Entrepreneurship and Prudence: The Transition Effect and the Size Effect

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Abstract

In this paper we introduce the concepts of transition and size effect caused by a change in future risk in the context of self-selection of occupations. We discuss the correct assumptions needed in order to have a consistent economic theory that explains the development of new ventures. First, we claim that the transition from secure employment to entrepreneurship is based on prudence instead of decreasing absolute risk aversion (DARA), which is something overlooked in the previous literature. Then, we provide the intuition of this result by separating the transition and size effect caused by a change in future risk. We also characterize the condition for self-selection of occupations via preferences on simple binary lotteries and show that, even in the behavioral context with lotteries, the key condition that explains the self-selection decision of occupations is prudence and not DARA.

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1 Introduction

Entrepreneurship and the development of new firms can be studied from an economic perspective. We can analyze the reasons, or the economic forces, driving the decision to become an entrepreneur. Knight (1921) was the first to develop the idea of the connection between entrepreneurship and risk attitudes. That idea was subsequently formalized and translated into an economic model by Kanbur (1979) and Kihlstrom and Laffont (1979), and since then, it has been a core component of the economic theory of entrepreneurship (Vereshchagina and Hopenhayn, 2009; Koudstaal et al., 2015). The main idea behind this theory is that the wealthy are, on average, **less risk averse** than the poor because well-behaved utility functions present decreasing absolute risk aversion and, therefore, the wealthy are more prone to starting risky ventures. Also, most of the recent literature that uses microeconomic models of entrepreneurship based on risk attitudes builds on the DARA assumption. Examples of the importance of this assumption are the works of Cressy (2000), van Praag and Cramer (2001), Cramer et al. (2002), Hartog et al. (2002), Kan and Tsai (2006), Ahn (2009), Caliendo et al. (2010), and Hvide and Panos (2014) among others. Furthermore, there is a second reason why (but that it is out of the scope of this paper) the wealthy are more likely to become entrepreneurs, and that is because they face fewer financial constraints in securing capital (Evan and Jovanovic, 1989). Consequently, we should expect to observe mostly wealthy people choosing the occupation of entrepreneurship. The poor, in contrast, are more likely to become employees for a

certain, fixed wage for both of the reasons mentioned above. In this paper we provide a fresh look at the relationship between risk attitudes and entrepreneurship and in doing so, we separate the effect of future risk into two different effects: the transition effect and the size effect. This strategy allows us to distinguish between prudence and DARA in order to correct an important previous misconception found in the economics literature on entrepreneurship based on risk preferences.

The theory of entrepreneurship contains an ample spectrum of possible research questions to be tackled from the economic perspective, such as, for example: the reasons why a worker may decide to become an entrepreneur; the way an entrepreneur may finance a new venture; the effects of entrepreneurship on economic development; or the importance of institutions in the entrepreneurial process. For the most part, these analyses are based on the concepts of uncertainty, financial constraints and potential bankruptcy, and the risk characteristics associated with the utility functions of entrepreneurs and workers. The reason for this is very simple: uncertainty and risk are the key elements in the development of new ventures.

Our paper incorporates concepts developed in the economics of risk and uncertainty literature to point out an important mistake found in the economic literature on entrepreneurship. In particular, we will argue that DARA is not the key condition that makes an individual switch from secure employment to risky entrepreneurship. Instead, the condition is prudence, and prudence is consistent with DARA and IARA. Prudence means that the "pain" of the risk, in utility terms, is lower at higher wealth levels (Eeckhoudt and Schlesinger, 2008) and this is true no matter whether the individual is DARA or IARA. The explanation for this goes back to Dreze and Modigliani (1972) who, in the context of the theory of consumption and savings, argued that the effect of future income risk that induces precautionary savings and a decrease in present consumption can be divided into two effects: the wealth effect and the substitution

effect. We will elaborate on this idea, but as applied to the entrepreneurial context we are analyzing here. To reinforce the intuition of our results, we provide a lottery example based on the behavioral approach provided by Eeckhoudt and Schlesinger (2006). We will show that prudence is also the correct assumption when we use the behavioral approach to study self-selection in entrepreneurship.

2 Model Set-Up

This economy is characterized by a single-good stochastic production function $f(L, \theta)$, where L is the labor hired and θ is an iid random variable indexing the state of the world and representing uncertainty in the model. $f(L, \theta)$ and $f_1(L, \theta)$ are increasing in θ, and the production function satisfies $f_{11} < 0 < f_1$. Inada conditions are assumed to hold and, therefore, an interior solution to the problem is expected.

There is a continuum of agents in the unit interval. Agents have identical preferences but differ in the initial level of wealth. They have the utility function $u(y)$, where y is the realized income. The utility function satisfies $u'' < o < u'$ and the prudence property coined by Kimball (1990) ($u''' > 0$). As we will see below, prudence (and not DARA) will turn out to be the key property that explains the self-selection of occupations.

Agents vary in the amount of initial wealth a, the distribution of which is exogenous. The agents have to choose between two occupations. They can become workers and earn a fixed wage w (their total income in this case would be $a + w$), or they can become entrepreneurs, hiring L units of labor and earning the residual profit from a stochastic production function, which is denoted as $y(\theta) = f(L, \theta) - wL + a$.

Each agent takes w as given and chooses the occupation that offers the highest utility. This result is a competitive equilibrium that translates into a partition of the set of agents into a set of workers and a set of entrepreneurs.

2.1 Entrepreneurship and Prudence

Let $V_E(a)$ be the value function of the entrepreneur, i.e., $V_E(a) = \max_L Eu(f(L,\theta) - wL + a)$. And let $V_W(a) = u(w+a)$ be the value function of the worker for a given a. In equilibrium, there is a wealth level $\bar{a}$ at which an individual is indifferent to any of the two occupations, i.e., being a worker or an entrepreneur provides the same level of utility, that is:

$$\max_L Eu(f(L(w,\bar{a}),\theta) - wL(w,\bar{a}) + \bar{a})) = u(w+\bar{a}) \tag{1}$$

Note that w in (1) corresponds to the certainty equivalent of the entrepreneur's random income for the marginal agent $\bar{a}$. We know that for risk averse agents ($u'' < 0$), $w + \bar{a} < Ef(L(w,\bar{a},\theta)) - wL(w,\bar{a}) + \bar{a}$, the certainty equivalent. Let us assume that the wealth level $\bar{a}$ is unique. As we will see below, prudence guarantees that for any other wealth level $a' > \bar{a}$, individuals would prefer to self select as entrepreneurs. The opposite occurs when $a' < \bar{a}$, i.e., individuals would prefer to self select as workers and receive a sure wage w. This means that the value function of the entrepreneur $V_E(\bar{a})$ cuts off the value function of the worker $V_W(\bar{a})$ from below and, therefore, the slope of the value function at $\bar{a}$ satisfies:

$$V'_E(\bar{a}) = Eu'(f(L(w,\bar{a}),\theta) - wL(w,\bar{a}) + \bar{a}) > u'(w+\bar{a}) = V'_W(\bar{a}) \tag{2}$$

To illustrate condition (2), we will assume, without loss of generality, that $f(L,\theta) = \theta f(L)$. Let $\pi(\theta) = \theta f(L) - wL$. A second-order Taylor expansion of $u(\pi(\theta)+a)$ around

$E\pi(\theta) + a$ is given by:

$$u(\pi(\theta)+a) = u(E\pi(\theta)+a)+(\pi(\theta)-E\pi(\theta))u'(E\pi(\theta)+a)+\frac{1}{2}(\pi(\theta)-E\pi(\theta))^2u''(\xi(\pi(\theta))) \tag{3}$$

for some $\xi(\pi(\theta))$ in between $\pi(\theta)$ and $E\pi(\theta)$. By applying the expectation operator to (3), we obtain the value function of the entrepreneur as follows

$$Eu(\pi(\theta) + a) = u(E\pi(\theta) + a) + \frac{1}{2}E[(\pi(\theta) - E\pi(\theta))^2u''(\xi(\pi(\theta)))] \tag{4}$$

Then, the slope of the value function of the entrepreneur becomes

$$Eu'(\pi(\theta) + a) = u'(E\pi(\theta) + a) + \frac{1}{2}E[(\pi(\theta) - E\pi(\theta))^2u'''(\xi(\pi(\theta)))] \tag{5}$$

Given that prudence implies a positive u''', the second term on the right-hand side of (5) is always positive.

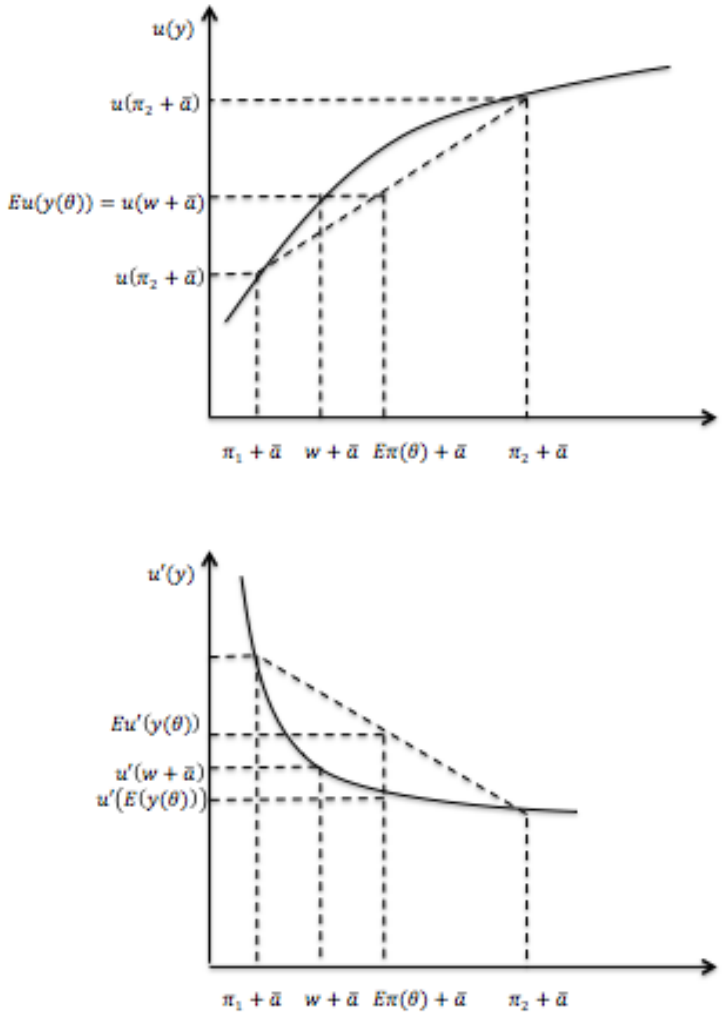
By replacing (5) on the left-hand side of (2) and evaluating it at $\bar{a}$ we get:

$$u'(E\pi(\theta) + \bar{a}) + \frac{1}{2}E[(\pi(\theta) - E\pi(\theta))^2u'''(\xi(\pi(\theta)))] > u'(w + \bar{a}) \tag{6}$$

Given risk aversion (decreasing marginal utility), we know that $E\pi(\theta) + \bar{a} > w + \bar{a}$ and $u'(E\pi(\theta) + \bar{a}) < u'(w + \bar{a})$. Therefore, condition (6) holds if and only if $u''' > 0$, i.e., if the marginal utility is convex. This result is illustrated in Figure 1, where the fixed wage w is the certainty equivalent of the entrepreneur's net income.

This point is relevant since we have already seen that the literature on economics of entrepreneurship is repleted with examples in which the DARA property is erroneously seen as the key ingredient that induces the agents to transition from secure employment with fixed wages to risky self-employment or entrepreneurship.

Figure 1: *Certainty Equivalent and Prudence*



The intuition why the key property that guarantees the transition to entrepreneurship is not DARA but rather prudence was previously insinuated in Dreze and Modigliani (1972) in the consumption and saving context. They basically divide an increase in future risk into an income effect and substitution effect and argue that, prudence guarantees that, even in the case of IARA, the substitution effect offsets the income effect, something that ensures the usual precautionary savings result known in consumption literature.

2.2 The Transition Effect and the Size Effect

For the present case, we can say that given that the agents are risk averse, uncertainty about the entrepreneurs's income causes disutility. Then, if this disutility decreases in wealth, the individuals will switch from secure employment to self-employment. Let us assume that an individual's wealth is a' and it is a bit higher than $\bar{a}$ (the marginal entrepreneur), and let us suppose that this agent (a') is considering becoming an entrepreneur but using the same amount of labor as the individual with wealth $\bar{a}$. Given that the utility function satisfies the property of prudence, which means that the "pain" of the risk is lower if wealth is higher. Then, the individual a' strictly prefers the entrepreneur's risky income to the worker's fixed wage. We will call this the **transition effect**. Now, the entrepreneur a' would optimally choose some level L different from the level chosen by $\bar{a}$, which means that he prefers entrepreneurship even more as the level of L adjusts to his optimal level $L(w, a')$. Note that prudence is consistent with either DARA or IARA, which means that a' may be less or more risk averse than $\bar{a}$, but he will prefer to become an entrepreneur anyway. This means that a DARA entrepreneur would choose a labor level $L(w, a') > L(w, \bar{a})$, while an IARA entrepreneur would choose a labor level $L(w, a') < L(w, \bar{a})$. The gap between $L(w, a')$ and $L(w, \bar{a})$ is what we define as the **size effect** of entrepreneurship. For a DARA entrepreneur, the size effect is positive, whereas it is negative for an IARA entrepreneur as we will observe in (7). More formally, we can find the expression of the size effect by implicitly differentiating the first-order condition for $L(w, a)$, which leads to the following equation:

$$\frac{dL}{da} = \frac{Eu''(f(L(w,a),\theta) - wL(w,a) + \bar{a})(f_1(L(w,a),\theta) - w)}{-SOC} \tag{7}$$

We observe that since the denominator is positive, because it is the negative of the second-order condition, $\frac{dL}{da}$ has the same sign as the numerator. Then, $Eu''(f(L(w,a),\theta) - wL(w,a) + \bar{a})(f_1(L(w,a),\theta) - w) > (<)0$ if and only if the entrepreneur is DARA (IARA), as we will show in the flowing proposition.

Proposition 1

When there is an increase in wealth for the marginal entrepreneur, i.e. the entrepreneur who is indifferent between choosing secure employment or self-select as an entrepreneur, he decides to transition to entrepreneurship. However, the size of the firm depends on the DARA or IARA property. When the individual is DARA, he tends to develop larger firms than when he is IARA.

Proof. The transition is due to prudence and that was already proven in the previous analysis. We now need to concentrate on the size effect, which we argue depends on the DARA or IARA property. To obtain the first-order conditions of the problem, we simply differentiate the left hand side of (1) to get:

$$Eu'(f(L,\theta) - wL + a)(f_1(L,\theta) - w) = 0 \tag{8}$$

From (7) we know that $\frac{dL}{da}$ has the same sign as $Eu''(f(L,\theta) - wL + a)(f_1(L,\theta) - w)$. We will assume that $\theta \in [\underline{\theta}, \overline{\theta}]$. Let us define $\hat{\theta} \in [\underline{\theta}, \overline{\theta}]$ such that:

$$f_1(L,\theta) - w \geq (<)0 \Leftrightarrow \theta \geq (<)\hat{\theta} \tag{9}$$

Thus, $f_1(L,\theta) - w$ is monotonic in θ, and it is positive for high enough values of θ and negative for low enough values of θ.

We know that the Arrow-Pratt measure of absolute risk aversion is defined as

$$A(y) = -\frac{u''(y)}{u'(y)} \tag{10}$$

and the DARA property guarantees that

$$A_y < 0 \Leftrightarrow \begin{cases} A(y(\theta))) > A(y(\hat{\theta}))) & \text{if } \theta < \hat{\theta}. \\ A(y(\theta))) = A(y(\hat{\theta}))) & \text{if } \theta = \hat{\theta}, \\ A(y(\theta))) < A(y(\hat{\theta}))) & \text{if } \theta > \hat{\theta}, \end{cases} \tag{11}$$

Where $\hat{\theta}$ is a pivot point. Then, using (9) and (11), for any $\theta \in [\underline{\theta}, \overline{\theta}]$ we have that

$$A_y < 0 \Rightarrow A(y(\theta)))(f_1(L,\theta) - w) \leq A(y(\hat{\theta}))(f_1(L,\theta) - w) \tag{12}$$

Now, by replacing the definition of $A(y)$ in (12) and rearranging we get

$$u''(y(\theta))(f_1(L,\theta) - w) \geq A(y(\hat{\theta})))u'(y(\theta))(f_1(L,\theta) - w) \tag{13}$$

Taking the expectation of (13) and using the first-order condition we get

$$Eu''(y(\theta))(f_1(L,\theta) - w) \geq A(y(\hat{\theta})))Eu'(y(\theta))(f_1(L,\theta) - w) = 0 \tag{14}$$

And consequently

$$Eu''(y(\theta))(f_1(L,\theta) - w) \geq 0 \tag{15}$$

We proceed similarly for the case of IARA. In this case we know that

$$A_y > 0 \Leftrightarrow \begin{cases} A(y(\theta))) < A(y(\hat{\theta}))) & \text{if } \theta < \hat{\theta}. \\ A(y(\theta))) = A(y(\hat{\theta}))) & \text{if } \theta = \hat{\theta}, \\ A(y(\theta))) > A(y(\hat{\theta}))) & \text{if } \theta > \hat{\theta}, \end{cases} \tag{16}$$

Using (16) and (9), we easily show that for any $\theta \in [\underline{\theta}, \overline{\theta}]$ we have

$$A_y > 0 \Rightarrow A(y(\theta)))(f_1(L,\theta) - w) \geq A(y(\hat{\theta})))f_1(L,\theta) - w) \tag{17}$$

From the definition of $A(y)$ given in (10), we observe that

$$u''(y(\theta))(f_1(L,\theta) - w) \leq A(y(\hat{\theta})))u'(y(\theta))(f_1(L,\theta) - w) \tag{18}$$

Taking expectations and again using the first-order condition the result is

$$Eu''(y(\theta))(f_1(L,\theta)-w) \leq A(y(\hat{\theta})))Eu'(y(\theta))(f_1(L,\theta)-w) = 0 \tag{19}$$

Now, from both of the above analyses, that is for the case of DARA and IARA, we can establish the following general result

$$A_y < (>)0 \Leftrightarrow Eu''(y(\theta))(f_1(L,\theta)-w) > (<)0 \Leftrightarrow \frac{dL}{da} > (<)0 \tag{20}$$

□

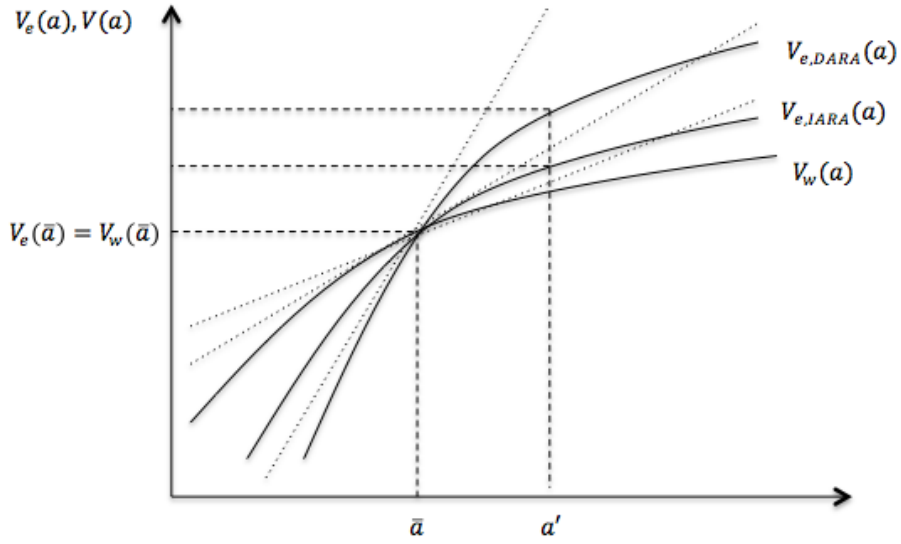
The intuition of the above proof is illustrated in Figure 2 below. Note that in $\bar{a}$ the marginal utility of the entrepreneur (DARA or IARA) is greater than the marginal utility of the worker. For both types of entrepreneurs (DARA and IARA), the condition that determines the threshold for switching to entrepreneurship is prudence, as was previously shown in equation (16). However, the relative return on entrepreneurship for the marginal entrepreneur is greater in the case of DARA than in the case of IARA. Given equation (7), the size effect determines the amount of labor required and the expected profit. The positive size effect means that DARA entrepreneurs establish larger and more profitable firms (larger $V(a)$) than their IARA counterparts.

2.3 Entrepreneurial prudence with lotteries

Recent studies have shown that many risk attitudes can be fully characterized by a preference relationship to some classes of lottery pairs (Eeckhoudt and Schlesinger, 2006; Eeckhoudt et al., 2009; Chiu et al., 2012; Li 2012).

We now present a comparison of two lotteries that allow us to understand, in general terms, the self-selection of occupations. Consider the following pair of lotteries where the individual can apportion the harm into two different lotteries A and B defined by:

Figure 2: *Relative return for the marginal entrepreneur*



$$A_e = [f(L,\theta) - wL + a_1, w + a_2; \frac{1}{2}, \frac{1}{2}] \tag{21}$$

$$B_e = [f(L,\theta) - wL + a_2, w + a_1; \frac{1}{2}, \frac{1}{2}] \tag{22}$$

where the level of initial wealth is $a \in \{a_1, a_2\}$ with $a_2 > \bar{a} > a_1$.

Next, we establish the connection between the choice of both lotteries A and B, expressed in an expected utility (EU) framework, and the theory of entrepreneurship. We know from Eeckhoudt and Schlesinger (2006) that an individual is prudent if he prefers to apportion the risk to the better outcome (a_2). In the EU framework this means that $B \succeq A$ if and only if:

$$\frac{1}{2}Eu(f(L,\theta) - wL + a_2) + \frac{1}{2}u(w + a_1) \geq \frac{1}{2}Eu(f(L,\theta) - wL + a_1) + \frac{1}{2}u(w + a_2) \tag{23}$$

Equivalently,

$$Eu(f(L,\theta) - wL + a_2) - Eu(f(L,\theta) - wL + a_1) \geq u(w + a_2) - u(w + a_1) \tag{24}$$

Using a continuous approximation and rearranging expression (24) we get

$$\int_{a_1}^{a_2} [Eu'(f(L,\theta) - wL + \omega) - u'(w + \omega)]d\omega > 0 \tag{25}$$

which is true if and only if:

$$Eu'(f(L,\theta) - wL + \omega) > u'(w + \omega) \tag{26}$$

for all ω. This result is precisely the one obtained in (2), in which we showed that the result depends on prudence. Thus, prudence, and not DARA, guarantees the condition of transition from worker to entrepreneur.

Observe that any lottery $\tilde{y}$ with a non-zero expected payoff can be decomposed into its expected payoff $E\tilde{y}$ and a zero-mean lottery $\tilde{y} - E\tilde{y}$. Thus, the entrepreneur's net income $\pi(\theta) = \theta f(L) - wL$ can be decomposed into $E\pi(\theta)$ and $\epsilon = (\theta - \mu_\theta)f(L)$. Therefore, the lotteries A and B can be rewritten as:

$$A_e = [E\pi(\theta) + \epsilon + a_1, w + a_2; \frac{1}{2}, \frac{1}{2}] \tag{27}$$

$$B_e = [E\pi(\theta) + \epsilon + a_2, w + a_1; \frac{1}{2}, \frac{1}{2}] \tag{28}$$

The theoretical literature on uncertainty showed that an individual dislikes transferring a zero-mean risk from a richer to a poorer state, i.e., all individuals prefer to bear a zero-mean risk in a wealthier state. In this case, we say that the individual is downside risk averse (Menezes et al., 1980). The individual dislikes any increase in downside risk if and only if $u''' > 0$, i.e., if he is prudent. In the context of the entrepreneurship theory under uncertainty this means that an increase in wealth reduces the pain generated by a zero-mean risk. Thus, the individual strictly prefers the entrepreneur's risky income to the worker's fixed wage.

3 Concluding Remarks

In this paper we have pointed out a common mistake found in the economic theory of entrepreneurship. First, we clarified that as wealth increases, the transition from secure-wage employment to risky self-employment or entrepreneurship is based on the property of prudence and not on DARA, as previous literature suggests. Also, prudence can be consistent with DARA or IARA, which means that as wealth increases, an individual may possess a decreasing or increasing level of absolute risk aversion but he will choose to become an entrepreneur anyway. We identified the transition and size effect in our model and connected the results with the wealth and substitution effects discussed in the classic work of Dreze and Modigliani (1972).

Second, a lottery example is provided in order to clarify the intuition of the above results and their connection with prudence in our context. This lottery is based on the behavioral approach to risk developed by Eeckhoudt and Schlesinger (2006).

We argued that given that entrepreneurship is immerse in a world of uncertainty, incorporating recent advances from the theory of risk into the economic theory of entrepreneurship can be of importance to clarify, or even in some cases to refute, some concepts that have been previously accepted by the literature, as we have done in this article.

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