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ABSTRACT

How does impatience affect job search? More impatient workers search less intensively and set a lower reservation wage. The effect on the exit rate from unemployment is unclear. In this paper we show that, if agents have exponential time preferences, the reservation wage effect dominates for sufficiently patient individuals, so increases in impatience lead to higher exit rates. The opposite is true for agents with hyperbolic time preferences: more impatient workers search less and exit unemployment later. Using two large longitudinal data sets, we find that various measures of impatience are negatively correlated with search effort and the exit rate from unemployment, and are orthogonal to reservation wages. Overall, impatience has a large effect on job search outcomes in the direction predicted by the hyperbolic discounting model.

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1 Introduction

The theory of job search is one of the cornerstones of labor economics. It characterizes the optimal job search policy for employed and unemployed workers, and it relates it to observable variables such as unemployment benefits, the arrival rate of offers, and the distribution of reemployment wages (Lippman and McCall, 1976; Burdett and Ondrich, 1985). A large empirical literature has tested the predictions of the model (Lancaster, 1979; Flinn and Heckman, 1983; Ham and Rea, 1987).

The rate of time preference is an important component of decisions that involve intertemporal trade-offs, such as job search choices. Yet the effect of impatience on job search has received little attention, despite a growing interest in time discounting in economics (Becker and Mulligan, 1997; Laibson, 1997).

In this paper we address theoretically and assess empirically the effects of impatience on job search outcomes. We set up a model in which an unemployed worker chooses at every period both the search effort and the reservation wage. These two variables then determine the transition out of unemployment.

Impatience has two contrasting effects on job search. On one hand, more impatient individuals assign a lower value to the future benefits of search, and therefore exert less effort: this tends to lower the job offer arrival rate and to increase the length of unemployment. On the other hand, higher impatience acts to lower the reservation wage and to shorten the unemployment spell: once a wage offer is received, more impatient individuals prefer to accept what they already have at hand rather than to wait an additional period for a better offer. The global effect on the exit rate depends on the relative strength of these two factors.

In this paper we sign the effect of impatience on the exit rate. We prove that, if individuals differ in the exponential discount rate, then for sufficiently patient individuals the reservation wage effect is stronger than the search effect. This implies that workers with higher impatience exit unemployment faster. We complement this theoretical result with simulations showing that the correlation of impatience and exit rates is indeed positive for plausible values of the discount rate. The result breaks down only when individuals are so impatient that they accept any wage offer, in contrast with the substantial rejection rate in the data.

This result rests on the assumption of exponential time discounting. While the assumption of a constant discount rate over time is standard in economics, an alternative hypothesis has been put forward. The main finding of experiments on intertemporal preferences is that high discounting in the short-run and low discounting in the long-run are common features

(Benzion, Rapoport and Yagil, 1989; Kirby and Herrnstein, 1995). An example by Thaler (1981) illustrates this point: a person may prefer an apple today to two apples tomorrow; however, we would be puzzled to find anybody that prefers an apple in 100 days to two apples in 101 days. In order to match this evidence on decreasing discount rates over time, we consider the case of hyperbolic time preferences (Laibson, 1997; O'Donoghue and Rabin, 1999).

In the paper we show that, if time preferences are hyperbolic, the correlation between impatience and exit rate is negative, unlike in the case of exponential discounting. If individuals differ in their degree of short-run impatience, the search effect dominates, and more impatient workers stay unemployed longer. Therefore, the correlation between impatience and the exit rate should be positive if individuals differ in their exponential discount rate, but should be negative if they are hyperbolic and they differ in their short-term discount rate. This result extends to a continuous-time model with hyperbolic discounting (Harris and Laibson, 2002).

For intuition on this result, consider the two separate decisions making up the search process. First, the worker chooses the probability with which he will receive an offer. Second, upon receiving an offer, he decides whether it is good enough. The first decision involves a trade-off between the present costs of searching and benefits that will start to materialize in the near future, once an offer is accepted. This time span is relatively short: in the United States, the mean duration of unemployment spells is 20 weeks. Over this limited time horizon, short-run impatience matters the most. On the other hand, the reservation wage decision involves a comparison of long-term consequences, once an offer is received: the worker chooses whether to accept the wage or wait for an even better offer. Since immediate payoffs are essentially not affected, the worker is making a choice for the long run. Therefore, variation in long-term discounting (as postulated by exponential preferences) matters more than variation in short-term discounting.

In addition to predictions about the exit rate, the model provides testable predictions about other job search outcomes. If measured impatience captures variation in the exponential discount rate, it should be negatively correlated to search effort and strongly negatively correlated to reservation wages and re-employment wages. If it captures variation in short-term discounting, then it should be negatively correlated to search effort and essentially orthogonal to reservation wages and re-employment wages.

The previous discussion illustrates one of the novel features of this paper. Flinn and Heckman (1982) have demonstrated that, using only unemployment duration and accepted wage information, it is impossible to identify separately the time discounting parameter from the utility flow of unemployment. This identification problem may explain the relative lack of attention in the literature to the effects of impatience on job search. Our approach to identification is fundamentally different, in that it is based on individual heterogeneity in time preferences and observed behavior in the job search process. To be clear, this identification strategy assumes that we are capturing heterogeneity in time preferences and not in other variables. We show that, in a model with endogenous search effort, different forms of heterogeneity yield different predictions with respect to the combined pattern of exit rates, search effort and reservation wages, hence making it possible to identify the source of variation in our results.

We test the predictions of the model using two large longitudinal data sets, the National Longitudinal Survey of Youth (NLSY), and the Panel Study of Income Dynamics (PSID). We proxy for impatience using a wide array of variables representing activities that involve trade-offs between immediate and delayed payoffs. In both data sets, the impatience measures are negatively correlated with the exit rate, even after controlling for a large set of background characteristics. The size of the effect is large and comparable to that of human capital variables. The effect of impatience on search effort is negative and sizeable, and search effort appears to be an important channel in driving variation in the exit rate. The effect of impatience on reservation wages and reemployment wages is essentially zero. Overall, impatience has a large effect on job search outcomes in the direction predicted by the hyperbolic discounting model. We also consider the possibility that the impatience proxies capture alternative determinants of job search, such as human capital level, taste for leisure, or layoff probability. Taken individually, these alternative explanations do not seem to explain the overall pattern of the results. The combined evidence supports the view that heterogeneity in the impatience measures captures variation in short-run impatience for individuals with hyperbolic time preferences. Of course, given the imperfection of these proxies, we can not rule out that we are in fact capturing a number of elements other than impatience, which, combined, generate the observed pattern of empirical results.

The contribution of this paper is twofold. The first contribution is to the field of job search. First, we uncover new theoretical implications of impatience for job search.[1] We test these implications using micro data on job search measures and proxies for impatience. Second, we analyze a model of job search with the novel assumption of hyperbolic time preferences. The main results is that hyperbolic agents devote little effort to search activities, and possibly less than they wish. This prediction matches the anecdotal advice of job counselors[2] to devote

[1] Munasinghe and Sicherman (2000) find that workers with higher measured impatience select jobs with flatter wage profiles.

[2] Job hunting books routinely warn against searching too little: "If two weeks have gone by and you haven't even started doing the inventory described in this chapter [...], don't procrastinate any longer! Choose a helper

more time to search, as well as the quantitative evidence that unemployed individuals report searching on average only seven hours per week (Barron and Mellow, 1979). The test of time-inconsistent preferences has important implications for the evaluation of welfare programs and policies for unemployed workers. For example, time-inconsistent workers may benefit particularly from policies that commit future selves to higher search intensity. Such policies can represent a Pareto improvement, meaning that they increase the welfare of all selves of a hyperbolic worker (Laibson, 1997). In particular, we show that a marginal increase in search in all periods raises the utility of all the selves, and is therefore strictly Pareto-improving. While we do not pursue welfare evaluations in this paper, collecting empirical evidence on the possible time inconsistency of workers is a first, necessary step to explore such issues.

The second contribution is to the literature on hyperbolic discounting. This paper joins a small but growing number of papers attempting to provide field evidence on time inconsistency. (Angeletos et al., 2001; DellaVigna and Malmendier, 2003; Fang and Silverman, 2004; Gruber and Mullainathan, 2002). The evidence in this paper supports the hyperbolic model based on the sign of the correlation between measures of impatience and job search variables.[3]

The rest of the paper is structured as follows. In Section 2 we outline the model and derive the comparative statics of impatience on job search outcomes. In Section 3 we describe the proxies of impatience in the NLSY and PSID data. In Section 4 we present the evidence on the effect of impatience on the exit rate from unemployment. In Section 5 we show the effect of impatience measures on search effort and reservation wage. We use these results to assess whether alternative explanations (including a simple human capital story) could rationalize the empirical findings. Section 6 concludes. Proofs and detailed data description are presented in the Appendix.

2 Model

In this section, we present a benchmark model of job search (Lippman and McCall, 1976) with one novel assumption about the agent's time preferences: in addition to the null hypothesis of exponential discounting, we consider the alternative hypothesis of hyperbolic discounting.

In the model, search effort is endogenous, and it determines the probability of receiving a wage offer in any period. Hence, workers choose both the level of search effort and the reservation

for your job-hunt." (Bolles, 2000. *What Color is Your Parachute?,* p. 87)

[3]By analyzing a different form of intertemporal preferences, this paper is also related to the literature that relaxes the intertemporal separability of the utility function in life-cycle labor supply models (Hotz, Kydland and Sedlacek, 1988).

wage to maximize the discounted stream of utility. The assumption of endogenous search effort is not new in the literature (Burdett and Mortensen, 1978; Albrecht, Holmlund and Lang, 1991; Mortensen, 1986), even though most search models focus exclusively on the reservation wage policy. This seems at odds with several pieces of evidence. First, empirical findings suggest that variation in unemployment duration is largely due to variation in the offer arrival rate, and not in reservation wages (Devine and Kiefer, 1991). Second, direct measures of job search are good predictors of post-unemployment outcomes (Barron and Mellow, 1981; Holzer, 1988).

2.1 Setting

The model is set in discrete time; it is helpful, although by no means necessary, to think of a week as the time unit. Consider an infinitely lived worker who is unemployed at time $t = 0$. In each period of unemployment, the worker exerts search effort s, parameterized as the probability of obtaining a job offer; therefore, $s \in [0, 1]$. In every period the agent incurs a cost of search $c(s)$, a bounded, twice differentiable, increasing, and strictly convex function of s on $[0, 1]$. In order to simplify the characterization of the solution, we also assume no fixed costs of search, i.e., $c(0) = 0$.

Upon receiving a job offer, the worker must decide whether to accept it or not. The job offer is characterized by a wage w, which is a realization of a random variable W with cumulative distribution function F. We further assume that F has bounded support $[\underline{x}, \overline{x}]$ and strictly positive density f over the support. If the worker accepts the offer, he becomes employed and receives, starting from the next period, a quantity w, which we refer to as the wage, even though it may also include non-pecuniary aspects of the job. We assume F to be known to the worker, constant over time and independent of search effort. In other words, search effort determines how often the individual samples out of F, not the distribution being sampled.

We also allow for the possibility of layoff. At the end of each period of employment, the worker is laid off with known probability $q \in [0, 1]$, in which case he becomes unemployed starting from next period. With probability $1 - q$, the worker continues to be employed at wage w. Additional technical assumptions A1-A3 are given in the Appendix.

Summing up, the timing of a period t of unemployment is as follows:

1. The worker decides the amount of search effort s and pays cost of search $c(s)$.
2. He receives b, the utility associated with unemployment, incorporating value of leisure, possible stigma, and the monetary value of unemployment benefits.

3. With probability s he then receives a job offer w (drawn from F).

4. Finally, contingent on receiving an offer, he accepts it or declines it. If he accepts, he is employed with wage w starting from period $t+1$. If no offer is received or the offer is declined, the worker searches again in period $t+1$.

Two final assumptions apply. First, we assume that the benefits b, the distribution F and the function c are time invariant. Second, we focus on workers' search behavior and abstract from the response of firms.

2.2 Time preferences

The assumption of exponential discounting is by far the most common in economics, and therefore we take it as our null hypothesis. In addition, we consider the alternative hypothesis that agents are impatient if the rewards are to be obtained in the near future, but relatively patient when choosing between rewards to be accrued in the distant future. Thaler (1981) uses hypothetical questions on comparisons between immediate and delayed payoffs to elicit annual discount rates. He finds that the annualized discount rate computed for a 3 month delay is two to five times higher than the annualized discount rate computed at a 3 year horizon.[4] This form of discounting implies that agents prefer a larger, later reward over a smaller, earlier one as long as the rewards are sufficiently distant in time; however, as both rewards get closer in time, the agent may choose the smaller, earlier reward. In an experiment with monetary rewards an overwhelming majority of subjects exhibit such reversal of preferences (Kirby and Herrnstein, 1995).

To allow for a higher discount rate in the short-run that in the long-run, we assume that agents have *hyperbolic* discount functions (Strotz, 1956; Phelps and Pollak, 1968; Laibson, 1997). The discount function is equal to 1 for $t=0$ and to $\beta\delta^t$ for $t=1,2,...$ with $\beta \leq 1$. Therefore, the present value of a flow of future utilities $(u_t)_{t\geq 0}$ is

$$u_0 + \beta \sum_{t=1}^{T} \delta^t u_t. \tag{1}$$

The implied discount factor from today to the next period is $\beta\delta$, while the discount factor between any two periods in the future is simply $\delta \geq \beta\delta$. This matches the main feature of the experimental evidence — high short-run discounting, low long-run discounting.

[4] Similar findings have been replicated using financially sophisticated subjects (Benzion, Rapoport and Yagil, 1989), monetary payments and incentive-compatible elicitation procedures (Kirby, 1997).

We interpret β as the parameter of short-run patience and δ as the parameter of long-run patience. For $\beta = 1$ we obtain the null hypothesis of time-consistent exponential preferences with discount function δ^t. For $\beta < 1$ we obtain the alternative hypothesis of hyperbolic time-inconsistent preferences. We further distinguish between the cases of sophistication and naiveté (O'Donoghue and Rabin, 1999). A sophisticated hyperbolic agent has rational expectations: she is aware that her future preferences will be hyperbolic as well. A naïve hyperbolic agent believes incorrectly that in the future he will behave as an exponential agent with $\beta = 1$.

2.3 The Optimization Problem

For any period t, we can write down the maximization problem of an unemployed worker for given continuation payoff V_{t+1}^U when unemployed and $V_{t+1}^E(w)$ when employed at wage w. The worker chooses search effort s_t and the wage acceptance policy to solve

$$\max_{s_t \in [0,1]} b - c(s_t) + \beta\delta \left[s_t E_F \left\{ \max \left(V_{t+1}^E(w), V_{t+1}^U \right) \right\} + (1 - s_t) V_{t+1}^U \right] \tag{2}$$

where the expectation is taken with respect to the distribution of wage offers F. Expression (2) is easily interpretable: the worker in period t receives benefits b and pays the cost of search $c(s_t)$. The continuation payoffs are discounted by the factor $\beta\delta$, where β is the additional term due to hyperbolic discounting (for the exponential worker, $\beta = 1$). With probability s_t the worker receives a wage offer w that he can then accept — thus obtaining, starting from next period, the continuation payoff from employment $V_{t+1}^E(w)$ — or reject, in which case he gains next period the continuation payoff from unemployment, V_{t+1}^U. With probability $1 - s_t$, the worker does not find a job and therefore receives V_{t+1}^U. Since we focus on a stationary environment, we can drop the time subscripts on the value functions. Thus, the continuation payoff from employment at wage w is

$$V^E(w) = w + \delta \left[qV^U + (1 - q) V^E(w) \right], \tag{3}$$

since the worker at any period is laid off with probability q.

Expression (2) shows that the optimal search and wage acceptance policy depend on the strategies of all future selves through the continuation payoffs $V^E(w)$ and V^U. Since different selves of the same individual have contrasting interests — each one would like to delegate search to the others — we treat the problem as an intrapersonal game between the selves. In keeping with the tradition in the hyperbolic discounting literature, we look for Markov perfect equilibria of the above game. The principal feature of Markov perfect equilibria is that the strategies should not depend on payoff-irrelevant elements. As a consequence, in our setting the strategies of the players do not depend directly on actions taken at previous periods. Propositions A.1 and A.2 in the Appendix characterize Markov perfect equilibria. Given the stationarity of the search environment, we concentrate our attention on stationary equilibria. The following result holds.

Theorem 1 (Existence and Uniqueness of equilibrium) *A stationary Markov perfect equilibrium of the above game exists and is unique for all types of agents.*[5]

The uniqueness of the stationary Markov perfect equilibrium differentiates this setting from other models of time-inconsistent agents. Harris and Laibson (2001) show that multiplicity of equilibria is the norm for hyperbolic consumers in a discrete time consumption-savings setting. The intuition for the uniqueness result in a search setting is straightforward. Since search in the present and in the future are substitutes, we do not observe a multiplicity of equilibria where all the selves either search little, or search much.

Since strategies should not depend on past actions, the wage acceptance policy consists of a reservation wage decision: the worker accepts all wage offers higher than a threshold value. Using expressions (2) and (3) and the stationarity assumption, we can solve for the reservation wage in equilibrium:

$$w^* = (1-\delta)\, V^U. \tag{4}$$

The higher the continuation payoff when unemployed, the higher the reservation wage: the worker has more incentives to wait one additional period. More importantly, the reservation wage does not depend directly on the short-run discount factor β. A worker that accepts an offer in period t will start working and receiving a wage only starting in period $t+1$. The worker therefore either enjoys the benefits of the outstanding offer starting tomorrow, or waits to receive an even better offer at some later period. Given that this decision does not involve any payoff at period t, only the long-run discount factor δ matters.

Using (2) and (4) we obtain the first order condition with respect to s as a function of the reservation wage:

$$c'\left(s^*\right) = \frac{\beta\delta}{1-\delta(1-q)}\left[\int_{w^*}^{\overline{x}} \left(u-w^*\right) dF\left(u\right)\right]. \tag{5}$$

At the optimum, the marginal cost of increasing the probability of finding a job equals the marginal benefit, which is the expected present value of obtaining a job offer in excess of the

[5] In a non-stationary environment, existence and uniqueness of the solution are guaranteed if the horizon is finite, or if the environment becomes eventually stationary. This second case applies, for instance, if workers receive unemployment benefits for a limited number of weeks.

reservation wage. The higher is the layoff probability q, the lower is the marginal benefit of search since the expected duration of a job decreases. As is apparent from expression (5), short-term impatience β directly affects the search effort.

2.4 Naïve agents

To build up intuition on the features of the equilibrium for the non-standard assumption of hyperbolic discounting, consider first the behavior of a naïve hyperbolic worker. The naïve worker believes that his future selves will have exponential preferences and thus will behave like the selves of an exponential worker with equal δ; therefore the continuation payoffs of a naïve and exponential worker coincide: $V^{U,n}(\beta,\delta) = V^{U,e}(\delta)$. Given equality of continuation payoffs, equation (4) implies that the reservation wages coincide as well:

$$w^{n*}(\beta,\delta) = w^{e*}(\delta). \tag{6}$$

The reservation wage is chosen by comparison of continuation payoffs that do not depend on short-run impatience either directly—only future payoffs are affected—or indirectly through expectations of future behavior. Therefore, short-run impatience does not affect the reservation wage for a naïve worker.

By contrast, short-run impatience has a strong effect on search effort. A comparison of the first order conditions for naïve and exponential agents using $w^{n*}(\beta,\delta) = w^{e*}(\delta)$ yields

$$c'\left(\sigma^{n}(\beta,\delta)\right) = \beta c'\left(\sigma^{e}(\delta)\right). \tag{7}$$

By convexity of $c(\cdot)$, search effort $\sigma^{n}(\beta,\delta)$ is strictly increasing in β. An increase in short-term impatience $(1-\beta)$ reduces the present value of the benefits of investing in search and therefore leads to lower search effort. This effect is accentuated by the fact that naïve agents (erroneously) believe that the future selves will search intensively and that, consequently, they do not need to search at present.

Finally, consider the effect of hyperbolic preferences on the exit rate from unemployment. The probability of exiting unemployment h depends on the probability of receiving a wage offer, and the probability of accepting it: $h = s\left[1 - F\left(w^{*}\right)\right]$. Short-run impatience influences only search effort: therefore decreases in β lead to lower exit rates. Naïve agents exit unemployment less than exponential agents with equal long-run discount factor. Note that this result does not require stationarity of b, $c(\cdot)$ or F.

2.5 Sophisticated agents

A result of the previous Section is that naïve hyperbolic agents search less than they expect to. We now show that sophisticated individuals, who correctly foresee their future search effort, search less than they would like to. This is an example of a general feature of sophisticated hyperbolic agents who, in the absence of a perfect commitment technology, invest less than they desire.[6]

Suppose that a market exists for commitment devices that induce the current as well as all the future selves of an individual to exert a given search effort. The next Proposition shows that a sophisticated individual would be willing to pay a positive price for a commitment device that raises search at all periods above the equilibrium level $\sigma^s(\beta, \delta)$ determined by (4) and (5). The reservation utility is chosen optimally for the new search level according to (4).

Proposition 1 *There exists an $\varepsilon > 0$ such that an increase of the search effort in all periods from $\sigma^s(\beta, \delta)$ to $\sigma^s(\beta, \delta) + \varepsilon$ strictly increases the net present utility of all the selves of a sophisticated hyperbolic agent.*

2.6 Impatience for exponential and hyperbolic agents

We now characterize the effect of impatience on labor market outcomes. As a corollary of the results below, the comparative statics with respect to β allows us to compare equilibrium behavior for hyperbolic ($\beta < 1$) and exponential agents ($\beta = 1$) with the same long-run discount factor δ. Proposition 2 illustrates the effects of impatience on search effort and the reservation wage:

Proposition 2 (Search and reservation wage) *(a) The equilibrium level of search effort s is strictly increasing in β and δ for all types of agents; (b) The reservation wage w^* is strictly increasing in δ for all agents; (c) The reservation wage w^* is independent of β for naive agents, and strictly increasing in β for sophisticated agents with $\beta < 1$.*

The effects of long-run and short-run impatience on search and reservation wages are analogous: an increase in impatience (a decrease in β or δ) reduces the incentive to invest in the future and

[6] We assume no commitment devices available for sophisticated agents — the present self cannot constrain the search behavior of future selves. In the labor market, employment agencies can be viewed as partial commitment devices. Since workers still have to prepare a résumé and go to interviews, delegation of some search activities may attenuate but is not likely to solve the tendency to delay search.

therefore reduces search effort. As a consequence, the value of staying unemployed is lower and the reservation wage decreases. Although changes in β and δ have a qualitatively similar effect, the magnitudes differ. In order to determine the effect on the exit rate from unemployment h, the magnitudes are indeed important. More impatient individuals both exert lower search effort and become less selective in their acceptance strategy: the global effect of impatience on the exit rate is a priori ambiguous. The next two propositions, the key theoretical results in the paper, show that under weak conditions it is possible to obtain precise predictions:

Proposition 3 **(**β **impatience)** *(a) The exit rate* $h = s\left[1 - F\left(w^*\right)\right]$ *for naive workers is strictly increasing in* β; *(b) The exit rate for sophisticated workers is strictly increasing in* β *if*

$$\frac{\partial E\left[W \mid W \geq x\right]}{\partial x} \leq \frac{1}{1-\beta} \text{ at } x = w^*. \tag{8}$$

Proposition 3 states that an increase in short-term impatience (a decrease in β) leads to lower exit rates from unemployment. Such changes affect search effort directly since they make the cost of search more salient; on the other hand, they affect the reservation wage (if at all) only indirectly through a sophistication effect: only because the sophisticated worker knows that her future selves will search little, does she accept more wages today. In Table 1, discussed in Section 5.4, we show that in a calibrated version of the model the effect of changes in β on the reservation wage are also quantitatively small for sophisticated agents. Figure 1a plots the relationship between β and the exit rate for calibrated values of the parameters.

Result (b) of Proposition 3 holds under the weak requirement (8). For β equal to 2/3, a value in the lower range of estimates in the literature, condition (8) requires that the increase in the expected reemployment wage associated with a reservation wage increase be less than threefold. This condition is always satisfied by the class of log-concave wage distributions, including the normal, the exponential and the uniform, and, for plausible values of the parameters, by most distributions used in the search literature.

Proposition 3 establishes that increases in short-term patience are associated with higher exit rates from unemployment. The effect of the long-term patience parameter δ on the exit rate is described in the following Proposition. Define the marginal cost elasticity $\eta\left(s\right) = sc''(s)/c'\left(s\right)$, and the failure rate $\psi\left(w\right) = f(w)/\left(1 - F\left(w\right)\right)$.

Proposition 4 **(**δ **impatience)** *For all types of workers, there exists a layoff probability* $\bar{q} > 0$ *such that for given* $q \leq \bar{q}$*: (a) the exit rate* h *is strictly decreasing in* δ *for* δ *close to 1; (b) if* $\eta\left(s\right)$ *is (weakly) increasing in* s *and* $\psi\left(w\right)$ *is (weakly) increasing in* w*, then there exists a*

$\delta_{\max}(q) \in (0,1)$ *such that the exit rate is increasing in* δ *for* $\delta < \delta_{\max}(q)$, *and decreasing in* δ *for* $\delta > \delta_{\max}(q)$.

To our knowledge, Proposition 4 is a novel result in the literature.[7] It characterizes the effect of the exponential discount factor δ on the exit rate in a model with both a search effort and a reservation wage choice. Result (a) guarantees that for sufficiently patient individuals the exit rate is a decreasing function of δ. Consider first the case of no layoff (q equal to zero): the wage is received for all future periods. As δ approaches one, the worker values increasingly more the benefits of receiving a high wage forever; therefore he both searches intensively and becomes very selective in his job offer acceptance strategy. There is an asymmetry between the two effects. The marginal costs of increasing search effort at some point outweighs the benefits, given the assumptions of concave costs and finite support of the wage distribution. An infinitely patient agent is better off becoming extremely selective. Therefore the exit rate converges to zero. This result depends on the probability of layoff being sufficiently small: below we show that, for plausible values of the layoff probability q, the exit rate is indeed decreasing in δ for δ close to 1.

Under appropriate assumptions, Proposition 4(b) allows a global characterization of the exit rate as a function of δ. The first assumption — marginal cost elasticity $\eta(s)$ increasing in s — requires that search become increasingly costly at the margin. The second assumption — failure rate increasing in w — is satisfied by all log-concave wage distributions. Under these conditions, the exit rate as a function of δ is hump shaped. Figure 1b illustrates this shape for a model calibrated on empirical data under selected parametric assumptions (see Appendix C). The calibrated model can be used to estimate $\delta^y_{\max}$, the level of the *yearly* discount factor at which the exit rate starts to decrease as a function of δ.[8] The top panel of Table 1 displays $\delta^y_{\max}$, as well as the corresponding probability of accepting a wage offer. Interestingly, $\delta^y_{\max}$ is never greater than 0.80 and in general is significantly smaller. The benchmark calibration implies a yearly discount rate of 54 percent, a value well beyond the range of estimates considered plausible in the literature. In a setting essentially identical to ours, Wolpin (1987) estimates a 95 percent confidence interval for the annual discount factor to be [0.936, 0.963], similar to the estimates in the consumption and finance literature (Gourinchas and Parker, 2002). A second interesting feature is that at $\delta = \delta^y_{\max}$ the individual accepts 90 percent or more of the wage offers. Given that the probability of acceptance is decreasing in δ (Proposition 2b), this implies

[7] Burdett and Mortensen (1978) and Albrecht, Holmlund and Lang (1991) derive the comparative statics effects of impatience on search effort and the reservation wage, but do not derive the effects of impatience on the exit rate.

[8] For ease of interpretation, we present these results in terms of the *yearly* discount factor δ^y, where $\delta^y = \delta^{52}$.

that for $\delta < \delta^y_{\max}$ the individual accepts essentially any wage offer. Extremely high acceptance probabilities contrast with our estimates from the NLSY data (0.54) as well as with previous estimates in the literature (Holzer, 1987, Blau and Robins 1990).[9]

The exit rate, therefore, is increasing in long-run patience δ only for high levels of discounting and for a counterfactually high acceptance probability. Over the plausible range of values for δ, the exit rate is decreasing in long-run patience.

2.7 Robustness[10]

Continuous time model. While in this Section we have focused on a discrete-time model, it is possible to extend the above results to continuous time using the instantaneous gratification framework of Harris and Laibson (2002). The instantaneous gratification model differs from standard continuous-time models with discount factor e^{-rt} because the discount factor is stochastic. Over a period Δt, the discount factor may decrease to αe^{-rt}, with $\alpha \leq 1$, with probability $\gamma \Delta t$. The expected discount factor for outcomes t periods ahead, therefore, is given by $e^{-\gamma t}e^{-rt} + \left(1 - e^{-\gamma t}\right) \alpha e^{-rt}$. The parameter α is the equivalent of the short-run discounting parameter β and specifies the drop in discounting that occurs once the discount function transitions from the present to the future. The parameter γ specifies how quickly the discount factor drop-off occurs. The case $\gamma \to \infty$ is the case of instantaneous gratification and is the most direct analogue of the hyperbolic discounting model presented above. Notice that assuming either $\alpha = 1$ or $\gamma = 0$ brings us back to a standard continuous-time exponential model.[11]

In Appendix D we set up the equivalent of the job-search model in continuous time for the case of no layoff ($q = 0$) and show that, in the case of instantaneous gratification, we obtain the same first order conditions as in the discrete-time model, with the difference that the parameter α replaces β, and the discount rate r replacing the discount factor δ according to $\delta = 1/\left(1 + r\right)$. Since the first-order conditions are the same, all the results that we prove in the paper apply also to the continuous-time case.

[9] Structural estimates of acceptance probability range from low values of acceptance—0.21 to 0.45 in Eckstein and Wolpin (1995, Table 4)—to acceptance probabilities very close to 1 (Wolpin, 1987; van den Berg, 1990).

[10] We thank two very perceptive referees for the suggestions that led us to add this Section.

[11] Note that this model is different from one in which agents the discount rate is simply equal to the interest rate, workers are perfectly rational and time-consistent, know that the interest rate will drop at some point in the future from r to r', but do not know exactly when. In this alternative model, agents understand that once the interest rate has fallen it will not change any more, and hence optimal decisions from that point onwards will be based on the lower interest rate, r'. By contrast, in the hyperbolic model (sophisticated) agents understand that in every period in the future the discount factor between the present and the immediate future will always be e^{-rt}.

Timing of wage receipts. The reader may be concerned that the assumption that the wage is paid one period after the acceptance of a job is crucial. The continuous-time model shows that this is not the case. In this latter model, the wage starts being paid off immediately in case of job offer.

On-the-job search. If search on the job is as costly as search when unemployed, then workers accept any offered wage above b, regardless of time preferences. Therefore, impatience affects exit rates only through search and Proposition 4 does not hold. However, if search on the job is sufficiently more costly, the effects outlined in this paper will apply (the model in the paper implicitly assumes infinite costs of on-the-job search). Direct evidence on the effectiveness of search while unemployed versus search on the job is inconclusive.[12]

Shifts of the wage distribution. An alternative possibility is one in which search effort affects the mean of the wage distribution as well as the probability of obtaining an offer. The first order condition for search effort s^* in equation (5) would still take the form of equality between immediate marginal cost of effort and future benefits discounted by $\beta\delta$. The reservation wage choice, again, would not depend directly on β. Based on this, it is unlikely that the main results in the paper would be affected.

2.8 Summary

In the above Section we have characterized the behavior of workers with hyperbolic time preferences. Impatient hyperbolic individuals (individuals with low β) display lower search effort when compared to exponential individuals with the same δ. The reservation wage for exponential and hyperbolic agents, instead, is (essentially) the same. The main feature of hyperbolic individuals is that they devote little effort to search, not that they accept many offers. The latter feature is consistent with the anecdotal advice given to job seekers (Bolles, 2000). The general recommendation is to spend more time on job search, rather than to be more selective.

The Section also highlights a fundamental difference between long-run and short-run impatience in job search. Variation in the short-run discount factor β affects mostly the search decision; therefore, the exit rate is increasing in β. For sufficiently patient individuals we obtain the opposite result for variation in δ: more patient agents are more selective in their choice of reservation wages and therefore exit unemployment later. The intuition for this result in-

[12] Holzer (1987) finds that search when unemployed is more effective, whereas Blau and Robins (1990) find the opposite, but note that unemployed workers do not accept all offers, and generally do stop searching once they find a job.

volves the different timing of the search and reservation wage decisions. The search decision involves a trade-off between immediate search costs and future benefits of accepting an offer, occurring within a few weeks. Over this limited horizon, variation in short-run impatience matters more than variation in long-run impatience. The reservation wage decision, instead, involves a comparison of the long-term consequences of obtaining a certain wage or waiting to receive an even better offer. Given that current payoffs are essentially not affected, variation in long-term discounting matters more than variation in short-term discounting. In a nutshell, due to the different time horizons variation in δ drives mostly variation in reservation wages, while variation in β drives mostly variation in search effort. The result holds for both the discrete-time and the continuous-time models of hyperbolic discounting.

This result suggests a way to distinguish empirically between different types of impatience. If individuals have exponential time preferences, more impatient individuals (low δ) should have higher exit rates from unemployment, due to lower reservation wages. If impatient workers have hyperbolic preferences with a high degree of short-run impatience (low β), instead, impatient workers should exit less frequently, due to lower search effort, while reservation wages should be essentially unaffected by the degree of impatience.

3 Empirical Strategy

To test the predictions of the model, we use two large longitudinal data sets, the Panel Study of Income Dynamics (PSID) and the National Longitudinal Survey of Youth (NLSY), that include detailed information on unemployment spells, on job search activities, and on a wide range of behavioral indicators that can be interpreted as correlates of impatience. In the following, we briefly describe the construction of unemployment spells in the two data sets, and then discuss our choice of impatience measures. A more detailed description of the data set construction is given in Appendix B.

3.1 Unemployment Spells in the PSID and the NLSY

The sample of unemployment spells in the PSID is similar to that used in Katz (1986) and Katz and Meyer (1990). Between 1981 and 1983, PSID heads of household were asked to provide detailed information on up to three unemployment spells contained at least in part in the previous calendar year. For every individual, we consider only the last unemployment spell mentioned at each interview. An unemployment spell makes it into our sample only if the respondent was a male head of household between 20 and 65 years of age. We retain more than one unemployment spell per individual where it is possible to determine with certainty that a given spell is not the same as a previously mentioned one.

For the NLSY, we use the Work History files to construct a week by week account of every male worker's labor force status from 1978 to 1996. Our measure of unemployment reflects the concept underlying the model: a worker is unemployed if he is out of a job but willing to work. Therefore, we classify as unemployment spells all the periods of nonemployment in which at least some search took place. This measure differs from the conventional definition in that a worker who does not actively search during the entire spell can still be classified as unemployed. We retain only those spells that were reported in 1985 or later by male respondents who were not part of the military subsample, and were not enrolled in school. This ensures that our sample of spells includes mainly workers with strong attachment to the labor force, and that our impatience proxies are measured prior to the beginning of the unemployment spells.

Table 2 gives summary statistics for the sample of unemployment spells for the PSID and the NLSY. The mean length of unemployment spells is essentially identical in the two samples. In the PSID, the survivor function is higher at long durations.[13] In both samples, many workers have repeated spells of unemployment. Finally, in the PSID sample a relatively large number of completed spells ends in recall to the previous employer. Overall, the distribution of unemployment durations in the two samples is comparable to that of previous studies.

3.2 Measures of Impatience

Attempts to measure rates of time preference have so far been conducted almost exclusively in laboratory experiments. Yet individuals pursue many activities that indirectly reveal a preference for early gratification. Relatively impatient individuals engage frequently in activities characterized by immediate rewards and delayed costs. Conversely, patient individuals are likely to take on activities with immediate costs and delayed benefits. We collect information on several such types of behavior from the PSID and the NLSY in order to construct measures of impatience.

Throughout the paper, we make three identifying assumptions. First, higher measures of impatience may be associated with either higher short-run $(1-\beta)$ or higher long-run $(1-\delta)$ impatience. Second, the individual's discount rate is the same across different activities. Third, the ranking of individuals with respect to impatience does not vary over time.[14] A potential

[13]In the PSID there are many more censored spells due to sample construction; any spell that was ongoing at the time of the interview in 1983 is censored.

[14]Despite the fact that time preferences may vary over time, individual differences in impatience appear to

confounding element is that, even if the third assumption is satisfied, our measures may change over time because of external factors. For instance, suppose that a long unemployment spell induces an individual to start smoking, and that this behavior persists over time. If the proxy (smoking in this example) is measured after the occurrence of the spell, we could find a spurious negative correlation between the measure of impatience and the exit rate. In order to avoid this problem, we choose proxies of impatience that are measured prior to the occurrence of the unemployment spells.[15] The only exception is the bank account measure in the PSID. Finally, we adjust, where possible, the impatience measures to eliminate confounding elements.

We should note from the outset that our measures are only imperfect proxies for impatience, and they may be picking up a number of other individual traits (unobserved wage potential, tastes for leisure, risk preferences, etc.) apart from time preferences. We return to this point in Section 5.3 below, where we argue that interpreting the proxies as any other single individual trait would generate predictions that are at odds with the empirical results.

NLSY Assessment of Impatience. At the end of each NLSY interview, the interviewer is asked to specify whether the respondent's attitude was "1. Friendly and interested; 2. Cooperative and not interested; 3. Impatient and restless; 4. Hostile." An impatient respondent reveals a dislike for the immediate burden of answering the NLSY questionnaire, even though at some previous time he or she had agreed to be interviewed (perhaps attracted by the monetary compensation or by the warm glow that comes from cooperating with a scientific enterprise). Such behavior is similar to that of an unemployed worker who plans to fill in forms and job applications, but then postpones such activities because of aversion to the immediate costs. A dummy for the third response was recorded between 1980 and 1985: the raw measure of impatience was calculated as the average of these dummies. Since individuals with a high opportunity value of time may be more likely to exhibit impatience during the interview, we adjust the raw indicator by partialling out the effects of employment status, hours worked, and wages at the time of the interview.[16]

Having a Bank Account. Simple models of savings behavior predict that more patient individuals delay consumption and accumulate more wealth, and are therefore more likely to

be quite stable: the ability of young children to delay gratification correlates strongly with achievement later in life (Mischel, Shoda and Rodriguez, 1989).

[15] Even correlates of impatience which are measured before unemployment spells may be biased: this is the case if individuals pick up impatient behavior during an unemployment spell, and unemployment durations are correlated over time. It is hard to believe, however, that this is a first-order effect.

[16] We have also attempted to adjust this measure for interview length, since longer interviews (due for example to more unemployment spells) may make the respondent impatient. The correlation between adjusted and unadjusted measure is .9999.

have some type of bank account. The decision to open a bank account depends also on short-run impatience. For example, an impatient salaried worker may be so eager to spend his weekly paycheck on Friday that he prefers to cash it in immediately at a check-cashing center (and pay an exorbitant transaction fee) rather than wait two days to have the money available for withdrawal from the bank.[17] Alternatively, a hyperbolic worker may delay opening a checking account at a bank. O'Donoghue and Rabin (2001) show that a relatively mild degree of short-run impatience, if associated with naïveté, may lead an individual to postpone forever a simple financial operation which has small present costs and substantial delayed benefits. As a raw measure of impatience, we use a simple indicator of whether individuals have any money in a checking or saving account in 1989 (for the PSID), or in any type of financial vehicle in 1985 (for the NLSY). Since the presence of a bank account may reflect past labor market success in addition to impatience, we adjust the raw indicator for the individual's age and cumulative past earnings.

Use of Contraceptives. An individual that has sexual intercourse with a partner must decide whether to use contraceptives: the higher the level of patience, the higher the value of avoiding sexually transmitted diseases and undesired pregnancies. We therefore expect more patient individuals to use contraceptives consistently, and more so when involved in casual relationships.[18] In the NLSY for the years 1984-1985, all individuals that have had sexual intercourse in the month prior to the interview are asked about the use of contraceptives. We classify individuals who use contraceptives as patient, and individuals who do not use them and are not married as impatient. We assign a missing value to married individuals who did not use any birth-control method, since we cannot know whether these individuals were planning to have a child.[19]

Life Insurance. Workers that choose among different job offers take into account non-monetary as well as monetary compensation. According to the theory of compensating wage differentials, individuals whose employers provide life insurance coverage should have a taste for the long horizon: impatient workers could have chosen a similar job with a higher wage but no insurance coverage. The raw measure in the NLSY is an indicator that takes the value of 1 if the current job includes life insurance coverage. Since the likelihood of having life insurance depends on whether the worker has family and on the availability of jobs with fringe benefits, we adjust the raw measure by partialling out the effects of marital status, number of children

[17] We thank Jerry Green for suggesting this example.

[18] Contraceptive use indicates both attitudes toward risk and time preferences. Controlling for direct measures of risk aversion did not affect the results.

[19] Assigning a missing value to all married individuals does not alter the results substantially.

and age.

Health Habits: Smoking and Drinking. In a pioneering study, Fuchs (1982) observed that the high correlation between health outcomes and schooling can be explained by the fact that relatively patient individuals are more likely to engage in healthy behavior and to invest in human capital accumulation, as both activities can be regarded as involving a trade-off between present and future payoffs. Fuchs found that implicit interest rates calculated from hypothetical questions on immediate or delayed acceptance of lottery prizes were correlated with smoking behavior, in the direction predicted by theory. Following this insight, we use smoking and heavy drinking as measures of impatience: both activities are pleasurable at the time of consumption but detrimental to health afterwards. In both samples, the smoking variable is a simple indicator for whether the individual smoked prior to the beginning of the unemployment spells. For the NLSY we also use the number of times an individual has had a hangover in the past month as a measure of impatience.

Vocational Clubs in High School. High school students participate in a wide range of time-consuming activities that will likely yield rewards in the future. In particular, some students are members of associations that are intended to prepare them for future jobs. The likely purpose of participating in these clubs is to obtain scholarships, create a network of contacts and build their own future career. This type of forward looking behavior is characteristic of patient individuals. Membership in these associations usually does not require particular skills so it is unlikely that we are selecting only the gifted students. Using the 1984 wave of the NLSY, we construct a measure of participation in vocational clubs in high school by taking the average over dummies indicating participation in any one of seven vocational clubs.[20]

In Table 3 we present summary statistics for our measures of impatience in the two samples. The first column displays summary statistics for the raw variables used to construct the final measures. We then adjust (whenever necessary) the raw measures and transform them so that higher impatience is always associated with a higher value of the measure. To facilitate comparison, we also standardize each measure, so that the final variable has mean zero and standard deviation one in the entire male population.

We report the summary statistics of the impatience measures, raw and final, for the sample of individuals who appear at least once in the unemployment spell sample (columns 2 and 3). We also report the final measures for the actual sample of spells (column 4). The means of

[20]The seven vocational clubs are: American Industrial Arts Association, Distributive Education Clubs of America, Future Business Leaders of America, Future Farmers of America, Health Occupations Student Association, Office Education Association (now called the Business Professionals of America), and Vocations Industrial Club of America.

most of the final variables are positive, implying that unemployed individuals rank relatively high in our measures of impatience when compared to the entire male population.

If the underlying factor behind these diverse behavioral traits is impatience, the correlations between all the variables should be positive. In fact, of the 21 pairwise correlations between the impatience measures in the NLSY, all but two have a positive sign and 16 are statistically different from zero. Partial correlations between the variables, after controlling for educational attainment, cognitive test scores, race and parental education, exhibit the same pattern. The value of Cronbach's reliability measure is 0.278, reflecting an average correlation between the measures of 0.052. The correlation between the two measures in the PSID is 0.099. Low correlations among different measures of an individual trait are not uncommon in the literature (see Glaeser et al., 2000), and expected in this case. The impatience proxies are noisy measures, derived from different sections and years of the NLSY. Measurement error is likely to attenuate the correlations between impatience and job search outcomes, but should not alter their sign.

We use factor analysis to create an aggregate measure of impatience. The details of the factor analysis are given in the Appendix. The aggregate measure is a weighted average of the individual variables: the measures that receive most weight are smoking, having a bank account, and use of contraceptives, while participation in vocational clubs receives almost no weight.

4 Exit Rate Results

4.1 Kaplan-Meier Estimates

We first illustrate graphically the exit rates from unemployment for patient and impatient workers. Figures 2 and 3 plot the Kaplan-Meier estimates of the hazard function in the PSID and the NLSY respectively.[21] For the PSID sample (Figure 2), we compare the exit rates of workers with and without a bank account (top panel), and of smokers and non-smokers. In both cases, the exit rates of workers which we classify as impatient are substantially lower than those of workers classified as patient, and especially so in the first weeks, where the exit rates are more precisely estimated. Figure 3 shows the results for the NLSY: in the top two panels we compare the exit rates of smokers and non-smokers (right panel), and of workers with a high and low propensity to have a bank account (i.e., workers in the top quartile and in the bottom quartile of the measure). In the bottom panel we compare the exit rates of workers

[21]The Kaplan-Meier estimate of the hazard function at t weeks is calculated simply as d_t/r_t, where d_t is the number of completed spells lasting exactly t weeks, and r_t is the number of spells lasting t or more weeks.

in the top and bottom quartiles of the aggregate impatience measure. Once again, impatient individuals have substantially lower exit rates than patient ones. *Prima facie,* impatience has a large effect on job search outcomes in the direction predicted by the hyperbolic discounting model.

4.2 Benchmark Results

We adopt a Cox proportional hazards model (Cox, 1972) to quantify the difference in hazard rates between patient and impatient workers, and to assess the robustness of the findings to the inclusion of a broad set of control variables. Let t_j be the observed duration of an unemployment spell and let $\mathbf{x}_j$ be the vector of covariates for individual j; the hazard rate can be written as

$$\lambda\left(t_j|\mathbf{x}_j,\boldsymbol{\beta}\right)=\lambda_0\left(t_j\right)\exp\left(\mathbf{x}_j'\boldsymbol{\beta}\right)$$

where no parametric specification is assumed for the baseline hazard $\lambda_0\left(t_j\right)$. Notice that in our sample a given individual may have more than one unemployment spell. We enter each of multiple spells by the same individual as separate observations, and, following Lin and Wei (1989), allow for robust standard errors that take into account this form of clustering.

The Kaplan-Meier estimates presented in the previous Section provide evidence on the simple correlation between impatience and exit rates. However, there are important individual differences in the productivity of search, in the value of unemployment, and in the distribution of wage offers. Our estimates may be biased if the impatience proxies are correlated with variables associated with the exit rate, and these variables are omitted from the regression. Therefore we control as well as possible for measures of human capital, family background, and other environmental factors. First of all, we include an extensive list of characteristics of the worker's job prior to the unemployment spell, including wage, industry and occupation dummies, and previous tenure. These variables convey information about a worker's potential distribution of wage offers that might be otherwise unobservable to the econometrician. We also include control variables for demographic characteristics (age, race, education, marital status, number of children), an indicator for health status, and cognitive ability as measured by the AFQT score. These variables are meant to capture individual heterogeneity in productivity on the job and in job search activities. We include family background characteristics such as parental education, father's occupation, and whether any household members received magazines, newspapers, or had a library card when the respondent was 14 years old. We also add a group of geographic and macroeconomic indicators: dummies for region of residence; a dummy for urban status; dummies for central city or SMSA residence; indicators for the local unemployment rate. Finally, we include a dummy for receipt of Unemployment Insurance benefits.

In Table 4 we present the benchmark estimates. Each row in the table reports the coefficients on the relevant measure of impatience from *separate* estimations of the Cox proportional hazards model. For each sample, we report both the results of a simple model that includes only the impatience measure, and the results of the full model that includes the entire set of control variables.

The model without control variables (column 1) shows that most of the measures of impatience are associated with lower exit rates. In the NLSY sample, a two standard deviation increase in the interviewer's assessment of impatience leads to an 11 percent increase in the exit rate from unemployment. The coefficients are of similar magnitude for the smoking variable, for the propensity not to have life insurance at one's job, and for non-participation in vocational clubs. Increases in the propensity to have unsafe sex and in the propensity not to have a bank account have somewhat larger effects on the exit rate. The only variable that appears to have no effect on the exit rate is the measure of heavy drinking. Overall, a two standard deviation increase in the aggregate impatience measure leads to a 30 percent drop in the exit rate from unemployment. The magnitude of this estimate is substantial and comparable to the effect of human capital variables. In similar Cox models estimated in the NLSY, we find that 4 years of education raise the exit rate by approximately 15 percent; that individuals at the 75th percentile of the distribution of AFQT scores have a 28 percent higher exit rate than individuals at the 25th percentile; and that individuals at the 75th percentile of the wage distribution prior to the unemployment spell have a 13 percent higher exit rate than individuals at the 25th percentile.

The results for the NLSY are confirmed when we analyze the two impatience measures available in the PSID. In fact, the difference in exit rates between smokers and non-smokers, and between workers with and without a bank account is larger than in the NLSY.

The results of the regressions with control variables are presented in column 2 in Table 4.[22] Overall, including the control variables has the expected effect; nearly all the coefficients on the impatience measures become smaller in absolute value. Most of them, however, remain statistically and economically significant. Arguably, some of the drop in the coefficients may be attributed to the inclusion of control variables that are themselves measures of impatience, as is the case for education. In the PSID sample, the coefficients on the smoking and bank account variables remain almost unaltered. In the NLSY sample, the aggregate impatience

[22]The full set of coefficients on the control variables is given in Appendix Table 1.

measure remains strongly significant: a two standard deviation increase in impatience is now associated with an approximately 18 percent lower exit rate. This effect is larger than the effect of four additional years of education (3 percent, insignificant), and also larger than the effect of moving from one end to the other of the interquartile range in the distribution of AFQT scores (16 percent) and previous wages (7 percent).

Summing up, measures of impatience are mostly negatively correlated with the exit rate, even after controlling for a large set of background variables. If most of this effect depends on impatience, then the model described in Section 2 implies that variation in rates of time preference reflects variations in the degree of short-run impatience. In what follows, we employ several different strategies to assess the robustness of this result, and to eliminate possible confounding elements. We concentrate mostly on the NLSY because of the greater wealth of information available in this sample. We restrict our attention to models with the full set of control variables.

4.3 Robustness checks

In Table 5, we present some alternative specifications of the hazard model, designed to assess the robustness of the basic results. In the first column, we report the results of the estimation of a Cox model where all the measures of impatience are included simultaneously. The coefficients on the impatience measures are similar to those obtained when each variable is included separately.

Last spell. In the second column of Table 5, we retain only the last spell for each individual. The last spell of unemployment occurs when the worker is older and therefore more attached to the labor force: such a spell fits more adequately the concept of unemployment spell described in Section 2. The main results are unchanged. Individual measures of impatience are negatively correlated with the exit rate, and coefficient estimates are comparable to those obtained in Table 4.

Active search. In the third column, we explore whether the results are sensitive to the exact definition of unemployment spells. We use an alternative definition of unemployment spells that includes only the periods in which active search took place. The newly defined unemployment spells are substantially shorter, and more likely to be censored. The estimated coefficients on the measures of impatience are largely unaffected by this change: a two standard deviation increase in the aggregate measure of impatience is associated with a 16 percent decrease in the exit rate from unemployment.

Measurement error. Finally, the above estimates are likely to suffer from considerable measurement error bias, since our proxies are only imprecise measures of impatience. We can correct for attenuation bias by transforming the model into a log-linear one,[23] and then instrumenting for each measure of impatience with all the remaining proxies. The OLS and instrumental variable (IV) estimates for the log-linear model are presented in the fourth and fifth columns of Table 5. The IV estimates are an order of magnitude larger than the OLS estimates. In addition, all the variables are strongly significant. The IV results suggest that the benchmark estimates could be substantially attenuated because of measurement error. This validates the above findings, even though the results should be viewed with some circumspection: the point estimates are imprecise and the F-statistic for the first stage regressions is above the conventional significance level only when smoking and heavy drinking are the instrumented variables.

Non-linearities. The empirical evidence presented so far indicates that the exit rate is decreasing in measures of impatience. The estimated negative correlation between impatience and exit rate could still be generated by variation in long-run patience if the exit rate is hump-shaped as a function of δ (Figure 1b) and workers are sufficiently impatient so that the majority is located on the increasing side of the hump. We examine the plausibility of this explanation by testing for the presence of a non-linear effect of the patience measure.[24] Figure 4 plots the predicted exit rates in a model that includes a quadratic term and specifies a flexible step function for the aggregate measure of patience. The quadratic specification is essentially indistinguishable from the linear one. In addition, the predicted exit rates for different deciles in the distribution of patience are increasing throughout most of the range, including at high levels of patience. There is no evidence that the exit rate is decreasing in δ for sufficiently patient individuals.

5 Reservation Wages and Search Effort

5.1 Alternative Explanations: Human Capital?

We have established the presence of a strong negative relationship between the measures of impatience and the exit rate from unemployment. It is legitimate to ask whether these measures are indeed capturing individual time preferences, or whether instead they simply reflect human

[23] See Kalbfleisch and Prentice (1980) for the necessary conditions for the model to admit a log-linear transformation.

[24] The aggregate patience measure is the negative of the aggregate impatience measure. We present the results this way for ease of comparison with Figures 1a and 1b.

capital. In the previous Section, we showed that the negative correlation is robust to the inclusion of a large set of observable human capital measures. We now consider the possibility that the measures of impatience are reflecting heterogeneity in human capital (or earnings potential), represented by μ in the model. In Section 5.3 we explore the possibility that the proxies capture variation in other parameters in the model.

According to the exponential discounting model, impatience should have a strong negative correlation with the reservation wage. Similarly, if the measures are capturing human capital, we should also observe a strong negative correlation with the reservation wage: individuals with lower human capital receive worse offers and need to lower their reservation wage (see also Section 5.3). On the other hand, the hyperbolic discounting model predicts that the correlation should be zero (naïve workers) or essentially zero (sophisticated workers). We can therefore test the hyperbolic model against the exponential and human capital model by measuring the size of the effect of impatience on self-reported reservation wages, on actual re-employment wages, and on offer acceptance probabilities.

Reservation wage. Between 1980 and 1986, and then again in 1994, unemployed respondents in the NLSY were asked "what would the wage or salary have to be for you to be willing to take [a job]?" We restrict our sample to males, not in school or in the military, interviewed after 1985, and we run least squares regressions of the log of the self-reported reservation wage on the measures of impatience, and the usual set of control variables. Columns 1 and 2 of Table 6 present the estimates. The results without control variables point to a moderate negative relationship between reservation wages and impatience. However, after inclusion of the control variables, all the coefficients but one are indistinguishable from zero, including the coefficient on the aggregate impatience measure. This result does not seem to depend on low power, since the estimates are quite precise. We can compare these results with the reservation wage effect of standard measures of ability and human capital. These variable have a large and significant effect: for example, 4 years of education raise the reservation wage by 23 percent, and a move from the bottom quartile to the top quartile in previous wages raises the reservation wage by 44 percent.

Re-employment wages. The human capital explanation predicts also a negative correlation between the impatience measures and the actual wage on the first job after unemployment. Re-employment wages are available in 88% of the spells used in the exit rate regressions. We run least squares regressions of the log of re-employment wages on the measures of impatience, and the usual set of control variables. Columns 3 and 4 of Table 6 present the estimates. The results confirm the above findings. After inclusion of the control variables, the aggregate impatience measure is not significantly related to the re-employment wage. The individual impatience measures are for the most part insignificant, with the exceptions of propensity to smoke and not to have a life insurance (negative correlation) and propensity to be impatient (positive correlation). On the other hand, measures of human capital display mostly a large and significant effect: for example, moving from one end to the other of the interquartile range of previous wages raises the re-employment wage by 30%.

The orthogonality between impatience and the reservation wage on one hand, and between impatience and the re-employment wage on the other hand, lends support to the hyperbolic model against the human capital and the exponential discounting explanations.

Acceptance probability. According to the exponential model, impatience should have a strong positive correlation with the probability of accepting a job offer. If the measures are capturing human capital, we expect a negative correlation.[25] Finally, according to the hyperbolic model, we should observe essentially no correlation. The 1981 wave of the NLSY provides information on acceptance and rejection decisions of unemployed workers. We run a probit model for the acceptance probability, conditional on receipt of a job offer, as a function of the impatience proxies. The mean acceptance probability is equal to 0.54. Columns 5 and 6 of Table 6 show that the acceptance probability increases by 13 percentage points for two standard deviation increases in the aggregate impatience measure with no controls, and by only 2 percentage points after including the control variables. The lack of a significant correlation between acceptance probabilities and impatience is consistent with the hyperbolic model. The results should however be taken with caution because the sample size is small, workers are very young, and most of the impatience proxies are measured after 1981.

Is the self-reported reservation wage meaningful? The lack of correlation between self-reported reservation wages and the impatience measures could be due to noisiness in the reservation wage measure. Alternatively, it's possible that, in deciding which jobs to accept, workers do not adopt an optimal rule, but instead use a rule of thumb, such as using the previous wage. In response to these concerns, we document three related facts. First, the self-reported reservation wage used in columns 1 and 2 of Table 6 coincides with the previous wage for only 11 percent of the respondents, and is within 20 percent of the previous wage for barely half of the respondents. More importantly, the self-reported reservation wage is correlated with important economic variables in the direction predicted by job search theory. Columns 1 and 2 of Table 7 show that reservation wages are positively correlated (t statistic 1.61) with a dummy for unemployment benefit receipt, and negatively correlated with the

[25]See Section 5.3. We interpret human capital changes as changes in mean productivity μ.

local unemployment rate, even after controlling for the previous wage. The stated reservation wage therefore responds to incentives in the way a job search model would predict. Finally, in Column 3 we show that the self-reported reservation wage is an important predictor for the actual re-employment wage, even after controlling for the worker's previous wage. Overall, self-reported reservation wages appear to reflect important aspects of the worker's job search strategy. This strengthens the significance of the above results on impatience and reservation wages.

5.2 Is search a channel?

Search intensity. One of the main predictions of the model is that more impatient individuals search less intensively; in fact, if individuals are heterogeneous in short-term discounting, the search effect should be strong enough to dominate the reservation wage effect. Therefore, if variation in short-run impatience is driving the results, we expect to observe a strong empirical link between impatience and search effort. As a measure of search intensity, we use information in the NLSY on the number of different search methods used by unemployed workers. The average number of methods used is 1.17. Details of the search measure are given in Appendix Table 2.

In Table 8 we present the results for Poisson regressions of search intensity on the impatience measures.[26] The simple correlations between the impatience measures and the exit rate are strongly negative. This negative relationship is strongest for the NLSY assessment of impatience and for contraceptive use. The inclusion of control variables renders some of the impatience measures insignificantly different from zero, but the overall sign pattern indicates a consistent negative effect of impatience on search intensity. The magnitude of the coefficients is again important: a two standard deviation difference in the aggregate impatience measure is associated with a 17 percent increase in the number of search methods used. This effect is similar in magnitude to the effect of human capital variables: 4 years of education raise search effort by 21 percent.

Effects of search and reservation wages on the exit rate. We now investigate whether the correlations between search effort and the exit rate, and between reservation wages and the exit rate can shed light on the form of intertemporal preferences. If workers differ in their (partially unobservable) degree of short-run patience β, but are otherwise homogeneous, then we should observe a strong positive correlation between search effort and the exit rate. All else

[26] We also estimated the model by OLS and the results did non differ substantially.

equal, workers with a high degree of short-run patience (high β) search more intensively and exit more frequently than their impatient counterparts (low β workers). On the other hand, we expect essentially no correlation between reservation wages and the exit rate since variation in β has only a small effect on reservation wages. Consider now the exponential model. If workers differ in their degree of long run patience δ, both correlations should be negative: patient (high δ) workers search more intensively and have higher reservation wages. Since the reservation wage effect dominates, they have lower exit rates.

We link search effort and reservation wages for workers who were unemployed at the time of the NLSY interview with the subsequent duration of unemployment spells. Table 9 presents the correlation between search effort and the exit rate, and between the reservation wage and the exit rate using a Cox proportional hazard model. Search effort, as measured by the number of different methods of search used, is strongly positively correlated with the exit rate: the exit rate increases by 9 to 12 percent for every additional method of search used. On the other hand, the correlation between reservation wages and the exit rate is essentially indistinguishable from zero: a 10 percent increase in the reservation wage lowers the exit rate by only 0.4 percent in the model with controls. Once again, the empirical findings suggest that the impatience measures capture short-run discounting for hyperbolic agents.

5.3 Other potential explanations

The first row of Table 10 summarizes the empirical results. The impatience measures are negatively correlated with exit rates from unemployment and with search effort. In addition, they are essentially orthogonal to reservation wages and acceptance probability. These results are consistent with a model of heterogeneity in short-run discounting (variation in β), and inconsistent with a model of heterogeneity in long-run discounting (variation in δ). Furthermore, heterogeneity in human capital (variation in the location of the wage distribution μ) does not seem to explain the results. We now review four other interpretations of the impatience proxies that could potentially rationalize the empirical findings.

The measures of impatience may be capturing a high taste for leisure — consider, for instance, frequency of hangover — or low search productivity, as may be the case for impatience during the interview. The measures may also reflect bad attitudes of workers that translate into a narrow set of potential wage offers, or high layoff probabilities: smoking and alcohol consumption are two examples. We therefore study the effect on job search outcomes of variation in the utility of leisure b, the productivity of search λ[27], the dispersion σ (as measured by mean

[27] We denote by s the search effort and by λs the resulting probability of finding a job in any period. Increases

preserving spreads) of the wage distribution, and the probability of layoff q.

The bottom part of Table 10 summarizes the comparative statics results with respect to these variables.[28] A definite sign indicates an effect of known direction. A sign in parenthesis indicates that, although the effect is a priori ambiguous, a broad set of simulations yields a consistent sign.

We first test the leisure explanation. High utility of leisure b is associated with high reservation wages. Individuals that enjoy spare time require a high wage in order to go back to work. This contrasts with the empirical finding of no significant effect of our measures of impatience on the reservation wage. Similarly, the data reject also the alternative story that individuals have both lower human capital μ and higher utility of leisure b. If this were true, we should find that higher impatience measures are associated with *lower* acceptance probability, against our findings of zero correlation (and positive correlation without controls).

The other three stories have similar implications. Individuals with low productivity of search λ, low dispersion of wage offers σ, or high probability of layoff q exhibit both low search effort and low reservation wages. The search effect, however, is second order relative to the reservation wage effect, so that these individuals have a higher exit rate, contrary to our empirical findings. The intuition for these results is clear. In general, the reservation wage effect prevails since even small differences in future wages have a larger impact on lifetime utility than a difference of a week or two in the length of the unemployment spell. The exception to this pattern is the response to short-run impatience, since in this case only the trade-off between today and tomorrow matters.

In conclusion, variation in the short-run impatience parameter β can explain in a unified manner all of the empirical correlations, while other economic explanations have difficulties in rationalizing at least one finding. It is still possible that the proxies are capturing a combination of the above stories, so that the global effect mirrors that predicted by variation in β. Nevertheless, the parsimony of this explanation lends it considerable appeal.

in productivity are associated with higher probabilities of finding a job for given search effort. Increases in productivity may occur because firms are more interested in hiring workers which do not display impatient behavior.

[28]The results are straightforward and can be obtained along the lines of Proposition 3. A set of proofs as well as simulations can be obtained from the authors upon request. Interestingly, none of the results depend on the form of intertemporal preferences.

5.4 A calibration

So far we have argued that the qualitative effects of impatience on job search outcomes are best explained by variation of short-run discounting for individuals with hyperbolic time preferences. Can we also match the magnitudes of the effects? We present a simple calibration in the bottom panel of Table 1 to address this question. We assume that workers are either patient or impatient and that patient workers have exponential preferences with yearly discount factor δ equal to 0.95. We take as given the empirical differential in exit rates between patient and impatient workers, and then compute the value of β for impatient workers that matches this differential.[29]

The calibration provides reasonable estimates on two accounts. First, the estimates of the short-run discount factor β_{imp} are mostly close to 0.9, a value compatible with the experimental evidence of time preferences.[30] Second, the calibrated acceptance probabilities for the patient and the hyperbolic impatient worker are (almost) identical. This follows from Proposition 2 – the reservation wage effect for hyperbolic individuals is either null (naïves) or very close to zero (sophisticates). This theoretical result fits nicely with the empirical findings in Section 5.1: the measures of impatience are orthogonal to the probability of acceptance.

6 Conclusion

In this paper we have addressed theoretically and assessed empirically the effects of impatience on job search. Within a model with endogenous search effort and a reservation wage decision, differences in impatience have two effects. More impatient individuals search less intensively and set a lower reservation wage. The effect of impatience on the exit rate depends on the relative strength of the two contrasting forces: lower search implies lower exit rates, while a lower reservation wage implies higher exit rates.

If individuals differ in the exponential discount rate, then for sufficiently patient individuals the reservation wage effect is stronger than the search effect. Therefore workers with higher discount rates exit unemployment faster. Instead, if individuals have hyperbolic preferences and differ in the short-run discount rate, the search effect dominates, and more impatient

[29] The average exit rate for individuals with average characteristics in the top quartile of the aggregate impatience measure (see Section 3.2) is 0.0604. The average exit rate for individuals in the bottom quartile is 0.0781.

[30] For example, our calibration of a hyperbolic discounting model to the experimental results in Benzion, Rapoport and Yagil (1989) yields estimates of a weekly β ranging between 0.85 and 0.96.

workers exit unemployment later. Therefore, the correlation between impatience and the exit rate should be positive if individuals differ in the exponential discount rate, but should be negative if individuals have hyperbolic preferences and they differ in the short-term discount factor. The latter finding would suggest that at least individuals with higher measured impatience have hyperbolic time preferences. The two hypotheses also make predictions about the magnitude of the effect of impatience on search effort, reservation wages, and reemployment wages.

In the empirical section, we find that, even after controlling for a large set of background characteristics, measures of impatience are negatively correlated with the exit rate. The size of the effect is economically significant and comparable to that of human capital variables. The impatience measures are also negatively correlated with search intensity. The effect on reservation wages, re-employment wages, and acceptance probability is essentially zero. The latter result suggests that the impatience measures are not capturing exclusively unobservable human capital. Similarly, the impatience proxies do not appear to reflect heterogeneity in any other single parameter of the model. The combined evidence supports the view that impatience has a large effect on job search outcomes in the direction predicted by the hyperbolic discounting model.

Nevertheless, we recognize that there can be alternative explanations for our empirical results. First, the impatience proxies are admittedly imperfect. While no single alternative interpretation of these proxies fits all the results, these proxies may capture a combination of variables (such as taste for leisure, human capital, and search cost) that overall can explain our results. Second, there is substantial measurement error in job search variables such as self-reported reservation wages. Unfortunately, this reduces the precision of the conclusions that can be drawn from the results. Finally, the model makes simplifying assumptions such as lack of on the job search and inability to borrow. It will be interesting to consider in the future whether removing some of these assumptions can bring the standard model closer to fitting the data. Overall, we hope that this paper stimulates interest in the role of intertemporal preferences in the job search process, and that future research addresses the open questions above.

The empirical support for hyperbolic time preferences has implications for labor market policies. For hyperbolic workers the difference between desired and actual search effort can be substantial. This identifies a new channel through which job search programs can operate, by reducing the short-term costs that undermine the success of search. In particular, direct assistance that forces the worker to go through the most unpleasant steps of the search process is likely to be beneficial. The evidence from randomized job search experiments seems supportive of this hypothesis: according to Meyer (1995), the most successful programs were characterized by direct involvement of the workers. Another potentially effective policy is one that closely monitors workers' search behavior (Paserman, 2004). The evidence on the actual effectiveness of such policies is mixed (Ashenfelter et al., 1999; van den Berg et al., 2004).

The results have also implications for the behavior of firms. In a labor market populated by hyperbolic workers, profit-maximizing firms should offer a signing bonus to job applicants: the immediate cash payment would offset the short-run search costs and constitute a strong incentive for workers to accept the job. Firms could make up for the additional costs by reducing the level of wages. Additionally, firms may try to reduce the direct costs of filing applications. Large retailers in the United States have set up interactive kiosks where potential job applicants can submit their résumés and schedule interviews at low cost. If modest costs represent a barrier to search for hyperbolic workers, then streamlining of the job application process may induce them to search more.

A Appendix A: Mathematical Section

Define $Q(x) \equiv \int_x^{\overline{x}} (u-x)dF(u)$. We introduce the following technical assumptions**:**

A1. Bounded discount factor δ. There exists a $\overline{\delta}$ such that $\delta \leq \overline{\delta} < 1$.

A2. Conditions on search costs. We assume $c'(0) < \beta\delta Q(b) / (1-\delta(1-q)) < c'(1)$.

A3. Low utility of leisure. We require $b < \overline{x}$.

Definition 1 *A Markov strategy for self t is a choice of* $(s_t, w_t^*) \in [0,1] \times R_+$.

The following Proposition characterizes Markov perfect equilibria for a sophisticated agent (an exponential individual is a particular case with $\beta = 1$).

Proposition A.1 *(Markov Perfect Equilibrium) The sequence* $\{(\sigma_t, \omega_t^*)\}_{t\geq 0}$ *of Markov strategies is a Markov perfect equilibrium for a sophisticated agent with impatience parameters* β *and* δ *if and only if there exists a sequence of continuation payoffs* $\{V_t^U\}_{t\geq 0}$ *such that*

$$\omega_t^* = (1-\delta(1-q))\left[V_{t+1}^U - \delta q\left(\sum_{s=0}^{\infty}\delta^s(1-q)^s V_{t+s+2}^U\right)\right], \tag{9}$$

$$\sigma_t = \arg\max_{s\in[0,1]} b - c(s) + \frac{\beta\delta}{1-\delta(1-q)}\left[(1-\delta(1-q))V_{t+1}^U + sQ(\omega_t^*)\right] \tag{10}$$

and the continuation payoff satisfies

$$V_t^U = b - c(\sigma_t) + \frac{\delta}{1-\delta(1-q)}\left[(1-\delta(1-q))V_{t+1}^U + \sigma_t Q(\omega_t^*)\right] \tag{11}$$

for all $t \geq 0$.

Proof. We first prove (9). Using iterated substitution of $V_s^E(w)$ in expression (3), we obtain

$$V_t^E(w) = \frac{w + q\delta\overline{V}_t^U}{1-\delta(1-q)} + \lim_{T\to\infty}\delta^T(1-q)^T V_{t+T}^E(w). \tag{12}$$

Given the assumption of bounded per-period payoffs, the last term is equal to 0. In a Markov perfect equilibrium, it is easy to see that the optimal acceptance policy is a reservation wage strategy. The worker accepts any offer higher than the reservation wage ω_t^*, which is defined as the wage w that equates V_{t+1}^U and $V_{t+1}^E(w)$. This generates expression (9). Consider now expression (10): the maximization problem in (2) can be rewritten as

$$\sigma_t = \arg\max_{s\in[0,1]} b - c(s) + \beta\delta\left[s\int_{\omega_t^*}^{\bar{x}} V_{t+1}^E(u)dF(u) + sF(\omega_t^*)V_{t+1}^U + (1-s)V_{t+1}^U\right].$$

Using expression (12) for $V_{t+1}^E(w)$ and the identity $1-F(x) = \int_x^{\bar{x}} dF(u)$, it follows that

$$\sigma_t = \arg\max_{s\in[0,1]} b - c(s) + \beta\delta\left[V_{t+1}^U + s\int_{\omega_t^*}^{\bar{x}}\left(\frac{u + q\delta\overline{V}_{t+1}^U}{1-\delta(1-q)} - V_{t+1}^U\right)dF(u)\right].$$

Expression (10) follows substituting for the value of V_{t+1}^U from (9). As for (11), this is just the continuation payoff for self $t-1$ from period t on. Finally, by strict convexity of $c(\cdot)$, ω_t^* and σ_t are uniquely defined for a given $\{V_s^U\}_{s\geq t+1}$. ■

The next Proposition characterizes Markov perfect equilibria for a naïve agent.

Proposition A.2 *The sequence* $\{(\sigma_t^n, \omega_t^{n*})\}_{t\geq 0}$ *of Markov strategies is a Markov perfect equilibrium for a naive agent with impatience parameters* β *and* δ *if and only if, given the Markov perfect equilibrium solution* $\{(\sigma_t^e, \omega_t^{e*})\}_{t\geq 0}$ *and the associated continuation payoff* $\{V_t^{U,e}\}_{t\geq 0}$ *for an exponential agent with impatience parameter* δ,

$$\begin{aligned} \omega_t^{n*} &= \omega_t^{e*}, \\ \sigma_t^n &= \arg\max_{s\in[0,1]} b - c(s) + \frac{\beta\delta}{1-\delta(1-q)}\left[(1-\delta(1-q))\, V_{t+1}^{U,e} + sQ\left(\omega_t^{e*}\right)\right]. \end{aligned}$$

for all $t \geq 0$.

Proof. Follows from the definition of equilibrium for a naïve worker since $V_{t+1}^{U,n} = V_{t+1}^{U,e}$. ■

Proof of Theorem 1. We prove the result for sophisticated agents (for the exponential case, set $\beta = 1$). The equilibrium for naïve agents can be easily characterized along the lines of Proposition A.2 using the equilibrium strategies for an exponential agent. By the stationarity assumption, $V_{t+s}^U = V^U$ for all $s \geq 1$. Therefore, expressions (9) and (10) simplify to

$$\begin{aligned} \omega_t^* &= (1-\delta)V^U, \\ \sigma_t &= \arg\max_{s\in[0,1]} b - c(s) + \frac{\beta\delta}{1-\delta(1-q)}\left[(1-\delta(1-q))\, V^U + sQ\left((1-\delta)V^U\right)\right]. \end{aligned}$$

Define $B = [b_1, b_2] \subset \mathbb{R}$ where $b_1 \equiv b/(1-\delta)$ and $b_2 \equiv b_1 + \delta Q(b)/[(1-\delta)(1-\delta(1-q))] \geq b_1$. Define $\Lambda : R \to R$ as follows:

$$\begin{aligned} \sigma\left(V^U\right) &\equiv \arg\max_{s\in[0,1]} b - c(s) + \frac{\beta\delta}{1-\delta(1-q)}\left[(1-\delta(1-q))\, V^U + sQ\left[(1-\delta)\, V^U\right]\right], \quad (13) \\ \Lambda(V^U) &\equiv b - c\left[\sigma\left(V^U\right)\right] + \frac{\delta}{1-\delta(1-q)}\left[\begin{array}{c} (1-\delta(1-q))\, V^U + \\ \sigma\left(V^U\right) Q\left[(1-\delta)\, V^U\right] \end{array}\right]. \quad (14) \end{aligned}$$

We introduce and prove a Claim regarding Λ that we use below.

Claim 1. The function $\Lambda(\cdot)$ defined by (13) and (14) maps B into B.

Proof of Claim 1. We first prove $\Lambda\left(V^U\right) \geq b_1$ for $V^U \geq b_1$. Consider the functions $D(s) \equiv -c(s) + s\delta Q\left[(1-\delta)\, V^U\right]/(1-\delta(1-q))$ and $B(s) \equiv -c(s) + s\beta\delta Q\left[(1-\delta)\, V^U\right]/(1-\delta(1-q))$. Clearly, $D(s) \geq B(s)$ for all $s \in [0,1]$. Notice that $\sigma(V^U) = \arg\max_{s\in[0,1]} B(s)$. Since $B(0) = 0$ and $s = 0$ can always be chosen, $B(\sigma(V^U)) \geq 0$ by optimality of $\sigma(V^U)$. Therefore, $D(\sigma(V^U)) \geq B(\sigma(V^U)) \geq 0$. It follows that, for $V^U \geq b_1$, $\Lambda(V^U) = b + \delta V^U + D\left(\sigma\left(V^U\right)\right) \geq b_1 + 0$, which is what we wanted to prove.

We now prove that $\Lambda\left(V^U\right) \leq b_2$ for $V^U \leq b_2$. By $\partial\Lambda(V^U)/\partial V^U \leq \delta$ and $\Lambda(b_1) \leq b_1 + \delta Q(b)/(1-\delta(1-q))$, we can derive $\Lambda\left(V^U\right) \leq b_1 + \delta V^U + \delta Q(b)/(1-\delta(1-q)) \equiv L(V^U)$.

In order to find the upper bound b_2, we solve the equation $L(b_2) = b_2$ which yields $b_2 = b_1 + \delta Q(b) / [(1-\delta)(1-\delta(1-q))] > b_1$. This implies $\Lambda(V^U) \leq L(V^U) \leq b_2$ for every $V^U \in B$, which is the second desired bound. ■

A stationary Markov perfect equilibrium satisfies $\Lambda(V^U) = V^U$. Hence, there is a one-to-one correspondence between the set of stationary Markov perfect equilibria and the fixed points of the function $\Lambda(\cdot)$. We now prove that a fixed point of $\Lambda(\cdot)$ exists and is unique. We first show $d\Lambda(V)/dV^U \leq \delta < 1$. By strict convexity and differentiability of $c(\cdot)$, and absolute continuity of the wage offer distribution $F(\cdot)$, $\Lambda(\cdot)$ is a differentiable function of V^U. Differentiating (14) with respect to $\sigma(V^U)$ and using the first order conditions for (13), we get

$$\begin{aligned}\frac{\partial\Lambda(V^U)}{\partial\sigma(V^U)} &= -c'\left[\sigma\left(V^U\right)\right] + \frac{\delta}{1-\delta(1-q)}Q\left[(1-\delta)V^U\right] \\ &= \frac{\delta(1-\beta)}{1-\delta(1-q)}Q\left[(1-\delta)V^U\right] > 0. \end{aligned} \tag{15}$$

We can use (15) to compute the derivative of $\Lambda(\cdot)$ with respect to V^U:

$$\frac{d\Lambda(V^U)}{dV^U} = \frac{\partial\Lambda(V^U)}{\partial\sigma(V^U)}\frac{\partial\sigma\left(V^U\right)}{\partial V^U} + \delta\left[1-\sigma\left(V^U\right)\frac{1-\delta}{1-\delta(1-q)}\left\{1-F\left[(1-\delta)V^U\right]\right\}\right] \tag{16}$$

where we use $Q'(x) = -(1-F(x))$. Since $\partial\sigma(V^U)/\partial V^U$ is negative and $\partial\Lambda(V^U)/\partial\sigma(V^U)$ is positive, $d\Lambda(V^U)/dV^U \leq \delta < 1$.

Claim 1 proves that $\Lambda(\cdot)$ maps B into B. Hence, $\Lambda(\cdot)$ is a continuous function from a compact subset of R into itself. This implies that $\Lambda(\cdot)$ has at least one fixed point. Moreover, since $d\Lambda(V^U)/dV^U \leq \delta < 1$, such fixed point is unique for $V \subseteq B$. Finally, it is easy to see that $V^U < b_1$ implies $\Lambda(V^U) > V^U$ and that $V^U > b_2$ implies $\Lambda(V^U) < V^U$. Therefore, no other fixed point exists for $\Lambda(V^U)$. ■

Proof of Proposition 1. Consider the expression maximized in (13), which is the net present utility U of all the selves of a sophisticated hyperbolic agent (recall that the setting is stationary). Consider the effect of a marginal deviation of the search level from the optimal one $\sigma^s(\beta,\delta)$. The effect on U is

$$\frac{dU}{ds} = \frac{\partial U}{\partial s} + \beta\delta\frac{\partial V^U}{\partial s}\left[1 - s\frac{1-\delta}{1-\delta(1-q)}[1-F((1-\delta)V^U)]\right]$$

where the first term is 0 by the first order condition and the second term is positive since $\partial V^U/\partial s > 0$, as shown in (15). Therefore, a small increase in the search effort increases U. ■

The comparative statics results for the sophisticated worker follow from straightforward differentiation of the system of implicit equations defining the stationary Markov perfect equilibrium (see Proposition A.1):

$$\begin{aligned} 0 &= w^* + c(s) - b - \frac{\delta s}{1-\delta(1-q)}Q(w^*), \\ 0 &= c'(s) - \frac{\beta\delta}{1-\delta(1-q)}Q(w^*). \end{aligned} \tag{17}$$

Proof of Proposition 2 (Search and reservation wage). (a) The system above yields the following result for sophisticated individuals (and therefore for exponential individuals when $\beta = 1$):

$$\begin{aligned}
\frac{ds}{d\beta} &= C\left(1+\frac{\delta s\left(1-F\left(w^{*}\right)\right)}{1-\delta(1-q)}\right)\left(\frac{\delta}{1-\delta(1-q)}Q\left(w^{*}\right)\right)>0, \\
\frac{ds}{d\delta} &= C\frac{\beta}{\left(1-\delta(1-q)\right)^{2}}Q\left(w^{*}\right)>0.
\end{aligned} \tag{18}$$

where

$$C^{-1}=(1-\beta)\frac{\beta\delta^{2}\left(1-F\left(w^{*}\right)\right)}{\left(1-\delta(1-q)\right)^{2}}Q\left(w^{*}\right)+c''\left(s\right)\left(1+\frac{\delta s\left(1-F\left(w^{*}\right)\right)}{1-\delta(1-q)}\right)>0.$$

Similarly, (b) and (c) for sophisticated agents yield

$$\begin{aligned}
\frac{dw^{*}}{d\beta} &= C\left(1-\beta\right)\left(\frac{\delta}{1-\delta(1-q)}\right)^{2}Q\left(w^{*}\right)^{2}\geq 0 \qquad \text{and } \frac{dw^{*}}{d\beta}>0 \text{ for } \beta<1, \\
\frac{dw^{*}}{d\delta} &= C\beta\left(1-\beta\right)\frac{\delta Q\left(w^{*}\right)^{2}}{\left(1-\delta(1-q)\right)^{3}}+C\frac{sc''\left(s\right)}{\left(1-\delta(1-q)\right)^{2}}Q\left(w^{*}\right)>0.
\end{aligned} \tag{19}$$

The proofs of (a), (b) and (c) for naïve agents are a straightforward consequence of equations (6) and (7) in the text. ■

Proof of Proposition 3 (β impatience). Part (a) is a straightforward consequence of Proposition 2. For Part (b),

$$\begin{aligned}
\frac{dh}{d\beta} &= \left[1-F\left(w^{*}\right)\right]\frac{ds}{d\beta}-sf\left(w^{*}\right)\frac{dw^{*}}{d\beta} \\
&= C\left[1-F\left(w^{*}\right)\right]\left(1+\frac{\delta s\left(1-F\left(w^{*}\right)\right)}{1-\delta(1-q)}\right)\left(\frac{\delta}{1-\delta(1-q)}Q\left(w^{*}\right)\right)+ \\
&\quad -Csf\left(w^{*}\right)\left(1-\beta\right)\left(\frac{\delta}{1-\delta(1-q)}\right)^{2}Q\left(w^{*}\right)^{2}= \\
&= \frac{C\delta Q\left(w^{*}\right)}{1-\delta(1-q)}\left[\left[1-F\left(w^{*}\right)\right]+\frac{\delta s\left[1-F\left(w^{*}\right)\right]^{2}}{1-\delta(1-q)}\left(1-\left(1-\beta\right)\frac{f\left(w^{*}\right)Q\left(w^{*}\right)}{\left[1-F\left(w^{*}\right)\right]^{2}}\right)\right]
\end{aligned}$$

and the result follows from the observation that

$$\frac{\partial}{\partial w^{*}}E\left(W\mid W>w^{*}\right)=\frac{\partial}{\partial w^{*}}\int_{w^{*}}^{\infty}\frac{udF\left(u\right)}{1-F\left(w^{*}\right)}=\frac{f\left(w^{*}\right)Q(w^{*})}{\left[1-F\left(w^{*}\right)\right]^{2}}. \blacksquare$$

Log-concavity of W is a sufficient condition for Proposition 3 to hold, since it implies $0 \leq \frac{\partial}{\partial w^{*}}E\left(W\mid W>w^{*}\right)\leq 1$, a result originally proved by Chamberlain and shown in Heckman and Honoré (1990).

Recall the definitions $\eta\left(s\right)\equiv sc''(s)/c'\left(s\right)$, and $\psi\left(w\right)\equiv f(w)/\left(1-F\left(w\right)\right)$.

Proof of Proposition 4 (δ impatience). We first show the result for sophisticated hyperbolic workers. Using (18) and (19), we get

$$\begin{aligned} \frac{dh}{d\delta} &= [1-F(w^*)]\frac{ds}{d\delta} - sf(w^*)\frac{dw^*}{d\delta} = \\ &= [1-F(w^*)]\,C\frac{\beta}{(1-\delta(1-q))^2}Q(w^*) + \\ &\quad -sf(w^*)\,C\beta(1-\beta)\frac{\delta Q(w^*)^2}{(1-\delta(1-q))^3} - C\frac{c''(s)s^2 f(w^*)}{(1-\delta(1-q))^2}Q(w^*) = \\ &= \frac{CQ(w^*)[1-F(w^*)]\,sc'(s)}{(1-\delta(1-q))^2}\begin{bmatrix} 1/[w^*-b+c(s)] + \\ -(1-\beta)\psi(w^*) - \psi(w^*)\eta(s) \end{bmatrix} \end{aligned} \tag{20}$$

where in the last equation we use the first order condition for search (17) and

$$c'(s)\,s = \beta(w^*-b+c(s)).$$

The strategy of the proof is to show that there exists a $\bar{q}>0$ such that for $q\in[0,\bar{q}]$ the second and third term dominate over the first for δ close to 1; therefore, the exit rate is eventually decreasing in δ.

Define $s(q,\delta)$ the search level chosen for layoff parameter q and long-run patience δ. Consider a discount factor $\underline{\delta}<1$ such that $\underline{s}\equiv s(0,\underline{\delta})>0$. Its existence is ensured by the conditions guaranteeing interior solutions.

Claim 1. There exists a level $\overline{w}$ with $(\overline{x}+b)/2<\overline{w}<\overline{x}$ such that, for $s>\underline{s}$ and $w>\overline{w}$, $\psi(w)\eta(s)>1/[w-b+c(s)]$.

Proof. Consider first the function $\eta(s)=sc''(s)/c'(s)$. The properties $c'>0$ and $c''>0$ imply that η is positive and bounded away from 0 for $s>\underline{s}$: there exists an $\underline{\eta}>0$ such that $\eta(s)\geq\underline{\eta}$ for $s>\underline{s}$. Turning to $\psi(w)=f(w)/(1-F(w))$, we can observe that, as w converges to $\overline{x}$, $F(w)$ converges to 1 and therefore, since $f>0$, the failure rate $\psi(w)$ diverges to $+\infty$. Therefore, using the fact that $\psi(w)$ can be made arbitrarily large, we know there exists a $\widetilde{w}<\overline{x}$ such that, for $s>\underline{s}$ and $w>\widetilde{w}$, $\psi(w)\eta(s)>\psi(w)\underline{\eta}>2/(\overline{x}-b)$. We can then take $\overline{w}=\max(\widetilde{w},(\overline{x}+b)/2)$ to conclude that, for $s>\underline{s}$ and $w>\overline{w}$, $\psi(w)\eta(s)>2/(\overline{x}-b)>1/[w-b+c(s)]$ (we use the fact that, for $w>(\overline{x}+b)/2$, $w-b+c(s)>w-b>(\overline{x}-b)/2$). Q.E.D.

Claim 2. There exist a $\overline{q}>0$ and a δ^* satisfying $\underline{\delta}<\delta^*<1$ such that both $w^*(\overline{q},\delta)>\overline{w}$ and $s(\overline{q},\delta)>\underline{s}$ hold for $\delta\geq\delta^*$.

Proof. A straightforward consequence of equation (11) is that

$$Q(w^*(q,\delta)) = \frac{1-\delta(1-q)}{\delta s(q,\delta)}(w^*(q,\delta)-b+c(s(q,\delta))).$$

For fixed $q>0$ the fraction $(1-\delta(1-q))/\delta s(q,\delta)$ converges to $q/s(q,\delta)$ as $\delta\to1$. Therefore, for $\delta=1$, we have $Q(w^*(q,1))=(w^*(q,1)-b+c(s(q,1)))\cdot q/s(q,1)\leq(\overline{x}-b+C)\cdot q/s(q,1)$ where $C=c(1)$. Moreover, one can prove that $s(q,1)$ is a decreasing function of q and therefore that $q/s(q,1)$ is an increasing function of q. Therefore, by choosing a layoff probability q close to 0, it is possible to make $q/s(q,1)$ arbitrarily small. It follows that we can pick a $\overline{q}>0$ such that both $(\overline{x}-b+C)\cdot\overline{q}/s(\overline{q},1)<Q(\overline{w})$ and $s(\overline{q},1)>\underline{s}$. By the above chain of inequalities,

$Q\left(w^*(\overline{q},1)\right) < Q(\overline{w})$. We know that $Q\left(w^*(\overline{q},\delta)\right)$ is a decreasing and continuous function of δ, since Q is decreasing and continuous in its argument and w^* is increasing and continuous in δ; moreover, s is continuous in δ. Therefore, there will be a discount factor δ^* with $\underline{\delta} < \delta^* < 1$ that guarantees that, for $\delta \geq \delta^*$, both $Q\left(w^*(\overline{q},\delta)\right) < Q(\overline{w})$ and $s(\overline{q},\delta) > \underline{s}$ hold. By monotonicity of Q we obtain $w^*(\overline{q},\delta) > \overline{w}$, which is what we wanted to prove. Q.E.D.

Claim 3. There exist a $\overline{q} > 0$ and a δ^* satisfying $\underline{\delta} < \delta^* < 1$ such that both $w^*(q,\delta) > \overline{w}$ and $s(q,\delta) > \underline{s}$ hold for $\delta \geq \delta^*$ and $q \leq \overline{q}$.

Proof. This fact can be established along the same lines of Claim 2, using the property that $q/s(q,\delta)$ is an increasing function of q. Q.E.D.

Claim 1 and Claim 3 together establish that there exists a $\overline{q} > 0$ and some $\delta^* < 1$ such that, for $q \leq \overline{q}$ and $\delta \geq \delta^*$, the expression in brackets in (20) is negative. Therefore, for $q \leq \overline{q}$ and $\delta \geq \delta^*$, $\partial h/\partial \delta$ is negative. This proves the Proposition for the sophisticated individuals, including exponential individuals as a special case. The proof for a naïve individual follows from the observation that $w^{n*}(\beta,\delta) = w^{e*}(\delta)$.

In order to prove (b), recall from Proposition 2 that s and w^* are increasing in δ. Under the assumption that both ψ and η are increasing functions, the bracketed term in (20) is a decreasing function of δ. Consider also that the exit rate is 0 for $\delta = 0$ since the optimal search in this case is 0. Therefore, for δ small enough the exit rate must be increasing in δ. Combining this argument with part (a), we obtain the desired conclusion. ■

B Appendix B: Data Description and Variable Construction

Unemployment Spells in the PSID. Our sample is similar to the one in Katz (1986) and Katz and Meyer (1990). Between 1981 and 1983, PSID heads of household were asked to provide detailed information on the length and on other characteristics of up to three unemployment spells contained at least in part in the previous calendar year. For every individual, we consider only the last unemployment spell mentioned at each interview. An unemployment spell makes it into our sample only if the respondent was a male head of household, between 20 and 65 years of age at the time of the interview. In order to maximize sample size, we retain more than one unemployment spell per individual when it is possible to determine with certainty (using self-reported information on the year the spell began) that a given spell is not the same as a previously mentioned one.

Unemployment Spells in the NLSY. We use the NLSY Work History files to construct a week by week account of every worker's labor force status from 1978 to 1996. At each interview, NLSY respondents were asked to report up to 10 employers they had since the date of the last interview (only 5 employers were retained in the public use files), up to 6 periods in which they were not working between jobs (between-job non-employment spells), and up to 4 periods during their tenure with one employer in which they were temporarily not working (within-job non-employment spells). For each non-employment spell (both between-job and within-job), respondents were asked whether they looked for work during all of the period, during part of the period, or whether they did not look at all. Our benchmark measure of unemployment spells is constructed by assigning an "unemployed" code to every week in a non-employment spell during which at least some search took place; workers who did not look for work because they believed that no work was available were also labeled as unemployed. In Section 4.3 we use a narrower definition of unemployment: a worker is unemployed only in the weeks that actual search took place.

Search Intensity. Between 1980 and 1993, workers who were unemployed at the time of the NLSY interview were asked which methods of search they had used in the past 4 weeks (see Appendix Table 2 for the list of methods). Consistently with the findings of previous studies, the most popular methods are direct contact with employers, looking up ads in newspapers, contact with the state employment service, and contact with friends and relatives. Our measure of search intensity is constructed by simply counting the number of different search methods used, and assigning a value of zero to those who reported having done "nothing" to find a job, and to those who were classified as out of the labor force by the NLSY, but declared that they "would want a job now, either full or part-time." The results are not sensitive to the inclusion of this latter category. In the regressions, we restrict our sample to male workers, neither in school nor in the military, interviewed after 1985.

Reservation Wage. We use data on self-reported reservation wages for select years in the NLSY. Between 1980 and 1986, and then again in 1994, unemployed respondents who were looking for work were asked "what would the wage or salary have to be for you to be willing to take [the job]." We restrict our sample to male workers, neither in school nor in the military, interviewed in 1985, 1986 or 1994 and use the response to this question as the measure of the reservation wage.

Acceptance Probability. In 1981, a detailed questionnaire on search activities was administered to NLSY subjects. Individuals were asked whether they engaged in any search activities in the previous 4 weeks; which methods of search they used, time spent on each method, and whether use of any of the methods resulted in a contact with employer, in a job offer, and in an accepted job offer. For each method that generates a job offer, we record whether the offer was accepted. To ensure that we are only focusing on search when unemployed, we restrict attention to males, neither in school nor in the military, who are unemployed at the time of the interview, or whose tenure at their current job is lower than four weeks.

Factor Analysis. We use factor analysis to create an aggregate measure of impatience derived from the impatience variables. Factor analysis is designed to reproduce the correlations between a set of observed variables ($z_1, ..., z_P$) by describing them as a linear combination of a set of common factors ($F_1, ..., F_Q$, with Q usually much smaller than P) and a unique factor (Y_p) for each variable.

$$z_p = a_{p1}F_1 + a_{p2}F_2 + ... + a_{pQ}F_Q + u_pY_p \qquad (p = 1, 2, ..., P)$$

The common factors account for the correlations among the variables, while each unique factor accounts for the remaining variance of that variable. The coefficients of the common factors are frequently referred to as factor loadings.

We estimate a factor model via maximum likelihood (Harman, 1976, Chapter 10) using the measures of impatience and report its results in Appendix Table 3. Likelihood ratio tests indicated that four factors should be retained in the model, but it was difficult to give a meaningful interpretation to all but the first factor. We therefore retain only the first factor which in the four factor model accounts for more than 50 percent of the variance: all the loadings have a positive sign, so it seems reasonable to interpret this factor as impatience. The uniqueness, reported in the next column, measures the percentage of the variance of each variable that is not explained by the factors. The variables that fit best the factor model are smoking, having a bank account, and use of contraceptives, but the percentage of unexplained variance is high for all the variables. In the last column of the Table we report the scoring coefficients on the individual measures of impatience used to construct the aggregate measure. The variables that receive most weight are smoking, having a bank account, and use of contraceptives, while participation in vocational clubs receives no weight.

C Appendix C: Calibration

We adopt the following assumptions in performing the calibrations in Table 1.

Time unit. We use weekly time units for consistency with the frequency of duration data in the PSID and the NLSY.

Wage distribution. We rely on previous studies of reservation wages in the search literature (Lynch, 1983, van den Berg, 1990) in order to determine the shape and the central moments of the wage offer distribution. We normalize the median of the wage distribution to be equal to 1, and then fix the standard deviation of log wages at 0.19, to match the value estimated in Lynch (1983), a representative study in this literature. We also consider a higher value of the standard deviation, 0.35, our estimate of the NLSY within-individual standard deviation in log weekly wages in two-year intervals. We assume that the wage offer distribution is either log-normal (in the benchmark calibration) or log-uniform (van den Berg, 1990).

Layoff probability. Bowlus (1995) estimates the mean duration of an employment spell for people that were previously unemployed to be around 90 weeks. Since layoffs are responsible for approximately 40 percent of job separations (our own estimates in the NLSY), we assume q equal to $0.4 \times 1/90 = 1/225$ in the benchmark calibration. We also let q equal to $1/100$ to examine the effect of high layoff probabilities.

Benefits. We set benefits b equal to 0.25, a value reflecting the utility of leisure as well as social stigma for non-recipients of unemployment benefits. For robustness purposes, we also present calibrations for b equal to 0 and 0.5.

Cost function. The cost function is characterized by two main features: the curvature and the absolute level of costs. The curvature reflects the extent to which increasing marginal costs set in for increases in s and is captured by the marginal cost elasticity $\eta(s) = sc''(s)/c'(s)$. We employ a power function with constant elasticity $\eta > 0$, $c(s) = ks^{1+\eta}$.

For each combination of utility of leisure, shape and dispersion of the wage distribution, and layoff probability, the parameters k and η are calibrated so as to match the empirical exit rate and acceptance probability of the most patient workers in the NLSY who do not receive UI benefits (i.e., workers in the bottom quartile of the distribution of the aggregate impatience measure). For these workers, the weekly exit rate is 0.0781, and the acceptance probability is 0.54. The resulting values for k are for columns (1) to (6) in Table 1: 27.35 (benchmark case), 22.41, 36.36, 42.17, 28.23, 53.11. The corresponding values for η are: 0.40 (benchmark case), 0.23, 0.63, 0.16, 0.35, 1.38.

D Appendix D: Continuous-Time Framework

The model is written as in Flinn and Heckman (1982). In addition, we incorporate continuous-time hyperbolic discounting. For simplicity we also assume $q = 0$ (no layoff). The value function is written as follows:

$$V = \max_{s,\hat{w}} \frac{[b-c(s)]\Delta t}{1+r\Delta t} + \frac{1-\lambda s\Delta t-\gamma\Delta t}{1+r\Delta t}V + \tag{21}$$
$$+\frac{\lambda s\Delta t}{1+r\Delta t}\left[F(\hat{w})V+\int_{\hat{w}}^{\infty}U(x)\,dF(x)\right]+\frac{\gamma\Delta t}{1+r\Delta t}\alpha W+o(\Delta t).$$

The continuation payoff incorporates the immediate payoffs from unemployment benefits and cost of search. These payoffs are defined in terms of one non-infinitesimal unit of time, say, one week. Therefore, as Δt shrinks, b and c do not change. We define s to be the fraction of one unit of time that an agent spends searching and assume that, over a short period Δt, the probability of finding a job offer is proportional to s, that is, is $\lambda s\Delta t$ for some $\lambda > 0$. The costs of searching $c(s)$ are increasing and concave in the fraction of time spent searching. Similarly, we define w to be the wage for one non-infinitesimal time period.

The second term in expression (21) is the discounted payoff for the case in which the agent does not get a wage offer and the discount function does not drop. These events occur with probability $1-\lambda s\Delta t-\gamma\Delta t$, since the probability that two distinct events occur in interval Δt is negligible and can be written as $o(\Delta t)$. The third component is the continuation payoff for the case in which the agent gets an offer and the discount function does not drop. The agent accepts offers that are higher than the reservation wage $\hat{w}$. We denote by $U(x)$ the net discounted value of an offer x. The next term in expression (21) reflects the presence of hyperbolic discounting. With probability $\gamma\Delta t$ the discount function drops by a factor $\alpha \leq 1$ and the agent does not receive an offer. If the discount function drops, the agent obtains a continuation payoff W, which is different from V since the drop can occur only once. Notice that if $\gamma = 0$ or $\alpha = 1$ we are back to the standard time-consistent discounting.

After some simplifications and after multiplying by $(1 + r\Delta t)$ and simplifying V, we can rewrite expression (21) as follows:

$$r\Delta tV = \max_{s,\hat{w}}[b-c(s)]\Delta t-\gamma\Delta tV+$$
$$+\lambda s\Delta t\left[\int_{\hat{w}}^{\infty}(U(x)-V)\,dF(x)\right]+\gamma\Delta t\alpha W.$$

We can then simplify Δt to get

$$rV=\max_{s,\hat{w}} b-c(s)+\lambda s\left[\int_{\hat{w}}^{\infty}(U(x)-V)\,dF(x)\right]+\gamma[\alpha W-V] \tag{22}$$

We now solve for U and W. The continuation payoff W is the continuation payoff from the point of view of the future self once the drop in discounting has already occurred. Formally,

$$W=[b-c(s^*)]\frac{\Delta t}{1+r\Delta t}+\frac{1}{1+r\Delta t}W+\frac{\lambda s^*\Delta t}{1+r\Delta t}\left[\int_{w^*}^{\infty}\left(\frac{x}{r}-W\right)dF(x)\right]$$

where s^* and w^* are the solutions for s and $\hat{w}$ in program (22). We solve for W to get

$$W=\frac{1}{r+\lambda s^*(1-F(w^*))}\left[b-c(s^*)+\lambda s^*\int_{w^*}^{\infty}\frac{x}{r}dF(x)\right]. \tag{23}$$

The function $U(x)$ is the discounted value of a wage offer x. The discounting function U satisfies the equation $rU(x)\Delta t = x\Delta t + \gamma \Delta t \left[\alpha \frac{x}{r} - U\right]$, that is, the flow in $U(x)$ equals the wage $x\Delta t$ plus the probability $\gamma\Delta t$ that the increased discounting occurs and the continuation payoff changes from U to $\alpha x/r$. We can solve this equation to get

$$U(x) = \frac{r+\gamma\alpha}{r+\gamma}\frac{x}{r}. \tag{24}$$

We also know that the reservation wage w^* is defined as the wage that makes the agent indifferent between accepting and rejecting, that is, $U(w^*) = V$. Using (24), we obtain

$$V = \frac{r+\gamma\alpha}{r+\gamma}\frac{w^*}{r}. \tag{25}$$

We can use expression (22) to obtain the first order condition for s^*:

$$c'(s^*) = \lambda\left[\int_{\hat{w}}^{\infty}(U(x)-V)\,dF(x)\right] = \lambda\frac{r+\gamma\alpha}{(r+\gamma)\,r}\left[\int_{w^*}^{\infty}(x-w^*)\,dF(x)\right] \tag{26}$$

where the second equality follows from substituting the expressions for $U(x)$ and V. Expression (26) provides the solution for s^* as a function of w^*. We now derive the second equation that closes the model. One can solve for V from (22) to get

$$V = \frac{1}{r+\lambda s^*(1-F(w^*))+\gamma}\left[b - c(s^*) + \lambda s^*\frac{r+\gamma\alpha}{r+\gamma}\int_{w^*}^{\infty}\frac{x}{r}dF(x) + \gamma\alpha W\right] \tag{27}$$

and the desired equation comes from coupling this with expressions (25) for V and (23) for W. We now consider the solution for the instantaneous discounting case ($\gamma \to \infty$). This assumption leads to the following two equations:

$$\frac{c'(s)}{\lambda} = \frac{\alpha}{r}\int_{w^*}^{\infty}(x-w^*)\,dF(x) \tag{28}$$

from (26) and

$$\alpha\frac{w^*}{r} = \alpha\frac{1}{r+\lambda s^*(1-F(w^*))}\left[b - c(s^*) + \lambda s^*\int_{w^*}^{\infty}\frac{x}{r}dF(x)\right]$$

from (27). This implies

$$b - c(s^*) + \frac{\lambda s^*}{r}\int_{w^*}^{\infty}(x-w^*)\,dF(x) = w^*. \tag{29}$$

Equations (28) and (29) are the equivalent of the system of equations (17), with the only differences that α replaces β, the discount rate r replaces the discount factor δ according to $\delta = 1/(1+r)$, and an additional parameter λ appears in equation (28). Since we can substitute α and r with β and δ and we can set $\lambda = 1$, we are back to the same system of equations that defines the discrete-time framework. Given the fact that in continuous time search effort s belongs to the set $[0,\infty)$, rather than to the set $[0,1]$, we replace Assumption A2 with the correspondent Assumption A2'.

Assumption A2'. We assume that there exists a $S > 0$ such that $c'(0) < (\alpha/r)\,Q(b) < c'(S)$.

Given this, Propositions 2, 3 and 4 apply in the continuous-time framework as well, with an obvious adjustment for the fact that the layoff probability q equals 0.

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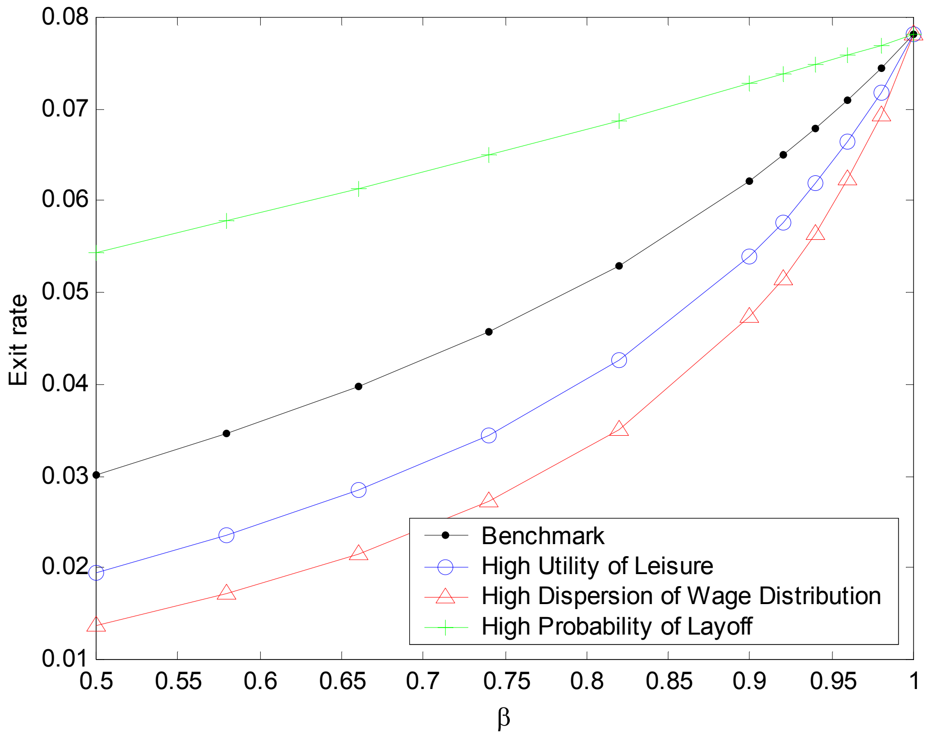

Figure 1a: Exit Rate and Short-Run Patience

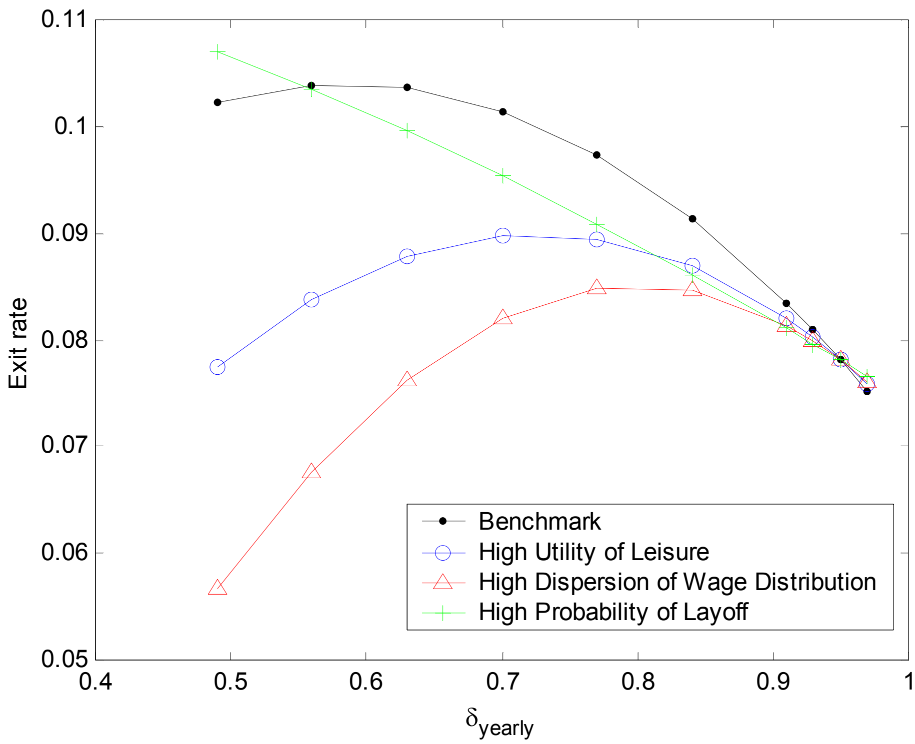

Figure 1b: Exit Rate and Long-Run Patience

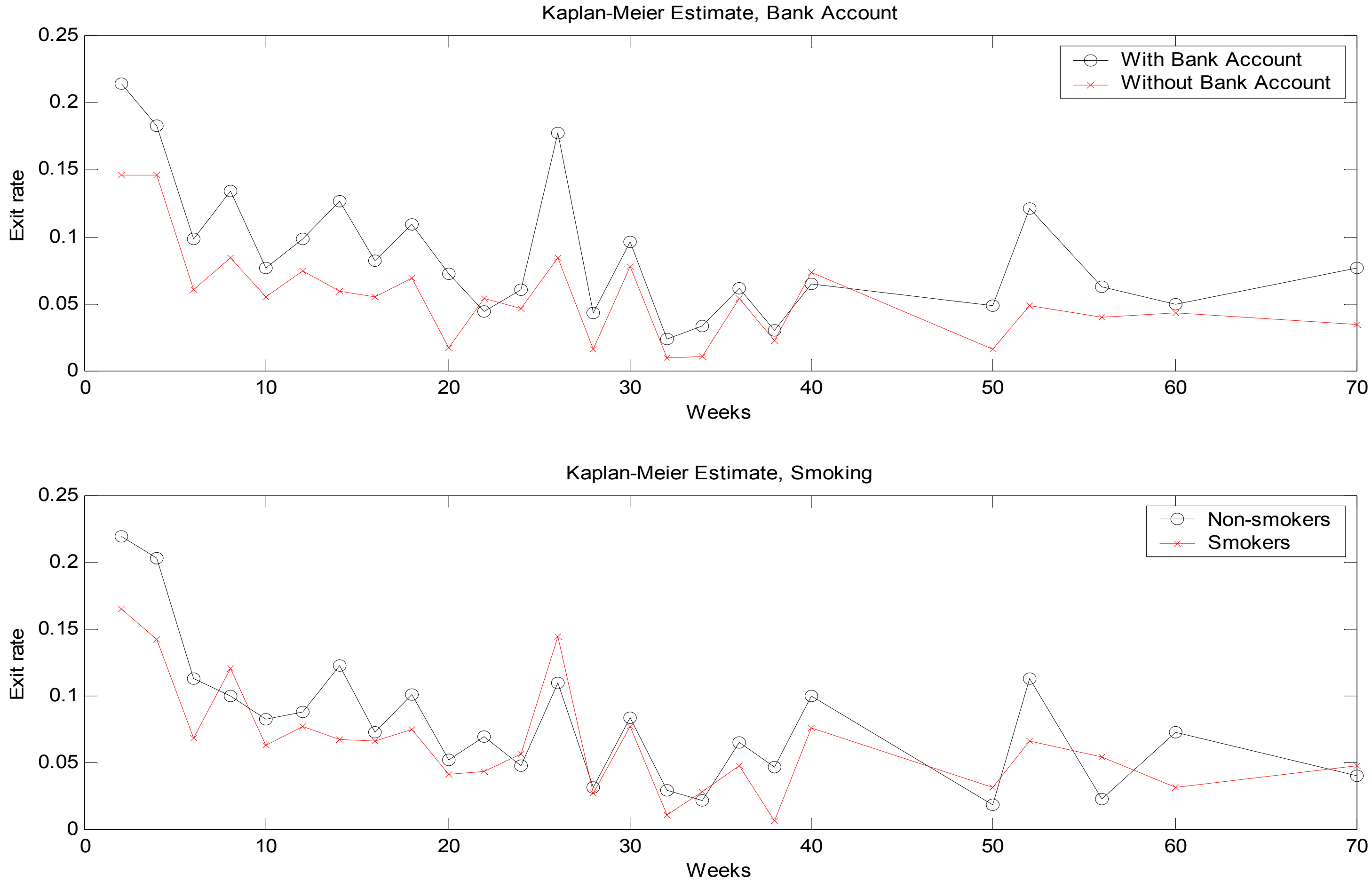

FIGURE 2: Exit Rates in the PSID

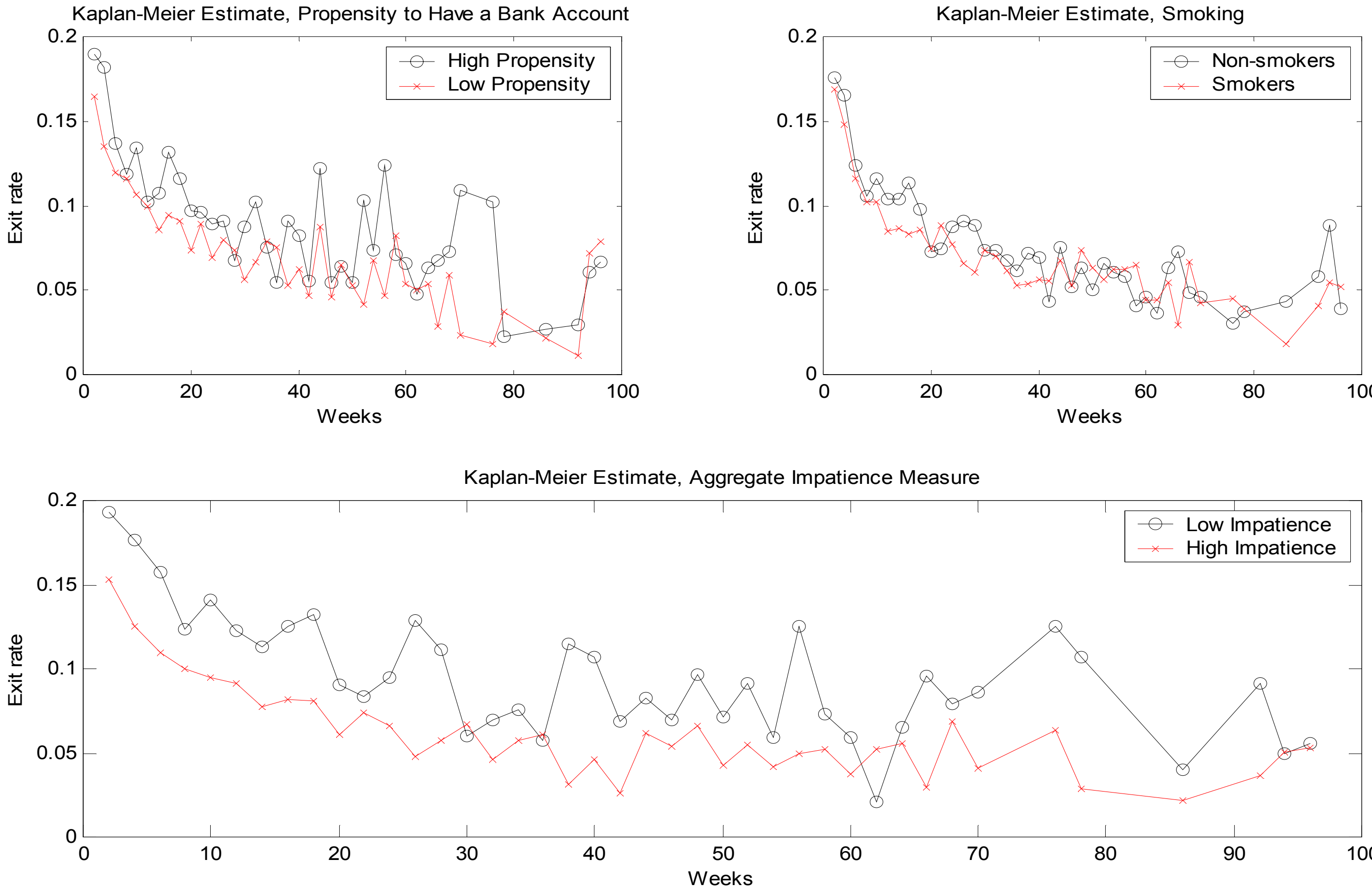

Figure 3: Exit Rates in the NLSY

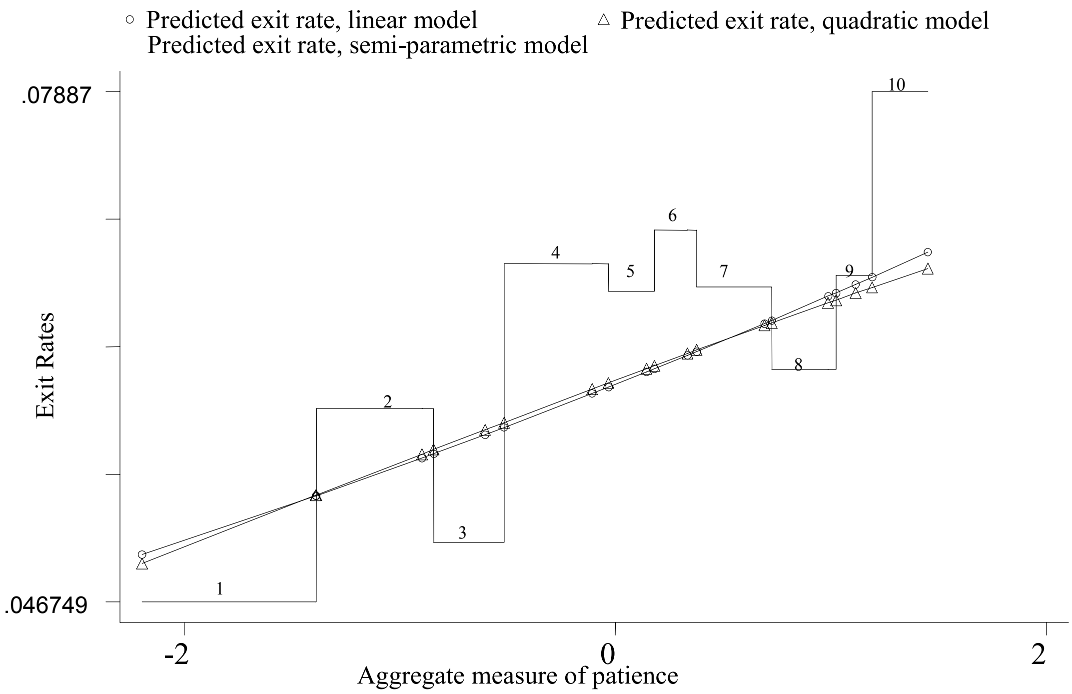

FIGURE 4: Nonlinearities in the Exit Rate:

Exit Rates at 13 Weeks and Patience

Table 1: Calibrations †

	Benchmark	High Utility of Leisure	Low Utility of Leisure	High Wage Dispersion	Log-uniform Distribution	High Layoff Probability
	(1)	(2)	(3)	(4)	(5)	(6)
1. Value of the long run discount factor δ_{max} such that the exit rate is decreasing in δ for $\delta > \delta_{max}$.						
δ_{max}	**0.585**	0.726	0.497	0.802	0.538	0.207
Probability of Acceptance for $\delta=\delta_{max}$	**0.897**	0.955	0.995	0.974	0.993	0.999
2. What value of β matches the empirical differential in exit rates between patient and impatient workers, assuming that patient workers are exponential with δ=0.95? For patient workers: δ_{pat}= 0.95, β_{pat} = 1, exit rate = 0.0781, probability of acceptance = 0.540. For impatient workers: δ_{imp} (hyperbolic) = 0.95, exit rate = 0.0604						
a. Naïve Hyperbolic						
β_{imp}	**0.902**	0.942	0.851	0.960	0.915	0.701
Probability of acceptance	**0.540**	0.540	0.540	0.540	0.540	0.540
b. Sophisticated Hyperbolic						
β_{imp}	**0.886**	0.933	0.825	0.954	0.902	0.640
Probability of acceptance	**0.545**	0.543	0.548	0.542	0.544	0.558

†**Notes:** Benchmark parameters: utility of leisure b = 0.25; wage distribution – log-normal with location parameter μ = 0 and dispersion paramter σ = 0.19; probability of layoff q = 0.0044.
Cost of search function: $c(s) = ks^{1+\eta}$. The parameters k and η are calibrated under each specification so as to match the exit rates and the acceptance probabilities of the most patient workers in the NLSY (see Appendix C for details). In the benchmark specification, k = 27.35, and η = 0.4025.

Table 2: Unemployment Spells, Descriptive Statistics [†]

	PSID	NLSY
Number of Spells	1997	8779
Mean Duration [1]	19.81	20.17
Duration Distribution		
Duration, 25th percentile	4	4
Median Duration	12	10
Duration, 75th percentile	30	25
Spells by Individual		
Number of individuals and mean duration for individuals with:		
1 spell	809, 21.65	849, 21.14
2 spells	378, 19.21	557, 22.01
3 spells	144, 17.42	397, 21.97
4 spells	-	242, 24.68
5 spells	-	200, 21.24
6 spells	-	169, 19.89
7 or more spells	-	299, 16.81
Total number of individuals	1331	2713
Survivor Function		
4 weeks	0.687	0.700
13 weeks	0.451	0.426
26 weeks	0.279	0.241
52 weeks	0.163	0.103
104 weeks	0.104	0.032
Completed Spells		
Number of completed spells	1604	8440
% of Total	80.32	96.14
% of Completed Spells:		
Ending in a new job	50.50	79.23
Ending in recall	49.50	20.77
% of Completed Spells lasting:		
1-4 weeks	38.97	31.03
5-13 weeks	29.30	28.09
14-26 weeks	19.51	18.63
27-52 weeks	9.41	13.52
53-104 weeks	2.56	6.48
105+ weeks	0.25	2.25

[†] **Notes:** For detailed explanation of the construction of the spells in the two samples, see Appendix B.
[1] Including censored spells

Table 3: Measures of Impatience, Summary Statistics [†]

NLSY Sample

	(1)	(2)	(3)	(4)
	Sample: Male Population	**Sample**: Individuals unemployed at least once during sample period	**Sample**: Individuals unemployed at least once during sample period	**Sample**: All Spells
	Measure: Raw	**Measure**: Raw	**Measure**: Standardized	**Measure**: Standardized
1. NLSY Assessment Measure of impatience during interview	0.042 (.114, 5518)	0.042 (.110, 2712)	0.001 (.993, 2712)	-0.006 (.983, 8778)
2. Bank Account Did not have a bank account	0.417 (.493, 5187)	0.501 (.500, 2627)	0.143 (1.024, 2627)	0.239 (.1.020, 8532)
3. Contraceptive Use Had unprotected sex	0.189 (.358, 4053)	0.217 (.376, 2053)	0.080 (1.050, 2053)	0.130 (1.075, 6696)
4. Life Insurance Did not have life insurance at job	0.643 (.378, 4829)	0.671 (.370, 2365)	0.043 (.995, 2365)	0.096 (.993, 7671)
5. Smoking Smoked before unemployment spells	0.442 (.497, 5270)	0.504 (.500, 2647)	0.125 (1.007, 2647)	0.236 (1.000, 8594)
6. Alcohol Average number of hangovers in past 30 days	0.262 (.774, 5455)	0.289 (.793, 2706)	0.035 (1.025, 2706)	0.029 (.938, 8764)
7. Vocational Clubs Measure of non-participation in vocational clubs	0.966 (.069, 5152)	0.963 (.074, 2590)	-0.041 (1.063, 2590)	-0.079 (1.111, 8400)

PSID Sample

	(1)	(2)	(3)	(4)
	Sample: Male Population	**Sample**: Individuals unemployed at least once during sample period	**Sample**: Individuals unemployed at least once during sample period	**Sample**: All Spells
	Measure: Raw	**Measure**: Raw	**Measure**: Standardized	**Measure**: Standardized
1. Bank Account Did not have a checking Account	0.303 (.460, 11762)	0.300 (.458, 940)	-0.007 (.998, 940)	-0.001 (1.0002, 1426)
2. Smoking Smoked before unemployment spells	0.334 (.472, 13206)	0.560 (.497, 1078)	0.477 (1.054, 1078)	0.474 (1.054. 1649)

[†] **Notes:** Standard deviation and number of observations in parentheses.
The standardized measure of impatience is created by adjusting (whenever necessary) the raw measure, and standardizing the resulting measure so that it has mean zero and standard deviation one in the entire male population.

Table 4: Benchmark Models †

	NLSY Sample (1)	(2)
Controls	No	Yes
Aggregate Impatience Measure	-0.1501** (.0159) [5664]	-0.089** (.0177) [5664]
1. NLSY Assessment of Impatience Measure of impatience during Interview	-0.0552** (.0138) [8778]	-0.0431** (.0135) [8778]
2. Bank Account Did not have a bank account	-0.135** (.0131) [8532]	-0.0793** (.0141) [8532]
3. Contraceptive Use Had unprotected sex	-0.0827** (.0141) [6696]	-0.0243 (.0148) [6696]
4. Life Insurance Did not have life insurance At job	-0.0456** (.0146) [7671]	-0.0131 (.0150) [7671]
5. Smoking Smoked before Unemployment spells	-0.0484** (.0136) [8594]	-0.0294** (.0136) [8594]
6. Alcohol Average number of hangovers In past 30 days	-0.0044 (.0140) [8764]	-0.0115 (.0140) [8764]
7. Vocational Clubs Measure of non-participation In vocational clubs in HS	-0.0438** (.0130) [8400]	-0.0320** (.0126) [8400]
	PSID Sample	
Controls	No	Yes
1. Bank Account [1] Did not have a checking account	-0.1974** (.0336) [1426]	-0.1622** (.0383) [1409]
2. Smoking Smoked before Unemployment spells	-0.1149** (.0283) [1649]	-0.0964** (.0288) [1639]

† **Notes:** Entries in the table represent the coefficient on the relevant variable from *separate* Cox proportional hazard models. Robust standard errors in parentheses. Number of spells used in each regression is in brackets. Observations with missing values for any of the control variables were discarded. All measures of impatience are standardized (see Notes to Table 3). All the impatience variables (with one exception specified below) are measured prior to the occurrence of the unemployment spells. The aggregate impatience measure is constructed using factor analysis (see Appendix for details).

Control Variables in the NLSY: age, education, marital status, race, dummy for kids, self-reported health status, AFQT score, father's occupation/presence (4 dummies), parental education, received magazines while growing up, received papers, had a library card, urban dummy, SMSA dummy, central city dummy, local unemployment rate (5 dummies), dummy for receipt of UI benefits, region (3 dummies), 8 occupation dummies, 12 industry dummies, log (hourly wage) before unemployment spell, tenure on last job.

Control variables in the PSID: age, education, race, marital status, self-reported health in 1986 (2 dummies), father's occupation (2 dummies), parental education (2 dummies), county unemployment rate, dummy for receipt of UI benefits, 7 industry dummies, 4 occupation dummies, log (hourly wage) before the unemployment spell.

[1] The bank account proxy in the PSID is measured after the occurrence of the spells.

Table 5: Robustness Checks †

	(1) Impatience measures included simultaneously	(2) Last Spell Only	(3) Alternative definition of Unemployment Spells	(4) Log-linear model: OLS	(5) Log-linear model: IV
Controls	Yes	Yes	Yes	Yes	Yes
Aggregate Impatience Measure	-	-0.1135**	-0.0825**	-	-
		(.0285)	(.0180)		
		[1727]	[6377]		
1. NLSY Assessment	-0.0504**	-0.0376*	-0.0549**	0.0567**	1.1655**
Measure of impatience	(.0186)	(.0215)	(.0144)	(.0244)	(.4300)
during interview		[2712]	[10024]	*F=1.61*	
2. Bank Account	-0.0634**	-0.0630**	-0.0819**	0.0772**	0.8983**
Did not have a bank	(.0171)	(.0219)	(.0144)	(.0196)	(.3438)
Account		[2627]	[9747]	*F=1.67*	
3. Contraceptive Use	-0.0106	-0.0720**	-0.0268*	0.0114	0.7954**
Had unprotected sex	(.0159)	(.0243)	(.0159)	(.0197)	(.3602)
		[2053]	[7618]	*F=1.45*	
4. Life Insurance	-0.0226	0.0054	-0.0132	0.0504**	0.9892**
Did not have life insurance	(.0172)	(.0224)	(.0153)	(.0195)	(.4448)
at job		[2365]	[8638]	*F=1.24*	
5. Smoking	-0.0322*	-0.0369*	-0.0198	0.0248	0.3092**
Smoked before	(.0167)	(.0210)	(.0139)	(0.0203)	(.1478)
unemployment spells		[2647]	[9813]	*F=5.90*§	
6. Alcohol	-0.0077	-0.0070	0.0074	0.0112	0.4026**
Average number of	(.0158)	(.0195)	(.0127)	(.0222)	(.1591)
hangovers in past 30 days		[2706]	[10006]	*F=5.25*§	
7. Vocational Clubs	-0.0343**	-0.0326	-0.0436**	0.0569**	0.8780**
Measure of non-participation	(.0159)	(.0214)	(.0132)	(.0176)	(0.3968)
in vocational clubs in HS		[2590]	[9599]	*F=1.56*	
	N=5664			*N=5450*	*N=5450*

†**Notes:** Entries in the first column represent the coefficient on the relevant variable from *a single* Cox proportional hazard models. Entries in columns 2 and 3 represent coefficients on the relevant variable from *separate* Cox proportional hazards models. Entries in columns 4 and 5 represent the coefficient on the relevant variable in a regression of log completed duration on the impatience measures and the control variables. The IV estimates are obtained by instrumenting for each measure of impatience with all the remaining measures.
Robust standard errors in parentheses. Number of spells used in each regression in brackets. Observations with missing values for any of the control variables were discarded. For the full list of control variables, see Notes to Table 4. All measures of impatience are standardized (see Notes to Table 3). All the impatience variables are measured prior to the occurrence of the unemployment spells. The aggregate impatience measure is constructed using factor analysis (see Appendix for details).
*: Significantly different from 0 at the 0.1 level.
**: Significantly different from 0 at the 0.05 level.
§: p-value for the F statistic smaller than 0.05.

Table 6: Reservation Wage, Re-employment Wage, and Acceptance Probability †

Dependent Variable	(1) Ln reservation wage, 1985, 1986, 1994	(2) Ln reservation wage, 1985, 1986, 1994	(3) Ln re-employment wage	(4) Ln re-employment wage	(5) Probability of Acceptance, 1981	(6) Probability of Acceptance, 1981
Estimation Method	OLS	OLS	OLS	OLS	Probit	Probit
Controls	No	Yes	No	Yes	No	Yes
Aggregate Impatience	-0.0711**	0.0003	-0.0898**	-0.0126	0.0656*	0.0111
	(.0237)	(.0191)	(.0128)	(.0082)	(.0376)	(.0472)
	[1010]	[1010]	[5018]	[5018]	[161]	[161]
1. NLSY Assessment	-0.098	0.0107	0.0005	.0099*	0.0393	0.0294
Measure of impatience	(.0116)	(.0099)	(.0098)	(.0058)	(.0329)	(0.0353)
during interview	[1675]	[1675]	[7767]	[7767]	[230]	[230]
2. Bank Account	-0.0848**	-0.0151	-0.0584**	-0.0007	0.0673*	0.0116
Did not have a bank	(.0182)	(.0164)	(.0102)	(.0065)	(.0372)	(.0443)
account	[1648]	[1648]	[7555]	[7555]	[213]	[213]
3. Contraceptive Use	-0.0251*	0.0159	-0.0592**	-0.0050	0.0472	0.0212
Had unprotected sex	(.0145)	(.0126)	(.0097)	(.0065)	(.0341)	(0.0357)
	[1283]	[1283]	[5937]	[5937]	[181]	[181]
4. Life Insurance	0.0551**	-0.0341**	-0.0563**	-0.0166**	0.0835**	.0759**
Did not have life	(.0179)	(.0155)	(.0118)	(.0067)	(.0336)	(.0356)
Insurance at job	[1330]	[1330]	[6789]	[6789]	[212]	[212]
5. Smoking	-0.0456**	-0.0057	-0.0514	-0.0149**	0.0013	-0.0081
Smoked before	(.0167)	(.0138)	(.0107)	(.0066)	(.0366)	(.0398)
unemployment spells	[1646]	[1646]	[7597]	[7597]	[217]	[217]
6. Alcohol	0.0011	-0.0118	0.0064	-0.0038	-0.0196	-0.0369
Average number of	(.0198)	(.0169)	(.0094)	(.0052)	(.0334)	(.0344)
hangovers in past 30 days	[1604]	[1604]	[7754]	[7754]	[226]	[226]
7. Vocational Clubs	0.0225	-0.0017	0.0209**	0.0027	-0.0420	-0.0301
Measure of	(.0166)	(.0145)	(.0090)	(.0054)	(.0318)	(0.0393)
in vocational clubs in HS	[1604]	[1604]	[7426]	[7426]	[216]	[216]

† **Notes:** The reservation wage variable is constructed using the response to the question "what would the wage or salary have to be for you to be willing to take [a job]?" in the 1985, 1986 and 1994 waves of the NLSY.
The re-employment wage is the starting real hourly wage received on the first job following the unemployment spells used in Table 4.
The acceptance probability models are based on probit regressions, where the dependent variable is a dummy indicating whether a job offer received using a particular method was accepted or not. (Data from the 1981 wave of the NLSY). The sample is restricted to unemployed males, not in school or in the military.

Entries represent the coefficients on the relevant variables from *separate* regressions. Robust standard errors in parentheses, number of observations in brackets. Observations with missing values for any of the control variables were discarded. For the full list of control variables, see Notes to Table 4. All measures of impatience are standardized (see Notes to Table 3). All the impatience variables are measured prior to 1985. The aggregate impatience measure is constructed using factor analysis (see Appendix for details).
*: Significantly different from 0 at the 0.1 level.
**: Significantly different from 0 at the 0.05 level.

Table 7: Is the Self-Reported Reservation Wage Meaningful? †

	(1) Ln reservation wage, 1985, 1986, 1994	(2) Ln reservation wage, 1985, 1986, 1994	(3) Ln re-employment wage
	OLS	OLS	OLS
Received unemployment benefits	0.060 (0.037)	0.061 (0.037)	-
Local unemployment rate 6.0 - 8.9%	0.001 (0.041)	-	-
Local unemployment rate 9.0 - 11.9%	-0.090* (0.050)	-	-
Local unemployment rate 12.0 - 14.9%	-0.074 (0.051)	-	-
Local unemployment rate 15.0% +	-0.090 (0.064)	-	-
Unemployment rate – continous	-	-0.033** (0.013)	-
Log reservation wage	-	-	0.237** (0.056)
Log previous wage	0.351** (0.045)	0.352** (0.045)	0.229** (0.052)
Controls	Yes	Yes	Yes
Number of observations	1199	1199	779

† **Notes:** The reservation wage variable is constructed using the response to the question "what would the wage or salary have to be for you to be willing to take [a job]?" in the 1985, 1986 and 1994 waves of the NLSY.
The re-employment wage is the starting real hourly wage received on the first job following the unemployment spells used in Table 4.

Entries represent the coefficients on the relevant variables. Robust standard errors in parentheses. Observations with missing values for any of the control variables were discarded. For the full list of control variables, see Notes to Table 4.
*: Significantly different from 0 at the 0.1 level.
**: Significantly different from 0 at the 0.05 level.

Table 8: Search Regressions[†]

	Dependent Variable: Number of Search Methods Used Estimation Method: Poisson	
	(1)	(2)
Controls	No	Yes
Aggregate Impatience Measure	-0.1188**	-0.0698**
	(.0265)	(.0267)
	[2076]	[2076]
1. NLSY Assessment	-0.0676**	-.0315*
Measure of impatience during	(.0197)	(.0178)
Interview	[3556]	[3556]
2. Bank Account	-0.0393*	0.0168
Did not have a bank account	(.0224)	(.0218)
	[3475]	[3475]
3. Contraceptive Use	-0.0752**	-0.0373*
Had unprotected sex	(.0216)	(.0210)
	[2649]	[2649]
4. Life Insurance	-0.0207	-0.0140
Did not have life insurance	(.0226)	(.0222)
at job	[2790]	[2790]
5. Smoking	-0.0724**	-0.0277
Smoked before	(.0220)	(.0208)
Unemployment spells	[3482]	[3482]
6. Alcohol	0.0014	-0.0045
Average number of hangovers	(.0162)	(.0157)
in past 30 days	[3549]	[3549]
7. Vocational Clubs	-0.0045	-0.0006
Measure of non-participation	(.0203)	(.0190)
in vocational clubs in HS	[3402]	[3402]

[†] **Notes**: Entries in the table represent the coefficient on the relevant variable from *separate* models. Robust standard errors in parentheses. Number of observations used in each regression is in brackets. Observations with missing values for any of the control variables were discarded. For the full list of control variables, see Table 4. All measures of impatience are standardized (see Notes to Table 3). All the impatience variables are measured prior to the occurrence of the unemployment spells.
*: Significantly different from 0 at the 0.1 level. The aggregate impatience measure is constructed using factor analysis (see Appendix for details).
**: Significantly different from 0 at the 0.05 level.

Table 9: Search Effort, Reservation Wages, and Exit Rates†

Sample: NLSY

Dependent Variable: Exit rate from unemployment after interview

Estimation Method: Cox proportional hazard model

	(1)	(2)	(3)	(4)
Controls	No	Yes	No	Yes
Search effort	0.119**	0.092**	-	-
	(0.018)	(0.019)		
Log Reservation Wage	-	-	0.185**	-0.049
			(0.090)	(0.116)
Duration prior to interview (weeks)	-0.012**	-0.009**	-0.012**	-0.013**
	(0.002)	(0.002)	(0.003)	(0.003)
Number of Observations	1931	1931	658	658

† **Notes:** Search effort is measured by the number of different search methods used by unemployed workers in the four weeks prior to the NLSY interview, for all waves of the NLSY from 1985 to 1993 (see Appendix Table 3 for details).
The reservation wage variable is constructed using the response to the question "what would the wage or salary have to be for you to be willing to take [a job]?" in the 1985, 1986, and 1994 waves of the NLSY.
Robust standard errors in parentheses. Observations with missing values for any of the control variables were discarded. For the full list of control variables, see Table 5.
**: Significantly different from 0 at the 0.05 level.

Table 10: What are the Impatience Measures Capturing?†

Dependent Variable:	Search Effort	Reservation Wage	Probability of Acceptance	Exit rate
Sign of the Empirical Relationship Between the Dependent Variable and the Impatience Measures	**-**	**(0)**	**(0)**	**-**
Sign of the Change in the Dependent Variable Predicted by Changes in Various Model Parameters				
Decrease in β (Short Run Patience)	-	-/0[1]	+/0[2]	-
Decrease in δ (Long Run Patience)	-	-	+	+
Shift left in μ (Location of the Wage Distribution)	-	-	-	-
Increase in *b* (Utility of Leisure)	-	+	-	-
Decrease in λ (Productivity of Search)	-[3]	-	+	(+)
Decrease in σ (Dispersion of the Wage Distribution)	-	-	(+)	(+)
Increase in *q* (Probability of Layoff)	-	-	+	(+)

† **Notes:** The signs in the Table indicate the predicted effect of a change in the parameter in the specified direction on job search outcomes. A sign in parenthesis indicates that the effect is ambiguous, but simulations point to the effect going consistently in one direction. Shaded areas correspond to predictions that are at odds with the empirical findings.

1 The effect of a decrease in β on the reservation wage is negative for sophisticated workers, and null for naive workers.

2 The effect of a decrease in β on the probability of acceptance is positive for sophisticated workers, and null for naive workers.

3 For given search effort *s*, the probability of finding a job is λs. Under this parameterization, decreases in productivity of search lower the amount of search effort. Alternative parameterizations may yield different results.

Appendix Table 1: Coefficient Estimates in NLSY Models[†]

	Exit rate regressions			Search regressions, OLS			Reservation Wage Regressions		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Mean	Coef.	Std. Err.	Mean	Coef.	Std. Err.	Mean	Coef.	Std. Err.
Aggregate Impatience Measure	0.310	-0.0890	0.0177	0.588	-0.0837	0.0328	0.477	0.000	0.019
Education	11.876	0.0083	0.0110	11.551	0.0535	0.0215	11.653	0.054	0.013
Age	28.305	-0.0207	0.0041	27.863	-0.0118	0.0095	26.357	0.012	0.010
Married	0.332	0.1931	0.0427	0.234	-0.0013	0.1050	0.248	-0.018	0.084
Any Kids	0.325	0.0008	0.0404	0.260	0.1533	0.0996	0.237	-0.004	0.084
Black	0.317	-0.2090	0.0466	0.467	-0.0550	0.0858	0.380	-0.108	0.048
Hispanic	0.184	-0.0571	0.0584	0.160	-0.1022	0.1027	0.183	-0.035	0.058
Bad Health	0.062	-0.5078	0.0670	0.137	-0.7000	0.0775	0.101	-0.061	0.091
Received UI Benefits	0.232	-0.3313	0.0300	0.176	0.4862	0.0868	0.129	0.047	0.048
Urban Residence	0.776	-0.0754	0.0525	0.819	0.2167	0.1039	0.793	0.108	0.082
Non-SMSA Dummy	0.266	Omitted		0.224	Omitted		0.261	Omitted	
SMSA Dummy	0.560	-0.0718	0.0511	0.542	-0.0910	0.1048	0.530	-0.049	0.067
Central City Dummy	0.174	-0.1731	0.0615	0.234	-0.1308	0.1293	0.209	-0.024	0.079
Local Unemployment rate: 0 - 2.9 %	0.009	Omitted		0.013	Omitted		0.000	Omitted	
Local Unemployment rate: 3.0 - 5.9%	0.343	0.1727	0.1295	0.305	-0.1169	0.2176	0.217	0.073	0.082
Local Unemployment rate: 6.0 - 8.9%	0.396	0.0395	0.1290	0.417	-0.1633	0.2259	0.411	0.041	0.075
Local Unemployment rate: 9.0 - 11.9%	0.164	0.0063	0.1338	0.171	-0.0542	0.2386	0.212	-0.033	0.085
Local Unemployment rate: 12.0 - 14.9%	0.073	-0.1056	0.1434	0.077	-0.1455	0.2551	0.124	-0.023	0.077
Local Unemployment rate: 15.0% +	0.015	0.0002	0.1674	0.016	0.0737	0.3106	0.036	Omitted	
Region: South	0.208	Omitted		0.216	Omitted		0.226	Omitted	
Region: Northeast	0.148	-0.0820	0.0599	0.173	0.1158	0.1112	0.168	-0.030	0.072
Region: North Central	0.258	-0.0361	0.0530	0.239	0.2217	0.1063	0.243	-0.054	0.058
Region: West	0.386	-0.0393	0.0500	0.372	0.1262	0.0982	0.363	-0.076	0.048
AFQT score	40.324	0.0033	0.0008	33.568	-0.0015	0.0016	36.901	-0.002	0.001
No father present	0.201	0.0978	0.0704	0.272	-0.3333	0.2019	0.251	-0.131	0.106
Father present, not working	0.091	Omitted		0.081	-0.2971	0.2211	0.102	-0.077	0.107
Father's occupation: white collar	0.105	0.1294	0.0789	0.079	-0.0721	0.2348	0.084	0.064	0.123
Father's occupation: pink collar	0.044	0.1860	0.0926	0.034	Omitted		0.043	Omitted	
Father's occupation: blue collar	0.559	0.1721	0.0633	0.534	-0.2231	0.1980	0.520	-0.115	0.105
Parents' highest grade	11.054	-0.0063	0.0072	11.017	0.0013	0.0123	11.010	0.007	0.007
Received magazines	0.483	0.0559	0.0373	0.420	-0.0545	0.0700	0.480	-0.006	0.038
Received Papers	0.708	-0.0076	0.0393	0.688	-0.0751	0.0693	0.664	-0.017	0.035
Had a Library Card	0.630	-0.0053	0.0363	0.644	0.0614	0.0682	0.635	-0.074	0.033
Tenure on Previous Job	84.503	0.0001	0.0001	70.766	-0.0005	0.0004	53.830	0.000	0.000
Previous Occupation: Professional	0.049	Omitted		0.034	Omitted		0.054	Omitted	
Previous Occupation: Managers	0.044	0.0309	0.0918	0.028	0.0232	0.2609	0.020	0.143	0.156
Previous Occupation: Sales	0.029	-0.0612	0.1028	0.020	0.1274	0.2846	0.016	0.041	0.116
Previous Occupation: Clerical	0.059	-0.0266	0.0904	0.042	0.1465	0.2324	0.058	0.118	0.151
Previous Occupation: Craftsmen	0.231	-0.0252	0.0815	0.160	0.0095	0.1975	0.190	0.136	0.140
Previous Occupation: Operatives	0.067	-0.0037	0.0942	0.044	0.0066	0.2264	0.044	0.186	0.138
Previous Occupation: Laborers	0.367	-0.0426	0.0797	0.547	-0.1252	0.1857	0.453	0.113	0.126
Previous Occupation: Farmers	0.022	-0.0101	0.1496	0.017	-0.4352	0.3181	0.033	0.034	0.158
Previous Occupation: Service Workers	0.132	-0.0171	0.0785	0.108	0.0306	0.2082	0.131	0.044	0.137
Previous Industry: Agriculture	0.053	Omitted		0.047	Omitted		0.063	Omitted	
Previous Industry: Mining	0.015	0.0449	0.1406	0.009	0.0561	0.3257	0.018	-0.073	0.082
Previous Industry: Construction	0.221	0.2208	0.0881	0.285	-0.1827	0.1487	0.217	0.066	0.069
Previous Industry: Manufacturing	0.231	0.1590	0.0883	0.218	-0.0483	0.1489	0.209	0.019	0.068
Prev. Ind.: Transport., Comm., Publ. Util.	0.059	0.0956	0.1006	0.046	0.4486	0.2020	0.051	0.097	0.083
Previous Industry: Wholesale Trade	0.029	0.1485	0.1156	0.020	0.2574	0.2552	0.021	-0.141	0.092
Previous Industry: Retail Trade	0.152	0.1202	0.0929	0.182	-0.0896	0.1599	0.184	0.069	0.067
Previous Industry: Finance, Insurance, RE	0.022	0.0473	0.1238	0.018	0.0614	0.2682	0.014	0.149	0.085
Previous Industry: Business Services	0.095	0.1594	0.0967	0.086	-0.2047	0.1659	0.091	-0.029	0.074
Previous Industry: Personal Services	0.029	0.0391	0.1208	0.025	-0.2999	0.2298	0.022	0.293	0.113
Previous Industry: Entertainment	0.020	0.1402	0.1263	0.015	-0.2611	0.2597	0.019	-0.124	0.134
Previous Industry: Professional Services	0.051	0.2336	0.1032	0.032	-0.0092	0.2342	0.053	0.056	0.096
Previous Industry: Public Administration	0.023	0.0784	0.1311	0.017	-0.2905	0.2331	0.038	-0.031	0.101
Log previous wage	1.665	0.1063	0.0341	1.622	-0.1957	0.0679	1.573	0.400	0.050
Dummy for 1994	-	-	-	-	-	-	0.246	-0.063	0.088
Constant	-	-	-	-	1.7050	0.5625	-	-0.047	0.265
Number of observations		5664			2076			1010	

[†] **Notes**: Full set of coefficients and standard errors for the Cox proportional hazards model (Table 5), the search regressions (Table 9), and the reservation wage regressions (Table 10) with the aggregate impatience measure. Columns (1), (4), and (7) represent the mean of the relevant explanatory variable in the sample used for the Cox proportional hazards model the search regressions, and the reservation wage regressions respectively.

Appendix Table 2: Search Intensity Measures [†]

A. Individual Methods

	Proportion using method
State Employment Agency	17.54
Private Employment Agency	4.33
Direct Contact with Employers	36.63
Friends and Relatives	14.23
Placed or Answered Ads	8.63
Looked at Newspapers	27.66
School Employment Service	0.93
Other Methods	6.94

B. Number of Methods Used

	Frequency	Percentage
None	1500	42.17
1	797	22.41
2	686	19.29
3	394	11.08
4	123	3.46
5	37	1.04
6	15	0.42
7	5	0.14
Total	3557	100.00

Appendix Table 3: Factor Analysis [††]

	Factor Loadings	Uniqueness	Scoring Coefficient on the Aggregate Measure of Impatience
NLSY Assessment	0.1664	0.9723	0.1038
Bank Account	0.4537	0.7942	0.3466
Contraceptive Use	0.3965	0.8428	0.2854
Life Insurance	0.1461	0.9786	0.0906
Smoking	0.3471	0.8795	0.2395
Alcohol	0.1230	0.9849	0.0758
Vocational Clubs	0.0001	1.0000	0.0001

[†] **Notes:** Distributions are based on the sample of unemployment spells that began after 1985 for males who were not in school, and that were matched to an interview date.
*: Significantly different from 0 at the 0.1 level.
**: Significantly different from 0 at the 0.05 level.

[††] **Notes**: Factor analysis is used to create an aggregate impatience measure derived from the individual standardized measures of impatience. Entries in the table represent maximum likelihood estimates for a factor analysis model with one factor retained.