Credit Checks and Labor Market Outcomes

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Abstract

According to a Survey by the Society for Human Resource Management (2010), 60% of human resource representatives interviewed in 2009 indicated that the companies they worked for ran credit checks on potential employees. In this paper, we explore how credit checks (observable signals based on an agent's unobservable type) may affect outcomes in a matching model of the labor market. We show that it may be individually optimal for employers to use such signals to make hiring/firing/compensation decisions. Such decisions however may have important implications for household welfare inducing a poverty trap. The analysis can shed light on the consequences of a law (the Equal Employment for All Act (H.R. 3149)) prohibiting the use of credit information in employment decisions which currently sits before Congress.

Very preliminary, comments welcome.

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1 Introduction

According to a Survey by the Society for Human Resource Management (2010), 60% of human resource representatives who were interviewed in 2009 indicated that the companies they worked for ran credit checks on potential employees.[1] The three primary consumer credit reports provided by (Equifax Persona, Experian Employment Insight, and TransUnion PEER) include not only personal information (such as addresses and social security numbers) and previous employment history but also any public record (such as bankruptcy, liens and judgments) as well as credit history. The Federal Trade Commission[2] published a consumer alert in May 2006 entitled "Negative Credit Can Squeeze a Job Search" warning consumers about the possibility of adverse employment actions due to a bad credit history. Further, the FTC writes "As an employer, you may use consumer reports when you hire new employees and when you evaluate employees for promotion, reassignment, and retention as long as you comply with the Fair Credit Reporting Act (FCRA)."[3]

In the survey, the most cited primary reason for credit checks in Table 1 is to reduce or prevent theft and embezzlement, which indicates that the employers control unwanted actions by means of monitoring credit market decisions. Table 2 summarizes the reasons why companies do not extend a job offer after a credit check, and it is clear that the credit market decisions are important when companies make hiring decisions even if the credit report includes other information as mentioned previously.

The actual practice of credit checks on employees has invoked debates of whether laws should prohibit it. Currently consumer reports may be used when firms hire new employees or evaluate employees for promotion, reassignment, and retention as long as the Fair Credit Reporting Act is complied.

[1] While we do not address it in this paper, earlier surveys show that the fraction of firms undertaking credit checks has steadily been growing. In particular, 25% of human resource representatives who were interviewed in 1998 indicated that the companies they worked for ran credit checks on potential employees while the fraction increased to 43% in 2004.

[2] http://www.ftc.gov/bcp/edu/pubs/consumer/alerts/alt053.shtm

[3] http://www.ftc.gov/bcp/edu/pubs/business/credit/bus08.shtm

Reduce/prevent theft and embezzlement	54%
Reduce level liability for negligent hiring	27%
Assess overall trustworthiness	12%
Comply with applicable state law	7%

Table 1: Primary reasons for credit check

Current outstanding judgement	64%
Accounts in debt collection	49%
Bankruptcy	25%
High debt-to-income ratio	18%
Foreclosure	11%

Table 2: Top cited reasons for not extending a job offer

Although only written authorization from the consumer is required before credit checks in most states, some states set additional laws to regulate this practice. For instance, Washington, Hawaii, and Oregon actually prohibit any credit checks for employment screening. Furthermore, the Equal Employment for All Act[4] (currently in committee) would prohibit the use of any consumer credit checks for the purpose of making employment decisions if passed. Our model can be used to evaluate the welfare consequences of such a law.

Given that employers are increasingly turning to credit checks in hiring and retention decisions, we lay out a simple labor matching model with unobservable types of workers. The project is in two parts. First, we take credit checks simply to be exogenous signals about an individual's unobservable type. We choose these signals to be consistent with default frequencies in the U. S. data. After calibrating the model to match labor market statistics, we show that workers are are worse off when the economy moves from an environment where firms do not use credit checks to one where they do (which is individually rational for the firm). This provides a framework to

[4] Details of the Equal Employment for All Act (HR 3149 IH) can be downloaded at http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=111_cong_bills&docid=f:h3149ih.txt.pdf

understand why there may be legislation mentioned above to prevent employers from using credit checks. Second, we intend to endogenize the signals by embedding the model into an incomplete markets framework with debt and default.

2 Simple Environment

The environment is based on a discrete time version of the Mortensen-Pissarides (1994) labor matching model with two key differences. First, a worker's type affects productivity but is unobservable and follows a Markov Process. Second, there are signals about a workers type.

2.1 Agents

The economy is populated by a unit measure of workers (who may be employed or unemployed). Workers can be of two types $i_t \in \{g, b\}$. At the beginning of each period, agents may switch from type $i_t = i$ to type $i_{t+1} = i'$ with probability $\delta_{ii'}$. The switching probability implies that the unconditional fraction of type g agents in a stationary economy is

$$\gamma = \frac{\delta_{bg}}{\delta_{gb} + \delta_{bg}}.$$

There is also a continuum of entrepreneurs (or firms).

2.2 Preferences

Workers are risk averse with utility function $u(c_t)$ which is strictly increasing and strictly concave in consumption c_t. Entrepreneurs are risk neutral and can have negative consumption. Workers discount the future at rate β and enterpreneurs discount the future at rate $1/(1 + r)$, both strictly less than one.

2.3 Matching

The matching function is assumed to be:

$$M(u_t, v_t) = \chi u_t^{\alpha} v_t^{1-\alpha} \tag{1}$$

where u_t is the fraction of unemployed workers and v_t is the number of job vacancies. An entepreneur can post a vacancy at cost κ and be matched with a worker with probability $\psi_t \equiv M(u_t, v_t)/v_t$. An unemployed worker meets a potential employer with probability $\phi_t \equiv M(u_t, v_t)/u_t$. Labor market tightness is defined as $\theta_t \equiv v_t/u_t$. A simple special case without aggregate uncertainty considered by a large body of literature assumes $\theta_t = 1$ in which case the matching probabilities are simply $\psi_t = \phi_t = \chi$. After matching, the entrepreneur decides whether to employ the worker and the worker decides whether to accept the job.

2.4 Production Technology

An employed worker of type i_t produces y_{i_t} at the end of the period where $y_g > y_b \geq 0$. An unemployed worker of type i_t receives k_{i_t} where $k_g \geq k_b$. To give meaning to the tags "good" and "bad" type, we assume that type b workers are more productive at home than at the office and type g workers are more productive at the office than at home (i.e. $y_g > k_g$ and $y_b < k_b$). Entrepreneurs must pay their workers at the beginning of the period. An unmatched entrepreneur earns zero. Entrepreneurs have deep pockets (i.e. there are no borrowing constraints).

2.5 Information

A worker's type is private information (unknown by the entrepreneur). However, after the type shock is realized an entrepreneur can costlessly receive a signal $d_t \in \{0, 1\}$ of the agent's type with probability $\rho_{i_t}^{d_t}$. We assume $\rho_g^0 \geq \rho_b^0$ with the interpretation that $d_t = 1$ represents an adverse event (such as a default) on the worker's credit record $d_t = 0$ represents no adverse events on one's record. Within a match output is observable, but after a match is dissolved, the past history of a worker's output is unobservable.

Note that upon production at the end of the period, the entrepreneur knows the worker's current type but the type switching probability means the entrepreneur does not know the worker's type at the beginning of next period with certainty. Given the markov structure of type change, in the case where δ_{gb} and δ_{bg} are not 1/2, the worker's current output y_t is informative about his future type.

When a worker first meets an entrepreneur, the information set at the beginning of the period is thus $I_t = d_t$. After being in the relationship for at least one period, the information set is $I_t = (i_{t-1}, d_t)$. Given the markov nature of type change and the fact that there is not randomness in the production technology, information on i_{t-1} in the information set I_t is sufficient to capture all history.

2.6 Wage Determination

Employed workers and entrepreneurs bargain over wages conditional on I_t. The employer makes a take-it-or-leave-it offer $w(I_t)$ to the worker. If the worker accepts, he produces $y(i_t)$. If the worker rejects, the match is dissolved and the worker receives home production $k(i_t)$ while the producer receives 0.

2.7 Timing of Events

1. Workers (whether employed or unemployed) receive their type shock i_t and signal d_t.

2. Any unmatched entrepreneur posts a vacancy at cost κ and becomes matched with a worker from the unemployment pool with probability ψ_t at the beginning of period $t + 1$.

3. Any unemployed worker searches and becomes matched with a job vacancy with probability ϕ_t at the beginning of period $t + 1$.

4. Upon becoming matched at the beginning of period t, workers and entrepreneurs decide whether to stay matched.

5. In any match, the entrepreneur makes a take-it-or-leave-it wage offer $w(I_t)$ where I_t depends on whether it is a new hire or retention wage offer.

6. Workers decide whether or not to accept the wage offer.

7. Output $y(i_t)$ is realized at the end of the period.

In matches that break up either in step (4) or step (6), the worker becomes unemployed and receives home production $k(i_t)$ while the entrepreneur has a vacancy.

3 Equilibrium in the simple economy

In this section, we study steady state equilibria which depend on the informativeness of signals. In particular, signals may be completely uninformative (i.e. where $\rho_g^{d_t} = \rho_b^{d_t}$), fully informative (i.e. where $\rho_g^0 = 1$ and $\rho_b^1 = 1$), and an intermediate case where they are partially informative (i.e. where $\rho_g^0 > \rho_b^0$). An entrepreneur must make hiring and retention decisions solely based upon I_t which contains the signal and may contain other information.

3.1 Posterior Functions

Let $p(i_t|I_t)$ be the entrepreneur's posterior of the probability of being matched with a type i_t worker given his information I_t. Since we will be using recursive methods, let $x \equiv x_t$, $x^- \equiv x_{t-1}$, and $x' \equiv x_{t+1}$.

In the case where an entrepreneur and worker first match, the entrepreneur's match specific information set simply contains the signal d. In this case, the entrepreneur also uses the distribution of types in the unemployment pool to infer the type of the worker. The entrepreneur's posterior in this case is given by:

$$p(i|\cdot, d) = \frac{\sum_{i^-} \mu_{i^-}^0 \delta_{i^- i} \rho_i^d}{\sum_{(i^-,\iota)} \mu_{i^-}^0 \delta_{i^- \iota} \rho_\iota^d} \tag{2}$$

where μ_i^e denotes the fraction of the population of type i in employment state $e \in \{0,1\}$ where $e = 0$ denotes unemployment (the determination of these population measures is described in section 3.5). In particular, $\mu_{i^-}^0$ denotes the fraction of type i at time $t-1$ who are unemployed. Thus $\mu_{i^-}^0 \delta_{i^- i} \rho_i^d$ is the fraction of unemployed who were type i^- at $t-1$, became type i at the beginning of t and received a signal d.

Within an existing relationship, the entrepreneur *knows* the type of a worker from the previous output realization, and he takes the type switching probability into account when he calculates the posterior:

$$p(i|i^-, d) = \frac{\delta_{i^- i} \rho_i^d}{\sum_\imath \delta_{i^- \imath} \rho_\imath^d} \tag{3}$$

This makes clear the simplifying assumption that the degenerate output distribution buys us; a simple prior and no need to keep track of an endogenous prior.[5]

3.2 Entrepreneur Value Functions

When an entrepreneur posts a vacancy at the cost of κ, he will be randomly matched with a worker from the unemployment pool with probability ψ at the beginning of the next period. He will observe the worker's signal d' but not his type i'

$$P = -\kappa + \frac{1}{1+r}\left[\psi \sum_{d'} \gamma^{d'} H^{d'} + (1-\psi)P\right] \tag{4}$$

where $\gamma^{d'}$ is the probability of matching with an unemployed worker with signal d' given by

$$\gamma^{d'} = \frac{\sum_i \left[\mu_i^0 \sum_{i'} \delta_{ii'} \rho_{i'}^{d'}\right]}{\sum_i \mu_i^0}. \tag{5}$$

Free entry implies that in equilibrium,

$$P = 0. \tag{6}$$

[5]A similar simplifying assumption was used in Athreya, et. al. (2011).

The (hiring) value function for an entrepreneur who has just been matched with an unemployed worker with information set $I = (\cdot, d)$ is denoted $H(I)$. It is given by

$$H(\cdot, d) = \max \left\{ P, \tilde{H}(\cdot, d) \right\} \tag{7}$$

where

$$\tilde{H}(\cdot, d) = \sum_i p(i|\cdot, d) \left\{ \begin{array}{c} 1_{\{w(\cdot,d) \geq \underline{w}_i\}} \left[-w(\cdot, d) + \frac{1}{1+r} \left(y_i + \sum_{i',d'} \delta_{ii'} \rho_{i'}^{d'} R(i, d') \right) \right] \\ +1_{\{w(\cdot,d) < \underline{w}_i\}} P \end{array} \right\} \tag{8}$$

is the value of making a take-it-or-leave-it wage offer $w(\cdot, d)$ given the newly matched worker's reservation wage $\underline{w}_i$ (to be described in section 3.4). The higher the entrepreneur's belief that he is matched with a type g worker (i.e. the higher $p(g|\cdot, d)$), the more likely the entrepreneur will hire the worker. If the value to hire this worker is lower than the value of vacancy, the entrepreneur will not extend a wage offer that exceeds any type's reservation wage and the job will remain vacant. Otherwise the entrepreneur will offer $w(\cdot, d)$ based on the signal received.

The (retention) value function for an entrepreneur in an existing match with information set $I = (i^-, d)$ is denoted $R(I)$. It is given by

$$R(i^-, d) = \max \left\{ P, \tilde{R}(i^-, d) \right\} \tag{9}$$

where

$$\tilde{R}(i^-, d) = \sum_i p(i|i^-, d) \left\{ \begin{array}{c} 1_{\{w(i^-,d) \geq \underline{w}_i\}} \left[-w(i^-, d) + \frac{1}{1+r} \left(y_i + \sum_{i',d'} \delta_{ii'} \rho_{i'}^{d'} R(i, d') \right) \right] \\ +1_{\{w(i^-,d) < \underline{w}_i\}} P \end{array} \right\}. \tag{10}$$

Again, the higher the entrepreneur's belief that he is matched with a type g worker, the more likely the entrepreneur will retain the worker.

3.3 Worker Value Functions

The value function for unemployed type i workers is given by

$$U_i = u(k_i) + \beta \sum_{i'} \delta_{i,i'} \left[\sum_{d'} \rho_{i'}^{d'} \left(\phi N_{i'}(\cdot, d') + (1-\phi) U_{i'} \right) \right]. \tag{11}$$

The value function for a type i worker with signal d who is newly matched with an entrepreneur and is offered a wage $w(\cdot, d)$ is given by

$$N_i(\cdot, d) = \max \left\{ U_i, u(w(\cdot, d)) + \beta \sum_{i'} \delta_{i,i'} \left[\sum_{d'} \rho_{i'}^{d'} Z_{i'}(i, d') \right] \right\}. \tag{12}$$

As will be discussed in section 3.4, if the worker receives too low a wage offer $w(\cdot, d)$, he can reject it and remain unemployed receiving U_i. Similarly, the value function for a type i worker with past type i^- and signal d who receives a "retention" wage offer $w(i^-, d)$ is given by

$$Z_i(i^-, d) = \max \left\{ U_i, u(w(i^-, d)) + \beta \sum_{i'} \delta_{i,i'} \left[\sum_{d'} \rho_{i'}^{d'} Z_{i'}(i, d') \right] \right\}. \tag{13}$$

It is clear that the Markov structure of type shocks implies continuation values are the same for newly hired workers and retained workers with identical i and d. The only difference is the utility stemming from their current wage offer $u(w(\cdot, d))$ or $u(w(i^-, d))$.

3.4 Wage Determination

As in Brugemann and Moscarini (2010) and Kennan (2010), here we implement Myerson's (1984) Neutral Bargaining Solution, which is a generalization of the Nash Bargaining Solution to a setting with incomplete information. Let $E_i(\omega)$ be the value for a type i worker from accepting any given wage offer ω:

$$E_i(\omega) = u(\omega) + \beta \sum_{i'} \delta_{i,i'} \left[\sum_{d'} \rho_{i'}^{d'} Z_{i'}(i, d') \right].$$

Notice that given the wage offer ω, the value of accepting $E_i(\omega)$ is independent of past type i^- and signal d. It is independent of i^- because by the end of he period, current output perfectly reveals the worker's type so past output provides no extra information. It is independent of d because the signal is iid across time conditional on type.

Since $E_i(\omega)$ is strictly increasing in ω and U_i is independent of ω, we know there exists a unique reservation wage $\underline{w}_i$ for a type i worker which solves

$$E_i(\underline{w}_i) = U_i. \tag{14}$$

This is the lowest wage offer that a type i worker has to receive in order to accept. Since only the continuation value matters for a worker and U_i is independent of signals, the reservation wage for a type i unemployed who just got matched and a type i employed worker who is in an existing match is the same, independent of the entrepreneur's set I.

Whether or not a worker is hired or retained and what wage offer he receives, however, does depend on the entrepreneur's information set I. If the entrepreneur offers $\omega < \underline{w}_b$, neither type worker will accept. If $\omega \in [\underline{w}_b, \underline{w}_g)$, then the worker will accept only if he is type b and the entrepreneur will receive y_b for sure. If $\omega \geq \underline{w}_g$, then both type workers will accept and the entrepreneur will get an output of y_g with probability $p(g|i^-, d)$ or an output of y_b and with probability $p(b|i^-, d)$.

Since the entrepreneur can make a take-it-or-leave-it wage offer, he maximizes the expected value of hiring an unemployed worker with signal d by choosing

$$w(\cdot, d) = \arg\max_{\omega} \sum_i p(i|\cdot, d) \left\{ \begin{array}{c} 1_{\{\omega \geq \underline{w}_i\}} \left[-\omega + \frac{1}{1+r} \left(y_i + \sum_{i',d'} \delta_{ii'} \rho_{i'}^{d'} R(i, d') \right) \right] \\ +1_{\{\omega < \underline{w}_i\}} P \end{array} \right\}. \tag{15}$$

Equation (15) is the analogue of equation (10) in Brugemann and Moscarini (2010). Notice that while the entrepreneur's costs are increasing in ω, the probability of worker acceptance (and hence revenue creation) is also increasing in ω. Given $w(\cdot, d)$, the entrepreneur will make the offer if $\tilde{H}(\cdot, d) \geq P$

as in (7).

Similarly, an entrepreneur chooses the retention wage offer conditional on information $I = (i^-, d)$ by choosing

$$w(i^-, d) = \arg\max_{\omega} \sum_i p(i|i^-, d) \left\{ \begin{array}{c} 1_{\{\omega \geq \underline{w}_i\}} \left[-\omega + \frac{1}{1+r} \left(y_i + \sum_{i',d'} \delta_{ii'} \rho_{i'}^{d'} R(i, d') \right) \right] \\ +1_{\{\omega < \underline{w}_i\}} P \end{array} \right\}. \tag{16}$$

Given $w(i^-, d)$, the entrepreneur will make the offer if $\tilde{R}(i^-, d) \geq P$ as in (9).

3.5 Population Proportions

We next describe the transition equations for the population of employed and unemployed agents of both types. Let $\mu_i^e)$ be the measure of type i who are in employment status $e \in \{0, 1\}$ where $e = 1$ implies employment.

$$\mu_{i'}^1 = \sum_i \left[\mu_i^1 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{R^{d'}(i) \geq P\}} + \mu_i^0 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} \phi 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{H^{d'} \geq P\}} \right] \tag{17}$$

$$\mu_{i'}^0 = \sum_i \left[\mu_i^1 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} \left(1 - 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{R^{d'}(i) \geq P\}} \right) + \mu_i^0 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} \left(1 - \phi 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{H^{d'} \geq P\}} \right) \right] \tag{18}$$

3.6 Definition of Equilibrium

A *Bayesian steady state equilibrium* is a list of:

1. worker value functions when unemployed, newly hired, and retained $\{U_i, N_i(\cdot, d), Z_i(i^-, d), \forall(i^-, i, d)\}$,

2. entrepreneur value functions when posting a vacancy and when making hiring and retention decisions $\{P, H(\cdot, d), R(i^-, d), \forall(i^-, d)\}$,

3. wage offers to new and existing workers $\{w(\cdot, d), w(i^-, d), \forall(i^-, d)\}$

4. population proportions of unemployed and employed workers $\{\mu_i^e, \forall(i,e)\}$

5. beliefs about new hires and retained workers $\{p(i|\cdot,d), p(i|i^-,d), \forall(i^-,i,d)\}$ which satisfy Bayes rule whenever possible.

4 Calibration of the simple economy

We calibrate our simple benchmark to an economy with private information where signals are uninformative. We think of the benchmark as the time period before credit checks were extensively used and label it PI(1). The set of parameters includes those we take as given outside the model $\{u(\cdot), \beta, r, k_g, \alpha\}$ and those we choose within the model $\{\delta_{gb}, \delta_{bg}, \chi, y_g, y_b, k_b, \kappa\}$.

The model period is one month. The discount rate β is set to be 0.9966 to have an annual rate of 0.96. The risk free is set to be 0.0034 such that $\beta(1+r)=1$. Workers have log preferences $u(c)=\log(c)$ where c is consumption.

The equilibrium of our economy is consistent with the following hiring and retention decisions: When an entrepreneur meets a worker, he makes a hiring wage offer to start a relationship. When an entrepreneur makes the retention decision, it is based on the past output realization which reveals the worker's past type perfectly. In particular, he makes a retention wage offer if the worker was a type g last period otherwise he fires the worker.

Parameter	Description	Values
β	Discount rate	0.9966
r	Risk free rate	0.0034
y_b	Type b output	0.01
k_g	Type g outside option	1
α	Matching power parameter	0.5

Table 3: Model Exogenous Parameters

To keep the model consistent with many matching models (e.g. Shimer (2005)), we start by setting market tightness to be 1, which then implies that $\phi=\psi=\chi$ (when we consider alternative economies, market tightness responds endogenously so that we must solve for (θ,ϕ,ψ) and in this case

Parameter	Description	Value
δ_{bg}	Type switching probability from b to g	0.23
δ_{gb}	Type switching probability from g to b	0.014
χ	Coefficient on matching technology	0.3
y_g	Type g output	1.065
k_b	Type b outside option	0.35
κ	Vacancy posting cost (solved)	0.4597

Table 4: Model Parameters Calibrated in PI(1) Equilibrium

Statistics	Data	PI(1)
Unemployment rate	0.06	0.07
Job separation rate	0.02	0.02
Job finding rate	0.31	0.30
Average consumption for employed over unemployed	1.51	1.49
Net corporate profit margin	0.055	0.047

Table 5: Data and Model Moments

we take $\alpha = 0.5$ as in Bils et al. (2010)). In PI(1), we choose the matching probability χ together with the type switching probabilities δ_{gb} and δ_{bg} such that the equilibrium distribution given the above hiring and retention decisions roughly match labor market statistics. Bils et al. (2011) estimate a monthly separation rate of 2% and an unemployment rate of 6% from the Job Openings and Labor Turnover Survey (JOLTS) data. This implies that the probability of being matched with a firm is 0.31 for an average worker in the steady state.[6] Our calibrated matching function elasticity parameter χ is 0.3, and the type switching probabilities are $\delta_{gb} = 1.4\%$ and $\delta_{bg} = 23\%$, which generate an unemployment rate of 7%, an endogenous separation rate of 2%, and a job finding rate of 30%. We note that these values of δ_{gb} and δ_{bg} imply that the population of good types is 94.26% and bad types is 5.74%.

The outside option for a type $i = g$ agent is normalized so that $k_g = 1$.

[6] To see this, from the law of motion for unemployment, we know $u = s(1-u)+(1-f)u$ in the steady state where s is the job separation rate and f is the job finding rate. Since s is 2% and u is 6%, this implies a job finding rate of $f = 2\%(1-6\%)/6\% = 31\%$ in their paper.

The outside option for a type $i = b$ worker is chosen to match the average consumption for employed workers over average consumption for unemployed workers of 1.51 calculated from the 1996 PSID. In this equilibrium, the wage for all workers is given by the reservation wage of the good type (i.e. $w(\cdot, d) = w(g, d) = \underline{w}_g$). An outside option $k_b = 0.35$ matches the relative consumption statistic of 1.51.[7] After exogenously fixing the output level of a type b worker to be 0.01 (which must be low enough so that an entrepreneur wants to fire a worker who was type b last period), the output level for a type g worker is chosen to be 1.065 such that the model net profit margin is 4.7% which is roughly consistent with the net profit margin of 5.5% from the data.[8][9]. The vacancy posting cost κ is set so that $P = 0$. This implies $\kappa = 0.45$, which is 45.39% of the average wage. This is a bit lower than Hagedorn and Manovskii (2008) who find the vacancy cost to be 58.4% of the average wage.

Since PI(1) is the uninformative signals case, we are free to choose any signal probability provided they are equal for good and bad types. Here we choose $\rho_i^1 = 0.0015, \forall i$, which will yield an annual default frequency of 1.7% which is in line with the 1998 SCF data.

5 Variation in Information

In our benchmark where signals are uninformative PI(1), the decision to hire (7) and fire (9) depends on the entrepreneur's beliefs about what type of worker he is matched with (appearing in equations (8) and (10)). Given that δ_{bg} and δ_{gb} imply there is a large proportion of good types in the economy (nearly 95%), the entrepreneur rationally believes that he is matched with a good type when he must make a hiring decision (i.e. $p(g|\cdot, \cdot) = 0.5993$). On the other hand, persistence for the bad type $\delta_{bb} = 0.77$ implies that when the entrepreneur witnesses low production it is likely that the same worker will

[7] The average consumption for employed workers is given by $\underline{w}_g$, while the average consumption for unemployed worker is given by $\left(\frac{1}{\mu_g^0 + \mu_b^0}\right) \cdot \left(\mu_g^0 k_g + \mu_b^0 k_b\right)$

[8] See http://www.hussman.net/rsi/profitmargins.htm

[9] Net profit margin is calculated by taking $\frac{\bar{y} - \underline{w}_g}{\bar{y}}$ where $\bar{y} = \mu_g^1 y_g + \mu_b^1 y_b$

produce low output next period if he remains with that worker. Hence, he fires the worker. He could try to offer the worker a lower wage next period, but since the outside option for good types following such a deviation from the equilibrium path is greater than that wage, all the entrepreneur would retain is the bad type and that is unprofitable.

In this subsection, we keep all parameters the same except for signal probabilities (thereby varying information sets). In particular, we consider the full information case (which we call FI) where $\rho_g^0 = 1$ and $\rho_b^1 = 1$ in order to see the impact of the information problem. Then we consider the case where signals are partially informative (which we call PI(2)). We choose $\rho_g^0 > \rho_b^0$ to be roughly consistent with data on the fraction of unemployed with a default on their record. We think of this case as the current practice by human resource managers of using adverse credit record information as a way to screen new hires and make retention/promotion decisions. Specifically, we choose $\rho_g^1 = 0.001$ and $\rho_b^1 = 0.01$ such that the fraction of individuals in the economy (weighted by the equilibrium distribution) who receive a signal $d = 1$ is the same as in PI(1) (consistent with the default frequency in the 1998 SCF data).

(i_-, d)	PI(1)	PI(2)	FI
$(\cdot, 0)$	0.5993	0.6013	1
$(\cdot, 1)$	0.5993	0.1300	0
$(g, 0)$	0.9860	0.9861	1
$(g, 1)$	0.9860	0.8757	0
$(b, 0)$	0.2300	0.2316	1
$(b, 1)$	0.2300	0.0290	0

Table 6: Equilibrium Posterior Functions $p(g|i_-, d)$

Table 6 summarizes the equilibrium posterior function. If the signal is uninformative as in PI(1), when an entrepreneur meets a worker from the unemployment pool, he believes that there is a 59.93% chance that he is a type g worker. However, when the signal is partially informative, when he meets a worker with $d = 0$, his belief will increase to 0.6013 (i.e. a rise of beliefs of 3/10 of one percent). On the other hand, if the signal turns from uninformative to partially informative, when the entrepreneur meets with a worker with signal $d = 1$, his belief that the worker is type g drops from 0.5993 in PI(1) to 0.13 in PI(2) (i.e. a drop of beliefs of 78 percent). The large change in beliefs associated with a bad credit report is because ρ_b^1 is 10 times more informative about a bad type than ρ_g^1. We observe a similar pattern when the entrepreneur forms the posterior for existing workers. In particular, the drop in beliefs when the entrepreneur receives the signal $d = 1$ when $i^- = g$ is only 11 percent while the rise in beliefs after receiving a $d = 0$ signal when $i^- = b$ is only 7/10 of one percent.

(i_-, d)	PI(1)	PI(2)	FI	
$(\cdot, 0)$	1	1	1	
$(\cdot, 1)$	1	0	0	
$(g, 0)$	1	1	1	
$(g, 1)$	1	1	0	
$(b, 0)$	0	0	1	
$(b, 1)$	0	0	0	

Table 7: Equilibrium Hiring/Retention Decisions

Given the changes in posteriors, the hiring/retention decisions differ across the three equilibria as evident in Table 7. In PI(2), although the retention decision does not depend on signals (as in PI(1)), the hiring decisions depend on signals. The entrepreneur hires only if the unemployed worker has a signal $d = 0$. This is because there is not sufficient variation in retention posteriors, but there is a big difference in hiring posteriors. Of course, with perfectly informative signals (i.e. in FI), *both* hiring and retention decisions depend and only depend on signals.

Table 8 summarizes the equilibrium distribution μ_i^e. The unemployment rate drops slightly for type g workers and rises slightly for type b workers when signals become more informative (and all type b workers are unemployed in FI). Since the signal probabilities $\rho_g^1 = 0.001$ and $\rho_b^1 = 0.01$ in PI(2) are so low, there are not large differences in the distribution between PI(1) and PI(2) with an unemployment rate around 7%. When signals become

	PI(1)	PI(2)	FI
μ_g^1	0.90808	0.90810	0.9128
μ_g^0	0.03454	0.03453	0.0298
μ_b^1	0.02122	0.02115	0
μ_b^0	0.03622	0.03623	0.0574

Table 8: Equilibrium Distribution

perfectly informative in FI, the unemployment rate increases to 8.72%.

	PI(1)	PI(2)	FI
θ	1	1.0023	1.1693
ϕ	0.3	0.3003	0.3244
ψ	0.3	0.2997	0.2774
$\underline{w}_g$	0.9918	0.9917	1
$\kappa\vert_{\theta=1}$	0.4597	0.4605	0.5166

Table 9: Job Market Tightness, Wages, and Vacancy Cost

Equilibrium job market tightness increases when signals becomes more informative as apparent in Table 9. This is because at the same vacancy posting cost, more information allows firms to avoid hiring some bad type workers in PI(2) and retaining bad type workers in FI resulting in higher profits. As profits rise for firms, with a constant vacancy cost, the measure of vacancy postings increases. This results in an increase in job tightness of 2/10 of one percent in PI(2) and 17% in FI relative to PI(1). The general equilibrium consequence of an increase in job market tightness is a decrease in the probability of matching with a worker (i.e. ψ_t) from 0.3 in PI(1) to 0.2997 in PI(2) and 0.2774 in FI. .

A particular firm however does not internalize the effect of using this information because it is of measure zero. If we hold the job market tightness constant at 1 across the three environments (i.e. we take a partial equilibrium approach), then to satisfy the free entry condition, it must be the case that the vacancy posting cost increases when the entrepreneur becomes more informative to offset the increased profits earned by the firm from better screening (from 0.4597 in PI(1) and 0.4605 in PI(2) to 0.5166 in FI). This provides a measure of the ex-ante private benefit to firms of using credit checks. In particular, there is a small rise in κ by 2/10 of one percent from PI(1) to PI(2) and a rise of 11% from PI(2) to FI as can be seen in Table 9.

To evaluate the welfare consequence of a change in the informativeness of signals on workers, we calculate the percentage increase in consumption each worker would be willing to pay (or need to be paid) in all future periods and contingencies so that the expected utility from the current PI(1) equilibrium equals that of the PI(2) or FI equilibria. Because of log preferences, the consumption equivalent welfare gain for an individual in state (i, i^-, d) can be computed as follows.

$$\lambda(i,\cdot,\cdot) = e^{(1-\beta)\left(U_i-\tilde{U}_i\right)} - 1 \tag{19}$$

$$\lambda(i,\cdot,d) = e^{(1-\beta)\left(N_i(\cdot,d)-\tilde{N}_i(\cdot,d)\right)} - 1 \tag{20}$$

$$\lambda(i,i^-,d) = e^{(1-\beta)\left(Z_i(i^-,d)-\tilde{Z}_i(i^-,d)\right)} - 1 \tag{21}$$

where $\{\tilde{U}_i, \tilde{N}_i(\cdot, d), \tilde{Z}_i(i^-, d)\}$ are the equilibrium values under the new policies (PI(2) or FI).

State (i, e)	PI(2)	FI
$(g, 0)$	-0.8495e-4	-0.0112
$(g, 1)$	-1.0513e-4	-0.0144
$(b, 0)$	-1.5747e-4	-0.0215
$(b, 1)$	-0.9008e-4	-0.0104
$\bar{\lambda}$	-1.0526e-4	-0.0144

Table 10: Equilibrium Consumption Equivalents

As Table 10 makes clear, all workers are worse off as signals become more informative, with type b workers receiving higher welfare losses than type g workers. Unemployed type b workers have the biggest welfare loss from PI(1) to PI(2) or to FI, because they are less likely to receive a wage offer.

The average welfare gain in the economy is calculated as follows:

$$\bar{\lambda} = \sum_{i'} \left\{ \begin{array}{rl} & \sum_i \left[\mu_i^1 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{R^{d'}(i) \geq P\}} \lambda(i', \cdot, \cdot) \right] \\ + & \sum_i \left[\mu_i^0 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} \phi 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{H^{d'} \geq P\}} \lambda(i', \cdot, \cdot) \right] \\ + & \sum_i \left[\mu_i^1 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{R^{d'}(i) \geq P\}} \lambda(i', i, d') \right] \\ + & \sum_i \left[\mu_i^0 \delta_{ii'} \sum_{d'} \rho_{i'}^{d'} \phi 1_{\{w(i,d') \geq \underline{w}_{i'}\}} 1_{\{H^{d'} \geq P\}} \lambda(i', \cdot, d') \right] \end{array} \right\}$$

where the distribution μ_i^e corresonds to the PI(1) equilibrium. The average welfare loss measured as consumption equivalents is 1.0526e-4 from PI(1) to PI(2), while it increases to 0.0144 from PI(1) to FI. This provides a rationale for why the government might actually choose to make the use of credit checks illegal.

6 Extended Environment

In this section, we add noncontinenegent debt and allow a default to be on a worker's credit record. This turns the exogenous signal ρ_i^d into an endogenous signal. In this case, when a worker chooses to default, there is potentially a harsh punishment beyond the standard exclusion from credit markets or exogenous losses in income. In particular, the earnings loss becomes endogenous which is different from most models of bankruptcy (e.g. Chatterjee, et. al. (2007)). In those models with endogenous default, agents default when they have lots of debt and a low income realization. The pattern of earnings implied in our matching model is consistent with that behavior, so we expect to be able to construct such equilibria.

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