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### Overconfident entrepreneurs: Innovating more and paying the piper

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#### Abstract

The net benefit of overconfidence as a personality trait in entrepreneurs has long remained undetermined. In particular, do the salutary effects of possessing an optimistic outlook overcome the drawbacks of an increased likelihood of acting rashly? In these preliminary results, we find that, on balance, overconfident entrepreneurs do add positive economic value through their increased financial investment in innovation, as well as through the outputs of these trailblazing activities. On the other side of the ledger, we also find that overconfident entrepreneurs are more likely to seek financing from informal sectors, which typically charge a much higher cost of capital compared with more traditional sources. Our results suggest that nationwide policies that help encourage innovation from these entrepreneurs, including those that mitigate the sometimes exorbitant costs of capital, may lead to increased economic growth. Our results also highlight the need for additional in-depth analyses in this important area of research.

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# 1. Introduction

“Overconfidence” on the part of corporate CEOs has been found to impact shareholder wealth under asymmetric information and agency conflicts between shareholders and managers (Landier and Thesmar 2009). This individual trait of “Overconfidence” tends to be relatively stable over time (Landier and Thesmar 2009), and it can be considered an enduring characteristic. It is also the case, however, that self-confidence results in high performance when abilities are correctly matched with job requirements. Without such a match, self-confidence can actually be detrimental (Ireland, Hitt and Williams 1992).

In particular, overconfident (OC) managers of large corporations pay too much for takeover targets (Roll 1986), and this is particularly true if the manager has access to internal financing (Malmendier and Tate 2008). In the same vein, excessively optimistic managers overinvest in their own corporate projects, while simultaneously underinvesting in externally financed projects (Malmendier and Tate 2005). In terms of innovation, OC corporate managers tend to accept highly convex compensation contracts that expose the firm to excessive risk (Gervais, Heaton and Odean 2011), but also introduce products that are more pioneering (Simon and Houghton 2003), invest more in innovation, and improve the quality and intensity of patents (Galasso and Simcoe 2011; Hirshleifer, Low and Teoh 2012).

In contrast, when studying *entrepreneurial* overconfidence, there are at least three significant differences that need to be considered relative to the previously outlined corporate manager overconfidence structure. First, entrepreneurs are owner-managers, and, as such, they do not experience the conflicts associated with the classical principal-agent relationship (Jensen and Meckling 1976); Second, most entrepreneurs are overconfident, with their levels of optimism and overconfidence clearly exceeding what prevails among the pool of managers (Busenitz and Barney 1997; Sarasvathy, Simon and Lave 1998; Koudstaal, Sloof and van Praag 2015); And third, it is rare for small businesses to include the governance mechanisms used by larger firms.

The literature has just begun to examine the link between business decision-making or outcomes and entrepreneurial psychological factors (Thomas 2018). To this end, the current analysis seeks to determine exactly how the presence of overconfidence in small, rather than large-firm leaders impacts those firms’ outcomes. Specifically, we examine how firm owner overconfidence relates to the decision as to seek alternative versus traditional funding as well as financial outlays to research and development, patents, or new products or processes.

We find that overconfident entrepreneurs (OCEs) make more innovation-related investments and decisions. However, in contrast to their non-overconfident peers, they chose to use a less formal method of financing these ventures. We find this to be true despite a similar credit rating for overconfident and non-overconfident firms. Policy implications are discussed for this associative, although not necessarily causative, relationship.

## 2. Background

### 2.1. Innovative Activities

In the corporate world, CEOs try to prove their managerial ability by pursuing innovation in the hopes of earning labor market rewards if their innovative efforts are successful (Galasso and Simcoe 2011). Furthermore, the reason overconfident CEOs adamantly pursue risky labor market rewards, is that overconfidence makes individuals undervalue risk and overvalue the

potential rewards from innovation (Gervais *et al.* 2011). This is also true when production changes are pioneering rather than just small improvements (Simon and Houghton, 2003). Herz, Schunk and Zehnder (2014) further demonstrated that optimism regarding one's mental abilities is positively related with being more exploratory (innovating), while Navis and Ozbek (2016) suggested that overconfident entrepreneurs would be drawn to business opportunities in more novel as compared to more familiar contexts.

Also on the innovation front, Hirshleifer *et al.* (2012) found that overconfident CEOs in innovative industries invest more resources into the process of innovation as well as in its product—as measured by patents and patent citations. Given that the pattern of overconfidence is stronger in entrepreneurs as opposed to managers or employees (Koudstaal *et al.* 2015), we would expect that OC entrepreneurs will invest more in innovation and its resultant products.

However, CEOs do not enjoy complete control over the choices that their firm makes. Galasso and Simcoe (2011) reported that the link between overconfidence and innovative activities is stronger for CEOs with fewer constraints on their decision making. As one example, this freedom from constraints could manifest itself by the joint titles of chairman and of president. The lack of constraints could also present itself in a temporal fashion. For example, Einhorn (1980) found that OCEs tend to invest more in innovation when feedback is slower, and ambiguities in feedback take longer to resolve.

In this vein, small firm entrepreneurs have a very significant ownership stake in their venture. They hold many “titles” simultaneously, which provides them with immense control over their firm's decision-making. Due to the reduced constraints faced by small-firm entrepreneurs, we would expect that the OCEs will be more likely to pursue innovation. Like overconfident CEOs, these overconfident entrepreneurs believe that this will happen because their successful innovation will prove their entrepreneurial ability.

Our combined assertions result in the following hypotheses:

**H<sub>1</sub>: Entrepreneurial overconfidence relates positively to a business's innovative activities, which may include spending for R&D.**

**H<sub>2</sub>: Entrepreneurial overconfidence relates positively to a business's innovative outputs, which may include the number of patents as well as the development of new products or processes.**

## *2.2. Financing Activities*

Adomdza, Astebro and Yong (2016) examined a sample of 780 Canadian inventor-entrepreneurs for impact of overconfidence on venture financing decisions. They found that overconfidence is unrelated to the amount funded by outside investors, or to the likelihood of investment by strong- and weak-tie investors. In regards to corporate finance, Hackbarth (2009) theoretically predicted that overconfident managers will choose higher levels of debt, exacerbating the typical firm's tendency to underinvest (Myer 1977).

Bridging the gap between CEOs and entrepreneurs, Heaton's (2002) argument that excessively optimistic managers believe that the capital markets undervalue their firm's risky securities and will act accordingly can also be applied to over-confident entrepreneurs. Specifically, when OC entrepreneurs believe that their risky securities are undervalued, they will assume that their formal loan applications are more likely to be rejected. Hence, overconfident entrepreneurs should also be less likely to apply for formal loans. In keeping with this assertion, Landier and Thesmar (2009) argued that optimistic entrepreneurs select into short-term debt because they are betting on their project's success, while investors will instead want to focus on

keeping their renewal options open. After controlling for other potential determinants of short-term leverage including firm risk, these authors find that short-term debt is correlated with optimistic expectation errors.

While there are a number of similarities between overconfident managers and overconfident entrepreneurs, we argue that a critical difference between these types of firms is the more severe informational asymmetries faced by startup owners, as compared to those faced by managers and CEOs of large public corporations. These informational asymmetries lead to a reduced rate of formal or traditional bank funding for entrepreneurs. These individuals hope that successful innovation will allow them to obtain more funding and better rates from the often very restrictive non-bank-based financial market, which serves as a primary source for funding their venture.

Included in this form of non-bank funding are the categories of spousal, parental, angel, venture capital, private firm, and government investments. Notice that, while these funding sources may vary, the majority of firms obtain funding from the first two sources, and we can thus think of these funds as coming from the “informal” financial market.

Given an OCE’s belief that he or she will face undervaluation in the formal capital market, the entrepreneur should be more likely to resort to informal funding sources. As mentioned above, the belief that they are facing an informational asymmetry can be overcome to some extent through disseminating entrepreneurial quality within the informal network. We propose the following hypotheses:

**H<sub>3</sub>: Overconfident entrepreneurs are less likely to apply for a formal loan due to their fear of rejection.**

**H<sub>4</sub>: Overconfident entrepreneurs are more likely to seek informal funding.**

### 3. Data Analysis

We employ the restricted-access Kauffman Firm Survey (KFS) micro-dataset, which is housed at the National Opinion Research Center (NORC) in Chicago, IL. The KFS tracks the form and function of small, US-based, privately held startup ventures. The KFS panel dataset is composed of 4,928 new businesses that began operating in the year 2004. The firms were followed annually until 2014. Because the survey designers intended to elicit a nationally representative dataset of entrepreneurial ventures that all began in the same year, the KFS is frequently considered one of the largest, and most current vetted surveys focusing on the behaviors of small private startup firms. The nature of the KFS is further described in Ballou et al. (2008) as well as in Baek and Neymotin (2016).

There are a number of measures of overconfidence that are employed in the public-firm CEO overconfidence literature. Some of the main ones include whether there was a delay in stock option exercise, the holding period of the company’s stock, as well as press descriptions of the firm (Hayward and Hambrick 1997; Hirshleifer *et al.* 2012; Hribar and Yang 2015; Malmendier and Tate 2005, 2008). Notwithstanding the problem of convergent validity among these measures (Hill, Kern and White 2015), those are either irrelevant or unobservable among the small and privately held startup firms in our sample. To detail, (1) plans for stock options are either nonexistent or else they are unobservable here, (2) our firms are not publicly traded, so we are unable to determine whether continuing to manage and run a company (holding company equity) is due to overconfidence or due to lack of liquidity, and (3) we do not generally see press coverage in the case of small private startups. For all of these reasons, our measure of

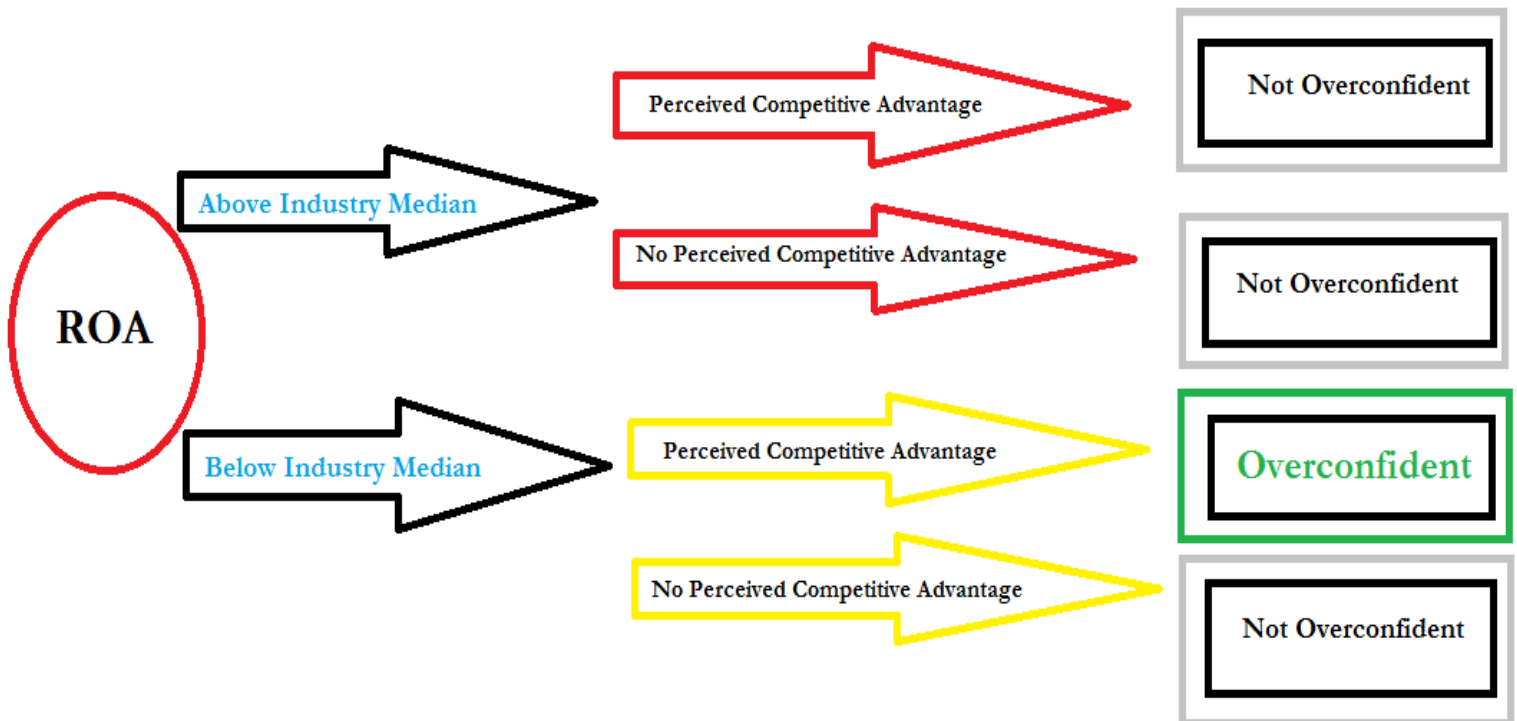
overconfidence must follow a different structure, and we choose to use direct observations of over-optimism as a measure of firm owner overconfidence.

Specifically, we classify an owner as ‘overconfident’ if (1) she believes that her firm has a competitive advantage, *and* (2) the firm underperformed relative to the industry. We consider (1) to be satisfied when an entrepreneur in our sample answered yes to the following survey question:

*Businesses often have to compete with other businesses. A competitive advantage is something unique or distinctive that a business provides and that gives it an advantage compared to competitors. In calendar year YYYY, did [NAME BUSINESS] have a competitive advantage over its competitors?*

The creation of our overconfidence measure is pictorially demonstrated in Figure 1. We measure (2) as a situation when the firm’s average return on asset (ROA) in its first years (2004-2007) is below the industry’s median ROA during that time-period.<sup>1</sup>

**Figure 1: Overconfidence Measure**



We also use several measures of innovation that we constructed from the KFS data. First, we employ *R&D*, calculated as the amount of research and development spending relative to

<sup>1</sup> Libby and Rennekamp (2012: 205) classify overconfidence as either being over-optimism, that is an overestimation of the mean, or else miscalibration, that is an underestimation of the variance. In this framework, their version of overconfidence employing over-optimism is consistent with our measure of overconfidence. Olsson (2014: 1766) categorizes three definitions of overconfidence: Overestimation, overplacement and calibration of subjective probabilities. Our measure is aligned with the definition of overplacement of one’s performance compared with others’ performances.

total assets. Second, we employ *Patents*, calculated as the log of the number of patents—technically adding one to avoid boundary issues. Third, we use *NewProdProc*, which is a binary indicator taking on a value of one if the firm chose to introduce a new (or significantly improved) product or process. We would note that our definition of *NewProdProc* is consistent with Hechavarria and Welter’s (2015) measure, where they measured innovativeness through three interview questions: 1) Will potential customers consider your product/service new and unfamiliar? 2) Are there other businesses offering the same product/service? 3) Were the technologies/procedures available more than a year ago?

In the areas of credit and funding, we also employed several different measures. First, we used the business’s credit risk (*CredRisk*), coded as a categorical value, taking on a whole number value between 1 and 5, where 5 was the riskiest and 1 was the safest category. Second, we used *DidNotApply*, which is a binary indicator taking on a value of one when a firm said that they needed credit, but they did not apply because they thought that their application would be denied. Third, we used *InformalFund*, which is a binary indicator taking on a value of one if the firm sought and acquired funding from informal sources such as family and friends during the period in question.

We also used the demographic variables of age, gender, work experience, education, race or ethnicity, and citizenship. We also use the methodology in Fairlie and Robb (2007) to determine the primary owner and employ that individual in determining owner characteristics. At the firm level, we included controls for total assets (firm size), as well as indicators for industry, year, and location of the firm’s main customer.

## 4. Results

We report summary statistics, including t-tests for differences of means in Table 1, keeping in mind the disclosure restrictions from the Kauffman Foundation. The number of firm-year observations ranges from 6,008 to 11,834 for each of the variables that are later employed in our regression analysis. On average, our full sample of firm owners spent 8.2% of their assets on R&D, and they produced .05 patents—where the maximum number of patents in the dataset is 150. It is also true that 28% of our firms introduced a new product or process in any given year, and that 13.8% of the entrepreneurs said that they needed credit, but they did not apply for a loan because they thought that their applications would be denied. Finally, approximately 5% of our sample of firms sought and acquired informal funding.

Turning next to overconfidence, we see several variations for these entrepreneurs relative to the patterns displayed by their non-overconfident peers. Specifically, OCEs spent more on R&D—11.8% vs 3.8% as a percentage of assets, they produced more patents (.09 vs .008), and they were more likely to introduce a new product or process (43% vs 14%). It is also true that, while their credit risk did not noticeably differ from that of their non-overconfident peers, OCEs were still more likely to need credit, but to avoid applying due to the fear of denial (14.5% vs 13%). Consequently, it is perhaps unsurprising that a larger number of overconfident entrepreneurs (6.5% vs 3.1%) chose to pursue informal funding sources. Furthermore, our intercorrelations (calculated separately) also found that overconfidence positively relates with R&D, patents, new product or processes, credit risk, not applying for a formal loan, and seeking funding in the informal sector. Variables measuring innovation were also positively correlated with seeking informal funding.

**Table 1: Sample Summary Statistics**

<i>[1] Full Sample</i>	<i>R&amp;D</i>	<i>Patents</i>	<i>NewProdProc</i>	<i>CredRisk</i>	<i>DidNot Apply</i>	<i>Informal Fund</i>
<b>mean</b>	0.082	0.049	0.276	2.842	0.138	0.049
<b>SD</b>	1.147	0.287	0.447	1.041	0.345	0.217
<b>range</b>	87.66	5.02	1	5	1	1
<b>N</b>	7602	11834	6494	10270	11806	8304

<i>[2] Overconfident Entrepreneurs</i>	<i>R&amp;D</i>	<i>Patents</i>	<i>NewProdProc</i>	<i>CredRisk</i>	<i>DidNot Apply</i>	<i>Informal Fund</i>
<b>mean</b>	0.118	0.086	0.433	2.858	0.145	0.065
<b>SD</b>	1.477	0.385	0.496	1.043	0.352	0.247
<b>range</b>	87.66	5.02	1	5	1	1
<b>N</b>	4212	6180	3034	5407	6185	4506

<i>[3] Not Overconfident Entrepreneurs</i>	<i>R&amp;D</i>	<i>Patents</i>	<i>NewProdProc</i>	<i>CredRisk</i>	<i>DidNot Apply</i>	<i>Informal Fund</i>
<b>mean</b>	0.038	0.008	0.139	2.824	0.130	0.031
<b>SD</b>	0.485	0.085	0.346	1.039	0.336	0.173
<b>range</b>	17	2.40	1	5	1	1
<b>N</b>	3390	5654	3460	4863	5621	3798

<i>Difference</i>	<i>R&amp;D</i>	<i>Patents</i>	<i>New ProdProc</i>	<i>CredRisk</i>	<i>DidNot Apply</i>	<i>Informal Fund</i>
<b>[2]–[3]</b>	<b>0.082</b>	<b>0.078</b>	<b>0.294</b>	0.033	<b>0.015</b>	<b>0.034</b>
<b>t</b>	3.017	14.909	27.989	1.623	2.387	7.230
<b>p</b>	0.003	0.000	0.000	0.105	0.017	0.000

The 95 percentile value of R&D is 1.7269, this value is used to Winsorize the values in the regressions analysis.

Our regression analysis begins by employing a Generalized Method of Moments (GMM) (probit) panel structure to examine the effect of entrepreneurial overconfidence on innovative activities. We additionally control for demographic characteristics including age, sex, education, race or ethnicity, citizenship, as well as a measure of firm size (total assets), and binary indicators for year, industry and customer location. We winsorize R&D and Total Assets at the 95% level, effectively top coding R&D at 1.7269 and Total Assets at 1,795,000.

Each in a separate regression and after including the controls listed above, we find that entrepreneurial overconfidence positively and statistically significantly (at the 1% level) relates to higher levels of R&D spending ( $\beta=0.039$ ,  $t=3.82$ ), Patents ( $\beta=0.062$ ,  $t=4.68$ ), and New Products or Processes ( $\beta=0.102$ ,  $t=4.64$ ). In particular, firms with overconfident entrepreneurs are approximately 10% more likely to introduce a new product or process than are firms headed

by a non-overconfident entrepreneur. All of these results show a clear and important relationship between overconfidence and innovation, as well as a concordance between the regression results and our first two hypotheses (**H<sub>1</sub>** and **H<sub>2</sub>**).

In the next step of this analysis, we examine the relationship between entrepreneurial overconfidence and firm financing decisions. We employ the same controls and GMM regression structure in constructing the results. The one variation we use is to include credit risk as a control variable when avoiding bank loan applications. Our reasoning is that lower credit may help to explain why a firm chooses to evade filling out a bank loan application due to the fear that it will ultimately be rejected.

What we find in these regressions strengthens the patterns that we previously observed in the summary statistics portion of our analysis. Specifically, while credit risk does not have a statistically significant relationship with overconfidence ( $\beta=0.080$ ,  $t=1.43$ ), overconfident firms were significantly less likely to apply for credit by 7% ( $\beta=0.069$ ,  $t=4.22$ ), and, perhaps consequently, significantly more likely to seek alternative informal funding by a 4% difference ( $\beta=0.040$ ,  $t=4.5$ ). We also found little effect of whether we did or did not include the control of credit risk, implying that the relationship between overconfidence and not applying for bank loans is not entirely explained away by differences in credit risk across overconfident and non-overconfident firms.

Taken together, these results provide evidence for our third and fourth hypothesis (**H<sub>3</sub>** and **H<sub>4</sub>**), which state that overconfident entrepreneurs are more likely to seek informal funding. Finally, we also take these results as an initial indication that the reluctance on the part of OCEs to engage in the formal loan application process is related to their further reliance on informal external funding.

#### *4.1. Financing and Innovation Activities*

In order to examine the relationship between the two previous sections focusing on innovation and on financing, we next asked how overconfidence affects R&D, Patents, and new products or processes. In each of these three cases we included additional controls for both informal funding, and, in the case of Patents and new products or processes, we also controlled for R&D spending.

What we found strengthens our initial results. Namely, while we do observe an impact of informal funding on affecting innovation via R&D ( $\beta=0.077$ ,  $t=4.46$ ), and via new products or processes ( $\beta=0.094$ ,  $t=1.84$ ), the coefficient on overconfidence continues to be statistically significant at similar levels, and its magnitude is within 1% of that seen earlier [for R&D, ( $\beta=0.044$ ,  $t=3.35$ ), and for new products or processes ( $\beta=0.088$ ,  $t=3.46$ )].

## **5. Conclusions**

Apart from initial business formation decisions, the effects of Entrepreneurial overconfidence on small, private startups is very under-researched. While it would be convenient to generalize the results for CEOs to small firm owners, we know that these owners have a number of differences in the structure, operations, and ultimate course of growth of their firms. In our research, we find that the psychology and cognitive processes of small-firm entrepreneurs play a clear role in firm financing and financial outlay decisions. Our results imply that policy which continues to neglect these facts is increasingly incomplete.

We hypothesized that overconfident entrepreneurs would be more motivated to innovate relative to their less-confident peers. We observed innovation as a firm's investment in R&D,



production of patents, and introduction of new products or processes. In line with our predictions, we indeed found a positive relationship between the presence of entrepreneurial overconfidence and increases in both inputs to innovation (R&D) as well as in innovative outputs (patents and new products or processes). In line with our priors, we also found a role for R&D inputs in helping to increase innovative outputs, thereby showing that investments in innovation translate into innovative results.

With regard to financing these innovations, we found that, despite having similar credit risks, overconfident entrepreneurs were more hesitant in seeking formal loan funding through banks, and seemed to instead resort to informal networks to accomplish this goal. This change in funding sources is an important element when examining the innovative process, since we also found that firms seeking to have high levels of R&D did have more (external) funding. As demonstrated previously, this investment in R&D translates into more innovation output.

Our preliminary results imply that, if we place a high value on innovation and economic growth, then we need to do more to enable startup firms to achieve their funding goals. As one strong possibility, policy may be designed to provide access to additional bank financing options rather than relegating smaller firms to mostly exist in the higher cost of credit alternative financing sector. Our work has additionally raised the important need for follow-up work to consider the questions we have raised in the present analysis, and to explore these preliminary results in a more in-depth and empirically complex fashion.

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