Behavioral Discount Rates for Entrepreneurs: the Effect of Overconfidence

Abstract

The present research extends the work of Mongrut (2016) with the aim of deriving discount rates that non-diversified entrepreneurs can use as required rates of return over their investments in case they suffer of moderate or excessive overconfidence. One used a hyperbolic absolute risk aversion utility function with a payoff function affected by the entrepreneur's overconfidence. Whenever the entrepreneur suffers of overconfidence (moderate or excessive) his required rate of return will be lower than the one of a non-overconfident entrepreneur. Moreover, in case of excessive overconfidence, his required rate of return will be close to the risk-free rate. Simulations, on the derived discount rate expressions, show that a non-overconfident entrepreneur will require an annual average required return of 65%, an entrepreneur with moderately overconfidence will require an annual average return of 19% and an entrepreneur with excessive overconfidence with require an annual average return of 4%. In the later situation excessive overconfidence could lead to undertake non-profitable investment projects.

Key words: Entrepreneurship, behavioral finance.

JEL Codes: L26, L29.

1. Introduction

While around 40% of the newly formed companies survive worldwide, in Mexico the percentage is only 25% (World Bank, 2009). According to the Global Entrepreneurship Monitor (GEM) there is a significant relationship between the reason to create new businesses in a country and its specific survival rate: in countries where this reason is the opportunity to make a business, the survival rate in the early stages is higher than in countries where the motivation lies in the necessity to survive (Williams, 2007).

Therefore, why do entrepreneurs keep looking for investment opportunities with a low survival rate? Leaving aside the ones that become entrepreneurs for necessity to survive, a good business opportunity is not a sufficient motivation and other factors play a role, such as the chance of satisfying personal fulfillment needs and/or of achieving non-monetary benefits (McMahon y Stanger (1994), Le Cornu, McMahon, Forsaith and Stanger, (1996)).

Entrepreneurs differ among each other because of their motivation, the information on which they base their expectations for the future, their investment horizon and their risk preferences. Hence, behavioral finance is needed to fully understand and explain the entrepreneurs' investment decisions based on their cognitive and motivational biases (Alson, 2006).

An entrepreneur who pursues personal fulfillment will be influenced by the perception of his own abilities and, therefore, might fall into an overconfidence bias. Overconfidence is the overestimation of one's own capabilities to perform well in a certain activity. The entrepreneur thinks he knows more than what he really does, so he will avoid looking for advices when taking important decisions. This is in contrast to overoptimism, which happens when the individual have the tendency to look on good results and underestimate the frequency of the bad ones (Shefrin, 2007). Heath and Tversky (1991) explain that there are different degrees of overconfidence and that normally people are most confident in fields in which they already have a certain experience.

Koellinger, Minniti and Schade (2005) analyze data from 18 different countries offered by the Global Entrepreneur Monitor (GEM). They find out that people trust more their own abilities than their objective investment opportunities, therefore their judgments could be influenced by the overconfidence bias and that this could lead to an overestimation of the success of their investment opportunities.

How does overconfidence influence the entrepreneur decision about an investment opportunity? The present study shows that this happens because the required return, determined by entrepreneurs affected by the bias, is lower that the one obtained by their non-overconfident peers, which leads to underestimate the business risk and to overestimate the investment opportunity benefits.

With respect to the magnitudes of required rates of return, there is a considerable variability among industries as shown by Phillips (1986), who analyzes that discount rates in Nepal varies from 0% to 30%, depending on the sector. Paglia and Harjoto (2009) report discount rates from 38.6% to 88.1%, with significant variability among sectors, while Nosic and Weber (2010) report discount rates between 33.9% and 48.4% depending on the different risk perceptions and calibration mistakes. These numbers are not justified by any asset valuation model that assumes a well-diversified investor, besides these numbers show a high volatility suggesting the existence of different factors, such as overconfidence, that influence them.

This study contributes to the current literature by determining the entrepreneur's required rate of return from a fundamental characterization of his preferences. The goal is to derive mathematical expressions that, starting from certain entrepreneur's characteristics, allow the estimation of the required return from an investment in presence of overconfidence. For this purpose, one used the Ego utility function proposed by Koszegi (2006). Interestingly enough, one finds that required returns from entrepreneurs suffering from overconfidence are lower than the ones required by entrepreneurs not being subject to this bias. Moreover, entrepreneurs suffering from excessive overconfidence require very small rates of return, situation that will lead to underestimate to project risk and undertake non-profitable investments.

The research is organized as follows: the second section presents the most relevant studies about the influence of overconfidence on the entrepreneur's decision-making process, while the third section offers expressions to calculate the required rate of return when entrepreneurs suffer from overconfidence. In the fourth section one provides a comparative analysis of the required rates of returns from overconfident and non-overconfident entrepreneurs. Finally, the last section concludes the study and presents the empirical implications.

2. Overconfidence and the entrepreneur's decision-making process

One may think of overconfidence as a systematic calibration according to which the assigned probability that all given answers are correct exceeds their true accuracy (Dawes and Mulford, 1996). Alternatively, one may think in the excessive accuracy relative to the individual's belief about an uncertain amount (Teigen and Jørgensen, 2005).

A third definition is the one provided by Grinblatt and Keloharju (2006), who consider overconfidence as the excess of an individual's confidence on his own abilities, knowledge and thoughts. Finally one may consider overconfidence as a phenomenon in which the person perceives himself as better than the average (Benoit and Dubra, 2008). In this study one considers overconfidence as a mix of the last two definitions, because overconfidence is born with respect to one self and reflected in external decisions. Overconfidence will cause the entrepreneur to act with a different ability than his innate one; she could act with a superior ability if she suffers from moderate overconfidence or with an inferior ability is she suffers from an excessive one.

Cooper, Woo and Dunkelberg (1988) explored a sample of 2994 entrepreneurs and obtain as a result that 81% of them believe that their chances of succeed are at least of 70%, while the remaining ones esteem their chances are of 100%. Nevertheless, around 75% of the new businesses cannot survive the first five years of operations (Cooper, Woo and Dunkelberg, 1988).

Cooper, Folta and Woo (1995) found that new entrepreneurs tend to look for less information before taking a decision compared to more experienced ones. Consequences are that they do not recognize their own limitations and take wrong decisions based on mistaken assumptions. Hence, overconfident entrepreneurs search for less information when starting a new business.

According to DeBondt and Thaler (1995) there are different human behavior principles that affect economical decisions and they argue that the most significant finding of judgment psychology is that individuals are excessively confident. Overconfidence makes people create businesses that otherwise wouldn't be undertake them.

In a research made by Barber and Odean (1999) a group of people is asked to qualify their own capabilities compared to other people, resulting in most of them being qualified themselves in the upper third of the population. Only few people qualify their abilities as below average.

Similarly, Camerer and Lovallo (1999) showed that one of the reasons of the high failure rate of the new business is overconfidence. They argue that this bias makes the entrepreneur insensitive to the level of risk so, even in the face of a high risk, the entrepreneur undertakes the business because he considers that he possesses all the abilities needed to succeed and to overcome eventual obstacles.

The work of Shane and Venkataraman (2000) showed how the decision of investing in a new business is influenced by the external conditions he is surrounded by. The entrepreneur tends to have high overconfidence levels due to his exposition to an uncertain environment (Hayward, Shepherd and Griffin, 2006).

Köszegi (2000) considers a Bayesian entrepreneur that maximizes his expected utility, being more influenced by his believes than his abilities. Koszegi (2000) focuses on the manipulation of the information. He considers that in case of moderate overconfidence, the individual's believes maximize his expected utility.

Bernardo and Welch (2001) propose a model to illustrate that moderate overconfidence can impose small costs to the entrepreneur, but it could bring big benefits when revealing private information to a group of entrepreneurs. They conducted an experiment over a group of entrepreneurs showing that moderate overconfidence produce external benefit from the shared positive information if the group is large enough.

Lowe and Ziedonis (2006) found differences on the overconfidence and overoptimism levels among entrepreneurs and firm's executives, being entrepreneurs the ones that show higher level of overconfidence.

In 2006, Köszegi modeled some implications of the Ego Utility Function in order to collect information and take economic decisions. The model starts with the assumption that people manifest ego in a specific activity, so that they see themselves as capable of succeed. According to Köszegi (2006) an individual derives his Ego Utility Function from positive opinions about himself keeping utility results constant. The entrepreneur's utility depends on the monetary results, as well as, on his believes about his abilities to succeed in a certain activity. The Ego Utility Function makes the entrepreneur to manipulate the information he receives about himself, which is called self-image protection's motive. If he is unsatisfied about the actual perception of himself, he will try to improve his believes according to the self-image enhancement's motive.

In 2007, Cassar and Friedman study the effects of overconfidence in the investment decision-making process starting from the PSED (*Panel Study of Entrepreneurial Dynamics)* and, as a result, they've found that overconfidence increases the probabilities that an individual starts his own business; likewise, they discovered that overconfidence does not significantly affect human capital decisions. The model could not find a relation between the bias and the investment risk represented by the industry risk.

Heller (2010) proposed a theoretical model to study the relationship between overconfidence and risk dispersion concluding that entrepreneurs might present different overconfidence levels according to the industry they are investing in. Likewise, he concluded that there is a conflict of interests between investors looking for risk-diversification and different entrepreneurs looking for the maximization of their own chances to succeed.

In 2016 Köszegi investigated again over the Ego Utility Function and derived several models for three economic applications: capital market participation, small companies and executives' decisions in investment projects. These three models focus on the employers' motivation and overconfidence is used as an incentive that implies small costs for the firm.

3. Required rates of return for an overconfident entrepreneur

Mongrut and Ramírez (2006) showed that there is not a unique rate of return required by different entrepreneurs for the same business, meaning that there are neither homogenous expectations nor market equilibrium, but there is a range of possible values depending on the entrepreneur's risk aversion, the project total risk and the entrepreneur's preferences for present and future consumption.

In this section one presents an extension of the work of Mongrut (2016) by deriving expressions for the required rate of return that a non-diversified entrepreneur should ask for, using a hyperbolic absolute risk-aversion utility function (HARA) and an overconfidence bias with ego as a component. The concept of ego is intended such as Köszegi (2006): the self-perception of the entrepreneur, compared to others, regarding his own abilities to undertake successfully a business.

The following derivation adopts the same assumptions of Mongrut (2016), specifically: the investment horizon includes two periods; the entrepreneur has habit formation implying that his preferences are the same and his preferences can be divided by periods. Likewise, it is assumed that the entrepreneur is non-diversified, that he has the least risk-aversion and that he invests all of his capital in the investment opportunity, being his initial wealth level close to zero. All of these characteristics are usually found in new investments (Mongrut, 2016).

Consider a non-diversified entrepreneur with the following HARA function for two consecutive periods:

$$U(C_t, C_{t+1}) = \frac{\gamma}{1-\gamma}\left[\left(1+\frac{\alpha C_t}{\gamma}\right)^{1-\gamma}-1\right] + \delta \mathrm{E}_t\left\{\frac{\gamma}{1-\gamma}\left[\left(1+\frac{\alpha C_{t+1}}{\gamma}\right)^{1-\gamma}-1\right]\right\} \quad (1)$$

C_t, C_{t+1} These variables represent consumption at time *t* and the consumption at time *t+1* respectively. The parameter (γ) represents the relative risk-aversion coefficient, $\alpha > 0$ is the absolute risk-aversion coefficient and δ represents the entrepreneur's preferences among present and future consumption.

The function is subjected to the following restrictions:

$$\mathrm{E}(R_{t+1}) = \frac{C_{t+1}}{W_t - C_t + X_{t+1}(a_t, s_{t+1})} \quad (2)$$

$$X_{t+1}(a_t, s_{t+1}) = \begin{cases} 0, if\ a_t = 0 \\ 1, if\ a_t = 1, s_{t+1} \geq 0 \\ -1_{t+1}, f\ a_t = 1, s_{t+1} < 0 \end{cases} \quad (3)$$

$$s_{t+1} = (\max(q, q^*) + \varepsilon_{t+1}) \quad (4)$$

Where:

$\mathrm{E}(R_{t+1})$: is the expected required rate of return in (t+1)

W_t : is the initial wealth level of the entrepreneur

X_{t+1}: is the entrepreneur's pay-off function

a_t: is a dummy variable that assumes value (1) if the entrepreneur is overconfident, (0) otherwise

s_{t+1}: is the environment faced by the entrepreneur composed by the entrepreneur's own abilities and the external negative random shock

q: is the innate ability of the entrepreneur

q* is the real ability of the entrepreneur

ε_{t+1}: is the external negative random shock, where:

$$\varepsilon_{t+1} \sim \mathrm{N}\left(u_{\varepsilon_{t+1}}, \sigma^2_{\varepsilon_{t+1}}\right)$$

In (t) the entrepreneur acts with a specific ability (q*) to set up a business that might be different than his innate abilities (q), and in (t+1) he receives the payment or benefit from his investment. The fact that the entrepreneur acts with an ability (q*) that is different than his innate one (q) implies that he is affected by the overconfidence bias. There are two kinds of entrepreneur: the ones who take decisions with an excess of overconfidence (q*<q) and the ones who take decisions with moderate overconfidence (q*≥q).

The fact that the entrepreneur has an excess of overconfidence implies that he acts with an ability that is less than his innate one (q*<q) due to the fact that he suffers of an excessive Ego component that makes him feel superior than the others and that prevent him from sharing his abilities and information with them. On the other side, the fact that an entrepreneur is moderately overconfident implies that he shares his abilities and information with others, leading him to empower his own abilities (q*≥q).

The classification of the entrepreneurs is given by $a_t \in (0,1)$, 0 for the entrepreneur that does not present the bias and 1 for the one that does. The scenario faced by the entrepreneur is the sum of his innate abilities plus the negative external random shock in *t+1*. The negative external random shock reflects external factors that reduce the business benefit such as entry barriers to the industry, strong competency, and political risk, among others.

X_{t+1} is the pay-off function of the entrepreneur: if he decides to start a business being moderately overconfident (q*≥q), his ability will be enough to compensate for the external negative random shock, in fact his pay-off function will be positive and equal to 1. On the other side, if the entrepreneur decides to start a business being affected by an excess of overconfidence (q*<q) his ability will not be enough to compensate the external negative random shock, then the pay-off function will be negative and equal to -1.

With the aim of solving the previous problem, one uses the basic identities associated to the discounted stochastic factor m_t as stated in Cochrane (2001):

$$1 = E_t(m_{t+1}R_{t+1}) \tag{5}$$

$$\frac{1}{R_f} = E_t(m_{t+1}) \tag{6}$$

Where R_f is the risk-free rate

Optimizing (1) subject to (2), (3) and (4), the following equation is obtained:

$$E_t\left\{\left(-R_f + R_{t+1}\right)\left[1 + \frac{\alpha\, R_{t+1}(W_t - C_t + a_t(q+\varepsilon_{t+1}))}{\gamma}\right]^{-\gamma}\right\} = 0 \tag{7}$$

In case of $a_t = 1$, one uses the binomial theorem:

$$E_t\left\{\sum_{k=0}^{n} -binomial(-\gamma,k)\left(R_f - R_{t+1}\right)R_{t+1}^{k}\left[\frac{\alpha\left(W_t - C_t + a_t(q+\varepsilon_{t+1})\right)}{\gamma}\right]k\right\} \approx 0$$

It is possible to factorize the factor *k=0* assuming that $\gamma \to -1, k = -1,\ \alpha > 0$, and establishing the condition of the least risk-averse entrepreneur, i.e. $c_t = \frac{\alpha-1}{\alpha}$. Likewise, considering that the wealth level of the entrepreneur approaches to zero, $w \to 0$, and with some algebraic manipulation, it is possible to obtain:

$$E_t(R_{t+1}) - R_f \approx E_t\left\{R_{t+1} - R_f\left(R_{t+1}\alpha\left(0 - \frac{1-\alpha}{\alpha} + X_{t+1}\right)^{-1}\right)\right\} = 0 \qquad (8)$$

Considering the lower discount rate for an entrepreneur with quadric preferences and an ego component:

$$E(R_{t+1}) \geq R_f + E_t\left\{\frac{R_{t+1}-R_f}{R_{t+1}(\alpha(1+X_{t+1})-1)}\right\} \qquad (9)$$

By dividing and multiplying for the investment's risk of the expected rate of return $\sigma(R_{t+1})$ one obtains:

$$E(R_{t+1}) \geq R_f + E_t\left\{\frac{R_{t+1}-R_f}{\sigma(R_{t+1})}\frac{\sigma(R_{t+1})}{R_{t+1}}\frac{1}{(\alpha(1+X_{t+1})-1)}\right\} \qquad (10)$$

In equation 10, $\frac{R_{t+1}-R_f}{\sigma(R_{t+1})}$ is the Sharpe ratio (SR_{t+1}) of the investment opportunity and $\frac{\sigma(R_{t+1})}{R_{t+1}}$ is its coefficient of variation (CV_{t+1}), therefore:

$$E(R_{t+1}) \geq R_f + SR_{t+1}\ \text{x}\ CV_{t+1}\ \text{x}\ E_t\left\{\frac{1}{(\alpha(1+X_{t+1})-1)}\right\} \qquad (11)$$

3.1 Required rate of return when the entrepreneur does not suffer from overconfidence

When the entrepreneur does not present overconfidence ($a_t = 0 \to X_{t+1} = 0$) and expression (11) reduces to the equation proposed by Mongrut (2016):

$$E(R_{t+1}) \geq R_f + SR_{t+1}CV_{t+1}\frac{1}{(\alpha-1)} \qquad (12)$$

When the entrepreneur does not have overconfidence, the required rate of return depends on the risk-free rate, on the Sharpe Ratio of the investment opportunity, on its coefficient of variation and on the absolute risk-aversion coefficient (Mongrut, 2016).

3.2 Required rate of return when the entrepreneur suffers from moderately overconfidence

Considering the special case of the pay-off function $X_{t+1} = a_t(\max(q, q^*) + \varepsilon_{t+1})$ of an entrepreneur with moderate overconfidence, $q^* \geq q$, the payoff function (X_{t+1}) will be equal to 1, therefore:

$$E(R_{t+1}) \geq R_f + SR_{t+1} \text{ x } CV_{t+1} \text{ x } E_t \left\{ \frac{1}{(2\alpha-1)} \right\} \quad (13)$$

Equation (13) shows the required return rate for an entrepreneur with moderate overconfidence (q*>q). In this case, the required rate of return is lower than the one of the non-overconfident entrepreneur (equation 12).

3.3 Required rate of return when the entrepreneur has an excess of overconfidence

An entrepreneur with an excess of overconfidence $(q^* < q)$ would have a payoff function (X_{t+1}) equal to -1 that leads to the following equation:

$$E(R_{t+1}) \geq R_f + SR_{t+1} \text{ x } CV_{t+1} \text{ x } E_t \left\{ \frac{1}{(0-1)} \right\} \quad (14)$$

Simplifying:

$$E(R_{t+1}) \geq R_f - SR_{t+1} \text{ x } CV_{t+1} \quad (15)$$

Equation (15) shows the rate of return required by an entrepreneur with an excess of overconfidence. Notice that in this case it does not depend on the absolute risk-aversion coefficient. This is consistent with the finding of Camerer and Lovallo (1999) according to which when the entrepreneur is excessively overconfident his risk-aversion does not play an important role in his investment decision.

Notice that the required rate return in this case is lower than the one of a moderately overconfident entrepreneur (equation 13). This is consistent with the fact that the entrepreneur that suffers excessively from overconfidence generally will choose to proceed with the investment opportunity independently from its risk.

4. Values of the required rate of return with different overconfidence levels

In this section one explores the magnitude of the require rates of returns derived in the previous section. In what follows, one discusses three situations for a non-diversifying entrepreneur: a non-overconfident entrepreneur, an entrepreneur with moderate overconfidence and an entrepreneur with an excessive overconfidence.

4.1 Required rates of return for a non-overconfident entrepreneur

In case of an entrepreneur not affected by the overconfident bias the proper required return is given by expression (12). Table No 1 shows the parameters used in the simulation of this expression with a 90% level of confidence. It is important to notice that in this simulation one is interested in finding out the possible values of equation (12) for the case in which the non-diversified entrepreneur is the least risk-averse ($\propto \rightarrow 1$), so the Sharpe Ratio will approach to 1. However, it is not possible to use a risk aversion coefficient equal to 1 because expression (12) cannot be solved. Hence, one uses an approximation for the coefficient of risk aversion equal to 1.5.

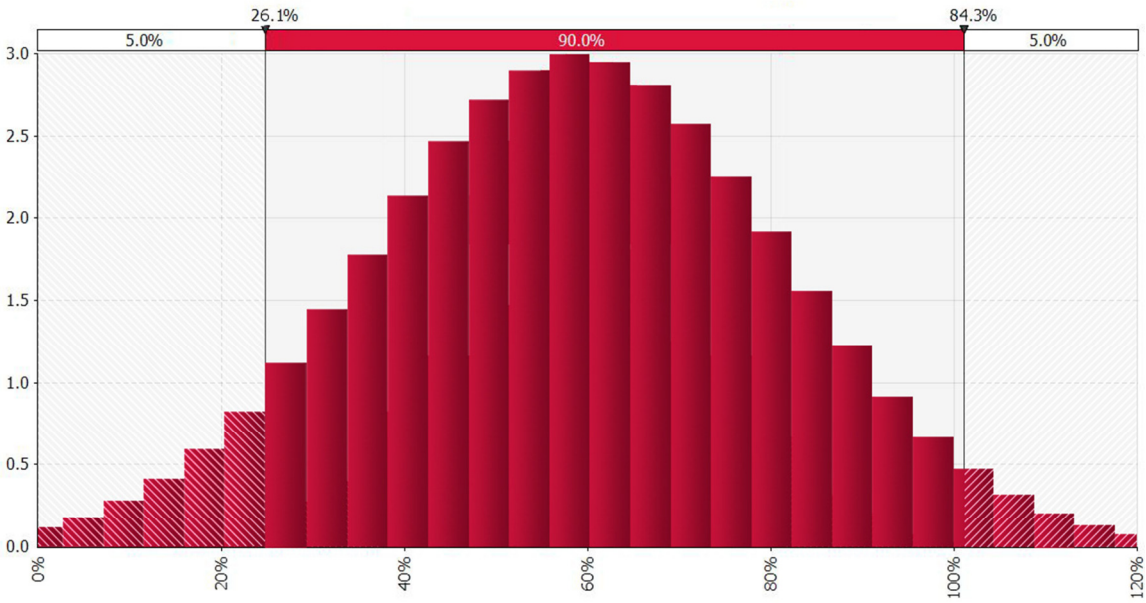
Table 1: Parameters used for the determination of the discount rate without overconfidence scenario

Parameter	Name	Value
Rf	Risk-free rate	0.06
SR	Sharpe Ratio	1
CV	Coefficient of variation	~N (1,0.20)
$\propto$	Risk aversion coefficient	~N (1.5,0.50)
X_{t+1}	Payoff function (overconfidence)	0

Source: Own elaboration

Figure No 1 shows that 90% of the simulated rates of return required by an entrepreneur, without overconfidence, will lie in a range between 26.1% and 84.3% with an average of 65.46%.

Figure No 1: Required rate of return without overconfidence

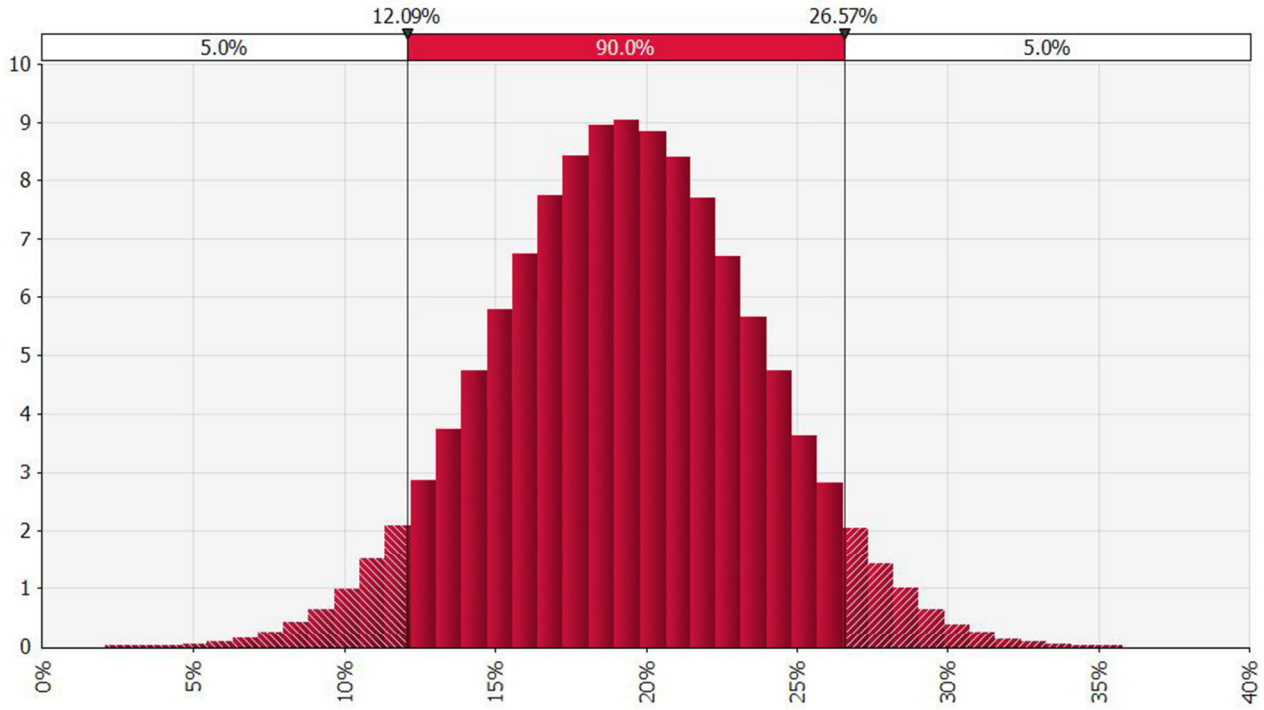


Source: Own elaboration

4.2 Required rates of return for an entrepreneur with moderate overconfidence

In this case, the simulated values were obtained using expression (13) with a 90% confidence level. The same parameters and scenarios were used with the exception of the payoff function that will take the value of 1. Figure No 2 shows that 90% of the rates of return required by a moderately overconfident entrepreneur lies between 12.09% and 26.57%, with an average of 19.33%.

Figure No 2: Required rate of return with moderate overconfidence



Source: Own elaboration

4.3 Required rates of return for an entrepreneur with an excess of overconfidence

One uses expression (15) in order to simulate the rates of return required by an excessively overconfident entrepreneur. In this case the expression is highly sensitive to the parameters. Hence, one has used a coefficient of variation uniformly distributed between 0.5 and 1. Also one has used a Sharp Ratio uniformly distributed between 2.5% and 5%; and a risk free ratio of 6%. (See Table No 2). Note that in this simulation we do not consider de risk aversion coefficient, this is consistent with the fact that the risk does not matter for the entrepreneur with and excessive overconfidence.

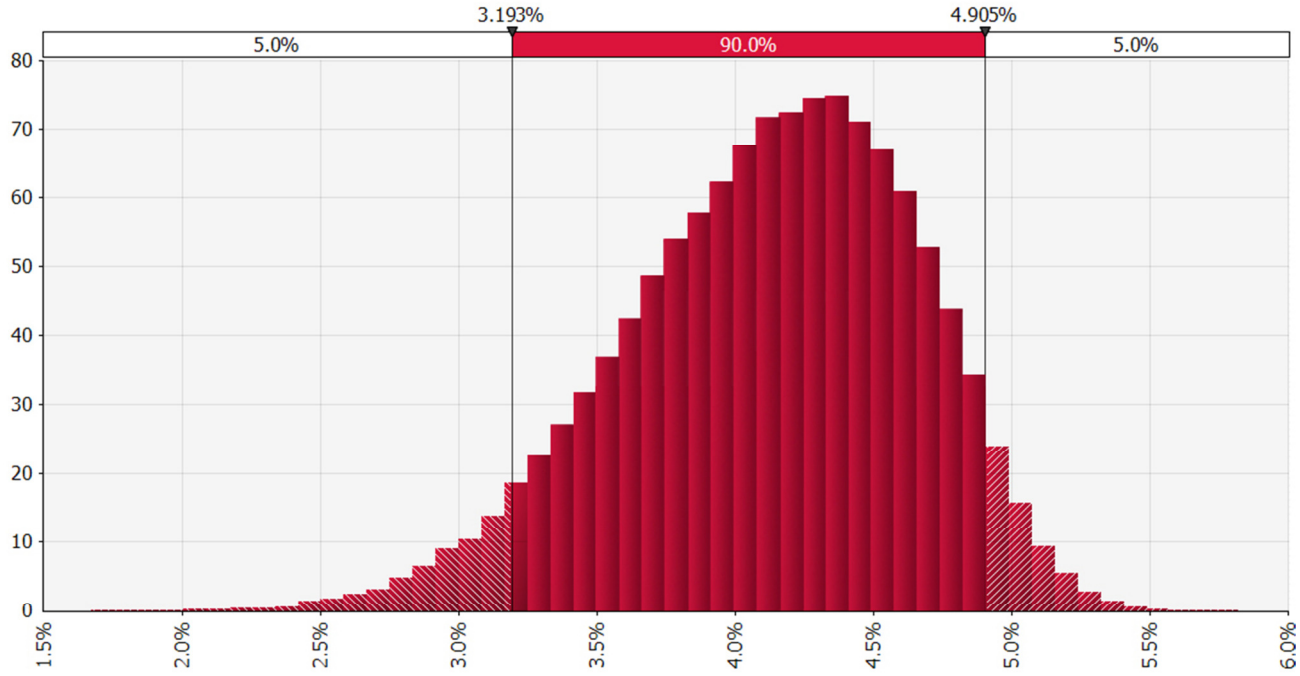
Table 2: Parameters used for the determination of the required rate of return in excess of overconfidence

Parameter	Name	Value
Rf	Risk-free rate	0.06
SR	Sharpe Ratio	U (0.025,0.05)
CV	Coefficient of variation	~N (0.5,0.10)
X_{t+1}	Payoff function	-1

Source: Own elaboration.

Figure No 3 shows with 90% of confidence level, that for an entrepreneur with excessive overconfidence, the required rates of return range between 3.19% and 4.90% with an average rate of 4.12%. This result shows that excessive overconfidence influences the magnitude of the required rate of return as compared to the ones obtained in absence of the bias or even in case of moderate overconfidence.

Figure No 3: Required rates of return for an entrepreneur with excessive overconfidence



Source: Own Elaboration

5. Conclusions

This study shows how the overconfidence bias can influence the entrepreneurs' required rate of return. Whenever entrepreneurs are suffering from the overconfidence bias, they will require a lower rate of return than when they are not subject to the bias. Furthermore, the underestimation of the investment opportunity's risk is serious whenever entrepreneurs suffer from an excessive overconfidence bias and this will lead to undertake bad investment opportunities.

An entrepreneur suffering from an excess of overconfidence will decide to pursue an investment opportunity based on the perception of his own abilities rather than on the real fundamentals of the opportunity, this can partially explain the high failure rate of new firms.

These findings suggest two questions worth an empirical validation: are overconfident entrepreneurs really asking for lower required rates of returns compared to non-overconfident entrepreneurs? Are excessively overconfident entrepreneurs requiring a lower rate of return than moderately overconfident entrepreneurs? In this sense, it would be interesting to design and conduct one field experiment to identify the presence of the bias among entrepreneurs and that would allow us the empirical verification of the previous hypotheses. In addition, the experiment could include entrepreneurs from different sectors in order to check for a correlation between the chosen industry and the entrepreneur's overconfidence level.

Another interesting question is: are entrepreneurs suffering from overconfidence also subject to overoptimism? This is a very important question because if entrepreneurs subject to moderate overconfidence are not subject to overoptimism, then one may argue that moderate overconfidence bias could be beneficial from an entrepreneur point of view. All in all, many interesting questions arise from the results of this study; questions that one hopes will promote even more the study of the behavioral entrepreneurial finance area.

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