The Right Stuff? Personality and Entrepreneurship*

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October 30, 2013

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Abstract: A puzzling feature of entrepreneurship is that many individuals remain self-employed even though they would earn more in paid-employment. To shed light on this puzzle, we examine the role of personality traits in determining entrepreneurial decisions and earnings. We estimate a model in which agents maximize expected utility by choosing between self and paid employment. We allow personality traits to affect earnings in each sector along with underlying preferences over sectors. We find that the personality traits that make entrepreneurship profitable are not always the same personality traits that drive people to open their own business This means that, in terms of personality traits, individuals who would be the highest earning entrepreneurs are not always the individuals who choose to be entrepreneurs.

Keywords: Entrepreneurship, Personality, Non-cognitive skills, Latent factors.
JEL Classification:

*We gratefully acknowledge helpful comments from: Bruce Hall, Andrew Knight, Richard Spady and Matthew Wiswall. The usual caveats apply.

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1 Introduction

Entrepreneurship has occupied economic thought for nearly a century. This sustained interest reflects a widely held view that individuals pursuing their own business ventures drive innovation and economic growth. Entrepreneurship, however, is poorly understood. For one, most small businesses fail, but it is unclear why some individuals are successful entrepreneurs while others are not. Second, and more puzzling, there is evidence that many individuals who remain self-employed would earn more in traditional, paid employment (Hamilton, 2000). A recent paradigm shift in economics has led to widespread acknowledgement of the role of non cognitive or *soft* skills—including personality traits—in driving economic behavior like labor supply. This shift raises the question: could personality differences explain which individuals become entrepreneurs and—among those who do—which ones succeed?

In this paper, we examine the role of personality traits in determining entrepreneurial decisions and earnings. We estimate a model in which agents maximize expected utility by choosing between self and paid employment. In the model, personality can affect earnings in each sector and can also capture underlying preferences over sectors. We also exploit multiple measures of personality taken over the lifecycle to identify the distributions of latent, stable personality traits, thus circumventing possible mis-measurement issues associated with standard personality assessments. Using our setup, we obtain sector-specific market prices of latent personality traits along with estimates of how personality links to preferences over sectors.

The estimated model reveals that individual differences in personality offer a cohesive explanation of puzzling entrepreneurial decisions. Our main result is that the personality traits that make entrepreneurship most profitable are not the same personality traits that drive people to open their own business. The starkest illustration of this dichotomy involves the trait "openness to new experiences". Income-maximizing individuals with this trait would do better to remain in paid employment, where relative earnings are higher. However, individuals that are open to new experiences also reveal a preference for entrepreneurship. In other words, personality may hold the key to understanding why individuals pursue unprofitable business ventures.

This study contributes to three separate literatures. The first studies the decision to open a business. In a seminal paper, Evans and Jovanovic (1989) show that credit constraints are binding for many would-be entrepreneurs, so that individuals with especially profitable ideas, but few assets, are unable to pursue their business venture.[1] Building on this work and using a similar conceptual framework, Paulson, Townsend, and Karaivanov (2006) show

[1] Their framework is similar to a Roy model of sector choice as discussed in (Heckman and Honore, 1990).

that credit constraints alone cannot explain why good business ideas are not pursued and that moral hazard also plays a role. Both these papers suggest that some paid employees would be successful entrepreneurs were it not for market imperfections. On the other hand, Hamilton (2000) shows that many entrepreneurs who are "successful" in that their businesses have not failed would have earned more had they remained in traditional, paid employment.[2] This finding may reflect that there are important non-pecuniary benefits of self-employment, such as autonomy. Taken together, this research leads to the following somewhat startling conclusion: entrepreneurship does not attract the subset of individuals for who it would generate the highest returns. If so, then society may lose out on valuable innovations that could increase wealth, raise employment and tax revenue, improve the quality of available goods and spur future innovation.

A second related literature, much of it from personnel psychology, studies how measurements of personality traits relate to job performance and job satisfaction. The correlations discussed in this research are intriguing and highlight the importance of including personality measurements in studies of entrepreneurship. As an example, Barrick and Mount (1991) show that individuals who are open to new experiences are especially good trainees, perhaps since they are eager to try new things.[3] However, they are not necessarily better employees. In line with our results, this work shows that traits like openness to new experiences might have different impacts on labor market choices versus labor market performance. More closely related to self-employment, Barrick and Mount (1993) show that two other traits, conscientiousness and extraversion, are associated with better job performance, especially for managers who exercise more autonomy at work. Since autonomy is a hallmark of self-employment, this finding suggests that the relationship between personality and success differs in paid versus self employment. Research relating personality to job satisfaction has been inconclusive. Judge, Heller, and Mount (2002) do so and generally find very mixed results or zero correlations. Their findings may reflect the shortcomings of simple correlations, in particular, their inability to separately identify how personality relates to earnings versus preferences, both of which may figure into job satisfaction. This shortcoming underscores the need for a model capable of capturing more nuanced linkages between personality traits and entrepreneurial decisions and returns.[4]

[2]Levine and Rubinstein (2013) argue that the payoff to entrepreneurship may be higher than Hamilton (2000) suggests, though their analysis focuses on a subsample of entrepreneurs who may be non-randomly selected because they are already successful.

[3]Section 2 provides a discussion of personality measures that are typically used in economic analysis and that will be used in this analysis.

[4]Further contributions to this line of work include Mount, Barrick, and Stewart (1998); Berings, De Fruyt, and Bouwen (2004); Barrick, Mount, and Judge (2001); Costa Jr and McCrae (1995); Barrick and Mount (1993); Mount, Barrick, and Stewart (1998); Hurtz and Donovan (2000); Judge and Bono (2001); Roccas

A third and burgeoning literature to which we contribute incorporates non-cognitive skills and personality traits into economic models of rational decision-making. Much of this work can be traced to Heckman and Rubinstein (2001).[5] They show that non cognitive skills can account for much more of the observed variance in sociodemographic outcomes than cognitive skills alone can. Building on this work, economists have studied how personality traits and non cognitive skills relate to a host of outcomes, including marriage (Lundberg, 2012, 2011), education (Barón and Cobb-Clark, 2010; Savelyev, 2010; Gensowski, Heckman, and Savelyev, 2011; Heckman and LaFontaine, 2010; Heckman, Pinto, and Savelyev, 2012) and health (Heckman, 2012). More closely related to our study are papers relating personality to labor market behavior (Heckman, Stixrud, and Urzua, 2006; Urzua, 2008; Wichert and Pohlmeier, 2009; Heineck, 2010; Störmer and Fahr, 2013). This research has led to some particularly striking results, showing, for example, that non cognitive skills differences can help to explain education and earnings differences between men and women and between blacks and whites.

Comparatively little research has directly connected self-employment and non-cognitive skills. Notable exceptions are Hartog, Van Praag, and Van Der Sluis (2010), who examine "social ability" and entrepreneurial firms, albeit in a reduced for setting, and Asoni (2010), who studies self-employment spells and self-confidence. Our approach differs in that we explicitly model selection into self-employment, which includes specification of counterfactual earnings distributions, sector preferences and credit constraints. Moreover, we focus on a set of widely used personality traits that have been shown to be stable over the life-cycle and highly informative. These are known as the "Big 5" and will be discussed in detail in Section 2. Finally , our approach uses multiple measures of personality traits to identify stable latent factors rather than relying on a single, potentially mis-measured assessment.

Despite the growing and fruitful integration of personality measures into economic models, important conceptual problems remain (Almlund et al., 2011). Most problematic is how (or even whether) personality fits within the utility paradigm in economics. Personality traits may reflect or be correlated with preferences. Alternatively, and as Almlund et al. (2011) propose, personality and preferences may both reflect some deeper, as yet unknown characteristic, which drives human behavior. Some recent work has begun to address this issue, proposing models that explicitly link preferences with non-cognitive skills (Bowles, Gintis, and Osborne, 2001; Anderson et al., 2011). Bowles, Gintis, and Osborne (2001), for example, model personality as enhancing preferences. Other researchers have used labora-

et al. (2002); Stawski et al. (2010).

[5]Excellent summaries of the state of this line of research are found in Borghans et al. (2008) and Almlund et al. (2011). The techniques used in this literature draw upon Goldberger (1972) and Jöreskog and Goldberger (1975).

tory experiments to ascertain how non-cognitive abilities relate to measures more familiar to economists, including preferences over risk, time and ambiguity (Dohmen et al., 2008, 2010; Fréchette, Schotter, and Trevino, 2011; Vandenberghe, St-Onge et al., 2008). Nonetheless, it remains an open question how best to incorporate personality into economic models and we will therefore return to this issue when we specify the structural model estimated in this paper.[6]

2 The "Big Five" Personality Traits

A large literature in psychology has settled upon five traits (oftentimes know as the *Big 5*), which summarize an individual's personality. These five are chosen using statistical models intended to focus attention on traits that are neither overlapping nor redundant. As with any rubric, there is some debate surrounding the Big 5, but they are attractive for a few reasons. Perhaps most appealing for economists, they appear to be stable over the lifecycle (Cobb-Clark and Schurer, 2012). This features dispels concerns about simultaneity if the Big 5 are used as exogenous right-hand-side variables in regressions explaining economic behavior. One explanation of this permanence is a potential genetic basis for personality traits (Zhang et al., 2009; Shane et al., 2010; Shane and Nicolaou, 2013). In the present study, we exploit multiple assessments of a given individual's personality traits to identity the distribution of permanent components of latent personality traits. This approach will focus our attention on the economic importance of stable, latent traits that are measured (or possibly mis-measured) by standard personality assessments. A second reason the Big 5 are widely used is that research in psychology and, of late, economics, has found them to be highly predictive of a wide range of economically relevant behavior. A third reason, which is less conceptually driven, but highly pragmatic, is that widespread use of the Big 5 in psychology means that many data sets contain measurements of them. Originally proposed in Goldberg (1971), the Big five are: *agreeableness*, *extraversion*, *neuroticism*, *conscientiousness* and *openness to new experiences*. Characteristics and attributes that they embody, are listed in Table 1.

3 Data

We use data from the National Survey of Midlife Development in the United States (MIDUS), which studies midlife from an unusually rich variety of perspectives. Information is collected

[6]Further work on issues integrating personality into economics are found in Heckman and Kautz (2012); Roberts et al. (2011); Borghans et al. (2011).

Table 1: The Big 5 Personality Traits

Personality Trait	Associated With:
Agreeableness	◇ Trust, altruism, kindness, affection, and other prosocial behaviors.
Extraversion	◇ Excitability, sociability, talkativeness, assertiveness, and high amounts of emotional expressiveness.
Neuroticism	◇ Emotional instability, anxiety, moodiness, irritability, and sadness.
Conscientiousness	◇ Thoughtfulness, good impulse control, goal-directed behaviors, good organization and mindfulness of details.
Openness to New Experiences	◇ Imagination and insight; having a broad range of interests.

The Big 5 along with the attributes and characteristics that they are widely acknowledged as embodying.

on the labor market choices and outcomes, physical health, and psychological well-being of a representative sample of working age men and women in the United States. Also included in the data set are a host of variables that are rarely seen in a representative sample, including measures of social responsibility, exposure to violence as a child and religiosity. Crucial for the present study, the MIDUS data set includes information on whether individuals are self-employed, their assets and standard measures of the Big 5 personality traits.[7]

MIDUS data collection occurred in two waves, the first (MIDUS I) in 1995 and the second (MIDUS II) in 2004. The sample surveyed in 1995 included over 7,100 men and women between ages 25 and 74 from the United States. The second wave surveyed a nationally representative subsample of 3,485 individuals with the goal of understanding the physical, health and psychological effects of aging. In our study, we use both waves of data, including the same individual's answers on two personality assessments. Using both assessments helps us to circumvent possibly mis-measured personality traits (including the effect of aging on responses to personality assessments). In particular, we use multiple measures to identify the distribution of latent traits that are measured by the personality assessments.

In out study, we restrict attention to the sector choice (paid or self employment) of male workers that are under age 65 in 2004. The subsample for analysis includes individuals who are not missing data on key explanatory variables, including personality assessments in both

[7]To our knowledge, only two previous papers in economics make use of the MIDUS data set. They are Lundborg (2013) and Cutler and Lleras-Muney (2010).

1995 and 2004 or assets, which are only measured in 1995. The fact that we use assets in 1995 to identify credit constraints in 2004 is not ideal, though preferable to using 2004 assets, which are measured at the same time as retrospective sector choice is measured. This means that assets measured in 2004 are potentially endogenous to sector choice. To be sure, we would prefer to use assets measured in, say, 2003. Instead, 1995 assets provide a noisy measure of assets at the time of the decision to become self-employed, which we prefer to a possibly endogenous measure.

Summary statistics of the subsample for analysis are found in Table 2 for the subsample used in our analysis and then separately for individuals in self versus paid employment. We also include differences in means between these two groups and p-values from t-tests of whether these differences are significant.[8] According to Table 2, entrepreneurs earn more, on average, than paid employees. A possible explanation of this earnings differential is that entrepreneurship is more lucrative than paid-employment. However, as Hamilton (2000) points out, these types of averages ignore selection into sectors. High earning entrepreneurs may earn the same or more in paid employment. In constructing the model estimated in this paper, it will therefore be important to take explicit account of sector choice, which requires us to specify the counterfactual earnings distributions that agents face when choosing between sectors.

Also important to the selection question is the possibility of credit constraints. Following Evans and Jovanovic (1989), we exploit data on assets to take account of possible credit constraints that would-be entrepreneurs face. Table 2 supports the possibility of credit constraints, showing that entrepreneurs, on average, have double the assets of paid-employees. Moreover, this difference is not driven solely by a highly left-skewed distribution, i.e., by a small number of entrepreneurs with very high assets. By plotting histograms of assets for the full subsample and then separately by paid and self employed individuals, we show that some part of the difference in assets comes from paid employees being more likely to have zero assets than self-employees (see Figure 1). A natural question to ask is whether assets are a valid way to measure credit constraints as successful entrepreneurship may be correlated with higher assets and therefore endogenous to the choice to become self-employed. How this is handled will be discussed in the specification of the model. Essentially, we follow Evans and Jovanovic (1989) and allow assets to influence the quality of business ventures.

Table 2 also reports average sociodemographic variables. We find that education, marriage, number of children and spouse education do not seem to differ between sectors. However, spousal employment in 1995 is significantly higher for individuals who choose self

[8] A similar summary statistics table for all working-age males who participated in the second wave is found in Appendix B (Table B1).

employment in 2004. There are many reasons why this might be the case, including the possibility of risk-sharing or access to benefits like subsidized health insurance. Entrepreneurs can effectively use their spouse's more steady employment or non-pecuniary benefits as a safety net given the high possibility of entrepreneurial failure and lack of benefits.

Cognitive skill, as measured by *fluid cognitive ability* does not differ by sector, though some of the Big 5 personality traits do. For example, Table 2 shows that entrepreneurs tend to be more agreeable, extraverted and open to new experiences than paid employees. Other trait differences are not significant, though point to paid employees being more neurotic. As our aim is to disentangle how personality traits affect relative earnings and preferences over sectors, we next consider reduced form results on earnings and sector choice. In Table 3, we present results from an OLS regression of reported earnings on sociodemographic characteristics and personality traits measured in 2004. Extraversion, according to Column [2], seems to increase earnings in both sectors in a regression that pools all observations. When sectors are considered separately, we see that extraversion is only marginally profitable in paid employment, but significantly profitable in self-employment. Agreeableness is not profitable in paid employment (which may indicate that assertive people make more money), though neuroticism is. Finally, no personality traits have significant (non-zero) sector specific prices in self-employment, which is probably partly due to a small sample size. However, openness to new experiences appears to suggestively to lower entrepreneurial earnings.

Turning to sector choices, Table 9 reports probit estimates of the probability of entering self employment in 2004 conditional on employment in 2004. We find that older people are more likely to enter self-employment as are individuals with more assets. In terms of personality traits, few are significant, expect for openness, which significantly predicts entry. Here, it is important to note that the sector choice model does not take account of earnings, which means that individuals appear more likely to enter self-employment even before we have accounted for the fact that openness seems to be a personality trait that is costly rather than profitable in self-employment. These reduced form results are therefore merely suggestive. Also problematic is that the reduced form results do not take explicit account of credit constraints. Finally, these results do not make use of multiple personality measures, which can be used to identify latent traits rather than possibly mis-measured traits. As selection, counterfactual earnings, constraints and mis-measurement may all play a role in how personality affects self-employment, we will incorporate these factors into a structural model of sector choice, which we will subsequently estimate. We now turn to the specification of the model.

4 Model

In period $t = 0$, agents learn their entrepreneurial ability θ_i. In period $t = 1$, agents decide between paid and self employment, choosing the option delivering the highest expected utility.[9] Utility for sector s is denoted V^s, where $s \in \{\text{SE}, \text{PE}\}$ with SE and PE referring to self-employment and paid-employment, respectively. Utility in sector s is composed of income I^s and flow utility $\tilde{u}^s$. Each of these will be derived below.

4.1 Latent Factors and Measurements

Suppose there are J latent traits that affect entrepreneurial preferences and returns. These could include cognitive skills, non-cognitive skills, personality traits and genetic traits. Henceforth, we refer to these collectively as *latent skills*. Further, suppose there is a system of measurements to be used to identify these latent skills. An observed measurement of skill $j \in \{1, \ldots, J\}$ for person i at time t is denoted C_{ijt} and specified as:

$$C_{ijt} = M_{it}\rho_{jt} + d^C_{jt} f_{ij} + \epsilon^C_{ijt} \tag{1}$$

where M_{it} is a row-vector of observed characteristics with accompanying vector of coefficients ρ_{jt}, f_{ij} is the value of latent skill j for person i and ϵ_{ijt} is an error term capturing mis-measurement. Latent factors f_{ij} are drawn from normal distributions so that for each j:

$$f_{ij} \sim N(\mu^C_j, \sigma^C_j). \tag{2}$$

Further, we assume that $\text{cov}(f_{ij}, \epsilon^C_{ijt}) = 0 \ \forall t$ (latent traits are independent of measurement error), $\text{cov}(f_{ij}, f_{ij'}) = 0$ for $j \neq j^{'}$ and that latent trait j does not affect the measured value of trait $j^{'}$: $\text{cov}(C_{ij't}, f_{ijt}) = 0$ for $j \neq j^{'}, \forall t$.[10]

[9] We ignore non-workers and, therefore, selection into employment, though extending our analysis to include the decision to become employed would be straightforward.

[10] We have also permitted that the measurement error be mixed-normally distributed (with two points of support), but cannot reject that errors are normally distributed since the estimation routine places nearly zero probability on the second distribution. Importantly, preference and earning coefficients do not change. Therefore, we continue with the assumption that measurement error is normally distributed.

4.2 Entrepreneurial Ability and Returns: Latent Factors

If the agent chooses paid employment, he earns wage w_i, where:

$$\ln(w_i) = x_i^w \beta^w + \sum_{j=1}^{J} \kappa_j^w f_{ij} + e_i^w \tag{3}$$

where x_i^w is a row-vector of observable characteristics that influence wage with prices β^w, κ_j^w is the price of latent skill j in the wage sector and e^w is a disturbance term that is distributed according to:

$$e_i^w \sim N(-\sigma_w^2/2, \sigma_w^2). \tag{4}$$

Entrepreneurial earnings are generated according to the production function

$$y_i = \theta_i k_i^\alpha \xi_i \tag{5}$$

where k_i is agent i's capital invested in the entrepreneurial venture and $\alpha \in [0, 1]$ is a technology parameter that captures returns to capital. We can rewrite this equation in logs so that:

$$\ln(y_i) = \ln(\theta_i) + \alpha \ln(k_i) + e_i^y \tag{6}$$

where $e_i^y \equiv \ln(\xi_i)$ and ξ_i is a disturbance term that is not observed by the agent before he chooses a sector. Further,

$$e_i^y \sim N(-\sigma_y^2/2, \sigma_y^2), \tag{7}$$

where the mean is specified as such so that $\mathrm{E}[\xi] = 1$. Entrepreneurial productivity will be treated similarly to other latent factors and is generated as follows:

$$\ln(\theta_i) = x_i^\theta \beta^\theta + \psi \ln A_i + \sum_{j=1}^{J} \kappa_j^\theta f_{ij} + e_i^\theta \tag{8}$$

where x_i^θ is a vector of observable characteristics influencing entrepreneurial ability, β^θ is a vector of coefficients, κ_j^θ governs how latent skills govern entrepreneurial ability and e_i^θ is a disturbance.[11] We assume e_i is has a mixed-normal distribution to account for the possibility

[11] Similar to Evans and Jovanovic (1989), we also permit entrepreneurial ability to be a function of assets. The intention is to control for the possibility that higher assets reflect previous success in entrepreneurship, which may influence the quality of current business ideas.

of skew in entrepreneurial earnings.[12] Formally,

$$e_i^\theta \sim \left[p^\theta N(\mu_{\theta,1}, \sigma^2_{\theta,1}) + (1-p^\theta)N(\mu_{\theta,2}, \sigma^2_{\theta,2})\right]. \tag{9}$$

Net income from self-employment is given by

$$I_i^{SE} = y_i + r(A_i - k_i) \tag{10}$$

where A_i denotes agent i's assets and r is the risk-free interest rate. Income from paid employment is given by

$$I_i^{PE} = w_i + rA_i \tag{11}$$

Credit constraints are imposed upon the entrepreneur such that $k_i \leq \lambda A_i$, where $\lambda \geq 1$. The entrepreneur is a net borrower when $A_i < k_i^*$ and a net-saver when $A_i \leq k_i^*$, where k_i^* denotes the optimal investment in the entrepreneurial venture conditional on having chosen self-employment.

The agent chooses the sector $s \in \{\text{SE}, \text{PE}\}$ that generates the highest expected utility where utility V_i^s is given by

$$V_i^s = \rho I_i^s + \tilde{u}_i^s \tag{12}$$

where $\tilde{u}_i^s$ are non-pecuniary returns for sector s and ρ is a scaling parameter that converts dollars to utils. As we can only identify differences in non-pecuniary returns from choosing on sector versus the other, we specify net non-pecuniary benefits to self-employment as:

$$u_i^{SE} = \tilde{u}_i^{SE} - \tilde{u}_i^{PE} \equiv z_i\gamma^{SE}. \tag{13}$$

which is equivalent to setting $\tilde{u}^{PE} = 0$. Here, z_i is a vector of factors of observable characteristics and γ^{SE} are net non-pecuniary returns to observable characteristics in self-employment.

Specified as such, preferences over sectors amount to a residual after we have controlled for the portion of sector selection that can be attributed to observed earnings. Therefore, the utility function captures preferences that are revealed in the sense that they reflect entry into self employment that is not a function of earnings in the first period after entry. We may be capturing factors that are related to preferences, but could alternatively be capturing other factors affecting entry, such as errors in beliefs (e.g. optimism with regard to entrepreneurial returns). Our interpretation of these revealed preferences, which will be discussed in greater

[12]Estimating means of e_i means that equation 8 does not include a constant. Further, we choose a mixed normal distribution since summary statistics show that earnings are left-skewed and the mixed-normal assumption, though still very tractable, does not impose normality.

detail as we present and discuss results, must therefore be fairly broad.

4.3 Optimal Investment and Sectoral Choice: Latent Factors

When deciding between paid employment versus self-employment, the agent must first determine how much he will earn as an entrepreneur. To this end, he computes the optimal choice of k_i (supposing θ_i is known) by solving the following maximization problem:

$$\begin{aligned} \max_k \quad & E[V_i^{SE}] \\ = \; & E[I_i^{SE} + u_i^{SE}] \\ = \; & E[\rho(y_i + rA_i - rk_i) + u_i^{SE}] \\ = \; & E[\rho\theta k_i^{\alpha}\xi_i + \rho r A_i - \rho r k_i + u_i^{SE}] \\ = \; & \theta k_i^{\alpha} - rk_i, \end{aligned} \tag{14}$$

where the last equality holds since any additive components of V_i^{SE} not including k_i can be treated as constants. We obtain:

$$k_i^* = \left(\frac{\alpha\theta_i}{r}\right)^{\frac{1}{1-\alpha}} = \phi \times \theta_i^{\frac{1}{1-\alpha}}, \tag{15}$$

where

$$\phi \equiv \left(\frac{\alpha}{r}\right)^{\frac{1}{1-\alpha}}. \tag{16}$$

Plugging the optimal capital into the credit constraint inequality yields the following condition: the entrepreneur is capital-constrained whenever:

$$\theta_i > \frac{r}{\alpha}(\lambda A_i)^{1-\alpha} \tag{17}$$

To understand this inequality, suppose $\lambda = 1$. Then, the agent is credit constrained when his entrepreneurial productivity is very high (a high draw of θ_i) in relation to the assets available to invest in the project A_i. In other words, credit constraints are more relevant for poorer agents with high entrepreneurial skill.

The decision to engage in entrepreneurship amounts to comparing utility in paid versus self-employment and in cases where credit constraints are binding versus when they are not. In particular, the value of the optimal choice, denoted V_i^* is given by:

$$V_i^* = \begin{cases} \max\{(\phi^{\alpha} - r\phi)\theta_i^{\frac{1}{1-\alpha}} + u_i^{SE}, w_i\} & \text{if} \quad \theta_i \leq \frac{r}{\alpha}(\lambda A_i)^{1-\alpha} \\ \max\{(\theta_i(\lambda A_i)^{\alpha} - r\lambda A_i + u_i^{SE}, w_i\} & \text{if} \quad \theta_i > \frac{r}{\alpha}(\lambda A_i)^{1-\alpha} \end{cases} \tag{18}$$

4.4 Parameters

Given the specification of the model, the vector of parameters to be estimated is:

$$\Phi \equiv \left[\beta^w, \sigma_w^2, \alpha, \sigma_y^2, \beta^\theta, \mu_{\theta,1}, \mu_{\theta_2}, \sigma_{\theta,1}^2, \sigma_{\theta,1}^2, \lambda, \gamma^{SE}, \kappa^w, \kappa^\theta, \Xi_f\right]$$

where Ξ_f includes all parameters of the measurement system of the latent factors f_{ij}:

$$\Xi_f \equiv \left[\rho_{jt}, d_{jt}^C, \mu_j^C, \sigma_j^C\right] \quad , \quad j \in \{1, \ldots, 5\}, t \in \{1995, 2004\}$$

In the following section, we discuss the estimation of Φ.

5 Estimation

We estimate the parameters of the model described in the previous section via simulated maximum likelihood. There are three main steps to the estimation procedure. First, at each set of parameter value suggestions, indexed by g and denoted $\Phi^{(g)}$, and for each individual i, we simulate earnings, personality traits and sector choice K times, where K represents the number of draws of unobservables for each individual. Second, we compute each individual's average likelihood contribution, where the average is taken over the K draws. Third, we sum over average likelihood contributions from each individual and compute the log, which yields the value of the simulated log likelihood function, the negative of which is then maximized as with standard likelihood functions.

5.1 Simulation

The simulation procedure begins as follows: we draw a block matrix of size $K \times I \times J + 2$ from a standard normal distribution. Recall that J is the number of personality traits and K is the number of draws per individual. We need a block matrix of size $J + 2$ since we draw J personality traits, but also draw unobservables for the mixed normal distribution of business ideas. We draw B once. Next, at each parameter suggestion $\Phi^{(g)}$ and for each individual i, we compute expected earnings in the paid employment (denoted $w_{ik}^{(g)}$), expected earnings in self-employment (denoted $y_{ik}^{(g)}$) and the resulting sector choice (denoted $d_{ik}^{(g)}$). For earnings and choices, the superscript (g) indexes the parameter suggestion and the subscript ik refers to the k-th draw of individual i.

Simulating earnings and sector choice occurs in several steps. Using parameters $\Xi_f^{(g)}$, we simulate vectors of latent factors $f_{ikj}^{(g)}$, $j \in \{1, \ldots, J\}$ for each individual i, and draw k.

Similarly, we use the parameters $\mu_{\theta,1}^{(g)}$, $\mu_{\theta,2}^{(g)}$, $\sigma_{\theta,1}^{2(g)}$ and $\sigma_{\theta,2}^{2(g)}$ to simulate a business draw for each individual i and draw k, which we denote $\theta_{ik}^{(g)}$. From here, we can determine whether or not each individual-draw pair is credit constrained using equation (8) suitably modified to permit multiple draws. In particular, individual i with draw k and at parameters (g) is credit constrained if:

$$\theta_{ik}^{(g)} > \frac{r}{\alpha^{(g)}} \left(\lambda^{(g)} A_i\right)^{1-\alpha^{(g)}}. \tag{19}$$

Note that the k subscript is omitted from α, which remains constant across all K draws. Moreover, assets A_i are data, and the interest rate r (set to 1.1 for this analysis) do not change with draws or with suggested parameters (g). $\theta_{ik}^{(g)}$, however, is different for each individual i, draw k and parameter suggestion (g).

Once it is clear which individuals are credit constrained, we can compute $y_{ik}^{(g)}$ for each individual, using r, A_i, $\alpha^{(g)}$ and $\lambda^{(g)}$ when the constants are binding and r, $\alpha^{(g)}$ and $\theta_{ik}^{(g)}$ when credit constraints are not binding. Similarly, we compute utility $u_i^{SE(g)}$ and paid earnings $w_i^{(g)}$ using parameter suggestions. Then, using equation (18), we compute a sector choice for each individual-draw pair, denoting this $d_{ik}^{(g)}$. In what follows, we use $f_{ikj}^{(g)}$, $w_{ik}^{(g)}$, $y_{ik}^{(g)}$ and $d_{ik}^{(g)}$ to construct the likelihood, which we describe in the following section.

5.2 Likelihood

Ultimately, we want to match paid employment earnings, self-employment earnings, measured personality traits and sector choices, which means that the likelihood function will consist of several components. Given the assumption that earnings shocks are normally distributed, we form the earnings portion of the likelihood using the normal density function, which we denote $f(y_{ik}^{(g)})$ and $f(w_{ik}^{(g)})$ for self-employment wage density and paid-employment wage density, respectively, for individual i, draw k and parameter suggestion g. Next, given assumptions on the normality of the measurement error in latent traits, we can also derive the density function for personality measurements for each individual i, draw k and parameter vector g, denoting this $f(M_{ik}^{(g)})$. Then, we must average these, though these averages are conditional on the relevant sector being chosen for a given draw. In other words, we compute:

$$L_i^{y(g)} \equiv \frac{1}{K_{i,SE}^{(g)}} \sum_{k=1}^{K_{i,SE}^{(g)}} \left[f\left(y_{ik}^{(g)}\right) \times f\left(M_{ik}^{(g)}\right) | d_{ik}^{(g)} = \text{SE}) \right] \tag{20}$$

and

$$L_i^{w(g)} \equiv \frac{1}{K_{i,PE}^{(g)}} \sum_{k=1}^{K_{i,PE}^{(g)}} \left[f\left(w_{ik}^{(g)}\right) \times f\left(M_{ik}^{(g)}\right) | d_{ik}^{(g)} = \text{PE}) \right]. \tag{21}$$

In the above equations, $K_{i,SE}^{(g)}$ denotes the number of draws for which individual i at parameter draw (g) chooses self-employment. Similarly, $K_{i,PE}^{(g)}$ denotes the number of draws for which individual i at parameter draw (g) chooses paid-employment. Therefore, $L_i^{y(g)}$ and $L_i^{w(g)}$ are the product of average earnings densities for each sector and average personality trait densities, conditional on a sector being chosen. In other words, they are a weighted average of each individual's likelihood contribution, where the average is taken over the subset of the K draws where the individual chooses the relevant sector at draw k.

Next, we weight likelihood contributions by the probability that the model predicts that a sector is chosen by a given individual. We denote this probability $\tilde{P}_i$, defined as the number of times that the individual chooses self-employment given K draws. In other words,

$$\tilde{P}_i = \frac{K_{i,SE}^{(g)}}{K}. \tag{22}$$

Then, the likelihood contribution for individual i and draw k will be given by:

$$L_i^{(g)} = \left[\tilde{P}_i^{(g)} \times L_i^{y(g)}\right]^{d_{it}=\text{SE}} \left[\left(1 - \tilde{P}_i^{(g)}\right) L_i^{w(g)}\right]^{d_{it}=\text{PE}}, \tag{23}$$

where d_{it} is the observed sector choice so that, for each individual, the contribution to the likelihood is only a function of the probability the model predicts their observed sector is chosen, multiplied by the average of the product of the earnings density in that sector and and personality traits density, where the average is conditional on the model predicting that sector.

Once we have constructed $L_i^{(g)}$ for each individual i, we take the log of each individual's contribution and then sum over individuals to obtain the log-likelihood:

$$l^{(g)} = \sum_{i=1}^{I} \log\left(L_i^{(g)}\right). \tag{24}$$

Using both simplex and gradient methods, we evaluate $l^{(g)}$ at different values in the parameter space, indexing these suggestions by (g) and continue until a maximum is found.

6 Results

We first present results on latent personality traits and their measurements. Second, we present findings on earnings distributions conditional on working in a sector. We also discuss counterfactual earnings distributions for individuals who choose a different sector. Third,

we discuss how personality influences entrepreneurship earnings and decisions.

6.1 Latent Personality Traits

Estimated coefficients of the measurement system that relates latent, stable personality grates to measurements from personality assessments are presented in Table 5. Means are not very far from raw data means of the personality assessments, though variance is significant, which means that measurement error could be a concern if we simply included both 1995 and 2004 measurements in our earnings and utility equations. Moreover, the factor loadings, though near one, are significant different from one, which means that the assessments are not perfect measurements. Finally, there are important changes as agents age. For example, the age parameter in the measurement equation for extraversion is 0.001 in 1995 and 0.005 in 2004. This means that age leads to a higher assessment in 2004 versus 1995 for the same underlying trait. For these reasons, it is important to exploit multiple measures of personality to identify the distribution of latent traits, which are then used in the choice and earnings equations.

6.2 Earnings Distributions

Structural estimates of the earnings equations are found in Table 6 for paid employment and Table 7 for self-employment. In paid employment, we find that agents earn more when they are more highly educated, older, married and of higher intelligence. In self-employment, education leads to even higher returns, which means the sectoral price of a year of education is higher for entrepreneurs versus paid employees. Further, age does not lead to higher earnings in self-employment, though marriage does, and more strongly so than in paid employment.

Interestingly, fluid cognitive ability, our measure of intelligence, does not have a positive return in entrepreneurship. In fact, it has a significant and negative impact on self-employment earnings. In particular, a one standard deviation increase is equivalent to a decrease of two-thirds of a year of education. This difference is not enormous, but the direction of the sign is puzzling. One possibility arises from well-established findings that fluid cognitive ability is time-varying and peaks around age 30, declining thereafter. Many entrepreneurs have enough assets to invest heavily in their business when they are older. Hence, this coefficient may be capturing the effects of aging and credit constraints. If so, then fluid cognitive ability amounts to a mis-measurement of a latent trait. Unfortunately, this cognitive skill is only measured once in the MIDUS data, which means we do not have enough information to identify a latent cognitive factor that would allow us to circumvent

this sort of mis-measurement. These sorts of problems underscore the need to apply methods that isolate latent, mis-measured factors, which is what we do in the case of personality traits.

Using our estimates, we plot the distribution of earnings distributions, comparing the model versus that data in both the paid-employment and self-employment sectors, shown in Figures 2 and 3. In both sectors, earnings are left-skewed and so the model matches means by shifting towards the right. This is less of a problem in paid employment earnings. In self-employment earnings, despite permitting a mixed normal distribution for the disturbance, the model still seems to have some trouble matching earnings. Nonetheless, the model is able to capture the peak around \$100,000 along with the skew.

The depicted distributions simulated by the model are conditional on individual i at draw k having chosen the sector. In Figure 4, we consider unconditional earnings in paid versus self employment. In other words, we use the simulated model to plot counterfactual earnings distributions for each individual and each draw and for both sectors. This allow us to show what each individual in the data set would earn in both sectors. Contrary to a naive interpretation of high average entrepreneurial earnings, the reason most people are not entrepreneurs is because they would be bad at it. Figure 4 shows this very clearly. The average unconditional earnings of a paid employee are far higher than the average unconditional earnings of an entrepreneur. Furthermore, the sharpness of the peak of entrepreneurial earnings comes from credit constraints for individuals who have little or no assets.

Not surprisingly, Figure 5 shows that the proportion of people who actually choose self-employment do quite well in comparison to those who do not choose it. Figure 5 plots the distribution of earnings conditional on choosing the sector in question. However, note that even those who choose self-employment are not necessarily going to make more than paid employees. There is a significant portion of the distribution of entrepreneurs who earn less than the average paid employee. In the end, the differences between the conditional and unconditional distributions show that selection prevents many people from entering self-employment who would not earn much, though definitely not all. This point is underlined in Figure 6, which compares conditional and unconditional earnings in self-employment.

Next, we want to isolate within-individual differences in sector-specific earnings. Figure 7 plots the counterfactual difference in self-minus-paid employment earnings for each individual and each draw. Again, we see that, although many individuals would earn quite a bit more in self employment, a majority would earn less. Figure 8 makes this point more strongly, plotting the counterfactual difference in self-minus-paid employment earnings for each individual and each draw conditional on self-employment being chosen. The earnings

distribution makes clear that agents will choose self-employment despite lower earnings in comparison to self-employment. This finding is consistent with findings in Hamilton (2000), who shows that many long-term self-employed entrepreneurs, i.e., those whose business has not failed, would earn more had they remained in paid employment.

Finally, Figure 9 plots the density of choices across individuals. For each individual and draw, a choice is computed using model parameters. Next, we count up the total number of times per draw that the individual enters self-employment, which delivers a number between 0 and 1. The density of these person-level percentages is then plotted. We see that most individuals would enter entrepreneurship about 19% of the time, though there are some individuals who would enter less and a plurality who, based on their earnings potential and utility over sectors, would enter more.

6.3 Personality, Earnings and Sector Preferences

Turning to the impact of latent personality traits on sector earnings and returns, several key findings emerge from parameter estimates. First, from Tables 6 and 7, we see that agreeableness is costly in both sectors, though more strongly so in self-employment. Intuitively, this finding is not necessarily surprising and lends credence to the idea that profitability may require unpleasant negotiations and competition. Extraversion is profitable in both sectors, though more so in self-employment. Conscientiousness is profitable in paid employment, though costly in self-employment, which may signal that attention to deal may be better in a traditional employment setting, but stifle an innovator's ability to be flexible, which may mean leaving some projects unfinished. Neuroticism, interestingly, is profitable in both sectors. Finally, openness to new experience, though marginally profitable in paid employment, is decidedly unprofitable in self-employment. This finding is surprising, perhaps since entrepreneurs choose careers that, by their definition, entail new experiences.

To better understand this finding, we turn to utility parameters, which are found in Table 8. Several interesting findings emerge. First, factors that were excluded from the earnings equation play an important role in the decision to enter self-employment. For example, spousal employment in 1995, which amounts to a noisy measure of spousal employment in 2004, induces men into self-employment. As mentioned before, this may signal that self-employment is lower cost in families with a second, steady income. For similar reasons of stability, more children seems to lower the desire to enter self-employment. Fluid cognitive ability, though costly in self-employment, is consistent with a strong preference for entrepreneurship. This finding suggests that intelligent people are more likely to be entrepreneurs, but may not be particularly good at it in terms of earnings.

Turning to personality traits, the most striking finding is that openness to new experiences, though it lowers earnings, seems to capture a strong preferences for entrepreneurship. This exemplifies a broad point of this study: the personality traits that are consistent with high earnings in self-employment are not necessarily the same ones that induce people into entrepreneurship

To underscore these dynamics, in Figures 10-14, we study the simulated probability of entry for each of the 898 individuals in the sample for each of the five personality traits: agreeableness, extraversion, neuroticism, conscientiousness and openness to new experiences. Recall that Figure 9 shows entry probability as predicted by the model. In Figures in Figures 10-14, for each trait, we show the model prediction against in counterfactual settings where the trait does not affect utility, earnings or both. For each trait we also show model predicted self-employment earnings differences versus earning differences where the trait does not affect earnings. These simulations highlight how entry decision distributions would look were it not for the impact of personality traits on returns and preferences.

Openness to new experience provides the starkest example. Consider Figure 14. In each of the four panels, the solid line is the simulated probability of entry as shown in Figure 9. The dashed line shows entry probability under different counterfactual regimes. In Panel 14(a), we simulate counterfactual entry if openness did not affect utility. In that case, entry would be much lower, as shown by a left-shifted distribution. In Panel 14(b), the we simulate counterfactual entry probability where openness does not affect returns, in which case there would be more entry as people with a high level of that trait would not be "penalized" for their personality. To make the returns difference clear, we plot individual-draw-level differences in returns (self-minus-paid) simulated by the model (as in Figure 7) and again where openness does not lower returns (Panel 14(c)). As expected, unconditional returns are higher under the counterfactual, which explains the shift in entry seen in Panel 14(b). Finally, we show how the countervailing affects of openness could easily be overlooked if we simply compared entry for groups distinguished by their traits. Panel 14(d) considers entry decisions under the counterfactual where openness affects neither returns nor utility. Notice that the shift is quite small since the effects on returns and utility cancel each other out.

7 Conclusion

We have shown is that the personality traits that make entrepreneurship the lucrative choice are not the personality traits that *ceteris paribus* induce people to become entrepreneurs. The most striking example is openness to new experiences, which lowers earnings in self-

employment, but drives people to be entrepreneurs. What we have not shown is whether the preference parameters are capturing preferences or some other factor that affects sector decisions. One example would be beliefs biases. For example, it might be the case that individuals who are open to new experiences are more likely to be optimistic or overconfident about their abilities as entrepreneurs. This would induce them to enter self-employment and do poorly once there. Given the data at hand, we cannot separately identify how personality traits influence preferences over sectors versus biased beliefs. Future research would attempt to distinguish between these two. For now, we are limited to showing the personality is informative about why individuals enter unemployment despite low returns.

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8 Tables and Figures

Table 2: Summary Statistics

	Analysis Sample	Paid Employment	Self Employment	Δ (Self−Paid)	p-values
Earnings in 2004	\$78,153.61	\$74,482.67	\$93,988.64	\$19,505.97	0.044
Assets in 1995	\$120,595.20	\$101,371.10	\$203,520.70	\$102,149.60	0.000
High school degree	0.19	0.19	0.20	0.01	0.669
Some college	0.27	0.27	0.26	-0.01	0.821
College graduate	0.25	0.25	0.25	0.00	0.946
Married	0.79	0.78	0.83	0.05	0.117
No. of children	2.19	2.19	2.19	0.00	0.991
Spouse educ. (years)	12.03	12.00	12.16	0.16	0.739
Spouse employed (1995)	0.58	0.56	0.66	0.10	0.020
Fluid Cognitive Ability	0.35	0.36	0.32	-0.04	0.608
Agreeableness (1995)	3.29	3.28	3.31	0.02	0.587
Agreeableness (2004)	3.24	3.23	3.30	0.07	0.087
Extraversion (1995)	3.14	3.12	3.25	0.14	0.002
Extraversion (2004)	3.04	3.02	3.16	0.14	0.002
Neuroticism (1995)	2.16	2.18	2.10	-0.08	0.170
Neuroticism (2004)	2.02	2.03	1.99	-0.04	0.469
Conscientiousness (1995)	3.40	3.39	3.44	0.04	0.224
Conscientiousness (2004)	3.46	3.46	3.48	0.02	0.586
Openness (1995)	3.07	3.06	3.13	0.07	0.075
Openness (2004)	2.97	2.95	3.06	0.11	0.004

Summary statistics for the subsample used in analysis.

Table 3: Reduced Form Results: Earnings

	Pooled		Paid Employment		Self-Employment	
	[1]	[2]	[3]	[4]	[5]	[6]
Education (years)	0.1***	0.09***	0.08***	0.07***	0.16***	0.18***
Age (2004)	-0.001	0.002	0.002	0.007	-0.01	-0.02
Married	0.21**	0.18**	0.2***	0.17**	0.26	0.18
Cognitive Ability Measure	.	0.07*	.	0.12***	.	-0.14
Agreeableness (2004)	.	-0.25***	.	-0.22***	.	-0.38
Extraversion (2004)	.	0.14*	.	0.12*	.	0.3
Neuroticism (2004)	.	0.08	.	0.09*	.	0.02
Conscientiousness (2004)	.	0.08	.	0.13	.	-0.1
Openness (2004)	.	-0.02	.	0.03	.	-0.27
Observations	898	898	729	729	169	169

OLS estimates where the outcome variable is earnings reported in 2004 for all observations (Columns [1] and [2], for paid employees only (Columns [3] and [4]) and self-employed individuals (Columns [5] and [6]). Significance at the 10%, 5% and 1% levels are indicated with one, two and three stars, respectively.

Table 4: Sector Choice

	[1]	[2]
Assets in 1995	9.54e-07***	9.54e-07***
Education (years)	-0.02	-0.02
Age (2004)	0.03***	0.03***
Married	0.13	0.16
Cognitive Ability Measure	.	0.02
Agreeableness (2004)	.	0.01
Extraversion (2004)	.	0.12
Neuroticism (2004)	.	0.05
Conscientiousness (2004)	.	-0.1
Openness (2004)	.	0.23*
Observations	898	898

Probit estimates where the outcome variable is an indicator variable for self-employment (as opposed to paid employment) reported in 2004. Significance at the 10%, 5% and 1% levels are indicated with one, two and three stars, respectively.

Table 5: Results: Latent Personality Traits

Variable	Coefficient	Std. Error
Agreeableness:		
Mean	3.143	0.037
Variance	0.453	0.015
Factor loading	0.916	0.012
Age parameter (1995)	0.003	0.000
Age parameter (2004)	0.007	0.001
Meas. error variance (1995)	0.318	0.010
Meas. error variance (2004)	0.340	0.010
Extraversion:		
Mean	3.095	0.033
Variance	0.484	0.014
Factor loading	0.902	0.015
Age parameter (1995)	0.001	0.000
Age parameter (2004)	0.005	0.001
Meas. error variance (1995)	0.291	0.010
Meas. error variance (2004)	0.352	0.009
Neuroticism:		
Mean	2.495	0.057
Variance	0.499	0.018
Factor loading	0.941	0.037
Age parameter (1995)	-0.008	0.001
Age parameter (2004)	-0.006	0.001
Meas. error variance (1995)	0.411	0.016
Meas. error variance (2004)	0.397	0.015
Conscientiousness:		
Mean	3.302	0.023
Variance	0.341	0.011
Factor loading	1.005	0.006
Age parameter (1995)	0.002	0.000
Age parameter (2004)	0.003	0.000
Meas. error variance (1995)	0.275	0.002
Meas. error variance (2004)	0.268	0.001
Openness to New Experiences:		
Mean	3.169	0.022
Variance	0.412	0.012
Factor loading	0.928	0.009
Age parameter (1995)	-0.003	0.000
Age parameter (2004)	0.000	0.001
Meas. error variance (1995)	0.245	0.000
Meas. error variance (2004)	0.333	0.007

Coefficients: distribution of latent personality traits

Table 6: Results: Paid Employment

Variable	Coefficient	Std. Error
Education	0.067	0.001
Age	0.008	0.002
Married	0.190	0.001
Fluid Cognitive Ability	0.108	0.000
Agreeableness	-0.200	0.001
Extraversion	0.108	0.001
Neuroticism	0.086	0.000
Conscientiousness	0.153	0.001
Openness to New Experiences	0.039	0.001
Constant	9.167	0.001
Variance	0.835	0.002

Coefficients: paid-employment earnings

Table 7: Results: Self Employment

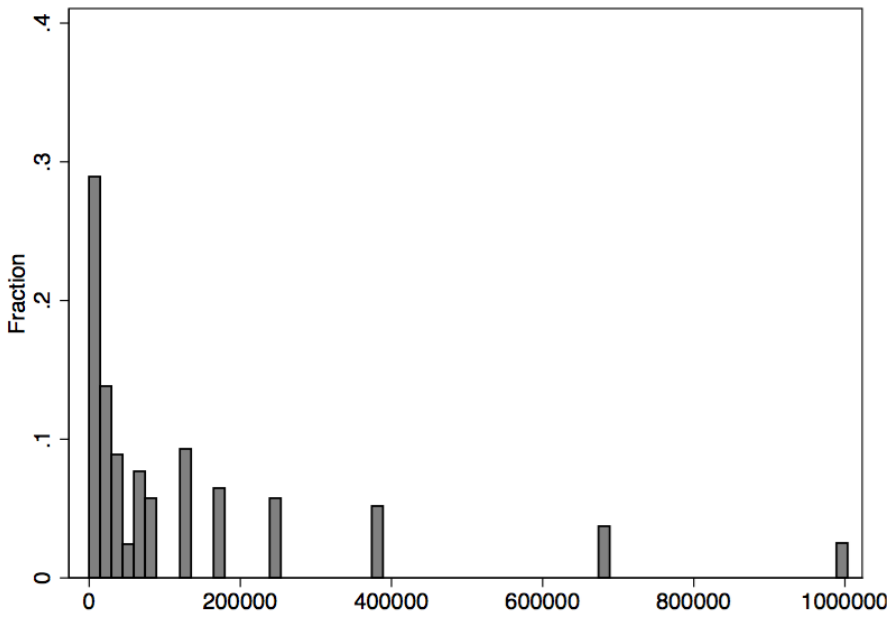
Variable	Coefficient	Std. Error
Log Assets	-0.004	0.002
Education	0.156	0.002
Age	-0.010	0.002
Married	0.256	0.004
Fluid Cognitive Ability	-0.095	0.001
Agreeableness	-0.291	0.000
Extraversion	0.225	0.000
Neuroticism	0.039	0.001
Conscientiousness	-0.072	0.001
Openness to New Experiences	-0.294	0.000
Constant 1	8.487	0.095
Constant 2	10.648	0.004
Variance 1	0.492	0.219
Variance 2	0.007	0.725
Mixture Probability	0.844	0.001
Earnings Uncertainty	1.547	0.008
Technology Parameter	0.133	0.002
Credit Constraints	1.990	1.895

Coefficients: self-employment earnings

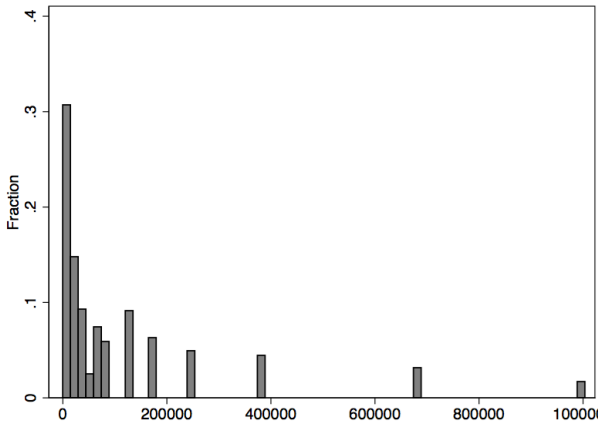
Table 8: Results: Preference Parameters

Variable	Coefficient	Std. Error
Earnings Utility Parameter	0.000	0.000
Number of Kids	-0.108	0.000
Spouse Education	0.005	0.000
Spouse Employment (1995)	0.379	0.047
Education	-0.025	0.001
Age	0.085	0.002
Married	0.045	0.042
Fluid Cognitive Ability	0.339	0.022
Agreeableness	0.104	0.001
Extraversion	0.085	0.000
Neuroticism	-0.002	0.001
Conscientiousness	-0.025	0.000
Openness to New Experiences	0.686	0.000
Constant	-6.112	0.047

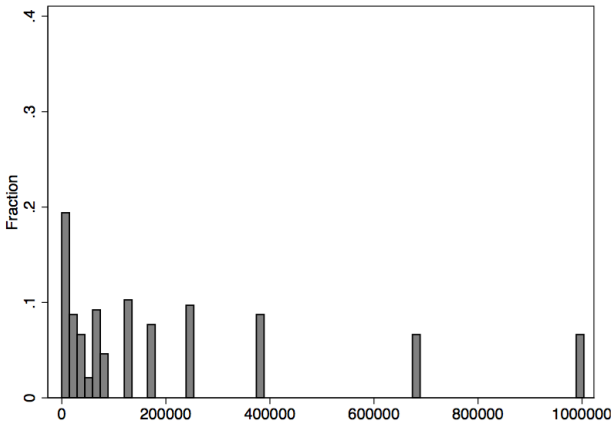
Coefficients: utility parameters



(a)



(b)



(c)

Figure 1: Histograms of assets in 1995 for the full sample (Panel 1(a)) and then separately by 2004 sector choice: paid-employment (Panel 1(b)) and self employment (Panel 1(c)).

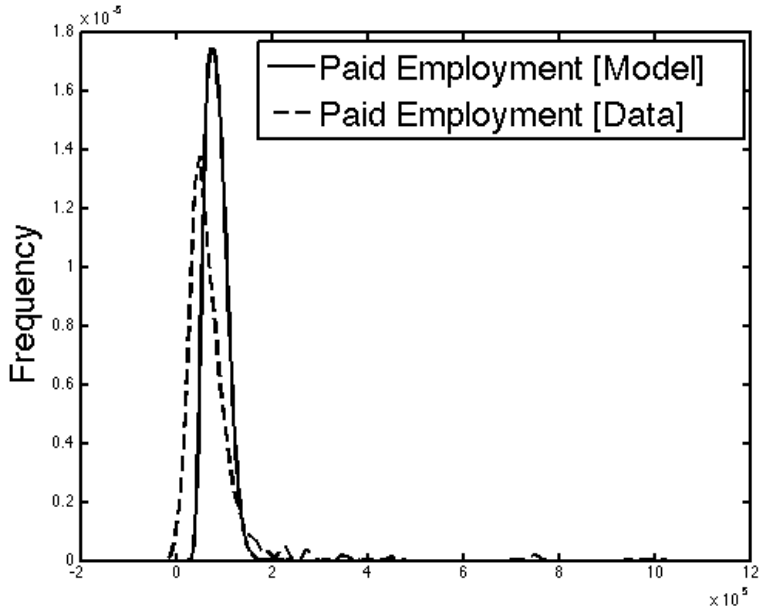


Figure 2: Model Fit—Paid Employment: The distribution of earnings in paid employment from the data and then simulated using the estimated structural model parameters for each individual (averaging over draws).

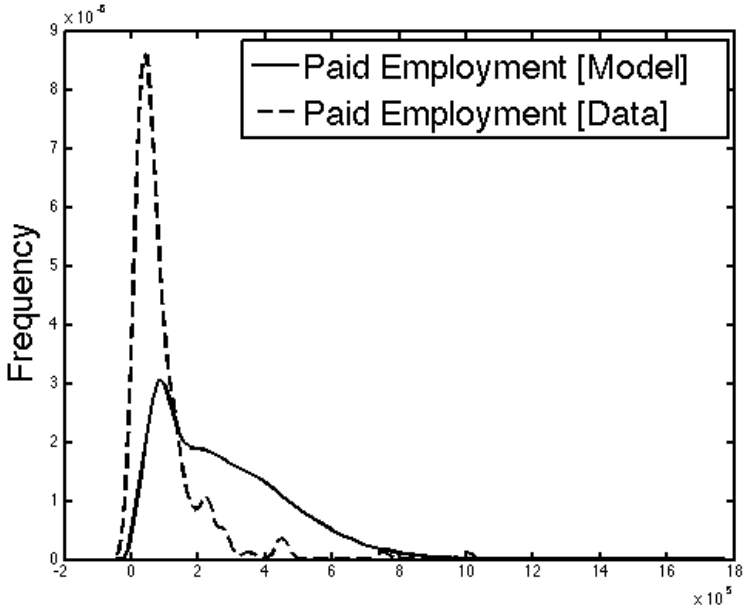


Figure 3: Model Fit—Self Employment: The distribution of earnings in self employment from the data and then simulated using the estimated structural model parameters for each individual (averaging over draws).

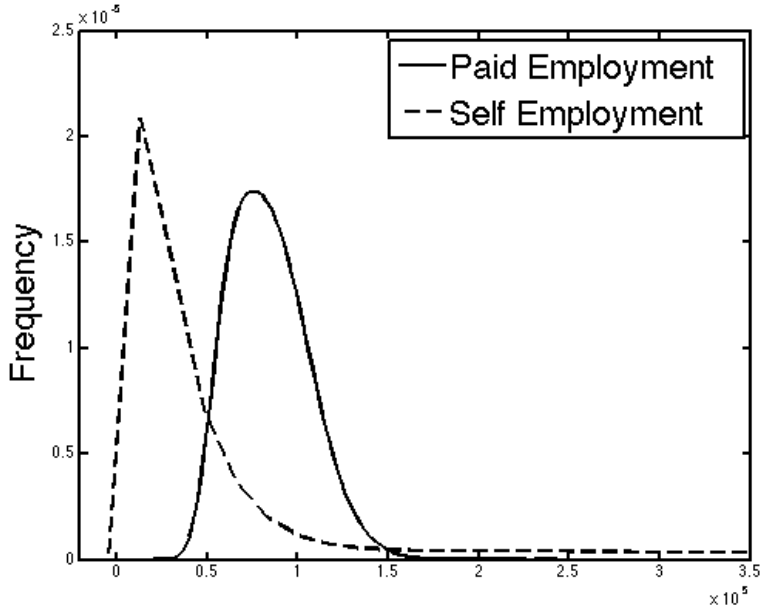


Figure 4: Simulated Earnings—Unconditional on Sector Choice: Earnings are simulated using estimated structural model parameters for each draw and for each of the 898 individuals in the sample and are not conditional on which sector the individual chooses

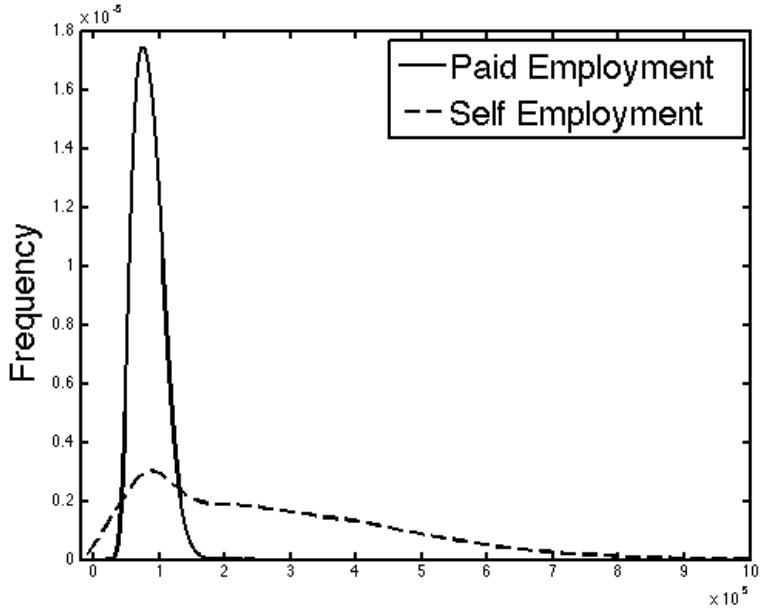


Figure 5: Simulated Earnings—Conditional on Sector Choice: Earnings are simulated using estimated structural model parameters for each draw for each of the 898 individuals in the sample and are conditional on selection into the the relevant sector.

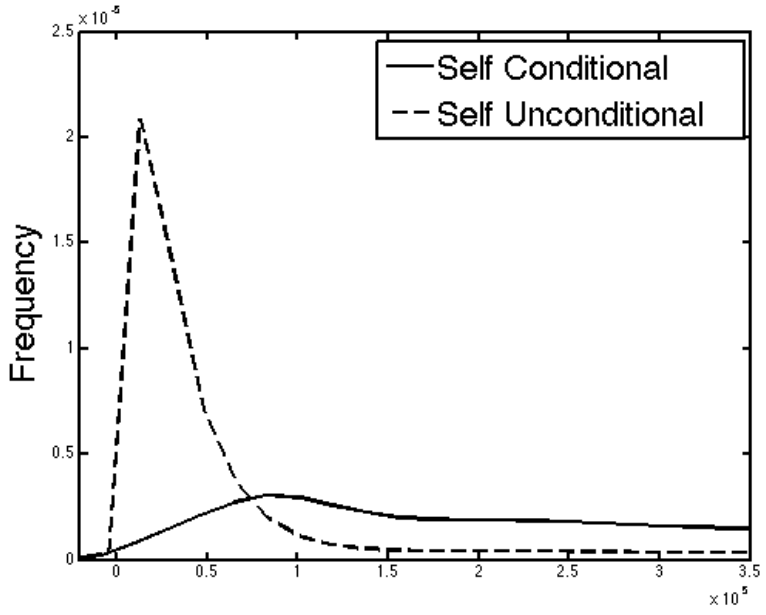


Figure 6: Simulated Paid Employment Earnings—Conditional and Unconditional: Earnings are simulated using estimated structural model parameters for each draw for each of the 898 individuals in the sample and both conditional and unconditional on selection into self-employment.

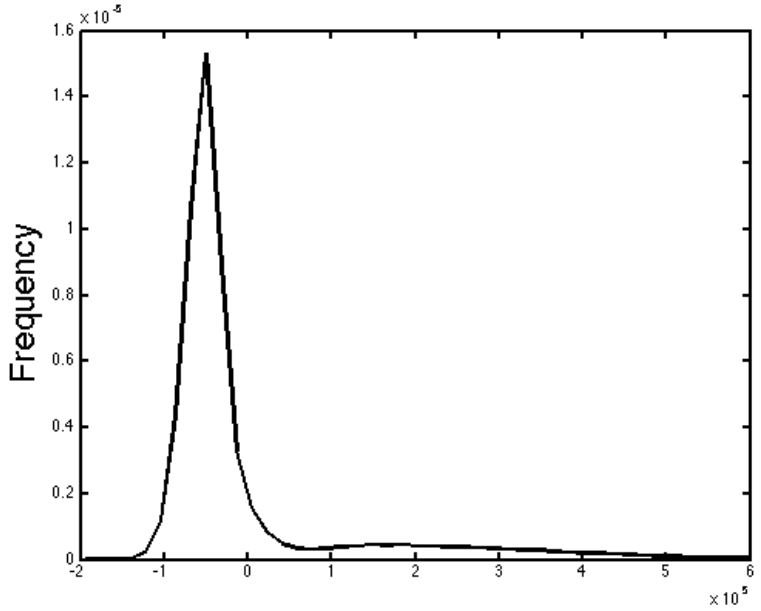


Figure 7: Simulated Earnings Differences (Self minus Paid)—Unconditional on Sector Choice: Earnings differences (self minus paid) are simulated for each draw for each of the 898 individuals in the sample and are not conditional on which sector the individual chooses

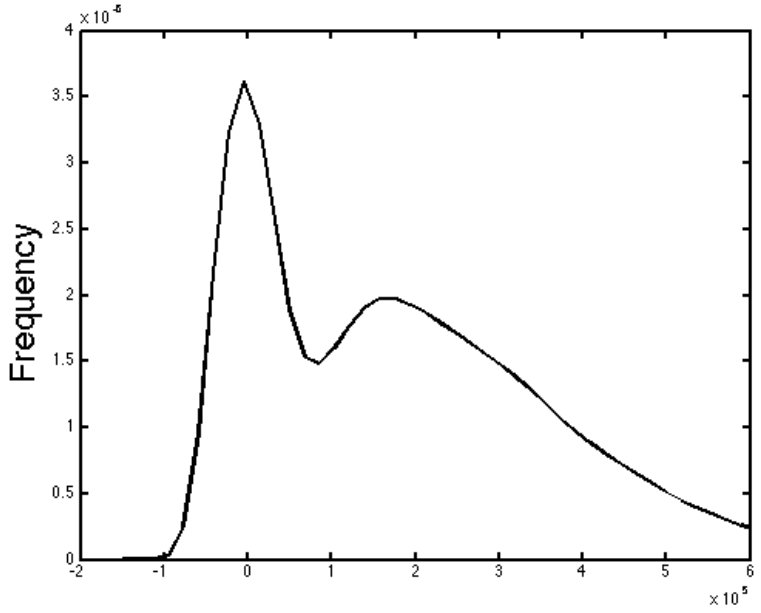


Figure 8: Simulated Earnings Differences (Self minus Paid)—Conditional on Self-Employment: Earnings differences (self minus paid) are simulated for each draw for each of the 898 individuals in the sample and are not conditional on which sector the individual chooses

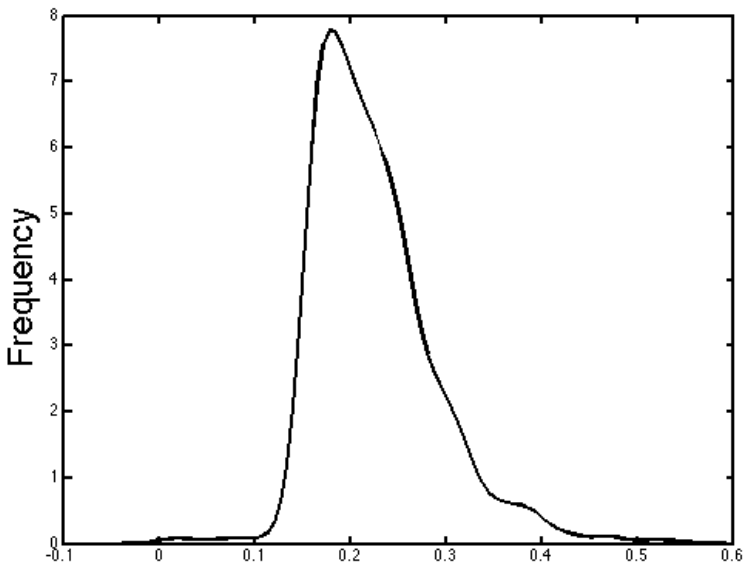


Figure 9: Simulated Self-Employment Entry: For each individual, the probability of entry is into self-employment is averaged over draws.

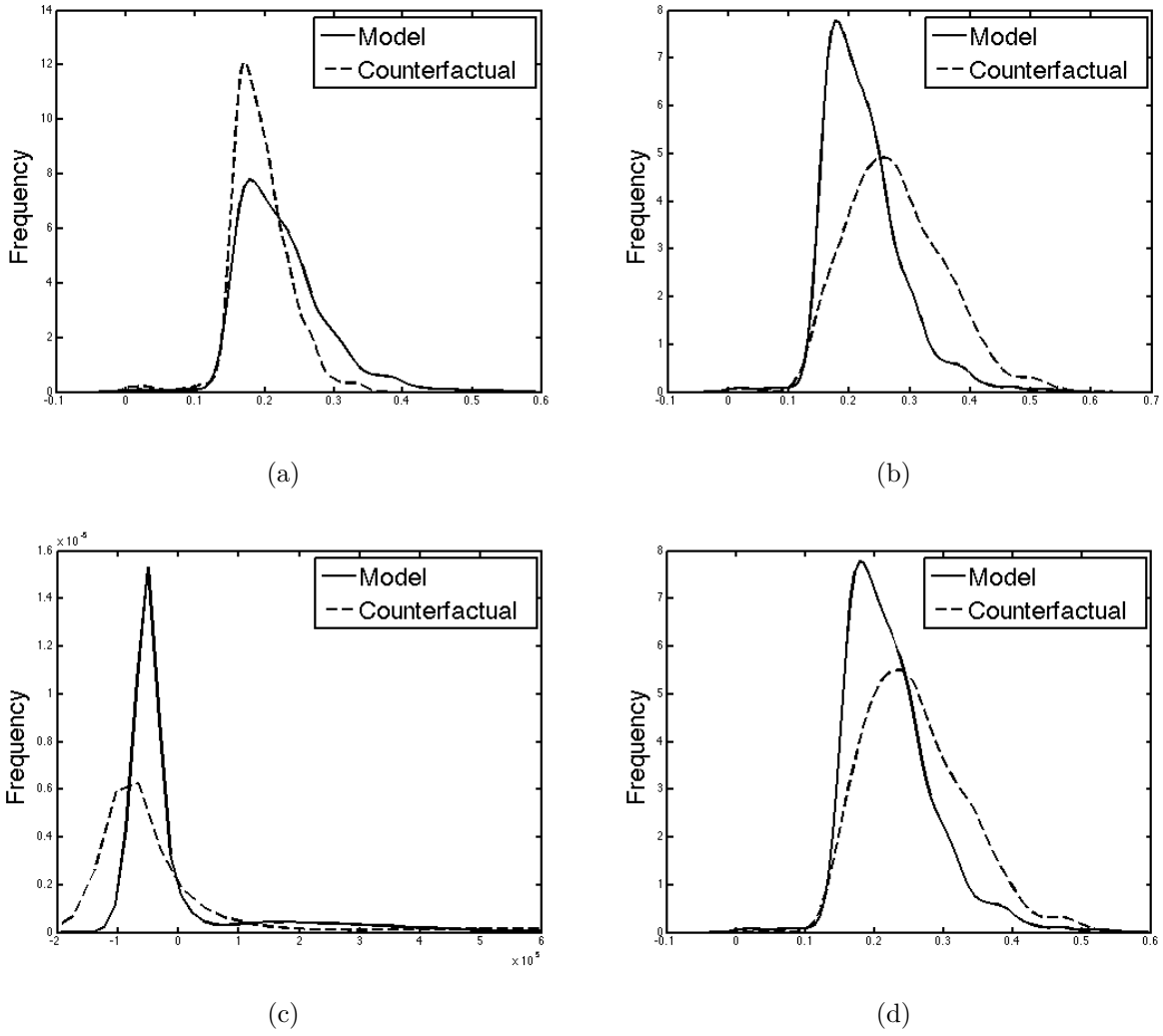


Figure 10: Agreeableness and Self Employment: The effect of the latent personality trait measured as *agreeableness* on self-employment earnings and entry for the 898 self or paid-employed men. Each panel shows the model prediction and a counterfactual distribution. Panel 10(a): model predicted entry probability and counterfactual entry probability where agreeableness does not affect preferences; Panel 10(b): model predicted entry probability and counterfactual entry probability where agreeableness does not affect returns; Panel 10(c): model predicted difference in sector specific earnings (self minus paid) and counterfactual differences where agreeableness does not affect returns; Panel 10(d): model predicted entry probability and counterfactual entry probability where agreeableness does not affect preferences or returns.

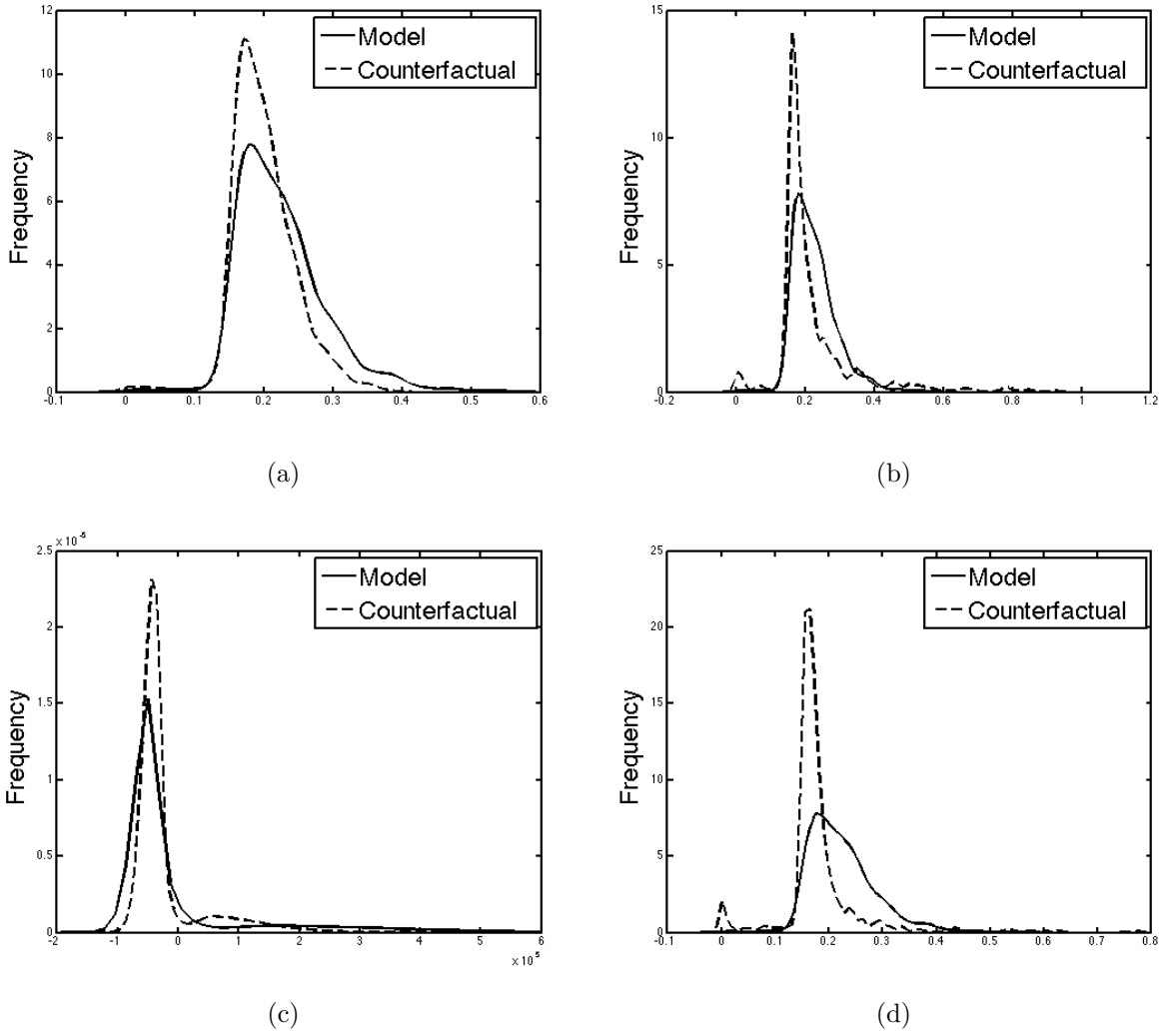


Figure 11: EXTRAVERSION AND SELF EMPLOYMENT: The effect of the latent personality trait measured as *extraversion* on self-employment earnings and entry for the 898 self or paid-employed men. Each panel shows the model prediction and a counterfactual distribution. Panel 11(a): model predicted entry probability and counterfactual entry probability where extraversion does not affect preferences; Panel 11(b): model predicted entry probability and counterfactual entry probability where extraversion does not affect returns; Panel 11(c): model predicted difference in sector specific earnings (self minus paid) and counterfactual differences where extraversion does not affect returns; Panel 11(d): model predicted entry probability and counterfactual entry probability where extraversion does not affect preferences or returns.

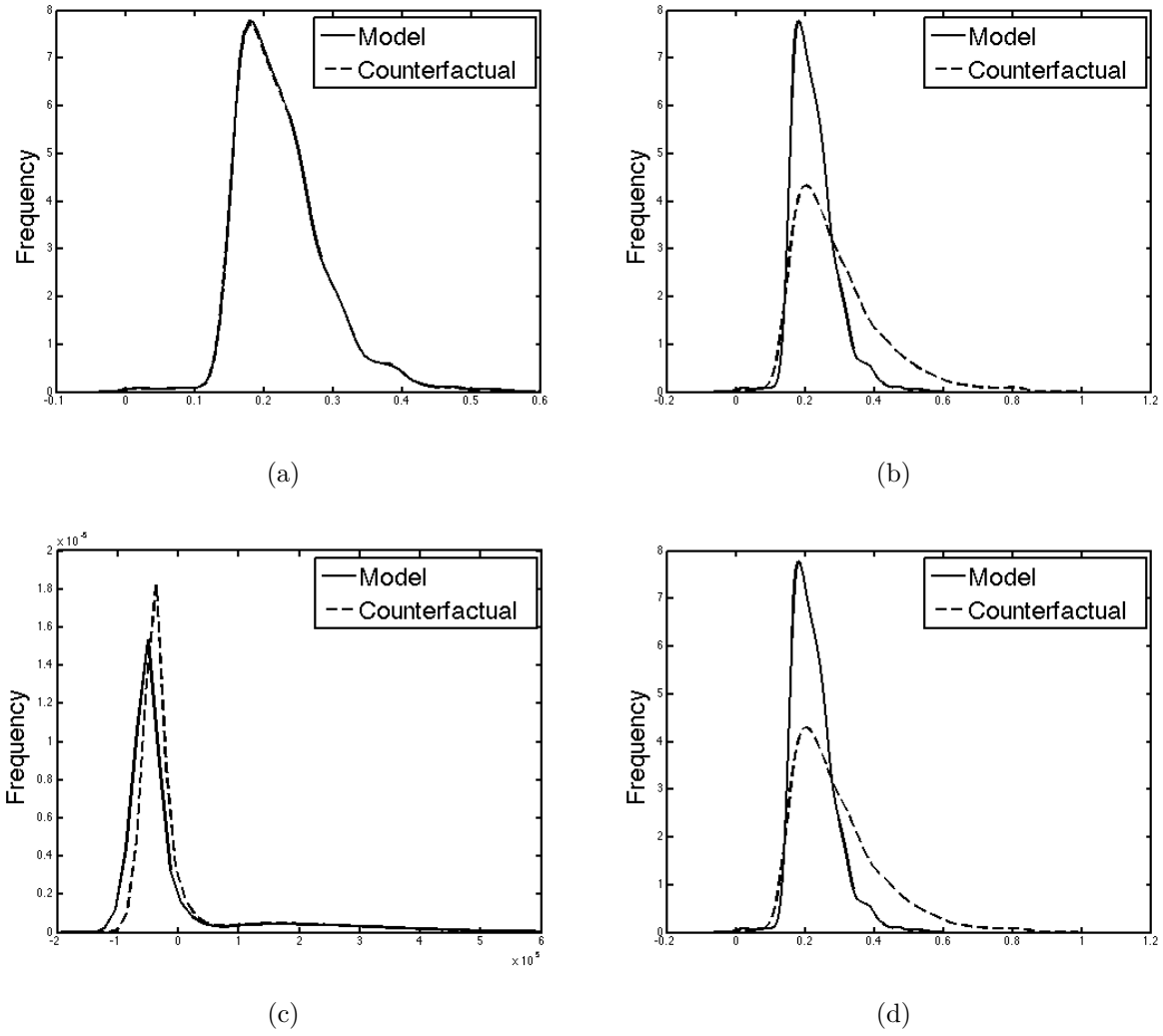


Figure 12: NEUROTICISM AND SELF EMPLOYMENT: The effect of the latent personality trait measured as *neuroticism* on self-employment earnings and entry for the 898 self or paid-employed men. Each panel shows the model prediction and a counterfactual distribution. Panel 12(a): model predicted entry probability and counterfactual entry probability where neuroticism does not affect preferences; Panel 12(b): model predicted entry probability and counterfactual entry probability where neuroticism does not affect returns; Panel Panel 12(c): model predicted difference in sector specific earnings (self minus paid) and counterfactual differences where neuroticism does not affect returns; Panel 12(d): model predicted entry probability and counterfactual entry probability where neuroticism does not affect preferences or returns.

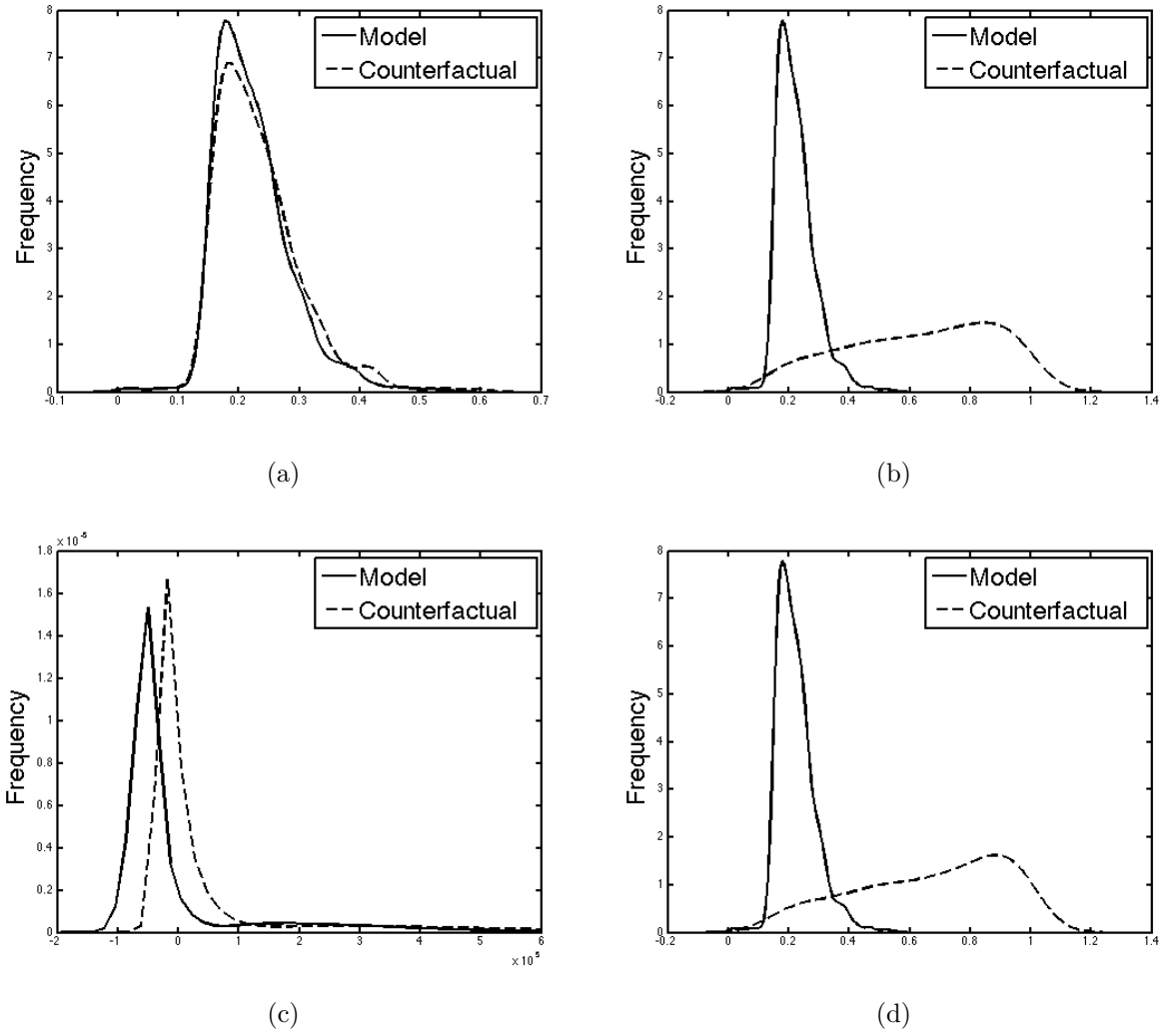


Figure 13: Conscientiousness and Self Employment: The effect of the latent personality trait measured as *conscientiousness* on self-employment earnings and entry for the 898 self or paid-employed men. Each panel shows the model prediction and a counterfactual distribution. Panel 13(a): model predicted entry probability and counterfactual entry probability where conscientiousness does not affect preferences; Panel 13(b): model predicted entry probability and counterfactual entry probability where conscientiousness does not affect returns; Panel 13(c): model predicted difference in sector specific earnings (self minus paid) and counterfactual differences where conscientiousness does not affect returns; Panel 13(d): model predicted entry probability and counterfactual entry probability where conscientiousness does not affect preferences or returns.

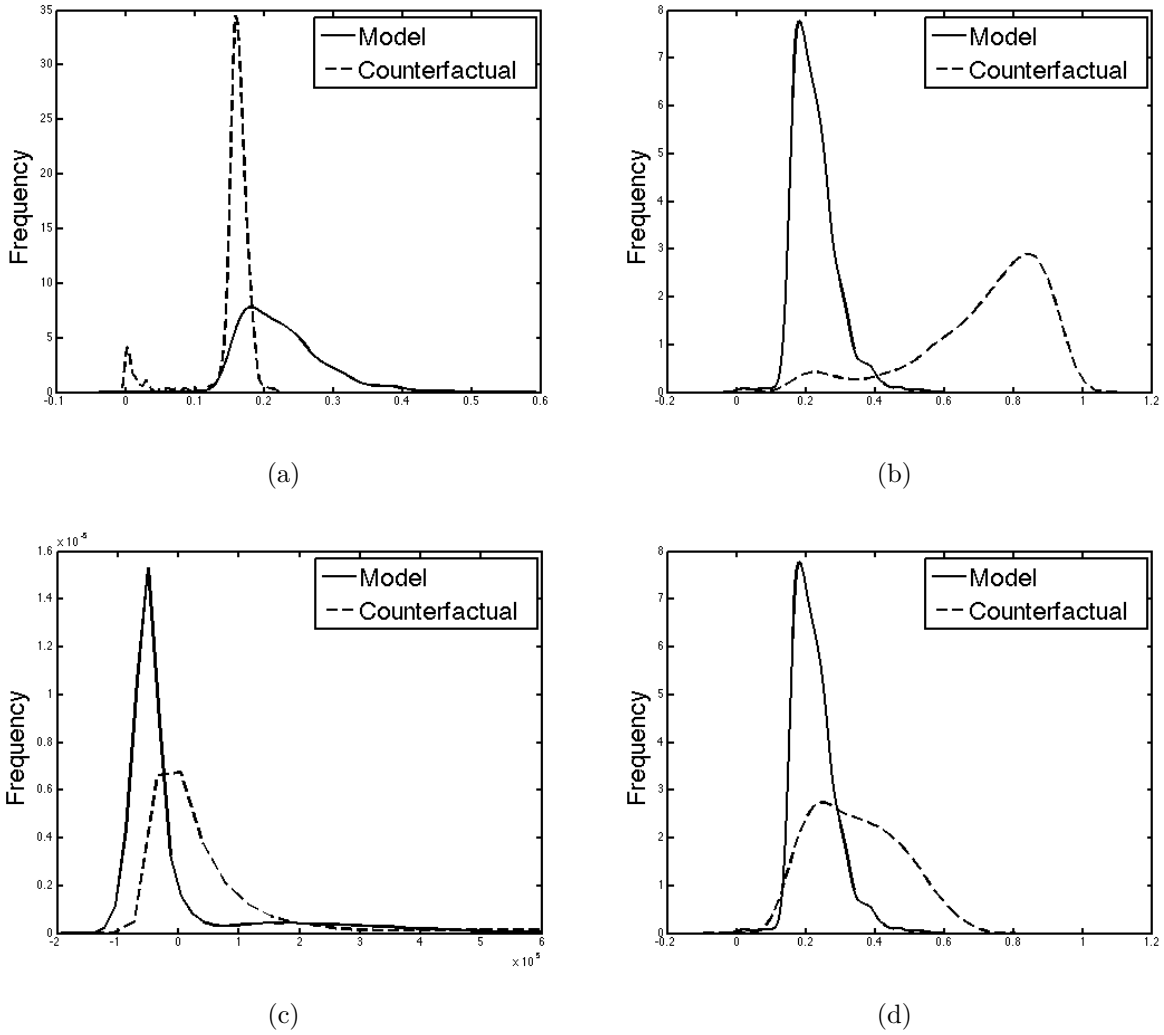


Figure 14: Openness to New Experiences and Self Employment: The effect of the latent personality trait measured as *openness to new experiences* on self-employment earnings and entry for the 898 self or paid-employed men. Each panel shows the model prediction and a counterfactual distribution. Panel 14(a): model predicted entry probability and counterfactual entry probability where openness does not affect preferences; Panel 14(b): model predicted entry probability and counterfactual entry probability where openness does not affect returns; Panel 14(c): model predicted difference in sector specific earnings (self minus paid) and counterfactual differences where openness does not affect returns; Panel 14(d): model predicted entry probability and counterfactual entry probability where openness does not affect preferences or returns.

Appendix A Identification of Latent Factors

We are interested in identifying the distributions of five latent personality traits, as measured by the Big 5 along with latent intelligence, as measured by fluid intelligence. For now, we focus on the Big 5, where the measurement of trait $j \in \{1 \dots 5\}$ for agent i at time $t \in \{1995, 2004\}$ is specified as follows (where we suppress notation indicating conditioning on a vector of observables):

$$C_{ijt} = d^C_{jt} f_{ij} + \epsilon^C_{itj} \tag{25}$$

Without loss of generality, focus on trait 1. For latent trait 1, there are two measurements:

$$\begin{aligned} C_{i1(04)} &= d^C_{1(04)} f_{i1} + \epsilon^C_{i1(04)} \\ C_{i1(95)} &= d^C_{1(95)} f_{i1} + \epsilon^C_{i1(95)}. \end{aligned} \tag{26}$$

Further, for each individual in the sample, we record earnings in one of the two sectors. If individual i is in the paid sector, we observe wages, specified as:

$$\ln(w_i) = x^w_i \beta^w + \sum_{j=1}^{J} \kappa^w_j f_{ij} + e^w_i. \tag{27}$$

If individual i is self-employed, we observe earnings (or entrepreneurial returns), specified as:

$$\ln(y_i) = \ln(\theta_i) + \alpha \ln(k^*_i) + e^y_i \tag{28}$$

where:

$$\ln(\theta_i) = x^\theta_i \beta^\theta + \psi \ln A_i + \sum_{j=1}^{J} \kappa^\theta_j f_{ij} + e^\theta_i \tag{29}$$

and, from first order conditions,

$$k^*_i = \left(\frac{\alpha \theta_i}{r} \right)^{\frac{1}{1-\alpha}} = \phi \times \theta_i^{\frac{1}{1-\alpha}}, \tag{30}$$

We can rewrite equation [28] as:

$$\ln(y_i) = x^\theta_i \beta^\theta + \psi \ln A_i + \sum_{j=1}^{J} \kappa^\theta_j f_{ij} + e^\theta_i + \alpha \ln(k^*_i) + e^y_i \tag{31}$$

and therefore show that for every individual in the sample there are two measurements of latent factor 1 as well as an outcome that is also function of latent factor 1. Assuming that

$\epsilon^C_{i1(04)} \perp \epsilon^C_{i1(04)} \perp e^y_i \perp e^w_i$, we have that:

$$\begin{aligned} \text{Cov}\left(C_{i1(04)}, \ln(w_i)\right) &= d^C_{1(95)}\gamma_1\sigma^2_{fj} \\ \text{Cov}\left(C_{i1(95)}, \ln(w_i)\right) &= d^C_{1(04)}\gamma_1\sigma^2_{fj} \end{aligned} \tag{32}$$

Then,

$$\frac{\text{Cov}\left(C_{i1(04)}, \ln(w_i)\right)}{\text{Cov}\left(C_{i1(95)}, \ln(w_i)\right)} = \frac{d^C_{1(95)}}{d^C_{1(04)}} \tag{33}$$

If we normalize $d^C_{1(04)} = 1$, we have that:

$$\frac{\text{Cov}\left(C_{i1(04)}, \ln(w_i)\right)}{\text{Cov}\left(C_{i1(95)}, \ln(w_i)\right)} = d^C_{1(95)} \tag{34}$$

Next, we go back to two measurement equations:

$$\begin{aligned} C_{i1(04)} &= f_{i1} + \epsilon^C_{i1(04)} \\ C_{i1(95)} &= d^C_{1(95)} f_{i1} + \epsilon^C_{i1(95)} \end{aligned} \tag{35}$$

Rewrite the second equation as:

$$\begin{aligned} C_{i1(04)} &= f_{i1} + \epsilon^C_{i1(04)} \\ \frac{C_{i1(95)}}{d^C_{1(95)}} &= f_{i1} + \frac{\epsilon^C_{i1(95)}}{d^C_{1(95)}} \end{aligned} \tag{36}$$

Under these conditions, we can apply a theorem attributed to Kotlarski, which is:

Theorem 1. *Suppose X_2, X_2 and ν are three independent, real-valued random variables where we define $Y_1 = X_1 + \nu$ and $Y_2 = X_2 + \nu$. If the characteristic function of (Y_1, Y_2) does not vanish, then the joint distribution of (Y_1, Y_2) determines the distributions of X_1, X_2 and ν up to a change of the location.*

In our case, ν is the latent factor, X_1 and X_2 are the measurement error and Y_1 and Y_2 are the measurements. Given that our system of equations satisfies the conditions under which Kotlarski's theorem applies, we can identify the densities of f_{i1}, $\epsilon^C_{i1(04)}$ and $\epsilon^C_{i1(95)}$. Further, the previous identification argument applies to the remaining "Big-5" measures, which means we can identify all 5 latent personality traits using the repeated measurements along with data on earnings.

Appendix B Additional Tables and Figures

Table B1: Summary Statistics - Full Sample

	Full Sample	Paid Employment	Self Employment	Δ (Self−Paid)	p-values
Earnings in 2004	$71,597.50	$72,126.53	$92,908.23	$20,781.70	0.003
Assets in 1995	$124,509.20	$95,436.44	$210,178.60	$114,742.16	0.000
High school degree	0.21	0.20	0.20	0.00	0.621
Some college	0.26	0.27	0.24	-0.03	0.426
College graduate	0.24	0.25	0.26	0.01	0.487
Married	0.78	0.78	0.80	0.02	0.523
Number of children	2.25	2.19	2.27	0.08	0.894
Spouse's education (years)	14.38	14.46	14.30	-0.15	0.600
Spouse employed in 1995	0.57	0.56	0.63	0.07	0.044
Fluid Cognitive Ability	0.25	0.33	0.31	-0.02	0.391
Agreeableness (1995)	3.31	3.29	3.32	0.03	0.757
Agreeableness (2004)	3.26	3.24	3.28	0.04	0.599
Extraversion (1995)	3.14	3.12	3.23	0.11	0.009
Extraversion (2004)	3.05	3.03	3.13	0.10	0.014
Neuroticism (1995)	2.17	2.20	2.10	-0.09	0.089
Neuroticism (2004)	2.05	2.06	2.00	-0.06	0.232
Conscientiousness (1995)	3.39	3.39	3.42	0.04	0.291
Conscientiousness (2004)	3.45	3.45	3.46	0.00	0.774
Openness (1995)	3.06	3.05	3.12	0.06	0.048
Openness (2004)	2.96	2.95	3.05	0.10	0.004

Summary statistics for all working age men (25-64) who are observed in the second wave of MIDUS data collection (MIDUS II).