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# Entrepreneurs: Jacks of all Trades or Hobos?

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Lazear (2005) suggests that entrepreneurs should be generalists, while those who work for others should be specialists. Many prospective entrepreneurs will develop varied skills by engaging in a variety of employment activities prior to become an entrepreneur, and incomes are higher for those that do so. An alternative view predicts that those with greater taste for variety are more likely to become entrepreneurs. Varied employment prior to becoming an entrepreneur is simply an expression of this taste, and is associated with lower earnings. Data from a survey of 830 independent inventors and 300 individuals from the general population are used to discriminate between these two theories. The results show that inventor-entrepreneurs typically have a more varied labor market experience, and that varied work experience is associated with lower household income.

*JEL Classification Codes:* J24, L26.

*Key words:* Entrepreneurship, employment choice, skill, jack-of-all-trades, taste for variety.

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## 1. Introduction

In his famous study of Tolstoy’s philosophy of history, Berlin (1953) recalls a line from the Greek poet Archilochus that says “the fox knows many things, but the hedgehog knows one big thing.” While Berlin was characterizing the different ways that writers interpret the world around them, the notion was loosely adapted for business by Collins (2002, p. 91), who argues that those who build “good-to-great” companies are hedgehogs, who “have a piercing insight that allows them to see through complexity and discern underlying patterns. Hedgehogs see what is essential, and ignore the rest.” In contrast, those whose businesses fail are foxes that are “scattered, diffused, and inconsistent.”

In recent papers, Lazear (2004, 2005) proposes a countervailing theory in which it is valuable for an entrepreneur to be a “Jack of all trades”, while those who work for others should be specialists. Even when entrepreneurs can hire others, they “must be sufficiently well versed in a variety of fields to judge the quality of applicants” (2005, p. 650). Individuals may become entrepreneurs because they are innately able in a variety of tasks, or as a result of purposive investment in human capital that is more diverse than individuals intending to become specialists. Lazear uses work histories and university transcripts of Stanford MBA alumni to provide support for the theory. Stanford alumni who are entrepreneurs had studied a more diversified MBA curriculum than those who work for others, and they had a greater variety of roles in the labor market prior to becoming an entrepreneur. Wagner (2003, 2006) notes that the Stanford alumni are hardly representative of any national labor force, but is able to show that diversity of roles in the labor market is a predictor of self-employment in a large random sample of the German labor force. Silva (2007) produces supporting evidence from Italy. He shows in cross-sectional analysis that graduates of Bocconi University who followed a balanced curriculum were more likely to become entrepreneurs, and that the number of prior roles held by individuals in the Longitudinal Survey of Italian Families is positively associated with the likelihood of becoming an entrepreneur.<sup>1</sup>

However, evidence relating varied curricula and work histories to entrepreneurship can also be explained by the simple story that individuals with a taste for variety prefer to become entrepreneurs because doing so provides utility. Indeed, Hamilton

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<sup>1</sup> However, Silva’s results are not robust to panel techniques, and Silva interprets the cross-sectional results as the consequence of selection on unobservables.

(2000) concludes from his analysis of the data in the Study of Income and Program Participation that entrepreneurship offers significant non-pecuniary benefits. Benz and Frey (2004) argue that a significant part of the non-pecuniary benefit is simply satisfaction gained from being one's own boss, but earlier evidence directly suggests that variety is in itself rewarding. Ghiselli (1974), for example, discusses taste for job change, a phenomenon he creatively labeled the "hobo syndrome."<sup>2</sup> Linking the hobo syndrome to entrepreneurial choice, Hyytinen and Ilmakunnas (2007) report that more varied job experience is associated with both greater entrepreneurial aspirations and stronger job-switching intentions. Psychologists have also provided evidence of differing predispositions towards job changes and job satisfaction levels, observing that some people get bored at work more easily than others [e.g., Judge, Heller, and Mount (2002)].

In this paper we conduct some empirical tests with a new dataset that enables us to discriminate between the Jack of all trades (JT) and taste for variety (TV) theories. Our dataset consists of a sample of 830 Canadian independent inventors (i.e., those that commercialize their inventions outside the confines of established organizations) supplemented by a comparable sample of 300 individuals from the general population. The sample contains an unusually high fraction of individuals that have owned businesses, it provides information on the extent to which their careers have spanned different occupations and industries, it records their earnings, and it records their responses to survey questions about preferences that relate to TV.

Both theories predict a positive association between occupational variety and entrepreneurship, and it is our data relating earnings to occupational choice and occupational variety that enable us to conduct tests that discriminate between JT and TV. JT predicts that entrepreneurs have higher average earnings than specialists, even though they may not be especially good at any one thing. At the same time, income is higher for entrepreneurs with more balanced skills, while balance does not matter for specialists. Because individuals create skill balance by investing in a varied education and by working in a variety of activities, JT implies a positive association between prior occupational variety and entrepreneurial earnings. In contrast, TV predicts that entrepreneurs earn less on average than wage workers. In addition, it implies a negative association between varied work histories and earnings, because individuals with a taste for variety are willing to forego income in order to gain some non-pecuniary benefits from variety. As a result, TV predicts a negative association between income and occupational variety for both wage workers and entrepreneurs.

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<sup>2</sup> For a recent analysis of the hobo syndrome see Munasinghe and Sigman (2004).

JT and TV are not mutually exclusive theories, but they imply distinctive interpretations of the cause and effects of occupational variety: JT interprets above-average occupational variety as a purposive investment in balancing skills and should be positively associated with entrepreneurs' earnings, while TV interprets occupational variety as something like a consumption good that is likely to be associated with lower earnings. Which of these effects dominates is a purely empirical question.

Our empirical results suggest that TV dominates. We first show that, consistent with both theories, the number of different professions or industries in which a person had worked is positively correlated with the odds that he or she had ever owned a business, and the number of business owned. These correlations survive the inclusion of controls for education, work experience, family business background and marital status. We then turn to an examination of the relationship between income, employment choice and occupational variety.

Our comparison of earnings of business earners with those of wage earners returns inconclusive results. However, we find evidence of negative returns to variety for all types of workers. Among individuals that had owned at least one business at some time during their career, changing professions five or more times is associated with an eleven percent decline in annual household income relative to comparable individuals that had specialized in one profession. Changing industry of employment five or more times is associated with an eight percent decline in relative income. Comparably diverse industry experience is also associated with a large decline in relative income among non-entrepreneurs, of about fifteen percent relative to those having remained employed in a single industry. Our survey data also provides an unusual opportunity to test directly the role of TV. We collected data on several individual-level traits that are likely related to TV, and show that these variables jointly predict entrepreneurship, variety of professional and industrial experience, and household income.

## 2. Theory

The earnings implications of JT are not explicitly laid out in Lazaer's (2005) exposition, although some details are available in a prior working paper [Lazear (2003)]. In this section, we therefore begin with a précis of the JT theory that focuses on its predictions about earnings. We then contrast these predictions with those of the TV theory.

### 2.1. *Jack of All Trades*

Suppose individuals have skill levels  $x$  and  $y$  in two activities. Employees specialize in

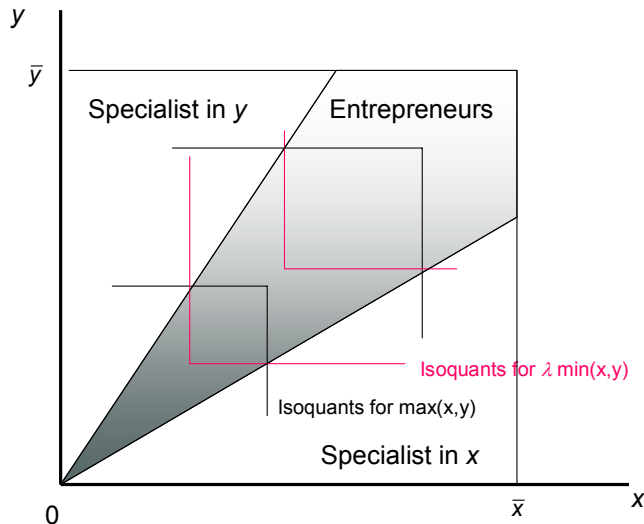


FIGURE 1. Entrepreneurs and specialists in Lazear's model.

one of them and earn an amount equal to their skill level in the activity in which they specialize. Employees therefore choose to specialize in their best skill, and earn  $w_s = \max[x, y]$ . In contrast, entrepreneurs must engage in both activities, and their income,  $w_E = \lambda \min[x, y]$ , depends upon their weakest skill. For any given  $\lambda$ , individuals with sufficiently balanced skills choose to become entrepreneurs, while those that are much better at one activity than another become specialists (see Figure 1). Lazear calls  $\lambda$  the premium to entrepreneurship: it is determined endogenously by the demand for entrepreneurs, and must always exceed unity if any individual is to become an entrepreneur.

One implication of JT is that, although entrepreneurs are not especially skilled at any one thing, their average earnings are greater than specialist earnings. To see this in a simple way, assume that an individual's skills are independent random draws from the standard uniform distribution, so that an individual may be located at any point in the unit square with equal probability. Let  $\mu$  be the exogenous relative demand for entrepreneurs, and let  $\theta_{(1)} = \min[x, y]$  and  $\theta_{(2)} = \max[x, y]$  denote the order statistics. The joint density of  $\{\theta_{(1)}, \theta_{(2)}\}$  is the constant 2, defined over  $\theta_{(1)} \in [0, \theta_{(2)}]$  and  $\theta_{(2)} \in [0, 1]$ . The fraction of the population that becomes entrepreneurs then satisfies

$$\mu = \int_0^1 \int_{\theta_{(2)}/\lambda}^{\theta_{(2)}} 2d\theta_{(1)}d\theta_{(2)} = \frac{\lambda-1}{\lambda}, \quad (1)$$

so the premium to entrepreneurship is  $\lambda = 1/(1-\mu)$ . The expected earnings of entrepreneurs are therefore

$$E[w_E] = \frac{1}{(1-\mu)\mu} \int_0^1 \int_{(1-\mu)\theta_{(2)}}^{\theta_{(2)}} 2\theta_{(1)}d\theta_{(1)}d\theta_{(2)} = \frac{2-\mu}{3(1-\mu)}, \quad (2)$$

which is greater than the expected earnings of specialists,

$$E[w_S] = \frac{1}{1-\mu} \int_0^1 \int_0^{(1-\mu)\theta_{(2)}} 2\theta_{(2)}d\theta_{(1)}d\theta_{(2)} = \frac{2}{3}. \quad (3)$$

A second implication of JT is that entrepreneurs' earnings are higher for those with more balanced skills, while balance does not matter for specialists. The claim is intuitive, and it is easily shown. We measure the balance of skills by the statistical range,  $\theta_{(2)} - \theta_{(1)}$ . Modify (2) to

$$E[w_E | \beta] = \frac{1}{(1-\mu)(\beta(\mu-1)+1)} \int_0^1 \int_{\beta(1-\mu)\theta_{(2)}}^{\theta_{(2)}} 2\theta_{(1)}d\theta_{(1)}d\theta_{(2)}, \quad (4)$$

which is identical to (3) when  $\beta = 1$ . Any increase in  $\beta$  within the admissible range,  $\beta \in [1, 1/(1-\mu)]$ , implies that we are averaging earnings over entrepreneurs with a smaller statistical range. Differentiating (4) yields  $dE[w_E]/d\beta = 1/3$ , thus confirming that balanced skills raise average wages for entrepreneurs. Similarly, modify (3) to

$$E[w_S | \gamma] = \frac{1}{1-\mu-\gamma} \int_0^1 \int_{\gamma\theta_{(2)}}^{(1-\mu)\theta_{(2)}} 2\theta_{(2)}d\theta_{(1)}d\theta_{(2)}, \quad (5)$$

which replicates (3) when  $\gamma = 0$ . Any increase in  $\gamma$  within the admissible range  $\gamma \in [0, (1-\mu)]$  implies averaging over specialists with a smaller statistical range. Equation (5) evaluates to  $E[w_S] = 2/3$  regardless of the value of  $\gamma$ .

Of course, the degree to which an individual's skill set is balanced is not, in general, observable. However, Lazear (2005) assumes that individuals may invest in the accumulation of specific skills through education or on-the-job training. As a result, individuals who intend to pursue an entrepreneurial career choose to learn a variety of skills, either by pursuing a varied curriculum in college or by accepting a variety of positions in work. Similarly, individuals who just happened to have varied educa-

tional or employment experiences will find themselves more fit for entrepreneurship, and thus are more likely to become an entrepreneur should any given opportunity to do so arise.

In summary JT makes the following empirical predictions:

P1 (JT): (a) *Individuals with varied educational and/or work experience skills are more likely to become entrepreneurs;* (b) *On average, entrepreneurs earn more than employees;* (c) *Varied experience is associated with higher earnings among entrepreneurs but not among employees.*

## 2.2 Taste for Variety

Suppose instead that  $w_E = \lambda(x + y) / 2$ . In contrast to the production technology in JT, skill levels in the two activities are perfect substitutes, and balance is no longer important for entrepreneurs. But suppose, in addition, that individuals gain benefits equivalent in value to  $v$  either by being an entrepreneur or by randomly switching between the two activities. The payoff to entrepreneurship is  $v + \lambda(x + y) / 2$ , while (assuming on average time spent in the two activities is equal), the expected payoff to the random switcher is  $v + (x + y) / 2$ .

It is easy to verify that there is a well-behaved equilibrium in this simple model. As before, let  $\mu$  be the relative demand for entrepreneurs, and let  $F(v)$  be the population distribution of  $v$ . If, consistent with evidence, the equilibrium includes both entrepreneurs and switchers, there cannot be a premium to entrepreneurship. Hence,  $\lambda=1$  and the fraction of the population who choose varied work experiences, by randomly switching jobs or by becoming entrepreneurs, is given by

$$\begin{aligned} & \int_0^1 \int_0^1 1 - F\left(\max(x, y) - \frac{x + y}{2}\right) dx dy \\ &= 1 - \int_0^1 \int_0^{\theta_{(2)}} 2F\left(\frac{\theta_{(2)} - \theta_{(1)}}{2}\right) d\theta_{(1)} d\theta_{(2)}. \end{aligned} \quad (6)$$

Individuals are indifferent between switching jobs and entrepreneurship, so they may be observed to do both at different points in their career. Moreover, because  $\max(x, y) > (x + y) / 2$ , it follows by construction that switchers and entrepreneurs earn less than stable specialists. Consequently, variety in occupational choice is positively associated with entry into entrepreneurship, but negatively associated with income:



P2 (TV): (a) *Individuals with varied experience skills are more likely to become entrepreneurs;* (b) *On average, entrepreneurs earn less than employees;* (c) *Varied work experience is associated with lower earnings.*

Note that if (6) does not exceed  $\mu$ , entrepreneurship is strictly preferred to random switching, and  $\lambda$  satisfies  $\int_0^1 \int_0^1 1 - F(\max(x, y) - \lambda(x + y) / 2) dx dy = \mu$ . It is easy to show, however, that the results in P2 hold in this case.

### 3. Data and Methods

To discriminate between JT and TV, we first need a sample of individuals who, if JT is correct, could clearly benefit from a greater diversity of skills. In situations where entrepreneurs need a limited set of specialized skills, JT's predictions, while still applicable, might be difficult to detect.<sup>3</sup> Second, not only do we need to compare variety in work experience of entrepreneurs with that of wage workers, we also need to examine variations in the variety of work experience within each group. To do so, we would like to have a sample in which entrepreneurship is a relatively common phenomenon. Third, we would like to supplement tests of the theories based on the predictions P1 and P2 with tests based on some direct measures of individual tastes.

To meet these goals, we use responses to a survey, conducted in 2004, of 830 independent inventors, self-identified through their use of the services of the Canadian Innovation Centre (CIC) sometime during the decade preceding the survey. Entrepreneurship was expected to be relatively common among these individuals. Responses to a survey of 300 Canadians supplement this pool of inventors, primarily with wage workers. The second survey, which queried a selected sample of Canadians based on province, work experience, and gender, was designed to reflect similarities with the inventors on these variables. The inventor sample began with a sampling frame consisting of 6,405 inventors that had asked the CIC to evaluate their inventions between 1995 and 2001. Of these 6,405, we had current addresses for 1,770 and contacted them by surface mail. We were then able to contact 934 by telephone, and from these we completed 830 surveys. The frame for the supplementary sample consisted of a set of random telephone numbers, stratified by province. We sorted the sample by province and set matching quotas by province, gender, and work experience. Finally, we used list-wise deletion to remove a total of 103 observations with

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<sup>3</sup> JT may be relatively unimportant in start-ups that begin large and with a high division of labor, in skilled trades (e.g., plumbing), and in instances in which the definition of entrepreneurship includes consulting or other spot-contracting work.

missing data on several key variables,<sup>4</sup> leaving 1,029 observations for analysis (735 inventors and 294 matched observations).

Along with the usual demographic information, the survey collected information on current and prior self-employment, business ownership, occupational variety, as well as some measures of individual preferences. These data are what make the survey so useful, but this does not come without cost. Most important, the data are cross-sectional and do not reveal the time paths of employment histories. Reverse causation is thus a possibility.<sup>5</sup> We will discuss the extent to which such patterns may invalidate some tests. Our analysis also includes some tests to alleviate concerns about unobserved heterogeneity and self-selection.

Disputes sometimes arise regarding the measurement of entrepreneurship. Because of data availability, self-employment is the measure most widely used<sup>6</sup>, although business ownership is also used. Some investigators, including Lazear (2005), argue that it is more appropriate to analyze the creation of new businesses. We examined all three measures. Subjects were asked whether they had ever been self-employed, whether they had ever owned a business, and how many businesses they had owned. Self-employment and business ownership are, of course, distinct phenomena: a wage-earner may own, but not be occupied full-time in the management of, a business, while some self-employed individuals may not consider themselves as owning a business.<sup>7</sup>

Summary statistics are in Table 1.<sup>8</sup> Consistent with our needs, the survey contains unusually high fractions reporting that they are or have been self-employed (63 percent), or have owned a business (60 percent). As expected, the figures are much

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<sup>4</sup> These were 53 observations with missing data on self-employment, 25 with missing data on business ownership, and 23 with missing data on occupational variety. For all remaining variables except income, which is discussed below, the non-response rate was less than two percent. In these cases, we imputed missing values by standard regression techniques under the assumption that they are missing at random. Descriptive data are reported with these few observations imputed; descriptive data without imputation are almost identical. List-wise deletion of all missing items produced results similar to those reported here.

<sup>5</sup> For example some of the diverse experiences in various occupations and industries may have occurred after an individual first chose to become an entrepreneur.

<sup>6</sup> In most of the large panel datasets, such as the PSID, it is the only measure available.

<sup>7</sup> Eighteen percent of our respondents reporting self-employment did not report business ownership, while 11 percent of business owners did not report self-employment.

<sup>8</sup> All analysis was carried out in Stata. Programs and data are available from the first author.

higher for the inventor sample than for the general population sample: 72 percent of the inventor sample report current or prior self-employment, compared with 43 percent of the general population sample; 67 percent of the inventor sample report current or prior business ownership compared with 43 percent of the general population sample. Overall, the average number of businesses that have been owned is 1.20; again, the figure is much higher for the inventor sample (1.49) than for the general population sample (0.69). Note also that individuals in the more entrepreneurial inventor sample are more likely to have come from an entrepreneurial family.

**TABLE 1**  
*Summary Statistics: Entrepreneurship Variables*

	Fractions			<i>t</i> statistic
	Total	Inventors	General Pop.	
Ever been self employed	0.63	0.72	0.43	8.75
Ever owned a business	0.60	0.67	0.43	7.31
No. of businesses owned	1.20 <sup>a</sup>	1.49	0.69	7.12
Entrepreneurial family <sup>b</sup>	0.53	0.55	0.47	2.63

*N* = 1,029. <sup>a</sup> Standard deviation 1.84. <sup>b</sup> Fractions of respondents stating that their family had at some time owned a business. Two-tailed *t*-statistics test with unequal group variances for significant differences between inventor and general population samples.

To assess variety in occupational experience, we asked respondents: “In how many different occupational fields of experience have you been active? Accounting, farming, marketing, and plumbing would be examples. We are interested not in the number of specific jobs you have had but the number of past and present occupational fields of experience” [see also Wagner (2003)]. We also asked how many distinct industries they had worked in. As Table 2 reports, there is considerable variation in the responses. Thirty-three percent have worked in five or more occupational fields, the median being three. Fifty-six percent have worked in three industries or fewer, while five percent have worked in more than ten. Inventors reported more varied work experience than did respondents from the general population, measured both by the number of occupational fields and the number of industries in which they had worked.

To obtain some direct measures of preferences, we constructed two variables that we believe relate to a person’s taste for variety as well as entry: risk aversion and adversity resilience. These constructed variables represent individual traits rather than choices and typically are unobserved by the econometrician. We expected that indi-

viduals who profess to be risk intolerant dislike variety, and those who are better able to cope with everyday adversity are more likely to seek out variety. For each construct, respondents were asked the extent to which they agree/disagree with each of several statements on a traditional five-point scale, with one representing strongly disagree and five representing strongly agree. The order of the items was randomized across subjects, some items were reverse coded, and the items were mixed with filler items. Scores on items were averaged to form a composite measurement. For the empirical estimation we assigned the value one to all observations above the median and zero to all observations below the median.

**TABLE 2**  
*Summary Statistics: Employment Variables*

	Fractions			<i>t</i> statistic
	Total	Inventors	General Pop.	
<b>OCCUPATIONAL FIELDS</b>				
1	0.12	0.11	0.16	-2.28
2 or 3	0.38	0.38	0.39	-0.44
4 or 5	0.27	0.26	0.28	-0.77
> 5	0.23	0.25	0.16	3.53
<b>INDUSTRIES WORKED IN</b>				
1	0.18	0.15	0.26	-3.53
2 or 3	0.40	0.40	0.41	-0.38
4 or 5	0.25	0.27	0.20	2.44
6 to 10	0.11	0.12	0.10	1.06
> 10	0.05	0.06	0.04	1.59

$N = 1,029$ . 20 observations on occupational fields and 7 observations were imputed for the number of industries. Two-tailed *t*-statistics test with unequal group variances for significant differences between inventor and general population samples.

We used a seven-item scale of risk aversion that was derived from the Jackson Personality Inventory [Jackson (1977)]. We chose all items from the inventory that represents willingness to take business risks plus some general items, while avoiding items representing sensation-seeking behavior such as hang-gliding. Example items are: “Taking risks does not bother me if the gains involved are high”; “I would participate only in business undertakings that are relatively certain”; and “I probably would not take the chance of borrowing money for a business deal even if it might be profitable.” There was reasonable general common construct agreement across the

items (Cronbach’s alpha = 0.60).<sup>9</sup>

Adversity resilience is a concept describing the ability of an individual to cope with everyday adversities [Wagnild and Young (1993), Masten (2001)]. We queried the respondents on the extent to which they feel they have control over events in their life and to imagine the events read out as if they were happening right now and their consequences. The scale was based on four items, one example being “People respond very unfavorably to your ideas” and another “Your computer crashed for the third time this week” [Markman, Baron, and Balkin (2005)]. The common agreement on this construct was not as high (Cronbach’s alpha = 0.48).

Table 3 reports summary statistics for our two preference measures. The inventors appear significantly less risk averse and somewhat more (at the 10 percent significance level) resilient to adversities than respondents from the general population.

**TABLE 3**  
*Summary Statistics: Preferences*

Mean Scores	Fractions			t statistic
	Total	Inventors	General Pop.	
Risk Aversion	0.52	0.47	0.63	-4.74
Adversity Resilience	0.57	0.59	0.53	1.72

*N* = 1,029. Two-tailed *t*-statistics test with unequal group variances for significant differences between inventor and general population samples.

Tables 1 through 3 report economically and statistically significant differences between the two groups in entrepreneurship and in occupational and industry variety. Table 4, which provides some demographic statistics for the two groups, indicates that these differences are not obviously due to observable demographic differences. To the contrary, the inventor and general population samples are well matched on gender, marital status, education, and income. The sample is 91 percent male and 89 percent married, and these figures are almost identical for the two groups. The gen-

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<sup>9</sup> Dohmen, *et al.* (2005) demonstrate that such a general measure is a good predictor of choices where money is at stake, and that it is good predictor of risk-seeking behaviors in decisions such as financial, health, occupational choice, and traffic violations. This instrument has also been shown to discriminate consistently between entrepreneurs and non-entrepreneurs [Stewart and Roth (2001), Rauch and Frese (2007)].

eral population sample is somewhat younger, and inventors are somewhat more likely to have a higher education. However, in both samples, the modal educational attainment is high school, while about 25 percent of both samples had some professional or graduate education. Inventors are also no different than the general population when it comes to programs studied at college or university.

**TABLE 4**  
*Summary Statistics: Demographic Variables*

	No. of Obs	No. Im- puted	Fractions		General Popula- tion	<i>t</i> statis- tic
			Total	Inventors		
MALE	1,029	0	0.91	0.91	0.91	0.00
MARRIED	1,029	16	0.89	0.90	0.88	0.56
AGE	1,029	18				
< 35			0.11	0.04	0.29	-8.85
35 – 44			0.32	0.30	0.35	-1.39
45 – 54			0.31	0.36	0.18	6.06
≥ 55			0.26	0.29	0.18	4.14
WORK EXPERIENCE	1,029	4				
< 9 years			0.02	0.01	0.05	-2.76
10 – 19 years			0.13	0.13	0.13	0.14
≥ 20 years			0.85	0.86	0.82	1.57
EDUCATION	1,029	3				
High school			0.27	0.26	0.31	-1.81
Trade school			0.14	0.14	0.13	0.63
Some college			0.17	0.16	0.18	-0.70
College degree			0.17	0.18	0.14	1.57
Professional degree			0.13	0.15	0.09	2.70
Graduate studies			0.12	0.11	0.15	1.70
Arts or social science	430		0.49	0.51	0.45	1.04
Science or engineering			0.33	0.34	0.29	0.99
Business degree			0.17	0.16	0.20	-0.89

Two-tailed *t*-statistics test with unequal group variances for significant differences between inventor and general population samples. Data are reported with imputations, with marginal differences as a result from non-imputed distributions. Data on type of university degree is conditional on having a university degree.

We use household income to measure earnings. We inquired about earnings in broad intervals of household income rather than exact personal earnings because asking detailed questions on personal earnings are known to produce very large non-responses in voluntary surveys such as this. In spite of this we received non-responses on household income for 26 percent of the sample. When we analyzed household income, the estimates are conditioned on list-wise deletion when household income is missing. As a robustness check, we also imputed values for item non-responses on household income, using the Bayesian multinomial data imputation method described in Chen and Åstebro (2003). We generated nine complete datasets where missing data were replaced assuming data were missing completely at random, and conditional on observed data (Rubin, 1987). Estimates were averaged over nine samples according to Little and Rubin (1987.) Results reported in later sections of the paper are those obtained using list-wise deletion, but they are consistent with those using this alternate method.

Table 5 provides summary statistics for reported incomes. Twenty-eight percent of the sample reported a household income exceeding \$100,000, rather more than the sixteen percent reported in the Canadian census of 2000 [Statistics Canada (2004)]. The median range in the sample is \$70,000 to \$100,000, which is also substantially higher than the national median in 2000 of \$55,000. These differences are not surprising, in view of the self-selection of the inventor sample, and the fact that the inventor sample is rather older than the Canadian labor force as a whole.

**TABLE 5**  
*Summary Statistics: Income*

	Fractions			<i>t</i> statistic
	Total	Inventors	General Population	
INCOME				
< \$30,000	0.12	0.12	0.14	-0.72
\$30,000 - \$50,000	0.18	0.17	0.20	-1.04
\$50,000 - \$70,000	0.19	0.21	0.16	1.62
\$70,000 - \$100,000	0.23	0.23	0.23	0.16
> \$100,000	0.28	0.28	0.27	0.25

*N*=778. Two-tailed *t*-statistics test with unequal group variances for significant differences between inventor and general population samples.

As discussed earlier, we considered missing data on earnings to be a significant potential problem and designed the survey to reduce that problem. This came at a cost of introducing potential measurement error in earnings. However, measurement error is often easier to deal with than inferring missing data. If measurement error is of the classical form, parameters estimates remain unbiased although the standard errors of estimates will increase. One can also allow the variance of error to differ across values of income; this induces heteroskedasticity, so all regressions are run with heteroskedasticity-consistent standard errors.

It is possible, however, that the error structure is more complicated because errors may be related to respondent characteristics. For example, personal earnings may differ more substantially from household income at greater age due to changes in household composition over time. More obviously, marital status is likely to cause household income to overstate personal income because the spouse may be employed. Such correlations between measurement errors and respondent characteristics would potentially cause bias in some estimates if these characteristics are unobserved. However, we control for age, marital status, and other variables that may describe changes in errors due to changes in household composition. In sensitivity analysis we also ran generalized models where errors were specified as functions of these variables. Results reported in later sections of the paper are consistent with those using this alternate estimation method.

Our measure of earnings may also be related to wealth, because household income includes asset income. If one believes that wealth constraints play a significant role in entry into self-employment, the use of household income would tend to exaggerate the impact of self-employment on measured income. We did not measure wealth in this survey because we considered it impractical to extract reliable self-reported data on pre-entry wealth in an ex post survey. However, it is not obvious that this omission would skew results with respect to our key predictor variables, variety in occupational experience and number of industries worked, as it is not self-evident that these are related to wealth constraints.

Finally, we also note that invention development-specific events may impact reported household earnings for inventors. We therefore included a dummy for inventor status and one for whether their invention was commercialized or not. In further sensitivity analysis we examined the inventor sub-sample and included several other variables describing the timing of invention events. None of these additional variables affected household income.



## 4. Results

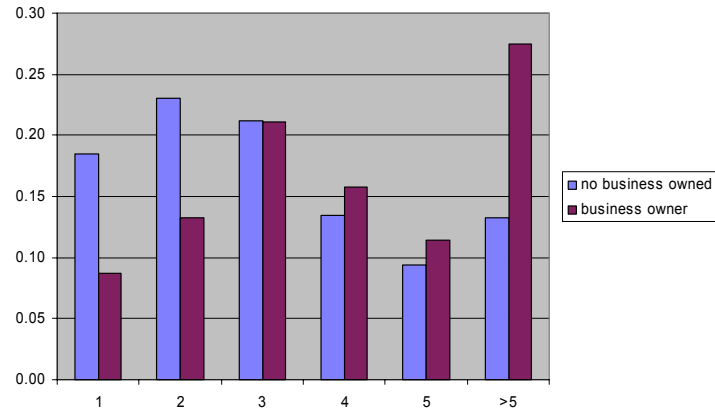
In this section, we report the results of our tests of JT and TV. We begin in section 4.1 with an examination of the effect of variety in labor market experiences on the propensity to enter entrepreneurship (part (a) of P1 and P2), Section 4.2 analyzes the relationship between occupational choice and income (part (b) of P1 and P2), and Section 4.3 turns to the effect of variety on income (part (c) of P1 and P2). The results favor TV, so in section 4.4 we use data on respondent attributes to test directly the effects of taste for variety on occupational choice and earnings. Finally, section 4.5 considers and rejects an alternative explanation based on unobserved ability that is negatively correlated with increased skills variety.

### 4.1 *Variety and Entrepreneurship*

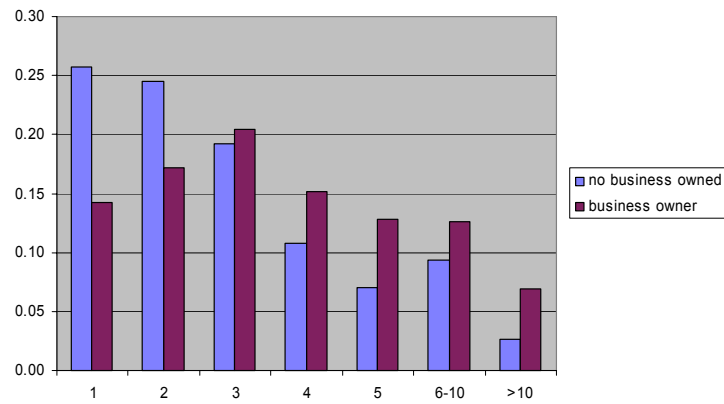
Raw differences in the numbers of occupational fields and industries worked in by respondents that have owned businesses and those that have not are clearly evident in Figures 2 and 3. These raw differences survive in formal analysis. Columns 1 and 2 of Table 6 report the results of probit regressions in which the dependent variables equal one if the respondent had ever been self-employed or had ever owned a business. Column 3 reports the results of a negative binomial regression in which the dependent variable is the number of business owned. In addition to measures of variety, the regressions include controls for family entrepreneurship, age, education and work experience. Age, education and work experience were reported in categories in the survey, but for ease of presentation these were transformed into years of age, education and years of work experience. Quadratic terms are used when relevant. Results using the ordinal categories are consistent with those presented here.

The key results in Table 6 are consistent with JT and TV. Respondents with an entrepreneurial background have had a more varied labor market experience than those without. Individuals who have worked in six or more occupational fields have a probability of ever being self-employed 17 percentage points, and a probability of ever being a business owner 22 percentage points, above individuals who have worked in only one field. Similarly, respondents reporting working in four or more industries are about 14 percentage points more likely to be self-employed and 10 percentage points more likely to ever have owned a business. Variety in occupational field and industry of employment are also positively associated with the number of business owned. These effects are highly significant and large. A Wald test that the four variety indicators in column 1 equal zero is strongly rejected ( $F=41.66$ ,  $p<0.001$ ). Note also that inventors have probabilities of being entrepreneurial 22 to 27 percentage points greater than non-inventors, while individuals with family members that have

operated a business are 15 to 16 percentage points more likely to be entrepreneurial as those that do not.



**FIGURE 2.** Number of occupational fields.



**FIGURE 3.** Number of industries worked in.

**TABLE 6**  
*Variety and Entrepreneurship*

	PROBIT		NEGATIVE BINOMIAL
	Prob (ever self-employed)	Prob (ever a business owner)	No. of businesses owned
	(1)	(2)	(3)
Occupational fields 2 to 5	0.05 (0.05)	0.09* (0.05)	0.35*** (0.14)
Occupational fields $\geq 6$	0.17*** (0.05)	0.22*** (0.05)	0.59*** (0.16)
Worked in 4 or 5 industries	0.12*** (0.04)	0.12*** (0.04)	0.42*** (0.13)
Industries worked in $\geq 6$	0.15*** (0.04)	0.08* (0.05)	0.43*** (0.10)
Family operated a business = 1	0.15*** (0.03)	0.16*** (0.03)	0.41*** (0.10)
Inventor = 1	0.27*** (0.04)	0.22*** (0.04)	0.56*** (0.11)
Years of schooling	0.005 (0.007)	0.00 (0.007)	0.001 (0.03)
Years work experience	0.02*** (0.007)	0.02*** (0.01)	0.06*** (0.02)
Age	-0.002 (0.002)	-0.00 (0.002)	0.003 (0.004)
Married = 1	-0.01 (0.05)	-0.03 (0.05)	-0.14 (0.12)
Male = 1	0.02 (0.06)	0.02 (0.06)	0.23* (0.13)
Mean prediction	0.63	0.60	1.05
Average Log-likelihood	-0.58	-0.60	-1.43
Pseudo $R^2$	0.12	0.10	n.a.

$N=1,026$ . Standard errors in parentheses are heteroskedastic-consistent using White's (1980) formula. Significance levels: \*\*\* 0.01, \*\* 0.05, \* 0.10. Marginal effects at sample mean reported.

#### 4.2 *Income and Occupational Choice*

Table 7 reports the results of interval regressions of household income on, *inter alia*, self employment and the number of business owned. Recall that JT predicts greater earning for entrepreneurs, while TV predicts the reverse. The two sets of regressions provide mixed results. Column (1) shows that each additional business owned is associated with a \$2,000 increase in household income, significant at the ten percent level; at the mean 1.2 business owned, this is a premium over average earnings of less than three percent. Column (2) shows that self-employment is associated with an imprecisely-estimated decline in income. On balance, these results provide some modest support for JT, but this may be contaminated by the effects of wealth constraints on selection into business ownership, selection of the more successful into serial and portfolio entrepreneurship [cf. Westhead *et al.* (2005)], and learning by doing. We turn, therefore, to the effect of variety on income, which we believe is less likely to be contaminated by such concerns.

#### 4.3 *The Returns to Variety*

Table 8 reports estimates of household income, again using interval regression. We include a dummy for those inventors that were successful in commercializing their invention as this may affect income.<sup>10</sup> Columns 2 and 3 display separate regressions for employed and self-employed. Results are similar when instead we split the sample by business owners and non-business owners.

The main result is that, consistent with TV but not with JT, a greater variety of labor market experience reduces household income for both entrepreneurs and employed. Column 1 shows that both the number of occupational fields and the number of industries worked in have large negative coefficients, and a Wald test that the four variety indicators in column 1 are all equal to zero is rejected ( $F=15.41$ ,  $p<0.01$ ). Columns 2 and 3 indicate that employed and self-employed alike have negative returns to skills variety. The negative effects of variety are of important magnitudes

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<sup>10</sup> Potential differences in income between inventors that did not commercialize and non-inventors will be indicated by the inventor dummy. Because 2004 income may be affected negatively by the timing of R&D expenditures for the focal invention, we included a set of dummies for the time when the majority of R&D was undertaken. We also included a set of dummies for the timing of market release of the focal invention. Finally, because we measure household income rather than personal income and because married may make different occupational choices than single we interacted marital status with all the variety indicators. None of these additional variables affected income.

**TABLE 7**  
*Income and Occupational Choice (Interval Regressions)*

	Dependent Variable: Household Income ('000s)	
	(1)	(2)
Ever Self-employed = 1	-----	-0.95 (2.84)
Number of business owned	2.02* (1.08)	-----
Family ever operated a business =1	2.59 (2.65)	3.71 (2.64)
Inventor = 1	1.00 (3.44)	2.30 (3.48)
Years of schooling	4.78*** (0.58)	4.79*** (0.59)
Years of work experience	-0.39 (0.60)	-0.27 (0.61)
Age	4.64*** (1.08)	4.70*** (1.07)
Age squared	-0.05*** (0.01)	-0.05*** (0.01)
Married = 1	20.31*** (4.79)	20.04*** (4.81)
Commercialized invention = 1	7.78 (4.94)	8.68* (5.08)
Male = 1	7.92 (5.60)	8.66 (5.70)
Constant	-113.43*** (23.02)	-116.54*** (23.05)
Average Log-likelihood	-1.71	-1.71
<i>N</i>	776	776

Sample only includes observations with complete data on household income and occupational choices. Item non-responses for other variables have been imputed. Standard errors in parentheses are heteroskedastic-consistent using White's (1980) formula. Significance levels: \*\*\* 0.01, \*\* 0.05, \* 0.10.

**TABLE 8**  
*The Returns to Variety (Interval Regressions)*

	Dependent Variable: Household Income ('000s)		
	(1)	Never self-employed (2)	Self-employed (3)
Occupational fields 2 to 5	-8.21* (4.13)	-6.64 (5.38)	-10.30* (6.30)
Occupational fields ≥ 6	-9.88* (5.10)	1.93 (7.72)	-16.02** (7.04)
Worked in 4 or 5 industries	-2.34 (3.18)	-10.93** (5.16)	2.06 (4.09)
Industries worked in ≥ 6	-10.93*** (4.27)	-25.62*** (7.15)	-4.97 (4.78)
Family ever operated a business =1	4.14 (2.60)	185 (4.01)	4.42 (3.56)
Inventor = 1	3.56 (3.38)	4.72 (4.35)	2.96 (4.99)
Years of schooling	4.65*** (0.59)	5.40*** (0.89)	4.16*** (0.81)
Years of work experience	-0.08 (0.61)	-0.58 (0.76)	0.18 (1.00)
Age	4.81*** (1.05)	5.03*** (1.50)	490*** (1.55)
Age squared	-0.06*** (0.01)	-0.06*** (0.01)	-0.06*** (0.01)
Married = 1	19.14*** (4.76)	17.80*** (6.43)	19.61*** (5.84)
Commercialized invention = 1	8.44* (5.02)	-6.90 (14.46)	9.97* (5.65)
Male = 1	9.35* (5.68)	8.79 (6.68)	9.53 (7.01)
Constant	-110.94*** (23.08)	-117.28*** (30.12)	-110.19*** (35.61)
Average Log-likelihood	-1.70	-1.70	-1.69
N	776	299	477

Sample only includes observations with complete data on household income and occupational choices. Item non-responses for other variables have been imputed. Standard errors in parentheses are heteroskedastic-consistent using White's (1980) formula. Significance levels: \*\*\* 0.01, \*\* 0.05, \* 0.10.

and the four dummies are jointly significant in both equations (column 2:  $F=17.51$ ,  $p<0.01$  column 3:  $F=10.21$ ,  $p<0.05$ ). Entrepreneurs changing occupational fields six or more times reduce their expected household income by approximately \$16,000 compared to those specializing in one profession. Similarly, entrepreneurs changing jobs across six or more industries reduce their expected household income by approximately \$5,000 compared to those specializing in one industry.<sup>11</sup>

#### 4.4 *Direct Proxies for TV*

We estimate a trivariate probit in which one branch of the decision tree describes the probability of switching into entrepreneurship, the second the probability of seeking variety and the third the probability of having income of at least \$70,000. The second branch consisted of the joint probability of working in six or more occupations and four or more industries. We selected this confluence of choices as the tabulations of both distributions indicated clear changes in probabilities at those cutoffs. The third branch is simply a collapsed version of the interval data on household income.

As Table 9 shows, the addition of taste-related variables has the expected results. A Wald test of joint significance soundly rejects the null that the variables do not jointly affect the choices observed ( $F=25.72$ ,  $p<0.001$ ). Examining them individually, it appears that those who are more risk averse are less likely to become entrepreneurs, less likely to choose a variety of jobs, and less likely to earn a high income. Those who are adversity-resilient are likely to have higher incomes, are more likely to seek out variety and more likely to choose entrepreneurship.

#### 4.5 *Unobserved Ability*

An alternative explanation for the results presented so far is that unobserved ability is negatively correlated with increased skills variety. Assume high-ability individuals are paid better than low-ability individuals, are less likely to seek out other employment, and are less likely to suffer involuntary separation. Thus, those who switch jobs more often are more likely to be of lower quality; more likely to switch into entrepreneurship, perhaps by chance; and more likely, by chance, to switch both across different professions and different industries. There is indeed empirical evidence

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<sup>11</sup> Because of the correlation between our four variety indicators we obtained a principal component from them. The first (principal) component represents 74% of the combined variances. Using this principal component in place of the four indicator variables, leads to an estimated returns to skill variety that is statistically significant at the 5% level, with elasticities of  $-1.7\%$  and  $-1.4\%$  for employees and entrepreneurs, respectively.

**TABLE 9**  
*Taste for Variety*

	TRIVARIATE PROBIT		
	Prob (self-employed) (1)	Prob ( $\geq 6$ occ. & $\geq 4$ ind.) (2)	Prob (income > \$70,000) (3)
<i>Observable choices</i>			
Occupational fields 2 to 5	0.09 (0.16)		-0.18 (0.16)
Occupational fields $\geq 6$	0.39* (0.22)		-0.33 (0.22)
Worked in 4 or 5 industries	0.43*** (0.13)		-0.16 (0.13)
Industries worked in $\geq 6$	0.65*** (0.17)		-0.47*** (0.15)
<i>Direct taste proxies</i>			
Risk averse = 1	-0.29*** (0.10)	-0.23*** (0.12)	-0.19* (0.11)
Adversity-resilient = 1	0.01 (0.10)	0.14 (0.12)	0.24** (0.11)
Correlations between errors	↑ _____ -0.05 _____ ↑ (0.12)	↑ _____ 0.06 _____ ↑ (0.10)	↑ _____ 0.11 _____ ↑ (0.06)
Average Log-likelihood	-1.48		

$N = 773$ . Likelihood function is estimated using the Geweke-Hajivassiliou-Keane (GHK) smooth recursive simulator (see Greene 2003, 931-933.) Standard errors in parentheses are heteroskedastic-consistent using White's (1980) formula. Significance levels: \*\*\* 0.01, \*\* 0.05, \* 0.10. All columns include years of schooling, years of work experience, age, age squared, an indicator variables for whether family had ever operated a business, inventor status, whether the focal invention was commercialized, marital status, and gender. Columns (1) and (3) further include the four employment variety indicator variables.



showing that individuals who change employers more often are both more likely to become self-employed and to earn less in self-employment [Evans and Leighton (1989)].

If this alternative explanation is correct, individuals who switch into entrepreneurship at some point in time should have unobserved ability that is lower than average. Moreover, this unobserved ability should be negatively correlated with household income. An examination of the disturbance coefficients of correlation in the tri-variate probit in Table 9 allows us to test this hypothesis. As can be seen, none of the correlation coefficients reach statistical significance (and the correlation between the disturbances of columns (1) and (3) has a sign inconsistent with this alternative explanation), indicating that there is no evidence for the presence of unobserved ability that is related both to household income and entrepreneurship. Moreover the absence of significant correlations in the errors implies that the equations can be estimated separately.

The main findings of the previous single-equation estimates survive once we add the taste-related variables: the probability of becoming an entrepreneur is positively associated with preferences for job-related variety, and seeking job-related variety reduces household income.

## 5. Conclusions

Lazear (2005) suggests that entrepreneurs will find it valuable to be a jack of all trades; that is, that entrepreneurs must be good at a wide variety of skills to succeed. Entrepreneurs tend to be generalists, while those who work for others should tend to be specialists. At the heart of this theory is the assumption that individuals rationally plan their human capital investments with an eye to a future choice of profession that entails one of two states, employment or entrepreneurship. The model further implies that the returns to skill variety should be positive for entrepreneurs but not for specialist employees. An alternative argument is that the choice of entrepreneurship is driven by a taste for variety. Entrepreneurship is known to involve a range of tasks that stimulate people with a taste for doing many different things. This taste for variety will also be reflected in an individual's preference for educational and occupational diversity. Thus, people with a taste for great variety will have a broad educational background, a diverse employment pattern, a greater likelihood of being an entrepreneur, and lower income.

We studied these alternative theories using a sample survey of 830 Canadian inventors coupled with a matched sample of 300 individuals from the general population. Consistent with both theories and with previous evidence, we found the probability of becoming self-employed and the expected number of businesses owned increase with the number of different professions and industries in which an individual has worked. We found that both the number of different professions and the number of industries worked in reduce household income among both entrepreneurs and employees. The effect was especially strong for entrepreneurs. Some direct indicators of taste for variety obtained from the survey data are also found to predict selection into entrepreneurship and choice of variety. These results are consistent with a world in which the decision to become an entrepreneur is driven predominantly by a taste for variety.

As in most studies we rely on proxy measures, particularly for earnings, job market choices, and taste for variety. The use of proxy measures typically introduces more noise than if better measures were available, therefore biasing test towards accepting the null hypothesis. A more difficult problem to deal with was missing item data on earnings. We designed the survey to reduce the tendency by respondents to withhold earnings data. However, with 26% missing item data on earnings conclusions have to be tempered. A multiple imputation technique nevertheless confirmed results which relied on list-wise deletion. We also use cross-sectional analysis, which opens the possibility for reverse causation and for common determination by unobservables. The source and generation of data unfortunately prohibited the development of panel data which would provide opportunities to deal effectively with these issues. Instead, we were able to gather rather detailed data which have not been explored in previous work. We also conducted a test that rejects the hypothesis that the outcomes are jointly determined by unobservables. We cannot, however, control appropriately for the possibility that the employment choices in terms of job variety may be a function of prior self-employment spells. However, such potential employment patterns does not invalidate our theory that people select entrepreneurship because it allows them to undertake many tasks satisfying a taste for variety. In fact, such patterns would be entirely consistent with taste for variety.

## **Appendix**

### **Further Details on Sample and Sampling Process.**

The sample is drawn from the universe of inventor-entrepreneurs using the services of the CIC. Its representation of all inventors is unknown. While this may seem an important

limitation it should be noted that there has been no prior study using a sample representing all inventors because the universe of inventors is not known. Other studies have used samples also limited in scope and representativeness to various degrees. Jewkes et al. (1959) and Baumol (2006) chose to study some historically well-known cases. Shane (2001) examined inventors from the Massachusetts Institute of Technology. Samples of inventors drawn from more than one university are quite common (e.g. Friedman and Silberman 2003; Lach and Schankerman 2004; Link and Siegel 2005), but there are of course many inventors not employed by universities. As an indication of this, only 11% of our sample have a post-graduate degree and fewer than 2% have a Ph.D. degree. Others use patent records to sample inventors (e.g. Agrawal, Cockburn, and McHale 2006; Kim, Lee, and Marschke 2005; Trajtenberg, Shiff, and Melamed 2006) or use commercially available databases of venture capital investments in start-ups (e.g. Gompers, Lerner, and Scharfstein 2005). None of these approaches represents all inventors. Using patents under-represent inventors. For example, Åstebro and Dahlin (2005) report that only 12% of inventions by independent inventors were patented. And only a small and highly selected fraction of start-ups receive venture capital. Lacking a known universe from which to draw inventors, we chose inventors randomly from a list of inventors using the Canadian Innovation Centre. Inventors turn to the CIC to have their early-stage ideas evaluated for a fee, rising from Canadian \$250 to \$1,000 during the sampling period. This fee is larger than the fee for registering a patent, thus ensuring some minimum level of quality of the invention. Further, as the CIC main service is to offer advice, extremely overconfident and optimistic inventors are not likely to use the service.

One important feature of our sample is that there was full personal contact information recorded for the inventor by the CIC at the time of assessment (name, title, home telephone number, home address, business telephone number). This proved a benefit over studies that use patents to track inventors. Patent records provide only the name and address of the inventor. A drawback was that the CIC as a rule only recorded the initial of the first name, making it more difficult to find exact name matches when searching telephone directories.

As we conducted data collection in three waves we present some sampling statistics from only one of them (the most recent) to illustrate the overall sampling approach and results. The same sampling strategy was followed in the first wave; there were no statistically significant sampling or response biases across year of submission, province in Canada, gender, and invention assessment. Follow-up data were collected in the second wave, which extended data on survival times and collected sales values for recent innovations in the first survey wave that (the first survey response indicated) had been commercialized. Using records from the Canadian Innovation Center, in 2004 we extracted a list of 6,405

records with inventors who had submitted ideas for IAP review between 1995 and 2001. This list was edited down to 4,425 records, deleting all but one application from the same inventor. Similarly to Giuru et al. (2005) we then used a tiered match search algorithm to search for the inventors' current home addresses and home phone numbers using the Yellow Pages. The results appear in Table A.1.

Table A.1. Address Match Results.

	Number	Percentage
Record where details did not change	948	21.4%
Record with new phone number, same address	160	3.6%
Record with new address, same phone number (local move)	371	8.4%
Record with new address and phone number	499	11.3%
Excessive number of name matches with no matching address/phone ( $> 3$ )	1,355	30.6%
Multiple name matches with non-matching address and phone ( $\leq 3$ ).	610	13.8%
No matching record	482	10.9%
Total	4,425	100%

We were able to match 45% of records (1,978 records). In contrast, Giuri et al. (2005) obtained 64% exact matches of patent holders in the White and Yellow pages. The percentage of matches was lower than that of Giuri et al. (2005) for several reasons. First, we identified 610 records (14%) where there were more than one match but typically fewer than four. Although it would have been possible to call these to find the inventor, we did not do so due to budget constraints. Second, as our records contained only the initial of the first name, we had more inventors with multiple matching records (41.5%). Finally, our sample consisted of 25% stayers and 75% movers, while the European survey contained 64% stayers; since our inventors moved more often, it was more difficult to trace them.

The Survey Research Centre mailed out 1,841 letters on Friday January 30<sup>th</sup> 2004, the difference being used for two pre-test rounds and the elimination of another 8 records that upon closer scrutiny had inventors with multiple submissions. After 71 refusals to participate were obtained the final sample size was 1,770. Contact attempt results are presented in Table A.2.

Many numbers in the sample did not lead to contact with an inventor, for any of the following reasons: moved, not in service, wrong number, and the person reached was not the inventor. By excluding these numbers (dispositions 3, 4, 5, and 10), we can calculate a

traceable rate by dividing the remaining contacted numbers over the sample total. Excluded dispositions corresponded to 418 observations. The traceable rate was  $1352/1770 = 76\%$ . The response rate can be calculated among the remaining cases by multiplying the contact rate by the cooperation rate. Using disposition codes to represent the number of such observations, the response rate is:

$$\frac{7 + 8 + 9 + 11 + 12 + 13 + 14}{1 + 2 + 7 + 8 + 9 + 11 + 12 + 13 + 14} \times \frac{13 + 9}{8 + 9 + 11 + 12 + 13 + 14},$$

which equals 61%.

Table A.2 Contact Attempt Results.

Disposition code	Description	# of Records
1	No Answer/Answering Machine	79
2	Busy	2
3	Not in service	164
4	Wrong Number	136
5	Moved	18
6	Callback - No interview started	0
7	Callback - partial interview	2
8	Refusal	390
9	Refusal - partial interview	49
10	Person did not submit invention to CIC	100
11	Person not available during study hours	7
12	Other	22
13	Complete	781
14	Deceased	21
<b>Total</b>		<b>1770</b>

## References

- Agrawal, Ajay, Iain Cockburn, and John McHale. "Gone But Not Forgotten: Knowledge Flows, Labor Mobility, and Enduring Social Relationships." *Journal of Economic Geography* 6 no. 5 (November 2006): 571-591.
- Åstebro, Thomas (2003): "The Return to Independent Invention: Evidence of Unrealistic Optimism, Risk Seeking or Skewness Loving?" *Economic Journal*, 113: 226-239.
- Åstebro Thomas, and Irwin Bernhardt (1999): "The Social Rate of Return to Canada's Inventor's Assistance Program", *The Engineering Economist*, 44(4):348-61.
- Åstebro Thomas, and Kristina Dahlin (2005): "Opportunity Knocks," *Research Policy*,

34:1404-1418.

- Åstebro Thomas, and Samir Elhedhli (2006): "The Effectiveness of Simple Decision Heuristics: Forecasting Commercial Success for Early-Stage Ventures," *Management Science*, 52(3):395-409.
- Baumol, William J. 2006. "Return of the Invisible Men: The Microeconomic Value Theory of Inventors and Entrepreneurs." Paper presented at the annual meeting of the American Economic Association, Boston.
- Benz, Matthias and Bruno S. Frey (2004): "Being Independent Raises Happiness at Work." *Swedish Economic Policy Review*, 11(2):95-134.
- Berlin, Isaiah (1953): *The Hedgehog and the Fox*, New York: Simon and Schuster.
- Chen, Gongyue and Thomas Åstebro (2003): "How to Deal with Missing Categorical Data: Test of a Simple Bayesian Method," *Organizational Research Methods*, 6(3):309-327.
- CIC. "Annual Report." Waterloo, Canada: Canadian Industrial Innovation Centre, 1996.
- Collins, Jim (2001): *Good to Great*, New York: HarperCollins.
- Dohmen, Thomas, Armin Falk, David Huffman, Uwe Sunde, Jürgen Schupp and Gert G. Wagner (2005): "Individual Risk Attitudes: New Evidence from a Large, Representative, Experimentally-Validated Survey," Discussion paper 511, DIW Berlin.
- Evans, David S. and Linda S. Leighton, (1989): "Some Empirical Aspects of Entrepreneurship", *American Economic Review*, 79(3):519-35.
- Friedman, Joseph, and Jonathan Silberman. 2003. "University Technology Transfer: Do Incentives, Management, and Location Matter?" *Journal of Technology Transfer* 28(1): 17-30.
- Giuri, P, Mariana, M. et al. "Everything You Wanted to Know About Inventors (but never asked): Evidence From the PatVal-EU Survey." LEM Working paper 2005/20, Laboratory of Economics and Management, Sant'Anna School of Advanced Studies (2005).
- Gompers, Paul, Lerner, Josh and Scharfstein, David S. "Entrepreneurial Spawning: Public Corporations and the Formation of New Ventures." *Journal of Finance*, 2005.
- Greene, William H. (2003): *Econometric Analysis*, 5th ed., Upper Saddle River, NJ: Prentice-Hall.
- Ghiselli, Edwin E. (1974): "Some Perspectives for Industrial Psychology," *American Psychologist*, Feb.:80-87.
- Hamilton, Barton (2000): "Does Entrepreneurship Pay? An Empirical Analysis of the Returns to Self-Employment," *Journal of Political Economy*, 108:604-31.
- Hyytinen, Ari and Pekka Ilmakunnas (2007): "Entrepreneurial Aspirations: Another Form of Job Search?" *Small Business Economics*, 29:63-80.
- Jackson, Douglas N. (1977): "Reliability of Jackson Personality-Inventory," *Psychological Reports*, 40(2): 613-614.

- Jewkes, John, David Sawers, and Richard Stillerman. 1959. *The Sources of Invention*. New York: St. Martin's Press.
- Judge, Timothy A., Daniel Heller, and Michael K. Mount (2002): "Five-factor Model of Personality and Job Satisfaction: A Meta-Analysis," *Journal of Applied Psychology*, 87:530-541.
- Kim, Jinyoung, Sangjoon John Lee, and Gerald Marschke. 2005. "The Influence of University Research on Industrial Innovation." NBER working paper 11447.
- Lach, Saul, and Mark Schankerman. 2004. "Royalty Sharing and Technology Licensing in Universities." *Journal of the European Economic Association*, 2(2-3): 252-264.
- Lazear, Edward (2003): "Entrepreneurship," Institute for the Study of Labor, Discussion Paper No. 760.
- Lazear, Edward (2004): "Balanced skills and entrepreneurship." *American Economic Review*, 94(2):208-211
- Lazear, Edward (2005): "Entrepreneurship," *Journal of Labor Economics*, 23(4):649-680.
- Link, Albert, and Donald Siegel. 2005. "Generating Science-Based Growth: An Econometric Analysis of the Impact of Organizational Incentives on University-Industry Technology Transfer." *European Journal of Finance*, 11(3): 169-181.
- Little, R. J. A. and D. B. Rubin (1987). *Statistical Analysis with Missing Data*. John Wiley & Sons.
- Munasinghe, Lalith and Karl Sigman (2004): "A Hobo Syndrome? Mobility, Wages and Job Turnover", *Labour Economics*, 11:191-218.
- Markman, Gideon, Robert A. Baron and David B. Balkin (2005): "Are Perseverance and Self-Efficacy Costless? Assessing Entrepreneurs' Regretful Thinking", *Journal of Organizational Behavior*, 26(1):1-19.
- Masten Ann S. (2001): "Ordinary Magic: Resilience Processes in Development", *American Psychologist*, 56, 227-239.
- Rauch, Andreas and Michael Frese (2007): "Let's Put the Person Back into Entrepreneurship Research: A Meta-analysis on the Relationship Between Business Owners' Personality Traits, Business Creation and Success", *European Journal of Work and Organizational Psychology*, 16(4), 353-85.
- Rubin, D. B. (1987). *Multiple Imputation for Nonresponse in Surveys*. John Wiley & Sons.
- Shane, Scott. 2001. "Technological Opportunities and New Firm Creation." *Management Science*, 47(2): 205-220.
- Silva, Olmo (2007): "Entrepreneurship: Can the Jack-of-All-Trades Attitude be Acquired?" *Economics Letters*, forthcoming.
- Statistics Canada (2004): 2001 Census Canada, <http://www12.statcan.ca/english/census01/home/index.cfm>, accessed on April 4, 2005.

- Stewart Wayne H., Philip L. Roth (2001): "Risk Propensity Differences Between Entrepreneurs and Managers: A Meta-Analytic Review", *Journal of Applied Psychology* 86(1): 145-153.
- Trajtenberg, Manuel, Gil Shiff, and Ran Melamed. 2006. "The Names Game: Using Inventors Patent Data in Economic Research." NBER working paper 12479.
- Wagner, Joachim (2003): "Testing Lazear's Jack-of-All-Trades View of Entrepreneurship with German Microdata," *Applied Economics Letters*, 10(11): 687-689.
- Wagner, Joachim (2006): "Are Nascent Entrepreneurs Jacks-of-all-trades? A Test of Lazear's Theory of Entrepreneurship with German Microdata," *Applied Economics*, 38:2415-19.
- Wagnild G.M., and H. M. Young (1993): "Development and psychometric evaluation of the resiliency scale", *Journal of Nursing Management*, 1(2), 165-178.
- Westhead, Paul, Deniz Ucbasaran, Mike Wright, and Martin Binks (2005): "Novice, Serial and Portfolio Entrepreneur Behaviour and Contributions," *Small Business Economics*, 25(2):109-132.
- White, Halbert (1980): "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity," *Econometrica*, 48(4):817-38.