# Self-Employment Does Not Measure Entrepreneurship[1]

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**Abstract**

This paper uses two newly assembled datasets to demonstrate that the common practice of relying on self-employment to proxy for entrepreneurship often gives to rise to misleading inference. I determine the source of wealth of all billionaires listed on Forbes Magazine's list, identifying 996 individuals in over fifty countries who became rich by founding new firms. Using these individuals to define the per capita rate of entrepreneurship, I show that entrepreneurship rates correlate negatively with self-employment rates. Countries with higher income, lower taxes and less regulation have higher entrepreneurship rates but less self-employment. I attempt to account for these results theoretically using a model where efficient financial markets and a favorable policy environment lead to a better allocation of capital to talent, higher wages, and thereby driving the least productive self-employed individuals to seek employment. This evidence is supplemented with data from a recently administered survey of $12,000$ Swedish twins. The survey asks individuals to identify as self-employed or entrepreneurs based on their intentions to innovate and grow their businesses. Whilst the self-employed have lower incomes than employees with similar characteristics, entrepreneurs have higher incomes. These relationships hold both in the cross-section and within family.

# 1 Introduction

Entrepreneurs fulfil a central function in the economy by carrying out innovations and exploring new ways to organize factors of production (Schumpeter 1934). They are consequently widely believed to play an important role for economic growth. The attention afforded to entrepreneurship by policy makers and academics is also rooted in historical experiences, as each wave of innovation in modern times has been associated with entrepreneurs such as James Watt, Andrew Carnegie, Henry Ford, Sam Walton and Bill Gates. Entrepreneurship theory is concerned with understanding the innovative process and with identifying policies that foster the creation of rapidly growing firms (Baumol, 2002). The dominant view of entrepreneurship in the literature is arguably the Schumpeterian definition of the entrepreneur as an innovator and as a driver of growth (Hébert & Link 2006, Henrekson and Roine 2007). While Schumpeter's description of entrepreneurs as "promoters of new combinations" is not the only existing perspective, it is the prevailing view in the field. When academics and business leaders were asked to define entrepreneurship, the most common choices were the creation and development of new ventures followed by innovation. In contrast "the creation of a mom-and-pop business" was not viewed as entrepreneurship (Gardner 1989).

However, the most common approach to proxying for entrepreneurship in empirical work, given data limitations, is to use self-employment. This measure is defined by a legal employment form, rather than the economic function performed by the individual in question. There are some obvious merits to this approach, for example that self-employed individuals, just like entrepreneurs, rarely work for someone else, operate a business and need to wrestle with issues such as risk, uncertainty (Knight, 1921) and responsiveness to opportunity (Kirziner, 1973). However, as an empirical matter an overwhelming majority of self-employed individuals are not entrepreneurial in the Schumpeterian sense, as they do not bring a new innovation to the market or plan to grow their business. Rather, many of them are construction workers, shop owners, taxi and truck drivers, gardeners, plumbers, fast food vendors, hair-dressers, and on the more high skilled end lawyers, physicians, consultants and accountants who have simply chosen a particular legal employment form in which to perform their work. In the United States, the industries with the largest concentrations of self-employed men are construction, landscaping services, auto repair, restaurants, truck transportation, and crop production (farmers). For women, the industries are private households (cooks, maids, caretakers), child day care services, services to buildings (janitors and cleaners), restaurants and beauty salons. The most common type of male self-employment within professional services is physicians and dentist followed by legal services. For women it is family child care homes followed by accounting, auditing, and bookkeeping. Conversely, not all entrepreneurs are self-employed. For example, Steve Jobs, whilst retaining some residual rights of control over Apple, would be classified as an employed CEO and not self-employed.

More than half of American business owners report that their primary function within the firm is to produce the goods or services of the business, rather than manage the company. In the latest Panel Survey of Income Dynamics, a representative social science survey, there are merely three self-employed business owners whose company's value exceeds ten million dollars, representing less than one half of one percent of America's self-employed. The Survey of Consumer Finance shows that three quarters of self-employed Americans operate firms with less than $100.000 of equity. And, according to the Census Bureau's Survey of Business Owners, the median business owner who works full time has zero employees. This figure is particularly low for unincorporated businesses, which make up well over two thirds of U.S self-employed. Only 14% of this group had any paid employees, only 3% had more than four employees and only 0.5% had more than twenty employees. Nor does it appear to be the case that most small business eventually grow large. Of all the small firms with employees started in 2002, four years later 90% were either out of business or still had fewer than 5 employees.

Hurst and Pugley (2010) provide a wide range of survey evidence suggesting that the vast majority of American self-employed neither innovate or intend to innovate, nor grow or intend to grow. Most of the small firms that do have employees are best described as permanently small rather than nascent entrepreneurial companies. Whilst this class of firms play an important role in the economy, they are not necessarily a good testing ground for theories of entrepreneurship. For example, since most of the actual firms that the self-employed manage require very little in terms of equity finance, constraints in raising capital for rapid growth are not as important as for someone trying to introduce a new technology into the market.

Even though there are good grounds to believe that self-employment is quite distinct from entrepreneurship, there is no dearth of articles in which self-employment or similar metrics are used as an empirical proxy for entrepreneurship. Some prominent papers taking this approach include Evans and Jovanovic (1989), Evans and Leighton (1989), Holtz-Eakin et al. (1994), Blanchflower and Oswald (1998), Quadrini (1999), Carroll et al. (2000), Gentry and Hubbard (2000), Hamilton (2000), McMillan and Woodruff (2002), Moskowitz and Vissing-Jorgensen (2002), Bruce and Schutze (2004), Gentry and Hubbard (2004), Hurst and Lusardi (2004), Lazear (2004) Bitler et al. (2005), Djankov et al. (2006), Cagetti and De Nardi (2006), Guiso et al. (2006), Paulson and Townsend (2006), Ardagna and Lusardi (2008), Kitao (2008), Cagetti and De Nardi (2009), Glaeser (2010), Glaeser and Kerr (2010) and Djankov et al. (2010).

Hurst and Pugley (2010) argue forcefully against using self-employment as synonymous with entrepreneurship. They point out that when new American startups were asked by the Panel Survey of Entrepreneurial Dynamics about growth ambitions, 75% of respondents state that "I want a size I can manage myself or with a few key employees". Based on the PSED and the Kaufman Firm Survey, Hurst and Pugley estimate that only between 10-20% of small businesses report any innovative activity at all.

The aim of this paper to evaluate self-employment (and similar metrics) as empirical proxies for entrepreneurship. The primary finding is that the bias is so strong that in several important applications, self-employment produces the reverse coefficient sign as entrepreneurship. In other words, the researcher who relied on this measure would find the opposite result than if entrepreneurship were to be used. Two complementary datasets are used to investigate the consequences of using self-employment data to proxy for entrepreneurship. The first dataset is constructed using information from Forbes Magazine world-wide list of billionaires between 1996 and 2010. For each billionaire, I gathered additional information on the source of wealth, allowing me to identify 996 individuals who became rich by founding new firms. Using these individuals to construct a per capita rate of entrepreneurship, I show that this measure is negatively correlated with self-employment rates. Countries with higher per capita GDP, lower taxes and fewer regulations on startups have higher entrepreneurship rates but *less* self-employment. I attempt to account for these results theoretically using a model where efficient financial markets and a good policy environment lead to a better allocation of capital to talent, raising wages, and thereby driving the least productive self-employed individuals to seek employment. In this application, it turns out that self-employment is not only a noisy proxy for entrepreneurship but a misleading one. A further examination of American billionaire revealed two additional applications where the self-employment variable can lead to misleading inference when it is intended to proxy for entrepreneurship. While the self-employment of immigrants is above average, they are under represented in high-impact entrepreneurship. Self-employment as well as related metrics such as firm density are also unable to identify Silicon Valley and Boston as regions with high levels of entrepreneurship.

This conclusion is further reinforced by evidence from a comprehensive survey of 12,000 Swedish twins. The survey includes detailed questions about business ownership which allows me to plausibly distinguish entrepreneurs, self-employed and salaried workers, allowing me to compare these groups on a number of background variables. Previous research has found that the self-employed have more volatile earnings from labor than wage earners, while their investments in non-public firms are less diversified. A careful examination by Hamilton (2000) demonstrates that the self-employed do not appear to be compensated for this higher risk, as their earnings are lower than that of salaried workers. Moskowitz and Vissing-Jorgensen (2002) confirmed that the self-employed earn lower returns on capital than the stock market. Since both these two influential studies use self-employment and entrepreneurship interchangeably, these finding has been interpreted as an entrepreneurial return puzzle. In the Swedish data however, self-identified entrepreneurs have significantly higher earnings than wage earners, while the non-entrepreneurial self-employed indeed earn significantly less than the wage earners. These results hold both in the cross-section and with family fixed effects, suggesting that the correlation is not driven by unobserved family factors. These results help us shed some light on the entrepreneurial return puzzle. Those business owners who actually self-identify as having

the ambition to grow or innovate do not earn less than salaried workers.

The paper is structured as follows. Section II describes the method used to construct the two datasets. Section III outlines a theoretical framework for understanding the differences between self-employment and entrepreneurship. Section IV reports and discusses the main empirical findings of the paper and Section V concludes with a discussion of the most important implications of these findings.

# 2 Data

This section describes the construction of the variables used in this paper. Entrepreneurship researchers have exhibited considerable ingenuity in tackling the methodological problem of distinguishing the self-employed from entrepreneurs. One strategy has been to study new firms, another has been to restrict attention to "high-impact entrepreneurs" (Leibenstein 1968, Acs 2008). The original empirical attempts defined high-impact entrepreneurship based on revenue growth (Birch 1982). In recent years the most commonly used definition is employment growth, with the rapidly growing firms often referred to as "gazelles" (Acs and Mueller 2008, Henrekson and Johansson2010). This paper instead measures high-impact entrepreneurship based on the amount of personal wealth created. The cross-country measure of entrepreneurship is determined based on counting the number of dollar billionaires who acquired their wealth by starting their own business.

As noted previously, almost all the research into entrepreneurship using micro level panel data-sets has relied on the self-employment to proxy for entrepreneurship. An important question is if the behavior or the self-employed corresponds to the behavior of the (much smaller) sub-sample of entrepreneurial self-employed. This paper uses data from the Screening Across the Lifespan Twin Study: Younger Cohort, also known as SALTY, which was recently administered by the Swedish Twin Registry. The SALTY survey contains questions specifically designed to distinguish these two groups. To the best of my knowledge no other dataset presently exist which allows for such a comparison. Below, I describe in greater detail the construction of the cross-country measure of entrepreneurship and the SALTY data.

## 2.1 A Cross-Country Measure of Entrepreneurship

Forbes Magazine annually compiles a list of the world's billionaires known as "The World's Billionaires". This paper's primary cross-country measure of entrepreneurship is constructed from all individual billionaires who appeared on the annual list at least once between 1996 and 2010. In total, there were 1723 unique such individuals. Some of these individuals cannot be plausibly be classified as entrepreneurs, because they did not acquire their wealth by starting a company. To identify the subset of these individuals who are entrepreneurs, I gathered data on the source of each billionaires wealth. Excluding individuals who did

not acquire their wealth by starting a company leaves 996 billionaires from a total of 53 countries. When available, I supplemented the Forbes data on citizenship with data on country of birth.

A majority of the world's entrepreneurs, 58%, did in fact acquire their wealth by starting a business. The figure is lower in Europe, 42%, than in the United States, where 65% of the dollar billionaires are entrepreneurs. Many of the billionaires who were not classified as entrepreneurs acquired their wealth through bequests, and in many cases these bequests reflected the entrepreneurial successes of the previous generation. Moreover, many of the non-entrepreneurial CEO:s who make the list of the world's richest were hired by entrepreneurial startups, such as Microsoft's Steve Ballmer (such individuals are not defined as entrepreneurs since they did not found the company). Other non-entrepreneurial billionaires includes traders in the financial sector, corporate CEOs, law firm partners and writers whose wealth exceeds the one billion dollar threshold. In the rare cases where the source of wealth could not be determined in any way, I coded the individual as a non-entrepreneur. Appendix A provides further information on the classification procedure and how ambiguous cases were treated.

This is to my knowledge the first study that attempts to estimate high-impact entrepreneurship through the growth of wealth for founders of new business ventures. This measure has the advantage of enabling us to create a cross country measure of high-impact entrepreneurship. Other cross country measures of entrepreneurship generally rely on various estimates of self-employment or entry into self-employment.[1] This measure of entrepreneurship can be criticized on a number of counts. A first potential problem is that one billion dollars is an excessively high threshold, as many successful entrepreneurs will be excluded as a consequence of this. The choice of this threshold is of course entirely due to data limitations. Hopefully the extreme tail of the distribution tells us something also about the mean, a country with many more top-entrepreneur is likely to have more ordinary entrepreneurs as well. Furthermore while the billionaire entrepreneurs are few, they are disproportionably important, representing many of the most valuable, innovative and influential firms created.

To examine the robustness of the results, I also consider an additional cross-country measure of entrepreneurship, the details of which are also in the Appendix. The measure is constructed by computing the fraction of large firms started by entrepreneurs in all countries with more than 30 companies on the Forbes List of the world's 2000 largest countries. In the United States, 31 out of the 100 largest firms were started by entrepreneurs, compared to 11 in Japan and 7 in the European Union. There is a strong and statistically significant correlation between this measure of entrepreneurship and the per capita number of billionaire

[1] Acs and Szerb (2009) construct a cross country index based on attitudes of the population towards entrepreneurship and the aspirations of business founders. Morck et al. (2000) were the first to take advantage of the billionaire data compiled by Forbes Magazine for academic research. Using the data for the year 1993, they found that countries in which a higher share of wealth was inherited tended to have lower rates of growth in subsequent years.

entrepreneurs. The correspondence between the two lists is not surprising, as about half the founders of the firms in this list can be directly identified in the list of billionaire entrepreneurs. American entrepreneurial firms in either or both samples include many of the usual suspects, such as Intel, Microsoft, Google, Yahoo, Oracle, Cisco, Sun Microsystems, Bloomberg, PayPal, AOL, Facebook, E-bay, Dell, Hewlett-Packard, Gateway, inc, Priceline.com, Amazon, Wal-Mart, Home Depot, Best Buy, Family-Dollar stores, The GAP, Urban Outfitters, Ralph Lauren, Nike, Trader Joe's, Starbucks, Chick-fil-A, Subway, Blackstone, Bridgewater, KKR, CNN, Fox News, Univision, HBO, The Weather Channel, Black Entertainment Television, DreamWorks, Lucas Arts, Ultimate Fighting Championship, Ty Inc. (Beani Babies), Conair, Enterprise Rent-A-Car, Dolby Laboratories, Bose, University of Phoenix and FedX. Europeans firms include IKEA, Aldi, Zara, H&M, Armani, Benetton, Red Bull GmbH, Virgin group and Ryanair. Other examples are Japanese Sony, Honda and Softbank, Canadians Research in Motion (Blackberry) and Cirque du Soleil, Israeli Check Point Software and Hong Kong's Cathay Pacific Airways.

Third and last, I use data from Bosma and Levie (2010) who provide estimates of venture capital investments in 2008 as a share of GDP for 31 advanced countries. This measure of entrepreneurial activity correlates 0.57 with per capita billionaire entrepreneurs and 0.53 with the share of largest firms founded by entrepreneurs.

I note some further potential limitations of these measures of entrepreneurship. A first is that entrepreneurship need not be productive, as emphasized by Baumol (1990), and as illustrated by events during the economic transition in Russia. This concern is especially pressing in countries with weak institutional environments. As noted, the theoretical definition I aim to capture in this paper is innovation and or growth in new firms, while the empirical strategy uses the measure growth of great wealth through founding new firms. None of these definitions necessary signify that the activity is socially valuable. Since most of the entrepreneurs and much of the focus is on industrialized countries with institutions that reward wealth creation rather than redistribution, this is hopefully a secondary concern. A careful inspection of the companies reveals that the incidence of billionaires who acquired their resources through expropriation rather than innovation is very low. All the main results of this paper hold when the sample is restricted to the OECD countries.

Yet another concern is that I measure successful entrepreneurship ex post, having no data on the ex ante attempts to enter entrepreneurship. Since much of the focus in the research is on entrepreneurial policy, a partial defense is that what matters most is in fact the final number of successful new firms, with the intermediate steps (are there more successful firms because more people had incentives to enter entrepreneurship or because more of the entrants succeeded?) of secondary importance.

## 2.2 SALTY Survey

To characterize differences between entrepreneurs and self-employed I also make use of another newly assembled dataset which includes a series of questions specifically designed for this purpose. I use data from a survey administered by the Swedish Twin Registry (STR). The most recent of these surveys, SALTY, is the first major survey of twins which features entire sections specifically devoted to economic decision-making. Beginning in the fall of 2008 SALTY was sent to a total of 24,914 Swedish twins born between 1943 and 1958. Final reminders were sent out during the spring of 2010 to those who did not initially respond to the survey, and the data collection was completed in the summer of 2010. The survey generated a total of 11,743 responses, a response rate of 47.1%. Out of the respondents 11,418 (97.2%) gave informed consent to have their responses stored and analyzed. In total, our sample is comprised of 1150 MZ pairs (identical twins), 1245 same-sex DZ pairs (half-identical twins), and 1117 opposite sex DZ pairs.

All respondents answered a detailed battery of questions on economic preferences, behaviors and outcomes. In addition, the sample has been matched to administrative data containing information on educational attainment and various measures of economic outcomes, including income. Detailed information on the variables used is provided in the Appendix. Cesarini et al. (2010) conduct an analysis of non-response and the representativeness of the sample. All survey respondents were given a series of questions on self-employment and entrepreneurship. The first question asked if the subject had ever founded his or her own business. Those who answered in the affirmative were then asked about the number of businesses started, the number of years in self-employment and whether they considered themselves an entrepreneur or self-employed. The question posed was as follows:

"It is sometimes desirable to distinguish entrepreneurs from those who are self-employed. An entrepreneur commercializes a new innovation or idea. An entrepreneur has, or plans to have, a number of employees and strives to expand the business. A self-employed person owns and runs his/her own company, for instance a restaurant or a law firm, where he/she works. A self-employed person normally does not strive to expand over a certain limit and has zero or a few employees. Would you say that you are primarily an entrepreneur or a self-employed person?"

We classify business owners as either entrepreneurs or self-employed based on their response to this question and refer to respondents who reported never started a business as salaried workers.

# 3 Theory

## 3.1 Previous Literature

The empirical regularity that self-employment is negatively related with economic development both cross countries and across time is well established (e.g Kuznets 1966), although the reason are not well understood. Lucas (1978) seminal paper pointed to the tendency of more advanced economies to, because of increased capital intensity, have larger firms and less self-employment[2]. Carre et al. (2002), Wennerkers et al. (2005) and Sander et al. (2010) are examples of a line of literature that instead argue that the relationship between entrepreneurship and economic development is U-shaped, using self-employment or business ownership proxies for entrepreneurship.

On the theoretical side, there are a number of studies in macroeconomics that have investigates occupational choice models with financial friction and its implication for productivity and entrepreneurships. Quadrini 2009 provides a recent review of this literature as well as more generally of the macro-entrepreneurship approach. Jeong and Townsend (2007) uses a two sector model where the self-employed in the undeveloped sector may remain small because of lack of access to capital. Amaral and Quntin (2010) show in simulations that financial friction can reduce the average plant size. Quintin (2008) similarly finds that a lack of contract enforcement can help explain the difference in establishment size between the United States and Latin America. Buera et al. (2010), Antunes et al. (2008a), Antunes et al. (2008b) are closest to the model used here, and show that financial imperfections can influence the mean and dispersion of the skill in entrepreneurial ventures as well as firm size. When financial frictions decreases, those entrepreneurs who are best at managing firms get to operate them, raising output, raising the average establishment size and raising wage levels. While many of the theoretical prediction are similar to this paper, none of these studies distinguish between entrepreneurs and self-employed or provide data on entrepreneurship levels. Furthermore the model used here also studies the effects of public policy on occupational choice, and includes a financial sectors that screens entrepreneurs based on imperfectly observed talent.

## 3.2 How Entrepreneurship Reduces Self-employment

Former JC Penny employee and retail franchise operator Sam Walton founded Walmart in 1962, when his idea for establishing discount stores in small town America was rejected by his employer. By 1985 Sam Walton was the richest man in America according to the Forbes Magazine ranking. Walmart grew to be

[2]The Lucas result relies on a elasticity of substitution between capital and labor strictly less than one, and would thus not hold if a standard Cobb-Douglas production function is used. While many studies of the elasticity of substitution find values lower than one, others find values close to one or occasionally even higher (Chirinko 2002, Antràs 2004, León-Ledesma et al. 2010). The long run elasticities are likely to be higher than the values estimated empirically, which makes this mechanism unattractive as a general explanation of the decline of self-employment in advanced countries

the largest private employer in the world, and has been estimated to have contributed to an non-negligible share of the productivity gain in recent years (Johnson 2002, Hausman and Leibtag 2009). The story of Walmart illustrates the impact that creative entrepreneurship can have on self-employment rates. Its growth was accompanied by, and indeed required, the replacement of thousands of smaller mom-and pop retail operations (Stone 1995, Basker 2005, Jia 2008). Between 1963 and 2002 the number of single-store retailers in the United States declined by over half (Basker 2007).

This pattern is not unique to Walmart; firms such as Home Depot, The GAP, IKEA, H&M, Borders and Amazon have similarly reduced the number of self-employed in their industry. Nor is the process unique to the retail sector. Starbucks replaced operations that before their entry, and in other countries where they have not yet entered, are managed by a multitude of self-employed. Even the growth of firms such as Intel, Microsoft and Google that do not directly compete with large number of small business reduce self-employment. In their case the mechanism is not taking market share, but offering better career prospective as employees and therefore raising the alternative cost of self-employment.[3] It is natural that entrepreneurship reduces the small-business share of employment, since each successful entrepreneurial venture results in an increase in the number of large firms. In the process of bringing new innovations to the market, entrepreneurs typically (according to some by definition) create entirely new organizations with thousands of new high paying jobs. Naturally some of which are filled by people who otherwise would work for themselves. In this way workers who in current day Greece (or 1960 America) saw self-employment as their best option instead find it more lucrative to be, and are more productive as, employees of larger more efficient firms. The effect is of course even stronger if the entrepreneurial firm directly competes with small business and reduces their share of the product market in addition to competing with them in the labor market.

This reverse relationship between entrepreneurship and self-employment only appears paradoxical if entrepreneurship is defined as merely the contractual form of working for oneself. If entrepreneurs are instead viewed as individuals engaged in innovation and the creation of new firms, and self-employment is viewed as a general ownership solution for a broad range of motivations, the process is quite natural. Examples of non-entrepreneurial impetus for self-employment include a preference for being one's own boss (Hurst and Pugsley 2010), solving agency problems in offering your skills and services (Bitler et. al 2005), better monitoring of employees (Marshal 1920), and evading taxes and regulations (Slemrod and Bakija 2008). Entrepreneurship is one of the mechanism through which firm with valuable innovations or firms that are

[3]It is also possible for entrepreneurial firms to increase self-employment as an indirect result of technological innovations. Information technology for example appears to have lowered the costs of operating a small, independent business. However, this indirect effect is incidental and and likely as often goes the other way, for example by introducing new technology that lowering the costs of doing transactions within large organization. Another way in which Appears entrepreneurship can increase self-employment is by creating franchises. As an empirical matter however franchises so far constitute a negligible share of American self-employment rates.

more efficiently organized than their competitors in the product and labor markets grow their share of the economy. As these firms expand they replace and absorb the previously self-employed by proving better options. This simultaneously leads to a wealthier economy and a lower rate of self-employment. Of course, the same tendency can be observed by large public firms with dispersed ownership, who are not included in this paper. Larger public firms that are growing also make self-employment a less lucrative option in the process of expanding their operations.

In order to better compare countries, the empirical measure in this paper are high-impact entrepreneurship is recent years (either because the founder was alive starting in 1996 or because the firm was founded after 1944). Needless to say most of today's large public firms were also entrepreneurial at some point in history, especially during their growth phase in which much of the process of replacing self-employment outlined here took place. Nevertheless sometimes firms are not founded by entrepreneurs (some large companies are for example former government monopolies), and even more often firms that were entrepreneurial a long time ago continue to growth rapidly under hired managers long after they cannot be meaningfully referred to as entrepreneurial. The lack of including publicly owned, innovative and growing and firms is one of the main drawbacks of the model presented here.

### 3.3 Asymmetric Policy Effects on Self-Employment and Entrepreneurship

The theoretical relationship between entrepreneurship and taxation is not unambiguous (Henrekson and Sanandaji 2011). The classical finding of Domar and Musgrave (1944) is that when losses are fully deductible taxes can stimulate risk taking activities by compressing the distribution of after-tax returns of the marginal investment. However because of the risk for abuse and moral hazard no real-world tax system offers full loss offsets. Another consideration to keep in mind is that it is not only taxes on entrepreneurship that matter, but the relative tax rate between running a business and working. A flat tax rate on all economic activity could therefore leave the relative attractiveness of entrepreneurship unchanged, even if the tax rate were to be high. Yet most tax systems are progressive and tax entrepreneurship more that work due to the higher dispersion in entrepreneurial returns compared to labor earnings.[4]

The story is complicated by the well documented ability of small business to evade taxes far more than average (Slemrod and Bakija 2008, Engström and Holmlund 2009, Hurst et al. (2010)). Tax evasion is closely related to firm size. As the company grows an ever smaller share of firm income can be used on personal consumption while the probability of tax audits increases. Empirical evidence suggest that taxes

[4]Whenever discussing entrepreneurial innovation and taxes it is very important to keep in mind the high chance of failure. Taxes, even very high taxes, would probably not significantly affect the effort to obtain a certain payoff of a very large sum of money (one billion, say). However, entrepreneurship is by its very nature associated with high risk of failure, and a small chances of success. Taxes matter in this tournament setting by reducing the expected value of success. Persson and Sandmo (2005) show that taxes even on excessively high earnings can reduce effort if the probability of obtaining those earnings is small.

stimulate self-employment, either because the self-employed face lower taxes than employees or because self-employment make it easier to evade taxes (Gordon and MacKie-Mason 1994; Gordon 1998; Bruce 2000; Cullen and Gordon 2002). There is no evidence however that large, successful entrepreneurial firms evade taxes at above average rates. Instead Chen et al. (2010) show that public American firms controlled by the founders or their family members - a little less than one half of all public firms - are less tax aggressive than widely held firms. There are therefore reasons to expect that taxes combined with the differential possibility of evasion increase small scale self-employment while reducing innovative entrepreneurship. Since the self-employed are the overwhelming majority of the observations in micro-datasets, they will dominate the result of any empirical estimations that do not distinguish between the self-employed and entrepreneurs, giving rise to spurious results for that sub-sample.

General equilibrium considerations add another possible mechanism through which taxes could be related to self-employment and entrepreneurship in opposite ways. As noted, new entrepreneurial firms offer more productive work opportunities and reduce the relative attractiveness of remaining self-employed. The same is true for expanding publicly controlled firms, which are effected by profit taxes similar to entrepreneurial firms. If taxes decrease the likelihood that new entrepreneurial firms emerge and reorganize the economy or limit the expansion of the large public firms, countries with higher profit taxes can be expected to have a greater number of less efficient self-employed firms. In this sense in general equilibrium it is not only the tax faced by the individual that determined the entry decision, but also the tax rates imposed on other potential entrepreneurs, particularly the most talented ones.

The relationship between regulations, self-employment and entrepreneurship is in many ways similar to taxes. Because self-employment does not go through formal contracts, they can more easily evade regulations than employees of large firms. Furthermore in most countries small firms under a certain threshold are formally exempt from many burdensome regulations on other firms. This in particular includes the onerous labor protection rights many countries impose on firms larger than a certain size. For example, many important statutes of the 2010 health care reform act in the United States depends on firm size. Smaller firms alone receive some benefits while many demands are made only on firms that grow beyond a certain size. A heavy regulatory burden can in this way reduce entrepreneurships centered on bringing a particular innovation to the market, while making it more lucrative to conduct a non-entrepreneurial activity as self-employed rather than an employee of a large regulated firm. Again similar to taxes, general equilibrium effects can lead regulations to increase self-employment in small unproductive firms precisely because they reduce innovative entrepreneurship and the retard the growth of larger companies.

## 3.4 The Model

I draw of Antunes et al. (2008) to create a new general equilibrium occupational choice model with heterogeneous managerial ability and financial frictions. The managerial ability can also be interpreted as the value of the business idea. Entrepreneurs are made distinct from the self-employed merely through the value of the firm: high ability firms are refereed to as entrepreneurs, while low ability owner-managers (or managers with a business idea which is not very innovative) that nevertheless start a business are viewed as non-entrepreneurial self-employed. There firms have few employees and little capital. This definition is thought to reflect reality, where there are rarely precise lines that neatly delineate entrepreneurs from the non-entrepreneurial self-employed. Agents choose consumption to maximize preferences subject to lifetime wealth. Contributions to the literature include policy variables with asymmetric impact on high and low talent individuals as well as a new way in which to model financial constraints. In Antunes et al. (2008), the financial repression is modeled as a deadweight cost to intermediate loans. Limited enforcement arises from an incentive constraint to ensure loan repayment. The capital allocated to each entrepreneur depends on her net worth and the objective profitability of the project. This assumes that the financial system has full information about ability of the entrepreneur. The model here allows for a more flexible approach in which the bank cannot perfectly observe the ability of the entrepreneur and offers loans that are bounded for the set of entrepreneur that share the same observable characteristics. Furthermore, the assumption is made that there is fixed cost of financial transactions and that the financial system is competitive, resulting in zero profit gains. Due to imperfect financial markets the most able individuals will not necessarily start firms. Further, the policy variables introduced in this paper give rise to the same phenomenon. The change in the model's equilibrium properties is assessed through several variables, including the extent of taxes and regulations, financial intermediation costs, the level of contract enforcement and the information set of the banks.

## 3.5 Methodology

Consider an economy with a continuum of measure one agents who live for one period. Agents have two endowments, capital and managerial skills. There is one good in one period that can be used either for consumption or production.

**Preferences** Agents maximize utility that arises from consumption. By monotonicity of the utility, I can refrain from defining an utility function as agents use all wealth on consumption. Thus, there is a bijection map between consumption and wealth, and agents simply maximize income.

**Heterogeneous Endowments** Each period, agents are distinguished by their endowments of initial wealth and ability as owner-managers, denoted by $(b_i, x_i)$. Each individual's talent for managing, $x_i$, is drawn from a continuous cumulative probability distribution function $F_X$, with $x \in [\underline{x}, \overline{x}]$. Each individual will choose to be either a worker or a manager. Managers create jobs and organize hired labor $(n_i)$ workers are employed by entrepreneurs at wage $w$.

**Production** Managers operate a technology that uses labor, $n_i$, and capital, $k_i$, to produce a single consumption good, $y_i$, where

$$y_i = f(x_i, k_i, n_i). \tag{1}$$

$f(\cdot, \cdot, \cdot)$ is twice continuously differentiable, strictly concave and increasing in all arguments. Function $f(x, \cdot, \cdot)$ is also homogenous of degree less than one for any fixed skill $x$. Moreover, enhanced managerial skill improves the productivity of noth capital and labor, that is:

$$y_i = \frac{\partial^2 f(x,k,n)}{\partial k \partial x} > 0, \frac{\partial^2 f(x,k,n)}{\partial l \partial x} > 0 \, \forall \, x, k, l \in \mathbb{R}^+. \tag{2}$$

It also satisfies the Inada conditions. Capital fully depreciates at the end of the period. Managers can operate only one project. The labor and capital markets are competitive, with prices $w$ and $r$, respectively.

**Capital Market Frictions** One contribution to the literature is a new method to examine financial friction. It is useful to understand the traditional framework for modeling financial friction in order to comprehend the difference of this proposed method. A large literature relies on the proportional punishment approach used by Krasa and Villamil (2000), Krasa et al. (2005) and Kehoe and Levine (1993) among others. In their framework, agents (lenders) deposit their wealth endowment $b_i$ in a financial intermediary and earn competitive return $r$. The intermediary lends the resources to managers. The part of the loan that is fully collateralized by $b$ costs $r$; the remainder costs $r + \tau$, where $\tau$ are financial costs usually assumed as sunk costs. While borrowers cannot commit ex-ante to repay, an exogenous enforcement technology exists. An agent who defaults on a loan incurs penalty $\phi$, which is the percentage of output forfeited net of wages. In other words, if the owner-manager forfeit, he/she has to pay $\phi(y_i - wn_i)$. Banks ensure payment when bounding the total available funds to at most $\phi(y_i - wn_i)/(1 + r + \tau)$. This restriction guarantees that managers have incentives to repay loans ex-ante. Three critical arguments can be made about this approach. First, it assumes that banks to have full information about the entrepreneurial talent of the agents and of the technology of production. Second, it rule out any possibility of forfeiting, as if the financial system eliminates all possible default threat through a contract where unobserved abilities are common knowledge.

Third, it assumes that agents with high entrepreneurial talent have access to an unrestricted amount of credit. An arguably more realistic approach is assuming that banks can only forecast the managerial skill of agents based on observed characteristics. In this view, banks would set bounds to the available loans for each manager. This is because have the opportunity to forfeit, leaving the bank with only the enforced amount determined by the financial technology parameter $\phi$. The model used here further assumes that banks operate in a competitive market which incur in zero profits. Banks are no longer assumed to perfectly observe the managerial skill. However they are still assumed to be aware of the distribution of managerial ability in the population. The assumption that $\tau$ is exogenously determined is maintained.

**Public Sector Distortions** A public sector is added to the occupational choice framework. Importantly, tax rates are different for owner-managers and for salaried workers. Furthermore, the effective tax rate on small firms is lower than for successful companies. This reflects the progressivity of the tax code, but also the ability of small firms to more easily evade taxes. Regulations are not modeled separately, and the tax rate can be interpreted as the regulatory burden on the firm (which also varies by firm size).

**Intuition** In a frictionless economy with perfect capital markets and no policy distortions, the individuals with the highest level of managerial ability (or those with the best business ideas) found companies and hire the least talented managers, driving up wages due to their high productivity as entrepreneurs. But because of liquidity constraint, in economies with little or no financial sector, many of the most talented individuals do not have access to the capital needed. Only those who have enough wealth, or those who require little capital, can start firms. In this economy wages are lower, because many of the most most skilled potential employers do not start firms. If the financial sector becomes better at allocating talent, more productive firms are created, raising the alternative cost of self-employment for the marginal owner-managers. This could under certain conditions lead to a lower overall rate of self-employment.

As this is not the focus of this paper, the model itself will not be further expanded on here and is instead developed in detail in the appendix. The main results are that more efficient financial markets as well as lower tax rates on successful entrepreneurs can under reasonable conditions increase the number of owner-managed firms with high managerial talent ("entrepreneurs) while raising wages and lowering the number of marginal firms with low levels of managerial talent ("the self-employed").

# 4 Results

## 4.1 Cross-Country Evidence on Self-Employment and Entrepreneurship

Figure 7a displays the rate of non-agricultural self-employment as measured by the OECD in 2008. Mexico, Greece, Italy, South Korea, Turkey and Portugal stand out as the countries with the highest rates of self-employment. Close to one third of the workforce is self-employed in these countries. By contrast, the United States has the second lowest among developed nations, with less than 7% of workers in self-employment. The average rate of self-employment in Western Europe is twice that of the United States. Figure 7b instead shows the number of billionaire entrepreneurs per million inhabitants for the same countries (henceforth referred to as the rate of Entrepreneurship). Hong Kong, Israel, the United States and Singapore stand out as particularly entrepreneurial economies. Western Europe and Japan on the other hand have a comparatively low number of high-impact entrepreneurs per capita.

onsidering the fact that self-employment is often used as a measure of entrepreneurship, the results in Figure 7c, which plots the national self-employment rates against the entrepreneurship rates, are quite remarkable. Entrepreneurship and self-employment rates among OECD countries are negatively related.[5]

The argument made in this paper is that primary channel behind this reverse relationship is the opposite ways in which self-employment and entrepreneurship are related to economic development and to the policy environment. Countries with better institutions and more business friendly policy have fewer self-employed more entrepreneurs. Consistent with this proposed mechanism, Figure 7d shows that self-employment is strongly negatively linked to per capita income levels among the OECD countries[6]. Figures 2a–2c instead show that entrepreneurship is strongly positively related to per capita income. Each of the three figures uses a different measure of entrepreneurship. Figure 2a uses the per capita number of Billionaire entrepreneurs. Figures 2b–2c relate income levels income levels to two other measure of how prevalent entrepreneurship is in the economy, namely the share of the largest firms founded by entrepreneurs and Venture Capital investments as a share of GDP. The relationship between income and entrepreneurship are similar when using different estimates of the rate entrepreneurship, which is not surprising as the three measures are highly correlated with each other. This illustrates an important application in which using self-employment as an empirical proxy for entrepreneurship would have produced the wrong coefficient sign.

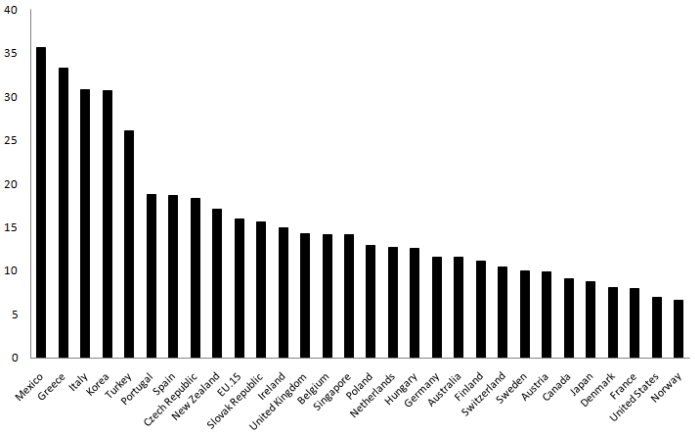
The patterns observed for wealthy countries also hold for the full sample of nations; entrepreneurship is positively related to per capita income levels (Figure 2d) and self-employment is negatively linked to per capita income levels (Figure 3a). Figure 3b differs from Figure 3a by instead using the log of per

[5]The linear relationship between the variables in Figures 3-14 are all statistically significant at the 10% level.

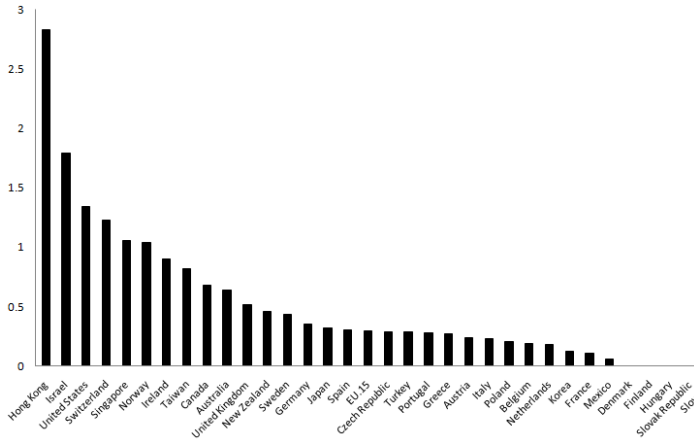
[6]The negative relationship between per capita income and self-employment is robust to only including the self-employment in the manufacturing sector, in order to make sure that shifts in sector compositions alone are not driving the results.

Figure 1: Cross-Country Rates of Entrepreneurship and Self-employment (1 of 4)

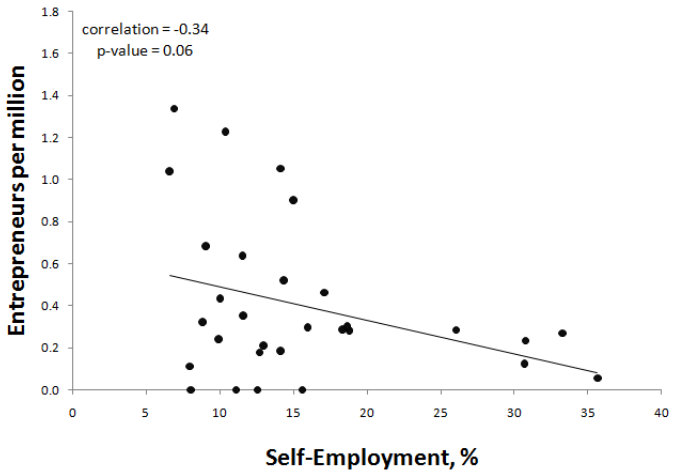
(a) Non-agricultural Self-Employment in the OECD



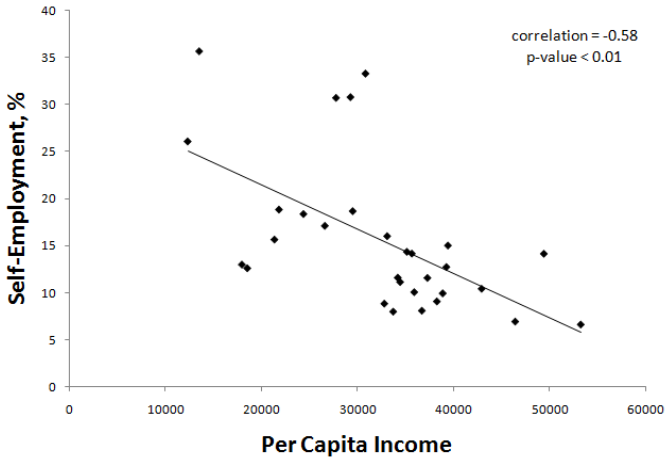

(b) Entrepreneurship rate: Billionaire Entrepreneurs per million, 1996-2010




(c) Entrepreneurship and Self-Employment, OECD-Countries



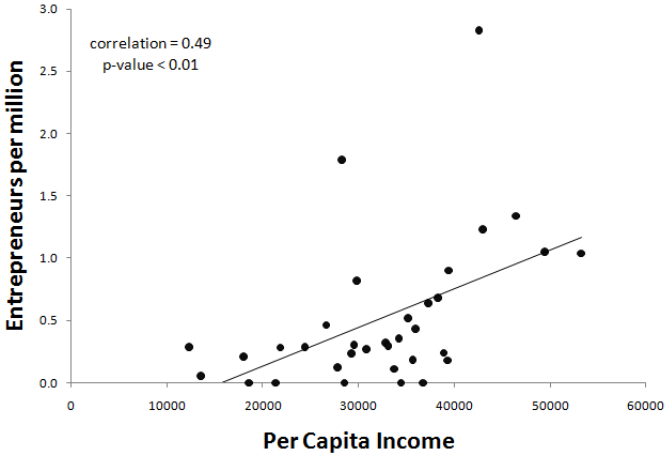

(d) Self-Employment and per Capita Income, OECD-Countries



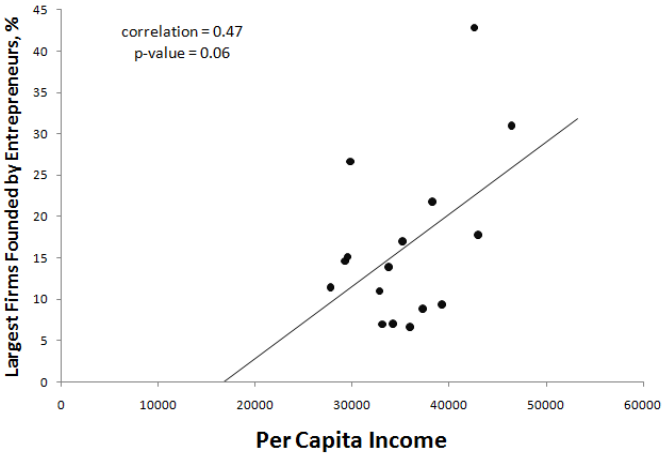

**Notes:** By Entrepreneurship I refer to the number of billionaire that became rich by founding a company per million inhabitants.

Figure 2: Cross-Country Rates of Entrepreneurship and Self-employment (2 of 4)

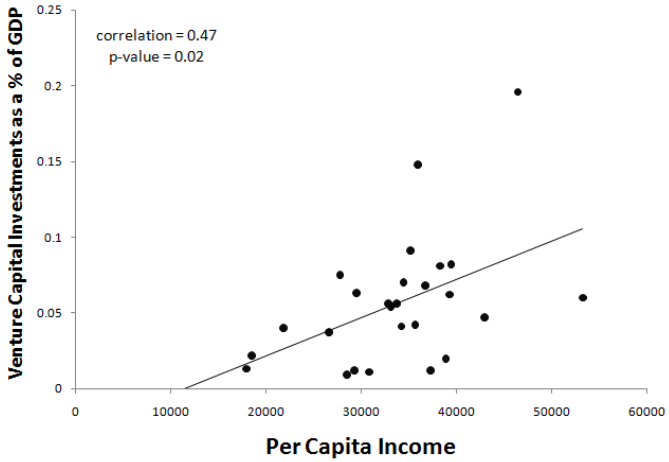
(a) Entrepreneurship and per Capita Income, Developed Countries



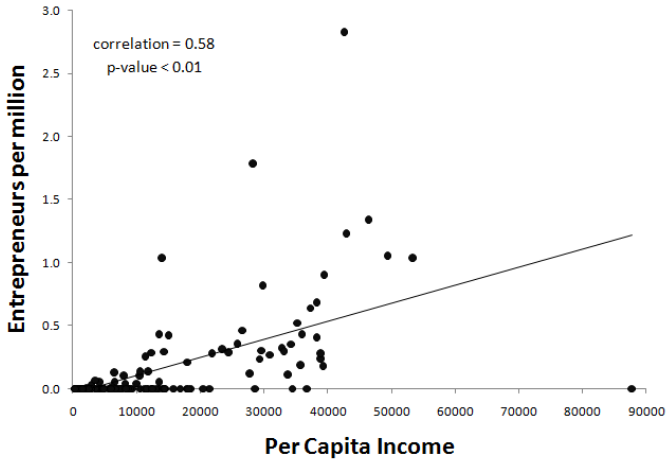

(b) Share of Largest Firms Founded by Entrepreneurs and per Capita Income, OECD-Countries




(c) Venture Capital as a Share of GDP and per Capita Income, OECD-Countries



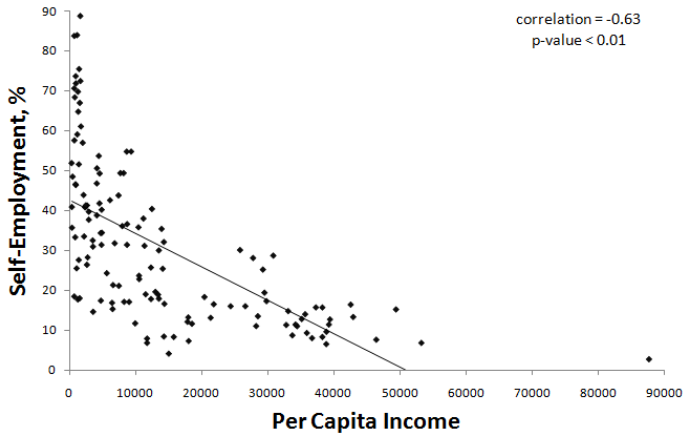

(d) Entrepreneurship and per Capita Income, all countries



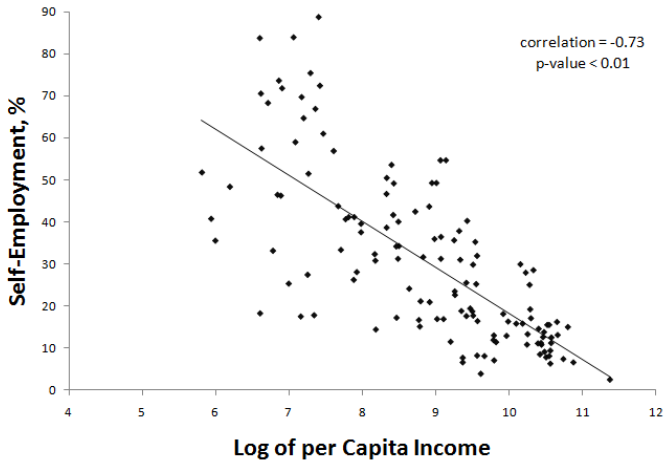

**Notes:** By Entrepreneurship I refer to the number of billionaire that became rich by founding a company per million inhabitants.

Figure 3: Cross-Country Rates of Entrepreneurship and Self-employment (3 of 4)

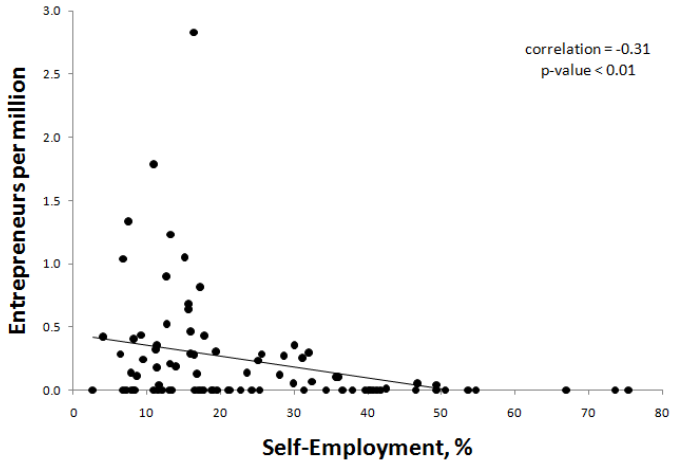
(a) Self-Employment and per Capita Income, all Countries



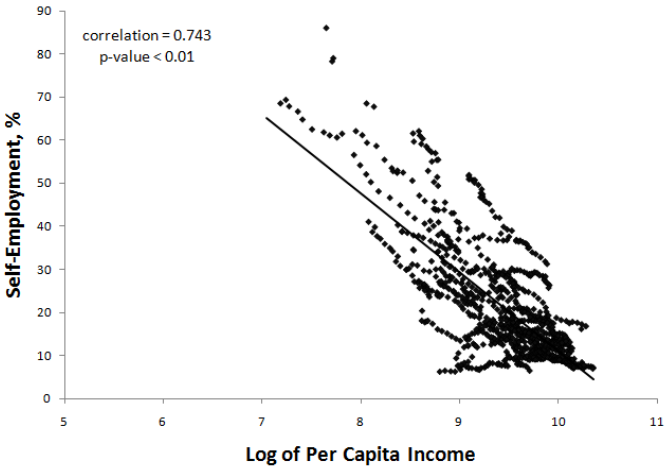

(b) Self-Employment and the Log of per Capita Income, all Countries




(c) Entrepreneurship and Self-Employment, all Countries




(d) Self-Employment and the Log of per Capita Income, Pooled OECD 1955-2008




**Notes:** By Entrepreneurship I refer to the number of billionaire that became rich by founding a company per million inhabitants.

capita income. Figure 3c plots self-employment and entrepreneurship rates for all available countries, again demonstrating a negative relationship that appears to be close to linear with regards to the log of income.

It has sometimes been argued that self-employment rates in the United States have witnessed a revival (e.g Carree and Thurik 2005), a fact which if true may eventually lead to a reversal of the negative relationship between self-employment and economic development. The argument is that while self-employment relates negatively with development in poor countries, the self-employment we observe rich world is different (more entrepreneurial) in nature, and after a threshold positively linked to income levels. However I find little evidence for this view. According to the BLS, the American non-agricultural self-employment rate in 2008 was 6.4%, the lowest figure in the nation's history. As can be seen in Figure 8 while the rate of decrease of American self-employment slowed in the 1970s the dominating pattern is still that of secular decline. Between 1960 and 2008, the self-employment rate declined in 20 out of 22 OECD nations, from a weighted average of 31% to 16%. Figure 3d is a 26 pooled cross-sectional correlation of self-employment rates and the log of per capita GDP in 30 OECD-countries 1955-2008. It serves to illustrate that the close negative relationship between the two variables also holds for mature economies both cross sectionally and across time, with income alone explaining half the variation in the self-employment rate.[7]

Figure 4a reports one of the more surprising findings of this paper, which is that the OECD index of regulatory burdens, "Administrative burdens on corporations and sole proprietor start-ups" (OECD 2005), is positively associated with self-employment. Countries countries where starting a new firms is more difficult have higher rates of self-employment. Meanwhile as predicted by standard theory entrepreneurship is negatively linked with the regulatory burden on start-ups (Figure 4b).

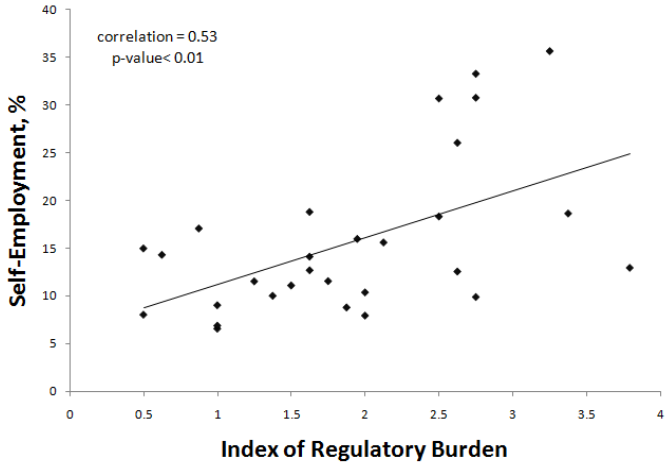
In the context of the model, regulations can both be interpreted as acting like taxes. One possible explanation is that regulation on startups also correlate positively with labor market regulations, which are driving the results. However, the positive association between self-employment and regulation on startups remains - with the coefficient virtually unchanged - if the degree of employment protection regulation (also measured by the OECD) is controlled for. Other potential explanation is as, previously mentioned, evasion and general equilibrium effects through lower entrepreneurship. In highly regulated countries, the self-employed can choose not to expand and hence continue to operate under the regulatory radar. Meanwhile in countries with less burdensome regulations employment in entrepreneurial firms and large public firms may be larger, driving out low productive self-employment.

Similarly, when the level of trust in a society is low, it becomes more important to monitor employees

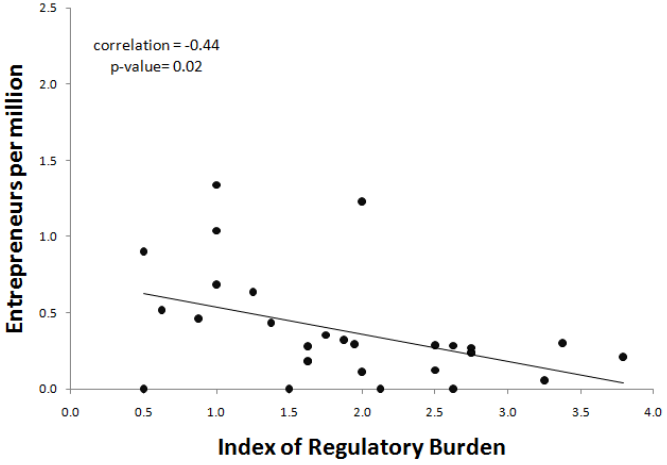
[7]Fixed effect and a random effect regressions of self-employment on per capita income again suggest that the two variables are negatively related, with per capita income explaining approximately half the variation in self-employment rates for OECD-countries 1955-2008. Note also that incorporated self-employment in the United States follows a different pattern, having increased from 2.9% of total employment in 1989 to 3.9% in 2008.

Figure 4: Cross-Country Rates of Entrepreneurship and Self-employment (4 of 4)

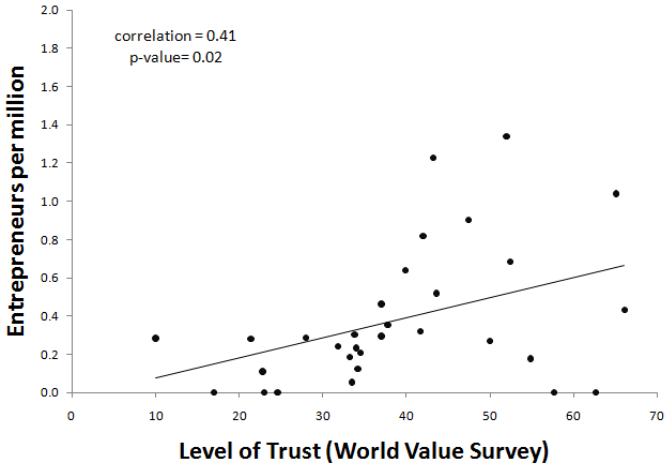
(a) Self-Employment and the Regulatory Burden on Firms, OECD-countries



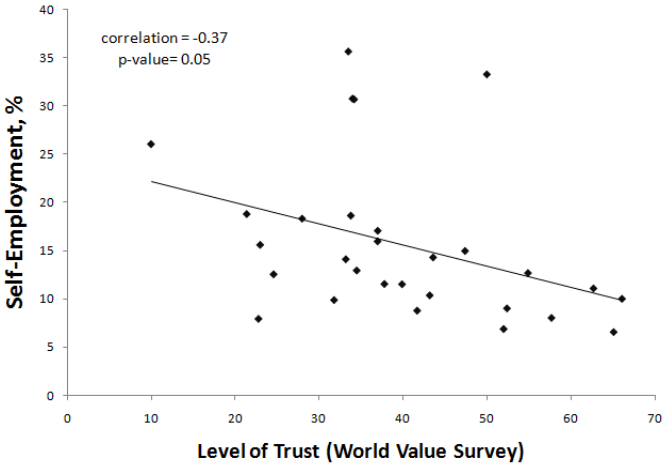

(b) Entrepreneurship and the Regulatory Burden on Firms, OECD-countries




(c) Entrepreneurship and Trust, OECD-countries

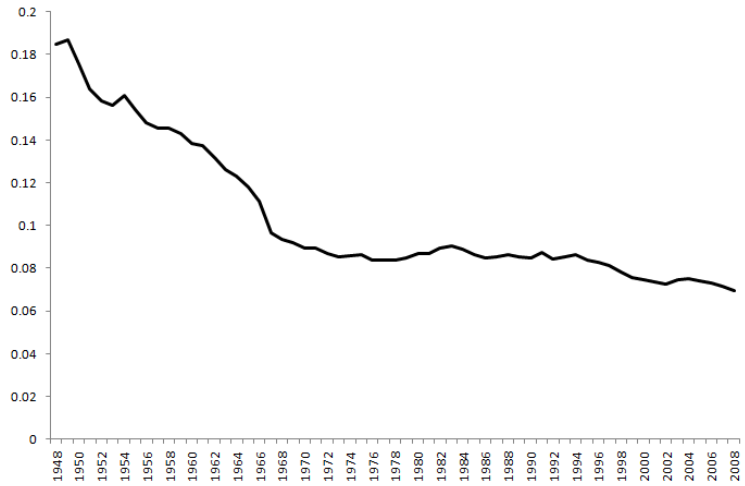



(d) Self-Employment and Trust, OECD-countries




**Notes:** By Entrepreneurship I refer to the number of billionaire that became rich by founding a company per million inhabitants.

Figure 5: U.S Self-Employment rate 1948-2008, Bureau of Labor Statistics




closely or rely or your own or family labor, which encourages self-employment. However where hired employees cannot be trusted entrepreneurs will have a difficult time growing their firms rapidly around innovative ideas. Alfred Marshal (1920, p. 284) anticipated this advantage of small firms: "the master's eye is everywhere; there is no shirking by his foremen or workmen, no divided responsibility, no sending half-understood messages". Figures 16 and 17 shows that in countries where trust is low, self-employment is high whereas entrepreneurship is high, and vice versa. High trust could also effect the levels of entrepreneurship and self-employment by reducing agency problems in the financial sector (Guisi et al. 2004).

Table 1–2 relate some of the correlations indicated in the figures in a more systematic way to self-employment and entrepreneurship rates in 90 countries, for which we have data for all variables of interest.(These countries represent over 80% of world GDP.) Table I reports the association between self-employment rates, per capita income, the highest corporate tax rate and the regulatory burden on firms. Since the OECD only provides data on regulation for developed countries, the measure of regulation used will be ranking on the World Banks "ease of doing business" index. Higher numbers imply a lower ranking and therefore a worse regulatory environment.

The central problem with cross country regressions is omitted variable bias. No clear cut theory about what variables should be included in the regression exists, and many variables that help determine the result are certainly missing. The claim that background variables such as taxes are casually linked to self-employment and entrepreneurship can therefore not be made with any confidence. But making such claims is not the focus of this paper. The argument put forward here is instead that several important variables are related in opposite ways to self-employment and entrepreneurship rates.

High taxes on profit and regulations are hence associated with higher self-employment. One explanation

could be that countries with higher profit tax rates have even higher taxes on employment, driving the results due to the tendency of the self-employed to more easily evade taxes. Another possibility in line the with the argument put forward in this paper is that the high profit taxes on entrepreneurial firms and on large public firms dampens economic activity by this class of companies. Higher rates lower the relative attractiveness of being employed in a firm that pays the profit tax rather than working for yourself and not paying the tax fully or at al.

## 4.2 Do Startup Rates, Rates of Business Ownership or Firm Density Rates Measure Entrepreneurship?

The problems with using self-employment to measure entrepreneurship has long been recognized. Researchers have in response to this devised new empirical measures, such as participation in startups and the rate of business ownership. The Global Entrepreneurship Monitor for example provides detailed cross country data on the share of the population that participated in a business startup during the last year. This has sometimes been interpreted as entrepreneurship rates, used to support a U-shaped relationship between entrepreneurship and economic development (e.g Reynolds et al. 2005, Wennekers et al. 2005). But the GEM measure for "nascent entrepreneurship" is simply a measure of opening a small business, regardless if wether the firm brings a new innovation to the market or otherwise has growth potential. Rather than entrepreneurship, the aggregate GEM figures are better understood as a flow into the stock of self-employment. Relying on the GEM estimates in face value leads to counterintuitive results, such as the Republic of Yemen having the highest rate of entrepreneurship among all measured countries (Bosma and Levie 2010). Lerner (2009) is just one example of GEM data being cited as a cross-country measure of entrepreneurship even by scholars the research frontier of entrepreneurship studies. Note that Lerner (2009) discusses data problems and takes the additional step of warning his readers that the GEM measure is "noisy". The arguments put forward in this paper goes further than this, claiming that entry into self-employment is not merely a noisy proxy of entrepreneurship, but one containing systematic bias. Not surprisingly, the GEM startup rates correlates strongly with the non-agricultural self-employment rate. However the GEM measure correlates negatively with high-impact entrepreneurship as measured by this paper. Koellinger (2008) has attempted to separate innovative from non-innovative business startups in GEM data, finding that startups with few competitors and with new products differ from the rest. The GEM is a valuable dataset about the creation of small business around the world, some of whom will indeed in time turn into vital new companies. However the GEM measure should not be interpreted in it's raw form as providing data primarily on innovative, growth oriented entrepreneurship.

The problems is more general than the GEM data. Since most new businesses do not aim at innovation and lack the potential for growth, relying on startup rates or rates or the rates of business ownership instead of self-employment does not solve the problem. Over than three quarter of American firms never hire anyone and likely never intended to hire anyone, and exist for other reasons. Using business ownership also has some additional problems. Rich individuals are more likely than others to own firms for tax purposes and as investment devices. This can lead to the spurious conclusion that more firms cause higher growth and wealth levels. Entrepreneurship theory is based on individuals who combine effort and ownership, and therefore constitutes a imperfect theory for explaining the passive investment patterns of the rich. Relying on the Survey of Consumer Finance and on Census Bureau data one can estimate that between one third and one half of American private firm equity is owned by people other than the manager. I further calculate the the per capita rate of small business startups for each U.S state using data from the Business Dynamics Statistics for the years 2000-2005. The advantage of this method is that it only includes new firms that actually hire some employees. Across U.S states there is no relationship between the business startup rate and the per capita rate of entrepreneurship[8]. Instead the rate of business startup is strongly linked to the self-employment rate.[9] The same pattern holds with firm density rates, which are strongly linked to self-employment rates but not in any significant way to entrepreneurship both within U.S states and across the OECD.

Silicon Valley, Boston and the New York metropolitan area are often identified as having above average rates of entrepreneurial activity (e.g Lerner 2009). Indeed New York State, Massachusetts and California are highly over-represented in number of billionaire entrepreneurs per capita, accounting for close to half of all of America's entrepreneurs. It is therefore interesting to investigate how common metrics of entrepreneurship perform in identifying entrepreneurial activity in these areas.[10] Compared to the national average these regions had a lower self-employment rate, lower firm density, a lower share of employment in firms with less than 20 employees and a higher share of employment in firms with more than 500 employees (SBO 2007, Current Population Survey 2008, California Employment Department 2008). The main exception is New York city, which has above average rates of firm registration per capita, perhaps because of its role as a commercial center.

[8]Billionaire entrepreneurs in the U.S are allocated to states based on Forbes Magazine reported home state, and if not available state of residence. Neither definition perfectly correspond to the state where their companies was actually founded, although the correlation appears to be high.

[9]The results are virtually identical if only self-employed with incorporated businesses are included.

[10]Silicon Valley is defined as the San Jose-Sunnyvale-Santa Clara and the San Francisco-Oakland-Fremont metropolitan statistical area. The results are similar if only San Jose is used, or if we restrict attention to Santa Clara County at the historical heart of Silicon Valley.

# 5 Auxiliary Results

In addition to the main results the data assembled are suggestive of other patterns that may be interesting to the reader. This section briefly summarizes these results

In an influential paper Acemoglu et al. (2001) relied on European mortality rates as an instrument to estimate the effects of institutions on economic performance. The hypothesis is that colonies with high mortality adopted institutions less favorable for economic activity, and that institutional quality has persisted to the present. I rely on their instruments for institutional quality (defined as the protection against expropriation risk) to measure the effect of institutional quality on entrepreneurship and self-employment. The results are reported in Tables 3–4.

Better institutions lead to higher rates of entrepreneurship and lower rates of self-employment. It should be emphasized that this regression tells us nothing about the mechanism through which institutions impact entrepreneurship and self-employment. The effect could be through institutions themselves, or through higher levels of per capita income because of better institutions. Another possibility is that institutions lead to higher rates of entrepreneurship, which in turn accounts for some of the higher rates of economic development found by Acemoglu et al. (2001)[11]. Either way, it can again be observed that rates of entrepreneurship and self-employment are related in opposite way to an important explanatory variable, in this case the quality of institutions.

Unlike the Lucas model the model of this paper predicts that countries with fewer entrepreneurs per capita have higher per capita earnings for the existing entrepreneurs. The reason is that other potential entrepreneurs are kept out of the market due to policy and transaction costs, and unable to bid up wages. This prediction receives some limited support from the data. While Western Europe has fewer per capita entrepreneurs as the U.S, the average wealth of those that are entrepreneurs is higher (2.8 versus 2.4 billion). Generally there is a negative but statistically insignificant correlation between the per capita number of entrepreneurs and the average wealth of the entrepreneur (p value 0.22).

The observation that the foreign born have higher self-employment rates than native Americans has helped inspire research about the determinants of self-employments among immigrants (Borjas 1986, Fairlie and Meyer 1996). According to the Census Bureau measure, the self-employment rate of the foreign born in the U.S in 2006-2008 was 7.5%, compared to 6.5% for the native born. Scholars and journalists rely on these figures to speak about higher than average rates of immigrant "entrepreneurship" (e.g . Lofstrom 1999, NYT 2008). In order to test this hypothesis, the country of birth for the American entrepreneurs is investigated.

[11] The results are the same when continent dummies are added. The coefficient sizes for self-employment and entrepreneurship are similar in size and the results still statistically significant when instead using mortality data from Albouy (2005). However the F-statistics for the first stage regression is reduced from 23 to 6, which suggests that there may be a weak instruments problem with this alternative dataset.

The foreign born constitute 16% of the American workforce (Newburger and Gryn 2009). However of the 411 entrepreneurs, only 11% are determined to be foreign born. The result that immigrants in the United States are under-represented as high-impact entrepreneurs while being over-represented as self-employed further illustrates that self-employment rates are a misleading substitute for entrepreneurship.

One possibility is that the number of entrepreneurs simply reflects income distribution, that the same person creating the same firm in France would earn million, whereas the American counterpart would be rewarded with a billion or more. However, there appears however to be no statistically significant relationship between the Gini coefficient of inequity as reported by the OECD and the rate of per capita entrepreneurship, either bilaterally or when controlling for per capita income. This indicates that the per capita number of billionaire entrepreneurs is not chiefly driven by the overall distribution of income in society.

The rate of entrepreneurship is positively related to growth of per capita income between 1980 and 2006, but the relationship is not robust to including starting year income. Since from a theoretical level the direction of causality between growth and entrepreneurship conceivably goes both ways (or may be related to other variables driving both growth and entrepreneurs), these correlations tell us little.

Financial sophistication may be an important factor that contributes to the ability to start rapidly growing firms (and to make money out of them). Stock market capitalization as a share of GDP as well as domestic credit to private sector correlate positively and significantly with high impact entrepreneurship, even when controlling for per capita income. Self Employment correlates negatively and statistically significant with both these two measures of financial depth.

Not surprisingly the billionaire entrepreneurs, an extremely selected group, differ in education outcomes from the self-employed. Even including the many college dropouts, only 16% of billionaire entrepreneurs lack a college degree, compared to 53% of the self-employed and 54% of salaried workers. Interestingly, 45% of entrepreneurs have an advanced degree (5 percentage points of which are PhDs), compared to 14% of the Self-Employed and 13% of salaried workers (about 1 percentage points of which are PhDs).

## 5.1 Micro-Level Data on Self-Employment and Entrepreneurship

I next turn to the SALTY survey, which contains detailed questions designed to distinguish self-employed individuals from entrepreneurs. This, and the rich battery of background questions on economic behaviors, preferences and outcomes, distinguishes the SALTY survey from other social science surveys. The SALTY survey has also been matched to administrative data from Statistics Sweden, allowing us to examine the educational attainment and the income of the participants. The survey is described in greater detail in the Appendix.

Approximately one in four out of the approximately 11,000 respondents report having started at least one business at some point during the course of their life. Amongst these individuals, approximately 80% self-identify as self-employed rather than entrepreneurs. This is a high figure considering that the term entrepreneur is one that carries positive connotations. While many of the remaining self-identified entrepreneurs may not strictly be entrepreneurs if stringent demands on innovativeness and growth prospects were imposed, the figure serves as an upper bound on the share of the self-employed in Sweden that can be defined as entrepreneurial.

Those who self-identify as entrepreneurs differ in important respects from the self-employed, as documented in Tables 5–7. Table 5 shows that there are systematic differences between entrepreneurs, the self-employed and salaried workers on a number of dimensions. Entrepreneurs are less likely to be female, are better educated, earn more money and have a higher variance of income. In terms of preference parameters, the self-employed and entrepreneurs are far more tolerant of risk than salaried workers, with the entrepreneurs even less risk averse than the self-employed. Knight (1921) argued that calculable risk was not the only important problem facing entrepreneurs. Not only do entrepreneurs more often face situations where the outcome is uncertain, they generally have to cope with not knowing the distribution of outcomes. For this reason, those individuals who are least averse to ambiguity will become entrepreneurs. However to my knowledge no previous study has empirically tested the degree of ambiguity aversion among either entrepreneurs or the self-employed. I find that those individuals who in their lifetime founded at least one firm and who self-identified the venture as entrepreneurial are more tolerant of ambiguity, with a statistically significant different compared to the rest of the population.The self-employed however do not differ in any statistically significant way from salary workers in terms of ambiguity aversion.

These findings are in line with what entrepreneurship theory would predict. Ambiguity is associated with the lack of knowledge that characterizes innovative endeavors. Most self-employed bear greater risk than do salaried workers. However, since non-entrepreneurial self-employment is not innovative, it is likely associated with far less ambiguity than entrepreneurship. A self-employed plumber or dentist who sells a familiar product does not generally need to wrestle with uncertainty about the distribution of outcomes, for example regarding consumer demand or the technological feasibility of some projects. This is not true for innovative entrepreneurs, who aside from risk face the uncertainty associated with doing something completely new. It is also worth noting that if the self-identified entrepreneurs and the self-identified self-employed are pooled together, no statistically significant difference in terms of ambiguity aversion from the rest of the population can be detected, a further reminder of the problems of identification that arise when the two groups are not analyzed separately.

There are no statistically significant differences between either entrepreneurs, the self-employed or the

general population in the measure of time discounting. As noted, entrepreneurs have the highest variance of income, followed by the self-employed and finally the salaried workers. Consistent with previous work, the self-employed have a greater locus of control than the general population. The locus of control of the entrepreneurs is greater still. Entrepreneurs and the self-employed also report higher rates of happiness than the general population. The same is true for behavioral inhibition. This finding is intuitive, as individuals with high degrees of behavioral inhibition are less likely to take the steps to create new firms. Tables 6–7 show that most of the documented differences also hold within gender. It is important to emphasize that most of these variables were collected towards or even after the end of the individual career. This suggests that there may exist a reverse causality problem, whereby lifetime experiences and occupational choices may be affecting risk preferences. Such considerations limit our ability to make casual claims about preferences and occupational choice. However, the data here are nevertheless useful descriptive facts and the finding of the reversal of patterns are strongly consistent with the main message of this paper, namely that it is usually inappropriate to use self-employment to proxy for entrepreneurship.

These descriptive differences between the self-employed, self-identified entrepreneurs and salaried workers have, again to the best of my knowledge, never previously been established. The most striking difference is that on some dimensions, most notably earnings, the self-employed are more dissimilar to the entrepreneurs than ordinary, salaried, workers. It is possible, indeed likely, that the income figures for the self-employed are biased downward due to higher ability to under-report income. However crucially this is equally true for previous studies, and true for the self-identified entrepreneurs in the sample, although perhaps to a lesser extent. Table 8 shows that the difference in earnings persists controlling for age and gender, and, more importantly also holds within family, though precision is weaker. The first column is a regression of the log of average earnings on a dummy for entrepreneur, a dummy for self-employment, gender and age. Column 1 shows that in the cross-section, holding the other covariates constant, being an entrepreneur is associated with earning 12.2% more than salaried workers and being self-employed is associated with earning 6.4% less. The earnings differential between the two groups is highly significant. Column 2 shows that similar patterns hold within family, with an imprecisely estimated earnings differential of 9.2% when the family fixed effects are added. Finally, when the sample is restricted to monozygotic twins, the estimated entrepreneurial premium is 13.6% (Column 4). This suggests that the correlation between employment status and earnings is not entirely driven by unobserved genetic or family background variables. Comparing the earning of a self-identified entrepreneur or self-employed with his or her identical twin if preferable to a comparison with the average of the population. The reason is that twins, while obviously not identical, are far more similar in terms of unobserved heterogeneity than two random individuals and therefore all else equal expected to have similar earnings. This method has for example been used to estimate the returns to education

(Card 1999), because it is believed to mitigate the problems with selection assuming that twins who differ in their educational outcomes. One interpretation is that entrepreneurs earn more than their salaried twins, either because they are forced to bear more risk and ambiguity, because of selection in which only successful owner-managers self-identify as entrepreneurs, or because they have a business idea which their twin did not. Similarly the fact that the self-employed earn less than their twins who are salaried workers could be due to underreporting income or due to the fact that they are willing to accept an income penalty for the non-pecuniary benefit of being ones own boss.

## 5.2 Discussion

Having to rely on poor empirical measures to test theoretical concepts is not a problem unique to entrepreneurship research. However, the results reported here suggest that the problem goes beyond just measuring the outcome with some classical error, as there appears to be a systematic component to the poor mapping from self-employment rates to entrepreneurship rates. Many of the motivations for self-employment involve overcoming what can be broadly referred to as transaction costs and a poor policy environment. This includes contractual problems, monitoring costs, moral hazard and attempts to evade taxes and regulation by staying small. What is problematic for the study entrepreneurship relying on self-employment data is that the institutional and policy environment that promotes self-employment is unfertile ground for innovation and for expanding new ventures. In dysfunctional economies fewer good ideas have the chance of developing into new companies. Individuals are instead motivated to become self-employed due to the lack of well-paying employment in larger firms and due to incentives to escape taxes and regulations. These street-vendors, clerks and artisans are unlikely to expand rapidly or to invent new products.

Developed economies instead have lower transaction costs and fewer costly regulations. Entrepreneur-driven enterprizes are founded more often, and both they and the best publicly owned CEO-controlled firms can expand their operations more easily. In such economies mom-and-pop operations are replaced by larger firms, both because they are outcompeted and because it becomes more attractive for the self-employed to instead carry out similar work as employees of a larger, more efficient firm. High transaction costs and taxes and regulation can thus increase the number of self-employed; while simultaneously reducing the propensity of the economy giving rise to truly innovative firms.

A finding of this study that it not central to the discussion about self-employment as an empirical measure is that the overwhelming share of earned top wealth in developed countries is earned through entrepreneurship, rather than through employment. This includes billionaires who became rich in the financial sector, all of whom are founders rather than employees of companies in the financial industry. In contrast to the

average wealth of 2.4 billion for American entrepreneurs the average pay of the 100 top earnings CEO:s in the United States in 2003 was 23 million dollars per year (in 2009 dollars, Saez and Pickety 2007). The fact that such high share of billionaires became rich through starting their own business rather than working for someone else indicates that there are fundemental economic forces at work. In the market for top talent, retaining residual ownership rights seems very important. Labor market contracts, even combined with options programs and bonus systems, simply do not appear powerful enough to fully handle the agency problem associated with earning top wealth created through entrepreneurship. It appears that for fundamental economic reasons radical innovation and the creation of vast personal wealth is disproportionably carried out in new rather than pre-existing firms, and through retention of ownership rights, rather than as employees of others.

One alternative to relying on self-employment when attempting to capture truly entrepreneurial activity that has been used increasingly by researchers is to focus on venture capital backed firms. Clearly far from all entrepreneurial firms use venture capital, but in countries with a well developed financial sector such as the United States, a significant share of the most important ones do. Fully 60 percent of entrepreneurial firms that took part in a IPO since 1999 have been VC-backed (Kaplan and Lerner 2010). Such firms deserve particular attention from economists as they are far more likely to be innovative, far more likely to grow, and overall far more likely to correspond to theories on entrepreneurial behavior.

# 6 Summary and Conclusions

Decades of academic research has shown that entrepreneurship is an elusive concept which is difficult to define and harder yet to measure. As an empirical matter, researchers have therefore used self-employment rates to proxy for entrepreneurship. Since the self-employed, just like entrepreneurs, expose themselves to certain risks and manage their own business, this approach has a certain superficial appeal. In this paper, I have shown, however, that in several respects, this empirical practice can lead to misleading inference not just about the magnitude of statistical relationships, but also about their signs. I develop a model which accounts for these findings theoretically. In the model, more efficient financial markets and a good policy environment leads to a more efficient matching of capital to entrepreneurs with commercially viable ideas. The better allocation of capital to talent raises wages, and thereby driving the least productive self-employed individuals to seek employment. An additional feature insight from the model is that bad policy environments may promote self-employment. Self-employment can substitute for some of the deficiencies of formal institutions, for example weak contract enforcement, in societies where individuals has access to a small network of friends and kin within which trust is high. Additionally, it may be easier for the self-employed to avoid taxes

and regulations. While taxation reduces the expected payoff of risky entrepreneurial ventures compared relative to an ordinary, salaried job, they might have the opposite effect on self-employment rates, as the self-employed are frequently beyond the purview of regulators.

The different - indeed opposite - expected impact of policy variables on rates of self-employment and entrepreneurship is therefore likely to cause misleading results if self-employment is used to proxy for entrepreneurship. This can for example be the case when evaluating the impact of taxes and regulation, when attempting to measure the return to entrepreneurship and when assessing the entrepreneurship rates of immigrants. Once it is granted that self-employment and entrepreneurship may sometimes or even often oftentimes react very differently to policy changes, it calls for a reevaluation of entire strands of research. For example the empirical finding that tax rates to increase self-employment (e.g Bruce and Schuetze (2004) can no longer be interpreted as relevant to the question of how tax policy affect entrepreneurship. This insight goes further than policy alone, and has implications for the economics of entrepreneurship in general. The empirical finding that the self-employed do not earn more than the employed (e.g Hamilton 2000) does not imply that entrepreneurship has no economic premium, and the higher rate of self-employment among immigrants to the United States does not entail that immigrants are more likely to create high-growth firms. Taken as a whole these findings suggest that self-employment and entrepreneurship are two distinct economic activities, explained by different forces and associated with different outcomes. Researchers and policy-makers are well advised not to treat self-employment as tantamount to entrepreneurship.

Instead, a strong case can be made that researchers should use a definition of entrepreneurship which is based on innovation, as this closer to how the concept is defined in entrepreneurship theory. Such a definition resonates with the implicit definition used by policy makers who express an interest in entrepreneurship research. What policy makers hope will emerge from the academic study of entrepreneurship is of course knowledge about how to spur technological progress through entrepreneurial policies. For example, the European Commission states that the aim of promoting entrepreneurship is "economic growth, innovation [and] employment" (EU-Commission 2010). When entrepreneurship is defined as self-employment, it makes sense to view entrepreneurship policy and so called SME policies - which seek to encourage the formation of small and medium size enterprizes - as essentially interchangeable terms (e.g Obama 2009). This paper has argued that such an approach obscures a potentially important policy tradeoff; some policies may well encourage the formation of small businesses whilst simultaneously dampening entrepreneurship rates.

Recognizing the theoretical and empirical differences between the two constructs, more effort should now go into analyzing them separately. The point is decidedly not that entrepreneurs are important and the self-employed are unimportant. The self-employed play a central role in any economy, simply not as innovators or job creators. Instead, self-employment can provide a flexible employment form, mitigate agency problems,

enable minorities to escape employment discrimination, and provide a safety valve for regulated or otherwise dysfunctional economies. Entrepreneurship, by contrast, is fundamentally related to innovation and an ambition to grow a business. Future work aimed at better elucidating these distinction is likely to lead to a better understanding of how entrepreneurship ought to be understood, measured and - ultimately - promoted.

# Appendix

## 6.1 A Cross-Country Measure of Entrepreneurship

The following step process was used to construct the sample. I first gathered information on all individuals who appeared in Forbes Magazine's annual ranking of the world's billionaires at least once between 1996 and 2010. There were 1723 such individuals. To establish whether or not each of these individuals is a self-made entrepreneur, I used a number of distinct sources. First, Forbes itself provides a brief description about the source of wealth of each billionaire. In many cases, this allowed me to remove individuals with inherited wealth, or non-entrepreneurial billionaires from the sample. For example, there are entertainers, writers, investment bankers and CEO:s in the sample.

If the description by Forbes magazine was not sufficient to determine entrepreneurial status, I consulted online sources, usually Wikipedia. In the rare cases where the information from Forbes and Wikipedia was insufficient to determine the status of a billionaire, I carried out additional library and internet searches. With a handful of exceptions (primary for east and south Asian billionaires), these steps were together sufficient to determine the source of wealth for the 1723 billionaires, leaving 996 self-made entrepreneurial billionaires. Out of the 1723 billionaires, I was unable to find sufficient information on 29 invidious. I classified these individuals as non-entrepreneurs, but additional analysis treating them as entrepreneurs yielded substantively identical results. Forbes reports the country of citizenship and the country of residence for each individual. I supplemented this information with data on country of birth, using the same sources as above. When no information on country of birth could be located I assumed the individual's country of birth is the same as his or her citizenship, which is available in the Forbes Data.

The second entrepreneurship variable uses data from Forbes Magazine's list of the "World's 2000 Largest Public Companies". I first identified all countries with more than 30 firms on this list, treating the EU-15 as one country. Three countries - the United States, the EU 15 and Japan - had more than 100 firms so for these I only investigated the largest 100 firms. I then computed the fraction of these firms which were started by entrepreneurs, following a multiple step process. I first gathered data on when and how each firm was founded, by consulting the firm's home-page. If the firm was founded after 1945 by one or several identifiable individuals I classified it as entrepreneurial. Since the comparison aims at measuring the level of current and not historical entrepreneurial level of economies, firms founded before 1945 were coded as non-entrepreneurial, even if founded by individuals. A surprisingly large share of the firms were in fact not entrepreneurial, but instead arose through mergers of non-entrepreneurial firms, were founded the state, came about through privatization of state assets or were spin-offs from pre-existing public firms. If a firm was created through a merger, I determined if one or more of the main merging companies were themselves

founded by entrepreneurs after 1945, in which case the firm was coded as entrepreneurial.

If the webpage did not contain sufficient information to determine the status of each firm, I consulted Wikipedia. In the rare cases where neither of these sources provided sufficient information, I conducted a broad internet and library search. With the exception of a small number of mostly East Asian firms, this allowed me to identify the fraction of entrepreneurial firms in each country.

My third measure of entrepreneurship uses data from Bosma and Levie (2010) who provide estimates of venture capital investments in 2008 as a share of GDP for 31 advanced countries.

Finally, for all the countries in my dataset with more than one million inhabitants I gather data on per capita income, business regulation and taxes. Data on population and purchasing power adjusted per capita income rates for the year 2009 were obtained from the International Monetary Fund (IMF, 2009). To measure national self-employment, I used non-agricultural self-employment rates from the OECD (2009) for the year 2000 when available. For non-OECD countries, I use data from the latest year for which ILO data is available. The data on trust levels is adapted from Bengtsson et al. (2008), who in turn uses information from the World Value Survey.

The data on business regulation is collected from two sources. For 28 developed countries, the OECD has constructed an index measure referred to as "Administrative burdens on corporations and sole proprietor start-ups", as well as a measure of employment protection regulation (OECD 2005). For most nations in the world the World Bank estimates the ranking of "the ease of doing business" (World Bank 2010) A low number on the ranking implies better, usually simpler, regulations for businesses. The corporate tax data is from the same source. I use the variable highest corporate tax rate to measure the tax burden imposed on firms.

## 6.2 The SALTY Data

SALTY is a major survey which features several sections specifically devoted to economic decision-making. Crucially, for our purposes, the survey also contains questions designed to distinguish self-employed individuals from entrepreneurs. This, and the rich battery of background questions on economic behaviors, preferences and outcomes, distinguishes the SALTY survey from other social science surveys. The SALTY survey has also been matched to administrative data from Statistics Sweden, allowing us to examine the educational attainment and the income of the participants.

The SALTY survey was sent out beginning in the fall of 2008 to 24,194 to a sample of Swedish twins born between 1943 and 1958. It eventually attained a response rate just short of 50%. The survey was administrated by the Swedish Twin Registry (STR). To be included in the SALTY study population, at

least one twin from each pair had to have responded in phone survey administered by the Swedish Twin Registry (STR) during the period 1998 and 2002. During this period, 74% of twins contacted by the Swedish Twin Registry did participate in the phone survey (Lichtenstein et al. 2006). For a detailed analysis of non-response bias in the SALTY survey, the reader is referred to Cesarini et al. (2010), who report that the sample is positively selected on educational attainment and income. Respondents are also more likely to be married. However, these differences are very small, typically a tenth of a standard deviation. Below, we describe the construction of the main variables used in the analysis of this paper.

The SALTY respondents have been matched to administrative records,containing information on income and educational attainment. The income variable used (förvärvsinkomst) is from administrative records. It is defined as the sum of income earned from wage labor, income from own business, pension income and unemployment compensation. The administrative records also contain information on highest degree attained. I convert this variable into years of schooling using population averages estimated by Isacsson (2004). Finally, for most men, data on cognitive ability from conscription is available. I standardize this variable by birth-year and transform it to have a normal distribution.

The survey also contains questions on ambiguity aversion, risk attitudes, loss aversion and measure of default bias. To study risk aversion, I use two sets of questions from the survey. The first is similar to those used in the Health and Retirement Survey and asks respondents to choose between various gambles over lifetime wealth. Based on their responses, respondents can be categorized into four groups from 0 to 3. The second question measures general risk attitudes on a 1–10 scale, where 1 is complete unwillingness to take risks and 10 is complete willingness to take risks. This scale question measures general risk attitudes and a very similar version of it has previously been used by Dohmen et al. (2005).

To study loss aversion, or small-stakes risk aversion, we use three questions that represent binary choices over participation in hypothetical gambles of varying degrees of loss aversion. In each question respondents were asked to either accept or reject a gamble that was associated with a 50% chance of loosing 1000 SEK and a 50% chance of winning either 1500, 2000 or 2500 SEK. Again, the variable is coded from 0 to 3, with 3 meaning that the individual is not loss averse over any of the hypothetical gambles.

To study discounting, respondents had to choose between 5000 SEK today or a larger amount in a week, where the larger amount was either 5500, 6000 or 7000 SEK. For the purpose of analysis individual responses to the three questions were aggregated and coded into four categories. Each category is represented by an integer between 0 and 3, where 0 denotes never choosing the delayed reward and 3 denotes always choosing the delayed reward.

To study ambiguity aversion, we use a slightly modified version of Ellsberg's (1961) urn with 30 red balls and 60 black and yellow balls of unknown proportions. Subjects were asked to choose between three

hypothetical lotteries, one paying 900 SEK if a red ball was chosen, one paying 1000 SEK if a black ball was chosen and one paying 1000 SEK if a yellow ball was chosen. If respondents preferred the lottery with red as the winning color they were coded as ambiguity averse.

In order to measure personal control, we administered a 13 item Locus of Control Scale (LOC) battery, which measures the extent to which individuals feel that they can control their own destiny. A low score on the scale is associated with an internal locus of control and a high score with an external locus of control. The survey included the 16 item Adult Measure of Behavioral Inhibition (AMBI) battery, which measures an individual's proneness to social avoidance.

Finally, and most importantly, in order to distinguish the entrepreneurs and the self-employed from salaried workers, all respondents were asked if they had ever run their own business. Those who responded in the affirmative were asked a number of follow up questions, including how many businesses they had run, for how many years, and most importantly whether or not they consider themselves an entrepreneur. The exact wording of the question used was:

"It is sometimes desirable to distinguish entrepreneurs from those who are self-employed. An entrepreneur commercializes a new innovation or idea. An entrepreneur has, or plans to have, a number of employees and strives to expand the business.A self-employed person owns and runs his/her own company, for instance a restaurant or a law firm, where he/she works. A self-employed person normally does not strive to expand over a certain limit and has 0 or a few employees. Would you say that you are primarily an entrepreneur or a self-employed person?"

# 7 The Model

A general equilibrium occupational choice model with heterogeneous managerial ability and financial frictions is constructed. Managerial ability can also be interpreted as the value of the business idea. Entrepreneurs are made distinct from the self-employed merely through the value of the firm: high ability firms are refereed to as entrepreneurs, while low ability managers (or managers with a business idea which is not very innovative) that nevertheless start a business are viewed as non-entrepreneurial self-employed. There firms have few employees and little capital. This definition is thought to reflect reality, where there are rarely precise lines that neatly delineate entrepreneurs from the non-entrepreneurial self-employed. Agents choose consumption to maximize preferences subject to lifetime wealth. Novel aspects of the model include policy variables and a new way in which to model financial constraints. In Antunes et al. (2008), the financial restriction is modeled

as a deadweight cost to intermediate loans. Limited enforcement arises from an incentive constraint to ensure loan repayment. The capital allocated to each entrepreneur depends on her net worth and the objective profitability of the project. This assumes that the financial system has full information about ability of the entrepreneur. The model here allows for a more flexible approach in which the bank cannot perfectly observe the ability of the entrepreneur and offers loans that are bounded. In my approach, entrepreneur that share the same observable characteristics are indistinguishable for the financial sector. As a consequence, banks fix the same borrowing constraint for these entrepreneurs. We also assume that banks in the financial sector bear a fixed cost and there is no entry barriers in the sector, resulting in zero profit gains. As in in Antunes et al. (2008), imperfect financial markets makes able managers not necessarily start firms. Further, the policy variables introduced in this paper give rise to a more complex interaction between financial imperfections and the managerial skill distribution of the economy. The change in the model's equilibrium properties is assessed through several variables, including the extent of taxes and regulations, financial intermediation costs, the level of contract enforcement and the information set of banks.

## 7.1 Occupational Choice Model

Our economy stems from the following framework:

- Consider an economy with a continuum of measure one agents $i \in \mathcal{I} = [0, 1]$ who live for one period.
- There is one numeraire good in one period that can be used either for consumption or production.
- Each period, agents are distinguished by their endowments of initial wealth and ability as owner-managers, denoted by $(b_i, x_i)$. Individual's managerial talent, $x_i$, and wealth, $b_i$, are drawn from a continuous joint cumulative distribution function $F_{X,B}(x_i, b_i)$, with $x \in \mathcal{X} = [\underline{x}, \overline{x}]$ and $b_i \in \mathcal{B} = [0, \overline{B}]$.
- Each individual will choose to be either a worker or a owner-manager. This decision is denoted by $E_i$, such that $E_i = 1$ for manager and $E_i = 0$ for a worker.
- Managers create jobs and organize hired labor, $n_i$, termed workers. These workers are employed by entrepreneurs at wage $w$. Workers' wages are homogeneous in my economy.
- The manager invests capital in his firm by using his own wealth $b_i$ or borrowing loans $l_i$ from the financial sector. If the entrepreneur decides to borrow loans, then the manager has to decide whether to forfeit or repay the borrowed loans at the end of the period. The decision of forfeiting is denoted by $D_i$. If the manager decides to forfeit, $D_i = 1$ and $D_i = 0$ otherwise. The remaining of this section explains my model in detail.

The subscript $i$ departs from traditional measure-theoretic notation, but it is usually adopted because it makes the discussion more intuitive as $i$ can be associated with agents. This way $\mathcal{I}$ denotes the set of all individuals in the universe of interest instead of the sample space. Nevertheless it is useful to characterize the problem through a common probability space. Let $(\mathcal{I}, \mathcal{A}, \mathbf{P})$ denote the probability space. All random variables will be defined on this probability space. As stated, if we denote $i$ as an element of $\mathcal{I}$, we can represent $x(i), b(i)$ as random variables corresponding, respectively, to managerial skills and to wealth. It is also useful write the joint distribution $F_{X,B}(x(i), b(i))$ using copulas. Let $X \sim F_X(x(i))$ and $B \sim F_B(b(i))$ be continuous random variables, then, by the probability integral transformation, $X = F_X^{-1}(U_X)$ $B = F_B^{-1}X(U_B)$, where $U_X$ and $U_B$ are uniform random variables $U_X \sim U[0,1]$ and $U_B \sim U[0,1]$. It is possible to write the joint distribution of managerial skills and wealth in a unique way through the copula $C(U_{x(i)}; U_{B(i)})$ associated with $F_{X,B}(x(i), b(i))$ (see proof of uniqueness in **?**). In other words, copulas provide conveniently means of assembling a joint distribution through its marginals, that is, $F_{X,B}(x(i), b(i)) = C(F_X(x(i), F_B(b(i)); \theta) = C(u_X(i), u_B(i); \theta)$, where $C$ denotes copula and $\theta$ is the dependency parameter.

## 7.2 Agents

**Preferences** Agents maximize utility that they derive from consumption. By monotonicity of the utility, I can refrain from defining an utility function as agents use all their income on consumption. Thus, agents simply maximize income. By income we mean the the return of his wealth according to interest rates $r$, the wage if the agent decides to be a worker or his firm's profit if the agent opts to be an entrepreneur.

**Production** Managers operate a technology that uses labor, $n_i$, and capital, $k_i$, to produce a single consumption good, $y_i$, where

$$y_i = f(k_i, x_i, n_i). \tag{3}$$

$f(\cdot, \cdot, \cdot)$ is twice continuously differentiable, strictly concave and increasing in all arguments. Function $f(\cdot, x, \cdot)$ is also homogenous of degree less than one for any fixed skill $x$. Moreover, enhanced managerial skill improves the productivity of both capital and labor, that is:

$$\frac{\partial^2 f(k,x,n)}{\partial n \partial x} > 0\,, \ \frac{\partial^2 f(k,x,n)}{\partial k \partial x} > 0, \ \forall\, k, x, n \in \mathbb{R}^+. \tag{4}$$

the technology $f(\cdot, \cdot, \cdot)$ also satisfies the Inada conditions, that is, $\lim_{w \to 0} f_w(k, x_i; w) \lim_{k \to 0} f_k(k, x_i; w) = \infty \forall\, k, x, n \in \mathbb{R}^+$. Capital fully depreciates at the end of the period. Managers can operate only one firm. The labor and capital markets are competitive, with prices $w$ and $r$, respectively.

**Capital Market Frictions** One contribution to the literature is a new method to examine financial friction. It is useful to understand the traditional framework for modeling financial friction in order to comprehend the difference of my proposed method. A large literature relies on the proportional punishment approach used by Krasa and Villamil (2000), Krasa et al. (2005) and Kehoe and Levine (1993) among others. In their framework, agents (lenders) deposit their wealth endowment $b_i$ in a financial intermediary and earn competitive return $r$. The intermediary lends the resources to managers. The part of the loan that is fully collateralized by $b$ costs $r$; the remainder costs $r + \tau$, where $\tau$ are financial costs usually assumed as sunk costs. While borrowers cannot commit ex-ante to repay, an exogenous enforcement technology exists. An agent who defaults on a loan incurs penalty $\phi$, which is the percentage of output forfeited net of wages. In other words, if the owner-manager forfeit, he has to pay $\phi(y_i - wn_i)$, where $y_i$ is the firm's revenue. Banks ensure payment when bounding the total available funds to at most $\phi(y_i - wn_i)/(1 + r + \tau)$. This restriction guarantees that managers have incentives to repay loans ex-ante. In my model, the assumption that $\tau$ is exogenously determined is maintained. Four critical arguments can be made about this approach. First, it assumes that banks to have full information about the entrepreneurial talent of the agents and of the technology of production. Second, it rule out any possibility of forfeiting, as if the financial system eliminates all possible default threat through a contract where unobserved abilities (that is to say managerial skills) are common knowledge. Third, it assumes that agents with high entrepreneurial talent have access to an unrestricted amount of credit ex-ante, but decide not to borrow an much due to the seizing technology on their known future revenue. Fourth, there is no reason for the parameter $\tau$ to be exogenously given. In my model, I relax this assumption by making the parameter endogenously determined as a result of the general equilibrium. An arguably more realistic approach is assuming that banks can only forecast the managerial skill of agents based on observed characteristics. In this view, banks would set a bound $L$ as the maximum amount loans that can be lended to managers. Managerial skills, $x_i$, are more likely to be unknown as it is a complex skill to be measured ex-ante. Thus, managers who share the same observable characteristics are subjected to the same borrowed constraint. The managers can decide whether to pay the loan or not. If the manager decides to forfeit, the bank has the right to seize $\phi$ share of the firm's profit after labor costs, that is $\phi\pi(l + a, x_i; w)$. The model used here further assumes that banks operate in a competitive market which incur in zero profits. Banks are no longer assumed to perfectly observe the managerial skill. However they are still assumed to be aware of the distribution of managerial ability in the population.

## 7.3 Optimal Behavior

**Labor given Capital** This section follows the model, as described in chapter 3. Agents who have sufficient resources and managerial ability to start their own firms choose the level of capital and the number of employees. This is done in order to maximize profit subject to a technological constraint and (possibly) a credit market incentive constraint. Consider first the problem of a manager for a given level of capital $k$ and wages $w$ :

$$\pi(k, x_i; w) = f(k, x_i, n_i) - wn_i. \tag{5}$$

$$n_i(k, x_i; w) = \arg\max_{n \in \mathbb{R}^+} f(k, x_i, n) - wn. \tag{6}$$

Equation (6) yields the labor demand of each owner-manager $i$, which is, $n_i(k, x_i; w)$ conditional on wages $w$, managerial skills $x_i$, and capital $k$. This labor demand is differentiable, continuous in all arguments, increasing in $k$ and $x_i$, and decreasing in $w$. Moreover, by Inada conditions, $\lim_{w\to 0} n(k, x_i; w) = \infty$ and $\lim_{w\to\infty} n(k, x_i; w) = 0$. Substituting Equation (6) into $f(x_i, k, n) - wn$ yields the manager's profit function for a given level of capital, $\pi(k, x_i; w)$.

*Remark* 7.1. The profit function is differentiable, continuous in all arguments, increasing in $k$ and $x_i$, and decreasing in $w$.

**Entrepreneur's Problem** The manager maximizes firm's profit. In doing so, he decides the optimal level of capital and labor. There are three choices on financing the firm's capital. This includes own wealth, borrowing from banks or a combination of the two. I denote the amount his own wealth invested as firm's capital by $a_i$, which has to satisfy the constraint $a_i \in [0, b_i]$, where $b_i$ is the wealth of the agent as mentioned. If some capital is borrowed from banks, the manager has to decide how much of loan $l_i$ will be borrowed. All managers are subjected to the same borrowed constraint, banks will only lend capital until a fixed level $L$, that is $l_i \in [0, L]$. We use the term borrowing restriction to denominate this restriction. The manager also have to decide whether to comply with the loan contract and repay the loan at a cost given by $(1 + r + \tau)l_i$, where $r$ is the interest rate of the economy and $\tau$ are financial costs. If the owner-manager decides to forfeit, the bank has the right to seize $\phi$ share of his profit after labor costs, that is $\phi\pi(l+a, x_i; w)$. I use $\Xi_p = \{w, r\}$ as a shorter notation for the prices of human and physical capital. I use $\Xi_f = \{\phi, \tau, L\}$ as a shorter notation for parameters related to the financial sector, namely, the seizing technology $\phi$ and financial cost $\tau$ and borrowing constraints $L$. I use $\Xi = \{\Xi_p, \Xi_f\}$ for the set of parameters associated with economy prices and financial constraints respectively.

Formally, the manager solves the following maximization:

$$V(b_i, x_i; \Xi) = \max_{a \in [0, b_i], l \in [0, L]} \pi(l + a, x_i; w) - (1 + r)a - min((1 + r + \tau)l \ , \ \phi\pi(l + a, x_i; w)) \tag{7}$$

Observe that Equation (7) can be also written as:

$$\begin{aligned} V(b_i, x_i; \Xi) &= max_{D \in \{0,1\}} V^D(b_i, x_i; \Xi) \\ V^0(b_i, x_i; \Xi) &= \max_{a \in [0, b_i], l \in [0, L]} \pi(l + a, x_i; w) - (1 + r)a - (1 + r + \tau)l \\ V^1(b_i, x_i; \Xi) &= \max_{a \in [0, b_i], l \in [0, L]} (1 - \phi)\pi(l + a, x_i; w) - (1 + r)a \end{aligned} \tag{8}$$

where $D$ is an indicator that means forfeit the loan agreement if $D_i = 1$ and $D_i = 0$ otherwise, namely:

$$D_i(b_i, x_i; \Xi) = \mathbf{1}[V^1(b_i, x_i; \Xi) - V^0(b_i, x_i; \Xi) > 0] \tag{9}$$

where $V^1(b_i, x_i; \Xi)$ is the value function for the entrepreneur $i$ whose values of managerial skills and wealth are given by $(x_i, b_i)$ and decides to forfeit the loans, while $V^0(b_i, x_i; \Xi)$ is the value function for the entrepreneur $i$ with the same values of managerial skills and wealth who decided to repay his loans. The two problems are analyzed separately, conditioning on the forfeiting decision. The lagrangian equation conditional on not forfeiting is given by:

$$\mathcal{L}^0 = \max_{a \in [0, b_i], l \in [0, L]} \pi(l + a, x_i; w) - (1 + r)a - (1 + r + \tau)l + \mu_a(b_i - a) + \mu_l(L - l)$$

The Kuhn-Tucker conditions are:

$$\frac{\partial \mathcal{L}^0}{\partial l} = \pi_1(l + a, x_i; w) - (1 + r) - \mu_l - \tau \leq 0 \tag{10}$$

$$\frac{\partial \mathcal{L}^0}{\partial a} = \pi_1(l + a, x_i; w) - (1 + r) - \mu_a \leq 0 \tag{11}$$

$$0 = \mu_a(b_i - a) \tag{12}$$

$$0 = \mu_l(L - l)$$

$$\frac{\partial \mathcal{L}^0}{\partial l} l = \frac{\partial \mathcal{L}^0}{\partial a} a = 0, \mu_a \geq 0, \mu_l \geq 0, b \geq 0, a \geq 0;$$

Observe that if $0 < l$, it is the case that $\pi_1(l + a, x_i; w) - (1 + r) \leq \tau$ from Equation (10) and restriction $\frac{\partial \mathcal{L}^0}{\partial l} l = 0$. From Equation (11), we have that $\mu_a \geq \tau$, thus $b_i = a$ to satisfy Equation 12. In economic terms, this says that if it is only optimal for the owner-manager to pay for more expensive capital from banks if

she is already using all of her own wealth.

The solution of the maximization conditioned on not forfeiting comprises four possible cases:

**Case 1 :** $0 < a < b_i, l = 0$. In this case, $\mu_a = \mu_l = \frac{\partial \mathcal{L}^0}{\partial a} = 0, \pi_1(a, x_i; w) = (1 + r) \leq (1 + r) + \tau$ and $l = 0$. The manager uses her own capital until the return of the investment equals the economy interest rates $r$.

**Case 2 :** $a = b_i, l = 0$. In this case, $\mu_l = 0, 0 < u_l < \tau, (1 + r) < \pi_1(b_i, x_i; w) \leq (1 + r) + \tau$. The manager uses all of her own wealth, which return is bigger than the interest rates of the economy $(1 + r)$, but smaller than the return of the economy interest rate plus the financial costs $(1 + r + \tau)$. Thus is is not optimal to borrow capital from banks.

**Case 3 :** $a = b_i, 0 < l < L$. In this case, $\mu_l = 0, \mu_a = \tau, \pi_1(b_i, x_i; w) > (1+r)+\tau, \pi_1(l+b_i, x_i; w) = (1+r)+\tau$. The manager uses all of her own wealth, and it is still optimal to borrow more capital from banks until the total return of the capital of the firm matches the interest rate $(1 + r)$ plus the financial costs $\tau$.

**Case 4 :** $a = b_i, l = L$. In this case, $\mu_l > 0, \mu_a > \tau$ and $\pi_1(b_i + L, x_i; w) > (1 + r) + \tau$. the manager is constrained by the borrowing bound imposed by the financial system. The return of the firm's capital is higher than the economy interest rates plus financial costs.

It is useful to define set of agents to according to the return to capital in order to analyze the role of personal wealth $b_i$ and borrowing constraint $L$. Let $H_i$ be an index of the marginal return of capital evaluated as following:

$$H^0(b_i, x_i; \Xi) = 1[\pi_1(b_i + L, x_i; w) > 1 + r + \tau] + 1[\pi_1(b_i, x_i; w) > 1 + r + \tau] + 1[\pi_1(b_i, x_i; w) > 1 + r] + 1; \quad (13)$$

As a shorthand notation, we use $H_i^0$ for $H^0(b_i, x_i; \Xi)$. Note that $H_i^0 \in \{1, \ldots, 4\}$ and represents cases 1–4 just defined.

Consider the case where the manager forfeit loans repayment. The lagrangian equation conditional on forfeiting is given by:

$$\mathcal{L}^1 = \max_{a \in [0, b_i], l \in [0, L]} (1 - \phi)\pi(l + a, x_i; w) - (1 + r)a + \mu_a(b_i - a) + \mu_l(L - l)$$

The Kuhn-Tucker conditions are:

$$\frac{\partial \mathcal{L}^1}{\partial l} = (1-\phi)\pi_1(l+a, x_i; w) - \mu_l \leq 0 \tag{14}$$

$$\frac{\partial \mathcal{L}^1}{\partial a} = (1-\phi)\pi_1(l+a, x_i; w) - (1+r) - \mu_a \leq 0 \tag{15}$$

$$0 = \mu_a(b_i - a)$$

$$0 = \mu_l(L - l) \tag{16}$$

$$\frac{\partial \mathcal{L}^1}{\partial l} l = \frac{\partial \mathcal{L}^1}{\partial a} a = 0, \mu_a \geq 0, \mu_l \geq 0, b \geq 0, a \geq 0;$$

Observe that due to restriction $\mu_a \geq 0$ and Equation (15), we have that $(1-\phi)\pi_1(l+a, x_i; w) \leq (1+r)$ from Equation 14, thus $(1+r) \leq \mu_l$ which implies that $L = l$ from Equation (16). The economic intuition for this result is that the profit is increasing in capital, and, as the cost of capital only depends on the wealth of the manager due to forfeit, so she will borrow as much as possible from the banks.

The solution of the entrepreneur maximization conditioned on forfeiting comprises three possible cases:

**Case 1 :** $a = 0, l = L$. In this case, $\mu_a = 0, 0 < \mu_l \leq 1 + r$, moreover, $\mu_l = (1-\phi)\pi_1(L, x_i; w)$ and $\pi_1(L, x_i; w) \leq (1+r)/(1-\phi)$. The return of the firm's capital when using all available credit is less than the economy interest rate, so the manager does not use her own wealth to increase the firm's capital.

**Case 2 :** $0 < a < b_i, l = L$. In this case, $\mu_a = 0, 0 < \mu_l = 1 + r = (1-\phi)\pi_1(L + a, x_i; w)$. Moreover, $\frac{\partial \mathcal{L}^1}{\partial a} = 0$, $\pi_1(L, x_i; w) > (1+r)/(1-\phi)$ and $\pi_1(L + b, x_i; w) < (1+r)/(1-\phi)$. The manager uses her own capital until the return of the additional capital invested in the firm equals the interest rate $r$ inflated by the seizing technology $\phi$.

**Case 3 :** $a = b_i, l = L$. In this case, $\mu_l = (1-\phi)\pi_1(L + b_i, x_i; w) > (1+r), \mu_a = (1-\phi)\pi_1(L + b_i, x_i; w) - (1+r) > 0$, and $\pi_1(L + b_i, x_i; w) > (1+r)/(1-\phi)$. In this case, the borrowing constraint imposed by the financial system is binding. The return of the firm's capital, which uses all external finance and all of the managers own wealth, is higher than the prevailing interest rates $r$ inflated by the seizing technology $\phi$.

Also define $H_i^1$ as an index of the marginal return of capital evaluated as following:

$$H^1(b_i, x_i; \Xi) = 1[\pi_1(b_i + L, x_i; w) > (1+r)/(1-\phi)] + 1[\pi_1(b_i, x_i; w) > (1+r)/(1-\phi)] + 1; \tag{17}$$

As a shorthand notation, we use $H_i^1$ for $H^1(b_i, x_i; \Xi)$. The indicator $H_i^1 \in \{1, \ldots, 3\}$ represents cases 1–3 just defined.

In summary, the optimal capital conditional on the forfeit decision $D$ is denoted by $k_i^D(b_i, x_i; \Xi) : D \in \{0, 1\}$ as the sum $k_i^D(b_i, x_i; \Xi) = a_i^D + l_i^D$ and:

$$[a_i^D, l_i^D] = \arg \max_{a \in [0, b_i], l \in [0, L]} D \cdot \Big( (1-\phi)\pi(l + a, x_i; w) - (1+r)a \Big) \\ (1 - D) \cdot \Big( \pi(l + a, x_i; w) - (1+r)a - (1+r+\tau)l \Big);$$

$$\text{such that } D \in \{0, 1\};$$

I denote the final capital of the firm by $k_i(b_i, x_i; \Xi) = a_i^{D_i} + l_i^{D_i}$, where $D_i$ is given by Equation (9).

**Lemma L-1.** For any $x \in \mathcal{X} \subset \mathbb{R}^+, w > 0$ and $r > 0$, the value functions $V^0(b, x; \Xi), V^1(b, x; \Xi)$, have the following properties:

a. $V^D(b, x; \Xi),\ D \in \{0, 1\}$ are continuous and differentiable in $x, w, r, \phi$, and $\tau$.

b. $V^D(b, x; \Xi),\ D \in \{0, 1\}$ are also strictly increasing in $x$ and strictly decreasing in $w$ and $r$.

c. $V^0(b, x; \Xi)$ is constant in $\phi$ and strictly decreasing in $\tau$ for $H_i(b_i, x_i; \Xi) = \{3, 4\}$ and constant in $\tau$ otherwise.

d. $V^1(b, x; \Xi)$ is strictly decreasing in $\phi$ and constant in $\tau$.

*Proof.* a. Continuity and differentiability of $V^D(b, x; \Xi),\ D \in \{0, 1\}$ follows from the Maximum Theorem and differentiability (cf., Theorem 4.11 of Stokey et al. (1989)).

b. From the envelop theorem we have:

$$\frac{\partial V^D(b_i, x_i; \Xi)}{\partial x} = (D(1-\phi) + (1-D))\pi_2(k_{i,D}, x_i; w) > 0$$
$$\frac{\partial V^D(b_i, x_i; \Xi)}{\partial w} = (D(1-\phi) + (1-D))\pi_3(k_{i,D}, x_i; w) < 0$$
$$\frac{\partial V^D(b_i, x_i; \Xi)}{\partial r} = -a + -(1-D)\tau < 0$$

c. By applying the envelop theorem to the profit maximization problem conditional on not forfeiting, we have that: $\frac{\partial V^0(b_i, x_i; \Xi)}{\partial \phi} = 0$, and $\frac{\partial V^0(b_i, x_i; \Xi)}{\partial \tau} = -l_i^0$, and the fact that $l_i^0 > 0$ for $H_i(b_i, x_i; \Xi) = \{3, 4\}$.

d. By applying the envelop theorem on the profit maximization problem conditional on forfeiting, we have that: $\frac{\partial V^1(b_i, x_i; \Xi)}{\partial \phi} = -\pi_1(a_i^1 + L, x_i; w) < 0$, and $\frac{\partial V^1(b_i, x_i; \Xi)}{\partial \tau} = 0$.

□

**Lemma L-2.** The associated policy functions $l^0(b,x;\Xi), l^1(b,x;\Xi)$

a. For all $b_i \in \mathcal{B}$, and $x \in \mathcal{X}$ if $x > x'$ then for $H^D(b_i,x;\Xi) \geq H^D(b_i,x';\Xi);\ D \in \{0,1\}$.

b. For all $b \in \mathcal{B}$, and $x_i \in \mathcal{X}$, if $b > b'$ then for $H^D(b,x_i;\Xi) \leq H^D(b',x_i;\Xi);\ D \in \{0,1\}$.

c. The following relations hold (we suppress arguments of functions for sake of brevity of notation):

$$
\begin{aligned}
H_i^0 = 1 &\Rightarrow \frac{\partial V^0}{\partial L} = 0, \frac{\partial V^0}{\partial b} = 0,\\
H_i^0 = 2 &\Rightarrow \frac{\partial V^0}{\partial L} = 0, \frac{\partial V^0}{\partial b} = \tau > 0,\\
H_i^0 = 3 &\Rightarrow \frac{\partial V^0}{\partial L} = 0, \frac{\partial V^0}{\partial b} = \tau > 0,\\
H_i^0 = 4 &\Rightarrow \frac{\partial V^0}{\partial L} > 0, \frac{\partial V^0}{\partial b} > \tau,\\
H_i^1 = 1 &\Rightarrow 0 < \frac{\partial V^1}{\partial L} \leq 1 + r, \frac{\partial V^1}{\partial b} = 0,\\
H_i^1 = 2 &\Rightarrow \frac{\partial V^1}{\partial L} = 1 + r, \frac{\partial V^1}{\partial b} = 0,\\
H_i^1 = 3 &\Rightarrow \frac{\partial V^1}{\partial L} > 1 + r, \frac{\partial V^1}{\partial b} > 0,
\end{aligned}
$$

d. If $\tau(1-\phi) < \phi(1+r)$ then $\forall\, i \in \mathcal{I},\ (H_i^0, H_i^1) \neq (1,3),(2,3),(3,3)$, and if $\tau(1-\phi) > \phi(1+r)$ then $\forall\, i \in \mathcal{I},\ (H_i^0, H_i^1) \neq, (1,3),(2,3),(4,1),(4,2)$.

e. Let the curve $\pi_1(b_i + L, x; w) = c \in [\pi_1(\max(\mathcal{B}) + \overline{L}, \underline{x}; w), \pi_1(0, \overline{x}; w)]$, then $\frac{\partial k}{\partial x} > 0$.

*Proof.* a. From entrepreneur maximization problem we obtain:

$$\frac{\partial \pi_1(k,x;w)}{\partial x} > 0 \,\forall\, x \in \mathcal{X}, k > 0.$$

the remaining of the claim comes from the definition of $H_i^D$.

b. From entrepreneur maximization problem we obtain:

$$\frac{\partial \pi_1(k,x;w)}{\partial k} < 0 \,\forall\, x \in \mathcal{X}, k > 0.$$

the remaining of the claim comes from the definition of $H_i^D$.

c. The relations are a direct consequence of $\frac{\partial V^D}{\partial L} = \mu_l$, $\frac{\partial V^D}{\partial b} = \mu_a$, for $D \in \{0,1\}$.

d. If $H_i^1 = 3$ then $\pi_1(b_i+L, x_i, w) > \frac{1+r}{1-\phi} \Rightarrow \pi_1(b_i+L, x_i, w) > 1+r+\tau$ due to $\tau(1-\phi) < \phi(1+r) \Rightarrow H_i^0 = 4$. Moreover, if

e. By implicity function theorem we have:

$$\frac{\partial k}{\partial x} = -\frac{\frac{\partial \pi_1(b_i+L,x;w)}{\partial x}}{\frac{\partial \pi_1(b_i+L,x;w)}{\partial x}}, \text{ but } \frac{\partial \pi_1(b_i+L,x;w)}{\partial x} > 0, \text{ and } \frac{\pi_1(b_i+L,x;w)}{\partial k} < 0.$$

□

Figure 6 has two graphs that partition the return to capital according to managerial skills and wealth. The graphs differ regarding the financial cost and the seizing technology of banks. Graph $(a)$ of Figure 6 assumes $1+r+\tau < (1+r)/(1-\phi)$, while graph $(b)$ assumes the opposite. The figure plots the lines associated with return to capital at levels $L, b_i$, and $L+b_i$. The return to capital can partition the space $\mathcal{B} \times \mathcal{X}$ into all possible combinations of the maximizing cases of the entrepreneurial profit maximization problem. The The number of possible cases can be considerable reduced if more constrains are assumed regarding the returns to capital at key capital levels ($L, b_i$ and $b_i + L$). As an example, Figure 7 presents the possible cases according to the marginal return of capital when the return of capital is fixed at the levels $\pi(b_i, x_i; w), \pi(L, x_i; w)$ and $\pi(b_i + L, x_i; w)$. Wealth and the borrowing constraint $L$ are represented in the y-axis. managerial skills are represented in the x-axis. The graph shows six possible combination cases according to the entrepreneurial profit maximization profit. The relation between wealth, managerial skills, financial parameters and economy prices with the forfeiting decision is complex.

**Forfeiting Decision** In this section it is shown how the individual characteristics can impact the forfeiting decision. In particular, for a given wealth $b_i$, a credit bound $L$, and a positive parameters $w, r > 0$, there is set of managerial skill $x$ denoted by $\mathcal{X}^1(b_i, \Xi)$ such that $x_i \in \mathcal{X}^1(b_i, \Xi) \Rightarrow D_i = 1$ and $\mathcal{X}^0(b_i, \Xi) = \mathcal{X} \setminus \mathcal{X}^1(b_i, \Xi)$, such that $x_i \in \mathcal{X}^0(b_i) \Rightarrow D_i = 0$ where $D_i = \mathbf{1}[V^1(b_i, x_i; \Xi) > V^0(b_i, x_i; \Xi)]$, as defined in Equation (9).

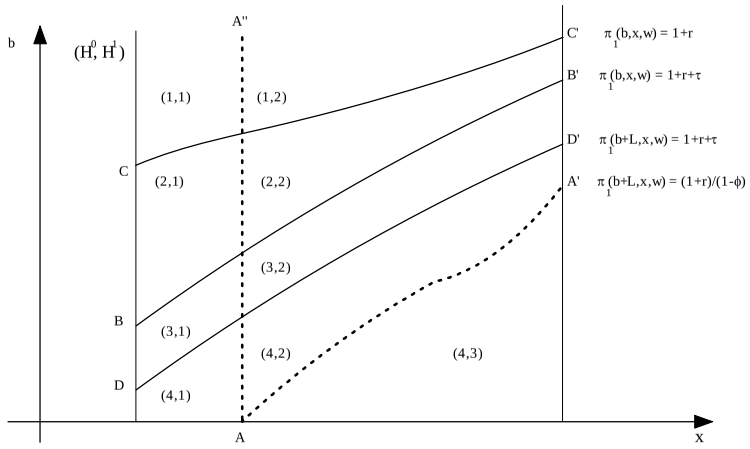
*Corollary* 7.1. A consequence of Lemma **L-1** is that: $\forall\, x, x' \in \mathcal{X}, r, r' \in \mathbb{R}^+$ such that $x > x'$, and $r > r'$, we have that:

$$V(b, x; \Xi) > V(b, x'; \Xi), V(b_i, x_i; w, r, \Xi_f) < V(b_i, x_i; w', r, \Xi_f)$$

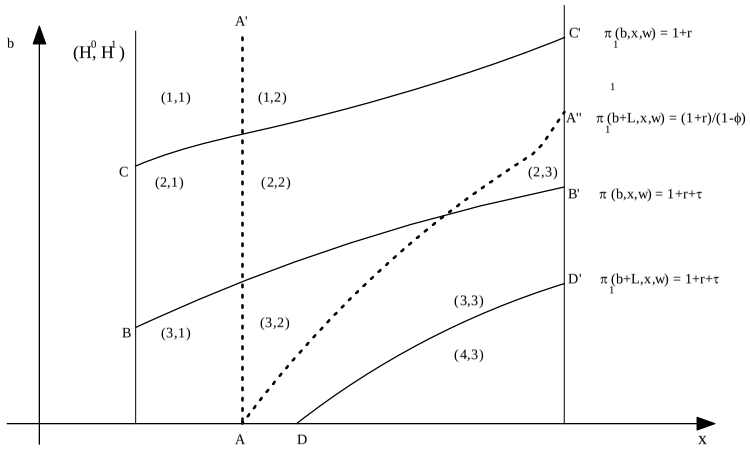
$$\text{and } V(b_i, x_i; w, r, \Xi_p) < V(b_i, x_i; w, r', \Xi_p).$$

Figure 6: Partition of agents $(b_i, x_i)$ according to Returns to Capital $\pi_1(k, x_i, w)$

(a) High Financial Costs $(\tau(1-\phi) < \phi(1+r))$



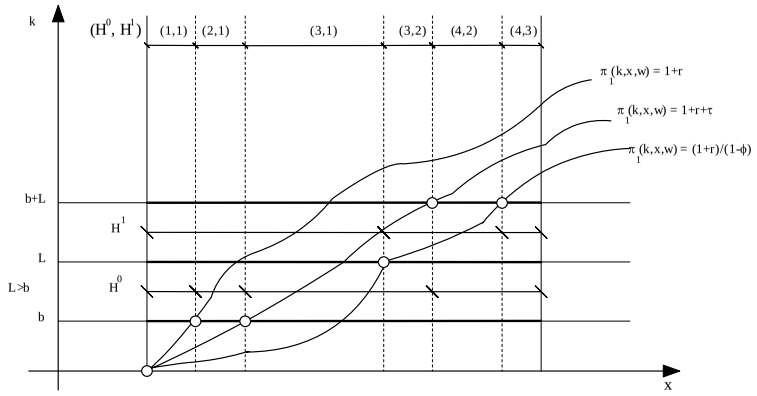

(b) High Financial Costs $(\tau(1-\phi) > \phi(1+r))$



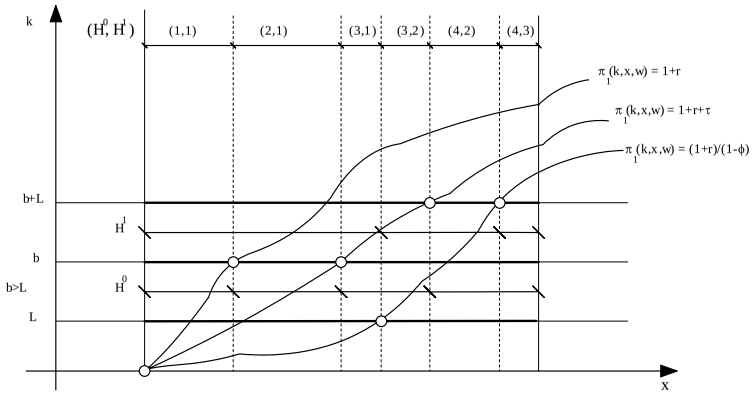

**Notes:** These two graphs partition the agents $i$ defined by the managerial skill and wealth $(x_i, b_i)$ into sets associated with possible cases $(H_i^0, H_i^1) \in \{1,2,3,4\} \times \{1,2,3\}$.

Figure 7: Partition of agents $(b_i, x_i)$ according to Returns to Capital $\pi_1(k, x_i, w)$

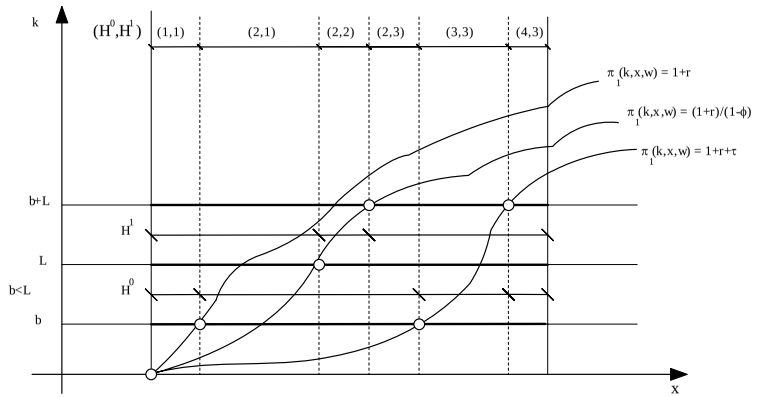
(a) High Financial Costs $(\tau(1-\phi) < \phi(1+r))$, $L > b$



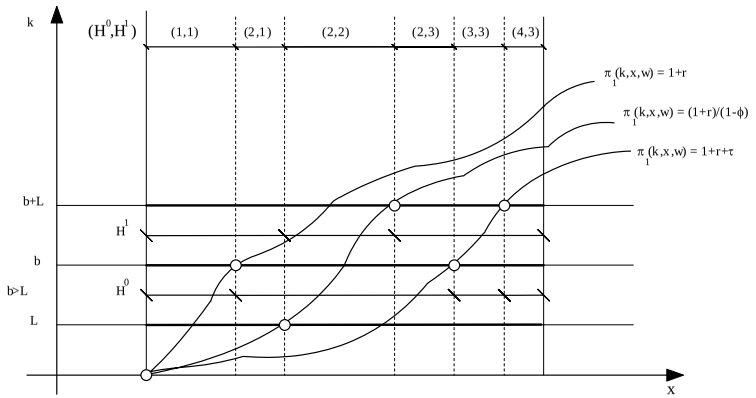

(b) High Financial Costs $(\tau(1-\phi) < \phi(1+r))$, $L < b$




(c) Low Financial Costs $(\tau(1-\phi) > \phi(1+r))$, $L > b$




(d) Low Financial Costs $(\tau(1-\phi) > \phi(1+r))$, $L < b$




**Notes:** These four graphs defines six sets that partition the possible values of managerial skills $x_i$ according to the return to capital $\pi_1(k, x_i, w)$ given $b_i$ and $L$.

A consequence of Lemma L-2 is that: $\forall\, b, b' \in \mathcal{B}, L, L' \in [0, \overline{L}]$ such that $b > b'$, and $l > L'$, we have that:

$$V(b, x; \Xi) \geq V(b', x; \Xi) \text{ and } V(b, x; \Xi_p, \phi, L, \tau) \geq V(b', x; \Xi_p, \phi, L', \tau).$$

**Entrepreneurial Decision** The following lemma characterizes the occupational choice for a given personal wealth $b_i$ and managerial ability $x_i$.

**Lemma L-3.** Define $b_e(x; \Xi)$ as the curve in set $\mathcal{X} \times \mathcal{B}$ such that $b_e(x; \Xi) = \inf\{b \in \mathcal{B}; V(b, x; \Xi) = w\}$. Thus $b_e(x; \Xi)$ is continuous in $x$ and and $E_i = 1\ \forall\ (b_i, x_i)$ such that $bi \geq b_e(x_i, \Xi)$.

*to be added.* □

**Consumers** The lifetime wealth of an agent characterized by $(b_i, x_i)$ is given by:

$$Y_i = Y(b_i, x_i; \Xi) = \max(w, V(b_i, x_i; \Xi)) + (1 + r)b_i. \tag{18}$$

which can also be written as:

$$Y_i = E_i(b_i, x_i; \Xi)V(b_i, x_i; \Xi) + (1 - E_i)w + (1 + r)b_i, \tag{19}$$

$$E_i \equiv E(b_i, x_i; \Xi) \tag{20}$$

$$= \mathbf{1}[V(b_i, x_i; \Xi) > w]; \tag{21}$$

Lifetime wealth is thus a function of agent-specific wealth $b_i$ and skill $x_i$, an addition to economy-wide parameters $w$ and $r$. Given lifetime wealth, agents maximize income which is fully spent on consumption. This problem defines optimal policies for consumption. The percentage of agents that become entrepreneurs $\mathcal{P}_E$ given the distribution of skills $x_i$ and wealth $b_i$ is given by:

$$\mathcal{P}_E = \mathbf{E}[E_i] \tag{22}$$

$$= \int_0^1 \int_0^1 E(F_X^{-1}(U_X), F_B^{-1}(U_B); \Xi) dC(U_X, U_B)\Big) \tag{23}$$

## 7.4 Financial Sector

Banks maximizes profit by choosing two parameters: the financial cost parameter $\tau$ and borrowing constraint $L$. We assume that the financial sector is a competitive market with no entry barriers. We assume that Banks bear a fixed operating cost and entrepreneurs prefer banks with lowest levels of financial costs $\tau$ and borrowing constraint (that is, highest $L$).

Banks cannot screen entrepreneurs on the basis of their entrepreneurial ability $x$. Therefore, banks offer the same package of financial costs and financial constraint for all entrepreneurs. The parameter $\phi$, associated with the technology of the seizing revenue, is exogenously given. Observe that the parameter $\phi$ is more likely to be associated with the culture of a country (such as the level of trust) and also depends heavily on the bankruptcy laws of the country. Formally:

The financial sector is based on the following assumptions:

*Definition* 7.1. **Financial Sector :**

1. There are $N$ banks indexed by $\mathcal{N} = \{1, \ldots, N\}$.
2. Each bank $n \in \mathcal{N}$ bares a fixed cost.
3. The financial market has no entry barriers which implies zero profit.
4. Each Bank $n \in \mathcal{N}$ maximizes profit by choosing parameters associated with loan repayment costs $\tau$ and borrowing constraints $L$.
5. Each bank $n \in \mathcal{N}$ is characterized by its choice of policy set $(\tau_n, L_n)$ that solves the profit maximization problem conditional on the choice of all other banks. We denote total set of policy choices by $\mathcal{P} = \{(\tau_n, L_n), n \in \mathcal{N}\}$.
6. Let a set of banks $\mathcal{N}_n \subset \mathcal{N}$ such each bank adopts the same parameters $\mathcal{P}_n = (\tau_n, L_n)$. Let the parameter choice of the remaining banks be $\mathcal{P}_{-n} = \{(\tau_{n'}, L_{n'}); n' \in \mathcal{N} \setminus \mathcal{N}_n\}$. Then the profit maximization function of each Bank in $\mathcal{N}_n$ is given by:

$$\pi_n = \frac{\Pr((b_i, x_i) \in \mathcal{I})}{|\mathcal{N}_n|} \cdot \max_{L \in [0, \overline{L}], \tau \in [0,1]} \Big( \mathbf{E}_{\mathcal{I}_s}[E_i \cdot D_i \cdot \phi\pi(b_i, x_i; \Xi)] + \mathbf{E}_{\mathcal{I}_s}[E_i(1 - D_i)(1 + \tau + r)l_i] - \mathbf{E}_{\mathcal{I}_s}[(1 + r)b_i] \Big) \tag{24}$$

where $\mathcal{I}_n = \{(u_B, u_X) \in [0,1] \times [0,1];$

$$V(F_B^{-1}(u_B), F_X^{-1}(u_X); \Xi_p, \phi, \tau, L) \geq max_{(\tau, L) \in \mathcal{P}_{-n}} \big( V(F_B^{-1}(u_B), F_X^{-1}(u_X); \Xi_p, \phi, \tau, L) \big) \}$$

Where $\mathbf{E}_{\mathcal{A}}[\cdot]$ means conditional expectation over set $\mathcal{A}$.

I do not explicitly write the fixed cost because the total profit of the sector will be such that it offset the aggregate fixed costs generating a zero profit sector. Equation(24) states that all banks with the chosen parameters have equal shares of the market.

It is useful to define a stable solution to the financial sector.

*Definition* 7.2. **Stable Solution :** Let $(\tau_n, L_n) : n \in \mathcal{N}$ be the profit maximization solution of Bank $n$ according to Equation 24 and let $\pi_n(\tau_n, L_n), \mathcal{P}_{-n})$ be the profit associated with his bank. A stable solution is a solution set $(\tau_n, L_n) : n \in \mathcal{N}$, such that $\forall\, n \in \mathcal{N}$, $\pi_n(\tau_n, L_n), \mathcal{P}_{-n}) \geq \pi_n(\tau'_n, L'_n), \mathcal{P}_{-n}) \,\forall (\tau'_n, L'_n) \in \mathcal{P}_{-n}$.

*Theorem* 7.1. **Cream Skimming:** For all $\mathcal{N}$ such that $|\mathcal{N}| > 2$, there exists a single stable solution in which all banks choose the same financial parameters $\tau^*, L^*$ given by: $(\tau^*, L^*) \in \mathcal{P}$ such that $\tau$ is minimal and $\mathcal{P}$ is given by:

$$
\begin{aligned}
\mathcal{P} &= \left\{ (\tau, L) = \arg \max_{L \in [0,\overline{L}], \tau \in [0,1]} \left( \mathbf{E}[E_i \cdot D_i \cdot \phi\pi(x_i, b_i; \Xi)] + \mathbf{E}[E_i(1 - D_i)(1 + \tau + r)l_i] - \mathbf{E}_{\mathcal{I}_s}[(1 + r)b_i] \right) \right\} \\
&= \Bigg\{ (\tau, L) = \arg \max_{L \in [0,\overline{L}], \tau \in [0,1]} \Bigg( \int_0^1 \int_0^1 E(F_B^{-1}(U_B), F_X^{-1}(U_X); \Xi) \\
&\qquad \cdot D(F_B^{-1}(U_B), F_X^{-1}(U_X); \Xi) \cdot \phi\pi(F_B^{-1}(U_B), F_X^{-1}(U_X); \Xi) dC(U_B, U_X) \Bigg) \\
&+ \int_0^1 \int_0^1 (1 - D(F_B^{-1}(U_B), F_X^{-1}(U_X); \Xi)) \cdot (1 + \tau + r) l(F_B^{-1}(U_B), F_X^{-1}(U_X); \Xi) dC(U_B, U_X) \\
&- (1 + r) \int_0^1 F_B^{-1}(U_B) dF(U_B) \Bigg\}
\end{aligned}
$$

we suppress the arguments of $l_i$ for brevity of notation in the first equation.

*in construction.* □

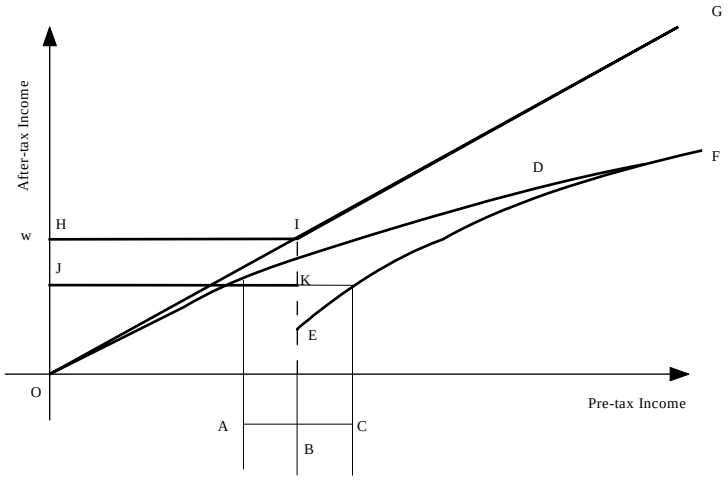
## 7.5 Taxation

Taxation may impact the occupational choice of individuals. In particular, progressive tax rates on entrepreneurs coupled with tax evasion by small business may have interesting effects on the composition of the population occupational choice. Let the post-tax income be given by $I_i; i \in [0, 1]$. I assume that the tax system complies with the following general rules:

*Definition* 7.3. **Tax System :**

1. Tax rate is fixed for workers, that is, $\forall\, i \in E_c(\Xi), I_i = (1 - \tau_w)w$.
2. Tax rate is progressive for entrepreneurs, that is, $\forall i \in E_1(\Xi) \cup E_0(\Xi)$, $I_i = (1 - \tau_e(V(b_i, x_i; \Xi)))V(b_i, x_i; \Xi)$, where $\tau_e : \mathbb{R}^+ \to [0, 1]$. For a shorthand notation, I will use $\tau_e(V_i)$ to denote $\tau_e(V(b_i, x_i; \Xi))$.

Figure 8: Tax System with Entrepreneurial Choice




**Notes:** This graph presents the tax system with tax evasion discussed in Definitions 7.3 7.4.

3. Entrepreneurial tax is bounded, $\forall\, v \in \mathbb{R}^+, \tau_e(v) \in [\underline{\tau_e}, \overline{\tau_e}]$, such that $0 \leq \underline{\tau_e} < \tau_w < \overline{\tau_e} = \lim_{v\to\infty} \tau_e(v)$.

4. Entrepreneurial tax is higher at wage level $w$: $\tau_e(w) = \tau_w + \delta; 0 < \delta < \overline{\tau_e} - \tau_w$.

5. $\forall\, v > v'; v, v' > 0 \Rightarrow \tau_e(v) > \tau_e(v')$ and $v'/v \leq (1 - \tau_e(v))/(1 - \tau_e(v'))$.

Definition 7.3 states a general tax system in which $1 > \tau_e(x) + x\tau'_E(x)$

*Definition* 7.4. **Tax Evasion :**

1. Tax rate is fixed for workers, that is, $\forall\, i \in E_c(\Xi), I_i = (1 - \tau_w)w$.

2. Tax rate is progressive for entrepreneurs, that is, $\forall i \in E_1(\Xi) \cup E_0(\Xi)$, $I_i = (1 - \tau_e(V(b_i, x_i; \Xi)))V(b_i, x_i; \Xi)$, where $\tau_e : \mathbb{R}^+ \to [0, 1]$. For a shorthand notation, I will use $\tau_e(V_i)$ to denote $\tau_e(V(b_i, x_i; \Xi))$.

3. Entrepreneurial tax is bounded, $\forall\, v \in \mathbb{R}^+, \tau_e(v) \in [\underline{\tau_e}, \overline{\tau_e}]$, such that $0 \leq \underline{\tau_e} < \tau_w < \overline{\tau_e} = \lim_{v\to\infty} \tau_e(v)$.

**Public Sector Distortions** A public sector is added to the occupational choice framework. Importantly, tax rates are different for owner-managers and for salaried workers. Furthermore, the effective tax rate on small firms is lower than for successful companies. This reflects the progressivity of the tax code, but also the ability of small firms to more easily evade taxes. Regulations are not modeled separately, and the tax rate can be interpreted as the regulatory burden on the firm (which also varies by firm size).

**Intuition** In a frictionless economy with perfect capital markets and no policy distortions, the individuals with the highest level of managerial ability (or those with the best business ideas) found companies and hire the least talented managers, driving up wages due to their high productivity as entrepreneurs. But because

of liquidity constraint, in economies with little or no financial sector, many of the most talented individuals do not have access to the capital needed. Only those who have enough wealth, or those who require little capital, can start firms. In this economy wages are lower, lacking because many of the most most skilled employers. If the financial sector becomes better at allocating talent, more productive firms are created, raising the alternative cost of self-employment for the marginal owner-managers. This could under certain conditions lead to a lower overall rate of self-employment.

As this is not the focus of this paper, the model itself will not be further developed here and is instead developed in detail in the appendix. The main results are that more efficient financial markets as well as lower tax rates on successful entrepreneurs can under reasonable conditions increase the number of owner-managed firms with high managerial talent ("entrepreneurs) while raising wages and lowering the number of marginal firms with low levels of managerial talent ("the self-employed").

## 7.6 Competitive Equilibrium

[Under Construction]

# 8 Tables

This section provides tables of data analysis.

Table 1: Cross-Country Correlates of Self-Employment Rates

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| GDP | −0.645*** | −0.654*** | −0.415*** | −0.445*** |
| | (0.085) | (0.083) | (0.105) | (0.105) |
| Taxes | | 0.373** | | 0.286*** |
| | | (0.161) | | (0.156) |
| Regulations | | | 0.119** | 0.107* |
| | | | (0.035) | (0.035) |
| Constant | 36.489*** | 26.932*** | 24.106*** | 18.028*** |
| | (2.076) | (4.583) | (4.160) | (5.279) |
| $R^2$ | 0.395 | 0.430 | 0.465 | 0.485 |
| # Obs | 90 | 90 | 90 | 90 |

This table reports standard cross-sectional regressions where the dependent variable is the self-employment rate. Taxes refer to the corporate income tax rate as measured by the World Bank. Regulations refer to the the ease of doing business, again as measured by the World Bank. Three stars (***) denote statistical significance at the 1% level, two stars (**) denote statistical significance at the 5% level and one star (*) denotes statistical significance at the 10% level.

Table 2: Cross-Country Correlates of Entrepreneurship Rates

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Population | 0.014*** | 0.015*** | 0.013*** | 0.014*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| GDP | 0.037*** | 0.039*** | 0.024*** | 0.027*** |
| | (0.002) | (0.002) | (0.003) | (0.003) |
| Taxes | | −0.027*** | | −0.024*** |
| | | (0.007) | | (0.007) |
| Regulations | | | −0.007*** | −0.007*** |
| | | | (0.001) | (0.001) |
| Constant | 0.159** | 0.750*** | 0.893*** | 1.393*** |
| | (0.078) | (0.174) | (0.150) | (0.212) |
| $R^2$ | 0.786 | 0.790 | 0.795 | 0.798 |
| # Obs | 90 | 90 | 90 | 90 |

This table reports coefficients from a Poisson Event Count Model where the dependent variable represents the emergence of each billionaire entrepreneur in the country. Taxes refer to the corporate income tax rate as measured by the World Bank. Regulations refer to the the ease of doing business, again as measured by the World Bank.Three stars (***) denote statistical significance at the 1% level, two stars (**) denote statistical significance at the 5% level and one star (*) denotes statistical significance at the 10% level.

Table 3: Institutions and Self-Employment Rates

| | |
|---|---|
| Institutional Quality | −16.38*** |
| | (3.35) |
| Constant | 147.83*** |
| | (22.17) |
| $R^2$ | 0.147 |
| # Obs | 56 |

This table reports coefficients from a 2SLS regression where the first stage relates a measure of institutional quality (expropriation risk 1985–1995) to the logarithm of colonial mortality rates. The second stage presented above relates the predicted quality of institutions based on mortality rates to self-employment rates. Three stars (***) denote statistical significance at the 1% level, two stars (**) denote statistical significance at the 5% level and one star (*) denotes statistical significance at the 10% level.

Table 4: Institutions and Entrepreneurship Rates

| | |
|---|---|
| Institutional Quality | 0.248*** |
| | (0.067) |
| Constant | −1.489*** |
| | (0.436) |
| $R^2$ | 0.082 |
| # Obs | 64 |

This table reports coefficients from a 2SLS regression where the first stage relates a measure of institutional quality (expropriation risk 1985–1995) to the logarithm of colonial mortality rates. The second stage presented above relates the predicted quality of institutions based on mortality rates to the number of billionaire entrepreneurs per capita. Three stars (***) denote statistical significance at the 1% level, two stars (**) denote statistical significance at the 5% level and one star (*) denotes statistical significance at the 10% level.

Table 5: SALTY Sample Summary Statistics for Entrepreneurs

| | Entrepreneur | | | Self-Employed | | | Other | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | # | Mean | S.D. | # | Mean | S.D. | # |
| Birth-year | 1950.1 | (4.62) | 550 | 1949.8 | (4.58) | 2211 | 1949.9 | (4.56) | 8425 |
| 1 if female | 0.19 | (0.39) | 550 | 0.38 | (0.49) | 2211 | 0.61 | (0.49) | 8425 |
| Years of Education | 12.38 | (2.89) | 532 | 11.99 | (2.75) | 2149 | 11.92 | (2.69) | 8258 |
| Cognitive Ability | 104.9 | (13.36) | 336 | 103.7 | (13.59) | 1009 | 102.5 | (14.16) | 2460 |
| Income | 366892 | (247008) | 533 | 275428 | (187886) | 2155 | 274923 | (141772) | 8273 |
| Variance Income | 86115 | (1745312) | 533 | 51031 | (183108) | 2155 | 26401 | (43414) | 8273 |
| Risk HRS | 1.56 | (1.09) | 522 | 1.21 | (1.11) | 2099 | 0.90 | (1.01) | 7808 |
| Risk General | 5.81 | (2.13) | 546 | 4.97 | (2.20) | 2192 | 4.33 | (2.10) | 8324 |
| Ambiguity Aversion | 0.39 | (0.49) | 538 | 0.37 | (0.48) | 2140 | 0.38 | (0.48) | 8051 |
| Loss Aversion | 0.53 | (1.02) | 532 | 0.37 | (0.85) | 2151 | 0.33 | (0.82) | 8133 |
| Fairness | 2.50 | (0.84) | 548 | 2.33 | (0.86) | 2172 | 2.19 | (0.84) | 8270 |
| Discounting | 2.69 | (0.71) | 545 | 2.67 | (0.73) | 2177 | 2.67 | (0.75) | 8229 |
| Happiness | 2.30 | (0.59) | 547 | 2.23 | (0.55) | 2191 | 2.10 | (0.56) | 8353 |
| Businesses Started | 2.02 | (1.77) | 538 | 1.58 | (6.89) | 2184 | 0 | (0.00) | 8425 |
| Status Quo Bias | 1.93 | (0.86) | 549 | 1.99 | (0.83) | 2181 | 1.92 | (0.81) | 8251 |
| Locus of Control | 6.99 | (2.11) | 506 | 6.68 | (2.10) | 1896 | 6.35 | (2.15) | 6959 |
| Behavioral Inhibition | 19.65 | (4.77) | 526 | 17.83 | (4.99) | 2104 | 17.17 | (4.93) | 7872 |

This table provides summary statistics for the three employment types: entrepreneurs, self-employed and others (salaried workers).

Table 6: Sample Summary Statistics: Women

| | Entrepreneur | | | Self-Employed | | | Other | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | # | Mean | S.D. | # | Mean | S.D. | # |
| Birth-year | 1950.3 | (4.69) | 105 | 1950.19 | (4.60) | 848 | 1949.9 | (4.60) | 5110 |
| Years of Education | 13.11 | (3.00) | 101 | 12.20 | (2.69) | 830 | 11.91 | (2.63) | 5022 |
| Income | 290100 | (155499) | 101 | 224181 | (115656) | 832 | 236808 | (93892) | 5030 |
| Variance Income | 46368 | (57181) | 101 | 38319 | (65217) | 832 | 23058 | (26797) | 5030 |
| Risk HRS | 1.33 | (1.08) | 99 | 1.055 | (1.06) | 797 | 0.81 | (0.99) | 4625 |
| Risk General | 5.60 | (2.23) | 103 | 4.78 | (2.24) | 841 | 4.19 | (2.09) | 5031 |
| Ambiguity Aversion | 0.50 | (0.50) | 102 | 0.40 | (0.49) | 819 | 0.41 | (0.49) | 4840 |
| Loss Aversion | 0.44 | (0.93) | 101 | 0.33 | (0.81) | 828 | 0.30 | (0.80) | 4912 |
| Fairness | 2.48 | (0.77) | 105 | 2.21 | (0.86) | 832 | 2.13 | (0.82) | 4992 |
| Discounting | 2.70 | (0.61) | 104 | 2.63 | (0.76) | 834 | 2.66 | (0.77) | 4962 |
| Happiness | 2.32 | (0.55) | 105 | 2.23 | (0.55) | 841 | 2.20 | (0.56) | 5060 |
| Businesses Started | 1.31 | (0.90) | 103 | 1.20 | (0.69) | 836 | 0 | (0) | 5110 |
| Status Quo Bias | 2.05 | (0.83) | 104 | 1.96 | (0.83) | 831 | 1.90 | (0.81) | 4974 |
| Locus of Control | 6.61 | (2.09) | 92 | 6.55 | (2.09) | 708 | 6.19 | (2.07) | 4035 |
| Behavioral Inhibition | 20.07 | (4.63) | 98 | 18.03 | (5.10) | 798 | 17.13 | (4.99) | 4691 |

This table provides summary statistics for females disaggregated by the three employment types: entrepreneurs, self-employed and others (salaried workers).

Table 7: Sample Summary Statistics: Men

| | Entrepreneur | | | Self-Employed | | | Other | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mean | S.D. | # | Mean | S.D. | # | Mean | S.D. | # |
| Birth-year | 1950.0 | (4.60) | 445 | 1949.55 | (4.55) | 1363 | 1949.8 | (4.50) | 3315 |
| Years of Education | 12.21 | (2.84) | 431 | 11.86 | (2.79) | 1319 | 11.95 | (2.78) | 3236 |
| Cognitive Ability | 104.88 | (13.360 | 336 | 103.65 | (13.59) | 1009 | 102.5 | (14.16) | 2460 |
| Income | 384852 | (260757) | 432 | 307656 | (215447) | 1323 | 334040 | (178489) | 3243 |
| Variance Income | 95407 | (190747) | 432 | 59026 | (227575) | 1323 | 31585 | (60422) | 3243 |
| Risk HRS | 1.61 | (1.09) | 423 | 1.31 | (1.13) | 1302 | 1.03 | (1.04) | 3183 |
| Risk General | 5.86 | (2.10) | 443 | 5.09 | (2.17) | 1351 | 4.55 | (2.09) | 3293 |
| Ambiguity Aversion | 0.36 | (0.48) | 436 | 0.35 | (0.48) | 1321 | 0.33 | (0.47) | 3211 |
| Loss Aversion | 0.56 | (1.04) | 431 | 0.39 | (0.87) | 1323 | 0.38 | (0.85) | 3221 |
| Fairness | 2.51 | (0.85) | 443 | 2.40 | (0.85) | 1340 | 2.29 | (0.85) | 3278 |
| Discounting | 2.68 | (0.73) | 441 | 2.69 | (0.72) | 1343 | 2.70 | (0.72) | 3267 |
| Happiness | 2.30 | (0.60) | 442 | 2.23 | (0.56) | 1350 | 2.20 | (0.56) | 3293 |
| Businesses Started | 2.18 | (1.89) | 435 | 1.82 | (8.75) | 1348 | 0 | (0) | 3315 |
| Status Quo Bias | 1.90 | (0.87) | 445 | 2.01 | (0.83) | 1350 | 1.93 | (0.81) | 3277 |
| Locus of Control | 7.08 | (2.11) | 414 | 6.77 | (2.11) | 1188 | 6.57 | (2.22) | 2924 |
| Behavioral Inhibition | 19.55 | (4.81) | 428 | 17.70 | (4.91) | 1306 | 17.24 | (4.84) | 3181 |

This table provides summary statistics for males disaggregated by the three employment types: entrepreneurs, self-employed and others (salaried workers).

Table 8: Cross-Sectional and Within Family Regressions of Earnings on Self-Employment and Entrepreneurship

| | (1) CS, ALL | (2) FE, ALL | (3) CS, MZ | (4) FE, MZ | (5) CS, ALL | (6) FE, ALL | (7) CS, MZ | (8) FE, MZ |
|---|---|---|---|---|---|---|---|---|
| Dependent Variable | Earnings | Earnings | Earnings | Earnings | Risk | Risk | Risk | Risk |
| 1 if Entrepreneur | 0.122 | 0.020 | 0.132 | 0.083 | 0.558 | 0.333 | 0.642 | 0.609 |
| | (0.022) | (0.061) | (0.042) | (0.086) | (0.050) | (0.166) | (0.095) | (0.239) |
| 1 if Self-Employed | −.064 | −.072 | −.089 | −.053 | 0.264 | 0.229 | 0.259 | 0.277 |
| | (0.011) | (0.033) | (0.022) | (0.051) | (0.027) | (0.092) | (0.053) | (0.145) |
| 1 if Female | −.298 | −.292 | −.305 | − | −.239 | −.341 | −.235 | − |
| | (0.008) | (0.029) | (0.018) | − | (0.021) | (0.086) | (0.044) | − |
| Age | 0.003 | − | 0.002 | − | 0.025 | − | 0.027 | − |
| | (0.001) | − | (0.002) | − | (0.002) | − | (0.005) | − |
| $R^2$ | 0.139 | 0.834 | 0.139 | 0.860 | 0.053 | 0.782 | 0.059 | 0.781 |
| # Observations | 10832 | 10832 | 2955 | 2955 | 10429 | 10429 | 2777 | 2777 |
| Test of equality | <0.001 | 0.14 | <0.001 | 0.09 | <0.001 | 0.535 | <0.001 | 0.153 |

This table shows the regression of earnings (columns 1-4) and risk-aversion (columns 5-8) on a dummy variable for entrepreneurship, self-employment, sex and age. The omitted category is salaried worker. Earnings is defined as the average logarithm of annual income in the period 2001-2005, omitting years when the individual was not in the workforce.The question on risk attitudes closely resembles that used in the Health and Retirement Survey, as outlined in the Appendix. CS stands for cross-section and means that family fixed effects are not included. FE stands for fixed effect and means that family fixed effects are included. Columns 1 and 2 use the whole sample, whereas columns 3 and 4 restricts the sample to MZ twins. Three stars (***) denote statistical significance at the 1% level, two stars (**) denote statistical significance at the 5% level and one star (*) denotes statistical significance at the 10% level.

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