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Dedication

I dedicate my thesis to Magnus Henrekson, for support and for intellectual inspiration

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Abstract

This thesis has three chapters. In the first chapter, a joint work with Magnus Henrekson, we discuss the taxation of entrepreneurial income. A review of the literature on firm taxation reveals that the economics of entrepreneurship has not sufficiently been taken into consideration. We discuss how this affects conclusions derived from standard models of capital taxation when applied to entrepreneurial income. Some defining features of entrepreneurship important for analyzing the effects of taxation of owner-managed firms are identified. These include the lack of a well-functioning external market for entrepreneurial effort, limited access to external capital and complementarities between entrepreneurial innovation, effort and capital. Due to these constraints, the entrepreneurial project is tied to the individual owner–manager. The entrepreneur is unable to decouple saving decisions from investment decisions, and makes joint decisions on the supply of effort and capital. The return from successful entrepreneurial ventures can therefore not be readily divided into labor and capital income, in deep contrast to what is typically assumed in taxation theory. It is argued that when distinct attributes of entrepreneurship are taken into account, certain conclusions of capital taxation models may no longer hold, including the neutrality of capital taxation in owner-managed firms. Cost of capital formulas derived from the behavior of public firms could underestimate distortions when applied to the investment behavior of entrepreneurial firms. For tax purposes and otherwise, it becomes useful to analyze return to entrepreneurial activity as income of a distinct factor of production. In this context, conceptual issues and the difficulties of measuring entrepreneurial income are discussed.

In the second chapter, which is a joint work with Andrea Asoni, we study the effect of taxation on entrepreneurship, taking into account both the amount of entry and the quality of new ventures. We show that even with risk neutral agents and no tax evasion progressive taxes can increase entrepreneurial entry, while reducing average firm quality. So called "success taxes" increase startup of lower value business ideas by reducing the option

value of pursuing better projects. This suggests that the most common measure used in the literature, the likelihood of entry into self-employment, may underestimate the adverse effect of taxation.

In the third chapter I use 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 defi ne 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.

Chapter 1

Entrepreneurship and the Theory of Taxation

1.1 Introduction

Advances in the theory of taxation in recent decades have had a significant impact on public policy. Most developed countries have broadened tax bases, closed loopholes and cut marginal taxes. Capital taxation has been reformed to limit the distortionary effects on the source and use of capital, based on principles of neutrality such as those outlined in King and Fullerton (1984). Economists—with powerful models at their disposal—are uniquely suited to offer guidance to policy makers in a field like capital taxation. But this strength also carries the risk of misguided advice, especially in instances when model structures are incomplete with regard to the real-life economic issues they are designed to address. The scholarly study of entrepreneurship taxation has suffered in this regard; the inherited models of capital taxation have been insufficiently adapted to the economics of owner-managed firms. With the help of neoclassical investment theory (Jorgenson 1963, 1967), it is possible to summarize the effects of a multitude of tax rates and rules in a few equations to describe the wedge between the effective average and marginal tax rate and the pretax cost of capital.

However, cost of capital formulas were originally derived from the behavior of a specific class of investors, namely large, public firms. There is reason to surmise that these models need to be adjusted when applied to the taxation of small and/or entrepreneurial firms. This class of models typically suggests that economic distortions do not arise from the taxation of owner-managed firms' capital return, since the firm's cost of capital is unaffected by taxes in steady state. This vital conclusion is analogous to the so-called "new view" result regarding dividend taxation for public firms and is indeed derived from the same underlying assumptions. If the marginal investment is assumed to be financed using already existing and already taxed capital, the cost of capital is invariant to taxation. The same assumptions lead to the remarkable result that capital taxes are neutral between private and public firms, even when entrepreneurial income is taxed at higher rates than return from passively invested capital. Before the effect of any tax can be analyzed, the underlying economic process on which the tax is imposed must be carefully modeled. Entrepreneurial investments differ in many respects from the investment situation that is assumed—sometimes implicitly— in the standard neoclassical model. For example, the cost of capital no longer acts as the only central variable when the capital and effort of the entrepreneur are complementary in production and jointly supplied. A new entrepreneurial venture can rarely rely on external debt financing or on already taxed ("trapped") equity to eliminate the costs of taxation. The ability to reduce the impact of taxes by pooling taxes with losses on successful projects is more constrained in smaller and less diversified startups, in which the probability of failure is far higher than in public firms. Consequently, the simple cost of capital formulas have a tendency to underestimate the distortions caused by taxing entrepreneurial firms. This difficulty in modeling entrepreneurship does not plague taxation theory alone, but embodies rather a general predicament in neoclassical economics (Bianchi and Henrekson 2005). Baumol (2010), however, has recently taken significant steps toward outlining a micro-founded theory of the supply of productive entrepreneurship. He adds the supply of entrepreneurship

to "the classical tripartite division of 'factors of production'—land, labor and capital," in order to create "a genuine four-group subdivision of the economy's inputs" (Baumol 2010). We illustrate the importance of including entrepreneurship in economic models of taxation by examining the so-called Nordic system of dual taxation, in which capital and labor income are taxed separately. Whereas most entrepreneurs in the US are taxed according to the individual income tax schedule, the Nordic system contains a sharp division between capital and labor income. Owners of closely held firms thus face special tax rules, which assign part of their income to capital income (taxed at a lower, flat rate) and the rest to labor income (taxed at a higher, progressive rate). It is in this context that the standard formulas for calculating capital taxation have been extensively applied to entrepreneurial firms. While the hazards of not taking entrepreneurship into account when analyzing entrepreneurial firms is particularly salient in the case of the Nordic dual taxation system, the problem is a general one. The income generated by innovative business owners' efforts and investments differ in many respects from other economic categories. Taking this into account, we outline a framework for incorporating elements of entrepreneurial choice into the theory of taxation, including the suggestion that entrepreneurship be viewed as a distinct factor of production. Our main conclusion is that neglecting the entrepreneur in theories of taxation has resulted in misleading policy implications. Indeed, issues of secondary importance in analyses of large, established firms may prove crucial.

1.2 Crucial Aspects of Entrepreneurship and Taxation

Entrepreneurship has a distinct character marked by risk, dynamism (Schumpeter 1934), uncertainty (Knight 1921), liquidity constraints (Holtz-Eakin et al. 1994a, b) and the inability to separate saving from investments (Gentry and Hubbard 2004). The entrepreneur has been described as a jack-of-all trades (Lazear 2004) who is particularly alert to change (Kirzner 1973) and distinct in his/her preferences (McClelland 1961; Brockhaus 1980). Although no

complete neoclassical theory of entrepreneurship has been developed, partial progress has been made on several counts by separate models, each focusing on a key aspect of the entrepreneurial process (Kihlstrom and Laffont 1979; Kanbur 1982; Aghion and Howitt 1992; Sinn 1991a, b; Holtz-Eakin et al. 2001; Cagetti and De Nardi 2006; Kanniainen et al. 2007). We will discuss those aspects that relate to the theory of taxation and the interpretation of entrepreneurial income. These include the joint factor supply of business owners, the non-contractibility of key competencies and the resulting lack of access to external capital, and variations in access to investment opportunities both across and between entrepreneurs and mature firms. Risk, uncertainty and liquidity constraints are also touched upon. Although this list is by no means complete, the crux of our argument remains salient: there exists great merit in incorporating a fuller range of entrepreneurship aspects into models of taxation. Agency problems and non-contractibility form the core of theories of the firm, including the entrepreneurial firm (Coase 1937; Williamson 1975). For example, many innovations are difficult or even impossible to sell when underlying ideas cannot be properly evaluated before they are sold, or when successful innovation depends on tacit knowledge tied to the individual entrepreneur. In general, the entrepreneur tends to know a project's quality and prospects for success much better than the providers of capital, creating an investment wedge. Similar agency problems exist with respect to entrepreneurial effort. To ensure that individuals make optimal decisions, exert a high level of effort, assume very high risks and bear the requisite uncertainty, incentives have to be aligned through a large ownership share. Firm equity owned by the self-employed increases effort and in turn firm performance, but this incentive mechanism limits the degree of external financing (Bitler et al. 2005)[1]. Hence, standard labor purchased in the market cannot be substituted for entrepreneurial effort. Neither can passive capital invested in large firms, since these firms generally lack access to

[1]Of course, large public firms face agency problems of their own. Imposing a formal managerial structure enables the separation of ownership and control, but at the high cost of limiting the firms' growth and hampering its adaptability.

the same innovative ideas and entrepreneurial talent[2]. Gentry and Hubbard (2004) point out that "the 'saving' and 'investment' decisions of entrepreneurs are likely to be related" due to higher costs of external financing. Inheritance, lottery wins and other "exogenous" liquidity gains increase the likelihood of both becoming an entrepreneur and promoting firm growth, indicating that liquidity constraints may be important (Holtz-Eakin et al. 1994a, b; Blanchflower 2004). Interviews with successful entrepreneurs confirm that the overwhelming majority were initially funded by modest amounts of personal assets (Gentry and Hubbard 2004). Entrepreneurs tend to have both substantially more savings and a higher savings to income ratio than other households. However, their wealth is far less diversified—close to half of entrepreneurs' total wealth resides in their business and complementary real estate (Gentry and Hubbard 2004; Cagetti and De Nardi 2006). Self-employment income is more correlated with the rate of return of stock markets than is wage income, partially explaining why households with more variable entrepreneurial income seem to substitute away from stocks (Heaton and Lucas 2000). This fact together with the aforementioned agency costs force entrepreneurs to hold a much less diversified portfolio than passive investors. Needless to say, incentive and information problems associated with entrepreneurship can be mitigated in many ways. Examples include specialized venture capital firms, banks with long-term relationships with local businesses and bonus programs that emulate entrepreneurial incentives. Assuming completely binding liquidity constraints for entrepreneurs would be misleading. It is however noteworthy that most standard models of capital taxation make the equally dubious assumption of costless access to external capital. The joint supplies of innovation, effort and investment that characterize entrepreneurship have important implications for tax policy. Even if capital and labor are separately taxed, capital taxation could

[2]The distinction is not absolute, but is often one of degrees. Both regular labor and passive capital can at times be used as imperfect substitutes for entrepreneurship, and the innovation or products produced through entrepreneurial ventures may in some way be replicated by non-entrepreneurial firms. Thus, the argument does not rely on the irreplaceably of entrepreneurship, only that such ventures enjoy comparative advantage in certain product categories and market functions (Baumol 2004).

affect entrepreneurial labor supply, while taxing owner–manager labor earnings could affect investments (Carroll et al. 2000b). Unlike taxes on passive owners, personal taxation of owners–managers may affect the expansion and hiring decisions of firms in a similar fashion. The negative cross-price elasticity between capital and labor offered by the same agent translates into a joint supply decision. In principle, this hypothesis could be empirically tested by measuring the cross-price elasticity of capital and income for the self-employed versus other agents. Controlling for income effects, the supply elasticity of hours worked should be affected by a change in capital returns (due to taxes, for example), and the supply of investments should be affected by changes in labor income. Before discussing the problems of standard capital taxation theory as applied to the earnings of entrepreneurial firms, it is worthwhile to take a step back and consider what these earnings are actually composed of.

1.3 Entrepreneurial Income

Let us imagine an alternative history. Say Wal-Mart founder Sam Walton remained an employee at JC Penney, choosing instead to invest the same fraction of his income in public assets with a risk and liquidity profile similar to Wal-Mart's. It is safe to say that he could not have become the richest man in the world using this strategy. Staunch in his role as employee, Walton could not have retained his billions of dollars worth of surplus, which he would have had neither the incentive nor even the opportunity to create. Any employee contract attempting to decouple ownership but retain the incentive structure enjoyed by the owner of an entrepreneurial firm would face insurmountable transaction costs. The Forbes 500 list of the world's billionaires reveals that self-made entrepreneurs hold more than 60% of total net worth of the super-rich in the US and other Anglo-Saxon countries[3]. In Europe, the corresponding figure reaches about 40%. Even these figures underestimate the importance of entrepreneurial income, as much additional wealth either emanates from self-made

[3]The wealth proportions are based on our own calculations from the 2006 list.

entrepreneurs' parents and spouses (e.g., Wal-Mart), or is created by entrepreneurs who inherited a small firm and are therefore not defined as self-made (e.g., Rupert Murdoch). Whether some entrepreneurs become rich through unusually high creation of value or because they were better than average at capturing the Schumpeterian surplus created by their innovations is not easily explained. Nevertheless, it is clear that the return on entrepreneurship is an important part of both national income and capital formation. However, this income does not fit the simple labor-capital division of factor income. How should the income of Sam Walton, Bill Gates and millions of other entrepreneurs be interpreted by economists? Does it simply represent a high return on labor in the form of reward for exceptional talent or rather unusual returns on capital accomplished through luck or risk taking? Does the income in excess of the risk-adjusted market return on labor and savings represent economic rents, or is it "bills on the sidewalk" that lucky agents will come across, but that carry no meaningful economic function? The answers to these questions are not trivial details—they determine how we should expect the income in question to respond to taxes (and to price changes in general). At one extreme, a suitcase containing a million dollars would be picked up even if it were taxed at 99%, assuming that pure rents are not influenced by taxes. If entrepreneurial earnings represent a sum of shadow labor returns and the return to invested capital, we would not expect these earnings to react any differently to taxation than those of ordinary investors. In contrast, if entrepreneurial income represents the reward for combining extraordinary effort, risk taking and thrift, these above market returns could be more responsive to taxation than ordinary capital income. Correctly interpreting entrepreneurial income is a critical component of accurate tax analyses of the self-employed. In principle, entrepreneurial income can be estimated empirically. Yet this is admittedly difficult, not least because of underreporting. The opportunity cost of labor and capital should be disentangled from total proprietors' income. More importantly, truly entrepreneurial ventures should be distinguished from non-entrepreneurial self-employment.

There are at least three mechanisms that contribute to the underestimation of entrepreneurial income as a share of GDP and two that leads to overestimation. Underreporting to evade taxes is the first and perhaps the most obvious mechanism—proprietors' earnings are more underreported than any other income source in the US (Slemrod 2007). Second, it is easy to forget that much entrepreneurial activity takes place in large, publicly listed firms (e.g., Apple), in which the return manifests itself as capital gains and dividends for Steve Jobs and the like. Lastly, only a small fraction of Schumpeterian returns to innovation tend to be captured by entrepreneurs themselves. Nordhaus (2004) estimates this figure to be as low as 2.2%, even when taking into account innovations by both independent entrepreneurs and within large organizations. The rest accrues to consumers in the form of lower prices and improved quality. This mechanism leads to an underestimation of the importance of entrepreneurship for national income, although it does not result in an underestimation of the earnings of individual entrepreneurs. Almost all measures of entrepreneurial income use self-employment income as a proxy, which leads to an overestimation since large part of self-employment is non-entrepreneurial. Another category usually identified as self-employed includes the more or less pure capitalists, who own firms without participating in the firm's activities (and perhaps are nominally recorded as holding a management position). This distinction may be a matter of degree, not least with respect to the life cycle. An entrepreneur who builds a firm in his or her career but has effectively retired may still own a large part of the firm. These measurement problems are substantial, but not unmanageable. Most data sources can weed out at least some of the non-entrepreneurial self-employed by using measures of employment, number of clients/ customers, industry, firm growth, amount of capital, and so forth. Furthermore, while proprietors in many countries are more numerous than entrepreneurs, they tend to earn less on average and have low capital intensity so that proxies for entrepreneurial income and investment may nevertheless be attributable to true entrepreneurs. The degree of entrepreneurship may also vary. An owner of a franchised

restaurant is not likely to be as entrepreneurial as the founder of the chain, but probably more so than a hired manager with no equity stake. Whereas entrepreneurial income is difficult to measure, we can readily estimate the earnings of the self-employed. Average earnings of the self-employed constitute 10% of GDP in the OECD. Not surprisingly, the income of the selfemployed is strongly correlated with the share of the workforce that is self-employed, with a correlation coefficient of 0.73. This article mainly discusses entrepreneurial and self-employment income in the context of taxation. However, there is value in adding a third factor of production and a third source of factor income to economic analysis in general. The question of income distribution and the relative earnings of capitalists and workers illustrate this fact. Both standard neoclassical and Marxist analyses have focused on the breakdown and distribution of national income between workers and capitalists; adding the selfemployed to the picture improves our understanding of income distribution. When the self-employed share is taken into account for 23 OECD countries, the dispersion of factor income across countries decreases, as the combined share of labor and self-employment of GDP has a variance that is only about half of that of the labor share alone. Furthermore, the share of GDP that goes to workers and the self-employed (and is thus earned through effort) is considerably larger than indicated by the labor share. For countries like Greece or Italy, where a large fraction of the economy consists of self-employment, labor and capital shares alone are likely to be misleading indicators of income distribution. After decreasing for many decades, self-employment income began to increase again in the early 1980s. In 2008, net non-farm self-employed income in the US was estimated at 1,050 billion dollars. Again, adding self-employment factor income to the usual capital labor division enriches the analysis. The increase in proprietors' income as a share of GDP accounts for 40% of the 4 percentage point decrease in the US labor share between 1980 and 2008.

1.4 Entrepreneurship as a Distinct Factor of Production

In order to achieve simplicity and analytical tractability, economic theory merges inputs into broader categories that are then used in production functions. To be specific, manufacturing workers, engineers and janitors are classified as labor, whereas factory buildings, machines and patents are classified as capital. These distinctions are based on the premise that factors differ from one another in crucial respects. The classifications are thus somewhat arbitrary. It is also important to recognize that the distinctions are economic, not descriptive. For this reason, the appropriate level of aggregation of inputs into factors of production depends on context. It is important to be able to separate the return to human capital from the returns to raw labor and general capital (Schultz 1961; Becker 1962), and distinguish "pure" land rents from total land income (Ricardo 1817; George 1879/1911). Similar to other economic inputs, entrepreneurship is valuable and scarce (Schultz 1979), has a definable (although hard to measure) quantity, and a shadow market price. In certain (but far from all) situations involving entrepreneurs, including entrepreneurial income as separate from labor and capital income increases analytical clarity. We believe that taxation of the self-employed is one such area. The entrepreneurial production function we have in mind includes the value of innovation and/or entrepreneurial talent, effort in the form of hours worked, and capital, broadly defined as any assets that are not consumed. Crucially, these factors are assumed to be complements. The entrepreneur often "creates" the capital of the firm by investing in tangible and nontangible assets that in time create a return, such as developing the product and building firm structures. At any given moment, this capital requires a continued commitment on the part of the entrepreneur, whether or not it is sold externally at value. The growth of the firm is often financed through retained earnings until the point when the firm is sufficiently developed so that it can be sold, or produce cash flow that can be

withdrawn by the owner without difficulty. Thus, the quantitatively important saving decision does not constitute the initial capital injection, but rather the fact that entrepreneurs refrain from withdrawing the equity value of their firms before they have matured in terms of production efficiency and asset tradability. The entrepreneur is rewarded for both effort and the postponement of consuming firm equity into an uncertain future. But the earnings of owners–managers are likely to be more complicated than a simple additive sum of capital and labor. Successful entrepreneurial firms need several components that are hard or nearly impossible to purchase externally. These include product or business ideas, sufficient managerial skills to implement innovations, and the willingness to exert time and effort to realize an uncertain outcome. Because of well-known agency costs, entrepreneurs must provide a significant share of requisite capital themselves. Lastly, these requirements must be combined with the postponement of consumption (and additional risk taking) in one individual—the entrepreneur. The inability to decouple saving, investment and effort incites the need for entrepreneurial talent and opportunity to intersect, unlike labor and capital markets. As a result, the supply of entrepreneurship tends to be more constrained than labor or capital supply of the individual entrepreneur, explaining the above-market returns earned by entrepreneurs (controlling for capital and labor output). Moreover, potential entrepreneurs with high-quality ideas and talent are few and far between. High risk, high uncertainty, large demands on effort, lack of access to capital markets and long time lags before expected returns reduce the number even more. This is especially true since the best potential entrepreneurs tend to have the most valuable outside options. While an external market for entrepreneurship does not exist, demand for products produced through entrepreneurial activity translates into a derived demand curve for entrepreneurship. Empirical observations have illustrated that entrepreneurs behave differently than comparable wage earners. One such aspect is the higher income elasticity with respect to taxes. Studies from many countries have consistently shown that the selfemployed tend to have a higher

elasticity of taxable income than employees (e.g., Sillamaa and Veall 2001; Chetty et al. 2009; Hansson 2009; Kleven and Schultz 2009, Saez 2009). Some of this higher responsiveness is likely to be behaviorally deep, while some is shallower. The self-employed usually have more flexibility in reporting income, shifting it across taxable categories, and substituting it intertemporally. For example, the self-employed are far more likely to locate at "kinks" in tax schedules. Relative taxation compared to wage earners also influences the choice of whether to become selfemployed, although the direct effect seems more important (Bruce and Gurley 2004). Business owners tend to enjoy more opportunities to evade taxes than wage earners. However, this type of self-employment is distinctly separate from entrepreneurship. Considering self-employment actually leads to an underestimate of the disincentives on entrepreneurship caused by a high general level of taxation, as the share of non-entrepreneurial self-employment is likely to be positively related to the tax level. Firm growth, investment, hiring of outside labor and personal effort have all been shown to be significantly affected by taxes (Carroll et al. 2000a, b, 2001; Rosen 2005). Several factors may describe the difference, such as the complementarity of capital returns and effort, or the self-employed's greater discretion in defining working hours and other margins compared to hired labor. In addition, higher marginal income taxes have been blamed for discouraging entry into entrepreneurship (Gentry and Hubbard 2000). Taken together, the empirical response of the self-employed to taxation supports the approach of including entrepreneurship as a distinct factor in the specific context of the taxation of entrepreneurial income.

1.5 Are Above-market Returns to Entrepreneurs Windfall Gains?

Imagine a production function with three factors of production: labor, capital and entrepreneurial effort. If such an economy is approximated with a production function that

only includes capital and labor, it is likely that we would appear to observe excess "rents" in areas of the economy intensely coupled to entrepreneurship. This is an artifact of the incomplete production function, and it would clearly be mistaken to believe that such "rents" could be taxed without efficiency costs[4]. Taxation theory frequently assumes that a rate of return above the market rate is a form of windfall gain or "rent," and is thus immune to taxation (e.g., Sørensen 2001). Hubbard (1997) discusses investments with "inframarginal returns," namely investment decisions that generate above-market rate of return due to superior ideas or managerial skills. Shaviro (2004) suggests that these returns constitute rents and that they are therefore worth exploiting regardless of the tax rate[5]. When including entrepreneurs in models, however, inframarginal returns do in fact become sensitive to taxation. Because these returns represent entrepreneurial income—the joint reward for effort, risk, uncertainty and the search for innovation—this policy conclusion no longer holds true. "Rent" is often used to describe earnings obtained through the diversion rather than creation of wealth[6]. Alternatively, they describe the return to fixed assets where appropriation is costless (e.g., land rents). Entrepreneurial rents, on the other hand, tend to reward innovation and the supply of entrepreneurial effort, which can be expected to be elastic in regard to rents[7]. If so, entrepreneurial "rents" do not differ much conceptually from the "rent" of workers (wage income) and the "rent" earned by savers (interest rate). Hence, the term "rent" can be misleading when analyzing the returns to entrepreneurship. Nor does it seem sufficient to ascribe the above-market returns of entrepreneurs to the simple arithmetic sum of labor and capital earnings. Instead, these returns more closely resemble those earned by factors of production, and should thus be referred to as entrepreneurial income.

[4]The controversy of how factor income should be separated from labor income is old (Marx 1891). Arguably one theoretical mistake of Marxism with considerable policy implications was assuming only one factor in the production function (labor), where at least two are needed for reasonable analyses.

[5]He also touches on the problem of conceptually separating capital from labor and various components of capital income, for example when effort and capital are combined.

[6]Entrepreneurs are rent seeking in the literal sense of the word, but not in the confiscatory sense most commonly used in public choice theory (e.g., Tullock 1967).

[7]Disregarding potentially offsetting income effects.

1.6 Taxation of Entrepreneurial Firms

1.6.1 Effective Taxation as a Function of Ownership and Source of Finance

The firm's cost of capital lies at the heart of the theory of taxation (Hall and Jorgenson 1967; Jorgenson 1963, 1967). King and Fullerton (1984) document that by the 1970s, effective tax rates on business income came to differ tremendously in rich countries depending on financing and ownership categories. Taxes favored debt as a form of financing, whereas new equity issues were penalized. In general, businesses held directly by individuals and families were taxed much more heavily than other ownership categories. These differences in effective tax rates can greatly affect the organization of business activity and the industry mix of productive activity[8], and therefore also incentives for entrepreneurship. To the extent that debt financing is less costly and more readily available for larger and more established firms, high statutory tax rates coupled with tax-deductible interest payments work to the disadvantage of smaller firms and potential entrepreneurs. Smaller and medium-sized firms do not only have lower average access to debt, the tax advantaged finance instrument. They are also more sensitive to the ebbs and flows of the credit cycle, a salient fact in 2008–2009. The argument has been made that innovative activities of small and medium-sized firms is especially disparately impacted by the tax advantage given to debt (Achleitner et al. 2009). Debt financing is also more easily available to firms with ready forms of collateral. Hence, firms and sectors that largely utilize physical capital reap greater benefits from tax code provisions that favor debt financing. This aspect of the tax system favors capital-intensive industries and modes of production over labor and knowledge intensive ones, which works to the detriment of entrepreneurial, often equity-constrained firms. In time, the wave of tax

[8]See, e.g., Rydqvist et al. (2009), who show how the tax system endogenously induces changes in the ownership structure favoring institutional ownership. For a case study discussing the evolution in the UK, see Bank and Cheffins (2008).

reforms that swept the OECD in the 1980s evened out many of these differences (Jorgenson and Landau 1993).

1.6.2 Application of the Principle of Neutrality

The criteria of neutrality of the marginal cost of capital is arguably too narrow; all changes in behavior resulting from ownership taxation should be included as potential distortions, in addition to the cost and source of capital. Keuschnigg and Ribi (2009) introduce moral hazard and derive financial constraints from this assumption. They then show that profit taxes affect investment, although not through the cost of capital, but through the effect on cash flows. Taxes distort not only the volume but also the direction of entrepreneurial supply. For example, they push entrepreneurial supply towards non-taxed "consumption" in the form of managerial control and empire building (Schumpeter 1934), or more hobby-oriented ventures rather than wealth creating schemes. Apel and Södersten (1999) argue that taxing equity returns may stimulate small-firm investments under certain conditions. They achieve their result with a model in which the stock and debt instruments of large firms are traded internationally, while small firms are financed locally. But these results stem from the effects on portfolio allocation in a model of small firms from which saving and investments are abstracted. In this framework, taxes lower the entrepreneurs' cost of capital by "pushing" funds away from large firms as savers adjust their portfolio holdings in response to taxes. While the argument is valid in a narrow sense, the result is nevertheless misleading. Our attention is directed by a model's structure; in this case, the assumption of a fixed supply of capital limits the focus to a secondary effect of portfolio adjustment. Clearly, it is more important to study incentives for wealth creation and potential tax-induced distortions rather than the potential taxdriven reallocation of assets that are simply assumed to exist. This has been one of the main flaws of the so-called "new view" of dividend taxation. The "new view" was originally developed for publicly owned firms, but the framework has

come to be applied to owner-managed firms as well. Indeed, one could argue that this class of models constitutes the intellectual basis for the Nordic system of dual income taxation of entrepreneurs. The division between the "new view" and "old view" has been a central theme in capital taxation theory, revitalized after the quasi-experiment of the 2003 dividend tax cut in the US. Harberger (1962) outlined the principles behind the old view, writing that private capital taxes adversely affect productive investment. In a frictionless world, taxes are less distortionary for firms that exclusively use the least taxed source of finance (Modigliani and Miller 1958). Since debt is the source most favored by taxes, all investments would then become debt financed, equalizing the marginal cost of capital with the interest rate (Stiglitz 1973). This "neutrality view" is clearly at odds with observed real-life behavior of firms. The new view (King 1974, 1977; Auerbach 1979; Bradford 1981) acknowledges instead that firms use a mix of debt and equity finance, not least to counter agency problems arising because of full debt financing. Nevertheless, the new view holds that dividend taxes should still be considered neutral whenever firms use retained earnings to finance the marginal investment[9]. Dietz (2005) develops a model that takes entrepreneurial financing decisions into account, concluding in turn that capital income taxation distorts the size distribution of firms. While already existing, publicly listed firms can use retained earnings as the (marginal) source of finance, dividend taxes are anticipated by entrepreneurs who consider the discrete choice of starting new firms and discourage some from doing so. Kanniainen et al. (2007) demonstrate that the dividend tax can create an entry barrier for firms and investments. After taking agency problems into account, Keuschnigg and Nielsen (2004) reveal that taxes impair entrepreneurship by reducing managerial support from the venture capitalists. For their part, Cullen and Gordon (2007) thoroughly evaluate the effects of taxes on entrepreneurial risk taking, considering both the risk-sharing element and the option value that exists in the US for successful firms to lower taxes through incorporation. Morck and

[9]Auerbach (2002) investigates the differences between the old and the new view, highlighting the assumed source of marginal investment as the driving force behind the conflicting results of the two theories.

Yeung (2005) find that firms responded to the cut in the dividend tax by increasing dividend payouts. They interpret this as an improvement on economic performance, since dividends reduce the agency problems stemming from excessive retention of cash flows (Jensen 1986). Poterba (2004) obtains the same result, arguing that the response to the 2003 tax cut lends support to old view predictions. Chetty and Saez (2005, 2006) suggest that the tax cut led to improved capital allocation, as the firms most likely to have fewer investment opportunities increased payouts by the largest degree. Our argument treads a parallel to these results and conclusions. Oversimplification has doomed the new view to underestimate the distortions of dividend taxation, a result of the assumption that different forms of capital are essentially perfectly substitutable. Because they fill other important roles, however, dividends are used despite tax disincentives, such as to reduce agency problems between management and owners. Chetty and Saez (2007) explicitly model agency problems in mature firms and find that dividend taxes distort investment decisions in such a setting.

1.6.3 Dual Taxation and the Self-employed

Models of dual taxation that claim that taxing the selfemployed is essentially a "free lunch" face the same problem, for similar reasons. If entrepreneurship is included in the models, the conditions for optimal taxation in theories of capital taxation change (Kanniainen et al. 2007). The neutrality result for the Nordic system of dual taxation is based on assumptions that may not correctly predict the economic behavior of entrepreneurs. Both sets of models fail to include the constraints that firms face regarding finance and incentive alignment. Entrepreneurial firms cannot solely rely on reinvested earnings and will indeed anticipate the trapped equity effect before startup. Distortions arise because capital cannot flow without cost between entrepreneurs with access to investments and firms with equity that has already been "trapped." The same mistake is committed in a broad class of investment models that examine a firm's investment choices. The problem begins when a firm is already

endowed with capital or access to financial markets, complete with the choice of various projects. The firm should invest if the return from the project exceeds the cost of capital by any proportion—the relationship between the rate of return and the cost of capital is all that matters. If the government allows a tax deduction for the cost of the investment, the two margins decrease at the same rate, and any previously profitable investments are also profitable after taxation by the same percentage (the absolute dollar return is lower and transferred to the government). This is seen as a neutral tax on "pure profit"[10]. The most serious problem with this analysis is its static nature. Even at the outset, the seemingly natural assumption that the returns be measured in percentage terms is greatly misleading. In many ventures, the profitability of capital is influenced by costly activities, such as ex ante search costs or ex post entrepreneurial effort. These costs are better expressed as fixed amounts rather than percentage returns and are carried by factors of production other than capital. Simple adjustments like this may suffice to overrule the neutrality assumption so often invoked in models of capital taxation. Such "fixed" extra-investment costs are more likely to be important in entrepreneurial ventures, rather than passive portfolio investments. The neutrality result only holds if firms hire entrepreneurs to search for ventures with above-market returns and subsequently exert the optimal amount of entrepreneurial effort to maximize these returns. Stiglitz (1988, p. 539) alluded to the problems involved with the neutrality result of capital taxation: "Some of the return may be attributed to managerial effort, in which case the difference between the present and discounted value of the returns and the direct costs (excluding those associated with management) is a mixture of pure profits and return to management and entrepreneurship." The deeper reason why both sets of theories can give rise to misleading results is an insufficient consideration of the agents making investments. While firms "should" rely on organic growth or "should" use capital gains instead of dividends, they do not do so to the extent that models free from

[10]A rudimentary version of this argument was already put forward by the Cowlyn Committee in Britain in the 1920s as a justification for the non-distortionary effects of profit taxation.

transaction costs predict. Disparity between model predictions and economic behavior is not likely to be due to irrationality on the part of the firms and entrepreneurs, but rather indicates that the models are missing some relevant characteristics. The fact that investors are willing to use financial tools with tax disadvantages, such as dividends, testifies to the substantive economic role of these devices.

1.6.4 Misapplying Domar–Musgrave's Results Concerning Risk Sharing Through Taxation

Revealed preferences and market behavior also prove informative in attempting to resolve another important controversy in firm taxation. The classical result of Domar and Musgrave (1944) that taxes can encourage risk taking has in some cases been used to justify high taxes on entrepreneurs (SOU 2002, p. 52). This risk sharing result in the Domar–Musgrave framework derives from the assumption of full loss offset, meaning that the government is in effect a silent partner in any business venture. Some of the gains are taxed away if the investment is successful, but the state also compensates the investor if it fails. However, no real-world tax system offers full loss offsets, as the risk for abuse and moral hazard is too substantial. A full loss offset rule would dramatically lower the effective tax rate, so that sharply higher statutory tax rates would be required for any given revenue, thereby increasing the marginal distortion of taxes. Furthermore, such rules would increase costs even further by creating transactions solely intended to lower taxes, such as purchases of loss-making firms. Nevertheless, the assumption of full loss offsets is frequently used (e.g., Keuschnigg and Dietz 2007). The practical difference between full loss offset and the actual rules of most tax systems is particularly important for entrepreneurial ventures, in which complete bankruptcy constitutes a vital part of the financial risk. Large established firms can often mitigate this difference between the theoretical and the practical, however, by offsetting the tax rebates generated by losses against existing profits in other ventures. As mentioned

previously, the risk-smoothing effects of taxes are less relevant for entrepreneurial income because of the mechanism through which entrepreneurial effort influences the investment cost function. Similar to new view theories, the risksmoothing framework models investment as a positive- sum gamble without entry cost and without the ability to influence the outcome by exercising effort. Entrepreneurial effort is, however, tantamount to a fixed cost of investment, and can also influence the likelihood of success; it is tax deductible in neither case. For most startups, the non-deductible opportunity cost of the entrepreneur widely exceeds initial capital investment. This is especially true of those startups that are most likely to evolve into successful firms, usually started by experienced and highly skilled entrepreneurs with attractive outside options. Taxes on the return of entrepreneurial effort entail no risk-smoothing advantages (as opposed to the Domar–Musgrave risk-sharing assumption) and are not symmetrically deducted from the investment cost (as opposed to the new view investment function). In order to evaluate the trade-off between tax and risk, the model in question should be able to account for why individuals choose to absorb non-diversified risk in the first place. Risk sharing with the government through taxes would be welcomed by investors if the individual absorption of risk occurs because of missing markets. However, there is an additional condition that must hold which is oft-neglected: the causes for the failures in financial markets do not apply (or apply to a lesser degree) to the state. For example, private markets lack the ability to share risk across generations. It is important to not make the flawed assumption that missing markets alone justify government risk sharing. Unless the government can reduce transaction costs, no efficiency gain will be had; what's more, intervention can exacerbate the problem. Markets for external finance may be missing or rationed due to agency problems, causing entrepreneurs to be less careful with outside money. In that case, government risk sharing would not solve the moral hazard problem; it would simply ignore it, leading to further inefficiency. As noted by Kaplow (1995), if "entrepreneurs voluntarily bear nonsystematic risk to improve their incentives, the provision

of government compulsory partial insurance through taxation would be welfare reducing."

1.6.5 Further Speculation on Taxation and Risk Sharing

Leaving aside whether risk is diversifiable, the Domar–Musgrave risk-smoothing framework analyzes calculable risk. However, influential arguments have been made that measurable risk should be distinguished from uncertainty (Knight 1921; Keynes 1921). Whereas risk depends on a known probability distribution of an event, uncertainty refers to future outcomes; the probability distribution is unknown, and outcomes cannot be calculated. Knight famously suggested that the entrepreneur's central role in the economy is to absorb, manage and reduce uncertainty. Despite this, a discussion of uncertainty has remained absent from models of taxation of entrepreneurship/entrepreneurs. Knightian uncertainty is often acknowledged as important, but it has proven difficult to model and close to impossible to measure. The discussion here is therefore speculative. It may indeed be more realistic to view most probabilistic events in the unknown as a mixture of risk and uncertainty. While the probability distribution of non-trivial experiments is seldom precisely known, forming some measure of the probability distribution is in most cases quite possible. Taking uncertainty into account influences the analysis of taxation. Because uncertainty can be reduced by investing time and effort in learning, the entrepreneur's handling of uncertainty differs crucially from risk. Indeed, transforming incalculable uncertainty into calculable risk may be viewed as one of the central roles of entrepreneurship[11]. Yet the classic models of taxation of risky investments fail to include this type of investment. If entrepreneurial learning that reduces uncertainty is socially beneficial, taxation of profits decreases the incentives for engaging in a valuable activity. This welfare result would stand in contrast to the effects of taxation in a model that includes risk but not uncertainty and learning.

[11]Entrepreneurs are not alone in facing uncertainty. Large public firms that enter new markets, governments that deal with new types of economic crises or agencies that attempt to explore space all face uncertainty. The arguments here only presuppose that entrepreneurs face some uncertainty, not necessarily that they face more or most of the uncertainty in the economy.

1.6.6 Taxation of Entrepreneurial Function or Organizational Form

Entrepreneurship is a function that usually occurs within the contractual form of self-employment. The state is incapable of directly taxing the function, and is thus restricted to mandating rules for entrepreneurship's most common guise: the owner-managed firm. Taxation is not the only capacity to suffer from the problem of observing an imperfect proxy of entrepreneurship; all public policy toward entrepreneurship shares the same fate (and, for that matter, all empirical investigations of entrepreneurship as well). Evaluating the extent of this problem depends on which theory of entrepreneurship one adheres to. Theories that emphasize rapid growth and innovation see a clear contrast between truly entrepreneurial firms and the vast majority of the non-innovative self-employed. Indeed, such a theory holds that the entrepreneurial self-employed are more similar to large innovative firms than to other self-employed firms[12]. At one extreme, many self-employed firms are pure tax entities, engaged in no entrepreneurial activity whatsoever; this consideration has, for example, dominated the design of the Nordic dual system. Theories that emphasize residual property rights or the market's responsiveness would see more of a continuum separating the "purest" entrepreneurial firms from other self-employed. The selfemployed restaurateur cannot be compared to the founder and operator of a Silicon Valley startup, but she is still more entrepreneurial than the hired manager of a chain restaurant. While no tax system can be geared perfectly toward the entrepreneurial function, taxes should at least not punish the form in which entrepreneurship often takes place. Furthermore, some of the issues we discuss here, such as credit constraints, are not unique to the entrepreneur; they may also apply to the nonentrepreneurial self-employed, who enjoys a role of her own in the economy.

[12]A thorough discussion of the tax treatment of intrapreneurial talent is beyond the scope of this paper. We can simply note that the innovative intrapreneur is likely to work in rapidly growing sections of firms, and be rewarded with residual property rights that emulate ownership, such as stock options, more than other employees. Thus, the taxation of stock options and similar reward instruments are likely to be especially important for the behavior of intrapreneurs.

1.7 The Nordic dual income tax

The dual income tax was introduced in Sweden, Norway and Finland as part of comprehensive tax reforms. In specifying the details of the tax system, the economic theory of taxation has in part driven policy formation in Sweden (Agell et al. 1998; SOU 2002, p. 52; Lindhe et al. 2004; Sørensen 2008). This also holds true for other Nordic countries (Sørensen 2001). According to the electorate's standard political preferences, labor should be taxed less heavily than capital, both on average and on the margin. Income from one's own toil is often considered more legitimate than investment income. Moreover, it is more evenly distributed than capital income. Yet, most dual tax systems impose lower and often flat tax rates on capital, while taxing labor income heavily and progressively. This occurs because dual taxation attempts to strike a compromise between the goals of efficiency and equality. The regressive effect of taxing capital at a lower rate is accepted since dual income taxation makes it easier to tax skilled workers at higher rates[13]. Differences in the sensitivity of tax bases dictate the dual tax's attraction (e.g., Sørensen 1994; Cnossen 2000). Capital income is thought to be more responsive to both the level and to the progressivity of the tax rate. While capital is transferable, human capital is almost completely tied to specific individuals. Capital can flow across national borders at low cost, whereas labor/human capital mobility requires migration[14]. The same underlying difference makes capital more sensitive to high levels of progressivity, as well as to the average level of taxation. While it is relatively easy for the rich to transfer ownership of financial capital (for example, to kin) in order to reduce the marginal rate, labor income is closely tied to the individual and

[13]Cnossen (2000) argues that high marginal taxes on labor are a better way to reduce inequality than capital taxation, since the latter taxes the choice to postpone consumption, while the former is a tax on innate ability. He adds that "rank and status in modern societies are related less and less to differences in wealth and more and more to differences in human capital." However, the distinction is far from obvious. Innate ability only translates into high income through effort and human capital investments, both of which are sensitive to taxation. In any case, wealth holdings tend to be strongly correlated with high wages, so that both taxes tend to fall on the same individuals.

[14]Additionally, both capital and in particular labor can internally "migrate" into the black market or to untaxed household production as a response to taxes (Davis and Henrekson 2005, Prescott 2004).

is thus hard to transfer. Several European countries have moved elements of their tax system towards the dual income model (Eggert and Genser 2005; Genser and Reutter 2007). Prominent economists have advocated introducing a dual income system in the rest of Europe and elsewhere (Sørensen 2009). Cnossen (2000) suggests that the Nordic dual income tax system should be adopted by the European Union as a whole. He argues that this would enable high progressive tax rates on labor income when coupled with low taxes on capital (for efficiency reasons). But this principle becomes somewhat less clear cut when considering the self-employed. In general, tax authorities divide the surplus of entrepreneurial firms into capital and labor income. In turn, the state specifies a presumed return on parts of the firm's equity to determine the capital share. Dual income tax systems' separation of capital income from progressive income taxation of wages is said to help small, open economies strike a better balance between multiple policy goals, such as attracting mobile international capital while maintaining high redistributive expenditures (e.g., Zodrow 2006; Cnossen 2000). Keuschnigg and Dietz (2007) propose introducing a dual income tax in Switzerland. Their analysis is primarily focused on the tax advantages of debt financing for large firms, but features a typically incomplete model of taxation of entrepreneurial firms. One important problem stemming from the dual taxation of the self-employed in Nordic countries is resolved by proposing that the effective tax on capital income be set equal to the highest marginal tax on labor income. This eliminates both the incentives for arbitrage and the need for complex income splitting rules. But Keuschnigg and Dietz (2007) are not alone in their approbation; the dual income tax is also viewed favorably by other leading capital taxation scholars. Zodrow (2006) writes that the dual income tax "deserves serious consideration by governments who are attempting to design capital income tax policy in the face of increasing capital mobility and international tax competition." However, the dual income tax system must first solve the problem of taxing entrepreneurs by not allowing the market process (in combination with accounting standards) to separate total income into eco-

nomically appropriate categories. Indeed, the administrative costs and potential distortive behavior that arise when the self-employed face different tax rates on income more or less artificially designated as capital and labor income have been referred to as "the Achilles heel of the dual income taxation system" (Sørensen 1994). We take this one step further, arguing that perfectly dividing the income of entrepreneurs into a capital and labor component is theoretically impossible, even when administrative obstacles are disregarded. Nor is there any economic law that says that the choice must be made between a dual and a uniform tax system. Based on analogous Ramsey-principle type arguments, one could, for example, imagine a triple income taxation system, in which capital income, wages and entrepreneurial income are taxed separately and at different rates. Under the Swedish dual income system of taxation, the "normal" rate of return of capital is imputed by the tax authority. Returns exceeding this level are assumed to be labor income and taxed at a higher progressive level. The normal rate of return is calculated as the risk free interest rate plus a risk premium determined by the state. In order to calculate the rate of return, the equity base of the firm must be calculated. However, the owner is not permitted to expand the firm's capital base using what the tax system views as labor income. So even if consumption is postponed and labor (or entrepreneurial) earnings are reinvested in the firm, the return on labor originating from investments will be taxed as labor earnings. This approach toes the philosophical line set by the labor theory of value, which saw labor as the original source of capital wealth, therefore attributing all subsequent earnings to labor. Such a system leaves entrepreneurs at a disadvantage compared to passive investors. This is true even if the split rate correctly reflects the average market rate of return of private equity. Since entrepreneurial investments are discrete in nature, and since entrepreneurs are not able to carry over losses from bad to good investments, a distortion will arise as a result. Assume that the split rate is indeed binding for investment decisions and that returns above 10% are taxed at 50%. Further imagine a risk-neutral investor who can invest in an entrepreneurial enterprise that

gives 0% return half the time and 20% return the rest of the time (the investment itself is always recovered). The entrepreneur can also invest in the public market and get a return of 8%. Even though the rate of return allowance is 2% points above the market rate in this example, taxation will induce the entrepreneur to make the socially less productive investment. This is so because good outcomes exceed the split rate, whereas bad outcomes cannot be netted against good outcomes. Such a tax rule would have been less harmful if it had been placed on returns on public equity, since it is possible to pool investments across many firms and projects. Ironically, with its assumption of risk smoothing, the tax system designed for owner-managed businesses is particularly ill-suited for characteristically discrete entrepreneurial investments. Kanniainen et al. (2007) demonstrate that the Nordic dual tax is seldom neutral. In particular, they examine the dual taxation system's impact on startups, where it affects investments, career decisions and the quality of entrepreneurs. This conclusion is reached in a model that incorporates startup decisions, uncertainty, and a schematic depiction of firms' growth life cycle (but not the joint supply of capital and labor). The principle of neutrality is itself not immune to criticism. It assumes implicitly the same responsiveness for all forms of taxed income, which is not always true. Sørensen (2005), for example, points to the potential conflict between neutral and optimal taxation that occurs when elasticities differ across different forms of capital. The introduction of dual taxation was itself based on the premise that the tax elasticity of labor and capital differed. This distinction is likely to hold equally true for entrepreneurial effort, a category that the dual income tax system ignores. While dual taxation highlights the difficulty of taxing entrepreneurial income under a model that implicitly assumes away the existence of entrepreneurial income, the issue is not unique to the Nordic dual system. Single income systems have the luxury to remain agnostic about the source of income from a tax collection viewpoint. However, modeling and estimating the source of the income of entrepreneurs are still important from other perspectives. For instance, disentangling the income of entrepreneurs is important for

national accounting (Gollin 2002). The recent debate about the highest marginal taxes in the US centered to a considerable extent around the incidence of taxes on small businesses, with opponents of the tax increase arguing that taxes on small business income would hurt entrepreneurial activity (e.g., Norqvist 2008; Wall Street Journal 2008). Indeed a sizable share of top incomes in the US emanates from small businesses. However, much of this is earned by high income non-entrepreneurs, who have incorporated for tax and legal reasons. Some is earned by non-entrepreneurial owners–managers, and some by entrepreneurs (yet another portion is earned by intrapreneurs, employees who pursue entrepreneurial activity). Disentangling these components is important for the policy debate and can only be done through a workable model of entrepreneurial income.

1.8 Concluding remarks

The inherited theory of capital income should not in its unadjusted form be used to evaluate the effects of taxation on entrepreneurship, as they abstract from key economic mechanisms that give rise to entrepreneurial income. This is not to deny that the cost of capital framework and the principle of neutrality have been valuable tools for economists and policy makers alike. But models derived from the behavior of public firms should not be applied to the taxation of entrepreneurial firms without proper adjustment. Entrepreneurial effort generally consists of the joint supply of labor and capital held by the unique owner– manager. Due to non-contractibility with external financiers, owners can rarely decouple their saving and investment decisions, and they are required to provide much of the initial financing of the firm themselves. Similarly, the labor supply decision of a proprietor is closely tied to investments, as the two are strongly complementary. The limited supply coupled with the significant value creation through the entrepreneurial process gives rise to expected returns that exceed the market return for the opportunity cost of work hours and postponed consumption. When properly defined, entrepreneurial income should thus not be considered as excess return that

can be taxed away without behavioral effects and negative welfare consequences. This has important implications for tax policy. When capital and labor are taxed separately, taxation of capital can affect the supply of entrepreneurial effort, and vice versa. Personal taxation of owners– managers may similarly affect firm expansion and hiring decisions, unlike taxes on passive owners. Thus, entrepreneurial income cannot be split into labor income and capital income as the dual income tax theory suggests. Another (empirically testable) implication of our arguments is that the cross elasticity of supply of entrepreneurial effort—in terms of hours and intensity—is positive and statistically and economically significant with respect to entrepreneurial capital. Conversely, the cross elasticity of supply of entrepreneurial capital is positive with respect to entrepreneurial effort. We would, for example, predict that the Nordic dual system reduces the supply of entrepreneurial capital both through less injections and through lower investments of retained earnings, even though the Nordic dual system ostensibly only adversely taxes self-employed effort. This prediction is in contrast to models based on the new view that analyze the Nordic dual tax and which predict that the cost of capital and the equilibrium amount of firm capital is unaffected by the tax on "labor" alone. Models of capital taxation can be misleading when applied to situations in which entrepreneurship is important. Such models have been used to analyze the taxation of small business owners, concluding in turn that this represents a "free lunch" in terms of distortions. This does not hold true when a broader set of decisions and constraints faced by entrepreneurs are taken into account. Still, these models have in many cases provided the basis for public policy. Future research in the theory of taxation should therefore pay attention to the particular nature of entrepreneurship, including aspects such as complementary resources provided by the individual entrepreneur and missing markets for entrepreneurial effort and uncertainty bearing. Due to the multifaceted nature of entrepreneurship, and the lack of one coherent and agreed upon model, entrepreneurship would in our opinion best be integrated into capital taxation theory in an incremental way. Likely the most fruitful outcome, in line

with the economic approach to market distortions, is to use separate models that each focus on a few assumptions underlying the base model. Separate models could each incorporate one or more unique aspects associated with entrepreneurial activity into existing models and analyze the implications. We have pointed to some assumptions, such as capital constraints and the joint supply of capital and labor, which we expect would alter the tax neutrality result.

Chapter 2

Taxation and the Quality and Quantity of Entrepreneurship

2.1 Introduction

Entrepreneurship is generally viewed as an important determinant of innovation and growth. For this reason public policy has focused on entrepreneurial activity and on the organizational form in which it often takes place; self-employment. One of the main components of entrepreneurial public policy in all developed countries is the taxation of the self-employed. However, the impact of taxation on entrepreneurial activity is not very clear. The empirical evidence for the impact of taxation on the level of entrepreneurship is generally inconclusive (Bruce and Schuetze 2004). One reason is that entrepreneurship is a somewhat vague concept, hard to exactly define and harder yet to measure. Another reason is that the theory on the relationship between taxation and entrepreneurship is ambiguous .

There are at least four ways in which taxation can effect entrepreneurial entry (Bruce and Gurley 2004). Most straight-forward, the effect of taxes is to lower returns from effort and risk taking; personal taxes on entrepreneurs are bound to reduce investments, hiring

and firm growth (Caroll et al. 2000a, 2000b, 2001). On the other hand, taxes can stimulate risk taking activities by compressing the distribution of after-tax returns, at least for the marginal investment, when losses are fully deductible (Domar and Musgrave 1944). Taxes can also increase self-employment if entrepreneurs face lower taxes than employees or if self-employment make it easier to evade taxes (Gordon and MacKie-Mason 1991, 1994; Gordon 1998; Bruce 2000; Cullen and Gordon 2002, Stenkula 2009).

Since entrepreneurial returns are more dispersed than wages, the progressivity of the tax schedule matters as well as the level. In an influential paper Gentry and Hubbard (2000) demonstrate that high marginal tax rates discourage entry into self-employment. The result that these "success taxes" discourage entrepreneurial entry is consistent with the risk-sharing framework of Domar and Musgrave (1944), since high marginal taxes enhance the asymmetry in a tax system where losses below bankruptcy level are not tax-credited.

The policy interest in taxes is not only in the number of self-employed but also in the value of the firms they create. Previous research however has focused only on the effect of taxes on the *quantity of entrepreneurship*, such as the share of entrepreneurs (or self-employed) or the probability that an individual enters entrepreneurship. However another interesting margin in terms of social and private value is the *quality of the entrepreneurial firms*. This depends on the importance of the innovation and of the class of the entrepreneur, and can also be a function of entrepreneurial effort. Clearly not all firms are equally successful or contribute equally to the general welfare of society.

In this paper we analyze the effect of taxes jointly on quality and quantity of entrepreneurship; we use a dynamic forward-looking framework where individuals decide to create firms by taking into account all future utilities and options. In various specifications we include progressive and proportional taxes, the relative tax rate on workers and the self-employed, the choice of effort given entry, and the importance of commitment to any given startup. Our results indicate that in a dynamic setting with a high level of commitment progressive taxes

can increase entry into self-employment, while reducing average quality of the firm. These findings are in contrast to the theoretical prediction of success taxes on entrepreneurship from Gentry and Hubbard (2000). The source of potential increase in self-employment due to taxes is also novel. It happens not through risk smoothing or tax evasion, but because progressive taxes reduce the alternative cost of pursuing a mediocre business idea rather than searching for a better one. If the start-up decision requires commitment and is associated with an alternative search cost for other (better) business ideas waiting has an option value[1]. Progressive taxes reduce this option value by disproportionately taxing the most successful firms. One implication of these results is that empirical investigation of the effect of taxation on self-employment can underestimate the distortionary effects of progressive taxes if (as is generally the case) only the quantity but not the quality of self-employment is studied.

Our results have parallels in the theory of equilibrium unemployment (Pissarides 1990; Ljungqvist and Sargent 1995) and in the investment under uncertainty literature (Dixit and Pindyck 1994). With risk and irreversible investments the issue of timing becomes important. There is an option value of waiting for better market prospects, similar to the entrepreneur in our model that can wait for a business idea with higher potential. While entrepreneurial entry is not touched upon by Dixit and Pindyck (1994), Panteghini (2007) uses this framework to analyze entrepreneurial investment decisions in a recursive setting, with the firm payoff follows a Brownian motion. The effect of progressive taxes on the quantity and quality of entry in our model are thus more broadly interpretable than entrepreneurial entry, and apply to any situation where investment now implies an alternative cost in terms of investment in the future.

[1]We abstract from the possibility that the worker might sell his/her entrepreneurial idea.

2.2 Quality and Quantity of Entrepreneurship

Entrepreneurship is a multifaceted phenomenon, distinct from other economic activities with respect to aspects such as risk, its dynamic nature (Schumpeter 1934), uncertainty (Knight 1921), alertness to change (Kirzner 1967) and managerial talent (Lucas 1978). The multiple aspects that distinguish entrepreneurship in general and the effects of taxation on entrepreneurial activity in particular have been proved difficult to capture with any one economic model (Henrekson and Sanandaji 2009). To the extent neoclassical economists have successfully modeled entrepreneurship they have highlighted a few of entrepreneurial characteristic in any single models, aware that this does not constitute a complete model of entrepreneurship (Lucas 1978; Kihlstrom et al. 1979; Kanbur 1982; Aghion and Howitt 1992; Cagetti and De Nardi 2005). Our focus will be on the effect of taxes on the timing of entry and how this impacts the total amount of self-employment and the average quality of the entrepreneurial firm. The potential entrepreneur decides whether to start a firm with a given entrepreneurial innovation or business idea or to remain employed and search for a new idea. Arguably the most important role entrepreneurs assume in the economy is that of innovators which is a motivation for our focus on the quality of the business idea. The quality of the firm also depends on the entrepreneurial effort exerted given startup which we will examine separately. Most other real life determinants of entrepreneurship are admittedly ignored.

The first important decision any prospective entrepreneur has to make is whether to start a firm or work for someone else. In our model each period the individual discovers an "entrepreneurial idea"; he then decides whether to use it to start a firm or to continue searching while remaining employed. The values of these innovations or business ideas differ, which represents the quality of entrepreneurship in our model. If the prospective entrepreneur does not act on the idea in a certain period it is assumed to be lost, reflecting the role of the entrepreneur as reacting to business opportunity in changing markets. Once a person decides

to start a firm he will earn profits that depend on the quality of the business idea. The share of workers that decide to start firms represents the quantity of entrepreneurship.

Quality can be thought of as representing the social value created by the firm. This can be through new technological innovations, new or improved goods or a more efficient ways of producing existing products. What is central is the recognition that entrepreneurial ventures differ in value generated for society. Identifying a market niche and opening a new restaurant in a neighborhood can be valuable entrepreneurship, but not as valuable as creating new concept that that leads to an entire chain of restaurants. From the perspective of policy makers it is not only important how many people become entrepreneurs. It also matters that these individual pursue the best possible ideas, exert high effort, bring together factors needed for successful ventures and create fast growing firms that create as many jobs and as much consumer surplus as possible. A proxy for entrepreneurial quality is the market value of the firm that they create[2]. Policymakers who wish to encourage entrepreneurship are seeking both quantity and quality. One "Google" is worth thousands of smaller entrepreneurial firms in terms of jobs, added value to gross domestic product or most other economic metrics of entrepreneurship.

We assume initially that the entrepreneur cannot search for new business ideas while managing his firms; this is the alternative cost of pursuing one project. We later relax this assumption and discuss how our results change. For simplicity we abstract from learning by doing: ideas cannot be improved upon once the project is pursued. Entrepreneurial ideas are not correlated over time. We also abstract from any general equilibrium considerations; in particular workers' wages are not determined in equilibrium but are given. This is not unreasonable as the entrepreneurial sector in most western economies is small and thus unlikely to affect equilibrium wages through the supply of labor (although the effect on the

[2]Admittedly this proxy is not faultless since, for example, markets are not perfect and not all consumer surplus is captured. It is however in our opinion a good first approximation.

demand of labor can be much more important). Lastly the behavior of other entrepreneurs does not change the returns faced by other potential entrants [3].

People who choose not to enter entrepreneurship and search for better ideas will earn a fixed wage and receive another entrepreneurial idea next period. Each period a certain fraction of entrepreneurs fails or quits and returns to the pool of workers. The wage rate is the same for all and can be interpreted as the relative advantage of employment vs. self employment. Crucially, the value of remaining as worker is the sum of wage income and the discounted option value of possibly discovering a better entrepreneurial idea in the future.

2.2.1 The Environment

The economy is populated by a continuum of infinitely lived agents of measure one. Each individual maximizes the discounted value of his life time utility, $\sum \beta^t u(c_t)$, where c_t denotes consumption in period t and β is the discount factor; β is strictly greater than zero and smaller than one. We will not analyze savings decision and further assume that agents are risk neutral. The utility function has the form $u(c_t) = c_t$, so that the problem facing the agent is to maximize the discounted value of consumption at present. Because of risk neutrality the Domar and Musgrave (1944) style variation smoothing effect of taxes on marginal investment are not included in the model, and are therefore not a driving mechanism for the results.

At the beginning of each period every individual receives an exogenous entrepreneurial idea, θ, drawn from a generic distribution, $F(\theta)$, defined over the positive interval $[\theta_l, \theta_h]$. Upon observing the value of θ the agent chooses between working on the market for wage w while looking for a better entrepreneurial idea or using the business idea to start a firm and earn the profit generated. Entrepreneurs receive the profits made by their firm, $Y_t^e = f(\theta_t)$;

[3]There is a theoretical justification for this assumption. Entrepreneurship is innovative in nature, and can open up new markets and opportunities for other entrepreneurs. For this reason, and in contrast to other factors of production, a higher level of preexisting entrepreneurship does not necessarily diminish the marginal return for other entrepreneurs (Henrekson 2007).

in our simplified economy $Y_t^e = \theta_t$.The value of the entrepreneurial idea, θ_t, is identically and independently distributed over time. Because there is no capital nor savings in the model $c_t = w$ for workers and $c_t = \theta_t$ for entrepreneurs.

2.2.2 Equilibrium

The problem can be written in a recursive form:

$$V(\theta) = \max\{V^e(\theta), V^s(\theta)\}$$

where $V^s(\theta)$ is the value function for the worker, and $V^e(\theta)$ is the value function for the entrepreneur. These value functions can be expressed as follows:

$$V^s(\theta) = w + \beta \int_\theta V(\theta) dF(\theta) \tag{2.1}$$

$$V^e(\theta) = \theta + \beta \left[pV^s(\theta) + (1-p)\, V^e(\theta) \right] \tag{2.2}$$

In formula (2.1) the integral value on the right hand side (RHS) is the discounted option value of waiting one more period and drawing one more time from the distribution of entrepreneurial ideas. Since θ is independently distributed over time this value is constant. This implies that $V^s(\theta)$ is constant with respect to θ.

The value function for the entrepreneur is the discounted value of the profit earned in the current period and of the profits earned in future periods, if the entrepreneurial activity continues. With probability p in fact the entrepreneur might be forced out of business and into the salaried-workers segment of the economy. As dependent worker however he might still be looking for a new entrepreneurial idea to create a new firm. The value function for the entrepreneur might be rearranged as:

$$V^e(\theta) = \frac{\theta}{1-\beta(1-p)} + \frac{\beta p}{1-\beta(1-p)} V^s(\theta) \tag{2.3}$$

notice that $V^e(\theta)$ is strictly increasing (linear) in θ.

We define θ^* as the "reservation entrepreneurial idea". It represents the level of entrepreneurial idea such that below it the agent will find it optimal to work in the market; for every idea above this level the agent will prefer to start a firm and earn a profit. In particular θ^* is defined as

$$\theta^* : \{\theta \in [\theta_l, \theta_h] : V^s(\theta) = V^e(\theta)\}$$

which implies:

$$\begin{aligned} V^s(\theta^*) &= \frac{\theta^*}{1-\beta(1-p)} + \frac{\beta p}{1-\beta(1-p)} V^s(\theta^*) \\ V^s(\theta^*) &= \frac{\theta^*}{1-\beta} \end{aligned} \tag{2.4}$$

Using the reservation value, θ^*, and (2.3) we can rewrite (2.1) as:

$$V^s(\theta) = \frac{1-\beta(1-p)}{1-\beta} \frac{w + \frac{\beta}{1-\beta(1-p)} \int_{\theta^*}^{\theta_h} \theta dF(\theta)}{1+\beta p - \beta F(\theta^*)} \tag{2.5}$$

θ^* will then be the solution to

$$w + \gamma \int_{\theta^*}^{\theta_h} \theta dF(\theta) = \frac{\gamma \theta^*}{\beta} \left[1 + \beta p - \beta F(\theta^*)\right] \tag{2.6}$$

with $\gamma = \frac{\beta}{1-\beta(1-p)}$. In the appendix we discuss the conditions required for the existence and uniqueness of this equilibrium.

The partial equilibrium model outlined above has certain useful features that will allow

us to capture important determinants of entrepreneurial entry. This is not to deny some limitations, such as not taking into account the effects of entrepreneurs' decisions on the rest of the economy. As we explained above this is a smaller problem if the entrepreneurial sector is small with respect to the rest of the economy *in the mechanism investigated*, such as the supply of workers (entrepreneurs probably have a more important role in determining productivity growth and the demand for labour). One could expand the model with an additional sector, such as a traditional corporate sector, and set the wage equal to the marginal product of that sector. The agent will then have to allocate labor between the two sectors and this will determine an equilibrium value for the wage. We do not think that this would add much to the intuition contained in the following sections, especially since the self-employed (of which only some are truly entrepreneurial firms) constitute about one tenth of all workers in most advanced countries.

2.3 Taxation and Entrepreneurial Entry

This section investigates the effect of taxation on the decision of starting a firm. We consider proportional and progressive taxes on business and labor income. Taxes on the self-employed should be interpreted as the effective personal tax rate of the proprietor from all income from business activity. Likewise, personal taxes should be broadly interpreted.

A first result is that proportional taxes do not affect entrepreneurial entry if the tax rates on business and capital income are equal (since other margins such as leisure are excluded). Our main result is that progressive taxes do have an effect on entrepreneurial entry even when the labor and business tax schedules are identical. In particular progressive tax schedules that decrease the workers' option value of waiting for a better idea result in a decline in the average quality of entrepreneurial firms accompanied by a reduction in the wait time to enter entrepreneurship, which increases the number of entrepreneurs in the economy.

2.3.1 Proportional Taxation

Let's call the proportional tax rate applied to business income τ_π and the proportional tax rate applied to labor income τ_w. The value functions (2.3) and (2.5) become

$$V^s(\theta) = \frac{1-\beta(1-p)}{1-\beta} \frac{(1-\tau_w)\, w + (1-\tau_\pi)\, \frac{\beta}{1-\beta(1-p)} \int_{\theta^*}^{\theta_h} \theta dF(\theta)}{1+\beta p - \beta F(\theta^*)} \tag{2.7}$$

$$V^e(\theta) = \frac{\gamma\,(1-\tau_\pi)\,\theta^*}{\beta} + \gamma p V^s(\theta^*) \tag{2.8}$$

and θ^*_τ is defined analogously to θ^* by:

$$(1-\tau_w)\, w + (1-\tau_\pi)\,\gamma \int_{\theta^*_\tau}^{\theta_h} \theta dF(\theta) = (1-\tau_\pi)\, \frac{\gamma \theta^*_\tau}{\beta} \left[1+\beta p - \beta F(\theta^*_\tau)\right] \tag{2.9}$$

It is immediate from (2.9) that if $\tau_w = \tau_\pi = \tau$ then θ^*_τ does not depend on τ and that $\theta^*_\tau = \theta^*$. In other words, when business and labor income are taxed at the same rate entrepreneurial entry is not affected.

Let's consider the case where $\tau_w \neq \tau_\pi$. We re-write (2.9) using the known result

$$E(x) = \int_a^b x dF(x) = \int_a^b (1-F(x))dx - [(1-F(b))b - (1-F(a))a]$$

which in our case implies

$$\int_{\theta^*_\tau}^{\theta_h} \theta dF(\theta) = \theta_h - \int_{\theta^*_\tau}^{\theta_h} F(\theta) d\theta - F(\theta^*_\tau)\theta^*_\tau$$

Using this result, writing $\theta^*_\tau = \theta^*_\tau(\tau_w)$ and differentiating (2.9) with respect to τ_w we get

$$\frac{d\theta^*_\tau}{d\tau_w} = \frac{-w(1-\beta(1-p))}{(1-\tau_\pi)\,(1+\beta p - \beta F(\theta^*_\tau))} < 0 \tag{2.10}$$

An increase in the tax rate on wage decreases the threshold level for entrepreneurial entry;

this implies that as taxes on labor income increase more individual will decide to become entrepreneurs but the quality of the average firm will decrease. Moreover this implies that when $\tau_w > \tau_\pi$, $\theta^*_\tau < \theta^*$. In other words when the tax on labor income is higher than the tax on business income more agents will choose to become entrepreneurs, and more will do so if the that tax is raised. This entry will be accompanied by a lowering of the average quality of entrepreneurs in the economy as agents with lower valued entrepreneurial idea are entering the sector.

The same way we can prove that

$$\begin{aligned} \frac{d\theta^*_\tau}{d\tau_\pi} &= \frac{-\beta \int_{\theta^*_\tau}^{\theta_h} \theta dF(\theta) + \theta^*_\tau \left[1 + \beta p - \beta F(\theta^*_\tau)\right]}{(1-\tau_\pi)\left[1 + \beta p - \beta F(\theta^*_\tau)\right]} = \qquad \text{using (2.9)} \qquad (2.11) \\ &= \frac{\left[1 - \beta(1-p)\right](1-\tau_w)\, w}{(1-\tau_\pi)^2 \left[1 + \beta p - \beta F(\theta^*_\tau)\right]} > 0 \end{aligned}$$

As in previous case this implies that when $\tau_w < \tau_\pi$, $\theta^*_\tau > \theta^*$. In other words when the tax on business income is higher than the tax on labor income less agents will become entrepreneurs (with respect to the case in which they are equal) and more will do this as the tax rate increases. This will be accompanied by an increase in the average quality of entrepreneurial firms as the low value ideas are those that are discarded.

2.3.2 Progressive Taxation

Consider a simple progressive structure for taxation and call T_w the progressive schedule for labor income and T_π the progressive schedule for business income. Higher levels of income will be taxed with higher tax rates. In particular

$$\begin{aligned} T_w &= 0 \qquad & w < \hat{w} \\ &= \tau_w \qquad & w \geq \hat{w} \end{aligned} \tag{2.12}$$

$$\begin{aligned} T_\pi &= 0 \qquad & \theta < \hat{\theta} \\ &= \tau_\pi \qquad & \theta \geq \hat{\theta} \end{aligned} \tag{2.13}$$

where $\tau_w > 0$, and $\tau_\pi > 0$. To further simplify the problem and allow us to make some interesting comparisons, let's assume that $\tau_w = \tau_\pi = \tau$ and $\hat{\theta} = \hat{w}$. The tax schedules are the same for labor and business income. We illustrate now different cases that may arise depending on the shape of the tax schedule, i.e. the relative position of $\hat{\theta}$, θ^* and w. Figure 2.1 illustrates graphically the equilibrium point θ^* when $\theta^* < \hat{\theta}$.

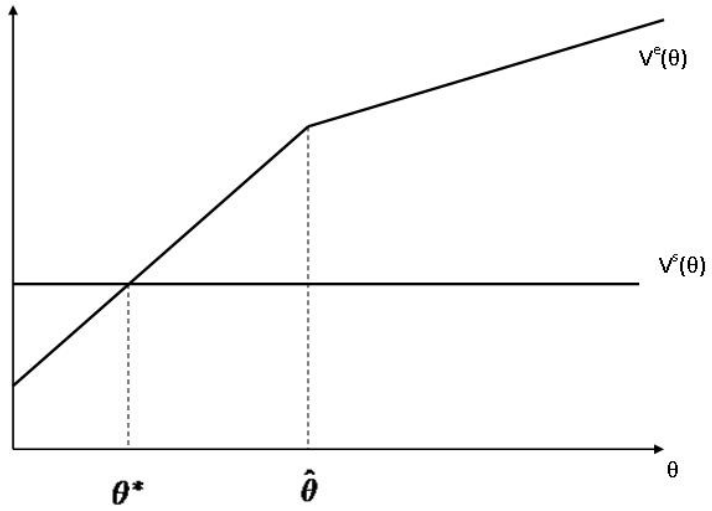
2.3.2.1 Case 1: $\hat{\theta} > \theta^*$

In this case the value functions can be written as

$$V_\tau^s(\theta) = w + \beta V_\tau^s(\theta) F(\theta_\tau^*) + \gamma p V^s(\theta) + \frac{\beta}{1-\beta} \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau \frac{\beta}{1-\beta} \int_{\hat{\theta}}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) \tag{2.14}$$

$$\begin{aligned} V_\tau^e(\theta) &= \frac{\theta}{1-\beta(1-p)} + \frac{\beta p}{1-\beta(1-p)} V^s(\theta) \qquad & \text{for } \theta < \hat{\theta} \\ &= \frac{\theta - \tau(\theta - \hat{\theta})}{1-\beta} + \frac{\beta p}{1-\beta(1-p)} V^s(\theta) \qquad & \text{for } \theta \geq \hat{\theta} \end{aligned} \tag{2.15}$$

Figure 2.1: Equilibrium



Notes: Graphical representation of a decision rule, θ^*. All individuals with an unobservable entrepreneurial idea, θ, above the threshold, θ^*, will choose to become entrepreneurs. The others will decide to be workers and wait for next period entrepreneurial draw. Entrepreneurial income has a kink because of the progressive nature of taxation. The graph illustrates the case where $\hat{\theta} > \theta^*$.

θ_τ^* is the solution to

$$w + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\hat{\theta}}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) = \frac{\gamma\theta_\tau^*}{\beta} \left[1 + \beta p - \beta F(\theta_\tau^*)\right] \tag{2.16}$$

and, as before, using the following expressions for the expected values

$$\begin{aligned} \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) &= \theta_h - \int_{\theta_\tau^*}^{\theta_h} F(\theta) d\theta - F(\theta_\tau^*)\theta_\tau^* \\ \int_{\hat{\theta}}^{\theta_h} \theta dF(\theta) &= \theta_h - \int_{\hat{\theta}}^{\theta_h} F(\theta) d\theta - F(\hat{\theta})\hat{\theta} \end{aligned}$$

writing $\theta_\tau^* = \theta_\tau^*(\tau)$ and differentiating (2.16) with respect to τ we get:

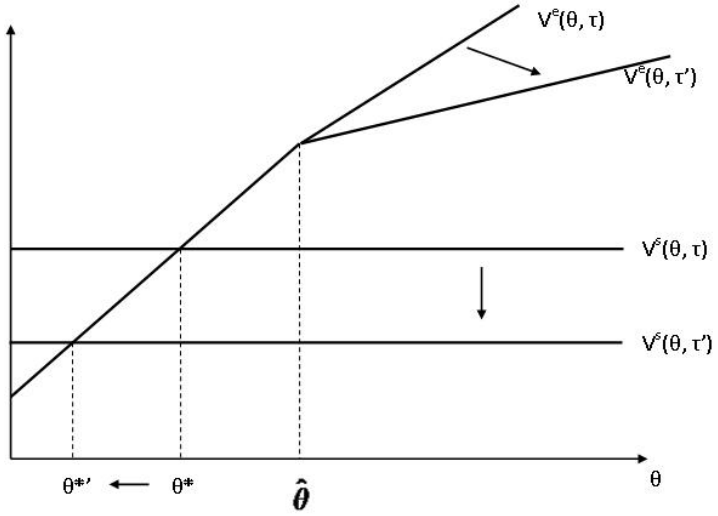
$$\frac{d\theta_\tau^*}{d\tau} = \frac{\beta \left[1 - F(\hat{\theta})\right]}{\left[1 + \beta p - \beta F(\theta_\tau^*)\right]} \left[\hat{\theta} - E(\theta | \theta > \hat{\theta})\right] \leq 0 \tag{2.17}$$

Note that the result in this case is that the "reservation entrepreneurial idea" is lower than in the case without taxes and depends negatively on the tax level: the higher the tax rate, the more agents will choose to become entrepreneurs and the lower the average quality of entrepreneurial firms.

The intuition behind this result is that convex taxes disproportionally decrease option value of working and searching for new ideas. Since the most successful businesses will be taxed at a higher rate the incentive to optimally wait for the best entrepreneurial ideas are diminished. Some workers with medium value ideas prefer to start a firm, and thus give up the chance of waiting and finding a better idea. Figure 2.1 illustrates graphically this mechanism.

Waiting for an entrepreneurial idea can be viewed as a form of passive search. In that case our model predicts that an increase in the convexity of the tax schedule can decrease search activity and make people more likely to hold on to their current occupation. Gentry

Figure 2.2: First effect of an increase in taxes on equilibrium



Notes: This figure shows the effect of an increase in the top marginal tax rate on the quality of entrepreneurial firms through a change in the option value of searching for better ideas. The threshold decreases as the value of waiting for a good entrepreneurial idea decreases. An increase in the top marginal tax rate decreases the workers' option value as the best ideas will be taxed more heavily; this will prompt more individuals to join the ranks of the entrepreneurs with lower quality firms. This happens irrespective of the relative position of $\hat{\theta}$ and θ^*. Here we draw the case when $\hat{\theta} > \theta^*$.

and Hubbard (2004) empirically demonstrate that tax progressivity decreases job turnover.

2.3.2.2 Case 2: $\theta^* > \hat{\theta} > w$

In this case the equilibrium is defined by:

$$w + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\theta_\tau^*}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) = \frac{\theta_\tau^* - \tau(\theta_\tau^* - \hat{\theta})}{1 - \beta(1-p)} \left[1 + \beta p - \beta F(\theta_\tau^*)\right] \tag{2.18}$$

As before we can calculate the total derivative of (2.18) with respect to the tax rate

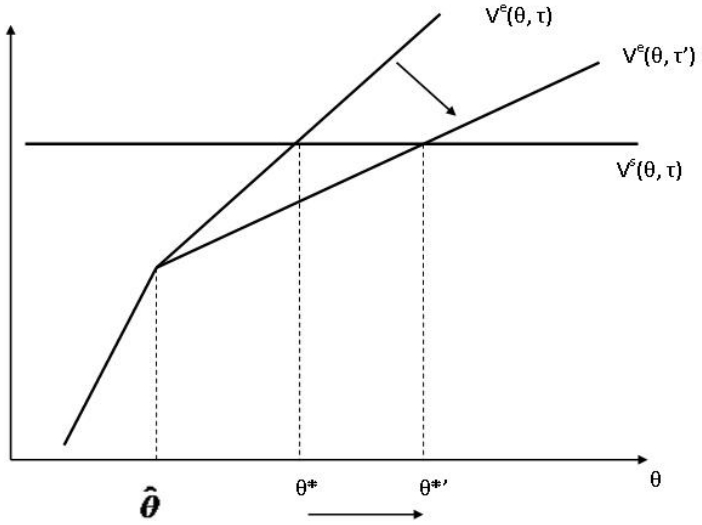
$$\frac{d\theta_\tau^*}{d\tau} = \frac{\beta \left[1 - F(\theta_\tau^*)\right]}{\left[1 + \beta p - \beta F(\theta_\tau^*)\right](1-\tau)} \cdot \tag{2.19}$$

$$\cdot \left[\hat{\theta} - E(\theta | \theta > \theta_\tau^*) + \frac{\left[1 + \beta p - \beta F(\theta_\tau^*)\right]}{\beta \left[1 - F(\theta_\tau^*)\right]} (\hat{\theta} - \theta_\tau^*)\right] \tag{2.20}$$

the sign of this derivative is not certain and depends on the relative position of $\hat{\theta}$ and θ_τ^*. We cannot determine the relative positions of θ_τ^* and θ^* either.

The difference with the previous case is that in addition to the decrease in the option value discussed above there's another effect of an increase in the tax rate. The agent is always comparing the value of starting a firm and the wage plus the option value of the worker. With convex taxes, the more successful the firm the higher share of value will be taxed away. Such "success taxes" will cause a decrease in the value of being an entrepreneur vis-a-vis the value of working and waiting one the more period, for all the ideas above $\hat{\theta}$. Since the household only cares about his consumption, i.e. his after-tax profit, he will rather wait longer than take the not-so-good entrepreneurial idea. These mediocre entrepreneurial ideas are θ^* and the values of innovation idea θ immediately above it. Notice in fact that, by definition, $V^e(\theta^*) = V^s(\theta^*)$ while $V_\tau^e(\theta^*) < V^s(\theta^*)$; by continuity of the value function

Figure 2.3: Second effect of increase in taxes on equilibrium



Notes: This figure shows the direct effect of an increase in the top marginal tax rate on the threshold for entrepreneurial activity. The threshold increases as the value of each entrepreneurial idea decreases vis-a-vis market wage. This only happens when $\hat{\theta} > \theta^*$. However there is a counterbalancing effect (not shown in this picture) resulting from the decrease in the value of being a worker and waiting for a good entrepreneurial idea, as illustrated in previous picture. In this case the total effect is indeterminate.

there is going to be a set of thetas with mass greater than zero such that the value function for the entrepreneurs will still be lower than the value of waiting one more period.

The effect described above affects θ^* in the opposite direction compared to the decrease in the option value described in previous section. Figure 2.3 illustrates this effect on θ^*. The overall effect on θ^* cannot be determined without further assumptions on the distribution of the thetas and the relative positions of θ^* and $\hat{\theta}$.

2.3.2.3 Case 3: $\theta^* > w > \hat{\theta}$

We consider the case in which labor income is taxed. As in the previous section we consider the case in which the kink in the entrepreneurial value function is below the value of searching. The situation when it is above the equilibrium is exactly the same as in Case 1.

The value function for the entrepreneurs is still the one described in (2.15) while the value function for the worker becomes

$$V_\tau^s(\theta) = w - \tau(w - \hat{w}) + \beta V_\tau^s(\theta) F(\theta_\tau^*) + \gamma p V^s(\theta) + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\theta_\tau^*}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) \tag{2.21}$$

θ_τ^* is the solution to

$$w - \tau(w - \hat{w}) + \gamma \int_{\theta_\tau^*}^{\theta_h} \theta dF(\theta) - \tau\gamma \int_{\theta_\tau^*}^{\theta_h} (\theta - \hat{\theta}) dF(\theta) = \frac{\theta_\tau^* - \tau(\theta_\tau^* - \hat{\theta})}{1 - \beta(1-p)} \left[1 + \beta p - \beta F(\theta_\tau^*)\right] \tag{2.22}$$

Once again we can calculate the derivative of θ_τ^* with respect to τ :

$$\frac{d\theta_\tau^*}{d\tau} = \frac{\beta \left[1 - F(\theta_\tau^*)\right]}{\left[1 + \beta p - \beta F(\theta_\tau^*)\right](1 - \tau)} \cdot \tag{2.23}$$

$$\cdot \left[\hat{\theta} - E(\theta | \theta > \theta_\tau^*) + \frac{\left[1 - \beta F(\theta_\tau^*)\right]}{\beta \left[1 - F(\theta_\tau^*)\right]} (\hat{\theta} - \theta_\tau^*) - \frac{(w - \hat{w})}{\gamma \left[1 - F(\theta_\tau^*)\right]}\right] \tag{2.24}$$

In this case the sign of the derivative is uncertain again. As before, it depends on the distribution of the thetas and on the relative positions of θ_τ^* and $\hat{\theta}$. Without any further assumptions on the value of the parameters, we cannot predict how θ_τ^* changes with the tax rate nor the relative position of θ_τ^* to θ^*. The intuition for this result is the same as in the previous section: there are two opposite effects given by the decline in the option value and the reduction in the profitability of entrepreneurial activities.

2.3.3 Empirical Implications

With taxes some individuals that otherwise would aim for high quality ideas enter self-employment earlier. Since progressive taxes compress the return of ideas the minimum quality of a business idea worth pursuring decreases. Because high marginal taxes reduce the private value of top quality projects, potential entrepreneurs may settle for medium quality business projects rather than pursuing the small chance of a brilliant idea in the future.

The individual welfare effect of taxes is negative, since it leads to a distorted choice between search and entry and reduces quality. However the societal welfare implications may be even more important, if we believe that high quality entrepreneurial ideas are disproportionally important, for example for technological progress. Nordhaus (2004) estimates that entrepreneurs only capture a small fraction of the surplus they create, which may be even more true for very important innovations.

Some of our results, such as the reduction in average quality of entrepreneurial firms and the entry of lower quality entrepreneurs following an increase in progressive taxes, hinge on the "persistent" nature of the entrepreneur's business idea once the entry decision has been made. If we instead assume that each period not only the workers but also existing entrepreneurs can receive a new entrepreneurial idea, the effect of higher taxes, proportional or progressive, will be an unambiguous increase in the average quality of entrepreneurial ideas and an unambiguous reduction in the number of entrepreneurs in the economy. We work out the details of this modification in the next section.

We will also discuss the effects of taxes on entrepreneurial effort using this extension to the model. In this case the quality will be given not only by the entrepreneurial idea but also by the effort exerted by entrepreneurs; more effort translates into a higher quality of entrepreneurial firms.

2.4 Searching for New Ideas Each Period

Here we modify the assumption that the decision to become an entrepreneur precludes search for new ideas. Some of the results from the previous section depend on the assumption of irreversible investment. In order to illustrate the importance of this assumption we consider the other extreme, that each period the old idea has run its course and there is a search for a new idea. We should emphasize we do consider this case because we believe it to be realistic rather it is done to illustrate a property of the previous model. There is no longer an alternative cost in terms of searching for new ideas when choosing self-employment. We maintain all the other assumptions, including the important assumption that the θ are not correlated over time.

We keep, when possible, the same notation. The problem can be rewritten as

$$V(\theta) = \max\{V^e(\theta), V^s(\theta)\}$$

where

$$V^s(\theta) = w + \beta \int_\theta V(\theta) dF(\theta) \tag{2.25}$$

$$V^e(\theta) = \theta + \beta \int_\theta V(\theta) dF(\theta) \tag{2.26}$$

It is straightforward from this formulation to conclude that $\theta^* = w$ and that for all $\theta < \theta^*$, $V^e(\theta) < V^s(\theta)$ and for all $\theta > \theta^*$, $V^e(\theta) > V^s(\theta)$.

2.4.1 Proportional Taxes

As before we consider taxation on business and labor income and we distinguish between proportional and progressive taxes. Again, proportional taxes do not have any effect if the tax rate on labor and business income are the same. If they are different the equilibrium reservation entrepreneurial idea is given by:

$$\theta_{\tau}^{*} = \frac{1-\tau_{w}}{1-\tau_{\pi}} w \tag{2.27}$$

From expression (2.27) it is possible to see that if $\tau_w > \tau_\pi$ then $\theta_\tau^* > \theta^*$ and vice versa and that θ_τ^* is decreasing in τ_w and increasing in τ_π. These results are identical to those obtained with persistent entrepreneurial ideas.

2.4.2 Progressive Taxes

Consider the tax schedules described in (2.12) and (2.13) and consider two cases. The case with $\theta^* > \hat{\theta} > w$ is no longer available since in this case $\theta^* = w$.

2.4.2.1 Case A: $\hat{\theta} > \theta^* = w$

The income level at which the tax rate increases from zero is higher than the equilibrium entrepreneurial entry level. As shown in the previous section, in this case the only effect of a change in the top marginal tax rate will be a change in the option value of waiting for a better entrepreneurial. However now both workers and the entrepreneurs have the same option: both of them will receive a new entrepreneurial idea unlike the previous case when only workers could receive another entrepreneurial idea while entrepreneurs were tied to their current project.

Clearly the change in the option value will be the same for both types and a change in the top marginal tax rates will not have any impact on the entry threshold into entrepreneurship. More precisely, the value function for the worker and the entrepreneur can be re-written as:

$$V_\tau^s(\theta) = w + \beta \int_\theta V(\theta) dF(\theta) \tag{2.28}$$

$$\begin{aligned} V_\tau^e(\theta) &= \theta + \beta \int_\theta V(\theta) dF(\theta) && \text{for } \theta < \hat{\theta} \\ &= \theta - \tau(\theta - \hat{\theta}) + \beta \int_\theta V(\theta) dF(\theta) && \text{for } \theta \geq \hat{\theta} \end{aligned} \tag{2.29}$$

and is clear that θ_τ^* in this case is:

$$\theta_\tau^* = w$$

so that taxes do not affect the optimal level of entry. The option value is the same for the entrepreneur and the worker; the mechanism that previously caused θ_τ^* to decrease with taxes is absent now.

2.4.2.2 Case B: $\hat{\theta} < \theta^* = w$

The value function for the entrepreneur stays as in (2.29), while the one for the worker can be re-written as:

$$V^s(\theta) = w - \tau(w - \hat{\theta}) + \beta \int_\theta V(\theta) dF(\theta) \tag{2.30}$$

and also in this case θ_τ^* is:

$$\theta_\tau^* = w$$

This result should not be surprising. As seen in previous section there are two mechanisms at work when $\hat{\theta} < \theta^*$. The first mechanism is the change in the option value described above. We now know that since the option value is the same for both the entrepreneur and the worker there should be no change coming through that channel. Moreover since wage and entrepreneurial income are taxed now at the same rate (the top marginal rate), any change will affect both sources of income in the same way; this changes the value of being an entrepreneur and the value of being a worker in the same way resulting in no change in the optimal threshold/decision rule.

2.4.3 Interpretation

The previous section demonstrates the importance of our assumption about the level of commitment associated with the entrepreneurial project.

When the entrepreneurial ideas that agents discover each period are not correlated over time neither proportional nor progressive taxes will affect optimal entrepreneurial entry through the mechanisms proposed in this model[4]. Our assumption about the possibility of changing one's project once the firm is created is simply a particular case where entrepreneurial ideas (the value of the innovation or firm) are perfectly correlated over time. This suggests that in the case of positive but imperfect correlation over time the effect of taxation on the option value will be different for the worker and for those that are already self-employed.

In particular since entrepreneurs tend to be those agents with high $\theta's$ and workers

[4]There are of course other mechanisms through which taxes can be important, such as distorting the choice between leisure and work or smoothing risks.

generally those with lower $\theta's$ the direction of the effect of taxation on the option value of searching for new ideas will be the one illustrated in previous section, albeit if not as strong in intensity. In practice the choice to enter with one idea is not irreversible, but involves some alternative value in terms of other perhaps better innovations or business ideas.

2.5 Conclusions

We study the effect of taxes on entrepreneurial entry in a dynamic setting that takes into account both the number of entrepreneurs and the quality of their firms. A novel finding is that when entry is associated with an opportunity cost in terms of searching for better ideas, progressive taxes can decrease the average quality of startups while increasing their number. Progressive taxes compress the returns to entrepreneurial activity, thus lowering the reward of the high quality ideas relative to mediocre ones. While the paper focuses on entrepreneurship, the model can be interpreted as the impact of taxes on any investment choice which involves taking irreversible decisions at the cost of pursuing better options.

In various specifications higher taxes are found to reduce high quality entrepreneurship, but may at the same time increase the number of new (lower quality) entrants. Empirical studies typically do not take into account the quality of entrepreneurship, and mainly focus on quantity measures, such as the probability of entry. Since we show that quality and quantity can go in opposite directions as a result of higher marginal taxes, this standard empirical framework risks leading to misguided policy conclusions. The result that high marginal taxes leave unchanged or encourage entrepreneurial entry should not be interpreted as a sign of small distortions, if quality is not taken into account. This is especially true if the value of entrepreneurship from a social welfare perspective mainly comes from high quality ventures and innovations.

Taxes can lead to a larger share of self-employed but less entrepreneurial quality through

other mechanisms as well. For example, the self-employed have an easier time evading taxes, so taxes can directly discourage the pursuit of entrepreneurial ideas, while encouraging self-employment motivated by tax evasion only. Clearly the later type of entrepreneur is hardly the same economic entity as a new firm based on innovative ideas. Studies that point to these opposing effects of taxes and argue that taxes have ambiguous impact on entrepreneurship miss an important point. Self-employment and entrepreneurship are not ends to themselves; they are sought after by policy makers because they are thought to increase economic growth and help create high paying jobs. Even if higher taxes lead to the swelling of the ranks of the self-employed encouraging the creation of many small stagnant firms, they are still detrimental to the economy because they stifle productive and fast growing entrepreneurial ventures.

Taxes can impact quality differently than quantity in more subtle ways. Monetary income is not the only reward from entrepreneurship; many individuals with have preferences conducive to entrepreneurship, such as a wish for independence. In a low taxes environment these individuals are strongly rewarded if they create successful firms and if they choose to grow. In countries with high taxes many of these individuals may nevertheless pursue the entrepreneurial lifestyle but because of dulled economic incentives choose "comfort" in their business rather than risk, competition and expansion. The latter countries might have the same quantity of entrepreneurs as the former but end up with lower quality entrepreneurship and disparate economic outcomes.

Chapter 3

Self-Employment Does Not Measure Entrepreneurship

3.1 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.

3.2 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.

3.2.1 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 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, Apple, Yahoo, Oracle, Cisco, Sun Microsys-

[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.

tems, 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.

3.2.2 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.

3.3 Theory

3.3.1 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.

[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

(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.

3.3.2 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 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

[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 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 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.

3.3.3 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 stimulate self-employment, either because the self-employed face lower taxes than employees or because self-employment make

[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.

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.

3.3.4 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.

3.3.5 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

$$y_i = f(x_i, k_i, n_i). \tag{3.1}$$

$f(\cdot, \cdot, \cdot)$ 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:

$$y_i = \frac{\partial^2 f(x,k,n)}{\partial k \partial x} > 0, \frac{\partial^2 f(x,k,n)}{\partial l \partial x} > 0 \, \forall \, x, k, l \in \mathbb{R}^+. \tag{3.2}$$

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 et al. (2000), Krasa et al. (2005), and Kehoe et al. (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 τ 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 ϕ, 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 ϕ. 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 τ 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").

3.4 Results

3.4.1 Cross-Country Evidence on Self-Employment and Entrepreneurship

Figure 3.7a 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 3.7b 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 Sin-

gapore 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 3.7c, 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 3.7d shows that self-employment is strongly negatively linked to per capita income levels among the OECD countries[6]. Figures 3.2a–3.2c instead show that entrepreneurship is strongly positively related to per capita income. Each of the three figures uses a different measure of entrepreneurship. Figure 3.2a uses the per capita number of Billionaire entrepreneurs. Figures 3.2b–3.2c 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.

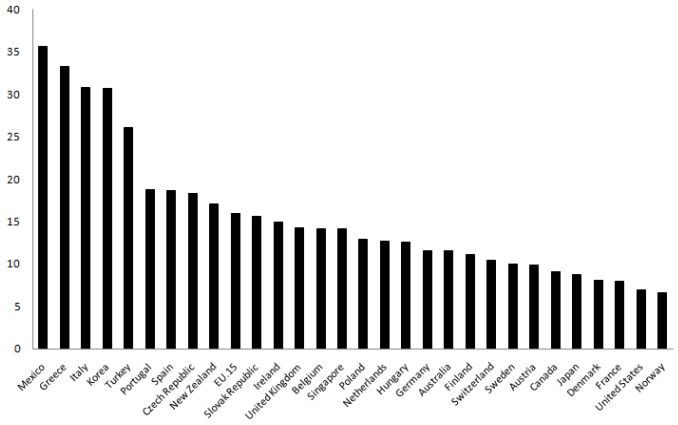
The patterns observed for wealthy countries also hold for the full sample of nations;

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

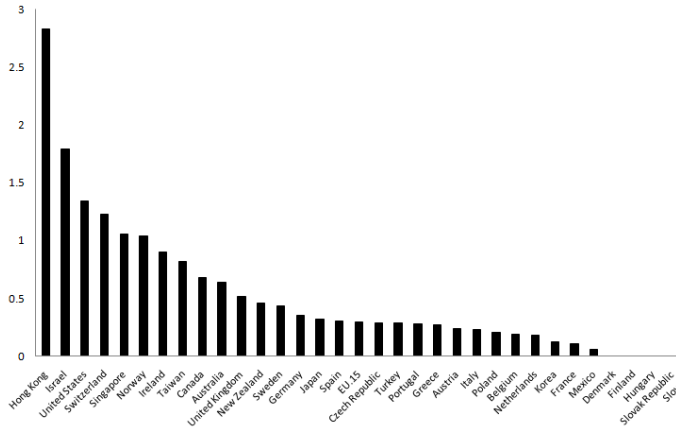
[6]The negative relationship between per capita income and self-employment is robust to only including the self-employment in the manufacturing sector, in order to make sure that shifts in sector compositions alone are not driving the results.

Figure 3.1: Cross-Country Rates of Entrepreneurship and Self-employment (1 of 4)

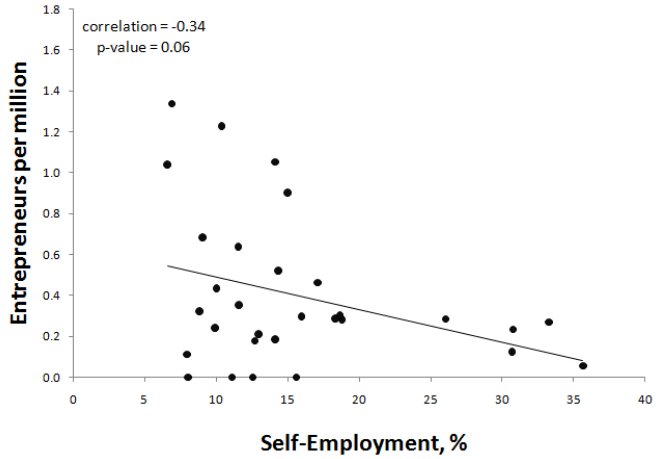
(a) Non-agricultural Self-Employment in the OECD



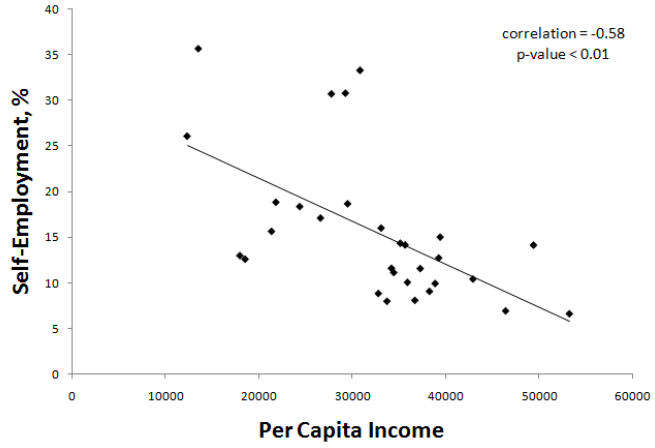
(b) Entrepreneurship rate: Billionaire Entrepreneurs per million, 1996-2010



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



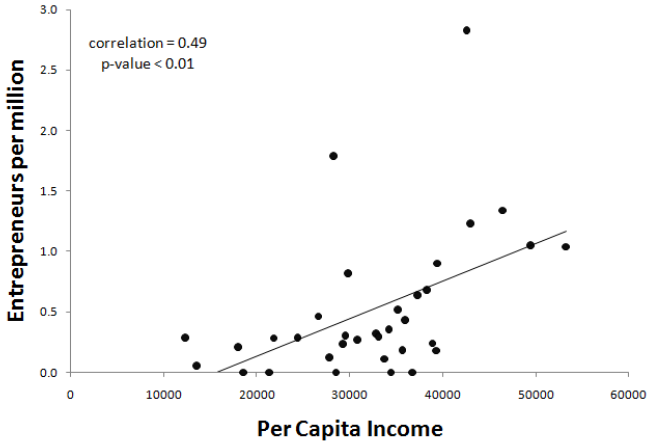
(d) Self-Employment and per Capita Income, OECD-Countries



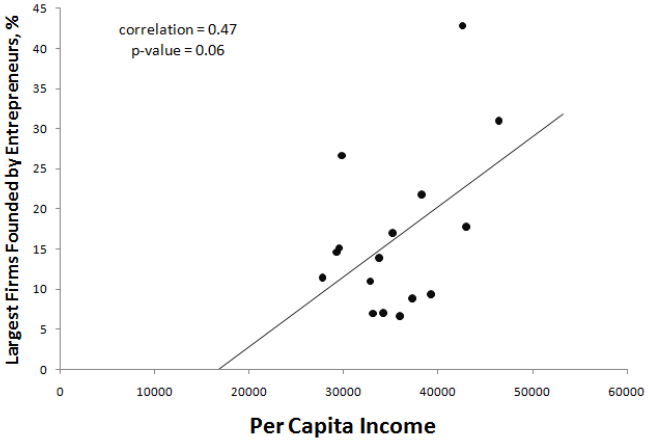
Notes: By Entrepreneurship I refer to the number of billionaire that became rich by founding a company per million inhabitants.

Figure 3.2: Cross-Country Rates of Entrepreneurship and Self-employment (2 of 4)

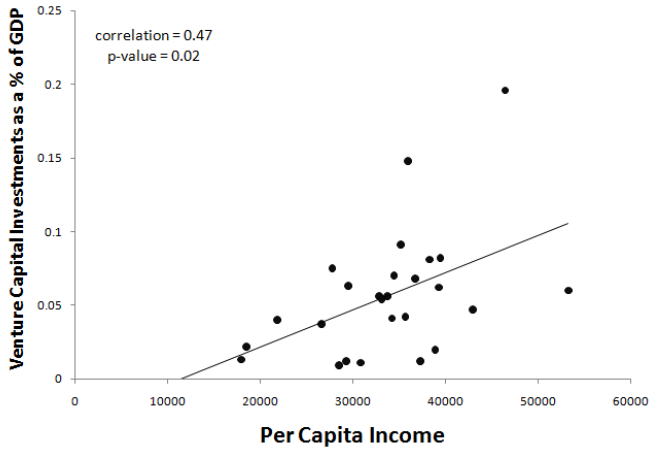
(a) Entrepreneurship and per Capita Income, Developed Countries



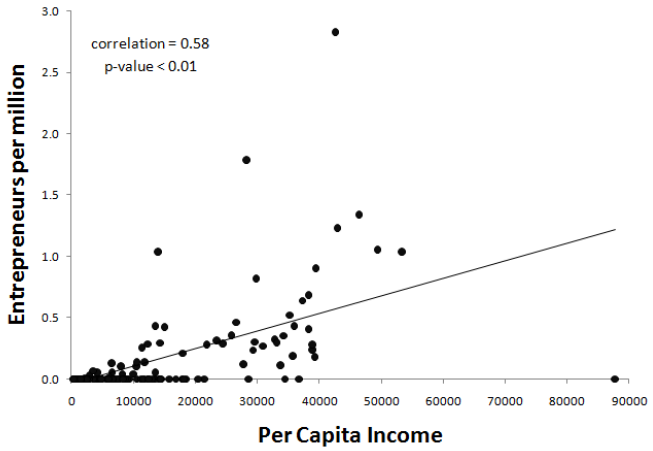
(b) Share of Largest Firms Founded by Entrepreneurs and per Capita Income, OECD-Countries



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



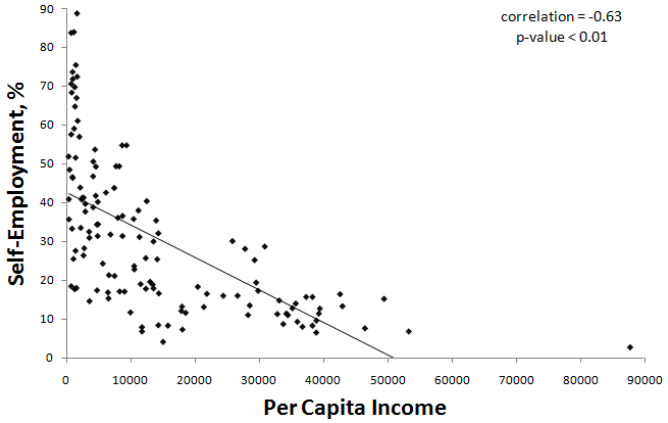
(d) Entrepreneurship and per Capita Income, all countries



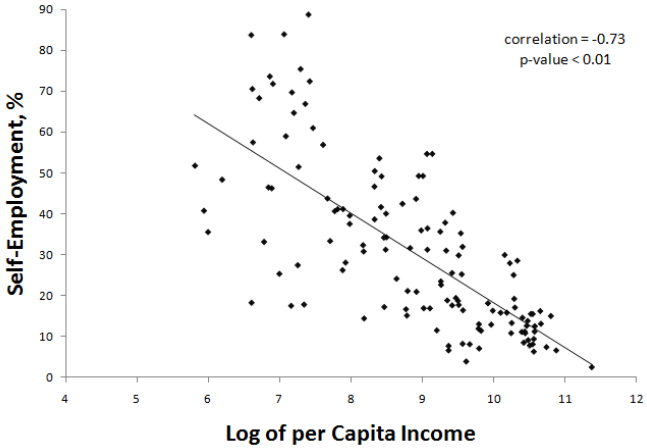
Notes: By Entrepreneurship I refer to the number of billionaire that became rich by founding a company per million inhabitants.

Figure 3.3: Cross-Country Rates of Entrepreneurship and Self-employment (3 of 4)

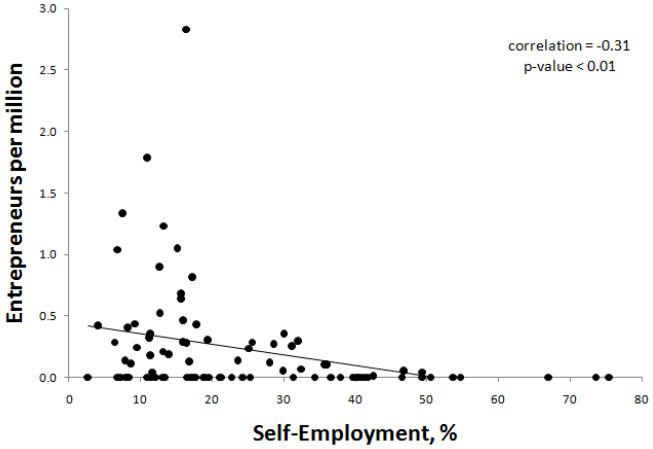
(a) Self-Employment and per Capita Income, all Countries



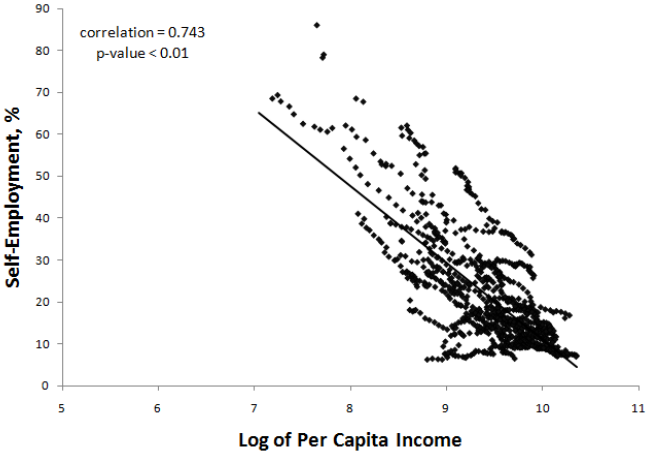
(b) Self-Employment and the Log of per Capita Income, all Countries



(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.

entrepreneurship is positively related to per capita income levels (Figure 3.2d) and self-employment is negatively linked to per capita income levels (Figure 3.3a). Figure 3.3b differs from Figure 3.3a by instead using the log of per capita income. Figure 3.3c 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.

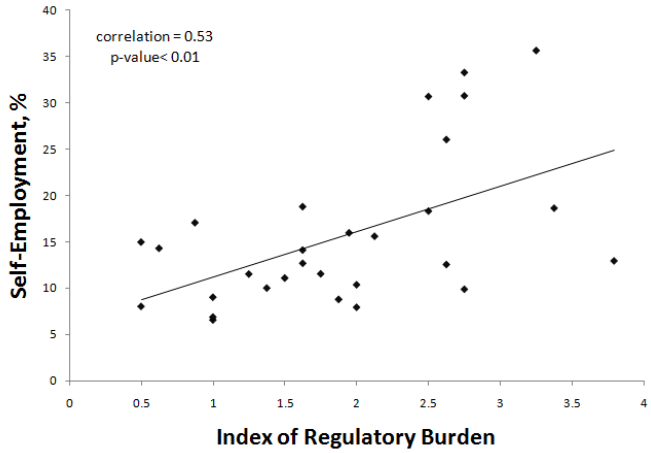
It has sometimes been argued that self-employment rates in the United States have witnessed a revival (e.g Carree and Thurik 2005), a fact which if true may eventually lead to a reversal of the negative relationship between self-employment and economic development. The argument is that while self-employment 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 3.8 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 3.3d 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 3.4a 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

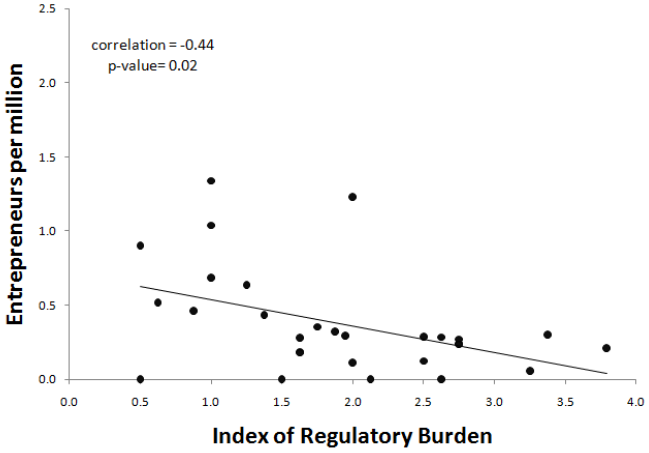
[7]Fixed effect and a random effect regressions of self-employment on per capita income again suggest that the two variables are negatively related, with per capita income explaining approximately half the variation in self-employment rates for OECD-countries 1955-2008. Note also that incorporated self-employment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

Figure 3.4: Cross-Country Rates of Entrepreneurship and Self-employment (4 of 4)

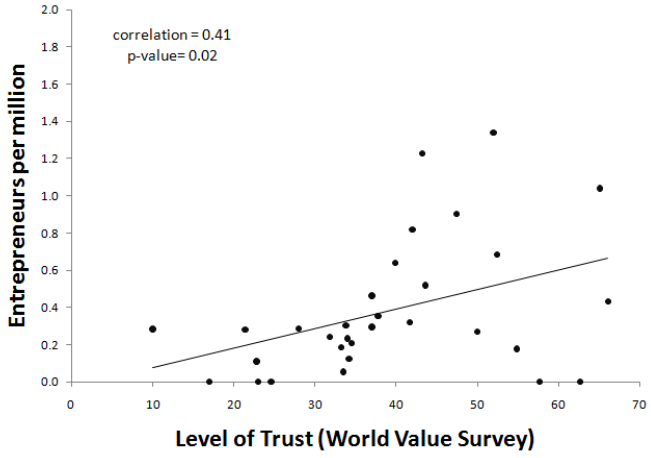
(a) Self-Employment and the Regulatory Burden on Firms, OECD-countries



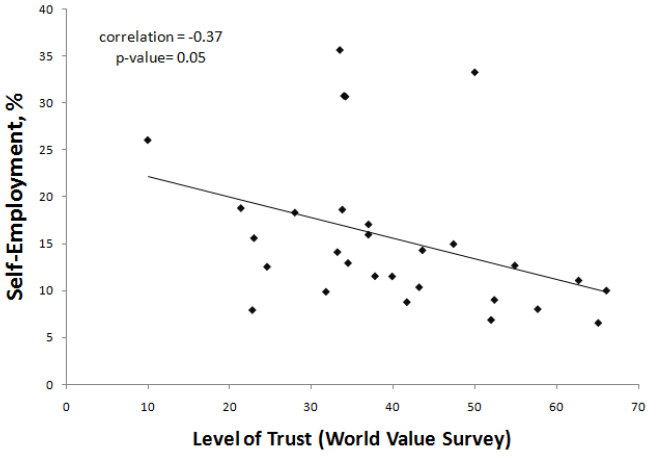
(b) Entrepreneurship and the Regulatory Burden on Firms, OECD-countries



(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.

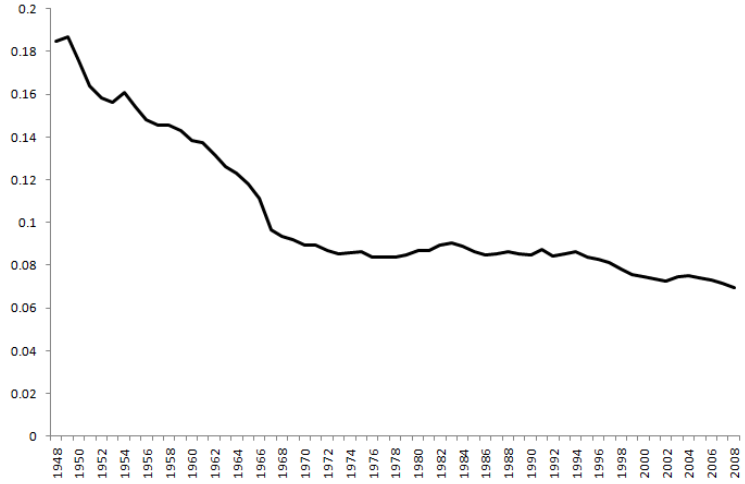
countries where starting a new firms is more difficult have higher rates of self-employment. Meanwhile as predicted by standard theory entrepreneurship is negatively linked with the regulatory burden on start-ups (Figure 3.4b).

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 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).

Tables 3.1–3.2 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

Figure 3.5: U.S Self-Employment rate 1948-2008, Bureau of Labor Statistics



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.

It is possible that the high rate of entrepreneurship of countries such as Hong Kong, Singapore and Switzerland is in part due to these nations being tax-paradises (and otherwise destinations for immigration from larger countries such as China and Germany). This problem is to a large extent mitigated because we rely on Forbes data for citizenship, not country of residence, and because Forbes appears to typically report the country of birth for dual-citizens. As a robustness check the results from Table 3.2 are reported when all foreign born entrepreneurs are removed. As table 9 shows, the results are qualitatively unchanged.

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.

3.4.2 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.

3.5 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

[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.

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 3.3–3.4.

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).

[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 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. 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).

3.5.1 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 3.5–3.7. 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 3.6–3.7 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 3.8 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.

3.5.2 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.

3.6 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

3.6.1 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.

3.6.2 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?"

3.7 Appendix of Chapter 3: Model Details

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.

3.7.1 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 Sklar (1959). 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 θ is the dependency parameter.

3.7.2 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

$$y_i = f(k_i, x_i, n_i). \tag{3.3}$$

$f(\cdot,\cdot,\cdot)$ 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:

$$\frac{\partial^2 f(k,x,n)}{\partial n \partial x} > 0\ ,\ \frac{\partial^2 f(k,x,n)}{\partial k \partial x} > 0,\ \forall\, k, x, n \in \mathbb{R}^+. \tag{3.4}$$

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 et al. (2000), Krasa et al.

(2005), and Kehoe et al. (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 τ 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 ϕ, 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 τ 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 τ 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 ϕ 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.

3.7.3 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 :

$$\pi(k, x_i; w) = f(k, x_i, n_i) - wn_i. \tag{3.5}$$

$$n_i(k, x_i; w) = \arg\max_{n \in \mathbb{R}^+} f(k, x_i, n) - wn. \tag{3.6}$$

Equation (3.6) 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 (3.6) 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 3.7.1. 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 τ are financial costs. If the owner-manager decides to forfeit, the bank has the right to seize ϕ 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 ϕ and financial cost τ 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:

$$V(b_i, x_i; \Xi) = \max_{a \in [0,b_i], l \in [0,L]} \pi(l+a, x_i; w) - (1+r)a - min((1+r+\tau)l\,,\, \phi\pi(l+a, x_i; w)) \quad (3.7)$$

Observe that Equation (3.7) can be also written as:

$$\begin{aligned} V(b_i, x_i; \Xi) &= max_{D \in \{0,1\}} V^D(b_i, x_i; \Xi) \quad (3.8)\\ V^0(b_i, x_i; \Xi) &= \max_{a \in [0,b_i], l \in [0,L]} \pi(l + a, x_i; w) - (1 + r)a - (1 + r + \tau)l \\ V^1(b_i, x_i; \Xi) &= \max_{a \in [0,b_i], l \in [0,L]} (1 - \phi)\pi(l + a, x_i; w) - (1 + r)a \end{aligned}$$

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

$$D_i(b_i, x_i; \Xi) = \mathbf{1}[V^1(b_i, x_i; \Xi) - V^0(b_i, x_i; \Xi) > 0] \quad (3.9)$$

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:

$$\frac{\partial \mathcal{L}^0}{\partial l} = \pi_1(l + a, x_i; w) - (1 + r) - \mu_l - \tau \leq 0 \tag{3.10}$$

$$\frac{\partial \mathcal{L}^0}{\partial a} = \pi_1(l + a, x_i; w) - (1 + r) - \mu_a \leq 0 \tag{3.11}$$

$$0 = \mu_a(b_i - a) \tag{3.12}$$

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

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

Observe that if $0 < l$, it is the case that $\pi_1(l + a, x_i; w) - (1 + r) \leq \tau$ from Equation (3.10) and restriction $\frac{\partial \mathcal{L}^0}{\partial l} l = 0$. From Equation (3.11), we have that $\mu_a \geq \tau$, thus $b_i = a$ to satisfy Equation 3.12. 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 τ.

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:

$$H^0(b_i, x_i; \Xi) = 1[\pi_1(b_i+L, x_i; w) > 1+r+\tau]+1[\pi_1(b_i, x_i; w) > 1+r+\tau]+1[\pi_1(b_i, x_i; w) > 1+r]+1; \tag{3.13}$$

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:

$$\frac{\partial \mathcal{L}^1}{\partial l} = (1-\phi)\pi_1(l+a, x_i; w) - \mu_l \leq 0 \tag{3.14}$$

$$\frac{\partial \mathcal{L}^1}{\partial a} = (1-\phi)\pi_1(l+a, x_i; w) - (1+r) - \mu_a \leq 0 \tag{3.15}$$

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

$$0 = \mu_l(L-l) \tag{3.16}$$

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

Observe that due to restriction $\mu_a \geq 0$ and Equation (3.15), we have that $(1-\phi)\pi_1(l + a, x_i; w) \leq (1+r)$ from Equation 3.14, thus $(1+r) \leq \mu_l$ which implies that $L = l$ from Equation (3.16). 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 ϕ.

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 ϕ.

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

$$H^1(b_i, x_i; \Xi) = 1[\pi_1(b_i + L, x_i; w) > (1+r)/(1-\phi)] + 1[\pi_1(b_i, x_i; w) > (1+r)/(1-\phi)] + 1; \tag{3.17}$$

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:

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

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 (3.9).

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:

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

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

and r.

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

4. $V^1(b, x; \Xi)$ is strictly decreasing in ϕ and constant in τ.

Proof. 1. 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 Lucas et al. (1989)).

2. From the envelop theorem we have:

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

3. 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 $H_i(b_i, x_i; \Xi) = \{3, 4\}$.

4. 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 $l^0(b, x; \Xi), l^1(b, x; \Xi)$

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

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

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

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

4. 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 $\forall\, i \in \mathcal{I},\ (H_i^0, H_i^1) \neq, (1,3), (2,3), (4,1), (4,2)$.

5. 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. 1. 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.

2. 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.

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

4. 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

5. By implicity function theorem we have:

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

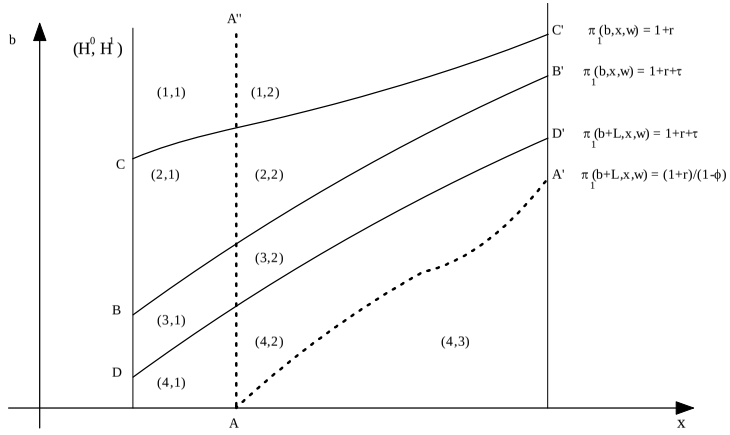
∎

Figure 3.6 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 3.6 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 3.7 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.

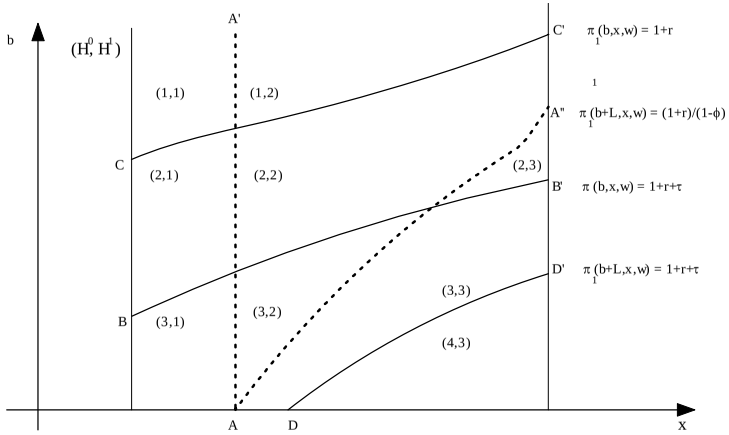
Forfeiting Decision In this section it is shown how the individual characteristics can impact the forfeiting decision. In particular, for a given wealth b_i, a credit bound L, and

Figure 3.6: Partition of agents (b_i, x_i) according to Returns to Capital

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



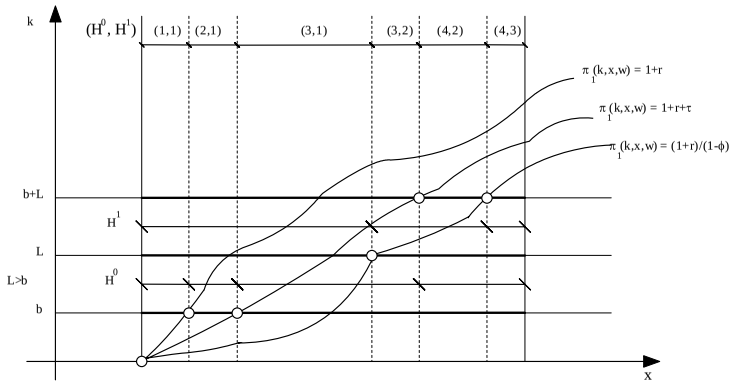
(b) High Financial Costs $(\tau(1-\phi) > \phi(1+r))$



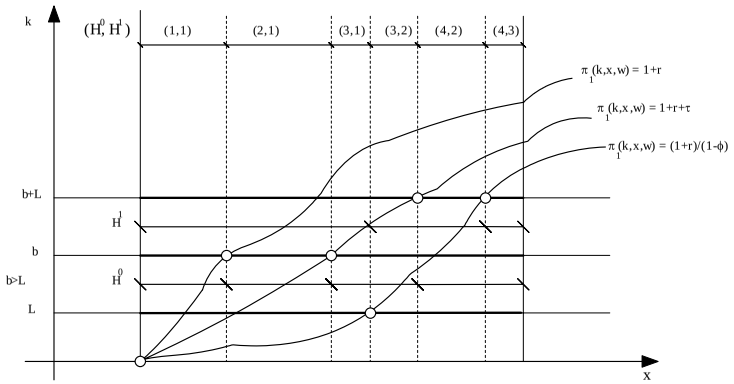
Notes: These two graphs partition the agents i defined by the managerial skill and wealth (x_i, b_i) into sets associated with possible cases $(H_i^0, H_i^1) \in \{1,2,3,4\} \times \{1,2,3\}$.

Figure 3.7: Partition of agents (b_i, x_i) according to Returns to Capital

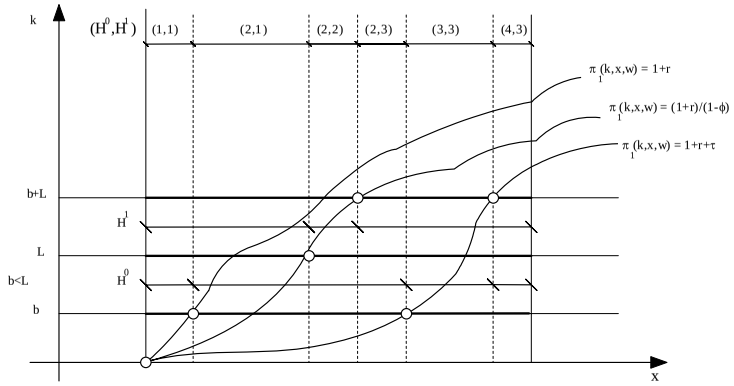
(a) High Financial Costs ($\tau(1-\phi) < \phi(1+r)$), $L > b$



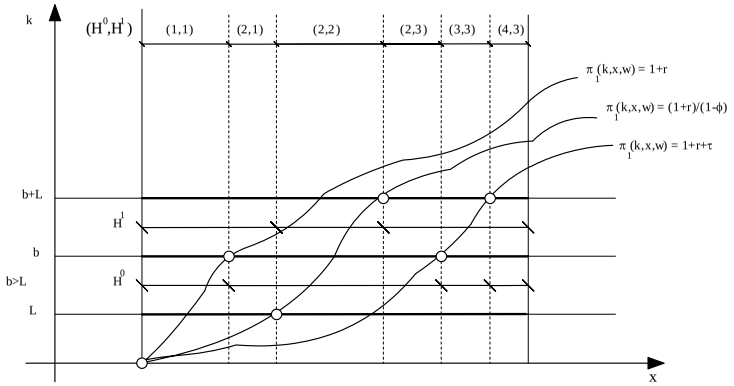
(b) High Financial Costs ($\tau(1-\phi) < \phi(1+r)$), $L < b$



(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 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 (3.9).

Corollary 3.7.1. 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:

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

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

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:

$$Y_i = Y(b_i, x_i; \Xi) = \max(w, V(b_i, x_i; \Xi)) + (1 + r)b_i. \tag{3.18}$$

which can also be written as:

$$Y_i = E_i(b_i, x_i; \Xi)V(b_i, x_i; \Xi) + (1 - E_i)w + (1 + r)b_i, \tag{3.19}$$

$$E_i \equiv E(b_i, x_i; \Xi) \tag{3.20}$$

$$= \mathbf{1}[V(b_i, x_i; \Xi) > w]; \tag{3.21}$$

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:

$$\mathcal{P}_E = \mathbf{E}[E_i] \tag{3.22}$$

$$= \int_0^1 \int_0^1 E(F_X^{-1}(U_X), F_B^{-1}(U_B); \Xi) dC(U_X, U_B)\Big) \tag{3.23}$$

3.7.4 Financial Sector

Banks maximizes profit by choosing two parameters: the financial cost parameter τ 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 τ 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 ϕ, associated with the technology of the seizing revenue, is exogenously given. Observe that the parameter ϕ 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 3.7.1. **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 τ and borrowing constraints L.

5. Each bank $n \in \mathcal{N}$ is characterized by its choice of policy set (τ_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:

$$\pi_n = \frac{\Pr((b_i, x_i) \in \mathcal{I})}{|\mathcal{N}_n|} \cdot \max_{L \in [0,\overline{L}], \tau \in [0,1]} \Bigg(\mathbf{E}_{\mathcal{I}_s}[E_i \cdot D_i \cdot \phi\pi(b_i, x_i; \Xi)] + \mathbf{E}_{\mathcal{I}_s}[E_i(1 - D_i)(1 + \tau + r)l_i] - \mathbf{E}_{\mathcal{I}_s}[(1 + r)b_i] \Bigg) \tag{3.24}$$

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(3.24) 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 3.7.2. **Stable Solution :** Let $(\tau_n, L_n) : n \in \mathcal{N}$ be the profit maximization solution of Bank n according to Equation 3.24 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 3.7.1. **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 τ^*, L^* given by:

$(\tau^*, L^*) \in \mathcal{P}$ such that τ is minimal and $\mathcal{P}$ is given by:

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

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

∎

in construction.

3.7.5 Taxation

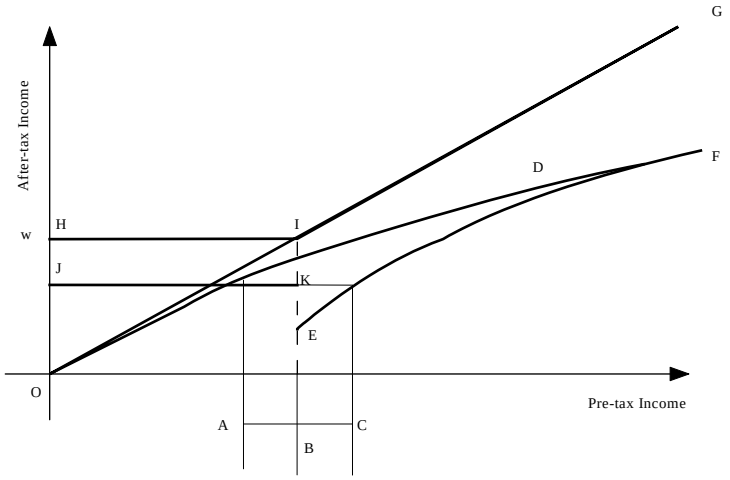
Taxation may impact the occupational choice of individuals. In particular, progressive tax rates on entrepreneurs coupled with tax evasion by small business may have interesting effects on the composition of the population occupational choice. Let the post-tax income be given by $I_i; i \in [0, 1]$.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

Definition 3.7.3. **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 3.8: Tax System with Entrepreneurial Choice



Notes: This graph presents the tax system with tax evasion discussed in Definitions 3.7.3 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 3.7.3 states a general tax system in which $1 > \tau_e(x) + x\tau'_E(x)$

Definition 3.7.4. **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"). For competitive Equilibrium, see Antunes et al (2008b).

3.8 Tables

This section provides tables of data analysis.

Table 3.1: 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 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 3.2: 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 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 3.3: 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 3.4: 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 3.5: 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 3.6: 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 3.7: 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 3.8: Cross-Sectional and Within Family Regressions of Earnings on Self-Employment and Entrepreneurship

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CS, ALL	FE, ALL	CS, MZ	FE, MZ	CS, ALL	FE, ALL	CS, MZ	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.

Table 3.9: Cross-Country Correlates of Entrepreneurship Rates, excluding Immigrant Entrepreneurs

	(1)	(2)	(3)	(4)
Population	0.014***	0.015***	0.013***	0.014***
	(0.000)	(0.000)	(0.000)	(0.000)
GDP	0.036***	0.038***	0.024***	0.026***
	(0.002)	(.002)	(.003)	(0.004)
Taxes		-0.025***		-0.022***
		(0.008)		(0.008)
Regulations			-0.007***	-0.007***
			(0.001)	(0.001)
Constant	0.068	0.626***	0.772 ***	1.249***
	(0.082)	(0.184)	.159746	(0.226)
R2	0.782	0.785	0.789	0.792
# 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, excluding immigrant entrepreneurs. Taxes refer to the corporate income tax rate as measured by the World Bank. Regulations refer to 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.

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