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Can a search model predict the effects of an increase in the benefit duration? Evidence from the Portuguese unemployment insurance reform

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Abstract

We test the predictions of an equilibrium search model about the effects of an increase in the maximum duration of unemployment benefits. We use the 1999 unemployment insurance reform of Portugal, a quasi-natural experiment. The reform increased the maximum duration of benefits for three groups of agents and maintained all features of the unemployment insurance for two other groups. We isolate the effects of the increase in the maximum duration of benefits and test the model. The model successfully predicts the effects on the unemployment rate, the labor force participation, and the levels of unemployment and employment.

JEL Classification: E24, J23, J64

Keywords: Unemployment duration, Unemployment benefits, Equilibrium search, Labor market reforms, Quasi-natural experiment

1 Introduction

In 1999, the Portuguese government increased the maximum duration of unemployment benefits for workers with specific ages. We use this event to test if an equilibrium search model correctly predicts the effects of an increase in the maximum duration of unemployment benefits.

We use the model of Alvarez and Veracierto (2000), a general equilibrium search model for which the unemployment insurance system is modeled through the replacement ratio, the criteria of eligibility, and the duration of unemployment benefits. We test the model to determine to what extent a policy maker can use the model to make predictions about changes in the unemployment insurance system. Following the argument in Lucas (1981), once the model reproduces the effects of simpler policies, we have more confidence in its predictions about more complex policy changes.

The 1999 reform is a quasi-natural experiment as it created treatment and control groups in a way that resembles a controlled experiment. We first estimate the impact of the increase in the maximum benefit duration, following the literature on the effects of the unemployment insurance system on the labor market. We then use our results to test the search model.

We find that the model is successful in predicting the effects on the unemployment rate, the labor force participation, and the levels of unemployment and employment. On the other hand, the average duration of unemployment decreased for the groups 15–24 and 40–44, while, as standard in search models, the model predicts an increase in the average duration of unemployment. In any case, the predictions lie within the confidence intervals for the estimates of the effects after the reform. For the group 30–34, the model correctly predicts the increase in the average duration of unemployment. In general, the differences between data and predictions are small.

2 The reform of the unemployment insurance system

The 1999 reform increased the maximum benefit duration for particular groups of agents. There were no changes in other aspects of the unemployment insurance system, such as the value of the benefit and the eligibility criterion. Before July 1999, there were eight maximum benefit durations. After July 1999, the number of maximum benefit durations decreased to four. The benefit duration is based only on the age of the recipient at the beginning of the unemployment spell. Table 1 summarizes the reform. The age groups 15–24, 30–34, and 40–44 are especially relevant for us, as these groups had an increase in the maximum benefit duration and each one has a well-defined control group.

The groups 15–24 and 25–29 form the first set of treatment and control groups, respectively. The maximum benefit duration of the group 15–24 increased from 10 to 12 months, which equalized the maximum benefit duration of the group 25–29. Similarly, the groups 30–34 and 35–39 form our second set of treatment and control groups, respectively. For the group 40–44, the maximum benefit duration increased from 21 to 24 months. As the maximum benefit duration of the next older age group, the group 45–49, also increased, we use the group 35–39 as control group for the group 40–44.

For the groups of agents older than 45, the maximum benefit duration became a function of the number of years of social security contributions. The dataset does not have the complete record of social contributions, and so, we cannot determine the increase in the maximum benefit duration. For the group 55–64, the reform introduced early retirement after a period of unemployment with little or no penalties. Early retirement affects agents in different ways than the increase in the maximum duration of benefits. For these reasons, we concentrate our analysis on the groups 15–24, 30–34, and 40–44. For these groups, we can determine the increase in the maximum benefit duration, and this was

Table 1 Maximum benefit duration before and after the reform

Age	Before (months)	Age	After (months)	Change (months)
15–24	10	15–24	12	2
25–29	12	25–29	12	0
30–34	15	30–34	18	3
35–39	18	35–39	18	0
40–44	21	40–44	24	3
45–49	24	45–49	30 (+8)[a]	6 (+8)
50–54	27	50–54	30 (+8)[a]	3 (+8)
55–64	30	55–64	30 (+8)[a]	0 (+8)

Age at the beginning of the unemployment spell

[a]For those aged 45 or older, the maximum benefit duration increased 2 months for each 5 years of social contributions during the previous 20 years

the only change of the reform. The reform increased considerably the maximum benefit duration. The size of the increase helps the identification of the effects of the reform.

The good conditions around the time of the reform indicate that the reform was exogenous. The average real GDP growth was 3.3%, and the unemployment rate was 4.7% from 1997 to 2002 (data from *Instituto Nacional de Estatistica*). The effects of a reform may be overstated if the reform is induced by recessions (Lalive et al. 2006; Lalive and Zweimüller 2004). This is not the case of the 1999 reform. Moreover, the rules of the reform applied only to those entering unemployment after the reform. This feature allows us to use agents before and after the reform to control for macroeconomic effects and for unobserved heterogeneity among agents.

3 The impact of the reform

We use social security administrative data from *Instituto de Informatica e Estatistica da Seguranca Social* for data on the recipients of benefits. The dataset has wages and the amount and duration of unemployment benefits of all spells of unemployment benefit recipients from 1998 to 2002. The recipients are followed from the moment in which they register until they leave the system. The before period corresponds to the spells initiated from January 1998 to June 1999. The after period corresponds to the spells initiated from July 1999 to December 2002.[1]

For data on nonrecipients of benefits, labor force participation, and other labor statistics, we use the quarterly labor force survey *Inquerito ao Emprego*, from *Instituto Nacional de Estatistica*. We use data from 1998:Q1 to 2002:Q4. We track transitions from inactivity, unemployment, and employment and compute the duration of unemployment spells. We have a total of 130,788 observations. From these, 104,686 correspond to spells initiated after the reform. Table 2 shows summary statistics by age group.

The proportion of males and females across treatment and control groups is similar. It varies from 41 to 60% for women, with the exception of the 40–44 group before the reform, with 35%. There are larger differences in ages and pre-unemployment wages. The effect of age is the result of the definition of the treatment and control groups, which yields older control units. Similarly, pre-unemployment wages are higher for older agents, which is expected given the age and tenure profile of wages. The inclusion of age in the conditional difference-in-differences estimator, as done below, corrects for the observed heterogeneity.

The average treatment impacts on the duration of unemployment of benefit recipients are 48, 76, and 115 days for the 15–24, 30–34, and 40–44 age groups, respectively (Table 2). All estimates are statistically and economically significant. The impact reflects the decisions of agents to increase the duration of their search as unemployed workers. They could have opted for not using the increased generosity and even reduce their unemployment spells, as it occurred for the two control groups.

An indicator of the quality of the experiment and of the data is the decrease in the difference of unemployment durations between the control and treatment groups. The difference decreased when the maximum benefit durations were equalized. Before the reform, the group 25–29, with two more months of maximum benefit duration than the group 15–25, had 57 days more of unemployment duration. After the reform, the difference in the unemployment duration between the two groups decreased to 9 days. For the group 30–34, the difference to the group 35–39 decreased from 95 to 19 days. Another

Table 2 Summary statistics and unconditional difference-in-differences

	15–24		25–29		30–34		35–39		40–44	
	Treatment		Control		Treatment		Control		Treatment	
	Before	After	Before	After	Before	After	Before	After	Before	After
Unemployment (days)	146.2	179.0	203.0	187.9	206.5	269.3	301.5	288.3	266.9	368.6
Differences	32.8		−15.1		62.9		−13.2		101.7	
	(1.8)		(1.7)		(2.8)		(3.0)		(4.8)	
Difference-in-differences	47.9		76.1		114.9					
	(2.5)		(4.1)		(5.4)					
Female (proportion)	0.49	0.57	0.48	0.60	0.43	0.56	0.41	0.52	0.35	0.47
Pre-unemployment wages										
Average	401.1	443.5	513.0	599.4	581.2	645.1	662.3	660.0	689.5	679.4
Median	385.8	416.1	458.8	525.6	472.7	537.3	502.3	514.8	495.5	517.9
Age	22.0	22.2	27.0	27.0	31.9	31.8	36.9	36.9	41.8	41.9
Observations	5149	17,962	7084	30,254	5075	24,478	5358	17,827	3436	14,165

Mean values unless otherwise noted. The dataset and the estimation include region, month, and year of unemployment insurance claims. Standard deviations in parentheses

indicator is the reduction in the unemployment duration of only 2 weeks for the control groups.

Table 3 shows the difference-in-differences estimates of the impact of the increase in the maximum benefit duration on the duration of unemployment for benefit recipients. The introduction of control variables yields a slightly lower impact: from 48 to 43 days for the group 15–24, 76 to 74 days for the group 30–34, and 115 to 110 days for the group 40–44.

The size of the estimates is consistent with estimates obtained for Portugal and for other countries. For Portugal, Addison and Portugal (2008) find a large elasticity of the unemployed workers to the benefit duration. Using survey data, they obtain that an increase in the benefit duration of 3 months reduces the escape rate by 70%. Pereira (2006) finds that an increase in the maximum benefit period decreases the probability of leaving unemployment with benefits. Our results are also consistent with Centeno and Novo (2007), although they use the nonparametric Kaplan-Meyer estimator and the quantile treatment effect method.

For Slovenia, Van Ours and Vodopivec (2006) obtain a large impact on unemployment duration for a reduction in the benefit duration. They find that the cumulative probability of leaving unemployment after 12 months increases from 63 to 77% when the benefit duration is reduced from 12 to 6 months. For Germany, Hunt (1995) obtains a reduction of 46% in the hazard of unemployment for an increase in the duration of benefits of 6 months.[2]

Table 3 The impact of the reform, difference-in-differences estimates (in days)

	Treatment groups					
	15–24		30–34		40–44	
	(1)	(2)	(3)	(4)	(5)	(6)
After	−15.1	16.8	−13.2	34.4	−13.2	21.2
	(1.6)	(3.0)	(2.9)	(5.0)	(3.4)	(6.4)
Treat	−56.8	−38.9	−95.1	−66.7	−34.6	−53.7
	(2.2)	(2.7)	(3.7)	(4.6)	(4.8)	(6.1)
After × treat	47.9	42.8	76.1	74.4	114.9	110.2
	(2.5)	(2.5)	(4.1)	(4.1)	(5.4)	(5.3)
Log of previous wage		1.8		34.3		57.2
		(1.2)		(1.6)		(2.1)
Female		0.4		14.4		34.5
		(1.0)		(1.7)		(2.3)
Age		−0.1		31.0		−9.3
		(2.9)		(7.6)		(11.7)
Age^2		0.1		−0.4		0.2
		(0.1)		(0.1)		(0.1)
Dummies						
Regional	No	Yes	No	Yes	No	Yes
Month of unemployment	No	Yes	No	Yes	No	Yes
Year of unemployment	No	Yes	No	Yes	No	Yes
Observations	60,449	60,449	52,738	52,738	40,786	40,786

The group 25–29 is the control group for the treatment group 15–24. The group 35–39 is the control group for the treatment groups 30–34 and 40–44. Age at the beginning of the subsidized period. The coefficient on *After* × *treat* is the difference-in-differences estimate of the impact of the increase in the maximum duration of benefits on the unemployment duration of benefit recipients. Standard deviations in parentheses

4 Can a search model predict the effects of the reform?

We use the model of Alvarez and Veracierto (2000) because it considers separately the duration of unemployment benefits, the replacement rate, and the eligibility criterion. Moreover, the labor force is endogenous in the model. We can then change the duration of benefits and calculate the effects on labor market variables, including the labor force.[3]

There are different production sectors. Productivity in each sector changes over time. The agents decide to stay, move to another sector, or leave the labor market according to the productivity. If the agents move, they search for one period as unemployed workers and are assigned randomly to another sector in the following period. If they leave the labor market, they engage in home production. Agents in home production have to search for one period to reenter the labor market.

Agents have preferences

$$E_0 \sum_{t=0}^{\infty} \beta^t \left(\frac{c_t^{1-\gamma} - 1}{1-\gamma} + h_t \right), \tag{1}$$

where c_t is consumption of market goods, h_t is consumption of home goods, $0 < \beta < 1$, and $\gamma \geq 0$. Higher γ implies that it is more difficult to substitute home goods for market goods. Production of market goods in each sector is given by $y_t = z_t g_t^{\alpha}$, $0 < \alpha < 1$, where g_t is the number of employed agents and z_t is the productivity of the sector. Productivity follows $\log z_{t+1} = \rho \log z_t + \varepsilon_{t+1}$, where ε_{t+1} has normal distribution with mean zero and variance σ^2, independent across sectors, $0 < \rho < 1$. Each sector begins with x agents. Some of these agents work and others leave, so $g(x,z) \leq x$. Let U, to be determined in equilibrium, denote the number of agents that arrive in each sector in every period as unemployed agents. The number of agents in the sector (x,z) in the following period is $x' = g(x,z) + U$.

Agents that stay in a certain sector receive wages $w(x,z)$ and begin the following period in the same sector as workers. Wages are equal to the marginal productivity of labor. The value of being in sector (x,z), so far without unemployment insurance, is

$$v(x,z) = \max \left\{ w\left(g(x,z), z\right) + \beta E\left[v\left(g(x,z) + U, z'\right) | z \right], \theta \right\}, \tag{2}$$

where θ is the value of the search. Home production yields w^h goods. As θ is the value of an agent who leaves a sector, it satisfies

$$\theta = \max \left\{ \beta E\left[v(x,z) \right], w^h + \beta\theta \right\}; \tag{3}$$

θ is equal to the maximum between the values of staying in the labor force as an unemployed worker, $\beta E[v(x,z)]$, and leaving the labor force, $w^h + \beta\theta$.

The equilibrium conditions are the following. First, agents outside the labor force are indifferent between searching or staying out of the labor force; therefore, $\beta E[v(x,z;U)] = w^h + \beta\theta$. Second, the value of leaving a sector is equal to the present value of home production. This condition implies $\theta = w^h/(1-\beta)$ when $\gamma = 0$ and $\theta c^{-\gamma} = w^h/(1-\beta)$ when $\gamma > 0$, where c is the aggregate consumption of the market good.

When unemployment insurance is available, the agents receive the unemployment benefit when they leave a sector to search for employment. The unemployment insurance system is modeled by the value of the benefit b, the probability of eligibility κ, and the probability of maintaining eligibility ψ. The unemployment insurance system is financed

with lump-sum taxes. The increase in the maximum duration of benefits is modeled as an increase in ψ.

The value of the search for ineligible agents, θ_0, and eligible agents, θ_1, are given by

$$\begin{aligned}\theta_0 &= \max\left\{w^h + \beta\theta_0, \beta E\left[\max\{v(x,z), \theta_0\}\right]\right\}, \\ \theta_1 &= b + \max\Big\{w^h + \beta\left[\psi\theta_1 + (1-\psi)\theta_0\right], \\ &\qquad \beta\left(\psi E\left[\max\{v(x,z), \theta_1\}\right] + (1-\psi) E\left[\max\{v(x,z), \theta_0\}\right]\right)\Big\}.\end{aligned} \tag{4}$$

The agents take into account that they will be eligible in the following period with probability ψ. The value of beginning in sector (x,z) for a worker employed in the previous period changes to

$$v(x,z) = \max\left\{w\left(g(x,z), z\right) + \beta E\left[v\left(g(x,z) + U, z'\right) \mid z\right], \kappa\theta_1 + (1-\kappa)\theta_0\right\}. \tag{5}$$

The value of the search, $\kappa\theta_1 + (1-\kappa)\theta_0$, now depends on the probability of eligibility. The equilibrium conditions are similar to the case without unemployment insurance, with the different functional form of $v(x,z)$ and the additional conditions for θ_0 and θ_1. The unemployment insurance system increases the value of work, which increases the labor force participation and the average duration of unemployment.

To obtain the parameters (Table 4), we follow Alvarez and Veracierto (2000, 2001), Gomes et al. (2001), Ljungqvist and Sargent (2007), and, for Portuguese data, Cavalcanti (2007) and Silva (2008). The three critical parameters of the model are b, ψ, and κ, which characterize the unemployment insurance system.

Given the heterogeneity of the groups, we obtain the parameters for each group separately. The groups are 10 to 25 years apart and in different positions of their life cycle. The unemployment rate of the group 40–44 before the reform, for example, was 3.8%, less than half the unemployment rate of 10% of the group 15–24. The ratio of recipients to unemployed workers was 8% for the group 15–24, 24% for the group 30–34, and 36% for the group 40–44.

We set the unemployment benefit b from the average replacement ratio in the period before the reform (1998:Q1 to 1999:Q2). In contrast to the structure in the USA, there are no experience-rated taxes or other taxes that mix unemployment benefits with firing costs (Anderson and Meyer 2000). For the probability of eligibility κ, we use the ratio of recipients to unemployed workers. As the reform did not change the eligibility criterion, we set κ equal to the average ratios before and after the reform. For the 30–34 group,

Table 4 Parameters

		15–24	30–34	40–44
b	Unemployment benefit	0.77	0.70	0.68
κ	Probability of eligibility	0.08	0.24	0.36
ψ	Persistence of eligibility, before the reform	0.38	0.13	0.33
	after the reform	0.53	0.36	0.52
ρ	Persistence of z	0.99095	0.99420	0.99524
σ^2	Variance of $z \times 100$	1.246	0.565	0.4355
w^h	Domestic productivity	1.404	0.7357	0.7759
α	Labor share	0.7	0.7	0.7
β	Intertemporal discount	0.99024	0.98058	0.98058

b in model periods of wages. Model period: 3 months for the group 15–24 and 6 months for the other groups. w^h for $\gamma = 1$; the other parameters do not depend on γ

for example, the ratio before and after the reform increased from 23 to 25%. We use the average of the two values, 24%.

The probability of maintaining eligibility ψ implies that the expected duration of eligibility is $1/(1-\psi)$ periods. As it is common in the literature, we use data on the average duration of unemployment benefits. For before the reform, we use the average duration from 1998:Q1 to 1999:Q2. For after the reform, we use the results from the controlled experiment obtained in Section 3. These results remove the effects unrelated to the reform. For the 30–34 group, for example, the average duration of benefits increased from 6.9 to 9.4 months. The duration of 9.4 months is obtained through the sum of the estimate in Table 3 to the unemployment duration of benefit recipients before the reform: $(206.5 + 74.4)/30 = 9.4$ months. Using raw data alone mix the effects of the reform with the effects of the economic cycle. The values of ψ for before and after the reform are such that the expected duration of unemployment benefits is 6.9 months before and 9.4 months after the reform. Notice that Gomes et al. (2001) and Ljungqvist and Sargent (2007) do not have a value for ψ, as the unemployment benefits in their models last for the whole duration of the unemployment spell.

For the labor share, we use Gollin (2002). He obtains three estimates for the labor share in Portugal: 0.602, 0.748, and 0.825, according to the calculation of the income of the self-employed. He set $\alpha = 0.7$, a little smaller than the mean of the three estimates, as Gollin points out that the highest estimate can overstate the labor share.[4] We set home production w^h so that the model matches the data on labor force participation before the reform. w^h only affects labor force participation; it does not affect the unemployment rate or the duration of unemployment.

We set ρ and σ^2 to match the average duration of unemployment and the unemployment rate before the increase in the benefit duration. The labor market in Portugal shows high average duration of unemployment combined with a relatively low unemployment rate: for the group 30–34, the unemployment duration before the policy change was 24 months while the unemployment rate was 4.9%. Blanchard and Portugal (2001) analyze the combination of high average duration and low unemployment rate for Portugal. High unemployment duration and low unemployment rate demands ρ close to one. As a result, the productivity process z approaches a random walk and the numerical algorithm cannot approximate precisely the theoretical distribution of z. To circumvent this problem, we use a model period of 3 months for the 15–24 age group and 6 months for the groups 30–34 and 40–44. We use a smaller model period for the 15–24 group because the benefit duration for this group is 4.9 months, smaller than 6 months.

We set the intertemporal discount β so that it is equivalent to an interest rate of 4% per year. We consider $\gamma = 0, 1, 8$. $\gamma = 0$ implies perfect substitution, and $\gamma = 1$ (logarithmic utility) implies that wages do not affect labor supply. $\gamma = 8$ matches the evidence on the elasticity of the labor force with respect to a tax on labor (Alvarez and Veracierto 2000).

We now subject the model to the increase in ψ implied by the reform. As in Section 3, we use the fact that the reform generated treatment and control groups to remove from the data the effects that were not related to the reform. The difference is that we now look at other variables beyond the duration of unemployment and that we use data on recipients and nonrecipients of unemployment benefits. We assume that all changes in the labor market for the control groups were caused by changes unrelated to the reform and use the before-after estimator. Table 5 shows the data before and after the reform, the

Table 5 Treatment of the labor market variables for the economic cycle

					After, with cycle correction	
Group	Variable	Before	After	After-Before	Estimate	Confidence interval
15–24	Unemployment rate	10.0%	8.7%		10.0%	[9.0%, 11.0%]
	Avg dur of unemployment	12.1	11.2		11.0	[7.6, 14.4]
	Labor force participation	46.9%	46.4%		45.7%	[45.0%, 46.3%]
	Employment/pop 15–64	42.2%	42.3%		40.8%	[39.9%, 41.7%]
	Unemployment/pop 15–64	4.7%	4.4%		5.0%	[3.9%, 6.0%]
25–29	Unemployment rate	5.9%	4.6%	−1.3%		
Control	Avg dur of unemployment	17.6	17.8	0.2		
	Labor force participation	85.7%	86.4%	0.8%		
	Employment/pop 15–64	80.6%	82.1%	1.5%		
	Unemployment/pop 15–64	5.0%	4.5%	−0.5%		
30–34	Unemployment rate	4.9%	3.8%		4.6%	[4.2%, 4.9%]
	Avg dur of unemployment	23.7	21.4		25.4	[21.5, 29.2]
	Labor force participation	87.9%	88.4%		86.8%	[86.2%, 87.4%]
	Employment/pop 15–64	83.7%	85.2%		83.2%	[82.6%, 83.9%]
	Unemployment/pop 15–64	4.3%	3.6%		3.9%	[3.5%, 4.3%]
35–39	Unemployment rate	4.0%	3.2%	−0.8%		
Control	Avg dur of unemployment	22.2	18.2	−4.0		
	Labor force participation	86.2%	87.7%	1.6%		
	Employment/pop 15–64	82.7%	84.6%	1.9%		
	Unemployment/pop 15–64	3.4%	3.1%	−0.4%		
40–44	Unemployment rate	3.8%	3.3%		4.1%	[3.8%, 4.5%]
	Avg dur of unemployment	28.0	23.4		27.4	[23.6, 31.3]
	Labor force participation	86.1%	86.0%		84.5%	[83.9%, 85.0%]
	Employment/pop 15–64	82.8%	83.2%		81.2%	[80.6%, 81.9%]
	Unemployment/pop 15–64	3.3%	3.0%		3.3%	[2.9%, 3.7%]

Before: 1998:1–1999:2. After: 1999:3–2002:4. Confidence intervals with two standard deviations. Average duration of unemployment in months. The values after correction for the cycle are obtained by subtracting the variation of the control group from the observed rate. For example: 10.0% = 8.7% − (−1.3%) for the unemployment rate of the group 15–24

correction factors obtained from the control groups, and the estimated values after the correction along with their confidence intervals.

Consider the unemployment rate for the group 15–24, which decreased from 10.0 to 8.7%. For its control group, 25–29, the unemployment rate decreased from 5.9 to 4.6%. As the unemployment insurance system did not change for the group 25–29, we assign the decrease of 1.3 percentage points to changes unrelated to the reform. Correcting for these changes, the unemployment rate for the group 15–24 stays constant at $8.7 - (-1.3) = 10.0\%$. We proceed in a similar way for the average duration of unemployment, the labor force participation, and the levels of employment and unemployment.

The changes in the control groups are as expected for an economy in expansion. The unemployment rate and the unemployment level decreased. The labor force participation and the level of employment increased. An exception is the average duration of unemployment of the group 25–29: it increased 0.2 months even with economic growth. For the group 35–39, in accordance with the expansion, the average duration of unemployment decreased 4 months.

We use nonrecipients of unemployment benefits for the average duration of unemployment as the average duration of unemployment in the model refers to unemployed agents without benefits (Alvarez and Veracierto 2000). A decrease in the search effort of eligible agents is compatible, for example, with the evidence in Lalive et al. (2005), who found a decrease in unemployment duration when the government increases the monitoring of benefit recipients.[5]

We confront predictions and data in Table 6 and in Fig. 1. Consider first the labor force, employment, and unemployment, the variables that depend on the substitution parameter γ. In the data, the labor force participation and the level of employment decreased for all groups.[6] Moreover, the level of unemployment increases for the groups 15–24 and 40–44 (it is approximately constant for the group 40–44). With low substitution, $\gamma = 8$, the model reproduces these facts: a decrease in the labor force, an increase in unemployment, and a decrease in employment after the increase in the maximum duration of benefits. The model with $\gamma = 8$ has a better match to the data. For this choice of γ, the predictions are on average 4% different from the data after the reform.

The model predicts an increase in the unemployment rate and in the average duration of unemployment when the maximum duration of benefits increase, as standard in search models. The data show approximately constant unemployment rate after the reform: from a decrease of 0.3% for the 30–34 group to an increase of 0.3% for the 40–44 group. The model better predicts the changes on the unemployment rate for the groups 15–24 and 40–44. The average duration of unemployment decreased for the groups 15–24 and 40–44 while it increased for the group 30–34. Therefore, the model better predicts the

Table 6 Data and predictions of the model

		Before the reform	After the reform			
Group	Variable	Data and model	Treated data		Model	
15–24	Unemployment rate	10.0%	10.0%		10.1%	
	Avg duration of unemployment	12.1	11.0		12.2	
				$\gamma = 0$	$\gamma = 1$	$\gamma = 8$
	Labor force participation	46.9%	45.7%	47.2%	47.0%	46.9%
	Employment/population 15–64	42.2%	40.8%	42.4%	42.2%	42.1%
	Unemployment/population 15–64	4.7%	5.0%	4.8%	4.8%	4.8%
30–34	Unemployment rate	4.9%	4.6%		5.1%	
	Avg duration of unemployment	23.7	25.4		24.3	
				$\gamma = 0$	$\gamma = 1$	$\gamma = 8$
	Labor force participation	87.9%	86.8%	88.9%	88.4%	87.9%
	Employment/population 15–64	83.7%	83.2%	84.4%	83.8%	83.4%
	Unemployment/population 15–64	4.3%	3.9%	4.5%	4.6%	4.5%
40–44	Unemployment rate	3.8%	4.1%		4.3%	
	Avg duration of unemployment	28.0	27.4		30.0	
				$\gamma = 0$	$\gamma = 1$	$\gamma = 8$
	Labor force participation	86.1%	84.5%	89.3%	86.6%	85.8%
	Employment/population 15–64	82.8%	81.2%	85.5%	82.9%	82.1%
	Unemployment/population 15–64	3.3%	3.3%	3.8%	3.7%	3.7%

Before: 1998:1–1999:2. After: 1999:3–2002:4. Average duration of unemployment in months. Treated data from Table 5. After the reform, model: outcome of the model with the increase in ψ

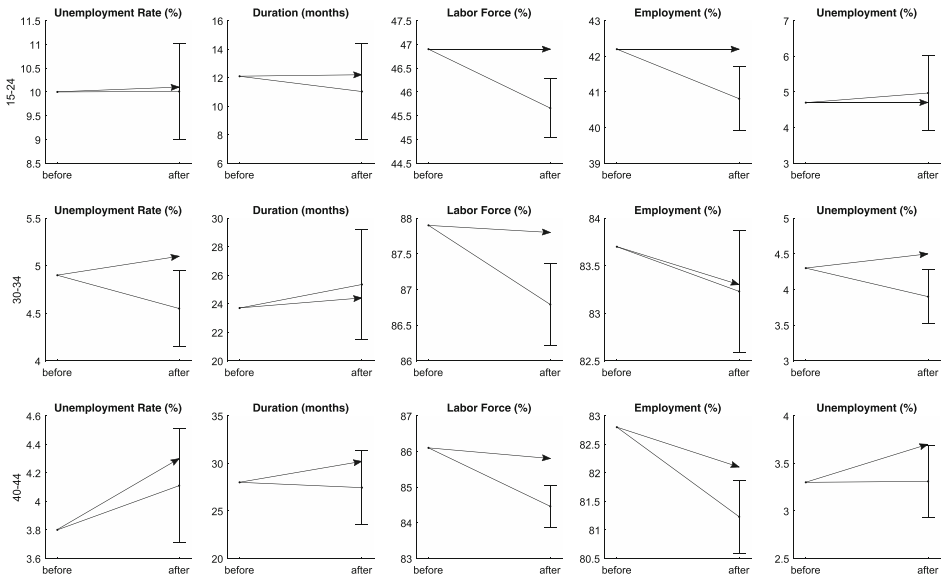

Fig. 1 Data and predictions. *Arrows*: model predictions, $\gamma = 8$. *Lines*: data and confidence intervals with two standard deviations

average duration of unemployment for the group 30–34. For all groups, the predictions are within the confidence intervals for the estimated values after the reform.

For the group 30–34, the duration of unemployment increased from 23.7 to 25.4 months. The model predicts an increase to 24.3 months, 1 month below the data, an error of 4%. The unemployment rate decreased from 4.9 to 4.6% while the model predicts an increase to 5.1%, an upward error of 0.5 percentage points or 11%.

For the group 15–24, the model predicts small changes because only 8% of the unemployed workers in this group received benefits. The duration of unemployment decreased from 12.1 to 11.0 months while the model predicts an increase to 12.2 months. The unemployment rate stayed constant at 10.0% while the model predicts an increase to 10.1%. Apart from the labor force participation and the employment level, the predictions are within the confidence intervals for the values after the reform.

For the group 40–44, the duration of unemployment decreased from 28.0 to 27.4 months while the model predicts an increase to 30.0 months. Relatively to the data after the reform, it implies a difference of 2.6 months or 9%. The unemployment rate increased from 3.8 to 4.1%, and the model predicts an increase to 4.3%, a difference of 0.2 percentage points or 4%.

The average duration of unemployment for the groups 15–24 and 40–44 decreased in the data. For the group 30–34, on the other hand, the average duration increased, as it is usually predicted by search models after an increase in the duration of benefits. It can be the case that the business cycle affects more strongly nonprime-aged workers, those outside the group 30–39. It is then possible for the good economic condition during the period to outweigh the effect of the longer benefit duration. In particular, the effects of the economic cycle for the group 40–44 may be underestimated, as the data for this group are corrected with the evolution of prime-aged agents (group 35–39). Moreover, the 15–24 group has few recipients, and so, the effect of the increase in benefit duration for

this group is small. Nevertheless, the predictions of the model are within the confidence intervals for all groups, as shown in Fig. 1.

The model does not have factors such as borrowing constraints, directed search, and ex ante heterogeneity of agents.[7] It is not a surprise to find that the model does not match the data in all cases. Moreover, part of the effects in the data may refer to a transitional period. To approximate the steady states, we follow the usual procedure of taking the average of a long period before and after the reform (see Van den Berg (1990) for an analysis of nonstationary job search models). In particular, for the period after, we take the average of more than 3 years after the reform.

The model gets closer to the data for the labor force participation, employment, and unemployment. For the labor force participation, the model correctly predicts the changes but the predictions for this variable are outside the confidence intervals. The model has a better match to the data for $\gamma = 8$. In this case, the model matches the direction of change of 9 out of 15 variables studied (five for each of the three groups). The model is able to predict satisfactorily the effects of the reform for the three age groups. When the model cannot predict the effects of the reform, the differences are usually small.

5 Conclusions

We identify a reform particularly appropriate to evaluate an equilibrium search model for the labor market. It is usually not possible to use a controlled experiment to evaluate a model. In rare cases, a change such as the 1999 reform resembles a controlled experiment. We show that an equilibrium search model is able to reproduce most of the effects of an increase in the maximum duration of unemployment benefits. The model predictions are close to the data on the unemployment rate, the labor force participation, and the levels of employment and unemployment.

General equilibrium models are useful for policy evaluation. As Meghir (2007) points out, these models can be used to predict long-run effects and to run counterfactuals. They complement empirical studies. However, we can only trust the predictions of a model if it reproduces the facts of policy changes for which we have alternative estimators of their impact. We conclude that the model reproduces the facts in various dimensions. This finding increases our confidence to expose the model to more complex changes.

Endnotes

[1] The dataset records subsidized unemployment duration, not the total duration of unemployment. However, as the maximum durations of benefit are large, the duration of a spell in the dataset is usually equal to the total duration of unemployment.

[2] Lalive et al. (2006) and Card et al. (2007) obtain smaller effects for Austria. Lalive et al. also obtain that, restricting the sample to narrower age groups, the estimates of the effects of extended benefits are three times larger than their baseline estimates.

[3] We describe the model briefly. The framework follows the search-island model of Lucas and Prescott (1974). An alternative is the matching model of Mortensen and Pissarides (1994). Cole and Rogerson (1999) compare the data and predictions of the Mortensen-Pissarides model. Ljungqvist and Sargent (2007) compare search-island and matching models.

[4] Cavalcanti (2007) uses $\alpha = 0.56$, not taking into account labor income of the self-employed. Silva (2008) uses $\alpha = 0.7$. The conclusions of the paper do not change with such changes in α.

[5] We use the official unemployment rate, which includes recipients and nonrecipients and the average duration of nonrecipients. As the unemployment rates for all unemployed agents and for nonrecipients move in parallel (it is 1.3 percentage points above the rate for nonrecipients before and after the reform), our conclusions do not change if we use the unemployment rate for nonrecipients.

[6] Haan and Prowse (2010), with data for Germany, find that employment increases if the duration of benefits decreases.

[7] Alvarez and Shimer (2011) consider a search-island model with rest unemployment, when agents wait until the labor market conditions improve. See Rogerson et al. (2005) for a survey. Another aspect is the optimal unemployment insurance policy, analyzed, for example, in Coles and Masters (2006) and Shimer and Werning (2007).

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Competing interests
The IZA Journal of Labor Policy is committed to the IZA Guiding Principles of Research Integrity. The authors declare that they have observed these principles.

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