC) yields:

$$pQ'(L_{WE}^{sr}) = y(p; L_{WE}^{sr}) \tag{2}$$

Provided that $y(p; L) - w > 0$ we get the well known result that the optimal amount of labor employed by the *WE* in the short run is smaller than for the corresponding *PMF*, given by the marginal condition $pQ'(L_{PM}^{sr}) = w$.

[3]For a recent survey on the literature on *WE* and labour participation see Moretto and Rossini (2003).

In the long run (lr) competition dissipates all rents. Fresh firms, using same technology $Q(L)$, same variable and fixed costs, will enter at the Marshallian point:

$$p_{WE} = AC(\hat{L}) \equiv \frac{w\hat{L} + I}{Q(\hat{L})}, \tag{3}$$

where $AC(\hat{L})$ is the long run average total cost evaluated at the minimum efficient scale, i.e.: $L_{WE}^{lr} \equiv \hat{L} = \arg\min AC(L)$. Moreover, in the long run profits are null and the two firms behave the same way, i.e. $L_{WE}^{lr} = L_{PM}^{lr}$.

3 *WE*'s entry under uncertainty

The above analysis is confined to a deterministic framework and considers a *WE* already in the market, neglecting the entry process.

Our main purpose is to model the entry policy of a single *WE* in isolation regardless of rivals. In this sense we may say that the firm is myopic. Then we shall see what happens if the firm becomes farsighted dismissing its myopic habit.

We start investigating a *WE* that has an option to enter the market with an irreversibly sunk investment project of finite size. The controls are time of entry and size in terms of labor membership.

In the vein of real option theory we assume that (Dixit and Pindyck, 1994):

1. The project, corresponding to a start-up decision, is of finite size with an entry cost I and technology described above.
2. The investment I is irreversibly sunk. It can neither be changed, nor temporarily stopped, nor shut down but it can be delayed while waiting for new information.[4]
3. For the sake of comparison with the textbook case, the instantaneous short run surplus per worker after entry is equal to (1) when the market wage w per unit of labour is constant over time.
4. The *WE* faces an infinitely elastic demand function: the uncertain market price is driven by the following trendless stochastic differential equation:

$$dp_t = \sigma p_t dB_t \qquad \text{with } \sigma > 0 \text{ and } p_0 = p, \tag{4}$$

   where dB_t is the standard increment of a Wiener process.[5]
5. The project is funded by *WE* members, who are all alike and maximize the discounted value of expected individual value added.

[4] This avoids the analysis of operating options, such as the ability of the firm to reduce output and to shut down. These options increase the value of the firm. See McDonald and Siegel (1986) and, for a thorough discussion, Dixit and Pindyck (1994, chs. 6 and 7).

[5] By the Markov property of the process p_t, the results do not change qualitatively assuming a positive (or negative) trend of price (Dixit, 1993). Moreover, analogous results will be obtained if uncertainty is embedded in costs (See Dixit and Pindyck, 1994).

6. Finally, as pointed out in the introduction with regard to the change in membership, L is chosen before entry and held fixed afterwards.

Given these assumptions, only if the price is high enough, the *WE* enters setting the optimal size (L). The decision process requires a backward procedure. First, for any L, the value of the individual option to enter is computed. Subsequently, homogeneous employee-members of the *WE* chose L which maximizes the individual (option) value at entry.

The employee-member of a *WE* of size L determines whether and when to start the new project solving an optimal stopping time problem by choosing the investment timing which maximizes:

$$f_{WE}(p; L) = \max_{T} E_0 \left[(y(p_T; L) - w) \, e^{-\rho T} \mid p_0 = p \right] \tag{5}$$

Each employee-member holds an option to invest corresponding to (5) and has an interest in exercising it cooperatively at the same time. He waits up to time T, where T is a random variable whose distribution can be obtained from that of (4). Then, he invests when p_t, starting from p_0, reaches an upper value, say p_{WE}. Assuming that p_{WE} exists, taking expectation of (5) and using the distribution of T, we are able to write the member's value function, before investing, as (Dixit and Pindyck, 1994; Dixit et al., 1999):

$$f_{WE}(p; L) \quad = \quad (y(p_{WE}; L) - w) \left(\frac{p}{p_{WE}} \right)^{\beta} \quad \text{for } p < p_{WE}. \tag{6}$$

where $1 < \beta < \infty$ is the positive root of the auxiliary quadratic equation $\Psi(\beta) = \frac{1}{2}\sigma^2 \beta(\beta - 1) - \rho = 0$. The individual option value (6) represents the expected net per capita dividend of the project, i.e., $y(p_{WE}; L) - w$, multiplied by the expected discount factor, i.e., $\left(\frac{p}{p_{WE}} \right)^{\beta}$. Therefore, the optimal investing rule implies that $f_{WE}(p; L) > y(p; L) - w$ for all $p < p_{WE}$.

Consistently with (1), entry occurs if the cash flow generated by the project is weakly larger than the long-run average cost. Maximizing (6) for p_{WE}, we see that the *WE* should invest when the market price exceeds the break-even threshold:

$$p_{WE} = \frac{\beta}{\beta - 1} AC(L) \tag{7}$$

which is the (deterministic) Marshall trigger $AC(L)$ multiplied by $\frac{\beta}{\beta-1} > 1$, due to irreversibility of entry. The consequence is that, with new observations on market profitability obtained by waiting, the enterprise reduces the downside risk (Dixit and Pindyck, 1994, p. 142).

Substituting (7) back into (6) and maximizing with respect to L, the optimal entry size of *WE* can be obtained from:

$$p_{WE} Q'(L_{WE}^{sr}) \quad = \quad w + f_{WE}(L_{WE}^{sr}) > w. \tag{8}$$

where $f_{WE}(L^{sr}_{WE}) \equiv \frac{1}{\beta-1}(w + \frac{I}{L^{sr}_{WE}})$.

The *WE* chooses the optimal size equating the value marginal product, which is decreasing by concavity of the technology, to the "supplemented wage", that exceeds the market wage w. The Marshallian full cost of the investment imputed to each employee-member is $w + f_{WE}$, larger than w, since each member of the *WE* owns an equal option to delay entry. After all, would-be employee-members are workers endowed with the option (and the skill) to build an egalitarian *partnership* making for a compensation larger than w.

Let us now turn to the long-run. Since competition dissipates all rents, the option value to delay entry goes to zero (i.e. $f_{WE} = 0$). However, by the infinite elasticity of demand, the optimal entry trigger (7) is not altered (Leahy, 1993, p.1118; Dixit and Pindyck, 1994, p. 254-257; Grenadier, 2002, p.703-704). All firms are alike and demand is infinitely elastic. Then, each employee-member maximizes her individual option to enter. By doing that she ends up choosing the optimal dimension of the industry as a whole. This means that L^{lr}_{WE} is the dimension of a *WE* encompassing all employee-members in the industry.

Then, we may prove that:

Proposition 1 *a) Long run competition forces the WE to operate with a larger dimension than in the short run, i.e.:*

$$L^{sr}_{WE} < \hat{L} < L^{lr}_{WE},$$

b) The entry trigger prices react in distinct ways in the long run vis à vis the short run, i.e.:

$$\frac{\partial p^{sr}_{WE}}{\partial L} > 0 \qquad \frac{\partial p^{lr}_{WE}}{\partial L} < 0.$$

Proof. See Appendix. ■

To sum up:

1. under uncertainty the *WE* enters in both the short run and the long run if the market price is larger than the average total cost $AC(L) \equiv \frac{wL+I}{Q(L)}$ multiplied by a coefficient $\frac{\beta}{\beta-1}$,

2. the myopic *WE* enters with a size lower than minimum efficient scale $\hat{L}$

3. the farsighted *WE* under long run competition adopts a size which is above the efficient scale $\hat{L}$.

In other words, in the short run myopic equilibrium, the *WE* operates to the left of the minimum efficient scale, while, in the long run farsighted equilibrium, to the right.

Furthermore, we notice that, the optimal entry triggers of the short run WE and of the long rune WE react in opposite ways with respect to dimension. Then, although we do not know whether p^{sr}_{WE} is larger or smaller than p^{lr}_{WE}, since it depends on the shape of $AC(L)$, as a result of competition - free entry - firms exercise their option sooner since the potential entry of new rivals reduces the value of the option to wait in the hands of the members of the *WE*.

Finally, in the long-run the *WE* chooses optimal size equating the value marginal product to the market wage w. This choice coincides with that of a

PMF that determines the amount of labor to hire before entry sticking to it afterwards, regardless of market signals (Moretto and Rossini, 2005). When considering the effects of free entry, both the *PMF* and the *WE* abandon their respective myopic attitude and their behaviors converge, i.e., they enter with a size larger than that dictated by the minimum efficient scale level and, ceteris paribus, wait less before entering.

4 Epilogue

In an uncertain dynamic environment firms may anticipate competitive reactions of potential rivals. If they have the option of deciding the best time to start producing and if they cannot change their size after entry, a long run coincidence between a *WE* and a conventional firm emerges.

At entry in a myopic environment *WE*s are smaller than conventional firms. While, in the long run under uncertainty, free entry and risk neutrality a *PMF* and a *WE* both enter with an equal and larger size than that dictated by the minimum efficient scale. Moreover, they wait less as they both anticipate the effects of entry.

Even though our results have been obtained in a simplified framework, the coincidence of behavior at entry between a *WE* and *PMF* facing after-entry labor rigidities, provide a further interpretation of the persistence of *WE* in many industries where human capital specificities make labor flexibility costly.

A more realistic picture requires that each firm perceive the industry demand in the long run as a downward sloping curve. If that was the case, also the optimal triggers would differ between the myopic and the non myopic *WE*. Nonetheless, as proved by Grenadier (2002) for the *PMF*, the results do not change much.

5 Appendix

First part of the *Proposition*.

Substituting (7) into ((6) and rearranging we write the L-th employee-member's value of the project prior to investing:

$$f_{WE}(p;L) = A(L)p^{\beta} \qquad \text{for } p < p_{WE}(L), \tag{9}$$

where the constant $A(L)$ is given by:

$$A(L) \equiv \frac{(\beta-1)^{\beta-1}}{\beta^{\beta}} AC(L)^{-\beta} \frac{(wL+I)}{L} > 0 \tag{10}$$

By (9) the optimal dimension requires choosing L for which $A(L)$ is the largest. This is equivalent to maximizing

$$a(L) \equiv AC(L)^{-\beta} \frac{(wL+I)}{L},$$

which gives the first order condition:

$$\frac{L_N Q'(L_N)}{Q(L_N)} = 1 - \frac{(\beta-1)}{\beta}\frac{I}{(\frac{w}{\rho}L_N + I)} \tag{11}$$

Since the r.h.s. of (11) is less than one, a necessary condition for an optimal solution is an output elasticity $\varepsilon_{QL} \equiv \frac{LQ'(L)}{Q(L)} < 1$, i.e., the average productivity $\frac{Q(L)}{L}$ must be a decreasing function of labor, as from Assumption 1. By simple manipulation of (11) we get (8).

By Assumptions 4 and 5, the option value to invest by the industry as a whole is given by:

$$F_{WE}(p; L) = f_{WE}(p; L)L \tag{12}$$

where $f_{WE}(p; L)$ is the value of the project for the L-th member of the *WE*, given by (9). Defining $b(L) \equiv La(L)$, the optimal size is simply given by:[6]

$$b'(L) = a(L) + La'(L) = 0, \tag{13}$$

Over the range where the *SOC* holds $a'(L^{sr}_{WE}) = 0$. Therefore, $b'(L^{sr}_{WE}) = a(L^{sr}_{WE}) > 0$. If an L^{lr}_{WE} exists such that $b'(L^{lr}_{WE}) = 0$, this will necessarily be:

$$L^{sr}_{WE} < L^{lr}_{WE}.$$

Second part of the *Proposition.*

Define the average cost function $AC(L) \equiv \frac{wL+I}{Q(L)}$. By the concavity of $Q(L)$ it is easy to show that $\lim_{L\to 0} AC(L) = +\infty$ and $\lim_{L\to +\infty} AC(L) = +\infty$. By taking the derivative with respect to L, we get:

$$\frac{\partial AC}{\partial L} = \frac{wQ(L) - (wL+I)Q'(L)}{Q(L)^2} = \begin{cases} < 0 & \text{if} \quad \varepsilon_{QL} = \frac{LQ'(L)}{Q(L)} > 1 - \frac{I}{(wL+I)} \\ > 0 & \text{if} \quad \varepsilon_{QL} = \frac{LQ'(L)}{Q(L)} < 1 - \frac{I}{(wL+I)} \end{cases} \tag{14}$$

Then, a value $\hat{L} > 0$ exists such that $\frac{\partial AC}{\partial L} = 0$ and it is given by:

$$\frac{\hat{L}Q'(\hat{L})}{Q(\hat{L})} = \left(1 - \frac{I}{(w\hat{L} + I)}\right). \tag{15}$$

The second order condition confirms that $AC(L)$ is a convex function with a minimum represented by $\hat{L}$. Since $\frac{(\beta-1)}{\beta} < 1$, by comparing (15) and (11), we notice that in the short run the *WE* operates only in the descending branch of the average cost curve to the left of the minimum. That is:

$$1 - \frac{(\beta-1)}{\beta}\frac{I}{(wL+I)} > 1 - \frac{I}{(wL+I)}$$

[6] The *SOC* is:

$$b''(L) = 2a'(L) + La''(L) < 0.$$

In general $a''(L) < 0$ does not imply that $b''(L) < 0$: the two regions, where the *SOC* holds, overlap only partially.

which implies that $\hat{L} > L_{WE}^{sr}$. On the contrary,by comparing (15) and (13), we have:

$$\frac{(\beta - 1)}{\beta}\left(1 - \frac{I}{(wL + I)}\right) < 1 - \frac{I}{(wL + I)},$$

which, in the range where the SOC holds, implies that $\hat{L} < L_{WE}^{lr}$.

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