Reference-Dependent Job Search: Evidence from Hungary*

Stefano DellaVigna[§] UC Berkeley, NBER

Attila Lindner[‡] UC Berkeley

Balázs Reizer[§§] Central European University, CERS-MTA

Johannes F. Schmieder[†] Boston University, NBER, and IZA

July 2014

Abstract

We propose a model of job search with reference-dependent preferences, where the reference point is given by recent income. Newly unemployed individuals search hard given that they are at a loss, but over time they get used to lower income, and thus search less. They search harder again in anticipation of a benefit cut, only to ultimately get used to it. The model fits the typical shape of the exit from unemployment, including the spike at the UI exhaustion point. The model also makes unique predictions on the response to benefit changes. We provide evidence using a reform in the unemployment system in Hungary. In November 2005, Hungary switched from a single-step UI system to a two-step system, with unchanged overall generosity. We show that the system generated increased hazard rates in anticipation of, and especially following, benefit cuts in ways the standard model has a hard time fitting, even when allowing for unobserved heterogeneity. We structurally estimate the model and estimate a weight on gain-loss utility comparable to the weight on the standard utility term, and a speed of adjustment of the reference point in the order of eight months.The results suggest that a revenue-neutral shift to multiple-step UI systems can speed exit from unemployment.

*We would like to thank Lajos Bódis, David Card, Sebastian Findeisen, Gábor Kézdi, Patrick Kline, Matthew Rabin, Hedvig Horváth, Edward O'Donoghue, Alex Rees-Jones, Emmanuel Saez, Mihály Szoboszlai, Owen Zidar and audiences at Boston University, at the UCSB Berhavioral Conference, and at the 2014 BEAM conference for very helpful comments. We are grateful for János Köllő, Kitti Varadovics, Mónika Bálint, Dániel Biró for giving us access to the administrative data and providing continuous help throughout the project. We also thank Tristan Gagnon-Bartsch, Jessica Shui, and Ferenc Szucs for excellent research assistance and Gautam Rao for sharing his code. Financial support from support from the Center for Equitable Growth at UC Berkeley is gratefully acknowledged. All errors are our own.

[§] sdellavi@econ.berkeley.edu, [‡] lindner@econ.berkeley.edu, [§§]reizer_balazs@ceu-budapest.edu,[†] johannes@bu.edu

1 Introduction

Unemployment insurance programs in most Western countries follow a common design. The benefits are set at a constant replacement rate for a fixed period, typically followed by lower benefits under unemployment assistance. In such systems, the hazard rate from unemployment typically declines from an initial peak the longer workers are unemployed, then surges at unemployment exhaustion, and declines thereafter. This has been shown in a variety of settings, such as Germany (Schmieder, Von Wachter and Bender 2012a), Austria (Card, Chetty and Weber 2007a), Slovenia (van Ours and Vodopivec 2008), Hungary (Micklewright and Nagy 1999) or France (Le Barbanchon 2012).[1]

It is well-known that a basic job search model a' la Mortensen (1986) and van den Berg (1990) is unable to match this pattern. This model predicts an increasing exit hazard up until benefit expiration, with a constant exit rate thereafter. To match the time path of the hazards, job search models add unobserved heterogeneity among workers. More productive workers are more likely to find a job initially, leading to a decrease in the hazard over time as the workers still unemployed are predominantly of the less productive type. Apart from heterogeneity, researchers have proposed that the spike at UI exhaustion might be explained by storable job offers (Boone and van Ours 2012), as well as sanctions imposed by the UI agencies (Cockx et al. 2013).

In this paper, we propose, and test empirically for, a behavioral model of job search which can account for this time path of unemployment, and other job search patterns. We propose that workers have reference-dependent preferences over their utility from consumption. As in prospect theory (Kahneman and Tversky 1979), workers are loss-averse with respect to payoffs below the reference point. Further, we assume that the reference point is given by consumption in the recent past.

To fix ideas, consider a reference-dependent worker who was just laid off. For simplicity, assume, as we do in the paper, that the worker has no savings and that in each period she consumes the benefits.[2] Because the unemployment benefits are significantly lower than the previous wage, this worker finds the new state of unemployment particularly painful given the loss aversion, and works hard to search. Over the weeks of unemployment, however, the reference point shifts as the individual adapts to the lower consumption level, and the loss

[1]The evidence for the United States is more limited, due to the lack of administrative data, with Katz and Meyer (1990) reporting a sharp spike but with small sample sizes., while others, such as Fallick (1991) do not find such a spike. Card, Chetty and Weber (2007b) provide a careful discussion of the evidence on spikes and highlight the importance of distinguishing the exit hazard from UI from the exit hazard from non-employment (that is into employment). While the exit hazard into employment shows less of a spike than the exit from UI, it is nevertheless quite pronounced in many papers relying on large and high quality administrative datasets.

[2]A hand-to-mouth consumption rule is approximately accurate if workers are highly impatient, as our estimates suggest. In ongoing work, we aim to estimate a model which includes a consumption-savings decision.

aversion is thus mitigated. Hence, the worker's search effort decreases. As the end of the UI benefits draws near, the worker, if still unemployed, anticipates the loss in consumption due to the exhaustion of the benefits, and searches harder. This force is at work also in the standard model, but it is heightened by the anticipation of the future loss aversion. If the worker does not find a job before UI expiration, the worker once again slowly adjusts to the new, lower benefit level. Hence, the hazard for unemployment for this reference-dependent worker decreases from the initial peak, increases at exhaustion, then decreases again. Hence, the hazard displays the same qualitative pattern as in the data, even in absence of unobserved heterogeneity.

Still, the two models are impossible to distinguish using the aggregate time path of exit from unemployment. As we discussed above, the standard model can also fit this path if one allows for unobserved heterogeneity, a plausible assumption. How would one test then for reference dependence in job search?

We sketch a simple model which highlights three robust predictions of the reference-dependent job search model which are not shared by the standard model, even with unobserved heterogeneity. Consider two UI systems, both of which have the same benefit level after some period T (say, from a second social insurance tier, such as welfare benefits or unemployment assistance). The first UI system is however more generous prior to period T (Figure 1 a). The standard model predicts that, starting from period T, the hazard rate in the two systems would be the same, as the future payoffs are identical (Figure 1 b). Furthermore, the hazard rate before period T will be higher in the system with lower payout given the moral hazard. Allowing for unobserved heterogeneity would alter the plot qualitatively, but the qualitative predictions above would hold.

The reference dependence model makes three qualitatively different predictions (Figure 1 c). First, right after period T the hazard in the second system would be higher because the loss in consumption relative to the recent benefits is larger. Second, this difference would attenuate over time and ultimately disappear as the reference point adjusts to the lower benefit level. Third, the hazard rate in the second UI system increases already *in advance of* period T, in anticipation of the future loss aversion.

We evaluate a change in the Hungarian unemployment insurance system which is ideally suited for a test of the above predictions. Before November 2005, the Hungarian system featured a constant replacement rate for 270 days, followed by lower unemployment assistance benefits. After November 2005, the system changed to a two-step unemployment system: benefits are higher in the first 90 days, but lower between days 90 and 270, compared to the pre-period (Figure 2). Importantly, there was no major change in the unemployment assistance system taking place after 270 days. As such, this UI set-up corresponds to the hypothetical case outlined above when evaluated around 270 days.

An additional feature of the set-up simplifies the evaluation of the pre- and post-regime. Differences in total benefits paid out could complicate the evaluation of the UI change given that they could lead to differences in the selection of workers still unemployed at 270 days. Yet, an important feature of the Hungary reform is that the total amount of benefits paid out to individuals unemployed up until day 270 remains about the same after the reform. Hence, differences in savings and in selection in the pre- and post- period are likely to be relatively small, allowing for a more straightforward comparison. We then evaluate the reform by comparing the hazard rates in the year before and after the reform.

The impact of the reform on hazard rates is strikingly in line with the predictions of the reference-dependent model. In the period immediately preceding the 270-day exhaustion of benefits, the hazard rate in the pre-period rises above the hazard rate in the post-period, despite the fact that benefits are higher in the pre-period. In the months following the exhaustion, the hazard rate in the pre-period remains higher, and then it ultimately converges to the post-period level after a couple months. The observed pattern around the exhaustion is consistent with the anticipation of, and then the direct effect of, the higher loss in consumption for individuals in the pre-reform period. The ultimate convergence between the two hazards indicates, in this interpretation, the timing of the reference point adjustment.

While we focused so far on the hazard rate around the exhaustion of benefits, we observe a similar spike in the hazard at 90 days in the post-period, corresponding to the first step down in benefits. Similarly to the pattern observed around day 270, the surge in hazard disappears after 3-4 months. However, notice that the spike itself in this period can be explained by the standard model.

We present several robustness checks of the policy evaluation. First, we show that controlling for a broad set of observable controls barely affects the estimated hazards. Second, we show that differential ways to control for a contemporaneous introduction of a re-employment bonus has a minimal effect on the results. (And in any case this change is unlikely to have any effect for individuals still unemployed after 200 days) Third, we present an event study analysis of the changes in the hazards showing that the breaks in the hazards occur immediately in the quarter of introduction of the reform, and do not appear to reflect previous trends.

In the final part of the paper, we structurally estimate a model of job search with optimal search effort and unobserved heterogeneity of cost of search.[3] Since the reference-dependent model embeds the standard model, we compute the best fit both with and without allowing for reference dependence. We estimate the model with a minimum-distance estimator, matching

[3]The model does not currently allow for a reservation wage choice, and assumes that consumption equals the benefits. We aim to relax both assumptions. In preliminary estimates, allowing for a reservation wage choice has little effect on the results.

the empirical hazard rates from unemployment in the pre- and post- period to the predictions of the model.

The best estimate for the standard model does a relatively good job of fitting the hazard rate path in the first 200 days. In particular, it matches qualitatively the spike in the post-hazard at 90 days, and the later decrease given a substantial degree of estimated heterogeneity in costs of search. The standard model, however, is unable to capture the observed behavior leading up to, and following, the exhaustion of benefits. In particular, as discussed above, the hazard rates from period 270 on in the pre- and post-period are predicted to be almost identical, counterfactually.

The best estimate of the reference dependence model captures the spike at 90 days and the subsequent decrease, similar to the standard model (and with a closer fit). Importantly, this behavioral model also captures key features of the data which the standard model does not fit: the increase in hazard in the month prior to the expiration of benefits in the pre- period, the spike at 270 days, the decrease thereafter, and the ultimate convergence of the hazard between the pre- and post-period after a few months. The fit of the model is not perfect: the model underfits the spike at 270 days and the difference in hazards in the following two months. Still, it captures most of the qualitative features which the standard model does not fit at all. Interestingly, the reference dependent model, even when estimated without allowing for any unobserved heterogeneity, still provides a better fit of the data than the standard search model with heterogeneity. In this latter comparison, the reference-dependent model fits better despite having fewer parameters.

Turning to the point estimates, the model estimates that the weight on the gain-loss utility is at least as large as the weight on consumption utility, indicating an important role for loss aversion in job search.[4] The estimates also indicate that the reference point is updated quite slowly, as an average over the income over the past 240 days. This is one of very few estimates of the speed of updating in backward-looking reference-point models (see also Post et al., 2008).

We examine alternative specifications of the model. For the reference-dependent model, we allow for different levels of gain utility and for an alternative process of reference-point updating, leading to similar results. We also allow for different specifications of the utility functions and for estimation of the discount factor, neither of which alters the qualitative results. Finally, we compare the estimates of the reference-dependent model to the estimates of a habit-formation model a la Campbell and Cochrane (1999). This latter model, like the reference-dependent model, induces a temporarily high marginal utility of income following

[4]The model allows for gain utility as well. Given that the unemployment benefits never increase over the unemployment spell, the gain utility applies to the utility of reemployment, not to the utility of unemployment. Such gain utility does not alter the path of exit from unemployment substantially.

a benefit cut. The habit-formation model indeed fits the data similarly to the reference-dependent model, although the fit is not quite as good.

The paper relates to the literature on job search and the design of unemployment insurance. This literature has mainly focused on the impact of the maximum duration and level of benefits, often using the estimated elasticities to gauge the welfare consequences of unemployment insurance (e.g. Chetty 2008, Kroft, Notowidigdo 2010, Schmieder, von Wachter, and Bender 2012). We evaluate a different type of reform: rather than changing the level or duration of benefits, the reform in Hungary changed the time path of the benefit schedule, keeping the overall payments approximately constant. While the theoretical literature of optimal unemployment insurance (e.g. Hopenhayn and Nicolini 1997, Pavoni 2007) has argued that benefits that gradually decline over the unemployment spell are likely optimal, we are not aware of research that has evaluated reforms that change the time path without also greatly increasing or reducing the generosity of the UI system.

The paper also contributes to a small literature on behavioral labor economics, including work on gift exchange between employer and employee (Akerlof, 1982, Fehr, Kirchsteiger, and Riedl, 1993 and Gneezy and List, 2006), horizontal pay equity (Kahneman, Knetsch and Thaler, 1986; Card, Mas, Moretti, and Saez, 2012), and target earnings in labor supply (starting from Camerer et al., 1997). More relatedly, within job search, DellaVigna and Paserman (2005) consider the impact of present-bias while Spinnewijn (2013) examines the role of overconfidence. We show that a reference-dependent model of job search make unique predictions which are not shared by these other models.

The paper also relates to the behavioral literature on reference dependence. Evidence of reference dependence comes from a number of settings including insurance choice (Sydnor 2010, Barseghyan, Molinari, O'Donoghue and Teitelbaum 2013), labor supply (Fehr and Goette 2007), domestic violence (Card and Dahl 2011), goal setting (Allen, Dechow, Pope and Wu n.d.), and tax elusion (Rees-Jones 2013). Across most of these settings, the reference point is the status-quo, or the forward-looking expectation (as in Koszegi and Rabin, 2006). In this paper, the set-up with varying payoffs allows us to estimate the speed of updating of a backward-looking reference point as in Bowman, Minehart, and Rabin (1999); the only other example we are aware of is (Post, Van den Assem, Baltussen and Thaler 2008). This paper is also part of a growing literature on structural behavioral economics which aims to identify the underlying behavioral parameters (Laibson, Repetto and Tobacman 2007, Conlin, O'Donoghue and Vogelsang 2007, DellaVigna, List and Malmendier 2012).

The papers proceeds as follows. In Section 2, we present a simple model of job search and reference dependence. In Section 3 we present the institutional details and the data for the Hungary unemployment insurance reform, which we evaluate in Section 4. In Section 5 we present the structural estimates, and we conclude in Section 6.

2 Model

In this section we present a simple discrete-time model of job search with reference dependent preferences. We follow the job search intensity model presented in Card, Chetty, and Weber 2007a, and we add a reference dependent utility function in consumption with backward looking reference point.

Each period a job seeker decides on how much effort $s_t \in [0,1]$ to put into searching for a job, which represents the probability of receiving a job offer at the end of period t and thus of being employed in period $t+1$. Search costs are given by the function $c(s_t)$ each period and we assume that the twice continuously differentiable function $c(s)$ is increasing and convex, with $c(0) = 0$ and $c'(0) = 0$.

The individuals receive unemployment benefits b_t if unemployed at period t, and they consume their income. Hence, the utility from consumption in period t for an unemployed person is $v(b_t)$. The novel aspect is the fact that the reference-dependent individual has, in addition to consumption utility $v(b_t)$, also gain-loss utility. Following the notation of Koszegi and Rabin (2006), flow utility in each period is

$$u(b_t|r_t) = \begin{array}{ll} v(b_t) + \eta [v(b_t) - v(r_t)] & \text{if} \quad b_t \geq r_t \\ v(b_t) + \eta\lambda [v(b_t) - v(r_t)] & \text{if} \quad b_t < r_t \end{array} \tag{1}$$

where r_t denotes the reference point for consumption in period t. The utility consists of the consumption utility $v(b_t)$ and in addition of the gain-loss utility $v(b_t) - v(r_t)$. Whenever the consumption is on the gain side relative to the reference point ($b_t \geq r_t$), the individual derives gain utility $v(b_t) - v(r_t) > 0$, which receives weight η. Whenever the consumption is on the loss side relative to the reference point ($b_t < r_t$), the individual derives loss utility $v(b_t) - v(r_t) < 0$, with weight $\lambda\eta$. The parameter $\lambda \geq 1$ captures the loss aversion, the fact that the marginal utility of consumption is higher on the loss side than on the gain side. This reference-dependent utility function builds on prospect theory (Kahneman and Tversky, 1979) without, for simplicity, modelling either diminishing sensitivity or probability weighting. Notice also that the standard case is embedded as the special case for $\eta = 0$.

The second key set of assumption is the determination of the reference point $r_{t.}$ Unlike in the recent literature on forward-looking reference points (Koszegi and Rabin, 2006 and 2007), but in the spirit of the literature on habit formation and of the older tradition on backward-looking reference points (Minehart, Bowman, and Rabin, 2001), we assume that the reference-point is a weighted average of past income over the N preceding periods:[5]

$$r_t = \frac{1}{N} \sum_{k=t-N}^{t-1} y_k.$$

To gain perspective on the impact of reference dependence on the marginal utility of consumption, consider the impact on utility of a small, permanent cut in benefits from b to $b - \Delta b < b$, taking place in period T. Assume that for the previous T periods, with $T > N$, benefits were constant, so that the reference point r_T equals b and utility in period $T - 1$ equals $v(b)$ (there is no gain-loss utility in steady-state). Then in period T the utility changes to The short-term change in utility $u(b_t|r_t)$ is, up to a linear approximation, equal to $(1 + \eta\lambda) \Delta b v'(b)$. Over time, however, the reference point adjusts to ultimately equal $b - \Delta b$ so that the utility after N periods equals $v(b - \Delta b)$. Hence, the long-term change in utility equals just $\Delta b v'(b)$. The term $\eta\lambda$ captures the additional short-term utility response to an income loss.

The reference point at time t depends on income in the past N period. For unemployed workers the reference point in period t is given by the paths of benefits (and by the pre-unemployment wage). For workers who have found a job, the reference point depends on how many periods prior to t a worker found a job. To make this distinction explicit, let's denote r_t the reference point in period t if the individual was unemployed until period $t-1$, and let's denote r_t^j the reference point of an individual in period t who started a job in period j. Note that $r_t^t = r_t$.

Turning to the job search decision, each period when unemployed, the worker chooses the search effort s_t to maximize the following value function:

$$V_t^U = \max_{s_t \in [0,1]} u(b_t|r_t) - c(s_t) + \delta \left[s_t V_{t+1}^E + (1 - s_t) V_{t+1}^U \right] \tag{2}$$

where V_{t+1}^U is the continuation payoff from being unemployed in period $t+1$ and V_{t+1}^E is the continuation payoff of finding a job. We assume that individuals hold a job with wage w forever after finding a job, with the wage w larger than the benefits b_t at any period. As such, V_{t+1}^E is given by

$$V_{t+1}^E = \frac{v(w)}{1-\delta} + \eta \sum_{i=1}^{N} \delta^i \left[v(w) - v\left(r_{t+i}^{t+1}\right) \right].$$

The first term in V^E is the standard term from receiving consumption utility of $v(w)$ forever, while the second term consists of the gain term, where the reference point will adjust over

[5] In the estimation below we also consider alternative ways of reference point formation, such as an AR(1) process.

time. Notice that the second term disappears after N periods, since by then the reference point $r_{t+N+1}^{t+1} = w$. We solve the model by backward-induction starting from a point $\bar{T}$ after which we assume that search effort is stationary (at least N periods after an individual finds a job).

Equation (2) for the case of interior solution implies that the optimal search s_t satisfies

$$c'\left(s_t^*\right) = \delta\left[V_{t+1}^E - V_{t+1}^U\right]. \tag{3}$$

Given our assumptions above we can define the inverse of the first derivative of the cost function: $\mathcal{C}(.) = c'^{-1}(.)$, so that we can solve for s_t^*:

$$s_t^* = \mathcal{C}\left(\delta\left[V_{t+1}^E - V_{t+1}^U\right]\right) \tag{4}$$

To highlight the predictions of the model and to contrast it with the standard model, we consider a specific case, highlighted in Figure 1 (a), which corresponds to UI systems in many countries including the US. UI benefits are at a constant level b up to the the maximum potential UI duration T, and afterwards drop to a lower second tier with benefits $\underline{b}$. Now consider an increase db in the level of UI benefits up to T, holding constant the second-tier benefits at $\underline{b}$. We compare how optimal search effort is affected by the old and the new regime in the standard and the RD model. The following proposition states how the benefit increase will affect search effort in the periods $t \geq T$, that is after benefits are exhausted.[6]

Proposition 1. *Consider an increase in benefits b up to period T.*

a) In the standard model ($\eta = 0$), the search effort in all periods after T is unaffected: $\frac{ds_{T+i}^*}{db} = 0$, for $i = 0, 1, ...$

b) In the reference-dependent model ($\eta > 0$ and $\lambda \geq 1$) search effort increases temporarily in the first N periods after T, increases, and remains constant in later periods: $\frac{ds_{T+i}^*}{db} > 0$, for $i = 0, 1, ...N-1$ and $\frac{ds_{T+i}^*}{db} = 0$, for $i = N, N+1, ...$

The first part is straightforward from equation (4). In the standard model, the search decision depends exclusively on future benefits and wages, and the reform leaves unaffected the benefits past period T.

In the reference-dependent model, instead, past benefits may affect current search effort through the reference point. Taking the derivative of equation (4) with respect to b we get:

$$\frac{ds_t^*}{db} = \left(\frac{dV_{t+1}^E}{db} - \frac{dV_{t+1}^U}{db}\right)\mathcal{C}'\left(\delta\left[V_{t+1}^E - V_{t+1}^U\right]\right) \tag{5}$$

[6]Note that search effort in period t is not affected by UI benefits in period t, since the individual will only start a job found in period t in period $t+1$. Thus search effort s_t corresponds to the exit hazard from unemployment in period $t+1$: $s_t = h_{t+1}$.

The second part on the right hand side $\mathcal{C}'\left(\delta\left[V_{t+1}^E - V_{t+1}^U\right]\right)$ is always positive, so the sign of $\frac{ds_t^*}{db}$ is determined by the first part. To see that the first part is also positive, notice that

$$\frac{dV_{t+1}^E}{db} = -\eta\frac{dv(r_{t+1})}{db} + \delta\frac{dV_{t+2}^E}{db} \tag{6}$$

and

$$\frac{dV_{t+1}^U}{db} = -\lambda\eta\frac{dv(r_{t+1})}{db} + \delta\left(s_{t+1}\frac{dV_{t+2}^E}{db} + (1-s_{t+1})\frac{dV_{t+2}^U}{db}\right) \tag{7}$$

. For $t+2 = P+N+1$ we have that $\frac{dV_{t+2}^E}{db} = \frac{dV_{t+2}^U}{db} = 0$ and in that case clearly $\frac{dV_{t+1}^E}{db} - \frac{dV_{t+1}^U}{db} = -\eta\frac{dv(r_{t+1})}{db} + \lambda\eta\frac{dv(r_{t+1})}{db} > 0$. The intuition is simply that the change in benefits increases the reference point during employment and unemployment. But since loss utility is larger than gain utility, the value of unemployment changes more and thus the gap between V_{t+1}^E and V_{t+1}^U increases, thus increasing the returns to searching for a job.

For $t+2 < T+N+1$, but still $t+2 \geq T+1$, we also have to consider the second term on the right hand sides of equations (6) and (7). We provide a formal proof in the appendix to show that the second term in (7) is larger than the term in (6) which implies part b) in Proposition 1. The intuition is that while the part $\frac{dV_{t+2}^E}{db}$ is positive (thus reducing incentives to search), the part in equation (7) is always larger due to the fact that changes in the reference point for someone who does not find a job in period $t+1$ has a lower reference point in period $t+2$ and the concavity of $v(.)$ as well as the fact that any utility coming from future time spend in unemployment is lower due to $\lambda > 1$.

Thus in the periods after benefits are exhausted ($t > T$), the benefit increase has starkly different effects on search effort: In the standard models, search effort will not be affected, while in the RD model search effort will rise for the next N periods. In the periods before benefits are exhausted, the standard model predicts a reduction in search effort, since the value of unemployment is increased, while the value of employment is unaffected. In the RD model the predictions are ambiguous and depend on the exact parameters: on the one hand the increase in UI benefits prior to T will increase the value of unemployment and thus tend to depress search effort - just as in the standard model - however the drop at benefit exhaustion is also increased thus threatening a larger utility loss if still unemployed after that. That will tend to increase search effort.

The predictions of the standard model are highlighted in Figure 1 (b). The optimal search effort will increase under both regimes up until period T, and then plateau at a constant level after period T, since the two regimes have identical benefits moving forward. Moreover, the hazard rate for regime 1 is always lower than the one for regime 2, given that the benefits are more generous in regime 1.

The optimal search effort under reference-dependence are quite different and shown in (c). First, the search effort at period T is substantially higher under the first regime, since it is under this regime that the loss in consumption is higher. The difference in hazards persists but in attenuated form in the subsequent period, until it fully goes away after N periods, which is the time length afer which the reference point has been full updated to the new benefit level. After this point, there is no more of a difference.

In addition, loss aversion generates a difference in hazards in anticipation of future losses. Namely, in the last few period before period T, for sufficiently high loss aversion, the hazard is actually higher under regime 1 compared to regime 2, despite the fact that regime 1 has more generous benefits. This reflects the fact that the reference-dependent agents anticipate the future loss, and this anticipation is stronger under regime 1. To the extent that this force is stronger than the usual direct benefit effect, we observe the pattern in the graphs.

While we do not include savings in this model, note that if individuals could save, then the standard model would actually predict a decrease in search effort after benefits are exhausted relative to a regime without a UI benefit increase. This is because some of the additional UI benefits will be saved thus increasing the value in unemployment and reducing the pressure to find a job. Thus even savings would not alter the insight from the model, that an increase in search effort (after T) in response to an increase in b would strongly support the RD model over the standard model.

3 Data and Institutions

3.1 Unemployment Insurance in Hungary

Hungary had a generous unemployment insurance system in the period we examine. The UI insurance had a two tiered structure. In the first tier, potential duration and benefit amount depended on past UI contribution.[7] The maximum potential duration, which was obtained after around 4 years of contribution, was 270 days,[8] while the benefit was calculated based on the earnings in the previous year. After all the benefit had been exhausted in the first tier, "unemployment assistance" (UA) benefits could be claimed in the second tier. The benefit amount in this tier was the same for everybody, while the potential duration depended on age.

On May 30th, 2005 the Hungarian government announced a comprehensive reform of the unemployment insurance system.[9] The main goal of the new UI regulation was to speed

[7]Every worker in the formal sector must pay a UI contribution. In 2005, employers contributed 3% to the UI fund, while employees 1%. There is no experience rating of UI benefits in Hungary.

[8]More specifically, potential benefit in the first tier was calculated as UI contribution days in the last 4 years divided by 5, but at most 270 days.

[9]The reform was part of a wider government program (called "100 steps"). Policies related to the labor

up transition from unemployment to employment. To achieve this goal, the government changed the benefit calculations formula in the first tier, but did not alter the way potential duration and earnings base were calculated. Before the reform, the benefit in the first tier was constant with a replacement rate of 65% and with minimum and maximum benefit caps. After the reform, a two-step benefit system was introduced. The length of the first step was half of the potential duration in the first tier, and at most 91 days. In the first step, the replacement was lowered to 60%, but both the minimum and maximum benefit caps were increased substantially. For most UI claimants these changes meant higher benefits than under the old schedule. On the other hand, in the second tier everybody received the new minimum benefit amount. In practice, most UI claimants received lower benefits in this tier than before. The benefit formula changes are summarized in Figure 2.

The most prominent change occured for those who had 270 days eligibility (four years of UI contributions before lay-off) and had base year earnings above the new benefit cap (that is, they earned more than 114,000HUF ($570) per month in 2005). The old and new benefit schedules are summarized on Figure 3 for this group. In the first tier, the potential duration is 270 days both before and after. In the old system, the benefits were constant in the first tier. On the other hand, under the new rules, benefits increased substantially in the first 91 days, but decreased afterwards. An important feature of the reform for this particular group is that the benefit increase in the first 91 days is almost the same as the benefit decrease between 90 and 270 days. Therefore, the expected benefit pay-out for individuals who were unemployed for 270 days is very similar under the two benefit schedules.

Even though the main element of the reform was the new benefit formula, there were other changes that occured at the same time. Most notably, a reemployment bonus scheme was introduced as well. The bonus amount was 50% of the remaining total first tier benefits. However, claiming the bonus was not without costs. First, if the bonus was claimed, then the entitlement for the unused benefit days was nulled. This could be very costly for risk-averse agents or for those who could only find an insecure job. Second, the bonus could only be claimed after the date of first tier benefit exhaustion. In practice, this meant substantial hussle costs, since UI claimants had to show up one more time in the local UI office and fill out the paper work. Given the presence of these costs, it is not surprising that the take-up rate of reemployment bonus was only 6%. In our main analysis, we focus on the pattern of the hazard that should not be affected by the presence of the reemployment bonus. Moreover, as a robustness check we show that the pattern of the hazard and our results are not sensitive to dropping the reemployment bonus users from our sample.[10]

---

market and unemployment insurance (such as reemployment bonus and training polcies) are discussed latter. In addition to that VAT and corporate income tax were decreased from January 1st.

[10]Lindner and Reizer (2014) investigate the reemployment bonus in detail and show that it does not affect

In addition to the introduction of the reemployment bonus, there were other minor changes that are relevant for our analysis. First, those who claimed UI benefit before February 5th, 2005 faced a shorter[11], but somewhat higher, benefit in the second tier.[12] To avoid the complications that this change caused we only focus on those who claimed their benefits after February 5th, 2005. Second, there were some minor changes in financing training programs.[13] Howevever, participation in training programs was very low (less than 5%) in our sample and our results are robust to dropping these claimants.

Those who exhausted benefits in both tiers and were still unemployed could claim means tested social assistance. The duration of social assistance is indeterminate, while the amount depends on family size, family income, and wealth. In most cases social assistance benefits are lower than the second tier UI benefit level. [14]

3.2 Data

We use administrative data[15] that contains information on the social security contributions for roughly 4 million individuals between January, 2002 and December, 2008. Every Hungarian citizen who was older than 14 and younger than 75 in 2002 and who was born on even days of months was selected into our sample. Therefore, the sample represents roughly half of the Hungarian population. Information on UI claims from February, 2004 to December, 2008 were merged to the data. We also observe basic information used by the National Employment Service, in particular, the starting and ending date of the UI benefit spells and the earnings base that is used for benefit calculations.

In this paper we only focus on UI claimants who are eligible for the maximum potential duration (270 days) in the first tier. The reason for this is that we would like to avoid

the shape of the hazard function.

[11] Before the reform, the potential duration in the second tier was 270 days above age 45 and 180 days below 45. Those who claimed UI after February 5th, 2005 were eligible for 180 days above age 50 and 90 days below 50 in the second tier.

[12] The change in the duration and benefit level in the second tier was introduced at November 1st, 2005 at the same time as other changes. However, it affected everybody who claimed second tier (UA) benefits after November 1st, 2005. A UI claimant who claimed her benefits after Ferbraury 5th, 2005 and had 270 days potential eligibility, could only claim second tier benefits (UA) after November 1st, 2005. Therefore, claimants between February 5th, 2005 and November 1st, 2005 are under the old benefit system in the first tier, but face with the same second tier (UA) insurance scheme, see Figure 4.

[13] Unemployed participating in training programs received the so-called income substituting benefit. Before November 1st, 2005 this amount was 22,200HUF ($111) or 44,400HUF ($222), depending on household characteristics and type of training. This benefit was payed in excess of the UI. After November 1st, the benefit was 34,200HUF ($171) for everybody. However, the UI benefit was suspended during training. Although ee can only observe training participation after November 1st, 2005 aggregate data show that the probability of participation in training programs remained constant throughout this period(Frey 2009).

[14] For large families, social assistance can be more generous than UI. However, social assistance cannot be claimed before all other benefits have been exhausted in the UI system.

[15] The dataset is requested and cleaned by the Institute of Economics - Hungarian Academy of Sciences.

the complications caused by varying potential duration. In addition to that we restrict our sample to those who are older than 25 years and younger than 49 years. We drop the older population, since specific rules were applied close to retirement. Moreover, we identify as our main sample UI claimants with high earnings base, since our goal is to explore the variation showed in Figure 3. To construct a consistent sample over time, we focus on the unemployed whose earnings base was above the 70th percentile of the earnings base distribution of the UI claimants in the given year. In 2005 UI claimant at the 70th precentile earned 100,800 HUF ($504). Our results are robust to alternative thresholds, in particular using those whose (real) earnigs base was above 114,000 HUF ($570).

3.3 Descriptives

Our empirical analysis focuses on how the search behavior of people claiming UI was affected by the reform in November 2005. We construct two comparison groups of workers who entered UI just before or just after the reform, since the claiming date determined under which regime an individual was. Due to the change in unemployment assistance in February 2005, we use all UI claimants between February 5th, 2005 and October 15, 2005 (to avoid getting too close to the reform) as our pre-reform group. In order to get a comparable post-reform group that shows similar seasonal patterns, we take UI entrants in the same date range (February 5 to Octotober 15) in 2006 as our comparison group. Figure 4 shows the timing of the two comparison groups, as well as highlights the range for which our data is available. For robustness checks, we will later show results using data in the earlier and later ranges as well.

Table 1 shows basic descriptives for the two groups. The basic demographic characteristics are almost unchanged. Age at time of claiming, education and log earnings in the years 2002 - 2004 are very similar. We also find that the waiting period (the number of days between job loss and the time of claiming UI benefits) is almost identical across the two groups, indicating that people towards the end of our before sample were not trying to delay UI claiming dates in order to become eligible to the new regime.

As we mentioned before, after 2005 the Hungarian government also introduced a reemployment bonus scheme. The take-up rates are quite low in the post period (and by default zero in the pre period). Below we present careful robustness checks to address the possibility that this bonus may have affected our results.

4 Reduced Form Results

4.1 Estimating Hazard Plots

In this Section, we evaluate the impact of the reform on the exit rates from unemployment. We focus in particular on the hazard rates around the exhaustion point at 270 days, which is where the models make the most distinct predictions. We estimate the hazard rates with a linear probability model separately for each 15 day period, indexed by t, after entering unemployment insurance:

$$I(t_i^* = t | t_i^* \geq t) = \beta_{0,t} + \beta_{1,t} POST_i + X_i \gamma + \epsilon_{it}, \tag{8}$$

where i indexes individuals and t_i^* represents the duration of unemployment of individual i. The left hand side is an indicator for individual i finding a job in period t, conditional on still being unemployed at the beginning of the period. The variable $POST_i$ is an indicator for individual i claiming benefits in the post-reform period, while X_i is a matrix of control variables. The equation is estimated separately for each period t on the sample of individuals who are still unemployed at time t (that is conditional on $t_i^* \geq t$). The estimates for $\beta_{0,t}$ are estimates for the hazard function in the pre-period, while the estimates for $\beta_{1,t}$ represent the shift of the hazard function between the before and after period. In our baseline estimates we do not control for any observables X_i, and instead show results controlling for X_i as additional specifications.

Note that these hazard functions should not be viewed as consistent estimates on the individual level, but rather as estimates of the average hazard function in the population before and after the reform. While the natural experiment, assuming the CIA holds, identifies the causal effect of the reform on the average hazard function in the population, the shape of this average hazard function is potentially affected by either behavioral responses (true duration dependence) or by changes in selection patterns that are due to the reform. While we address differential selection in our reduced form results section, by comparing how observables vary throughout the unemployment spell, an important aspect of our structural estimation below will be to explicitely model the potential of unobserved heterogeneity affecting these hazard functions.

4.2 Main Result

Figure 5 (a) shows the estimates of equation (8) for each t. The blue line represents the coefficient estimates of $\beta_{0,t}$- the estimated hazard function in the before period - while the red line represents the estimates $\beta_{0,t} + \beta_{1,t}$ - the estimated after period hazard. Vertical lines between the two periods indicate that the difference between the two lines is statistically significant at the conventional 5% level.

The exit hazard from unemployment in the pre-reform period shows a familiar pattern for a one-step unemployment system. The exit hazard falls in the first months after entering UI, and then it increases as it approaches the exhaustion point of UI benefits (at 270 days). After this exhaustion point, it falls and spikes again as people exhaust the second tier benefits, unemployment assistance, at 360 days. The hazard rate then decreases monotonically after this point, as unemployed people are only eligible for welfare programs.

The exit hazard changes substantially after the introduction of a two-step unemployment insurance system. The hazard rate increases by 90 days, at the end of the higher unemployment insurance benefit, and remains elevated compared to the pre-reform period for the following 2.5 months. By 180 days, the pre- and post-reform hazards have converged back, and both hazards increase at the exhaustion of the UI benefits at 270 days. Importantly, though, the post-reform hazard increases significantly less, and the pre-reform hazard remains significantly higher for the 2 months following the UI exhaustion. Finally, by 360 days, the end of the unemployment assistance, the two hazards have once again converged back together.

The most striking difference occurs around day 270, when in the pre-reform period, the exit hazard remains significantly higher after the UI exhaustion point (270 days) relative to the after period. The observed difference in hazards is hard to reconcile with the standard model. From day 270 onwards, the benefit levels are identical in the pre- and post- period, and in addition the total amount of benefits received up to that point is also almost identical. Hence, as we discussed in Section 3, we would expect similar hazards (even with heterogeneity, as we show below).

The difference in hazards instead fits very nicely with the predictions from the reference dependent model: the workers in the pre-reform period experience a larger dropoff in benefits around day 270, inducing an increase in the value of search. The persistence for 2-3 months of the higher hazard suggests that it takes a substantial amount of time for the reference point to adjust to the new level. Furthermore, we also observe that the increase in hazard in the pre- period happens already in anticipation of benefit expiration at day 270, as predicted by the reference-dependent model.

While we focused so far on the hazard rate around day 270 because it leads to the most distinct predictions, the observed patterns around day 90 are also consistent with reference dependence. The spike in the hazard at 90 days in the post-period, corresponding to the first step down in benefits. disappears after 3-4 months, consistent once again with loss utility relative to slowly-adjusting reference points. However, notice that the spike itself in this period could be explained by the standard model in the presence of unobserved heterogeneity, as we show further below.

In order to see how the reform affected the total amount spent in unemployment in the two groups, Figure 5 (b) shows the estimated survival function for the two groups. We obtain these estimates using a variant of equation (8), where we estimate the equation again pointwise for all t but for the whole sample at each point and with $P(t_i^* \geq t)$ as the outcome variable. This provides natural non-parameteric estimates of the survival function, as well as whether differences between the two are pointwise significant. The figure shows clearly that the survival functions diverge after 90 days, with the after groups showing substantially lower survival probabilities than the before group. This difference stays until around 300 days, after which the two lines converge and the difference disappears. Since the expected duration in unemployent is simply the integral over the survival function from 0 to infinity (or rather the age of death/retirement), the expected unemployment duration is significantly reduced in the after period.

It is striking that even though the reform made the UI system more generous on average (since short term unemployed received more benefits, while the long-term unemployed received about the same overall), the expected duration actually decreased.

4.3 Robustness Checks

The results presented so far do not control for demographic characteristics. Even though the differences in demographics between the pre- and the post- period are quite small (Table 1), they could potentially explain differences in the hazard patterns over time if the demographic impacts on the hazard rates are large. Thus, we re-estimate equation (8) controlling for a rich set of observable characteristics, where we allow these characteristics to have arbitrary effects on the hazard function at each point, the only restriction being that the effect is the same in the before and after period. As Figure 6 (a) shows, controlling for observables has virtually no effect on the differences between the two hazard rates, implying that they cannot easily explain our finding.

A separate concern regards the introduction of the reemployment bonus in November 1st, 2005. While the take-up rate of the bonus was just 6% in our sample, it is likely to affect the hazard rate in the post-reform period, especially in the first 90 days. One way to check for potential impacts of this is to drop all individuals that received a reemployment bonus and estimate our baseline specification on this restricted sample. Figure 6 (b) shows that the results are virtually unchanged.

In order to assure that the differences in the hazard rates are in fact due to the reform in the UI system and not simply the result of some general trend, we exploit the fact that we have additional data from 2004 and after 2006. First we show two 'placebo' tests for whether there are differences in the year 2 years before the reform and the year 1 year before the reform, using the same estimation strategy as before. Figure 7 (a) shows these results, revealing that the hazard rates are virtually unchanged between 2004 and 2005. The difference right after the 270 line is expected due to the reduction in unemployment assistance in February 2005, thus leading to a slight increase in the hazard at this point in 2005. Similarly Figure 7 (b) shows that there are virtually no differences between the hazards 1 and 2 years after the reform, again indicating that the differences between our before and after period line up nicely with the reform and thus are likely due to the reform.

We explore the timing further by plotting time-series graphs of the exit hazards over specific intervals. Figure 8 (a) shows the evolution over time of the exit hazard between 30 and 90 days (red line) and between 90 and 150 days (black line). Each dot indicates the average hazard for each 3-month period between 2004 and 2007, with quarter 1 indicating the first 3-month period after the reform. Prior to the reform, the hazard at 90-150 days is smaller than the hazard at 30-90 days, consistent with the patterns in Figure 5. Subsequent to the reform introducing a step down of benefits after 90 days, the pattern abruptly changes. Already in the first quarter after the reform, the hazard at 90-150 days increases sizeably, becoming similar to the hazard at 30-90 days, a pattern that remains largely similar over the next 6 quarters. The figure provides little evidence of previous trends, suggesting that the changes in hazards are indeed a causal effect of the reform.

Figure 8 (b) provides parallel evidence for the hazard at 210-270 days versus at 270-330 days. In the quarters pre-reform, the hazard at 270-330 days is significantly higher than the hazard at 210-270 days, a pattern that changes abruptly with the first quarter following the reform. The time0series plots again indicate a change that is coincidental with the reform and not due to previous trends.

5 Structural Estimation

Set-up. We use the model of Section 2, imposing four additional assumptions, some of which we relax later. First, we assume that the search cost function has a power form: $c(s) = ks^{1+\gamma}/(1+\gamma)$. This form implies that the parameter γ is the inverse of the elasticity of search effort with respect to the net value of employment. To show this, recall that the first-order condition of search effort (equation 3) is $c'(s^*) = v$, where we denote with v the net value of employment (that is, the right-hand-side of equation 3)). Given the parametric assumption, this yields $s^* = (v/k)^{1/\gamma}$, and the elasticity of s^* with respect to v is $\eta_{s,v} = (ds/dv)\, v/s = 1/\gamma$.

Second, we assume for most of the estimates a log utility function, $v(b) = \ln(b)$), but we also generalize to a power utility function, $v(b) = b^{1+\rho}/(1+\rho)$ which admits log utility as a special limit case, as well as to a linear utility function. Third, we assume that reemployment wages are constant over the UI spell and they are equal to past wages. In our main estimation we set past wages (and so reemployment wages) equal to the median earnings in our sample, which is 135,000 HUF ($675).

Fourth, we allow for a three-point heterogeneity among the unemployed workers in the cost of search. Thus, we estimate five parameters: three levels of cost of search k_{high}, k_{med}, and k_{low}, with the assumption $k_{high} \geq k_{med} \geq k_{low}$, as well as the probability at the start of the unemployment spell of low-cost types, p_{low}, and the probability of the medium-cost types, p_{med}.

The vector of parameters ξ that we estimate for the standard model are: (i) the three levels of search cost k_{high}, k_{med}, and k_{low}, and the two probability weights p_{low} and $p_{med;}$ (ii) the search cost curvature γ; (iii) (in some specifications) the 15-day discount factor δ.

For the reference-dependent model, we estimate in addition: (iv) the loss aversion parameter λ; (v) the number of (15-day) periods N over which the backward-looking reference point is formed.[16] Notice that the weight on the gain-loss utility η is set to 1 rather than being estimated; thus, the loss-aversion parameter λ can be interpreted also as the overall weight on the gain-loss utility. The reason for this assumption is that over the course of the unemployment spell the individual is always on the loss side since the benefits are always (weakly) lower than the reference point. Hence, it is difficult to estimate a separate weight on gain utility and loss utility.[17]

Estimation. To estimate the model, we use a minimum-distance estimator. Denote by $m(\xi)$ the vector of moments predicted by the theory as a function of the parameters ξ, and by $\hat{m}$ the vector of observed moments. The minimum-distance estimator chooses the parameters $\hat{\xi}$ that minimize the distance $(m(\xi) - \hat{m})' W (m(\xi) - \hat{m})$, where W is a weighting matrix. As a weighting matrix, we use the diagonal of the inverse of the variance-covariance matrix. Hence, the estimator minimizes the sum of squared distances, weighted by the inverse variance of each moment. (As robustness check we alternatively use the identity matrix as a weighting matrix.) To calculate the theoretical moments, we use backward induction. First we compute numerically the steady state search and steady state value of being unemployed using a hybrid bisection-quadratic interpolation method, pre-implemented in Matlab as the fzero routine. Then going backward we analytically calculate the searching effort and the value of being unemployed in each period.

Under standard conditions, the minimum-distance estimator using weighting matrix W achieves asymptotic normality, with estimated variance $(\hat{G}'W\hat{G})^{-1}(\hat{G}'W\hat{\Lambda}W\hat{G})(\hat{G}'W\hat{G})^{-1}/N$,

[16]In the estimations tables we report the speed of adjustment in days, which is just N*15.

[17]In principle, the weight on gain utility η could be separately identified since gain utility affects the utility of reemployment, but the remployment utility does not allow for precise identification of η, as we show in robustness checks below.

where $\hat{G} \equiv N^{-1} \sum_{i=1}^{N} \nabla_\xi m_i(\hat{\xi})$ and $\hat{\Lambda} \equiv Var[m(\hat{\xi})]$ (Wooldridge 2010). We calculate $\nabla_\xi m(\hat{\xi})$ numerically in Matlab using an adaptive finite difference algorithm.

Moments. As moments $m(\xi)$ we use the 15-day hazard rates from day 15 to day 540. We include in the estimation the respective moments from both the pre-reform and post-reform period leading us a total of 35*2=70 moments. We do not use the hazard from the first 15 day period, since it would require modelling search on the job.

Identification. While the parameters are identified jointly, it is possible to address the main sources of identification of individual parameters. The cost of effort parameters k_j are identified from both the level of search intensity and the path for search over time. This is clearest in the standard model, where the heterogeneity in the parameters is needed, for example, to explain the decay in the hazard after day 360, when benefits remain constant and thus, in absence of heterogeneity, the hazard would be constant in the standard model (but not in the reference-dependent model).

The search cost curvature parameter, γ, is identified by the responsiveness of the hazard rate to changes in earnings since $1/\gamma$ is the elasticity of search effort with respect to the (net) value of finding a job. Once again, this clearest in the standard case. The increases in hazard once the benefits decrease identify the elasticity, and as such the curvature parameter.

The discount function δ, which is set in most of the specifications, is identified largely by how much the hazard rate responds in anticipation of future benefit cuts, holding constant the current benefits.

Turning to the reference-dependence parameters, for a given value of η (fixed to 1 in the benchmark specification), the parameter λ denotes the extent of the loss utility. A major component to identification for this parameter is the extent to which the hazard for the pre- group is higher both before and after day 270, in response to a larger loss. Remember that instead the standard model has essentially identical hazards from day 270 on. The loss parameter of course is also identified by the response to other changes in the benefits, such as at 90 days in the post- period.

The parameter N is identified by the speed with which the losses are reabsorbed into the reference point. The main source of identification is the fact that the hazard is higher in the pre-period after day 270, but it converges again after 3-4 months. Similarly, the speed of convergence of the hazard after day 90 contributes, similarly suggesting several months of adjustment.

Estimates. Columns (1)-(3) in Table 2 report the estimates for the standard model (that is, with η set to zero). In Column (1) we start with the most restrictive specification with no heterogeneity and a fixed 15-day discount factor at 0.99 and log utility. The fit of the model improves dramatically in Column (2) where we allow for unobserved heterogeneity in costs:

the estimates indicate a substantial heterogeneity among the workers, with k varying from the high-cost type at $\hat{k}_{high} = 235$ to the low cost type at $\hat{k}_{low} = 91$. It is noticeable how the estimated ex ante share of the high-cost type is very small, at $1 - .458 - .538 = .004$. This very small initial share ensures that even after 300 days there is still enough heterogeneity in the population left, so as to reproduce the declining pattern of the hazard for long durations (400 days+). This underscores the important role for a three-point heterogeneity in the standard model, since with two types the heterogeneity is typically much reduced at that point. The estimate of the cost elasticity $\hat{\gamma} = .11$ indicates a high elasticity of search effort to incentives, needed in order to fit the large increase at 90 days in response to the different benefit levels.

Column (3) allows for the estimation of the discount factor, yielding a high degree of myopia with $\hat{\delta} = .91$. As a result of the higher discounting, the elasticity of the effort function is now lower ($\hat{\gamma} = .55$) and the search cost estimates are lower. We also report the standard goodness of fit (GOF) measure $(m(\xi) - \hat{m})' W (m(\xi) - \hat{m})$, which allows to compare the model fit across different specifications. As can be seen while allowing for unobserved heterogeneity dramatically improves the fit of the standard model, estimating the discount rate lowers the GOF only slightly to 238.1 from 243.1.

Figure 9 (a) shows the fit of the standard model for the estimate in Column (2). The model does quite well in fitting the surge in hazard around day 90 in the post-period, and in general the decreasing path of the hazard in the first 200 days. The fit is also reasonably good for the period from day 400 on. However, the fit between days 250 and 400 is poor. As discussed above, the standard model predicts that the hazard for the two models in this period should be almost exactly the same, in sharp contrast to what we observe in the data. As such the model misses both the sharp difference in hazard between day 260 and day 360, as well as the spikes at both 260 and 360 days.

Columns (4) to (6) of Table 2 present the results for the reference dependent-model. In Column (4) we display the results for the model with no unobserved heterogeneity in costs and fixed discount rate. Interestingly, this model fits the data better than the full standard model with unobserved heterogeneity (Column (2)), despite having only 4 parameters compared to 6 parameters (goodness of fit of 217.6 compared to 243.1). The reference-dependence parameters are quite precisely estimated. The weight on loss utility is estimated at $\hat{\lambda} = 3.2$ (s.e. .2), indicating a substantial role for gain-loss utility. The estimate for the adjustment speed of the reference point N indicates a long duration of adjustment, $\hat{N} = 200$ (s.e. 14) days. The slow adjustment of the reference point is consistent with the duration of a few months before the spikes in hazard taper down, both after the benefit drop at 90 days in the post period, and after the benefit drop at 260 days.

The fit of the reference-dependent model improves sizably with the introduction of unobserved heterogeneity in costs (Column (5)) and somewhat with the estimation of the discount factor (Column (6)). The weight on gain-loss utility is estimated at $\hat{\lambda} = 1.7$ (s.e. .2, Column (5)) and $\hat{\lambda} = 3.5$ (s.e. .6, column (6)), indicating again a substantial role for gain-loss utility. The estimates for the adjustment speed of the reference point N are similar to the one in Column (4). The estimates of the auxiliary parameters – the cost levels and the curvature of the cost of search function – are relatively comparable to the ones for the standard model.

Importantly, the reference-dependent model fits the time path of the hazards significantly better than the standard model. Figure 9 (b) shows the improvement in fit for the specification in Column (5). The fit in the first 250 days is very good, though it was quite good also for the standard model. But, as anticipated, the model does much better for longer durations, when the standard model fits poorly. In particular, the model fits better the surge in the hazard rate in the pre-period in anticipation of the benefit cut after 270 days (which is larger in the pre period than in the post period), as well as the elevated level for the following three months, compared to the pre-period. Then the model tracks quite well the period following the exhaustion of unemployment assistance (after 360 days).

The fit of the reference-dependent model, while clearly superior to the standard model, is certainly not perfect. The most striking aspect of the data which the model does not capture is the very large spike on day 270 for the pre- period; storable offers may play a role in this case. In addition, the reference-dependent model under-fits the difference in hazards between the pre- and post-period after day 270.

Appendix Figure A-3 shows the fit of the hazard rates for all the six specifications in Table 2. Panel (d), corresponding to Column (4), shows how the reference-dependent model captures the key patterns in the hazard significantly better than the standard model even without any heterogeneity. Indeed, the qualitative fit is almost as good in this model as in the reference-dependent models with unobserved heterogeneity (panels e and f). This is certainly not the case for the standard model. A second clear pattern is how allowing for the estimation of the discount factor (panels c and f) leads only to modest improvements of the fit. Given also that the estimation of the discount factor leads to significantly noisier estimates of the some of the other parameters, in the subsequent estimates we hold it fixed.

Appendix Figures A-4 and A-5 show some of the key model components for the benchmark standard estimates (Column (2) of Table 2) and the benchmark reference-dependent model (Column (5) of Table 2)). Panels a and b display the flow utility for unemployed workers. In the standard model (panel a), it follows the step down in the benefits, with the size of the later steps accentuated by the curvature of the utility function. In the reference-dependent model (panel b), the flow utility captures also the intensity of the loss relative to the reference point. Considering for example the pre-period (dotted blue line), the flow utility of unemployment is particularly low at the beginning given the large loss relative to the pre-unemployment wage (which is the reference point then). The flow utility keeps increasing all the way to day 270 despite constant benefits because of adaptation in the reference point. Panels c and d show the value of unemployment. In the standard model, the value of unemployment is always decreasing given that benefits never increase over time. In the reference-dependent case, instead, thevalue of unemployment actually increases most of the time reflecting the importance of reference-point adaptation. Panels a and b of Appendix Figure A-5 show that the value of employment is constant in the standard case, but increasing in the reference-dependent case. The increase occurs because over time the reference point declines and hence obtaining a job becomes more attractive. This increase in the value of employment is monotonic and nearly linear, unlike the pattern for the value of unemployment, and hence does not contribute much to the explanation of the patterns in the hazard. Finally, Panel c shows the path for the reference point.

Alternative Reference-Dependent Models. In Table 3 we consider variants of the benchmark reference-dependent model (Column (5) in Table 2). First, we consider the role played by the gain utility parameter, η, which we had previously arbitrarily set at 1. In Column (2) and (3) of Table 3 we report the estimates setting, respectively, a value of η of 0.2 and of 5. 10 Interestingly, as the (assumed) weight on gain utilityη increases, the estimated λ decreases, holding the product$\eta\lambda$, which is the weight on loss utility, at comparable (though not constant) levels. The goodness of fit is slightly better for $\eta = 5$ (168) than for the benchmark case (172.6) or for $\eta = 0.2$ (175), but, as it is shown in Figure 10 (b) and in Figure 10 (c), the predicted hazards are virtually the same as in the benchmark case. This indicates the key role played by loss utility, which appears in the value of unemployment, as opposed to the weight of gain utility, which affects the value of employment.

Next, we explore an alternative updating of the reference point. Instead of defining the reference-point as the average of past income over the N preceding periods, we assume the the reference point follows an AR(1) process:

$$r_t = \rho r_{t-1} + (1-\rho) b_t = (1-\rho) \sum_{i=1}^{\infty} \rho^i b_{t-i}$$

This updating rule has longer "memory" and adjusts more smoothly than the benchmark reference point, with the speed of adjustment captured by ρ. [18]Column (4) of Table 3 shows the estimated speed of adjustment ρ=0.83, which implies slower adjustment (half-life is 56.5 days) than in the benchmark case. The estimates for the other parameters such as λ and γ are close to the benchmark estimates. The goodness of fit with AR(1) updating, though,

[18]When we implement this estimate we assume that the memory of the AR(1) update goes back to 1050 days (or 70 15-day period).

(188.4) is not quite as good as the benchmark estimates (172.6). Figure 10 (d) highlights that the AR(1) model lags behind the benchmark reference-point model in fitting the moments between 270 and 360 days.

Finally, we consider a model related to the reference-dependent one: a habit-formation model a la (Campbell and Cochrane 1999). We replace our reference dependent utility function (defined in Equation (1)) with the following one:

$$v(b_t, r_t) = log(b_t - zr_t),$$

where z captures the responsiveness of the utility function to changes in the habit stock, while r_t is calculated the same way as before, but reinterpreted as a measure of habit stock.[19] This model, which embeds the standard model for $z = 0$, is similar to the reference-dependent model in that it induces a temporarily high marginal utility of income following a benefit cut. The habit-formation model indeed fits the data better than the standard model (204.6 in the habit model vs 243.1 in the standard model), although its performance lags behind the reference dependence model (172.6), as also Figure 10 (d) shows.

Robustness. In Table 4 we consider the robustness of the key estimates of the standard model and of the reference-dependent model (respectively, Columns (2) and (5) of Table 2). First, we explore alternative curvature of the utility function: linear utility in Columns (1) and (2), a CRRA utility function with relative risk aversion parameter of 0.5 in Columns (3) and (4), and CRRA utility function with relative risk aversion parameter of 2 in Column (5) and (6). The best performing specification for the standard model is the linear utility in Column (1), but the improvement compared to our benchmark specification is negligible.[20] For the reference-dependent model the goodness of fit of these alternative models is slightly inferior compared to our benchmark specification, but the difference in fit is small and the estimates for key reference-dependence parameters, λ and$N$, are similar to the one in Column (5) suggesting that the curvature of the utility function is not crucial in explaining the observed hazard rates.

Next, Column (7) and Column (8) in Table 4 present estimations using the identity matrix to weight the moments in the minimum distance estimator. Though the goodness of fit cannot be compared to the previous estimates, the qualitative conclusions are the same as before: the reference-dependent model fits substantially better than the standard model and the reference-

[19]Observe that for low levels of b_t and high level of z this function is not defined. To avoid this problem(Campbell and Cochrane 1999) made z a non-linear function of $b_t - r_t$. For simplicity we treat z as a parameter instead and we check in the optimum whether our utility function is defined for the relevant b_t and r_t.

[20]In the standard model we were able to estimate the relative risk aversion parameter and we found that the best performing CRRA utility function is close to linear utility (results are not reported).

dependence parameters, λ and N remain comparable to the benchmark specifications. In Column (9) and Column (10) we estimate the model using moments after controlling for observables (shown in Figure 6 (b)). Again the key parameters are unaffected and the goodness of fit, even if they cannot be compared to the previous estimates, depicts the the same picture.

Finally, in Columns (11) and in Column (12) we estimate the average welfare (social assistance) benefit after UI expiration, which we have so far assumed to be \$90 per month. While \$90 is our best estimate of the average level of welfare benefis, we do not have direct data on welfare take-up rate and on the paid amount (since it depends on various family chracteristics). Including welfare in the estimation has negligible effect on the fit of the standard model (243.1 shrinks to 241.2), but it helps sizeably the fit of the reference-dependent model (172.6 shrinks to 159.5). The key parameters of the reference-dependent model are again very close to the benchmark estimations. The point estimates for the welfare amount are substantially different in the standard model (\$111) than in the reference-dependent model (\$61.7). [21]

Alternative Samples. So far we focused on individuals with pre-unemployment income sufficiently high such that they qualify for the highest possible UI benefit levels before and after the reform, thus yielding the cleanest natural experiment. One strength of our setting however is that we can compare whether other demographic groups that experienced different rule changes also display the same behavior and whether we obtain similar parameter estimates if we estimate our model on this subgroup of the population. Figure 2 highlights two alternative pre-unemployment income samples that we use. These are individuals with 75,000 to 85,000 HUF and 85 to 114,000 HUF. While they were not affected by the cap on the first step UI benefits after the reform, they nevertheless experienced the introduction of a two step UI system.

Figure 11 shows the corresponding actual hazard plots (the moments) and the simulated hazards from the estimated standard and the RD models for the two groups. Since both groups had lower earnings prior to becoming unemployment, their UI benefits in the post-period over the first 90 days are lower than in our main sample while benefits between 90 and 270 days are unaffected. Thus there is a much smaller drop-off in benefits after 90 days, which is reflected in the absence of a clear spike in the post-period in Figure 11 (a) and (c) at 90 days. There is however still a clear difference in the size of the benefit drop at 270 days between the before and after period, both for the medium and the low earnings base group and we still see a much

[21] The median welfare amount for those who are receiving welfare benefit is 22,800HUF (\$114), which is very close to that number. However, someone has to have very low level of household income to be eligible for this amount. This household income is very unlikely in our main sample given that we are focusing on UI claimants who had high earnings and were strongly attached to the labor market before job loss. Moreover, anecdotically there is substantial stigma and hussle cots associated with welfare in Hungary, which makes the take-up rate very low (30-50%).

larger spike in the hazard rate for the before period at 270 days and then a smaller one at 360 days. In particular the hazard rates of the before and after period still cross just before the 270 days mark, as would be expected with reference dependent preferences if people search harder in anticipation of the large loss-utility occurred after the 270 day mark. The basic pattern is thus still in line with our main sample and consistent with reference dependent preferences.

Table 5 Columns (3) and (4), as well as Columns (6) and (7)show the results for estimating our baseline standard and RD model on these two alternative samples. For both samples the standard model again provides a substantially worse fit than the RD model (the goodness of fit being 165.8 vs 148.1 for the first sample and 110.3 vs. 94.4 for the second sample). It is also noteworthy that we obtain almost the same estimates for the adjustment time for the reference point of 270 and 277days as in the benchmark model. Similarly the estimates suggest very similar values for λ, the gain-loss utility parameter. The fact that the estimates are so similar even though based on different samples and somewhat different natural experiment, is quite reassuring for our main estimates. Of course it is somewhat expected that the reference dependent model would be able to fit the data at least slightly better, since it allows for two additional free model parameters to be fitted thus offering more flexibility. In order to have a comparison of the reference dependent model with the same number of parameters as the standard model, we also estimated our model on the medium earnings base, however setting N and λ at the values that we obtain from our benchmark estimates (i.e. 255 and 1.73). Thus we estimate the same parameters as in the standard model (that is all the search cost parameters), while assuming the ame utility function across different samples. The estimates are shown in Columns (5) and (8). For both the medium and low earnings base samples, using the loss aversion parameter and adjustment speed parameter from our benchmark estimates, yield almost the same fit as when the parameters are allowed to differ across sample. For example in the medium earnings base sample, holding N and λ at the benchmark values decreases the goodness of fit from 148.1 to 149.7, which is still much better than for the standard model. The same holds for the low earnings base sample.[22]

[22]Finally we also estimated our model using all three pre-unemployment income groups jointly. For this we used 70 moments from each of the three groups, thus 270 in total. We allowed for different cost parameters and shares of the different unobserved search cost groups, across the three income groups. This captures the fact that individuals in different income groups are likely different along other dimensions and face different job prospects. We do however restrict the parameters of the utility functin to be the same across the three groups, in particular the search cost elasticity parameter γ as well as the RD parameters λ and N. In this joint model, the RD model still provides a substantially better fit than the standard model. What is most striking is that even in this joint estimation we still obtain very similar estimates for the gain-loss parameter $\lambda = 2.04$ and for the adjustment period $N = 255$, suggesting that both estimates are quite robust to different samples and specifications.

6 Discussion and Conclusion

In the previous section, we provided evidence that a model with referent-dependent preferences can explain qualitative features of the hazards which a standard model has a hard time fitting. The model itself builds on one of the most robust behavioral deviations from the standard model, reference dependence, and uses a natural candidate for a backward-looking reference point.

An important implication of the results above is that they open the door to potential redesigns in unemployment insurance policies. In particular, the evidence suggests that it is possible to design simple quasi-revenue-neutral transitions to two-steps systems which speed exit out of unemployment. While more evidence is needed to fully assess such UI designs, they open the door for a qualitative redesign of unemployment systems which typically instead involve only a one-step decrease. We should be clear though that we have not presented a full welfare analysis of such plans, which is beyond the scope of this paper.

Turning to some caveats, we want to stress two limitations of the above analysis. First, the job search model does not incorporate a reservation wage choice for the unemployed workers. In ongoing work, we extend the model to include a reservation wage decision, assuming linear utility. The preliminary result indicate that the qualitative conclusions are unaltered. In particular, it is hard to see how a reservation wage choice would help the standard model explain the path of the hazard for the longer durations.

Second, the model makes the stark assumption that individuals in each period consume their income. We make this assumption of hand-to-mouth consumers for computational reasons: incorporating a consumption-savings model with backward-looking reference-dependent preferences is computationally prohibitve, especially with slowly-updated reference points, as the evidence suggests. In the light of a consumption-savings model, o

ne can interpret the current set-up as the approximate solution for an individual with high impatience and therefore no assets, since this individual would optimally choose to essentially consume hand-to-mouth. The high rates of discounting implied by the current estimates is not inconsistent with this scenario.

References

Akerlof, George A, "Labor contracts as partial gift exchange," *The Quarterly Journal of Economics*, *97* (4), (1982), 543–569.

Allen, Eric, Patricia Dechow, Devin Pope, and George Wu, "Reference-Dependent Preferences: Evidence from Marathon Runners," *Working paper.*

Ashraf, Nava, Dean Karlan, and Wesley Yin, "Tying Odysseus to the mast: Evidence from a commitment savings product in the Philippines," *The Quarterly Journal of Economics*, *121* (2), (2006), 635–672.

Barbanchon, Thomas Le, "The Effect of the Potential Duration of Unemployment Benefits on Unemployment Exits to Work and Match Quality in France," *Insee, CREST, Working Paper*, (2012-21), (2012).

Barberis, Nicholas and Richard Thaler, "A survey of behavioral finance," *Handbook of the Economics of Finance*, *1* (2003), 1053–1128.

Barseghyan, Levon, Francesca Molinari, Ted O'Donoghue, and Joshua C. Teitelbaum, "The Nature of Risk Preferences: Evidence from Insurance Choices," *The American Economic Review*, *103* (2013), 2499-2529.

Boone, Jan and Jan C van Ours, "Why is There a Spike in the Job Finding Rate at Benefit Exhaustion?," *De Economist*, *160* (4), (2012), 413–438.

Bowman, David, Deborah Minehart, and Matthew Rabin, "Loss aversion in a consumption-savings model," *Journal of Economic Behavior & Organization*, *38* (1999), 155-178.

Camerer, Colin, Linda Babcock, George Loewenstein, and Richard Thaler, "Labor supply of New York City cabdrivers: One day at a time," *The Quarterly Journal of Economics*, *112* (2), (1997), 407–441.

Campbell, John Y and John H Cochrane, "By Force of Habit: A Consumption-Based Explanation of Aggregate Stock Market Behavior," *The Journal of Political Economy*, *107* (2), (1999), 205–251.

Card, David, Alexandre Mas, Enrico Moretti, and Emmanuel Saez, "Inequality at Work: The Effect of Peer Salaries on Job Satisfaction," *American Economic Review*, *102* (6), (2012), 2981–3003.

– and Gordon B. Dahl, "Family Violence and Football: The Effect of Unexpected Emotional Cues on Violent Behavior," *The Quarterly Journal of Economics*, *126* (2011), 103-143.

– , Raj Chetty, and Andrea Weber, "Cash-On-Hand and Competing Models of Intertemporal Behavior: New Evidence from the Labor Market," *Quarterly Journal of Economics*, *122* (4), (2007a), 1511–1560.

– , – , and – , "The spike at benefit exhaustion: Leaving the unemployment system or starting a new job?," *American Economic Review Papers and Proceedings*, *97* (2), (2007b), 113–118.

Chetty, Raj, "Moral hazard versus liquidity and optimal unemployment insurance," *Journal of political Economy*, *116* (2), (2008), 173–234.

– , Adam Looney, and Kory Kroft, "Salience and taxation: Theory and evidence," Technical Report, National Bureau of Economic Research (2007).

Cockx, Bart, Muriel Dejemeppe, Andrey Launov, and Bruno Van der Linden, "Monitoring,

Sanctions and Front-Loading of Job Search in a Non-Stationary Model," *mimeo*, (2013).
Conlin, Michael, Ted O'Donoghue, and Timothy J. Vogelsang, "Projection Bias in Catalog Orders," *American Economic Review*, *97* (2007), 1217-1249.
DellaVigna, Stefano and M Daniele Paserman, "Job Search and Impatience," *Journal of Labor Economics*, *23* (3), (2005).
– , John. A. List, and Ulrike Malmendier, "Testing for Altruism and Social Pressure in Charitable Giving," *Quarterly Journal of Economics*, *127* (2012), 1-56.
den Berg, Gerard J Van, "Nonstationarity in job search theory," *The review of economic studies*, *57* (2), (1990), 255–277.
Fallick, Bruce Chelimsky, "Unemployment insurance and the rate of re-employment of displaced workers," *The Review of Economics and Statistics*, (1991), 228–235.
Fehr, Ernst and Lorenz Goette, "Do Workers Work More if Wages Are High? Evidence from a Randomized Field Experiment," *The American Economic Review*, *97* (2007), 298-317.
– , Erich Kirchler, Andreas Weichbold, and Simon Gächter, "When social norms overpower competition: Gift exchange in experimental labor markets," *Journal of Labor economics*, *16* (2), (1998), 324–351.
– , Georg Kirchsteiger, and Arno Riedl, "Does fairness prevent market clearing? An experimental investigation," *The Quarterly Journal of Economics*, *108* (2), (1993), 437–459.
Frey, Mária, "The legal and institutional environment of the labour market," in Fazekas Károly and Köllõ János, eds., *The Hungarian labor market- Review and Analysis*, Institute of Economics IE-HAS, National Employment Service - Hungary, (2009).
Handel, Benjamin R, "Adverse selection and switching costs in health insurance markets: When nudging hurts," Technical Report, National Bureau of Economic Research (2011).
Hopenhayn, Hugo A. and Juan P. Nicolini, "Optimal Unemployment Insurance," *Journal of Political Economy*, *105* (2), (1997), 412–438.
Kahneman, Daniel and Amos Tversky, "Prospect theory: An analysis of decision under risk," *Econometrica: Journal of the Econometric Society*, (1979), 263–291.
– , Jack L Knetsch, and Richard Thaler, "Fairness as a constraint on profit seeking: Entitlements in the market," *The American economic review*, (1986), 728–741.
Katz, Lawrence F and Bruce D Meyer, "Unemployment insurance, recall expectations, and unemployment outcomes," *The Quarterly Journal of Economics*, *105* (4), (1990), 973–1002.
Kőszegi, Botond and Matthew Rabin, "A model of reference-dependent preferences," *The Quarterly Journal of Economics*, *121* (4), (2006), 1133–1165.
Kroft, Kory and Matt J. Notowidigdo, "Should Unemployment Insurance Vary With the Local Unemployment Rate? Theory and Evidence," *mimeo*, (2010).
Laibson, David, Andrea Repetto, and Jeremy Tobacman, "Estimating Discount Functions with Consumption Choices over the Lifecycle," *Working paper*, (2007).
Lindner, Attila and Balazs Reizer, "Frontloading the Unemployment Benefit: An Empirical Assessment," *mimeo*, (2014).
McCall, John J, "Economics of Information and Job Search," *The Quarterly Journal of Economics*, *84* (1), (1970), 113–26.
Micklewright, John and Gyula Nagy, "Living standards and incentives in transition: the implications of UI exhaustion in Hungary," *Journal of Public Economics*, *73* (1999),

297–319.
Mortensen, Dale T, “Job search and labor market analysis,” *Handbook of labor economics*, *2* (1986), 849–919.
Pavoni, Nicola and Giovanni L. Violante, “Optimal Welfare-to-Work Programs,” *Review of Economic Studies*, *74* (1), (2007), 283–318.
Post, Thierry, Martijn J Van den Assem, Guido Baltussen, and Richard H Thaler, “Deal or no deal? Decision making under risk in a large-payoff game show,” *The American economic review*, (2008), 38–71.
Rees-Jones, Alex, “Loss Aversion Motivates Tax Sheltering: Evidence from U.S. Tax Returns,” *Working paper*, (2013).
Schmieder, Johannes F, Till Von Wachter, and Stefan Bender, “The Effects of Extended Unemployment Insurance over the Business Cycle: Evidence from Regression Discontinuity Estimates over 20 years,” *The Quarterly Journal of Economics*, *127* (2), (2012a), 701–752.
– , – , and – , “The Causal Effect of Unemployment Duration on Wages: Evidence from Unemployment Insurance Extensions,” (2013).
Spinnewijn, Johannes, “Unemployed but Optimistic: Optimal Insurance Design with Biased Beliefs,” (2013).
Sydnor, Justin, “(Over)Insuring Modest Risks,” *American Economic Journal: Applied Economics*, *2:4* (2010), 177-199.
Thaler, Richard, “Toward a positive theory of consumer choice,” *Journal of Economic Behavior & Organization*, *1* (1), (1980), 39–60.
Thaler, Richard H, “Anomalies: interindustry wage differentials,” *The Journal of Economic Perspectives*, *3* (2), (1989), 181–193.
Tversky, Amos and Daniel Kahneman, “Loss aversion in riskless choice: A reference-dependent model,” *The Quarterly Journal of Economics*, *106* (4), (1991), 1039–1061.
van Ours, Jan and Milan Vodopivec, “Does reducing unemployment insurance generosity reduce job match quality?,” *Journal of Public Economics*, *92* (3-4), (2008), 684-695.
Wooldridge, Jeffrey M., *Econometric analysis of cross section and panel data*, MIT Press, (2010).

Table 1: Descriptive Statistics: Comparing Means of Main Variables Pre- and Post UI Reform

	before	after	diff	t-stat
Percent Women	41%	46%	5.2%	5.75
	(0.006)	(0.006)		
Age in Years	36.8	36.9	0.06	0.47
	(0.1)	(0.1)		
Imputed Education (years)	12.83	13.00	0.17	4.20
based on occupation	(0.028)	(0.031)		
Log Earnings in 2002	11.55	11.52	-0.03	-3.56
	(0.006)	(0.006)		
Log Earnings in 2003	11.70	11.68	-0.03	-2.72
	(0.005)	(0.007)		
Log Earnings in 2004	11.79	11.78	-0.01	-1.37
	(0.007)	(0.007)		
Waiting period*	31.1	32.0	0.84	1.18
	(0.47)	(0.51)		
Reemployment bonus claimed	0.000	0.059	0.059	19.81
	(0)	(0.003)		
Participate in training	N.A.	0.042		
		(0.003)		
Inconsistent observations	0.024	0.022	0.022	-0.75
	(0.002)	(0.002)		
Number of observations**	6305	5562		

Notes:
Participation in training programs was not recorded prior to 2006.
* number of days between jobb loss and UI claim.
* for log earnings in 2002; 2003; 2004 there are some missing values.

Table 2: Structural Estimation of Standard and Reference Dependent Model

Models:						
	Standard Model			**Reference Dep. Model**		
	(1)	(2)	(3)	(4)	(5)	(6)
Parameters of Utility Function						
Utility function $v(.)$	log(b)	log(b)	log(b)	log(b)	log(b)	log(b)
Loss aversion λ				3.16	1.73	3.47
				(0.24)	(0.22)	(0.56)
Gain utility η				1	1	1
Adjustment speed of reference point N in days				200.9	255.0	240.0
				(14.1)	(34.4)	(21.0)
Discount factor (15 days) δ	0.99	0.99	0.91	0.99	0.99	0.91
			(0.05)			(0.02)
Parameters of Search Cost Function						
Elasticity of search cost γ	3.04	0.11	0.69	0.12	0.06	0.52
	(1.49)	(0.02)	(0.28)	(0.02)	(0.01)	(0.13)
Search cost for high cost type k_{high}	999999.98	235.5	215.8	246.4	227.0	174.57
	(4802121)	(10.6)	(112.3)	(5.6)	(4.3)	(49.89)
Search cost for medium cost type k_{med}		193.6	138.8		186.0	42.45
		(4.2)	(55.0)		(11.7)	(30)
Search cost for low cost type k_{low}		91.2	46.4		83.2	10.3
		(5.0)	(9.8)		(18.7)	(11.0)
Share of low cost UI claimant		0.458	0.427		0.09	0.02
		(0.04)	(0.05)		(0.04)	(0.02)
Share of medium cost UI claimant		0.538	0.571		0.37	0.06
		(0.04)	(0.05)		(0.16)	(0.03)
Model Fit						
Number of moments used	70	70	70	70	70	70
Number of estimated parameters	2	6	7	4	8	9
Goodness of Fit	455.3	243.1	238.1	217.6	172.6	164.1
Heterogeneity in cost	no	yes	yes	no	yes	yes
Delta estimated	no	no	yes	no	no	yes

Notes:
The table shows parameter estimates for the standard and the reference dependent search model. Estimation is based on minimum distance estimation, using the hazard rates in the pre- and post-reform periods as the moments.
Standard errors for estimated parameters in parentheses.

Table 3: Alternative Specifications for Structural Estimation of Reference Dependent Model and Habit Formation Model

Models:	**Benchmark**	**Alternative Eta**		**AR(1) Updating**	**Habit Formation**
	(1)	(2)	(3)	(4)	(5)
Parameters of Utility Function					
Utility function $v(.)$	log(b)	log(b)	log(b)	log(b)	log(b-z*rf)
Loss aversion λ	1.73	6.58	0.84	1.94	
	(0.22)	(1.11)	(0.04)	(0.37)	
Gain utility η	1	0.2	5	1	
Adjustment speed of reference point N in days	255.0	240.0	300.0		120.0
	(34.4)	(27.09)	(44.72)		(38.76)
Habit formation parameter z					0.38
					(0.04)
AR(1) parameter				0.83	
				(0.03)	
Implied half life of AR(1) process				56.5	
Parameters of Search Cost Function					
Elasticity of search cost γ	0.06	0.07	0.08	0.06	0.12
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Search cost for high cost type k_{high}	227.0	216.4	296.2	221.0	251.4
	(4.3)	(3.8)	(13.9)	(4.5)	(8.0)
Search cost for medium cost type k_{med}	186.0	182.2	217.9	176.3	207.4
	(11.7)	(15.3)	(14.4)	(7.9)	(7.5)
Search cost for low cost type k_{low}	83.2	82.7	85.1	82.5	133.5
	(18.7)	(20.3)	(18.2)	(18.8)	(6.0)
Share of low cost UI claimant	0.09	0.08	0.11	0.09	0.60
	(0.04)	(0.04)	(0.04)	(0.05)	(0.04)
Share of medium cost UI claimant	0.37	0.31	0.45	0.45	0.40
	(0.16)	(0.23)	(0.08)	(0.09)	(0.10)
Model Fit					
Number of moments used	70	70	70	70	70
Number of estimated parameters	8	8	8	8	8
Goodness of Fit	172.6	175.0	168.0	188.4	204.6
Heterogeneity in cost	yes	yes	yes	yes	yes

Notes:
The table shows parameter estimates for the reference dependent search model and the habit formation model. Estimation is based on minimum distance estimation, using the hazard rates in the pre- and post-reform periods as the moments.
Standard errors for estimated parameters in parentheses.

Table 4: Estimating Standard and Reference Dependent Model, Robustness Checks

Models:	Linear Utility		CRRA Utility		CRRA Utility		Weighting Matrix Identity		Moments with Controls		Welfare benefits Estimated	
	Stnd. Model	Ref. Dep. Model	Stnd. Model	Ref. Dep. Model	Stnd. Model	Ref. Dep. Model	Stnd. Model	Ref. Dep. Model	Stnd. Model	Ref. Dep. Model	Stnd. Model	Ref. Dep. Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Parameters of Utility Function												
Utility function $v(.)$	b	b	$\frac{b^{(1-\kappa)}}{(1-\kappa)}$	$\frac{b^{(1-\kappa)}}{(1-\kappa)}$	$\frac{b^{(1-\kappa)}}{(1-\kappa)}$	$\frac{b^{(1-\kappa)}}{(1-\kappa)}$	log(b)	log(b)	log(b)	log(b)	log(b)	log(b)
Util. function parameter κ			0.5	0.5	2	2						
Loss aversion λ		1.95		1.97		1.37		1.93		1.68		1.77
		(0.15)		(0.19)		(0.17)		(0.14)		(0.21)		(0.21)
Gain utility η		1		1		1		1		1		1
Adjustment speed of reference point N in days		211.9		240.0		270.0		255.0		255.0		240.0
		(17.5)		(24.3)		(43.3)		(26.2)		(34.2)		(35.0)
Discount factor (15 days) δ	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Welfare level	90	90	90	90	90	90	90	90	90	90	110.1	61.7
											(12.9)	(8.33)
Parameters of Search Cost Function												
Elasticity of search cost γ	0.05	0.04	0.07	0.05	0.23	0.09	0.10	0.07	0.10	0.06	0.09	0.06
	(0.007)	(0.005)	(0.011)	(0.007)	(0.045)	(0.012)	(0.015)	(0.008)	(0.015)	(0.008)	(0.017)	(0.009)
Search cost for high cost type k_{high}	61759.7	65866.3	3618.5	3862.6	1.45	1.13	230.3	252.1	229.4	225.54	207.6	272.54
	(1014.7)	(1034.7)	(96.7)	(229.6)	(0.18)	(0.03)	(8.7)	(45.82)	(8.7)	(4.11)	(16.7)	(16.97)
Search cost for medium cost type k_{med}	56044.3	62194.0	3145.2	3633.3	1.03	0.73	191.3	228.7	191.2	187.40	176.5	217.17
	(279.9)	(458.1)	(31.8)	(36.9)	(0.09)	(0.03)	(3.2)	(3.33)	(3.4)	(8.94)	(9.8)	(11.09)
Search cost for low cost type k_{low}	37306.5	32785.5	1803.2	1898.1	0.28	0.22	95.9	124.87	93.9	88.70	87.9	100.50
	(1424.4)	(11535.8)	(84.4)	(350.0)	(0.02)	(0.04)	(4.4)	(7.86)	(4.7)	(18.17)	(4.9)	(13.34)
Share of low cost UI claimant	0.42	0.034	0.44	0.081	0.46	0.148	0.50	0.194	0.48	0.100	0.43	0.141
	(0.04)	(0.026)	(0.04)	(0.038)	(0.04)	(0.037)	(0.04)	(0.003)	(0.04)	(0.044)	(0.04)	(0.045)
Share of medium cost UI claimant	0.58	0.96	0.55	0.92	0.54	0.55	0.50	0.81	0.51	0.41	0.57	0.66
	(0.04)	(0.027)	(0.04)	(0.039)	(0.04)	(0.045)	(0.04)	(0.009)	(0.04)	(0.150)	(0.04)	(0.064)
Model Fit												
Number of moments used	70	70	70	70	70	70	70	70	70	70	70	70
Number of estimated parameters	6	8	6	8	6	8	6	8	6	8	6	8
Goodness of Fit	239.3	179.8	240.4	175.3	251.8	173.7	0.0034*	0.0027*	219.7	146.8	241.2	159.5
Heterogeneity in cost	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes

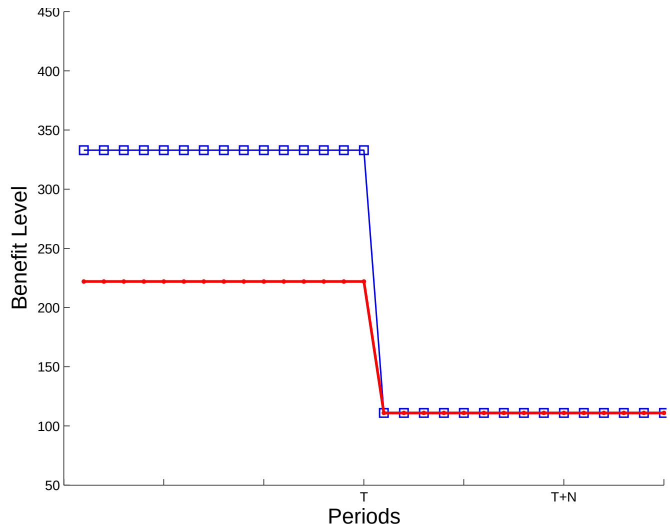
Notes:
The table shows parameter estimates for the standard and the reference dependent search model. Estimation is based on minimum distance estimation, using the hazard rates in the pre- and post-reform periods as the moments.
Standard errors for estimated parameters in parentheses.
These are the SSE with the identity weighting matrix and are not comparable to the goodness of fit statistics in the other columns.

Table 5: Estimation of Standard and Reference Dependent Model

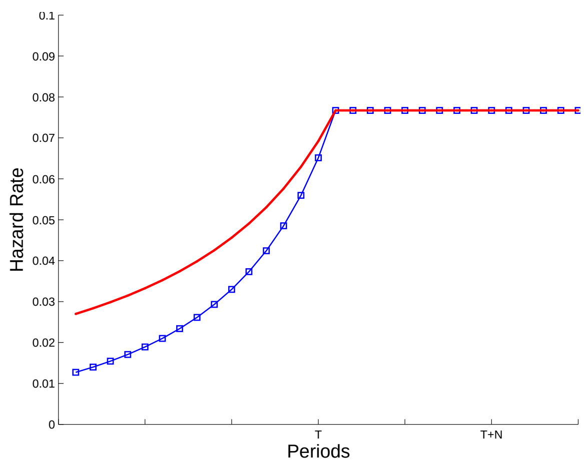
Samples:	Benchmark Sample		Pre-UI Income Medium Earnings Base			Pre-UI Income Low Earnings Base		
	Standard Model	Ref. Dep. Model	Standard Model	Ref. Dep. Model	Ref. Dep. Model	Standard Model	Ref. Dep. Model	Ref. Dep. Model
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Parameters of Utility Function								
Utility function	log(b)	log(b)	log(b)	log(b)	log(b)	log(b)	log(b)	log(b)
Loss aversion λ		1.73		1.97	1.73		1.66	1.73
		(0.216)		(0.364)			(0.353)	
Gain utility η		1		1	1		1	1
Adjustment speed of reference point N in days		255		270	255		277	255
		(34.4)		(62.3)			(77.2)	
Discount factor (15 days) δ	0.99	0.99	0.99	0.99	0.99	0.99	0.99	0.99
Parameters of Search Cost Function								
Elasticity of search cost γ	0.11	0.06	0.18	0.10	0.12	0.07	0.07	0.07
	(0.018)	(0.009)	(0.043)	(0.024)	(0.022)	(0.013)	(0.016)	(0.010)
Search cost for high cost type k_{high}	235.5	227.0	233.4	206.7	229.7	165.1	176.6	175.4
	(10.6)	(4.3)	(27.9)	(8.4)	(21.0)	(4.0)	(7.6)	(2.2)
Search cost for medium cost type k_{med}	193.6	186.0	177.5	129.9	202.1	136.2	137.9	135.8
	(4.2)	(11.7)	(12.5)	134.2)	(5.7)	(4.8)	(14.0)	(13.3)
Search cost for low cost type k_{low}	91.2	83.2	54.2	62.2	77.9	57.2	67.2	66.6
	(5.0)	(18.7)	(9.1)	52.4)	(13.7)	(4.2)	(11.3)	(12.0)
Share of low cost UI claimant	0.458	0.091	0.248	0.078	0.1745	0.404	0.210	0.2005
	(0.039)	(0.040)	(0.054)	(0.174)	(0.0401)	(0.045)	(0.093)	(0.0815)
Share of medium cost UI claimant	0.538	0.367	0.749	0.108	0.8228	0.519	0.366	0.3694
	(0.039)	(0.158)	(0.054)	(0.148)	(0.0403)	(0.049)	(0.155)	(0.0901)
Model Fit								
Number of Moments	70	70	70	70	70	70	70	70
Number of estimated parameters	6	8	6	8	6	6	8	6
Goodness of Fit	243.1	172.6	165.8	148.1	149.7	110.3	94.4	94.8
Heterogeneity in cost	yes	yes	yes	yes	yes	yes	yes	yes

Notes:
The table shows parameter estimates for the standard and the reference dependent search model. Estimation is based on minimum distance estimation, using the hazard rates in the pre- and post-reform periods as the moments.
Standard errors for estimated parameters in parentheses.

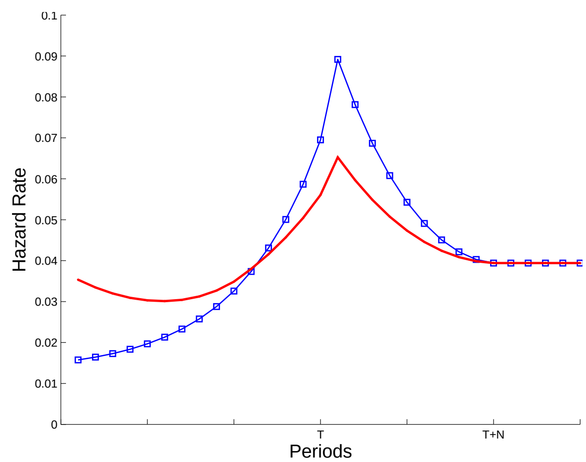
Figure 1: Model Simulations of the Standard and the Reference-Dependent model



(a) Benefits



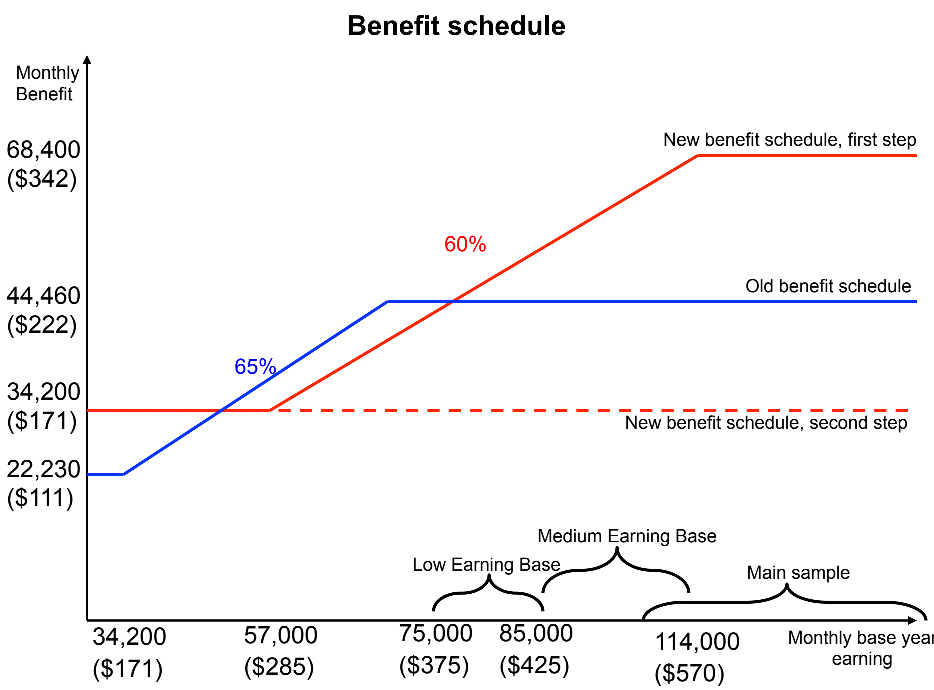
(b) Standard Model



(c) Reference-Dependent Model

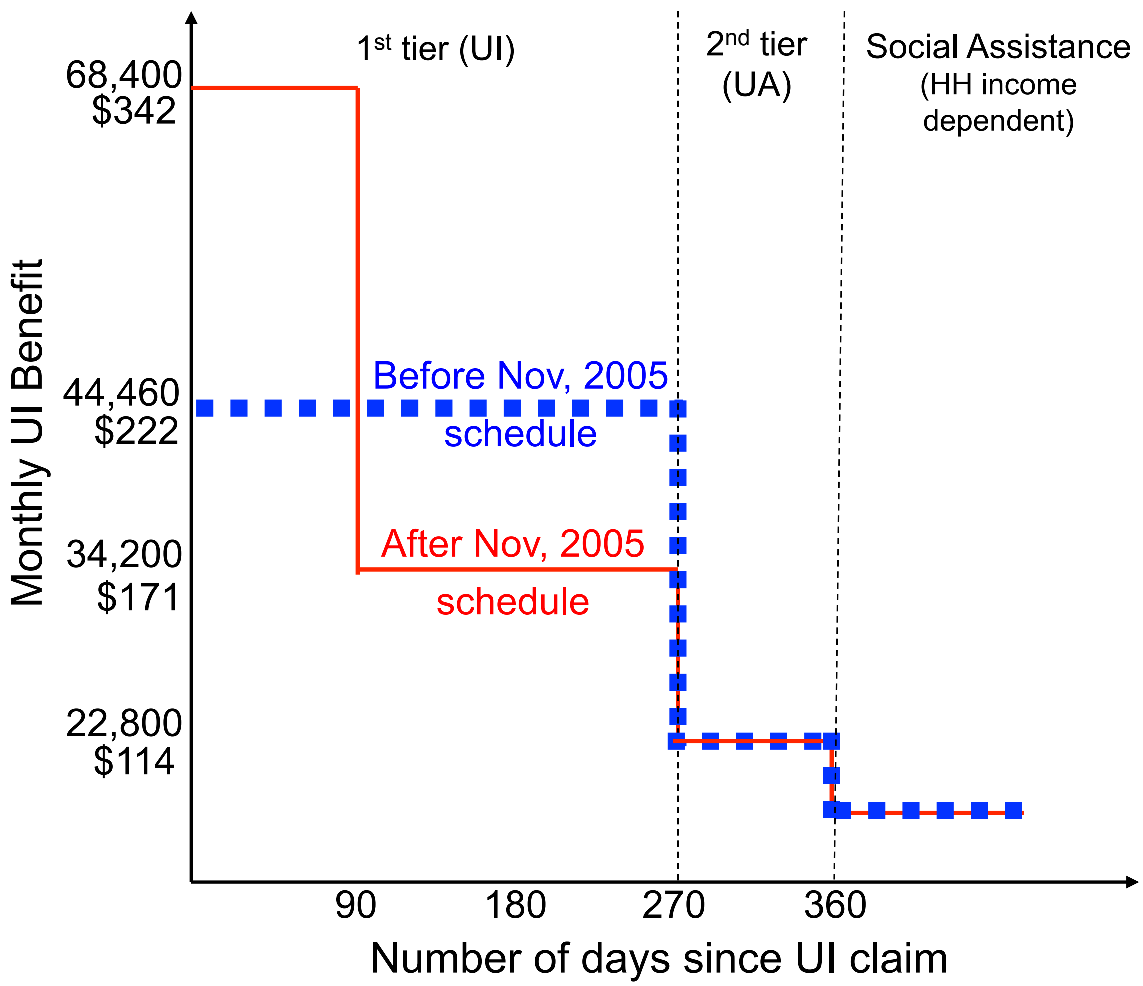
Notes: Panel (a) shows two benefit regimes, both of them having a step-down benefit system. In the first step benefits are higher in the regime represented by squared blue line than in the regime represented by red solid line. In the second step benefits drops to the same level. Panel (b) shows the hazard rates predicted by the standard model (with $k = 130$, $\gamma = 0.6$, $w = 555$, $\delta = 0.99$) while Panel (c) the prediction of the reference-dependent model (with $k = 160$, $\gamma = 0.6$, $w = 555$, $\delta = 0.99$, $\lambda = 2$, $N = 10$).

Figure 2: The UI Benefit Schedule Before and After the 2005 Reform in Hungary



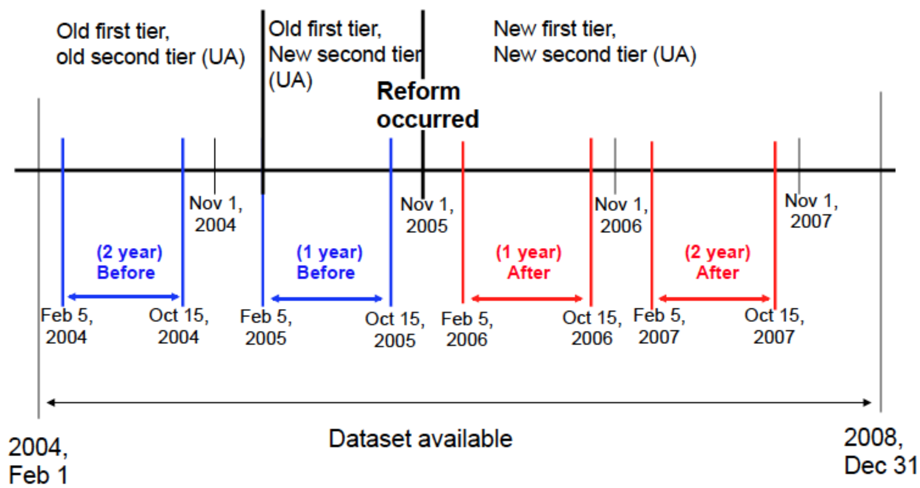
Notes: The figure shows monthly UI benefits in the first tier under the old rule (blue solid line) in the first 90 days under the new rules (red solid line) and between 91-270 days under the new rules (red dashed line) as a function of the monthly base salary. The main sample, defined by being above the 70th percentile of the earnings base distribution of the UI claimants in the given year, denoted by the curly brackets. We also show the sample definitions used for our out of sample analysis (results presented in Table 5): medium earnings base sample is defined by being between the 60th and 78th percentile of the earnings base distribution of the UI claimants in the given year, low earnings base sample is defined by being between the 60th and 78th percentile of the earnings base distribution of the UI claimants in the given year.

Figure 3: Benefit Path Change, Main Sample



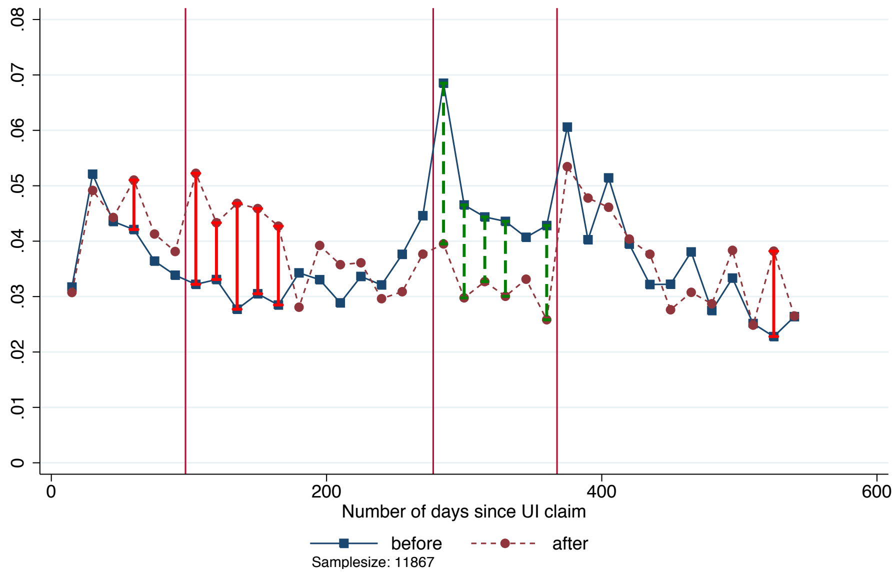
Notes: The figure shows the benefit schedule if UI is claimed on October 31, 2005 (old benefit schedule, dashed blue line) and benefit schedule if UI is claimed on November 1st, 2005 (new benefit schedule, solid red line) for individuals who had 270 potential duration in the first-tier, were less than 50 years old and earned more than 114,000 HUF ($570) prior to entering UI. Hypothetical benefit level is shown under social assistance. Benefits levels in social assistance depended on family income, household size and wealth and we do not observed these variables in our data.

Figure 4: Before-After Comparison Groups for Quasi-experiment

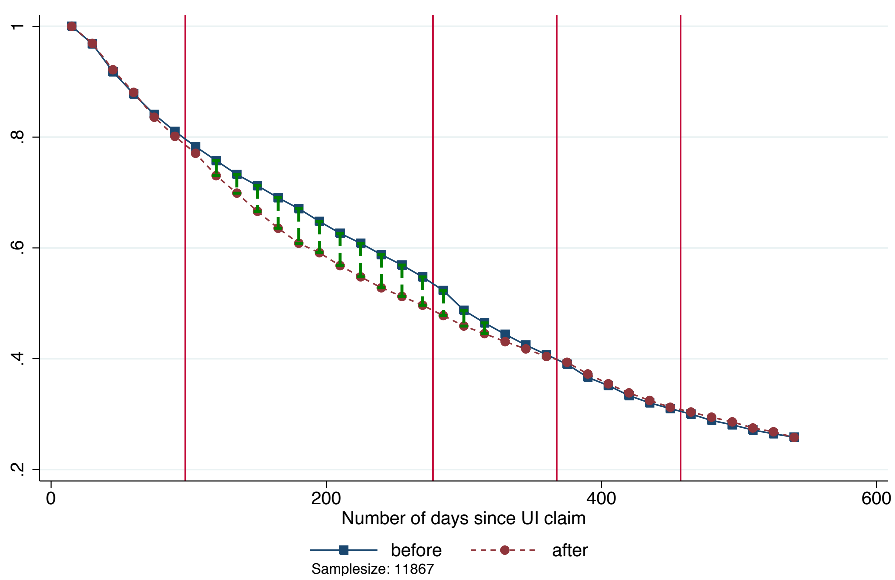


Notes: The figure shows the time frame for which we have access to administrative data on unemployment insurance records, the time of the reform and how we define the before and after periods that we use for our before-after comparison.The timing of the reform was the following: those who claimed UI benefit before February 5th, 2005 faced with the old first tier schedule and old second tier schedule; those who claimed benefit between February 5th, 2005 and October 31th, 2005 faced with the old benefit schedule in the first tier and the new benefit schedule in the second tier; those who claimed benefit after November 1st, 2005 faced with the new benefit schedule in the first tier and the new benefit schedule in the second tier. To avoid complications caused by changes in the second tier, in our main specifications we focus on the (1 year) before sample, claimed UI between February 5th, 2005 and October 15th, 2005, and (1 year) after sample, claimed UI between February 5th, 2006 and October 15th, 2006. We use the (2 year) before sample and the (2 year) after sample to show that the changes in the hazard rates are in line with the timing of the reform. The first tier changes before and after October 31th, 2005 are presented in Figure 2 and Figure 3. The changes in the second tier in February 5th, 2005 were the following: potential duration shortened to 180 days above age 50 and to 90 days below that. Before, it was 270 days above age 45 and 180 days below that. The benefit level was raised slightly from 21,000 HUF ($101) to 22,800 HUF ($114).

Figure 5: Empirical Hazard and Survival Rates under the Old and the New Benefit Schedule



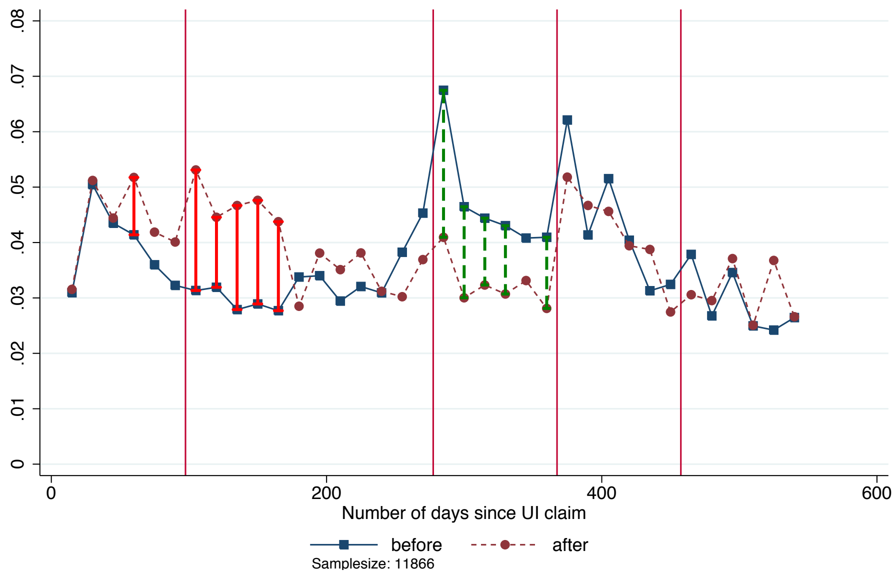
(a) Empirical hazard rates



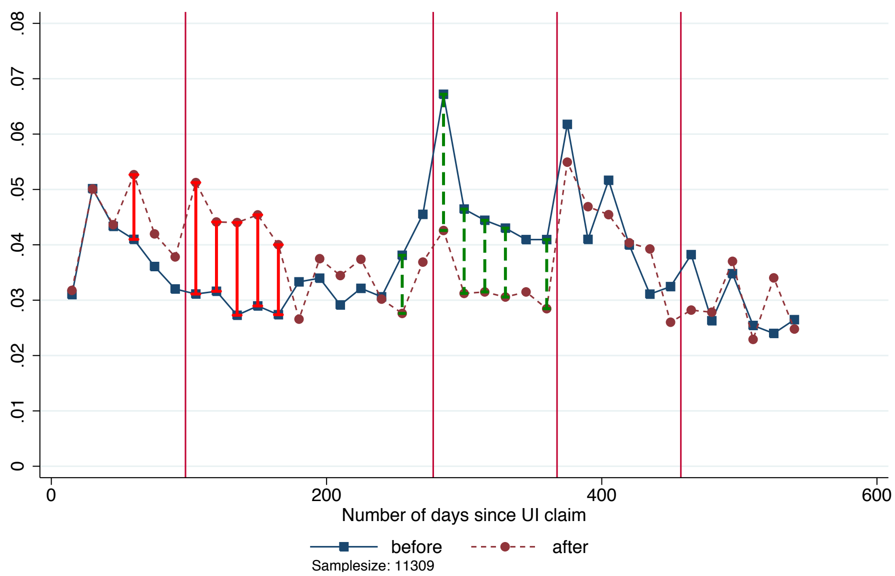
(b) Empirical survival rates

Notes: The figure shows point wise estimates for the empirical hazards, Panel (a), and for the empirical survival rates, Panel (b), before and after the reform. The differences between the two periods are estimated point-wise at each point of support and differences which are statistically significant are indicated with a vertical bar. The three major (red) vertical lines indicate periods when benefits change in the new system. The sample consists of unemployed workers claiming UI between February 5th, 2005 and October 15th, 2005 (before sample) and February 5th, 2006 and October 15th, 2006 (after sample), who had 270 days of potential duration, were 25-49 years old, and were above the 70th percentile of the earnings base distribution of the UI claimants in the given year (See Figure 4 for details).

Figure 6: Robustness Checks for change of Hazard rates before and after the reform



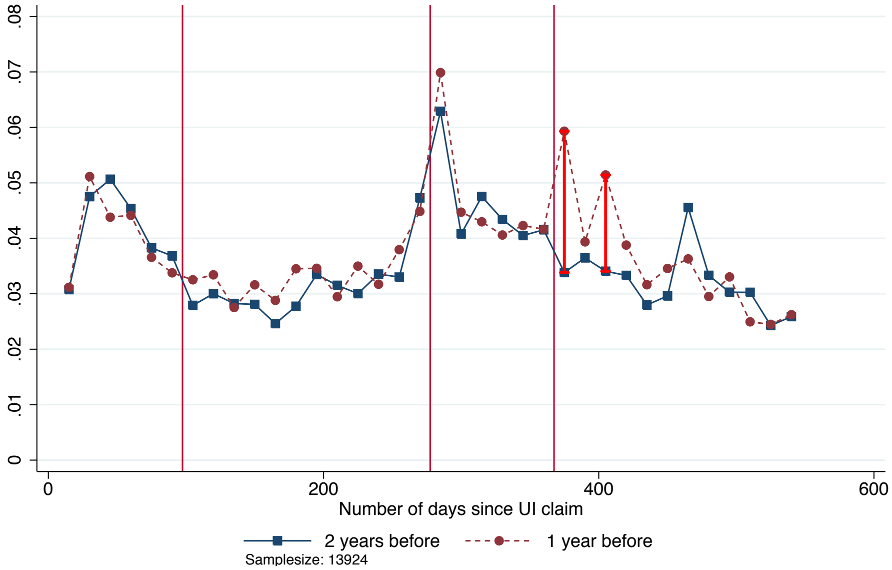
(a) Controlling for observable differences



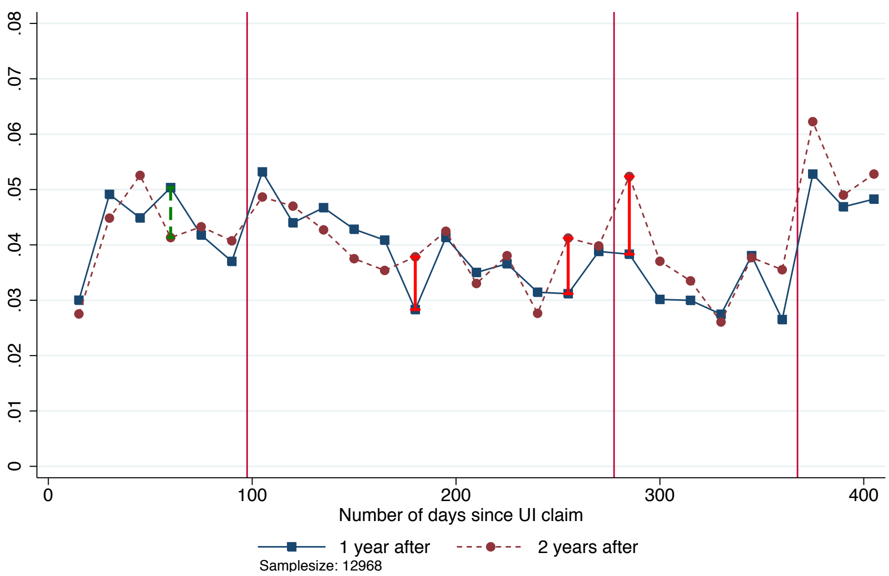
(b) Restricted sample

Notes: The figure shows point wise estimates for the empirical hazards before and after the reform. The differences between the two periods are estimated point-wise at each point of support and differences which are statistically significant are indicated with a vertical bar. The three major (red) vertical lines indicate periods when benefits change in the new system. In Panel (a) we controlled for sex, age, age square, waiting period (the number of days between job lost and UI claimed), the county of residence, day of the month UI claimed claimed, education, occupation (1 digit) of the last job, log earnings in 2002 and 2003. In Panel (b) in addition to controlling for these control variables we dropped reemployment bonus claimants and those participating in training program (after the reform), see text for the details. The sample is otherwise the same as in Figure 5.

Figure 7: Comparison to (2 year) Before and (2 year) After



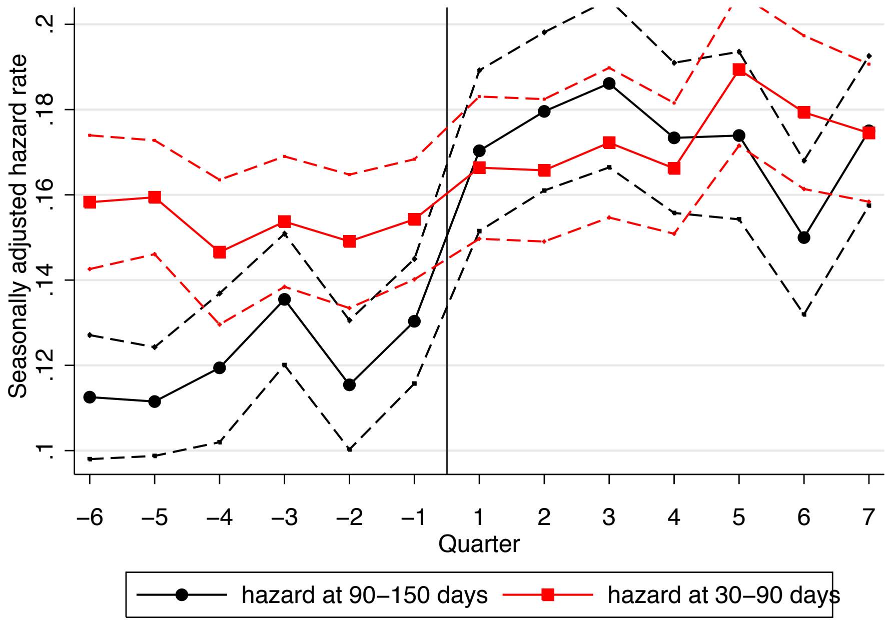
(a) Compare the hazards 2 year before and 1 year before



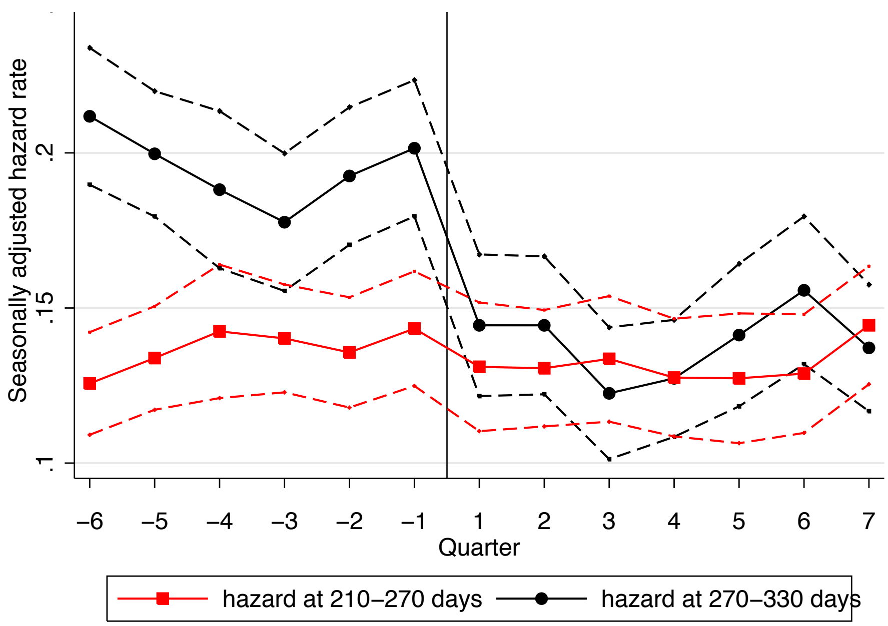
(b) Compare the hazards 2 year after and 1 year after

Notes: Panel (a) shows point wise estimates for the empirical hazards for two year before (claimed benefit between February 5st, 2004 and October 15th, 2004) and one year before (claimed benefit between February 5th, 2005 and October 15th, 2005) the actual reform. Panel (b) shows point wise estimates for the empirical hazards for one year after (claimed benefit between February 5th, 2006 and October 15th, 2006) and two year after (claimed benefit between February 5th, 2007 and October 15th, 2007) the actual reform. This graph is censored at 400 days because of data limitations. The differences between the two periods are estimated point wise at each point of support and differences which are statistically significant are indicated with a vertical bar. The three major (red) vertical lines indicate periods when benefits change in the new system. Other sample restrictions are the same as in Figure 5.

Figure 8: Interrupted Time Series Analysis of Exit Hazards



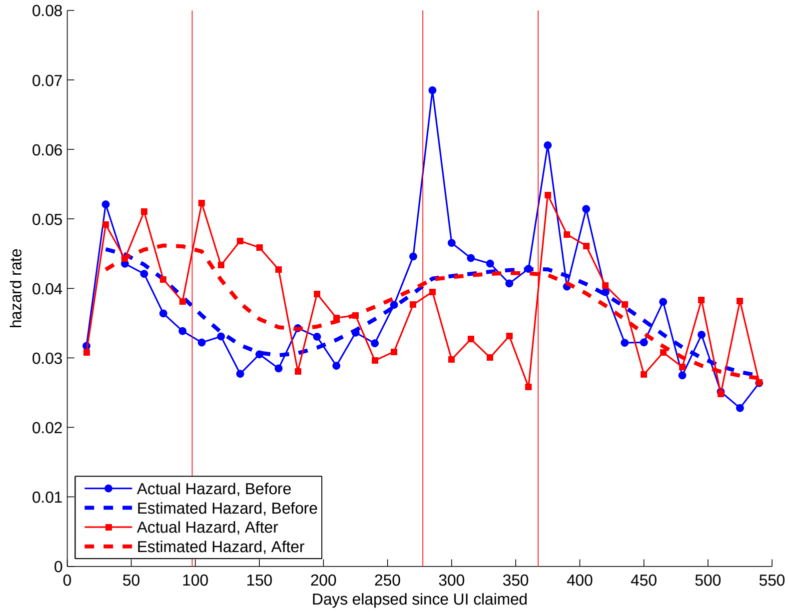
(a) The evolution of the hazard rates between 30 and 150 days



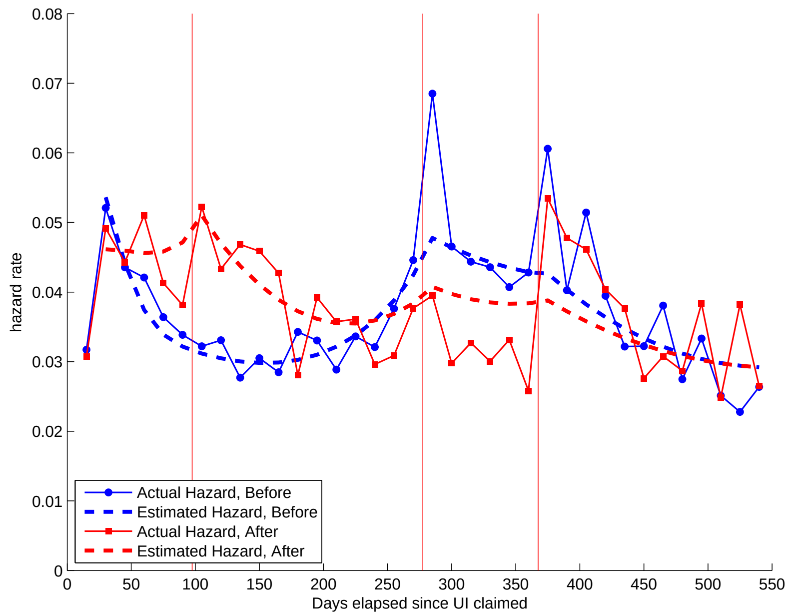
(b) The evolution of the hazard rates between 210 and 330 days

Notes: The figure shows the level of the most important hazard rates 6 quarters before and 7 quarters after the reform. Panel (a) shows the seasonally adjusted hazard rates between 30 and 150 days, while Panel (b) shows the seasonally adjusted hazard rates between 210 and 330 days. The monthly seasonal adjustment of hazard rates takes into consideration the level shift present in the data in November, 2005. The figures highlight that the shift in the hazard plots documented earlier corresponds to the precise timing of the reform. Other sample restrictions are the same as in Figure 5.

Figure 9: Structural Estimation of the Standard and the Reference-dependent model



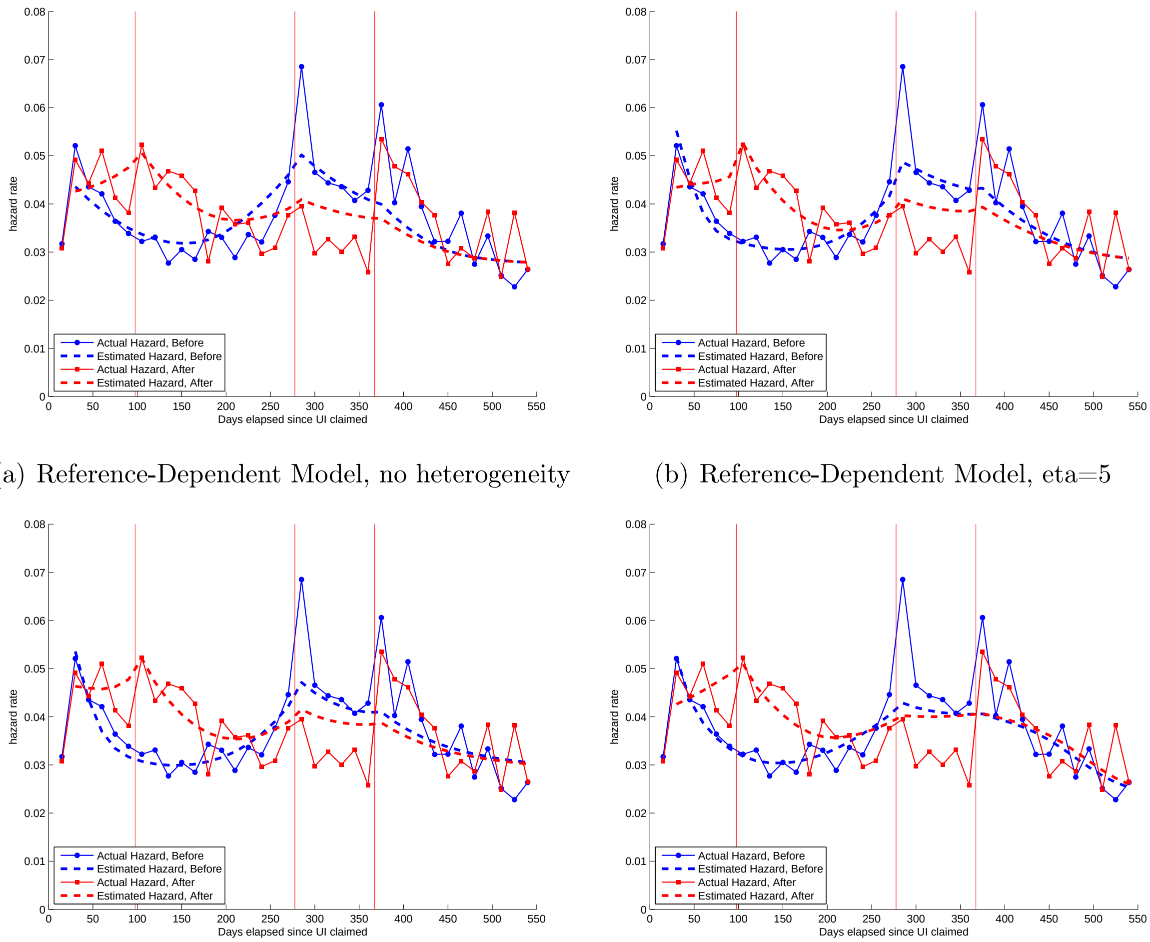
(a) Standard Model



(b) Reference Dependent Model

Notes: The figure shows the empirical hazards and the predicted hazards of the standard model, Panel (a), and of the reference-dependent model, Panel (b), with three cost types (column (2) and column (5) in Table 2, respectively). The three major (red) vertical lines indicate periods when benefits change in the new system.

Figure 10: Alternative estimates of the reference-dependent model



(a) Reference-Dependent Model, no heterogeneity

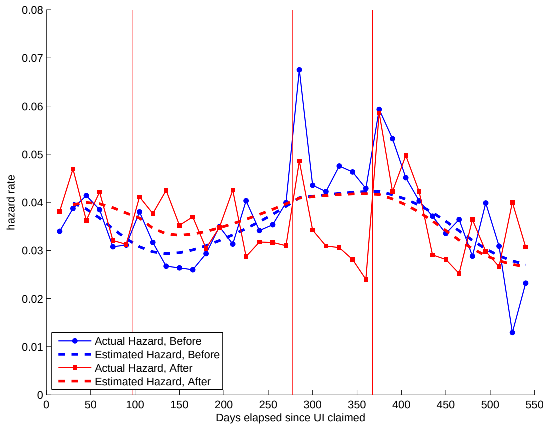
(b) Reference-Dependent Model, eta=5

(c) Reference-Dependent Model, AR(1) update

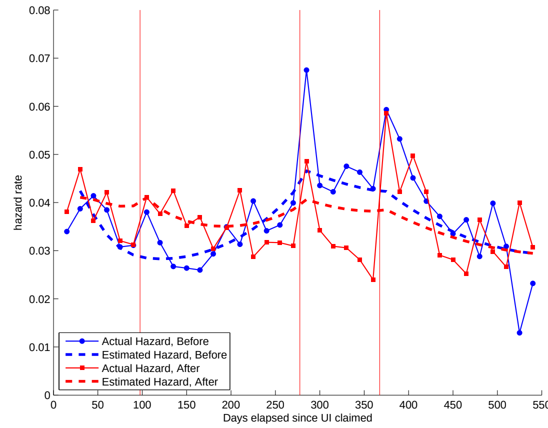
(d) Habit Formation Model

Notes: The figure shows the empirical hazards and the predicted hazards of the alternative versions of the structural estimations. Panel (a) shows the reference-dependent model with no heterogeneity in search cost (column (4) in Table 2). Panel (b), (c) and (d) present estimates with three cost types. Panel (b) shows the reference-dependent model with eta=5 (column (3) in Table 3) and Panel (c) presents the reference-dependent model with AR(1) updating of the reference point (column (4) in Table 3). Panel (d) shows the predictions of the habit formation model (column (5) in Table 3). The three major (red) vertical lines indicate periods when benefits change in the new system.

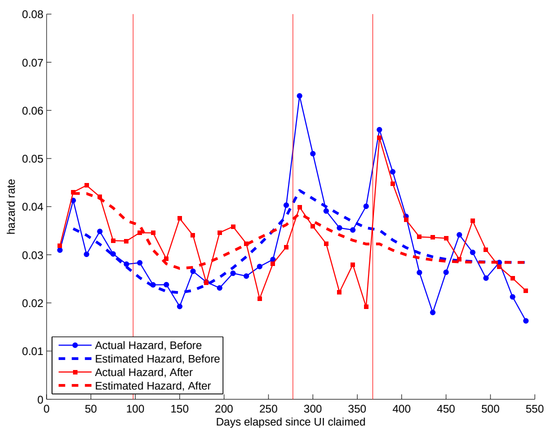
Figure 11: Structural Estimation of the Standard and the Reference-dependent model for groups with alternative earnings base



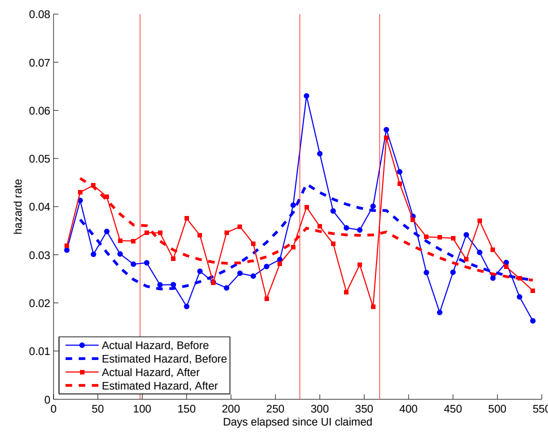
(a) Standard model, Medium Earnings Base



(b) Reference-Dependent Model, Medium Earnings Base



(c) Standard Model, Low Earnings Base

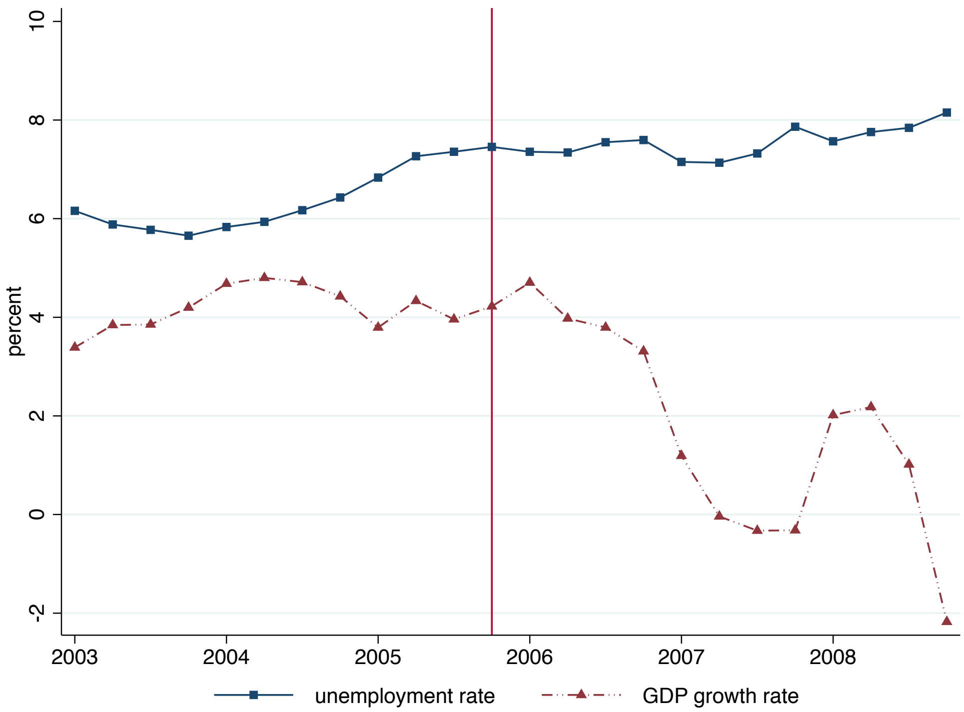


(d) Reference-Dependent Mode, Low Earnings Base

Notes: The figure shows the empirical hazards and the predicted hazards of the UI claimant with alternative earnings base. Panel (a) and Panel (b) present estimates for those whose earnings base were between the 60th and the 78th percentile of the earnings base distribution of the UI claimants in the given year. Panel (a) shows the fit of the standard model (column (3), Table 5) and Panel (b) for the reference-dependent model (column (5), Table 4). Panel (c) and Panel (d) present the results for those whose earnings base were between the 49th and the 60th percentile of the earnings base distribution of the UI claimants in the given year. Panel (a) shows estimates for the standard model (column (5), Table 5) and Panel (b) illustrates the estimates for the reference-dependent model (column (6), Table 5). All panels present estimations with three cost types. The three major (red) vertical lines indicate periods when benefits change in the new system.

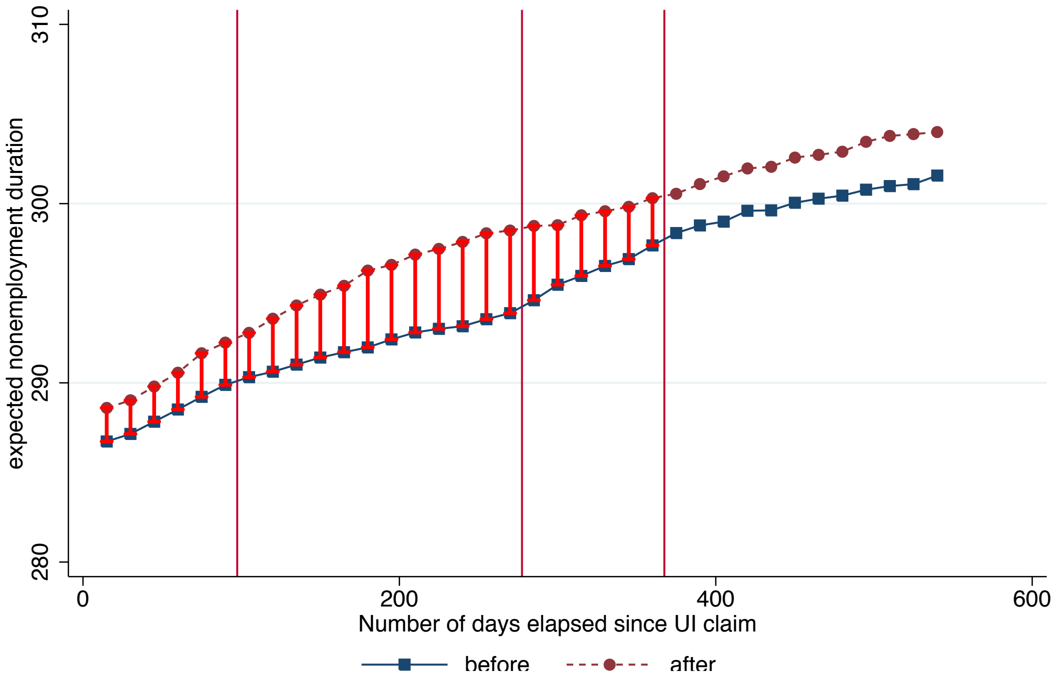
Appendix

Figure A-1: GDP growth and unemployment rate in Hungary



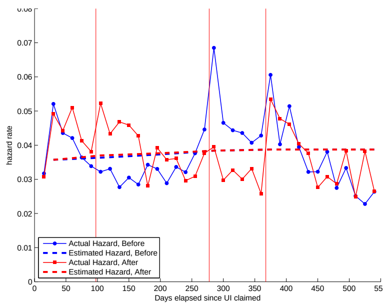
Notes: The figure shows the seasonally adjusted GDP growth rate (dashed red line) and the seasonally adjusted unemployment rate (solid blue) between 2003 and 2008 in Hungary. The major (red) vertical lines indicate the quarter in which the new system was introduced. The data was obtained from the Hungarian Central Statistical Office.

Figure A-2: Selection Throughout the Spell of Non-employment

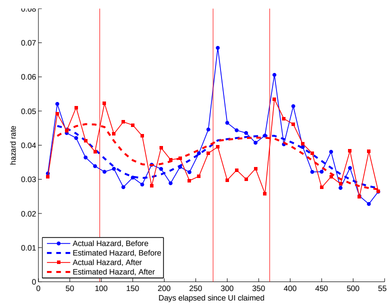


Notes: The figure shows estimates of the expected nonemployment duration of individuals exiting unemployment at the respective time. The expected nonemployment duration is derived as the predicted values from a regression of nonemployment duration on observable characteristics at the time of entering unemployment. These observable characteristics are the following: sex, age, age square, waiting period (the number of days between job lost and UI claimed), the county of residence, day of the month UI claimed claimed, education, occupation (1 digit) of the last job, log earnings in 2002 and 2003. The differences between the two periods are estimated point wise at each point of support and differences which are statistically significant are indicated with a vertical bar. The three major (red) vertical lines indicate periods when benefits change in the new system. The sample consists of unemployed workers claiming UI between February 5th, 2005 and October 15th, 2005 (before sample) and February 5th, 2006 and October 15th, 2006 (after sample) who had 270 days of potential duration, were 25-49 years old, and were above the 70th percentile of the earnings base distribution of the UI claimants in the given year.

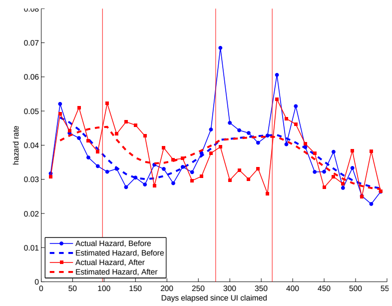
Figure A-3: Structural Estimation of the Standard and the Reference-dependent model



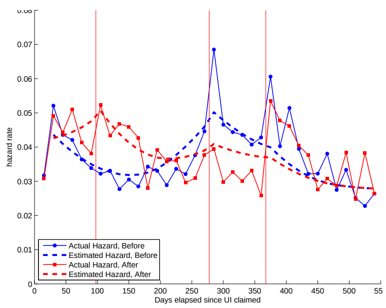
(a) Standard Model, 1 type



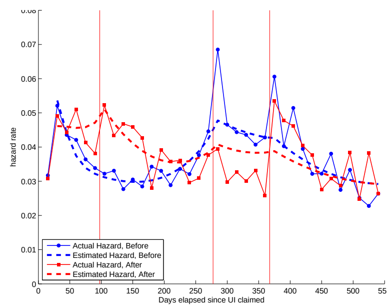
(b) Standard Model, 3 type



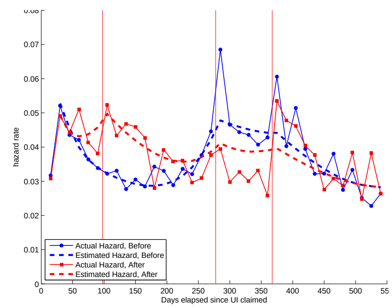
(c) Standard Model, 3 type, δ Estimated



(d) Reference-Dependent Model, 1 Type



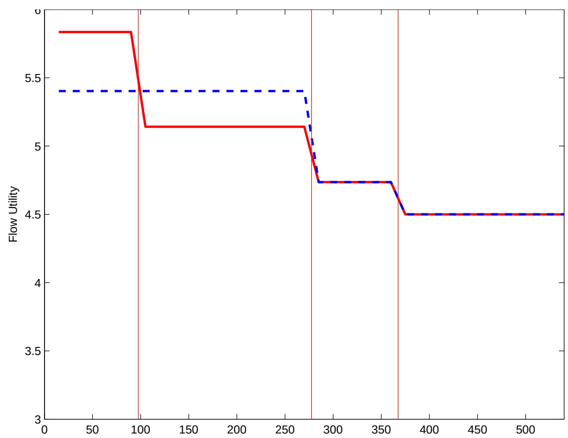
(e) Reference-Dependent Model, 3 Type



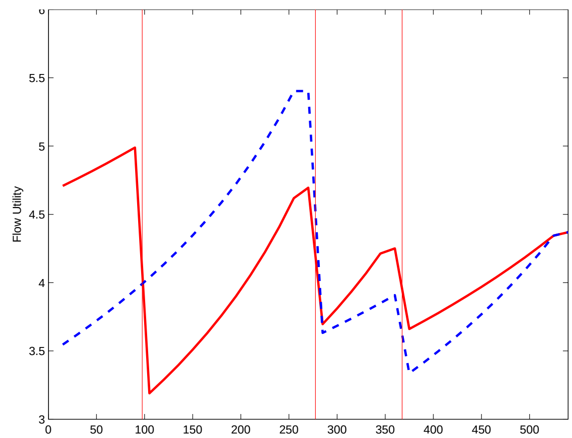
(f) Reference-dependent model, 3 type, δ Estimated

Notes: The figure shows the empirical hazards and the predicted hazards for estimations presented in Table 2. Panel (a), (b) and (c) show the fit for the standard model, while Panel (d), (e), and (f) for the reference-dependent model. In Panel (a) and Panel (d) we show estimates without any heterogeneity in cost level (column (1) and (4) in Table 2). In Panel (b) and Panel (e) three-type heterogeneity in cost level introduced (column (2) and column (5) in Table 2), and in Panel (c) and (f) in addition to that the subjective discount factor was also estimated (column (3) and column (6) in Table 2). The three major (red) vertical lines indicate periods when benefits change in the new system.

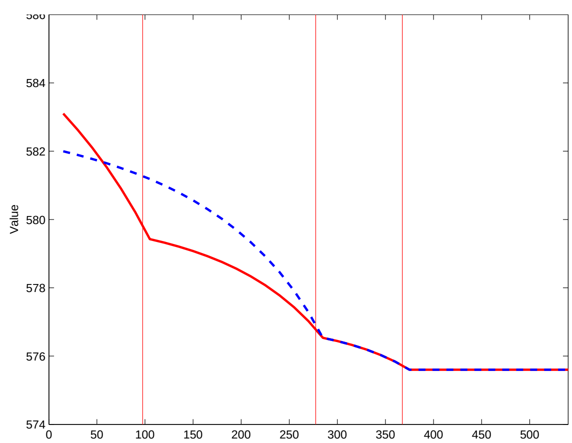
Figure A-4: Model Components for Simulated Standard and Reference-Dependent Model, Part I



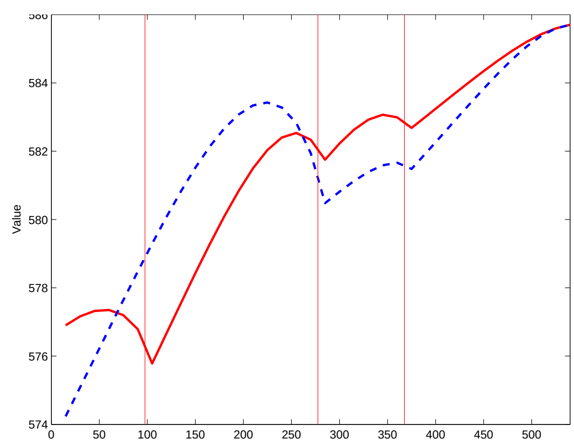
(a) Flow Utility, Standard Model



(b) Flow Utility, Reference-Dependent model



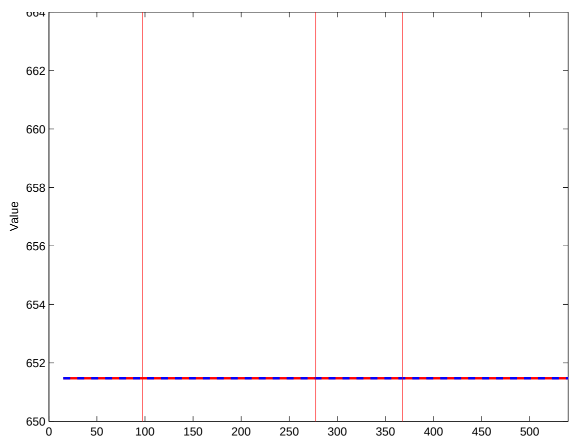
(c) Value of Unemployment for the Low Cost Type, Standard Model



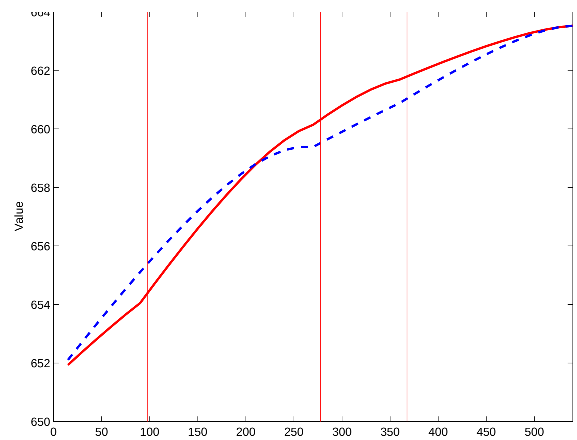
(d) Value of Unemployment for the Low Cost Type, Reference-Dependent model

Notes: The figure shows the model components for the standard model (estimates showed in column (2) in Table 2) and for the reference-dependent model (estimates showed in column (5) in Table 2). Panel (a) and Panel (b) shows the flow utility for the standard model and for the reference-dependent model, respectively. Panel (c) and Panel (d) shows the value of unemployment for the low cost type for the standard model and for the reference-dependent model, respectively. The three major (red) vertical lines indicate periods when benefits change in the new system.

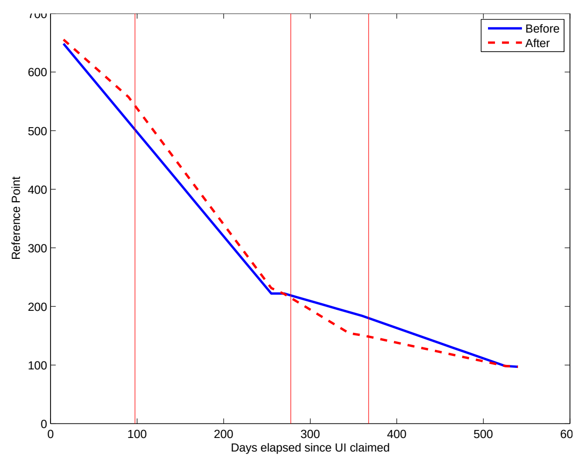
Figure A-5: Model Components for Simulated Standard and Reference-dependent Model, Part II



(a) Value of Employment, Standard Model



(b) Value of Employment, Reference-Dependent model



(c) Reference Point, Standard Model

Notes: The figure shows the model components for the standard model (estimates showed in column (2) in Table 2) and for the reference-dependent model (estimates showed in column (5) in Table 2). Panel (a) and Panel (b) shows the value of employment for the standard model and for the reference-dependent model, respectively. Panel (c) shows the the evolution of the reference point in the reference-dependent model. The three major (red) vertical lines indicate periods when benefits change in the new system.