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Does academic entrepreneurship pay?

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We investigate the private returns for academics that start new businesses. Total earnings for the universe of 478 individuals working at Swedish universities who quit to become full-time entrepreneurs between 1999 and 2008 are compiled. To the best of our knowledge, this is the first analysis of entrepreneurial returns to include capital gains. Entrepreneurship for academics appears a gradual process and episodic. Earnings are similar before and after becoming an entrepreneur, and dividends and capital gains are inconsequential. But the income risk is more than three times higher in entrepreneurship.

JEL classification: O32, J39, J62, M13.

1. Introduction

Various policies have been devised to stimulate the creation of spinoffs from universities by academics, such as the Bayh–Dole Act in the United States; the Law on University Patenting in Denmark; and similar changes in employment legislation in Germany, Norway, Austria, and Finland to name a few (Åstebro and Bazzazian, 2011). Universities have also dramatically changed their policies, behavior, and cultures during the past 30 years to promote the creation of more university spinoffs. But we still do not know whether it is privately beneficial for academics to start new businesses.

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We care about the private returns to entrepreneurship because we believe that money is an important motivator for employment choices.[1] Knowing this simple number might also motivate policy in different ways. If, as for R&D (Mansfield *et al.*, 1977), the social returns are considerably higher than the private returns, there is an important argument for why university spinoffs should be actively stimulated. In particular, if the private returns are negative but social returns are clearly positive, there is an interesting conundrum. From a public perspective, such activities are gainful and should be stimulated. But from a private perspective, they are wasteful and should be discouraged. As the public gains on private but wasteful activities, it constitutes a market failure, and the academic entrepreneur may therefore require subsidies. To provide a starting point for analysis along these lines, we explore the private rates of return of academic entrepreneurs along with other features associated with their spells of entrepreneurship.

For most start-ups, the private return to entrepreneurship is negative (Hamilton, 2000). The exception seems to be private returns to entrepreneurship for recent university graduates in sciences and engineering, which have been shown to be either positive or not significantly different from staying/becoming employed (Gort and Lee, 2007). It is an ongoing discussion whether one should focus the analysis on all entrepreneurs or whether some select group is preferable (e.g. Shane and Venkatamaran, 2000; Busenitz *et al.*, 2003; Davidsson, 2005; Carter, 2011). Linked to this is the argument whether studying entrepreneurship should not include "self-employment" because it tilts the study of entrepreneurs towards low-income earners (e.g. Davidsson, 2005). Instead, it is claimed that one should focus on understanding high-growth or high-tech ventures, or some other fraction of all entrepreneurs, which are more likely to create employment, innovation, and growth (Henrekson and Johansson, 2010). Most studies of the returns to entrepreneurship do however involve representative samples; these will be dominated by low-income earners (Hamilton, 2000).[2]

In this article, we concern ourselves with the returns to full-time academic entrepreneurship in Sweden. We chose this sample for several reasons. First, the creation of spinoffs from university research has increased dramatically since the early 1980s (Mowery *et al.*, 2004). University spinoffs have been considered an important phenomenon, and many studies have examined them

[1]With the "returns to entrepreneurship," we mean the financial returns to an individual from the choice to be or become an entrepreneur in comparison with staying employed. The topic was most recently reviewed by Parker (2004), van Praag and Versloot (2007), Parker (2009), Carter (2011), and Åstebro (2012).

[2]Self-employed individuals running businesses, which employ others are almost always included in representative samples, but as few entrepreneurs are successful enough to employ anyone, entrepreneurs employing others represent a minority. For a separation of earnings between these groups, see, for example, Ajayi-Obe and Parker (2005) and Berglann *et al.* (2011).

(Shane, 2004; Rothermael *et al.*, 2007; Djokovic and Souitaris 2008; Åstebro and Bazzazian, 2011). Second, although university spinoffs have been studied at length, we still do not know much about how much money academic entrepreneurs make. To our knowledge, there is only one prior study on the topic (Åstebro *et al.*, 2012). Third, we focus on Sweden because both employment and tax records in this country are exceptionally detailed and will allow us to capture returns previously unrecorded. We discuss the extent to which the Swedish data are representative of common trends. Finally, this sample of university spinoffs will represent mostly high-tech (knowledge-based) businesses, which is of greater economic importance than general self-employment (Sanandaji and Leeson, 2013).

University spinoffs represent a small fraction of all start-ups. In the current analysis on how much money academic entrepreneurs make, we compile the universe of 478 individuals working at Swedish universities in science, engineering, and medicine who quit to become full-time entrepreneurs between 1999 and 2008. The Swedish data are unique in their comprehensiveness and detail. Through tax filings, we collate wages, business income, dividends, and capital gains (losses). To our knowledge, this is the first study on the returns to entrepreneurship, which includes capital gains specific to the venture.[3]

The average annual earnings as academics before leaving were SEK 397,000, and they were SEK 450,000 after becoming entrepreneurs. On average, these earn SEK 50,000 (approximately $8500) more per year as entrepreneurs. However, when controlling for year dummies, this difference becomes insignificant. The difference in log (percentage) earnings is negative and significant, but disappears after controlling for covariates. The Swedish data thus indicate that academic entrepreneurs on average do not make less than they would if staying employed at their university. However, they do take on substantially more risk: the standard deviation of earnings is more than three times larger after becoming an entrepreneur. This result is similar to those obtained by Åstebro *et al.* (2012) for US academics and by all other studies showing that entrepreneurs take on too much risk in relation to the returns they obtain (e.g. Moskowitz and Vissing-Jorgensen, 2002). This result poses follow-on questions. One might, for example, worry that the estimate of entrepreneurial earnings are not measuring all economic benefits from becoming an entrepreneur, in particular those not reported to tax authorities.[4]

[3]Berglann *et al.* (2011) include income from all types of capital (public and private stocks, bonds, savings, etc.) and show that such capital income represents approximately 50% of total annual earnings for entrepreneurs in limited liability companies. Capital income from the business itself is however not separately reported. Hamilton (2000) reports the equity-adjusted draw, the sum of the draw (wages), and the change in equity between two annual reports (available for approximately 25% of the sample) for 2 years, 1984 and 1985, limiting the ability to compute cumulated capital gains.

[4]See Edmark and Gordon (2013, this issue), for an analysis of the role of Swedish taxes on entrepreneurship.

It seems however unlikely that academics would leave a steady and reasonably well-paying job for another with highly uncertain rewards for the purpose of tax arbitrage. Swedish academics have plenty of time to operate small consulting businesses earning a part-time side income into which they both can shift some private consumption to pretax expenses and enjoy lower tax rates, thus increasing disposable income as an academic.[5] The opportunity to reduce taxes is thus already present for Swedish academics without needing to become a full-time entrepreneur. Another follow-on question arising is whether there are potential non-monetary benefits that cause these individuals to leave their full-time employment to become entrepreneurs. We leave for future research to address this question.

2. The returns to academic entrepreneurship

Raw data indicate that entrepreneurial incomes in general have been declining in comparison with wages.[6] Parker (2004) summarizes the evidence from a number of studies and report US entrepreneurs to earn on average 48% more than employees from 1951 to 1954 and 23% more from 1975 to 1979. By 1980–1984, average earnings for entrepreneurs were 10% less than average earnings for employees and then fell to 20% less between 1985 to 1989. Relative average earnings declined sharply from a peak of 90% more for entrepreneurs in 1979 to approximately 35% more for entrepreneurs in 1993 (Robson, 1997).[7] By 2005, the mean annual earnings were almost identical, whereas the median earnings for self-employed were clearly below that of wage workers: £12,948 annually for entrepreneurs versus £17,316 annually for employees (Blanchflower and Shadfordth, 2007). These numbers are informative, but earnings must be analyzed by comparing similar individuals to avoid biased results. For this, we turn to regression-based approaches.

Hamilton (2000) offers an early, careful study of the returns of entrepreneurship. The main analysis is in the form of cross-sectional ordinary least squares and quantile regressions of earnings-tenure functions of the form

$$y_{ijt} = X_{it}\beta_j + f_j(EXPR_{ijt}) + e_{ijt} \quad (1)$$

where y_{ijt} is the hourly earnings of individual i in sector j (wage, self-employment) at time t, X is a vector of observed individual productivity characteristics such as

[5]As shown by Hansson (2008), the propensity to start a part-time business is highest among those in the higher income brackets.

[6]This section contains edited extracts from Åstebro (2012).

[7]Robson (1997) used aggregate national accounts. Using instead the British household panel data, Taylor (1996) reports that by 1991, the self-employed on average earned less than the employed (£8.20 versus £9.71 per hour.)

education, *EXPR* is a vector of experience and tenure variables, and *e* is a sector-specific random error term. The function *f*(.) relates to a sector-specific earnings function.

One of the main contributions of Hamilton's article to the discussion of the magnitude of entrepreneurial returns was to use three alternative measures of self-employment earnings and to show that results were, for the most part, qualitatively similar across all three measures: net profits, draw (wages), and equity-adjusted draw (EAD).[8] He found that both net profit and draw were less for *all* entrepreneurs compared with wage workers' earnings at all points of the distribution. For EAD, earnings grew larger for entrepreneurs at the top 25th percentile. The earnings distributions had much higher variance (standard deviation between 2 and 3.6 times greater) and a higher positive skew (longer upper tail) for entrepreneurs than for employees. For example, approximately 13% of entrepreneurs earned more than $20 per hour when the EAD was used, compared with only 4.2% of employees. The conclusion that most workers earn more than entrepreneurs did not change when using multivariate regression. Hamilton's work has since been updated by several studies using self-employment data (Kawaguchi, 2003; Hartog *et al.*, 2010; Tergiman, 2011). In general, these studies indicate that the returns to self-employment are negative.

The returns to high-tech entrepreneurs might however be different than for self-employed. Relating this study to the returns of high-tech entrepreneurs seems appropriate, as many university-employed academics in science, engineering, and medicine who become entrepreneurs are likely to use their knowledge from their employment at the university to their startup, and these ideas might most often be qualified as high-tech (or at least knowledge-based.) High-tech entrepreneurs might on average be more highly educated than self-employed, and we know that the returns to entrepreneurship increase considerably with education (van der Sluis *et al.*, 2008; Hartog *et al.*, 2010; Van Praag *et al.*, forthcoming). Further, high-tech entrepreneurs might have higher opportunity cost having greater employment opportunities than others. This would tend to increase the average returns among those that choose to become entrepreneurs. Finally, high-tech entrepreneurs might have better ideas for new and disruptive businesses based on patents than typical businesses started by self-employed.

Data seem to agree with the conjecture that the returns to high-tech entrepreneurs are higher than the returns to self-employed (Gort and Lee, 2007). Braguinsky *et al.* (2013) further identify occupations and jobs that require especially intensive use of technical knowledge acquired through formal education and show that entrepreneurship generates considerable higher conditional mean and median pecuniary returns as compared with paid work in such jobs. In contrast, among scientists and

[8]Draw is the wage equivalent, or the consumption the business generates for its owner. EAD represents draw plus adjusted change in business equity over [t,t + 1].

engineers whose business ventures are not related to their education, the entrepreneurial earnings differential is negative, in line with findings in the previous literature. The positive earnings differential in education-intensive occupations increases with tenure in business but declines with age.

Although the expected return might be higher for high-tech entrepreneurs than self-employed, there is another important feature of the returns distribution for this select sample of entrepreneurs. The distribution is highly skew (Schankerman and Pakes, 1986; Schankerman, 1998; Harhoff *et al.*, 1999; Scherer and Harhoff, 2000; Åstebro, 2003; Hall *et al.*, 2005; Giuri *et al.*, 2007; Thursby and Thursby, 2007). For example, the Research Corporation, which functioned as an intermediary between US universities and buyers of intellectual property, accepted at least 9000 disclosures and patented approximately 980 inventions sourced from US universities between 1945 and 1985, but Research Corporation's top five inventions still represented as much as 98% of its yearly royalty income during this period (Mowery *et al.*, 2004).

In a previous attempt examining how much money academic founders of university spinoffs earn from creating their businesses (Åstebro *et al.*, 2012), though not including capital gains, the earnings of entrepreneurs who were previously employed in academia in Science and Engineering are compared with their peers staying in academia.[9] Raw data reveal that entrepreneurs receive sharply higher compensation than those who stay in academia. The gap between earnings by entrepreneurs and their peers in academia is lower for top-rated universities. This is probably because scientists at top-rated universities earn more than peers at other universities. Also, the pre-move earnings of former university employees who leave academia to launch their own businesses are much lower than earnings of those who stay in academia. This may indicate that university spinoffs may actually be driven by less-productive scientists, at least less productive as members of the academic community. Other factors also play a role and to control for these factors, the authors use regression analysis.

The aforementioned study estimated Mincer-type regressions models of the kind reported in equation (1), except that they pool observations across university-employed academics and those who left universities to start a business. When controlling for everything observable, the mean difference in earnings is not economically relevant. This is a surprising finding. One would expect there to be a premium to entrepreneurship, given the rather clear evidence that there is a preference for doing science among US academics (Stern, 2004; Roach and Sauermann, 2010). University quality has a positive and convex effect on wages. However, for entrepreneurial earnings, the university quality has a positive impact only for the top 10 research universities in the United States.

[9]Data cover college-educated US scientists and engineers (Computer and mathematical sciences, Life sciences, Physical sciences, Social sciences, and Engineering).

3. Swedish academic entrepreneurship—some background facts

We start this section with some general observations concerning the settings in which Swedish universities operate, reflections on the specifics of the Swedish academic labor market, the tradition and rate of university–industry collaboration and academic entrepreneurship, and, finally, the tax environment for Swedish entrepreneurs.

3.1 Structure, institutions, and attitudes

The Swedish university system is characterized by considerably smaller size, less variety, and a substantially smaller share of private universities than in the United States. A major change in the Swedish higher education system was its spatial decentralization with a major expansion of university education in 15 new institutions starting in 1987.[10] These new institutions started as "university colleges" with shorter degree programs and vocational orientation in locations where there was no prior university, partly for regional employment purposes as shown by (Andersson *et al.* 2004; 2009). The aforementioned studies also provide evidence that this policy experiment has substantially increased patenting activity and productivity growth in the municipalities where the new institutions were located. With the signing of the "Bologna declaration" in 1999, these colleges drastically increased their volumes in international master's programs, as education was free to international students while the colleges lagged behind the established universities in research funding. A case example is given in Box 1.

The Swedish labor market has been among the most heavily regulated among the OECD countries leading to comparably low mobility rates, although regulation has been relaxed during the past decade.[11] This regulation of course also applies to universities. The combination of heavy regulation and being part of a higher

[10](Andersson *et al.* 2004, 2009) report that as of 1977, there were only six universities and five other educational institutions operating in Sweden. By 1987, this number had grown to 36 located in 26 different municipalities.

[11]Mobility rates vary substantially across countries from low in Norway, Sweden, and Finland, to high in France, Italy, and the United States. (Lazear and Shaw, 2007). In Sweden, there are strict rules regarding the order of layoffs (based on a last-in first-out principle), the legally accepted reasons for layoffs, and prohibitive liabilities for obstructing those rules. As a result, the Swedish labor market was characterized by low mobility and considerable barriers for marginal groups to enter (Skedinger 2009). During the past decade, the labor protection rules have however been reformed. In particular, temporary employment contracts, allowing labor to be hired for 24 months, have been allowed since 2006. The result is a dual labor market, with considerable greater mobility and flexibility, but only for those with time limited contracts (approximately 15–16% of the labor force). The remaining part of the labor force still falls under the old rules. Nevertheless, lack of work, e.g. owing to a downturn in the business cycle, has always been a legally accepted reason to fire. And smaller firms (less than 10 employees) are exempted from some of the stricter labor protection rules.

Box 1 The case of University College Halmstad

A small teachers' college was created in Halmstad in 1973 from which University College Halmstad was formed in 1983; it is one of the youngest universities in Sweden. In the mid-1980s, it was focused on teacher's education and shorter degree programs. Not until 1997 was University College Halmstad granted the rights to employ Full Professors; before that, the teaching staff had lower status positions. The first Ph.D. was conferred in 1999. In 2008, University College Halmstad had some 50 degree programs, 5000 full-time (11,500 total) students, approximately 40 professors, and a research budget of 88 MSEK ($8 million). Thus, it graduated students in numbers 55% of Chalmers University of Technology in Göteborg, one of the oldest institutions in the country, but had an R&D budget only 6% to that of Chalmers.

education system owned by the state suggests low labor mobility. As a benchmark, the private sector average yearly mobility rate in Sweden was 12.5% during the period 1987–2005 (Andersson and Thulin, 2013). It was lower for Ph.D.s less than 11%, and mobility can thus be expected to be even lower for university employees. Younger scholars at universities are particularly often employed on temporary contracts, whereas senior scholars more often are on permanent contracts (Swedish National Agency for Higher Education, 2010), not unlike the US tenure system.

In 1993, the government decided to enlarge the role of the universities to include a "third mission"—i.e. to better diffuse university-based research and to take a more active part in the process of commercialization. To "kick-start" this process, the first private holding companies, seeded with governmental money, were installed at 11 universities in 1994–1995.[12] Today, 15 university-based holding companies are in place. More recently, several Technology Transfer Offices (TTOs) have been created to further enhance commercialization. The creation of these offices lags behind the United States by roughly 15 years, where approximately 75% of all TTOs were created before 1995 (Thursby and Thursby, 2007). The success of the Swedish

[12]Those were (their endowments in parenthesis, million SEK) as follows: Uppsala University (SEK 9M), Lund University (SEK 10M), University of Gothenburg (SEK 6M), Stockholm University (SEK 5M), Umeå University (SEK 5M), Linköping University (SEK 5M), Karolinska institutet (SEK 5M), The Royal Institute of Technology (SEK 7M), Luleå University of Technology (SEK 4M), Swedish University of Agricultural Sciences (SEK 4M), and Halmstad University (SEK 5M). Their initial governmental endowments were thus rather modest but have since increased. Since then, another four regional universities have been added to the list. See http://www.hsv.se/download/18.5b73fe55111705b51fd80004652/0733R_uppdrag_kontakter.pdf and various documents at the Swedish National Agency for Higher Education (www.hsv.se).

TTOs varies substantially across universities, several of the TTOs performing poorly.[13]

Irrespective of recent changes in university behavior in Sweden, there has always been a fairly high degree of interaction between Swedish university researchers and industry. For example, the Community Innovation Survey repeatedly shows that Swedish firms collaborate with universities much more frequently than firms in almost any other European country (Broström, 2009). This can partly be traced to the so-called "Teacher's Exemption," allowing faculty at Swedish universities to own their ideas.[14] This exemption is in contrast to the 1980 Bayh–Dole Act in the United States, stipulating that the university owns the outcomes of university-funded research. Historically, Swedish university researchers have worked together with primarily larger, and to some extent smaller, private firms to obtain access to industry funding and private research facilities. In turn, faculty could often transfer Ph.D. students to employment as well as assign their patents to collaborating firms (Goldfarb and Henrekson, 2003; Wahlbin and Wigren, 2007; Åstebro and Bazzazian, 2011). For example, Valentin and Jensen (2007) report that among biotech firms specialized in drug discovery, Swedish firms have university co-inventors on patent applications on average 43% of the time, whereas comparable Danish firms have university co-inventors on patent applications on average 22% of the time.

As a direct effect of the relatively frequent university-industry interactions, a possible explanation of the lack of university-owned patents in Sweden is the high rate by which businesses are assigned patents by academics (Lissoni *et al.* 2008).[15] However, that does not mean that Swedish university researchers are lagging their US counterparts. Rather, Swedish academics are *more* active at patenting their research than their US counterparts. Computing the share of academic patenting over total patenting in the United States and Sweden, Lissoni *et al.* (2008) find approximately 6% in Sweden, and the same approximate fraction for the United States over the period 1994–2001.[16] Using an alternative sampling process, Ejermo (2012) confirms that between 5–7% of all Swedish patents filed with the European Patent Office are from Swedish academics.

[13]See the analyses in Braunerhjelm (2007, 2008) based on a survey sent out by the Swedish National Audit Office to scholars at all Swedish universities in the natural sciences, medicine, and engineering departments.

[14]see also Färnstrand Damsgaard and Thursby (2013, this issue).

[15]The fractions are similar in France and Italy. In France, and to a lesser extent in Italy, a sizeable share of academic patents is also owned by large governmental research organizations, reflecting the importance of these actors in these countries (Lissoni *et al.* 2008).

[16]Overall, Italian academics represent 3% of European Patent Office patents awarded to Italians (Balconi, Breschi, and Lissoni, 2004). In Finland academics represent 8% of all patent assignees (Meyer, 2003) and in Norway they represent almost 10% of all assignees (Iversen *et al.*, 2007).

Swedish academics further seem positively inclined towards the commercialization of research. There are, however, marked differences across universities (Braunerhjelm, 2007). These differences are primarily related to university culture and the extent to which universities are well connected to industry.[17] In a national survey of academics, Wahlbin and Wigren (2007) found that the average rates of entrepreneurship varied by a factor of five across different educational institutions. It is rather interesting to note that three of the five highest rates of entrepreneurship were among the newly founded institutions: the university colleges of Kristianstad, Blekinge, and Borås. Data further show that the number of started firms were seven to eight times larger than the number of licenses sold in 1 year, which may reflect the rather large number of patents voluntarily assigned to firms by researchers without transfer of money. Swedish academics increase their engagement in start-up activities with tenure as well with scientific reputation (Wahlbin and Wigren, 2007). This is no different than in the United States (Stuart and Ding, 2006).

Regarding the number of full-time academic entrepreneurs, we made an effort to compare the Swedish employment register data with the US SESTAT data. From the United States, we obtained an extract showing the proportion of doctorate recipients in the Sciences, Engineering, and Medicine aged up to 75 years, working at universities and surveyed in 1993, 1995, 1997, 1999, 2003, and 2006, who were recorded as full-time owner-entrepreneurs in the next consecutive survey. The difference in the average percentage rate of owner-entrepreneurship between Sweden and the United States across comparable years is −25%.[18] Swedish academics thus appear to be considerably less ownership-entrepreneurial than their US counterparts.

3.2 Taxes

Although the attitudes of academics and labor laws appear associated with the entrepreneurial orientation of Swedish academics, the Swedish tax system is also likely to impact the rate of academic entrepreneurship. Sweden is well-known as a high-tax

[17]The old Swedish universities are located within or close to large and medium-sized cities, but some of them are primarily administrative centers rather than commerce oriented (Braunerhjelm, 2008). The new institutions are located in cities with less than 100,000 inhabitants and typically around 50,000 inhabitants.

[18]We thank Serguey Braguinsky for extracting the U.S. data. The extract was approved for release by NSF. The data covers biological, agricultural, and environmental life sciences; computer and information sciences; mathematics and statistics; the physical sciences; psychology; the social sciences; engineering; and health fields. The varying periodicity between surveys makes it somewhat complicated to compute an average rate of entrepreneurship. We have three sets of comparable pre-entrepreneurship employment years: 1997, 1999 and 2003 and three follow-up years: 1999, 2003, and 2006 for the United States and Sweden.

society with taxes in relation to GDP being 45.5%, whereas the corresponding figures are 24.8% and 33.8% for the United States and the OECD average, respectively.[19]

In the early 1990s, the Swedish tax system was thoroughly reformed, and a dual system was imposed, implying that the tax system distinguished between labor income, which is taxed at progressively higher rates, and capital income, which is taxed at a lower proportional rate. Since then, several amendments have been made to the Swedish tax system, including introducing an earned income tax credit for labor income and a reduction of taxes for incorporated, private firms.[20]

More precisely, labor income is taxed at three different levels.[21] At the municipal level, a flat rate (varying across municipalities) averaging 31.6% is levied up to an income threshold of SEK 414,000 where after a 20% state tax is charged. Income above 587,000 SEK is subject to an additional 5% state tax.

Capital income was, until 2006 with few exceptions, taxed at a flat rate of 30%. Since then, the tax rate on capital depends on the type of capital income. Income from interest is still taxed at 30%, as is capital income from listed companies. For unlisted shares, the tax rate is 25%, whereas closely held corporations falls under a different set of complex tax rules.[22] For the latter, a shareholder-specific dividend allowance is defined for active owners, taxed at 20%. Dividends in excess of this allowance are taxed as labor income. The dividend allowance has substantially increased since the legislation was introduced in 1991, the latest change occurring in 2006.

Finally, corporate income tax has been lowered from 28% to first 26.3% in 2009, and it will be further reduced to 22% in 2013. Dividends are distributed to owners from after-tax corporate profit, the recipient is then taxed, where the tax rate depends on characteristics of both the owner and the corporation. Consequently, the dividends are taxed twice. Labor income can as well be argued to be taxed twice: first by payroll taxes at the corporate level, which only partly relate to social insurance systems and then by income tax faced by individuals. This double taxation of labor income is however not unique to Sweden; many of its fellow European countries have similar systems.

The dual tax system encourages tax arbitrage between different sources of income, particularly for high-income earners. By shifting income from wages to dividends, an entrepreneur would experience a reduction in the overall tax burden by 25.4 percentage points (2011 rates), taking the social security contribution paid by the

[19]See OECD (2012).

[20]For details, see Alstadsaeter and Jacob (2012).

[21]If not stated differently, figures refer to 2012.

[22]Corporations with four or fewer shareholders who control at least 50% of the shares and where all active shareholders in sum count as one shareholder. In this article, we study this group and sole proprietorships.

employer into account. Thus, there are strong monetary reasons for individuals in Sweden to set up a firm to reduce their tax load. Taxes on wages are further withdrawn at source, making it difficult for a wage earner to avoid the wage tax. Regular wage earners in fact have little opportunity to reduce their tax rates beyond standard deductions. Income from secondary sources can however easily, and as permitted by law, be recorded as business earnings, making many academics prone to start their own business in order to reduce their taxes on such income. This clearly affects the rate of business start-ups recorded by the Swedish tax authority, and we have therefore made a deliberate decision to avoid studying businesses started by academics where the individual remains an employee of their university, as many of these are started for tax arbitrage reasons. The level of taxes and the marginal tax rates during the past decade are shown in the Appendix Table A1.

In sum, since the early 1980s, there has been an important increase in the rate of university-originated start-ups by faculty both in Sweden and in the United States, even though the institutional set-up partially differs. Researchers have studied this important phenomenon from many perspectives. Only one study so far has indicated the earnings difference between those employed in universities and those leaving universities to become entrepreneurs (in the United States). That study indicated a somewhat complex set of relationship where the raw data indicate a positive difference, but the marginal effect was not significantly different from zero.

4. Data and methodology

4.1 Data

The Swedish register on all employed individuals working in the country was matched with register data from their employers by their social security number. From this matched employer–employee data set, we extracted all 19,171 individuals aged 60 or less with a Ph.D. in Medicine, Natural Science, or Engineering, who at some point during 1999–2008 were employed at a Swedish university.[23] In addition, we merged in annual data on research funding and staff at Swedish universities from the Swedish National Agency for Higher Education.

4.2 Variables

4.2.1 Income

Data on annual income are collected from the Swedish tax register. Four different sources of income are considered: (i) wages; (ii) earnings from business activities;

[23]We include the natural sciences, mathematics, computer science, and agricultural science in Natural Science. Individuals over 60 years of age were excluded to eliminate entrepreneurship due to retirement.

(iii) dividends from firms in which the individual is or was working in; and (iv) gains or losses from the sale of stocks in such ventures (hereon "capital gains").[24] Dividends and capital gains from the venture for up to five years after leaving entrepreneurship are included and are allocated to the year when leaving entrepreneurship. These are inflation corrected with the consumer price index to the year 2008. Capital gains are likely truncated for firms started towards the end of the panel; selling the firm is only possible after some development. To proxy for the potential future sale value, we collected data on both dividends and capital gains for all firms for the 2 years, 2009 and 2010, and added them to year 2008 values.

4.2.2 Entrepreneurship

Statistics Sweden defines an individual as a full-time entrepreneur if she owns a registered sole proprietorship or closely held corporation in a given year *and* her total income from this company (labor and capital income) is 1.6 times greater than labor income from employment in the single next greatest source of labor income. The adjustment with 1.6 is based on a separate labor survey performed by Statistics Sweden, which suggests that entrepreneurs work 1.6 more hours than employed for every krona/dollar earned.

Using this definition, we extracted 278 individuals leaving Swedish universities to become entrepreneurs during 1999–2008.[25] To augment the study with more observations, we consider as entrepreneurs also those individuals who leave a position in academia to work full-time for a company with 10 or less employees founded in the year they left academia.[26] Using this definition, we extracted 200 additional entrepreneurs. Unfortunately, data on ownership are not complete for this latter group; such relationships can only be traced if the individual receives dividends and/or sells

[24]Dividends and capital gains only for closely held corporations (firms where ownership is concentrated (>50% to a maximum of four individuals). This requirement is imposed to exclude dividends and capital gains from public stock.

[25]A peculiar characteristic of the Swedish academic system is that Ph.D. students are employed by their university and are thus registered as wage earners. These face a different opportunity set than regular faculty members, leading Ph.D. students to be more likely to become entrepreneurs or take jobs in industry than faculty. We therefore exclude from analysis those that move to non-academic wage employment/entrepreneurship directly on or the year after graduation.

[26]Several studies using the Danish-matched employer–employee data set have employed a similar definition of entrepreneurship (e.g. Sorensen, 2007; Nanda and Sorensen, 2010). These studies assume that an individual that leaves a job and becomes an employee with at least a management position (as defined by occupational codes) in a newly registered firm is an entrepreneur. We presume that employees with Ph.D. degrees leaving universities to join a newly registered firm with 10 or less employees are relatively important employees such that imposing additional occupational code constraint to define them as entrepreneurs is not necessary. We perform sensitivity analysis including and excluding these individuals in analysis and further analyze the extent to which they share profits in the new firm.

shares in the firm during the window of observation. We found 25% of the employees to be owners in this way and recoded these as owner-entrepreneurs. Summing the two groups of owner-entrepreneurs and non-owner-entrepreneurs, the rate of entrepreneurship varies between 0.4 and 1.4% per year, at an average 0.9%. In comparison with the mobility of Swedish Ph.D.s in the private sector (≈11%), a 0.9% rate of entrepreneurship is limited.

4.2.3 Other covariates

We include socio-demographics of the individual and data about the university at which the individual is (or recently was) employed and the region where the individual works (based on the address of the employer). Capturing the socio-demographic background of the individual, we have unique data on their high-school grade point average (when available), and also more typical background characteristics such as their labor market history, education, country of birth, gender, and age.

For labor market experience, we use two measures. First, we measure the number of years since obtaining the Ph.D.[27] Second, we include a measure of whether the individual had recent labor market experience outside academia before obtaining the Ph.D. We use dummy variables to control for sectoral differences in earning opportunities as entrepreneur. To capture the R&D intensity of the university, we use research funding per employee (in millions of Swedish kronor). We choose two variables to describe local opportunities. Sweden is divided into 72 pre-constructed functional labor market regions on the basis of commuting patterns. For each such region and year, we approximate the size of the local labor market by the count of the number of individuals with tertiary education (bachelor degree or higher; in thousands). We further include a measure of the local rate of regional entry. This measure is deployed with a lag of 2 years to avoid simultaneity issues. Finally, for academics switching to entrepreneurship, we deploy dummies capturing three broad sector classifications—manufacturing, high-end services, or low-end services.

Data are organized as an unbalanced panel, entry and exit can occur any time. The average number of years of observation for an individual in the panel is 4.6 years; those who never become entrepreneurs are observed for an average 4.6 years, whereas those who become entrepreneurs are observed for an average 7.3 years, of which 5.2 years are as employed at university and 2.1 years are as entrepreneurs. We exclude individual-year observations whenever an entrepreneur switches back to the wage sector.

Table 1 reports variable definitions, means, and standard deviations for two data sets. The first column includes all university-employed individuals with a Ph.D. in medicine, engineering, or natural sciences who never became entrepreneurs during

[27]The more typical measure of experience; number of years since first employment, would be censored by the year 1999 and thus measured more imprecisely.

Table 1 Definitions of variables, means, standard deviations and *t*-tests

Variable	Description	Mean (SD)		*t*-test
		Entrepreneur	Never entrepreneur	
Total income$_{i,t}$	Sum of wages, business income, dividends, and capital gains	418,247 (518,466)	443,994 (346,775)	−3.75**
Entrepreneur$_{i,t}$	Equals 1 if active as entrepreneur, else 0	0.395 (0.489)		
Medicine$_i$	Equals 1 if Ph.D. in medical science, else 0	0.225 (0.417)	0.275 (0.444)	−5.44**
Engineering$_i$	Equals 1 if Ph.D. in engineering, else 0	0.411 (0.492)	0.329 (0.463)	10.9**
Natural science$_i$	Equals 1 if Ph.D. in natural sciences, else 0	0.364 (0.480)	0.424 (0.490)	−4.32**
Foreign born$_i$	Equals 1 if born outside Sweden, else 0	0.150 (0.357)	0.198 (0.398)	−6.20**
Male$_i$	Equals 1 if male, else 0	0.750 (0.433)	0.695 (0.460)	6.14**
Age$_{i,t}$	Age of individual	43.5 (9.46)	44.0 (9.46)	−2.67**
GPA$_i$	Grade point average from secondary education	15.7 (2.23)	16.1 (2.23)	−6.38**
Years experience$_{i,t}$	Number of years since obtaining PhD	8.20 (6.89)	9.69 (8.50)	−9.01**
Non−academic experience$_i$	Equals 1 if worked outside academia before reentering university, else 0	0.388 (0.487)	0.152 (0.356)	33.3**
Manufacturing$_i$	Equals 1 if the new firm operates in manufacturing industry, else 0	0.095 (0.293)		
High end service$_i$	Equals 1 if the new firm operates in high-end service sector, else 0	0.633 (0.482)		
Low end service$_i$	Equals 1 if the new firm operates in low-end service sector, else 0	0.272 (0.445)		
Sole proprietor$_i$	Equals 1 if the new firm is a sole proprietorship, else 0	0.094 (0.292)		
Ownership not registered	Equals 1 if the academic's ownership in the new firm cannot be established	0.320 (0.467)		

(continued)

Table 1 Continued

Variable	Description	Mean (SD)		*t*-test
		Entrepreneur	Never entrepreneur	
Local market size$_{i,t}$	Number of individuals with tertiary education in the labor market region	645 (200)	658 (0.198)	−3.15**
Local market dynamism$_{i,t}$	Number of entry/ Number of current firms in the labor market region	0.121 (0.051)	0.126 (0.051)	−5.29**
University R&D intensity$_{i,t}$	Research funding per FTE at university where the individual is employed (million SEK)	1.26 (0.665)	1.31 (0.667)	−3.33**

Notes: 2720 year-observations on 478 individuals moving from employment at a university to entrepreneurship after 1999 and before 2009. 85,020 year-observations on 18,661 individuals staying within academia for all observed years. Data are individual-year observations, varying across individuals *i*, and years *t*. Sector dummies and start-up firm characteristics apply only to those becoming entrepreneurs. Yearly observations for individuals who exit entrepreneurship are excluded from analysis. Future dividends and stock sales, if emanating from the firm held during entrepreneurship, are exempt from this rule. Data on dividends and capital gains extend to 2010.

**Significant at 1% level or better.

1999–2008. The second column those equally defined, but who quit their employment at the university and became full-time entrepreneurs some time during 1999–2008. The final column reports *t*-tests for significant differences between those becoming entrepreneurs and those never leaving academia.

In a cross-sectional comparison, Table 1 reveals that entrepreneurship does not pay. Those becoming entrepreneurs earn, on average, SEK 418,247, whereas those never becoming entrepreneurs on average earn SEK 443,994. The difference is statistically significant ($t = -3.75$, $P < 0.001$). This difference may be owing to pooling effects: the entrepreneurs may be different in some or several respects. We examine these differences in Table 1. Those becoming entrepreneurs are more likely to have an engineering degree and are less likely to have either a medicine or a natural science degree than those staying academics. Those born in Sweden, the young, males, those with lower high-school grades, less experience, and with experience outside of academia before becoming university-employed are all more likely to become entrepreneurs. All these differences mean that comparing earnings between those not

becoming entrepreneurs and those becoming entrepreneurs without taking into account that the two groups are composed of different people might be misleading.

Table 1 further reports that 40% of the year-observations refers to when academics have transcended into entrepreneurship, that only 1 of 10 firms are run as sole proprietorships (the rest are closely held corporations), and that a majority of the firms are started in high-end services (63%), whereas 27% are started in the low-end service sector and 10% in manufacturing. The fraction of sole proprietorships is considerably smaller among all startups in Sweden (see Andersson and Klepper, 2013).

4.3 Methodology

4.3.1 Estimating equations

The key issue with estimating an income equation for entrepreneurs is that the choice of entrepreneurship may be endogenous. It might be a function of expected returns and unobserved (for the econometrician) characteristics. To address this, we use a difference regression approach; we only analyze the difference in earnings for those that become entrepreneurs. The estimating equation is the earnings model

$$y_{it} = \alpha + E_{it}(\beta + \delta X_{it}) + \theta_i + \tau_t + \varepsilon_{it} \quad (2)$$

where y_{it} is annual earnings for individual i in year t, E_{it} is employment status (=1 if entrepreneur, = 0 if employed in academia) in year t, X_{it} is a vector of (potentially time-varying) covariates that may determine the returns to entrepreneurship, θ_i are person-fixed effects that do not vary over time, τ_t are time-fixed effects, and ε_{it} is an *i.i.d.* error term. We also run the equation taking the log of annual earnings. This alternative specification is useful for estimating the percentage change in earnings, whereas the base equation is useful for estimating the impact of becoming an entrepreneur on the earnings level. When estimating the log of earnings, observation with negative total earnings (12%) are re-coded to earning one krona to compute the log.

We thus estimate the effect of the covariates on the difference in income between entrepreneurship and employment for a given individual. Identification is based on the individuals who are observed to change employment status once. The difference approach controls for unobserved individual characteristics that do not change over time and thus eliminates bias originating in permanent disposition and inclination for entrepreneurial activity. It will not eliminate bias from unobserved characteristics that vary systematically with employment status over time, or from unobservable circumstances that stimulate an individual to become an entrepreneur at a particular point in time, such as the arrival of an idea, or the disagreement with a co-worker. We assume that these unobservable circumstances are random in the sense that they are not correlated with the covariates in the equation.

A secondary set of analysis is performed distinguishing between those that become entrepreneurs and those who stay in academia. There is likely selection into

entrepreneurship based both on observable and unobservable characteristics. This analysis is by no means necessary as selection on individual-fixed attributes in a non-issue in the aforementioned difference analysis. To examine what we can tell about whom among all academics becomes an entrepreneur, we estimate a panel-data logistic regression of the general form,

$$P(E_{it}) = \alpha + \beta X_{it} + \theta_i + \tau_t + \varepsilon_{it} \quad (3)$$

where notation is as before. The panel-logit model identifies who becomes an entrepreneur based on observable covariates X_{it}.

4.3.2 Missing data

Data were missing for grade point average (GPA) for about 50% of the sample. Although grades from those with secondary studies in Sweden after 1980 are reported without fail, data for other individuals have been collected in surveys reaching only a limited part of the population. Missing data were imputed three times assuming data were missing at random using a switching regression approach described in van Buuren *et al.* (1999), where missing data were randomly replaced conditional on observed data. We report coefficient estimates and standard errors computed for the three complete data sets.

5. Results

5.1 Descriptive statistics

We start the analysis with some descriptive statistics. Table 2 reports total earnings (the sum of wages, pre-tax business income, dividends, and capital gains) for those who become entrepreneurs before and after becoming entrepreneurs. It is immediately apparent that total earnings increase sharply for the average academic once they become full-time entrepreneurs. The average pre-entrepreneurship earnings are SEK 397,307, and increases to SEK 450,341 as an entrepreneur. The difference is statistically significant with $t = -2.61$, $P < 0.01$. The difference in total earnings between the year before and the first year as an entrepreneur is smaller. The former is SEK 367,886 and the latter SEK 395,349, and their difference is statistically insignificant. From these comparisons, we can immediately draw the conclusion that academic entrepreneurship, on average, pays off moderately. However, those becoming full-time entrepreneurs also take on substantially more risk: the standard deviation of earnings is more than three times larger after becoming an entrepreneur.

That the earnings in the year before entrepreneurship are less than the average pre-entrepreneurship earnings cannot be owing to pooling effects. There are instead two other potential explanations. First, that the academics before switching experience a negative earnings shock, for example by having funding of "top-up" salary cut.

Table 2 Earnings for academics before and after becoming entrepreneurs

Variable	Before becoming entrepreneur	After becoming entrepreneur	t-value
Total earnings	397,307 (223,126)	450,341 (776,616)	−2.61*
Regular earnings (wages + business income)	390,131 (205,735)	380,744 (781,291)	−0.46
Dividends	6433 (95,790)	73,028 (845,879)	−2.95*
Capital gains	743 (19,541)	4753 (109,240)	1.34
Number of observations	1646	1074	

In 2008 Swedish kronor; 1 Swedish krona varied between 0.12 and 0.17 $US in 2008. Values are annual, except for capital gains, which are computed as described in Table 1.

*Significant at 1% level or better.

Second, that this is the result of a gradual transition. Earnings in the year before entrepreneurship may not be a full year of wages if the individual switches to part-time entrepreneurship some time in that year but does not get registered as full-time entrepreneur until the next year. (Recall that Statistics Sweden unfortunately do not record number of hours worked in a year, except on a smaller random sample.) We examine whether there is a negative earnings shock by differencing earnings 2 years and 1 year before becoming an entrepreneur. The difference is negative SEK 8,657 and statistically insignificant, indicating that becoming an academic entrepreneurship on average is not associated with a prior negative earnings shock.

Table 2 also displays that entrepreneurs pay themselves a significant amount of salary, which is not unexpected, as the reported average level of salary closely matches the level, which entitles the individual to full access to the Swedish social insurance systems. Additional payroll fees above the entitlement level constitute a pure tax. Hence, beyond the entitlement level, it is more beneficial to extract earnings as dividends, as such incomes are taxed at a lower rate than wages. Moreover, to enjoy the lower tax rate on dividends (30% until 2005, 20% thereafter), a business owner must pay himself some wages as a fraction of his total income.

Before becoming an entrepreneur, the business income is small; mean SEK 8,038 (median SEK 25,000). This income might be generated from part-time consulting or similar activities. There are also both dividends and capital gains reported before becoming an entrepreneur, on average SEK 6,433 and 743 per year (median values of SEK 21,000 and 19,000). However, these numbers come from only seven individuals who have capital gains from entrepreneurship already as university employees, of whom three have annual capital gains above SEK 200,000. Although small, these numbers indicate that there are some modest entrepreneurial activities before

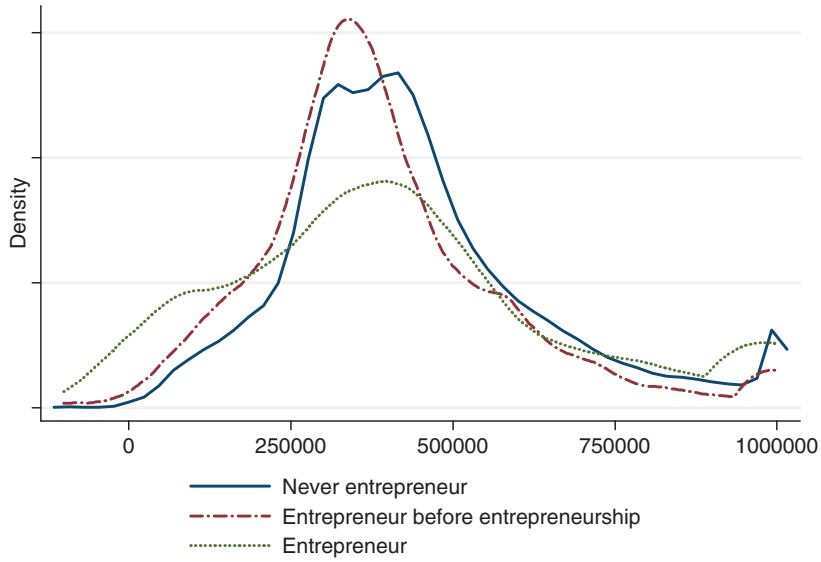

Figure 1 Kernel Density Estimate, Total Income. *Note*: The kernel used was Epanechnikov, with bandwidth 1.5×10^4.

becoming a full-time entrepreneur for many. Indeed, one in four had some side income from business activities while employed at universities.

Notably, both the dividends and capital gains increase substantially when becoming an entrepreneur to SEK 73,028 and 4,753 (median values SEK 82,000 and 30,000), respectively. Nevertheless, the bulk of entrepreneurial earnings (61% at the mean but 99% at the median) are still from wages. The reason for that dividends and capital gains do not affect total earnings for most entrepreneurs is because dividends and capital gains are substantially uneven and infrequent. Only eight individuals have capital gains from full-time entrepreneurship. Of these, only four year-observations (four different individuals) are higher than SEK 200,000.

Figure 1 illustrates the distribution of total earnings for three groups: the solid line represents those academics never becoming entrepreneurs, the dotted line the earnings during entrepreneurship, and the dashed line earnings before becoming an entrepreneur. The figure shows a shift to higher earnings after becoming an entrepreneur and also higher earnings compared with those never becoming entrepreneurs. The entrepreneurial earnings distribution clearly has fatter tails, meaning greater risk. All three distributions (even those never becoming entrepreneurs) have a significant bump at the top representing capital gains.

A final piece of descriptive statistics covers the survival length of academic entrepreneurship. To illustrate this, we plot a Kaplan–Meier survival graph in Figure 2. This graph represents the length of time, which the individual remains an

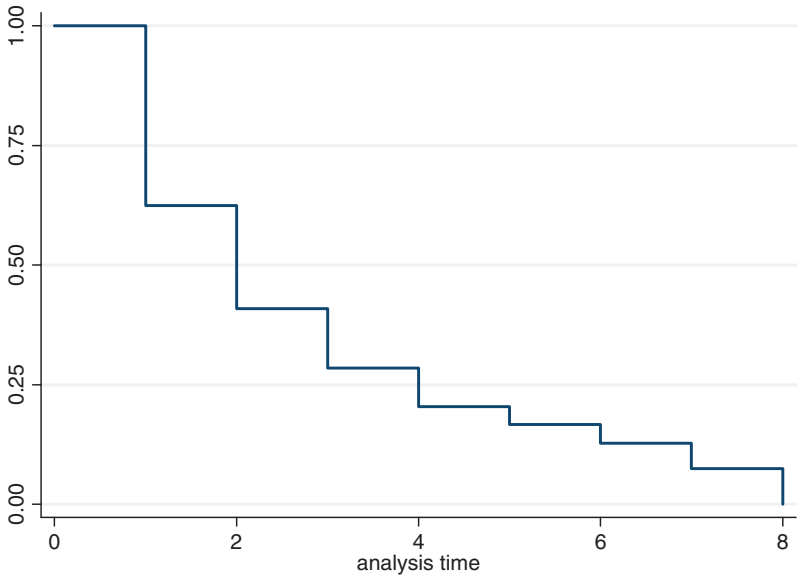

Figure 2 Business survival for academic entrepreneurs. *Note*: The survival graph was estimated using Kaplan–Meier, which corrects for right censoring.

entrepreneur (not the survival of their business). The figure shows that many of the spells as entrepreneur are short. More than 30% of the individuals exit from entrepreneurship within 1 year and more than 60% within 2 years. Out of those leaving entrepreneurship within 2 years, fully 66% return to academia.

5.2 Regression results

After presenting the descriptive data, we move to regression analysis. The first column in Table 3 reports the baseline earnings regression, which includes the entrepreneurship indicator and year dummies. The coefficient for switching to entrepreneurship is economically small (SEK 26,070) and statistically insignificant. The reason for the change as compared with the descriptive data is the inclusion of the year dummies. It turns out that annual earnings have been increasing almost monotonically from 1999 to 2008 (at 2008 prices) reflecting a boom in the economy, and that this increase is associated with becoming an entrepreneur purely for statistical reasons (the cumulative probability of something happening increases as time at risk increases). To illustrate this increase, we plot the estimated changes in average total earnings for each year between 1999 and 2008 in Figure 3 (obtained from the first regression in Table 3) as well as the estimated earnings effect from switching to entrepreneurship. We checked whether the estimated earnings difference between entrepreneurship and wage work is increasing with time and found that it is not. The

Table 3 Difference in earnings regressions for those becoming entrepreneurs

Variable	Total income	Total income	ln(Total income)	ln(Total income)
$Entrepreneur_{i,t}$	26,070 (28,673)	−263,670 (141,481)	−0.256* (0.112)	0.641 (0.908)
$Ent*Medicine_i$		66,971 (67,737)		0.125 (246)
$Ent*Engineering_i$		−3708 (24,877)		−0.093 (0.204)
$Ent*Foreign\ born_i$		−13,539 (40,088)		−1.00** (0.321)
$Ent*Male_i$		15,939 (30,145)		0.063 (0.242)
Ent*Age		2506 (2320)		−0.003 (0.016)
$Ent*GPA_i$		5339 (3387)		−0.013 (0.014)
$Ent*Years\ Experience_{i,t}$		−7.79 (2733)		0.003 (0.018)
$Ent*Non-academic\ experience_i$		6143 (38,585)		0.159 (0.180)
$Ent*Manufacturing_i$		11,192 (45,624)		0.301 (0.282)
$Ent*High\ end\ service_i$		−36,537 (29,707)		0.278 (0.232)
$Ent*Sole\ prop_i$		−239,841** (34,665)		−3.22** (0.612)
$Ent*Ownership\ not\ registred_i$		−24,136 (29,321)		0.305* (0.134)
$Ent*Local\ market\ size_{i,t}$		73 (65)		0.001 (0.001)
$Ent*Local\ market\ dynamism_{i,t}$		728,182 (457,026)		2.12 (1.79)
$Ent*University\ R\&D\ intensity_{i,t}$		6918 (221,934)		−0.089 (0.124)

Estimate of the effect on total income of switching from employment at a university to entrepreneurship. Year dummies included in all models.

*Significant at 5% level.

**Significant at 1% level or better.

estimated zero gain to entrepreneurship is statistically the same across all years in the data set.

The second column includes all covariates (except the year dummies) interacted with the entrepreneurship indicator. The entrepreneurship indicator is still not strongly significant ($P = 0.06$), the sign turns negative and the magnitude is 12 times as large as before (SEK 263,670). Among the covariates, only one is significant. Operating as a sole proprietor reduces earnings by SEK 239,841 ($t = -6.92$, $P < 0.01$) compared with entrepreneurship in closely held corporations. Entrepreneurs where business ownership is not recorded do not earn a different income than owner-entrepreneurs. Introducing the covariates does not markedly change the magnitudes or significance of the year dummies, indicating that "a rising tide lifts all boats." The third column reveals the percentage change in earnings from becoming an entrepreneur when controlling for year effects, estimated as $100*[\exp(-0.256) - 1] = -23\%$. The reason for obtaining a negative base estimate

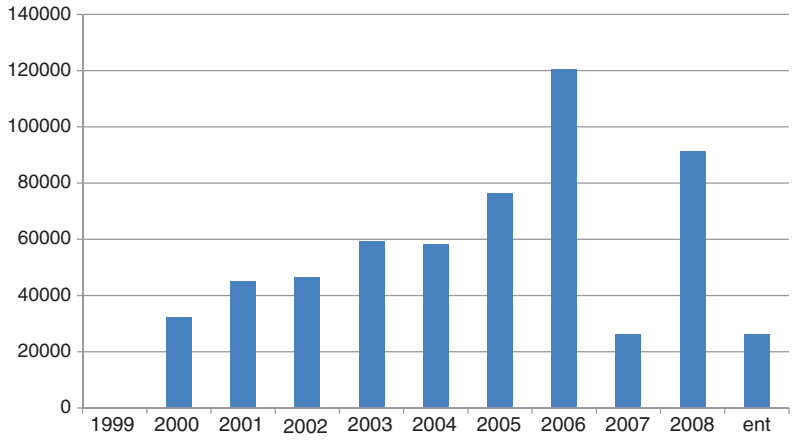

Figure 3 Total income across years. *Note:* Bars represent dummy variables estimated as τ_t in equation (2). 1999 represents the intercept. The final right-hand bar is the estimated return to entrepreneurship. All year dummies, except that for 2007, are statistically significantly different from 1999. Values are the sum of wages, business income, dividends, and capital gains in 2008 SEK. 1 Swedish krona varied between USD 0.12 and 0.17 in 2008.

compared with obtaining a positive before is that the log of earnings transforms down a proportionally larger group with extreme earnings among the entrepreneurs. The impact of this transformation is illustrated in Figure 4, which shows the distributions of the log of total earnings for the same three groups as in Figure 1.

The fourth column of Table 3 shows that the percentage change estimate in earnings does not vary much across different groups of entrepreneurs, and that the average percentage change in earnings from becoming an entrepreneur is not statistically significant. There are however three groups which have statistically different earnings among all entrepreneurs. Those born outside of Sweden and sole proprietors have significant lower percentage earnings, while those where ownership is not registered (employees in small startups) have significantly higher percentage earnings compared to their pre-entrepreneurship earnings.

As stated before, there is no need to estimate or control for selection into entrepreneurship when running an earnings equation with individual fixed effects of the type described in equation (1). However, we nevertheless move on to explore the reasons for why some academics become entrepreneurs to give an insight into their composition beyond what is reported in Table 1. For this purpose, we expand the sample to all academics working in Medicine, Natural Sciences, and Engineering between 1999 and 2008.

Results of a panel-data logit model are presented in Table 4. A few of the variables are correlated with who becomes an entrepreneur. At the individual level, there are negative correlations with GPA, years of experience, and with being born outside of

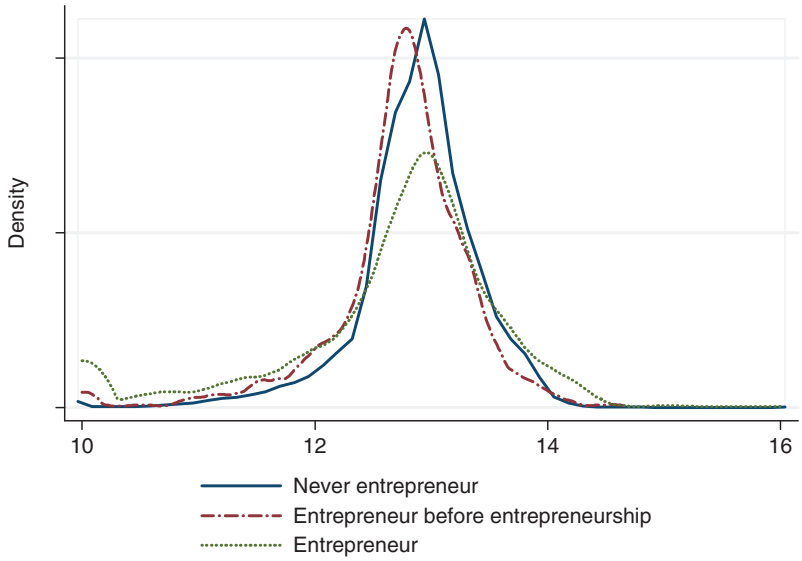

Figure 4 Kernel Density Estimate, Logged Value of Total Income. *Note:* The kernel used was Epanechnikov, with bandwidth 0.037.

Sweden. Males and those with non-academic experience are more likely to become entrepreneurs. Those who have an engineering degree are more likely to become an entrepreneur than those with a Ph.D. in medicine or the natural sciences. The higher the R&D intensity of the university, the greater the likelihood of becoming an entrepreneur, whereas the greater the local entry rate, the lower the probability of becoming an entrepreneur.[28] When including lagged income, the effect of grade point average drops out while other variables remain at around prior magnitudes. This result indicates that prior earnings may be a good proxy for (otherwise) unobserved ability, as traditionally assumed. Those who are less able, both in terms of GPA and prior wage, are more likely to become entrepreneurs. That is, there is negative selection into entrepreneurship in this data set. The final variable added in the second column is the difference in earnings 2 years lagged versus 1 year lagged. This variable is not significant, confirming the prior *t*-test, indicating no specific effect of a prior negative earnings shock upon entry.

[28]The result regarding R&D intensity is opposite to that estimated from survey data in Wahlbin and Wigren (2007). We also ran a conditional logit model to examine whether changes in covariates explained the probability of becoming an entrepreneur while controlling for individual fixed effects. These also showed a significant effect for university R&D intensity, while the effect of local market dynamism became insignificant. Results are available on request from the corresponding author.

Table 4 Maximum likelihood logit regressions predicting the probability of an academic becoming an entrepreneur

Variable	Panel-logit random effects	Panel-logit random effects
$Medicine_i$	−0.152 (0.157)	0.100 (0.159)
$Engineering_i$	0.357** (0.128)	0.481** (0.129)
$Foreign\ born_i$	−0.342* (0.159)	−0.370* (0.159)
$Male_i$	0.270* (0.132)	0.487** (0.137)
$Age_{i,t}$	−0.010 (0.010)	−0.001 (0.010)
GPA_i	−0.077** (0.027)	−0.055 (0.028)
$Years\ experience_{i,t}$	−0.054** (0.012)	−0.034** (0.012)
$Non\text{-}academic\ experience_i$	1.49** (0.115)	1.64** (0.115)
$Local\ market\ size_{i,t}$	2.3e−04 (3.9e−04)	2.2e−04 (3.9e−04)
$Local\ market\ dynamism_{i,t}$	−8.98* (4.24)	−9.32* (4.26)
$University\ R\&D\ intensity_{i,t}$	0.280** (0.096)	0.276** (0.096)
$Total\ income_{i,t-1}$		−2.7e−06** (3.9e−07)
$Total\ income_{i,t-2} - total\ income_{i,t-1}$		−4.8e−07 (2.6e−07)

Selection into entrepreneurship among university-employed Ph.D.'s.

Year dummies included.

*Significant at 5% level.

**Significant at 1% level or better.

6. Summary and conclusions

Various policies have been devised to stimulate the creation of spinoffs from universities by academics. But we still do not know whether it is privately beneficial for academics to start new businesses. To address this question, we compile total earnings for each individual aged 60 or less, excluding Ph.D. students, working at Swedish universities at any time between 1999 and 2008 in the areas Medicine, Natural Sciences, or Engineering. For a total of 478 individuals, approximately 0.9% of these academics quit every year to become full-time owner-entrepreneurs or employed in a small startup. Earnings data include tax filings on wages, business income, dividends, and capital gains. The average annual earnings as academics before leaving were approximately SEK 397,000, whereas they were approximately SEK 450,000 after leaving. This difference in earnings is a result of pooling effects over years with generally increasing earnings. When controlling for year dummies, this difference instead becomes negative, but only marginally significant. The difference in log (percentage) earnings is negative and significant, but disappears after controlling for covariates. Little explains the earnings difference. There is negative selection into entrepreneurship; those with lower pre-entry earnings are more likely to become entrepreneurs.

These are surprising findings. One would expect there to be a premium to entrepreneurship, given the rather clear evidence that there is a preference for doing science (Stern, 2004; Roach and Sauermann, 2010). In addition, the academics also take on substantially more risk: the standard deviation of earnings is more than three times larger after becoming an entrepreneur compared with before. The lack of a premium to compensate for this added income risk is yet another puzzle, although these results are consistent with several prior studies showing similar findings (summarized in Åstebro, 2012).

Both dividends and capital gains are inconsequential for total earnings except for a small group of individuals. We found only four entrepreneurs (less than 1%) obtaining capital gains higher than half the average pre-entrepreneurship earnings. Further, it appeared that entrepreneurship is a gradual process for many academics.[29] At least one quarter of all academics who become full-time entrepreneurs already operated as part-time entrepreneurs while employed at their university. Finally, full-time academic entrepreneurship is episodic. A large fraction, more than 60%, quit full-time entrepreneurship within 2 years, and 66% of those return to academia.

In conclusion, full-time entrepreneurship by former university-employed is not a frequent phenomenon. Neither does entrepreneurship appear to be important for those that undertake it. Most of them glide into it gradually and rapidly switch out of it. The gains from becoming an entrepreneur are equivalent to remaining at work at the university and entail much greater income risk.

It seems that supporting this type of activity with public policies might not matter much. Nevertheless, there is no reason to actively try to discourage the behavior. Even though there are large income risks involved, academics appear to easily switch out of the risky activity. The social rates of return to this activity could be large even though the private returns are here estimated to be close to nil. As such, it appears that academics should be left alone to do what they enjoy best.

Acknowledgements

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[29]Which corroborates previous findings, see e.g. Wennberg *et al.* (2011).

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Appendix

Table A1 Tax rates and marginal tax rates by type of Income, 2000–2012

Year	Labor income		Capital income						Corporate income
	Without social security contribution	With social security	Interest	Capital gains, not 3:12	Dividend				
					Listed shares	Unlisted	CHC 3:12	CHC 3:12 Exceeding allowance	
2000	30.4–55.4	47.6–66.4	30	30	30	30	30	30.4–55.4	28
2001	30.5–55.5	47.7–66.5	30	30	30	30	30	30.5–55.5	28
2002	30.5–55.5	47.7–66.5	30	30	30	30	30	30.5–55.5	28
2003	31.2–56.2	48.2–67.0	30	30	30	30	30	31.2–56.2	28
2004	31.5–56.5	48.4–67.2	30	30	30	30	30	31.5–56.5	28
2005	31.6–56.6	48.4–67.2	30	30	30	30	30	31.6–56.6	28
2006	31.6–56.6	48.3–67.2	30	30	30	25	20	31.6–56.6	28
2007	31.6–56.6	48.3–67.2	30	30	30	25	20	31.6–56.6	28
2008	31.4–56.4	48.2–67.1	30	30	30	25	20	31.4–56.4	28
2009	31.5–56.5	47.9–66.9	30	30	30	25	20	31.5–56.5	26.3
2010	31.6–56.6	47.9–67.0	30	30	30	25	20	31.6–56.6	26.3
2011	31.6–56.6	47.9–67.0	30	30	30	25	20	31.6–56.6	26.3
2012	31.6–56.6	47.9–67.0	30	30	30	25	20	31.6–56.6	26.3

Source: Alstadsæter and Jacob (2012).