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Loss aversion and risky entrepreneurship

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ABSTRACT

The rise of experimental economics has made us wonder if the traditional approach to studying economics under risk (expected utility and risk-averse agents) is the best way to represent actual behavior. In this paper, we introduce an alternative model of economics of entrepreneurship under risk using reference-dependence preferences and analyze if the basic comparative static results from the traditional model still hold under loss averse preferences. We find minor differences between what we know under risk aversion and what we get under loss aversion. This is a positive result, if we expect policies that promote entrepreneurship to be effective, no matter if the individual is risk or loss averse.

1. Introduction

Traditionally, the economic literature on entrepreneurship assumes risk aversion as a natural way to model economic behavior under risk. This assumption comes from the seminal contribution of Kihlstrom and Laffont (1979) who developed an equilibrium model of entrepreneurship that was based on the assumption of Decreasing Absolute Risk Aversion (DARA) preferences and the idea that more risk averse agents tend to become employees, while less risk averse agents tend to become entrepreneurs, since they are better at managing the inherent risk of developing new ventures. However, the rise of experimental economics has triggered questions about the way in which we model economic agents' behavior under risk and it has made us wonder if, by using the expected utility paradigm and risk averse preferences, we are missing important pieces of the behavioral puzzle.

An alternative way to model preferences under risk that emerge from the experimental literature is reference-dependence preferences (RDP or Prospect Theory) (Kahneman and Tversky (1979)). The central trait of this alternative framework is that economic agents exhibit loss aversion, which is the main feature of the "economic agent" in this paper.

The idea that entrepreneurial behavior can be better explained by loss aversion instead of risk aversion (Morgan and Sisak (2016), Koudstaal et al. (2016)) challenges previous results in the field of entrepreneurship, especially because no economic theory of entrepreneurship under loss aversion has been yet developed. In this article, we advance the analytical framework of entrepreneurship by incorporating loss aversion into the model, and by doing so, we also check if the main results form entrepreneurship under risk aversion also hold under loss aversion. We build on the seminal work of Fishburn (1977) and follow the steps of Jarrow and Zhao (2006) and Eeckhoudt et al. (2016) to advance the economic theory of entrepreneurship under risk. We also reduce the gap between theory and experiments in the entrepreneurship literature.

2. Related literature

Loss aversion has been recently studied extensively and used to calibrate the behavior of economic agents in different contexts. For instance, it has been applied successfully to the portfolio problem of an investor (Jarrow and Zhao (2006), Eeckhoudt et al.

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(2016)), to corporate policy analysis (Kim and Nguyen (2022), Weining and Qingduo (2018)), to intertemporal models of saving and consumption (Siegmann (2002)), to moral hazard contexts and optimal contracts (Macera (2018)) and to asset pricing theory (Li and Yang (2013)).

Preferences exhibiting loss aversion account for a greater disutility of losses when compared to utility obtained from gains of the same size from a references point (a target wealth level in our case). We build from Eeckhoudt et al. (2016) and assume that the utility function is globally weakly concave, in which any amount of money above the target wealth level (gains) will cause the agent to behave risk-neutrally (i.e. the utility function will be linear), and any amount below the target (losses) will cause him to behave risk-aversely (i.e. the function will be concave). Having this as a baseline, we show that most basic classical results in the literature of entrepreneurship under risk aversion also hold under loss aversion. This similarity of most results provides some reassurance that, in terms of the fundamental comparative static results, no substantial differences in the behavior of both types of entrepreneurs appear to emerge.

3. Loss aversion and entrepreneurship

The economy is characterized by a single-good stochastic production function defined by $f(L,\theta)$, where L is the labor hired by the entrepreneur and θ is a continuous random variable with support on $[\underline{\theta},\overline{\theta}]$ that represents uncertainty in the model.[1] We think of θ as a random productivity shock that positively affects the production function and its corresponding marginal production. That is, $f_\theta(L,\theta)>0$ and $f_{L\theta}(L,\theta)>0$, where the subscripts denote partial derivatives. The production function is increasing and concave in L, so $f_{LL}(L,\theta)<0<f_L(L,\theta)$ and Inada conditions are assumed to hold. Therefore, an interior solution to the problem is expected.

Entrepreneurial profits are characterized by $f(L,\theta)-wL+a\equiv\pi(L,\theta,w,a)$, where w is the unit labor wage and a is the exogenous initial wealth of the entrepreneur. To simplify notation, we will denote profits by $\pi(L,\theta)$, unless developing a specific exercise of comparative static on w or a.

Fishburn (1977), Jarrow and Zhao (2006) and Eeckhoudt et al. (2016) developed an interesting economic model of a loss averse investor within the classical portfolio problem. We follow their footsteps and modify the model for our entrepreneurial context. Then, an entrepreneur with a loss-averse utility function is defined as follows:

$$v(\pi(L,\theta))=\begin{cases} u(\pi(L,\theta)) & \text{if } \pi(L,\theta)<t \\ u(t)+u'(t)(\pi(L,\theta)-t) & \text{if } \pi(L,\theta)\geq t \end{cases} \tag{1}$$

where $u(\pi(L,\theta))$ is a continuous, three-times differentiable, increasing, risk-averse and prudent utility function, i.e., $u''(\pi(L,\theta))<0<u'(\pi(L,\theta))$ and $u'''(\pi(L,\theta))>0$, for all $\pi(L,\theta)\in[0,t)$. We think of t as an exogenous target or reference wealth level that divides outcomes into gain and losses. Above the references point t the utility function starts behaving as if the agent was risk-neutral (the function is linear beyond this point). Therefore, we have a concave-linear utility function denoted by $v(\pi(L,\theta))$ that represents an entrepreneur whose losses under the reference point have a greater impact on utility than the gains of the same size above t, which is the key characteristic of loss averse preferences. Intuitively, the loss averse utility function used produces a marginal utility of gains that is constant and smaller in size than any marginal disutility of losses under the reference point. This can be observed when we compare the slopes of the utility function to the right and to the left of the reference point.

The entrepreneur then must solve the following problem:

$$\underset{L}{\text{Max}}\; V(L)=E[v(\pi(L,\theta))]$$

which, under loss aversion, translates into choosing L in order to maximize

$$V(L)=\int_{\underline{\theta}}^{\theta_t}u(\pi(L,\theta))dF(\theta)+\int_{\theta_t}^{\overline{\theta}}[u(t)+u'(t)(\pi(L,\theta)-t)]dF(\theta) \tag{2}$$

where θ_t represents the random productivity shock that corresponds to the target (or reference) wealth level for a given L; that is, $t=f(L,\theta_t)-wL+a=\pi(L,\theta_t)$.

The cumulative distribution function F is continuous on the support in order to guarantee integrability conditions. The first order condition (FOC) of the maximization problem (2) becomes

$$V'(L^*)=\int_{\underline{\theta}}^{\theta_t}u'(\pi(L^*,\theta))(f_L(L^*,\theta)-w)dF(\theta)+u'(t)\int_{\theta_t}^{\overline{\theta}}(f_L(L^*,\theta)-w)dF(\theta)=0 \tag{3}$$

Observe FOC (3) and note that $u'(\pi(L,\theta))>u'(t)>0$ for $[\underline{\theta},\theta_t]$, given that $u''<0$. Also, we know that $f_L(L,\theta)$ is increasing in θ ($f_{L\theta}(L,\theta)>0$) and, therefore, a sufficient condition for the optimal solution to exist is to have $(f_L(L^*,\theta)-w)<0$ in $[\underline{\theta},\theta_t)$, and $(f_L(L^*,\theta)-w)>0$ in $[\theta_t,\overline{\theta}]$, which guarantees that $\int_{\underline{\theta}}^{\theta_t}(f_L(L^*,\theta)-w)<0$ and $\int_{\theta_t}^{\overline{\theta}}(f_L(L^*,\theta)-w)>0$ in FOC (3).

The second order condition (SOC) of the problem is

$$V''(L)=\int_{\underline{\theta}}^{\theta_t}\left[u''(\pi(L,\theta))(f_L(L^*,\theta)-w)^2+u'(\pi(L^*,\theta))f_{LL}(L,\theta)\right]dF(\theta)+ \\ u'(t)\int_{\theta_t}^{\overline{\theta}}f_{LL}(L,\theta)dF(\theta)<0 \tag{4}$$

[1] According to recent literature on entrepreneurship under risk, capital input is treated as a constant parameter and thus does not appear explicitly in the production function (see, for example, (Watt, 2020) or (Bonilla and Vergara, 2021)).

which, given the assumption of the problem, confirms that the problem is concave in L and therefore, the optimal solution is a maximum.

In the next section, we will study different comparative static exercises for the loss-averse entrepreneur. From previous literature on entrepreneurship and risk – mainly based on the seminal work of Kihlstrom and Laffont (1979) – we know the following basic results for risk-averse entrepreneurs:

1. Less risk-averse individuals become entrepreneurs, while more risk-averse individuals become employees.
2. Within the group of entrepreneurs, less risk-averse entrepreneurs develop larger ventures.
3. If the entrepreneur exhibits DARA preferences, an increase in exogenous wealth leads to larger ventures.
4. An increase in the wage paid to employees will lead to smaller ventures, as long as the entrepreneur exhibits DARA preferences or the utility function satisfies relative risk aversion no larger than 1.

How these previous results change or not under loss aversion is what we analyze next.

4. New results under loss aversion

Let us start by analyzing what happens when the loss-averse entrepreneur has a small increase in exogenous wealth a.

If we add to FOC (3) $\pm \int_{\theta_t}^{\overline{\theta}} u'(\pi(L^*,\theta))(f_L(L^*,\theta)-w)dF(\theta)$, which is a convenient zero, we get

$$h(L^*,a) = E[u'(\pi(L^*,\theta))(f_L(L^*,\theta)-w)] + \int_{\theta_t}^{\overline{\theta}} [u'(t) - u'(\pi(L^*,\theta))](f_L(L^*,\theta)-w)dF(\theta) = 0 \tag{5}$$

First, note that the second term of (5) is positive as for every $\theta \in (\theta_t, \overline{\theta}]$ we have that $(f_L(L^*,\theta)-w) > 0$ and, given that $u'' < 0$, we know that $u'(t) > u'(\pi(L^*,\theta))$. In consequence, for FOC (5) to be satisfied, the first term in (5) must be negative. That is, $E[u'(\pi(L^*,\theta))(f_L(L^*,\theta)-w)] < 0$, which is exactly the FOC for the risk-averse entrepreneur[2] but evaluated at the loss-averse optimal scale. This implies the following proposition:

Proposition 1. *Two almost identical entrepreneurs, different only in that one of them is risk-averse and the other is loss-averse, invest in projects of different optimal scale, where the loss-averse entrepreneur invests in larger ventures.*

The intuition of this result is the following: the risk-neutral portion of their utility function induces larger ventures, just like in the case when risk aversion and linear utility are compared in previous traditional literature.

Let us now turn to the effect of a small change in a on the scale of the venture. In this case, we simply apply the implicit function theorem to (5) and obtain

$$L_a^* = -\frac{h_a(L^*,a)}{h_L(L^*,a)}$$

Observe that $h_L(L^*,a)$ is the SOC of the problem, which is negative and, therefore, the sign of L_a^* is the same as the sign of $h_a(L^*,a)$, where

$$h_a(L^*,a) = E[u''(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)] - \int_{\theta_t}^{\overline{\theta}} u''(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)dF(\theta) \tag{6}$$

Note that the second term of (6) is positive, given the minus sign before the integral, that $u'' < 0$ and that $(f_L(L,\theta)-w) > 0$ for $[\theta_t, \overline{\theta}]$. Then, a sufficient condition for $h_a(L^*,a) > 0$ is that the first term of (6) would also be positive.

Working on the first term of (6) we get

$$\begin{aligned} E[u''(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)] &= -E\Big[-\frac{u''(\pi(L^*,\theta,a))}{u'(\pi(L^*,\theta,a))}u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)\Big] \\ &= -E\Big[A(\pi(L^*,\theta,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)\Big] \end{aligned} \tag{7}$$

where $A(\pi(L^*,\theta,a))$ is the absolute risk aversion coefficient. If we assume DARA preferences in the concave part of the loss-averse preferences, $A(\pi(L^*,\theta,a))$ is a weakly decreasing function of its argument and therefore

$$\begin{aligned} &A(\pi(L^*,\theta,a)) > A(\pi(L^*,\theta_t,a)) && \text{if } \theta < \theta_t \text{ (concave part)} \\ &A(\pi(L^*,\theta,a)) = A(\pi(L^*,\theta_t,a)) = 0 && \text{if } \theta \geq \theta_t \text{ (linear part)} \end{aligned} \tag{8}$$

From the sufficient condition used in FOC (3), we know that $u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w) < (>) 0$ for $\theta < (>) \theta_t$. Then, multiplying both sides of (8) by $u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)$, we get

$$\begin{aligned} &A(\pi(L^*,\theta,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w) < \\ &A(\pi(L^*,\theta_t,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w) \;\; \text{if } \theta < \theta_t \end{aligned}$$

[2] $E[u'(\pi(L,\theta))(f_L(L,\theta)-w)] = 0$ is the FOC of the risk averse entrepreneur with utility function given by $\int_{\underline{\theta}}^{\overline{\theta}} u(\pi(L,\theta))dF(\theta)$.

and

$$A(\pi(L^*,\theta,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w) = A(\pi(L^*,\theta_t,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w) = 0 \ \text{ if } \theta \geq \theta_t$$

which implies that

$$A(\pi(L^*,\theta,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w) < A(\pi(L^*,\theta_t,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w) \ \text{ for all } \theta \text{ in } [\underline{\theta},\overline{\theta}]$$

Applying the expectation operator and multiplying by -1 the previous expression, we get

$$-E[A(\pi(L^*,\theta,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)] > -A(\pi(L^*,\theta_t,a))E[u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)]$$

and we know from the analysis of (5) above that $E[u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)] < 0$, which implies that $-A(\pi(L^*,\theta_t,a))E[u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)] > 0$ and therefore

$$-E[A(\pi(L^*,\theta,a))u'(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)] > 0$$

which is expression (7), which guarantees that the first term of $h_a(L,a)$ is also positive, implying the following proposition:

Proposition 2. *An increase in the exogenous wealth of a loss-averse entrepreneur induces an increase in the optimal scale of the venture if, in the concave part of their utility function, they exhibit the DARA property.*

Now, let us shift our attention to the effect of an increase in the wage paid to the workers w. Again, considering condition (5) and applying the implicit function theorem, we get

$$L^*_w = -\frac{h_w(L^*,w)}{h_L(L^*,w)}$$

and since $h_L(L^*,w)$ is the SOC, the sign of L^*_w is the same as the sign of $h_w(L^*,w)$, where

$$h_w(L^*,w) = -E[u''(\pi(L^*,\theta,a))L^*(f_L(L^*,\theta)-w)+u'(\pi(L^*,\theta,a))] + \int_{\theta_t}^{\overline{\theta}}\left[u''(\pi(L^*,\theta,a))L^*(f_L(L^*,\theta)-w)+u'(\pi(L^*,\theta,a))\right]dF(\theta)$$

$$h_w(L^*,w) = -L^*\left[E[u''(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)] - \int_{\theta_t}^{\overline{\theta}} u''(\pi(L^*,\theta,a))(f_L(L^*,\theta)-w)dF(\theta)\right] - E[u'(\pi(L^*,\theta,a))] + \int_{\theta_t}^{\overline{\theta}} u'(\pi(L^*,\theta,a))dF(\theta)$$

$$h_w(L^*,w) = -L^*h_a(L^*,a) - \int_{\underline{\theta}}^{\overline{\theta}} u'(\pi(L^*,\theta,a))dF(\theta) + \int_{\theta_t}^{\overline{\theta}} u'(\pi(L^*,\theta,a))dF(\theta)$$

$$h_w(L^*,w) = -L^*h_a(L^*,a) - \int_{\underline{\theta}}^{\theta_t} u'(\pi(L^*,\theta))dF(\theta) \leq 0 \tag{9}$$

where the first term is negative, given that $h_a(L^*,a)$ is positive and the second term is also negative, implying the following proposition:

Proposition 3. *An increase in the wage paid to workers induces a decrease in the optimal scale of the venture for the loss-averse entrepreneur if, in the concave part of their utility function, they exhibit the DARA property.*

From Propositions 2 and 3, we see that the DARA assumption is important in our results. This is because DARA preferences imply more risk taking (larger size of a venture) when profits increase (π), which is equivalent to an increase in the exogenous wealth or to a decrease in the wage paid to the workers, given that $\pi(L,\theta) = f(L,\theta) - wL + a$.

5. Concluding remarks

The rise of behavioral economics and its applications to decision-making under risk has triggered several questions about how well the traditional expected utility paradigm under risk aversion explains actual economic agents' behavior in risky environments.

One of the most important competing paradigms is reference-dependent preferences. This alternative theory divides gains and losses from a reference point and presents loss aversion as a well-suited alternative approach to risk aversion.

In this paper, we have incorporated loss aversion into the basic economic model of entrepreneurship as a way to advance the economic theory of entrepreneurship under risk, and show that most of the traditional comparative static results from risk aversion also hold under loss aversion. However, even though the direction of the effects is maintained, the size of the effects are different. Therefore, policy recommendations based on the expected utility paradigm have also the potential to be useful under this alternative approach, but caution must be kept in mind when scaling or downsizing are part of the policy objectives.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.frl.2022.102985.

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