Beyond Severance Pay: Labor Market Responses to the Introduction of Occupational Pensions in Austria*

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WORK IN PROGRESS – DO NOT CIRCULATE

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Abstract

This paper studies how a major policy change in Austria – the introduction of mandatory occupational pensions and the abolition of employer-provided severance pay – affects job mobility. The new rules were applied to employment relationships that started on January 1, 2003 or later, whereas jobs having started before that date continued to be subject to the old system. The new rules brought about two major changes. First, under the old system only laid-off workers were subject to a severance payment, whereas under the new system both quitters and laid-off workers are able to transfer their pension account with the associated separation payment to a new employer. Second, the system abolishes a discontinuous payment scheme (with severance payments jumping at tenure thresholds) to a continuous payment scheme (with monthly employer contributions smoothly increasing the balance on one's pension account). We find that workers subject to the new system are more than 20 percent more likely to leave a distressed firm (where a plant closure or a mass layoff will take place in the near future) than workers subject to the old system in a similar situation. We set up a model of on-the-job-search in which demand shocks to firms generate heterogeneous layoff probabilities, predicting that workers are more likely to leave when their firm is in a bad shape. Estimating the model by Simulated Method of Moments, we study the quantitative response in job mobility when a voluntary quit (but not a layoff) is penalized with loss of a payment upon job separation compared to a situation where this is not the case. We find that the estimated model can fit the mobility response generated through abolishing severance pay and introducing occupations pension under realistic parameter values.

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1 Introduction

Lack of labor market flexibility resulting from excessive firing costs is cited among the most frequent obstacles against achieving high employment. In this perspective, high firing costs tie firms to workers and inhibit socially optimal job separations and mobility choices. Hence, such costs tend to give weak mobility incentives to workers when searching for better job matches; and it force firms to continue inefficient employment relationships, resulting in sub-optimally low productivity and low output.

To shed light on this issue, this paper looks at a major change in Austrian labor market regulations: the introduction of an occupational pension scheme for private sector workers with the associated separation payment and the simultaneous abolition of a previous system of severance pay. The new system was implemented for all employment relationships starting after January 1, 2003, whereas jobs that started before this date continued to be subject to the old system. Thus a comparison of jobs starting before the date of the policy change with jobs starting after this date is informative on how workers and firms react to the introduction of occupational pensions / separation payment and the simultaneous abolition of severance pay.

The switch from the old Austrian severance pay system to the new occupational pension system brought about two major changes. The first change concerns eligibility rules with respect to quits and layoffs. Under the old severance pay system, only layoffs were subject to severance pay, whereas (voluntary) quits were not eligible. Under the new occupational pension system, both (voluntary) quits and (involuntarily) laid-off workers keep their accumulated separation payments on the pension account (and transfer it to a new employer once they have a new job). The second major change involved a switch from from a discontinuous schedule to a continuous scheme. Under the old severance pay system, job losers with less than 3 years of tenure were not eligible to severance pay; and severance pay amounted to 2 (3, 4, 6, 9, 12) monthly wages when the worker had at least 3 (5, 10, 15, 20, 25) years of tenure. The introduction of occupational pension accounts made this schedule for separation payments continuous (with monthly employer contributions of 1.53 % of the worker's salary) with workers keeping them upon job separation (the account being transferred to a new employer when a new job is started).

This paper studies how this policy change from severance pay to occupational pensions (with separation payment) affects job mobility. Notice that the policy change affects the incentives of workers who anticipate a major shock to their firm and a high likelihood of being laid off. Under the old severance pay system, workers have an incentive to "wait for a layof" (as a layoff is associated with a severance payment) but a low incentive to quit (as quitting is associated with the loss of the severance payment). Hence job mobility under the new system of occupational

pensions should be higher than under the old severance pay system.

To identify the impact of the policy change on job mobility, we look at job separations before a plant closure (or a mass layoff). An important literature (Jacobson, LaLonde, & Sullivan, 1993; Fallick, 1996; Stevens, 1997) has documented that a job loss has long-lasting effects on a worker's future career. This literature also emphasizes the importance to account for worker mobility immediately before a plant closure (Pfann and Hamermesh (2001) among others). Our empirical approach builds on this literature and identifies the impact of the switch from severance pay to occupational pensions/separation payments focusing of worker mobility preceding a plant closure.

We find that the policy change had a significant impact on job mobility. Consider two workers, both employed in a firm that closes down two years from now. According to our empirical results, the probability that a worker subject to the new system is still employed at the firm at the date of plant closure is 6.1 percentage points (or 22 percent) lower than the corresponding probability of a worker subject to the old system. These results suggest that a system in which quits are penalized (as in the old Austrian system of severance pay) leads to inefficiently long job durations in the face of a negative shock compared to a system where quits are not associated with such a penalty (as in the new Austrian system of occupational pensions). This result turns out to be robust and does not depend on the particular way we define a shock (a plant closure or a mass layoff; and whether the shock takes place in a limited amount of time or is spread out over a longer period). For instance, if the shock to the firm is defined as a 50 percent reduction of the work force, the probability difference is 8 percentage points (or 25 percent). Furthermore, the effect does not depend on the particular time window that is used to define a shock (i.e. whether a 50 percent reduction of the worker force occurs within a quarter or within a year).

We conclude that our empirical results suggest that the switch from severance pay to occupational pensions/separation payments leads to a robust and quantitatively important increase in job separations from distressed firms in the wake of a shock. We also find that workers under the new system do not only separate sooner from distressed firms but also find new jobs more quickly. This finding is consistent with the change in incentives due to the reform: Under the old system, a worker expecting an adverse shock to the firm has an incentive to wait for a layoff to cash in the severance payment whereas under the new system, otherwise similar workers have an incentive to move to a new job (without foregoing any severance payment). Hence, the new system encourages moves from "bad" to "good" firms. This may have important consequences for the allocation of workers and total factor productivity, in particular in a Schumpeterian perspective.

In order to address our concern that employment reductions by firms are endogenous to prevailing institutions and might react to the reform itself, and to explore the reform's aggregate implications, we propose an equilibrium search model featuring endogenous lay-offs and job-to-job mobility. In the model firms face demand- (or productivity-) shocks, changing the likelihood that a worker in a distressed firm will experience a layoff. When the layoff probability is high, a worker who might lose a severance payment will wait for being laid off under the old system (rather than searching hard for a new job and accepting reasonable job offers), while a worker who will keep the payment (because the separation payment can be transferred to a new employer) will be more likely to move and accept a new and more efficient employment relationship. We estimate the model by Simulated Method of Moments to find the parameter values that are most in line with the data. It turns out that, under realistic parameter values, the estimated model generates differences in mobility behavior of a similar order of magnitude as those found in the empirical analysis.

The paper is organized as follows. The next section reviews the related literature. Section 3 gives an overview of the institutional setting before and after the reform. Section 4 describes our data. In Section 5, we present empirical evidence on worker mobility in declining firms. Section 6 describes the specification of our model. The estimation strategy and identification is explained in Section 7, while Section 8 discusses the results and model fit. In Section 9, we conclude.

2 Related Literature

The theoretical literature on severance pay was sparked by Bentolila and Bertola (1990) and Bertola (1990). As demonstrated by Lazear (1990), in a frictionless environment any severance payment scheme can be offset by an efficient labor contract and thus should not have real effects. As a response, subsequent theoretical work analyzing the effects of lay-off costs introduced frictions of different forms, such as indivisible labor (Hopenhayn & Rogerson, 1993), or search frictions (e.g. Burda, 1992; Saint-Paul, 1995; Alvarez & Veracierto, 1998; Garibaldi, 1998; Cahuc & Zylberberg, 1999; Mortensen & Pissarides, 1999). As discussed in Ljungqvist (2002), these models produced mixed results on the effect of lay-off costs on overall employment level.

In addition to this literature, normative theories have emerged (see Parsons (2013) for a recent overview), arguing that severance packages arise as optimal contracts in certain market environments. A recent example is Boeri, Garibaldi, and Moen (2013), who show that tenure-related severance pay is optimal if there are wage deferrals and moral hazard on the side of employers and workers.

A more recent strand of literature stresses the importance of on-the-job search and voluntary payments (see, e.g., Fella (2007) and Postel-Vinay and Turon (2014)). In particular, employers hit by an adverse shock may find it worthwhile to make a transfer in order to induce a worker to accept an outside offer.

On the empirical side, there is a number of studies using cross-country variations that find that higher employment protection reduces job or labor turnover (e.g. Gomez-Salvador, Messina, & Vallanti, 2004; Micco & Pagés, 2006; Messina & Vallanti, 2007; Haltiwanger, Scarpetta, & Schweiger, 2008), while Gielen and Tatsiramos (2012) show that quits respond less to reported job satisfaction in countries with higher job protection. Other studies use within-country variation (e.g. Boeri & Jimeno, 2005; Autor, Donohue, & Schwab, 2006; Kugler & Pica, 2008; Fraisse, Kramarz, & Prost, 2014) and generally find a negative effect on job or labor turnover, while yielding ambiguous results in terms of employment. Our empirical strategy relies on the behavior of workers in distressed firms (firms with mass layoffs or plant closures). On this last side, a large literature has used plant closure or mass layoffs to study how job losses affect the long-run career prospects of such workers and has typically found large and long-lasting effects. For recent studies, see e.g. Huttunen, Men, and Salvanes (2011), Song and von Wachter (2014), Schmieder, von Wachter, and Bender (2010), Ichino, Schwerdt, Winter-Ebmer, and Zweimüller (2014), among many others.

3 Institutional Background

In this section we briefly describe the system of mandatory severance pay covering the jobs that started before 2003 and the change to a system of occupational pensions/separation payments that affects all jobs that started afterwards.

All jobs starting before January 1, 2003, (old-system) are subject to a mandatory severance payment. Firms are required to make a lump-sum transfer at the time of the layoff, whose size depends on a step function of the worker's tenure in the firm. In particular, jobs below three years of tenure at the time of the separation are not eligible for mandatory severance pay. After three years, firms have to make a transfer of at least two months of salary. There are further tenure thresholds where the mandatory level increases as depicted in Figure 1. Importantly, quits and other lay-offs (for cause) are exempt from this rule, meaning that firms only have to make a transfer in case of a lay-off. The only exception here is at retirement, when a worker receives a severance payment even in the case of a voluntary separation if she has accumulated at least 10 years of tenure.

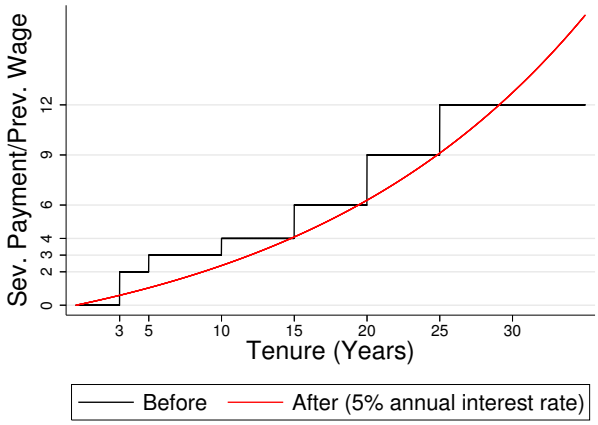


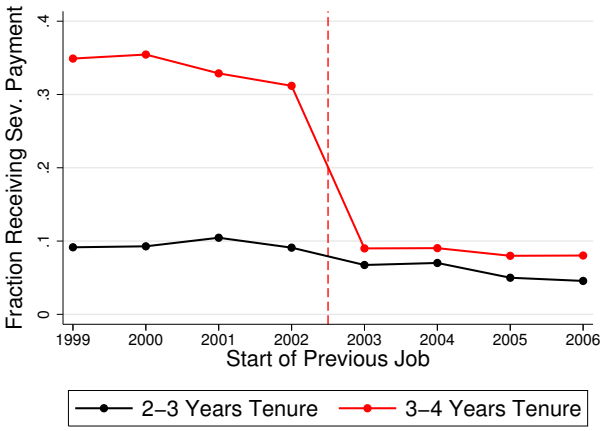
Figure 1: Severance pay relative to previous wage before and after the reform (assuming 5% annual interest rate and constant wage)

All jobs starting as of January 1, 2003, (new-system) are subject to the new system of occupational pensions/separation payments. Starting from the second month of the employment relationship, the employer has to transfer 1.53% of the current salary to a pension account, on which the employee earns interest. At the end of the employment relationship – be it by a lay-off or a quit – the worker has the possibility to access the funds accumulated on the account. Alternatively, the worker could choose to leave his funds on the account or transfer his claims to the subsequent employer. Importantly, claims are never lost.

Thus, there are two major changes affecting firms' and workers' incentives to lay-off workers and to quit, respectively:

1. Eligibility rules with respect to quits and lay-offs: Under the old system, workers quitting voluntarily are not eligible to a severance payment, while under the new new system they do not lose their claims.
2. Change from a discontinuous schedule to a continuous one: Old-system jobs are subject to a step function of tenure in the firm, whereas the accumulation is smooth under the new system.

Regarding the latter aspect, again consider Figure 1, where we plot the occupational pension benefits accumulated in a new-system job after different tenure levels, assuming an annual interest rate of 5% and a constant wage. Clearly, this figure must be interpreted as an upper bound since interest rate earnings are usually lower and wages generally increase with tenure. Hence, benefit levels are in general lower under the new system than, conditional on receiving severance payment, under the old system. On the other hand, there are many jobs with short tenure levels – below three years – which are now eligible. Moreover, benefit levels are not capped after 25 years as is the case under the old system. In fact, anecdotal



Source: Own calculations, ASSD, and ATD.

Figure 2: Fraction receiving severance payment for different tenure levels

evidence suggests that the new system was designed in a way that made sure that employers' burden remained more or less the same.

The treatment can clearly be seen in Figure 2, where we plot the fraction of job separations for which we observe a severance payment for different tenure categories by the year where the (previous) job started. Among jobs with three to four years tenure, i.e. jobs eligible for a payment under the old system, we observe a severance payment for around one third of all separations for jobs starting until 2002, while this number is below 10% for jobs with two to three years tenure, i.e. jobs not eligible under the old system. The latter number is not equal to zero because of voluntary firms' payments, whereas the former is not equal to one because of the existence of quits and potential difficulties in matching payments to separations in the data source. For the new-system jobs, we only observe if and when a worker has accessed his funds.

4 The Data

We combine data from two sources: (i) the Austrian Social Security Database (ASSD), and (ii) the Austrian Earnings-Tax Database.

ASSD covers the universe of Austrian private sector workers, providing longitudinal information from 1972 onwards. The data has been collected in order to verify old-age pension claims and hence covers all information relevant for this aim. In particular, it reports individuals' complete earnings and employment history, as well as other labor market states, such as registered unemployment, sickness or maternal leave.

The Austrian Earnings-Tax Database (ATD) covers the universe of private sector earnings-tax records and can be matched to ASSD via an individual identifier. It is based on reports the employer has to complete for the tax office every year. The report contains the base salary and several other categories. In general, employees are not obliged to file individual tax returns, since the reports by the employer are detailled enough. Among other things, tax reports also report income subject to the fixed tax rate of 6%, among which is also a category for severance payments. This category comprises three types of payment: (i) mandatory severance-pay, (ii) voluntary severance-pay, and (iii) refunds for vacation days not taken.

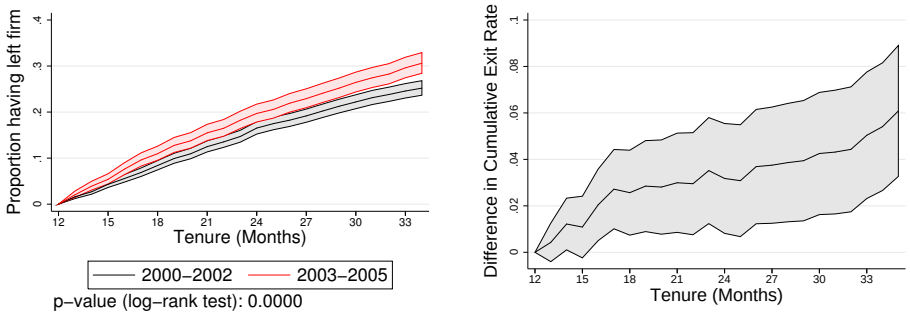
To examine the effect of the severance payment reform in Austria, we select workers having entered firms either during the three years before the reform (years 2000 - 2002) or during the three years after the reform (years 2003 - 2005). To limit interaction with other programs, in particular the above-mentioned exceptions for retirements, we only include workers with age above twenty or below 55 at the time of job termination. Further, we exclude construction workers, who are subject to different regulations, and the tourism sector.

5 Empirical Evidence

This section presents empirical evidence on workers' behavior in declining firms, starting with firm closures and moving to a broader definition of adverse shocks later on.

5.1 Firm Closures

Using the sample of workers described above, we investigate how workers of the two different systems behave in firms which are about to close down. We define a firm closure as a reduction in employment from some number above 30 to zero within one month. We then focus on workers who have entered these firms between 3 and 3.5 years before the firm closure, comparing those entering before and after the reform. We choose this time window in order to, on the one hand, make sure that old-system workers are eligible for a mandatory severance payment at the time of the closure, while, on the other hand, still retaining enough observations.

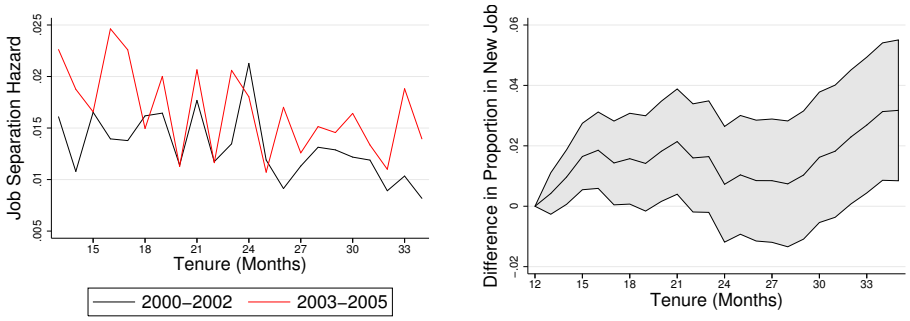


(a) Cumulative exit rates (conditional on tenure ≥ 12 months)

(b) Difference in cumulative exit rate (conditional on tenure ≥ 12 months)

Figure 3: Worker exit before firm closure

In Figure 3a, we plot the cumulative share of workers who have left the firm about to close down after different tenure levels, conditioning on at least 12 months of tenure to exclude short-term work. In Figure 3b we plot the difference between the red and the black line in percentage points with confidence bands. It is apparent that the workers subject to the old-system are much more likely to wait for the shock to occur – among the group with at least 12 months of tenure, they are about 6.1 percentage points (22% in relative terms) more likely to still be in the firm after three years, when the shock window begins. A log-rank test for the null hypothesis of equality in cumulative exit rates rejects the null very strongly in all cases. A different way of looking at the same question consists in plotting the job separation hazard, i.e. the probability that a worker who has not left the firm before reaching a given tenure level. As can be seen in Figure 4a, new-system workers are in general more likely to exit the declining firm. Another interesting aspect is that new-system workers not only leave declining firms sooner, but also end up in different jobs more quickly, as can be seen in Figure 4b. Directly before firm closure, new-system workers are 3.2 percentage points more likely to have ended up in a different firm, which translates into a relative difference of 13%.



(a) Job separation hazard (b) Difference in proportion in new job

Figure 4: Job separation hazard and proportion in new job

Up to now, we have been pooling three years before and after the reform to obtain more precise estimates. However, this also increases the risk of capturing changes other than the severance payment reform. To assess this concern, we make pairwise comparisons of the cumulative exit rate at tenure 35 (in months) for multiple years, thus ending up with five placebo checks. If the difference in exit rates before a firm closure is indeed due to the reform, we should only see a difference comparing those entering a firm in 2002 and in 2003. All other comparisons should not yield any difference, since we are comparing workers subject to the same system. Indeed, as shown in Table 1, differences in cumulative exit rates are in general insignificant, except for the comparison of the years 2002 and 2003, where the result is in line with the previous results. Moreover, it can be seen that there is a permanent shift in the level of exit rates from below 29% to above 32%. These findings make us confident that we capture the reform effect and not something else[1]. In particular, it appears that the business cycle has limited influence.

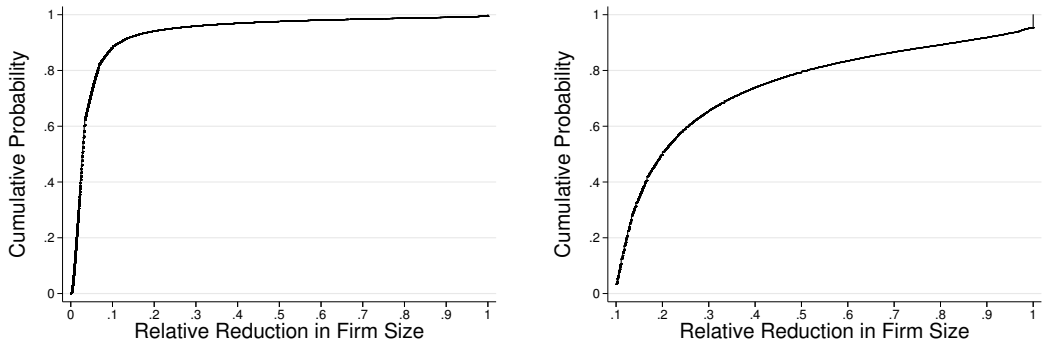
[1]Note that we cannot make a narrower comparison due to seasonality effects. Those entering a job in December are very different from those entering one in January.

Comparison	Change in exit rate (job started in t vs. $t-1$)	Mean exit rate (job started in $t-1$)	Change in policy	Observations
2000 vs. 2001	0.020	0.269	NO	2231
2001 vs. 2002	-0.019	0.289	NO	1450
2002 vs. 2003	0.059**	0.270	YES	1254
2003 vs. 2004	-0.003	0.329	NO	1025
2004 vs. 2005	0.022	0.326	NO	1034
2005 vs. 2006	0.015	0.348	NO	1140

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 1: Placebo test

5.2 Broader Definition of Adverse Shocks



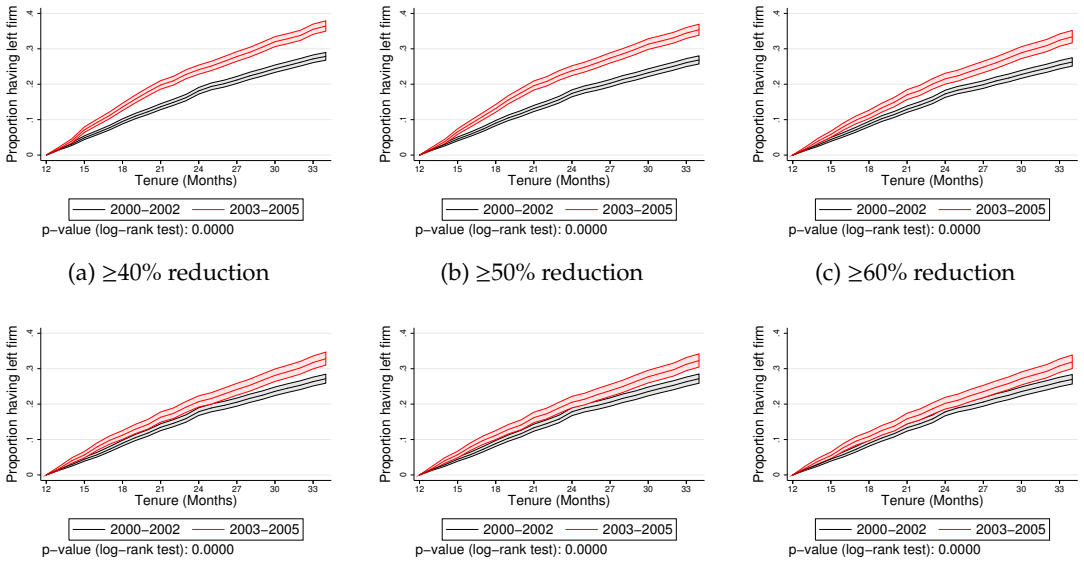
(a) All reductions

(b) Conditional on ≥ 10%

Figure 5: Cumulative distribution function of monthly reductions in firm size

Up to now, we have concentrated on firm closures, a very narrow definition of an adverse shock. While very robust, it only captures a small fraction of all potential adverse shocks. In Figure 5, we plot the c.d.f. of all relative monthly reductions in employment, conditional on a reduction of at least 10%. Clearly, firm closures only make up a tiny fraction, with 0.55% among all reductions and 4.65% among all reductions of at least 10%. Hence, in order to investigate whether the reform has a wide-ranging impact on the labor market, it is necessary to apply a broader definition of adverse shocks.

An obvious way to proceed is to define an adverse shock not only along the extensive margin but also along the intensive margin. In Figure 6, we plot cumulative exit rates of workers entering firms 3 to 3.5 years before a monthly reduction in firm size by 40% to 90%. If anything, the results become more pronounced and more precisely estimated because of the increased sample size when applying this



(a) ≥40% reduction (b) ≥50% reduction (c) ≥60% reduction

(d) ≥70% reduction (e) ≥80% reduction (f) ≥90% reduction

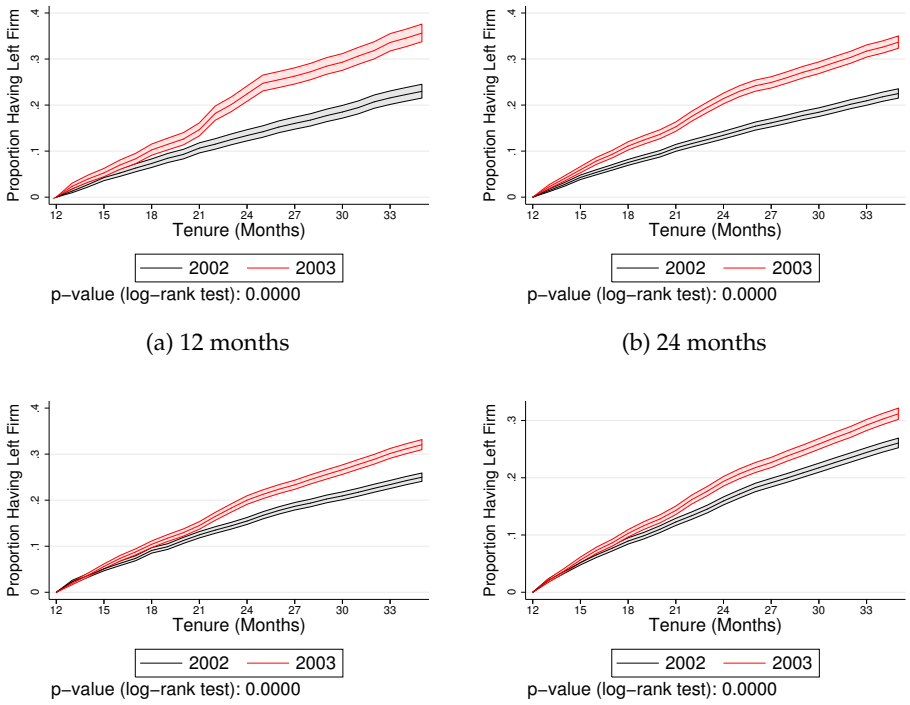
Figure 6: Results according to size of shock

broader definition. Thus, the previous result is not limited to firm closures but also applies more broadly.

Another way of broadening the definition of a shock is to move from monthly reductions to reductions over a longer time horizon. In particular, we look at workers entering in 2002 (resp. 2003) into firms that undergo a reduction in their workforce of at least 33% between January 1, 2006 (resp. 2007), and one to four years later. Choosing the respective start days makes sure that every worker has at least three years of tenure when the shock window starts. In Figure 7, we plot the cumulative exit rate before the shock window starts for different lengths of the shock window. Again, what we find is in line with the previous results, while the results now become larger and more significant. We also obtain marked results if we look at the probability to have moved to a different job, as shown in Figure 8.

5.3 Discussion

To summarize our empirical findings, we find that new-system workers are clearly more mobile in anticipation of a future adverse shock and a future potential lay-off. Moreover, new-system workers not only exit the declining firm sooner, but also end up in different jobs more quickly. These results are consistent with the intuition that workers subject to the old system do not want to forego the option value of a future severance payment by quitting voluntarily. For new-system workers, this incentive disappears since their claims to occupational pension benefits/separation payments



(a) 12 months

(b) 24 months

(c) 36 months

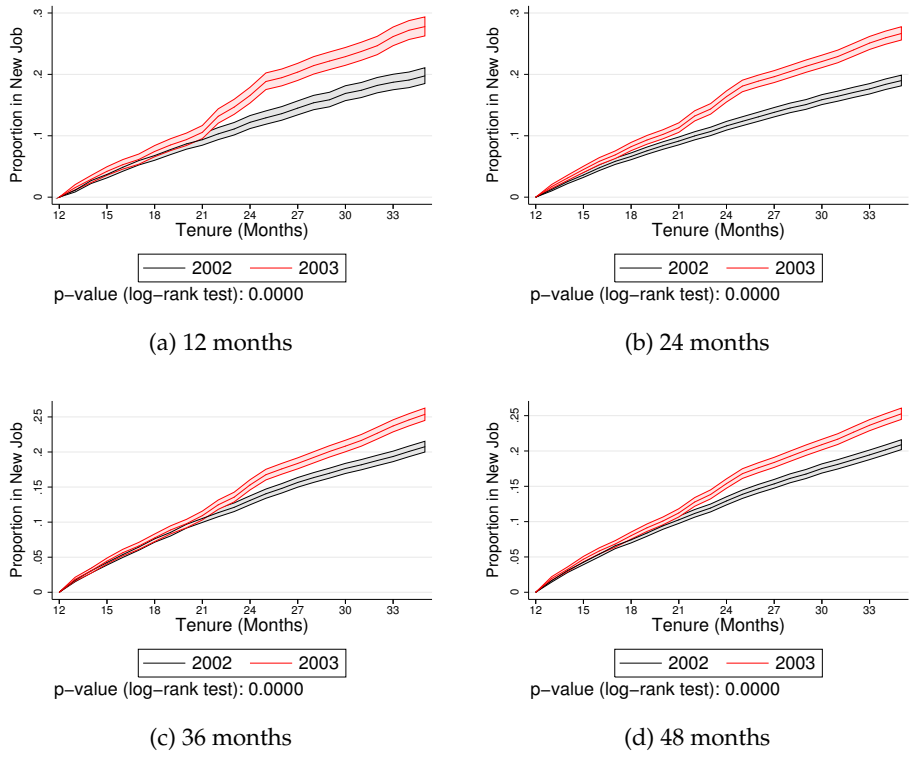
(d) 48 months

Figure 7: Long-run decline in firm size (worker exit) for different shock windows

are never lost. Thus, they want to minimize the risk of becoming unemployed and of wage cuts by moving to a different employer as soon as a suitable match is found.

Then again, in interpreting these results, we have to be aware of the fact that the setting we analyzed is by no means causal: firm closures and reductions in firm employment are firms' decisions and likely react to the composition of the workforce and are hence endogenous. The share of new-system workers among the workforce is affected by many factors and firms might take this into account. In particular, we might differentially select firms when making the comparison between the old and the new system. If we think of firms as being subject to demand shocks and choosing lay-offs optimally, the effect might go in either direction: on the one hand, lay-offs are less costly for the firm after the reform, when on the other hand, lay-offs might not be necessary any more since there is higher attrition among workers anyway.

Hence, since we cannot come up with a reduced-form setting which can be interpreted causally, we need a theoretical model in order to assess the reform's effect on the labor market. A model will give predictions on workers' reactions to the reform, while explicitly taking into account firms' reactions.



(a) 12 months

(b) 24 months

(c) 36 months

(d) 48 months

Figure 8: Long-run decline in firm size (reemployment) for different shock windows

6 A Model of the Severance Payment Reform

In this section we will try to rationalize our previous empirical findings using a simple model of the severance payment reform.

6.1 Environment

Time is discrete. There is a continuum of risk-neutral workers of mass 1 who are either employed or unemployed. Production features constant returns to scale. If employed, a worker produces one unit per period which can be sold at price $p \in \left[\underline{p}, \overline{p}\right]$. Prices at the firm-level evolve according to a Markov process and are i.i.d. across firms. The model does not change if we instead interpret p as productivity. At the beginning of a period, firms can dissolve matches. In this case, a payment ψ has to be made to the worker, if he is eligible. Workers in a match start out as non-eligible and become eligible with probability α every period. At the end of a period, workers receive outside offers with endogenous probability χf, where χ denotes employees' search effort relative to the unemployed, and decide whether to accept them (in which case they do not receive a payment ψ). In addition, matches are

dissolved exogenously with probability λ. The unemployed receive benefits b every period and meet vacant firms with probability f and decide whether to accept their offer or not. Workers incur moving costs ξ when there is an unemployment-to-job or job-to-job transition.

Everyone can set up a firm, meaning that vacancies have value zero ex-ante. Vacant firms draw initial prices from the unconditional price distribution and either meet unemployed or employed workers with some (endogenous) probability. These workers will then decide whether to accept the firms offer or turn it down. Wages are set by Nash bargaining.

6.2 Bellman Equations

The value of a firm employing an eligible worker, $J_1(p)$, is then given by (throughout, primes denote next-period values)

$$J_1(p) = p - w_1(p) + \delta(1 - \chi f \mu_1(p) - \lambda) \int_{\underline{p}}^{\overline{p}} \max\{-\psi, J_1(p')\} \, dF(p'|p),$$

where $w_1(p)$ is the bargained wage of an eligible worker given price[2] p, δ is the discount rate, $\mu_1(p)$ is the endogenous probability that an eligible worker accepts an outside offer given price p, and $F(p'|p)$ is the conditional distribution of a future productivity realization given that current price is p. Firms currently earn $p - w_1(p)$. With probability $(1 - \chi f \mu_1(p) - \lambda)$, the match persists and a new price realization p' is drawn. Upon observing this draw, firms can either shut down and pay ψ or continue to produce, earning $J_1(p')$.

The value of a firm employing a non-eligible worker, $J_0(p)$, satisfies

$$J_0(p) = p - w_0(p) + \delta(1 - \chi f \mu_0(p) - \lambda) \int_{\underline{p}}^{\overline{p}} \alpha \max\{-\psi, J_1(p')\} + (1-\alpha) \max\{0, J_0(p')\} \, dF(p'|p),$$

where $\mu_0(p)$ is the probability that a non-eligible worker accepts an outside offer given price p. Given that the match persists, workers become eligible with probability α. In this case, the firm has to pay ψ if shutting down and has continuation value $J_1(p')$ else. If the worker does not become eligible, the firm does not have to make a transfer in case of a lay-off, while it continues with $J_0(p')$ if not.

[2] Since we think of firms as being subject to idiosyncratic demand shocks, we refer to the state variable p as "price". However, the model would not change in any way if we thought of p as match-specific productivity instead.

The value of an eligible worker, $W_1(p)$, is given by

$$W_1(p) = w_1(p) + \delta\lambda U + \delta\chi f \int_{\underline{p}}^{\overline{p}} \max\left\{W_0(p^o) - \xi, \int_{\underline{p}}^{\overline{p}} \gamma_1(p')(U+\psi) + (1-\gamma_1(p'))W_1(p')dF(p'|p)\right\} dG(p^o) + \delta(1-\lambda-\chi f)\int_{\underline{p}}^{\overline{p}} \gamma_1(p')(U+\psi) + (1-\gamma_1(p'))W_1(p')dF(p'|p),$$

where U is the value when unemployed, $G(p^o)$ is the distribution of outside offers p^o (i.e. the unconditional distribution of p), and $\gamma_1(p)$ takes the value 1 if a firm employing an eligible worker is shut down given p and zero otherwise. A worker currently earns $w_1(p)$, with probability λ an exogenous separation occurs, and with probability χf an outside offer with price p^o is obtained. If the workers does not receive an outside offer or turns it down, the worker becomes unemployed and receives ψ if the firm is shut down, while receiving continuation value $W_1(p')$ otherwise.

The value of a non-eligible worker, $W_0(p)$, is given by

$$W_0(p) = w_0(p) + \delta\lambda U + \delta\chi f \int_{\underline{p}}^{\overline{p}} \max\left\{W_0(p^o) - \xi, \int_{\underline{p}}^{\overline{p}} \alpha\left[\gamma_1(p')(U+\psi) + (1-\gamma_1(p'))W_1(p')\right] + (1-\alpha)\left[\gamma_0(p')U + (1-\gamma_0(p'))W_0(p')\right] dF(p'|p)\right\} dG(p^o) + \delta(1-\lambda-\chi f)\int_{\underline{p}}^{\overline{p}} \alpha\left[\gamma_1(p')(U+\psi) + (1-\gamma_1(p'))W_1(p')\right] + (1-\alpha)\left[\gamma_0(p')U + (1-\gamma_0(p'))W_0(p')\right] dF(p'|p),$$

where $\gamma_0(p)$ takes the value 1 if a firm employing a non-eligible worker is shut down given p and zero otherwise. Note that neither an eligible nor a non-eligible worker will accept an offer that results in an immediate layoff $\gamma_i(p^o) = 1$ due to the bargaining assumption. Hence, we do not have to account for this possibility.

The value when unemployed reads:

$$U = b + \delta f \int_{\underline{p}}^{\overline{p}} \max\left\{W_0(p^o) - \xi, U\right\} dG(p^o) + \delta(1-f)U$$

We assume that firms have to pay ψ to an eligible worker if bargaining breaks down. As the value of a vacancy is 0, firms' outside value is $0 - \psi = -\psi$. Workers' outside value is $U + \psi$. The common surplus, $S_1(p)$ is then given by

$$S_1(p) = (W_1(p) - (U+\psi)) + (J_1(p) - (-\psi)) = W_1(p) - U + J_1(p).$$

Nash bargaining implies

$$W_1(p) - (U + \psi) = \beta S_1(p) \text{ and } J_1(p) + \psi = (1 - \beta)S_1(p),$$

where β denotes workers' bargaining power. Similarly, the surplus if the worker is not eligible, $S_0(p)$, is given by

$$S_0(p) = W_0(p) - U + J_0(p)$$

and

$$W_0(p) - U = \beta S_0(p) \text{ and } J_0(p) = (1 - \beta)S_0(p).$$

There is no need to solve explicitly for the values of workers and firms, since all equilibrium objects can be characterized as functions of the surplus functions. Combining the firm's and worker's value functions and using the bargaining assumption, we find

$$S_1(p) = p - b + \delta f \int_{\underline{p}}^{\overline{p}} (\chi\mu_1(p, p^o) - \mu_u(p^o))(\beta S_0(p^o) - \xi)\, dG(p^o) + \delta(1 - \chi f \mu_1(p) - \lambda) \int_{\underline{p}}^{\overline{p}} (1 - \gamma_1(p'))S_1(p')dF(p'|p) \quad (1)$$

and

$$S_0(p) = p - b + \delta f \int_{\underline{p}}^{\overline{p}} (\chi\mu_0(p, p^o) - \mu_u(p^o))(\beta S_0(p^o) - \xi)\, dG(p^o) + \delta(1 - \chi f \mu_0(p) - \lambda) \int_{\underline{p}}^{\overline{p}} \alpha(1 - \gamma_1(p'))S_1(p') + (1 - \alpha)(1 - \gamma_0(p'))S_0(p')dF(p'|p), \quad (2)$$

where $\mu_u(p^o)$ takes the value 1 if an unemployed accepts an offer with initial price p^o and the decision rules to shut down the firm, γ_0 and γ_1, are given by

$$\gamma_0 = \mathbb{1}\{S_0 < 0\} \text{ and } \gamma_1 = \mathbb{1}\{S_1 < 0\}.$$

That is, due to the bargaining assumption, it does not matter whether we think of a lay-off as firm- or worker-induced, since both parties choose to shut down the firm as soon as the joint surplus falls below zero.

$\mu_0(p, p^o)$ and $\mu_1(p, p^o)$ take the value one if a non-eligible and eligible worker employed at a firm with productivity p accepts an offer from a firm with initial

price draw p^o, respectively. They can be written in the following way:

$$\mu_0(p,p^o) = \mathbb{1}\Bigg\{\beta S_0(p^o) - \xi > \alpha\psi + \int_{\underline{p}}^{\bar{p}} \alpha\left[(1-\gamma_1(p'))\beta S_1(p')\right] + (1-\alpha)(1-\gamma_0(p'))\beta S_0(p')\, dF(p'|p)\Bigg\}$$

$$\mu_1(p,p^o) = \mathbb{1}\Bigg\{\beta S_0(p^o) - \xi > \psi + \int_{\underline{p}}^{\bar{p}} (1-\gamma_1(p'))\beta S_1(p')\, dF(p'|p)\Bigg\}$$

ψ enters the decision rule in a very transparent way. Clearly, a higher ψ makes workers more reluctant to switch jobs ceteris paribus.

The probabilities that a worker accepts an outside offer when employed at a firm with price p are then given by

$$\mu_0(p) \equiv \int_{\underline{p}}^{\bar{p}} \mu_0(p,p^o)\, dG(p^o) \text{ and } \mu_1(p) \equiv \int_{\underline{p}}^{\bar{p}} \mu_1(p,p^o)\, dG(p^o).$$

The decision rule for the unemployed is given by

$$\mu_u(p^o) = \mathbb{1}\left\{\beta S_0(p^0) - \xi > 0\right\}.$$

How does the severance payment ψ feed back into the decision to shut down the firm? First, note that ψ does not enter the recursive equations for the surplus directly. Hence, the lay-off cost does not lead to the expected effect that lay-offs occur less often as they are more costly. The effect is "bargained away" by higher wages, which leads to an unchanged decision rule. The only way in which ψ affects the surplus function is through its negative effect on job-to-job transitions. But this effect may go in either direction: The worker decides her job mobility by trading off *her* share of the surplus in the new and in the old firm, but does not take into account the firm's share of the current surplus, which is lost in case of a job-to-job transition. The net effect of higher job mobility can be positive or negative: the expected surplus in a continuing match can be larger (or smaller) than the worker's share of surplus in a new match net of moving costs.

6.3 Stationary Employment Distribution

In order to derive the zero-profit condition, which involves the probability to meet a worker currently employed at a firm with price p, we need to solve for the stationary productivity distribution. In particular, denote by $n_0(p)$ and $n_1(p)$ the

stationary number of non-eligible and eligible workers employed at a firm with current price p. Since there is a unit measure of workers, the unemployment rate satisfies $u = 1 - \int_{\underline{p}}^{\overline{p}} n_0(p) + n_1(p)\, dp$.

$n_0(p)$ and $n_1(p)$ satisfy the following properties: For all $p' \in \left[\underline{p}, \overline{p}\right]$,

$$n_0(p') = (1-\gamma_0(p'))(1-\alpha)\int_{\underline{p}}^{\overline{p}} (1-\chi f \mu_0(p) - \lambda) n_0(p) f(p'|p)\, dp + f u \mu_u(p') g(p') + \chi f \int_{\underline{p}}^{\overline{p}} (n_0(p)\mu_0(p,p') + n_1(p)\mu_1(p,p')) g(p') dp \quad (3)$$

and

$$n_1(p') = (1-\gamma_1(p'))\int_{\underline{p}}^{\overline{p}} (1-\chi f \mu_1(p) - \lambda) n_1(p) f(p'|p)\, dp + (1-\gamma_1(p'))\alpha \int_{\underline{p}}^{\overline{p}} (1-\chi f \mu_0(p) - \lambda) n_0(p) f(p'|p)\, dp, \quad (4)$$

where $g(p)$ is the p.d.f. of initial price draws. A non-eligible worker currently employed at a firm with price p' was either employed at the firm before and not laid off, or entered it from unemployment or a different job. An eligible worker either was either employed before or promoted to be eligible.

6.4 Zero Profit Condition

The number of meetings between a vacant firm and a potential employee is given by the meeting function

$$m = m(u + \chi(1-u), v),$$

where v denotes the number of vacancies. Define labor market tightness $\theta \equiv \frac{v}{u+\chi(1-u)}$. Assuming that $m(u+\chi(1-u), v)$ satisfies constant returns to scale, we can write for the probability that a vacant firm meets a worker, q,

$$q = \frac{m}{v} = m(\theta^{-1}, 1) \equiv q(\theta) \text{ with } q'(\theta) < 0.$$

The probability to meet an unemployed person is given by $qu/(u+\chi(1-u))$, whereas the probability to meet an employed person is given by $q\chi(1-u)/(u+\chi(1-u))$. The probability that an unemployed person meets a firm, f, can be written

$$f = \frac{m}{u+\chi(1-u)} = m(1,\theta) \equiv f(\theta) \text{ with } f'(\theta) > 0,$$

while the probability that an employed person meets a firm is given by χf.

The expected value of a vacancy, V, satisfies

$$V = -c + \delta q(\theta) \int_{\underline{p}}^{\overline{p}} \left[\frac{u}{u + \chi(1-u)} \cdot \mu_u(p^o) + \frac{\chi(1-u)}{u + \chi(1-u)} \cdot \frac{\int_{\underline{p}}^{\overline{p}} n_0(p)\mu_0(p, p^o) + n_1(p)\mu_1(p, p^o)dp}{1-u} \right] J_0(p^o)\, dG(p^o).$$

A vacant firm pays hiring costs c every period. With probability q the firm meets a potential worker and draws initial price p^o from the distribution $G(p^o)$. The term in square brackets denotes the probability that the offer is accepted either by an unemployed or employed person. If the offer is accepted, the firm can start producing in the subsequent period, yielding value $J_0(p^o)$.

Due to free entry, a vacancy has to yield zero expected profits, i.e. $V = 0$. In terms of the surplus functions, this implies

$$\frac{c}{\delta q(\theta)} = \int_{\underline{p}}^{\overline{p}} \left[\frac{u}{u + \chi(1-u)} \cdot \mu_u(p^o) + \frac{\chi(1-u)}{u + \chi(1-u)} \cdot \frac{\int_{\underline{p}}^{\overline{p}} n_0(p)\mu_0(p, p^o) + n_1(p)\mu_1(p, p^o)dp}{1-u} \right] (1-\beta) S_0(p^o) dG(p^o), \quad (5)$$

pinning down θ, q, and f.

6.5 Equilibrium

In equilibrium, firms and workers have rational expectations and choose their strategies optimally, meaning that the surplus functions $S_0(p)$ and $S_1(p)$ solve the recursive equations (1) and (2). Moreover, vacancies yield zero profit, taking as given optimal behavior by firms and workers and the stationary employment distribution. Definition 6.1 summarizes the equilibrium conditions.

Definition 6.1. *An equilibrium is given by functions* $\{n_0(p), n_1(p)\}$, *values* $\{S_0(p), S_1(p)\}$ *and labor market tightness* θ *such that*

1. $\{S_0(p), S_1(p)\}$ *solve the recursive equations (1) and (2);*
2. $\{n_0(p), n_1(p)\}$ *solve the recursive equations (3) and (4);*
3. *labor market tightness* θ *solves the zero-profit condition (5).*

Note that the bargaining assumption is not restrictive as it might appear. In particular, the model's structure does not require bargaining every period. In fact, the equilibrium is only affected by β due to the formation of new matches: On the one hand, the surplus functions depend on β as it determines the share of the new

match surplus which is captured by workers when they move to a new job. On the other hand, firms' vacancy creation depends on their share of the surplus. It does not matter, however, whether this share of the match is preserved in ongoing matches every period, since the definition of the equilibrium will not be affected. Instead, we can interpret β as the share of the match surplus that a worker expects to receive *on average* over all future periods when entering a new match. The only additional assumption we need then is that renegotiation takes place if either margin of the bargaining range is hit (see Malcomson (1997)).

7 Structural Estimation

7.1 Model Specification

We estimate the model by Simulated Method of Moments. That is, after choosing functional forms and fixing part of the parameters of the model, we use the model to simulate artificial data sets. We then require the parameters of the model to minimize the distance between specific moments of the actual and the simulated data.

Periodicity is set to one month. We assume that prices evolve according to

$$\log p_t = \rho \log p_{t-1} + \varepsilon_t,$$

where $\varepsilon_t \sim \mathcal{N}(0, \sigma_\varepsilon^2)$. We approximate this process by a 51-state Markov chain using the algorithm due to Tauchen (1986). The meeting function is assumed to be of Cobb-Douglas form, i.e.

$$m(u + \chi(1-u), v) = m_0(u + \chi(1-u))^\phi v^{1-\phi}.$$

We have to choose part of the parameters exogenously, for several reasons: The level of the severance payment and the probability of becoming eligible, ψ and α, are dictated by the institutional setting. In reality, severance payments are indexed to the monthly wage before the layoff. In order to approximate this rule, we index the severance payment to $w_1(\tilde{p})$, where $\tilde{p}$ is the lowest level of productivity for which $\gamma_1(p) = 0$. We then have $\psi = \psi_w w_1(\tilde{p})$, where we set $\psi_w = 2$ to match two monthly wages for the time before the reform, while setting $\psi_w = 0$ after the reform. Moreover, we set $\alpha = 0.029$ to match an average waiting time until eligibility of three years.

Other parameters are not identified separately from other parameters of the model or typically hard to estimate. However, we find them reasonably constrained by previous choices in the literature. We set $\delta = 0.997$, which yields an annual interest rate of approximately 4%. We follow Hall and Milgrom (2008) in choosing

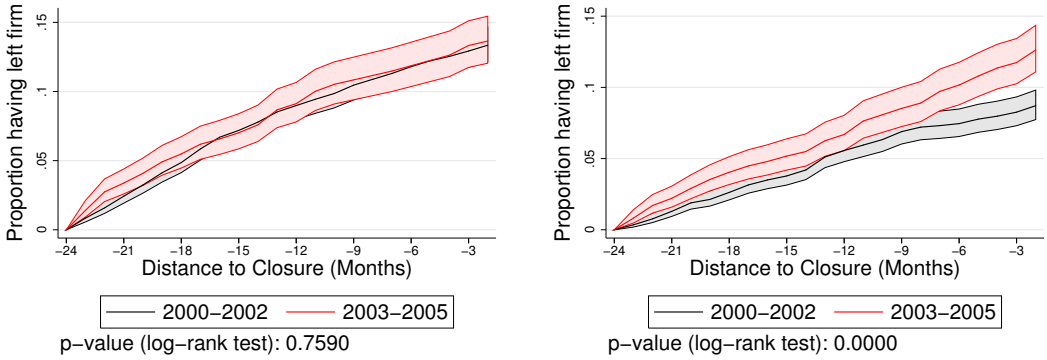
$b = 0.71$. The meeting function elasticity ϕ is fixed at 0.6, which is the middle of the range of values reported by Petrongolo and Pissarides (2000). The condition due to Hosios (1990) then provides a natural choice for workers' bargaining power and hence we set $\beta = 0.6$. In accordance with Postel-Vinay and Robin (2002), we fix the relative search effort of the employed, χ, at 0.3. Lastly, we need to fix autocorrelation of idiosyncratic firm shocks, ρ, for computational reasons[3]. We choose $\rho = 0.944$, so that the half-life of a shock is one year. Different choices for ρ yield similar results, while the fit of the model seems to improve somewhat if the shock is more persistent. We summarize the parameter choices in Table 2.

Parameter	Definition	Value	Source/Target
δ	Discount rate	0.997	4% annual interest rate
β	Workers' bargaining power	0.600	Hosios (1990) condition
ϕ	Elasticity of q w.r.t. θ	0.600	Petrongolo and Pissarides (2000)
α	Probability of becoming eligible	0.029	12 quarters average waiting time
χ	Relative search effort of workers	0.300	Postel-Vinay and Robin (2002)
ψ_w	Severance payment per previous wage	2.000	2 monthly wages
ρ	Autocorrelation of prices	0.944	Half-life of shock 4 quarters
b	Opportunity cost of employment	0.710	Hall and Milgrom (2008)

Table 2: Exogenously chosen parameters

The remaining parameters of the model, that is, the exogenous separation rate λ, the standard deviation of innovations ε_t, σ_ε, moving costs ξ, the efficiency parameter of the meeting function m_0, and hiring costs c are chosen to match empirical moments. On the one hand, we require the model to match the observed cumulative exit shares into unemployment (JTU) and to a new job (JTJ) in the months 24 to 2 before the firm closure. We classify a transition as JTJ if the intervening period of unemployment does not exceed one month. Of course, this will lead us to misclassify part of the JTU transitions as JTJ. However, this is not a problem if we apply the same definition to simulated data. In Figure 10, we plot these exit rates. Note that the two curves will add up to the exit rates in Figure 3a. Moreover, it is apparent that the entire difference in exit rates is driven by JTJ transitions.

[3]In particular, estimation is computationally feasible as we can keep the same set of stochastic shocks in every iteration. If we vary the standard deviation of ε_t, we just have to scale the shocks. If we varied ρ, by contrast, we would have re-generate the trajectories in every iteration.



(a) Cumulative exit rates (JTU)

(b) Cumulative exit rates (JTJ)

Figure 9: Cumulative share of workers leaving into unemployment and to another job

In addition, we require the model to match certain macro moments: Using the universe of workers observed in ASSD, we measure a monthly probability of closing down a firm of 0.23%[4], a monthly job-finding rate of 29%, and an average unemployment rate (years 1994-2013) of 4.2%. For lack of Austrian data on labor market tightness, we require that the model matches a labor market tightness of 0.634 as measured by Hagedorn and Manovskii (2008) for the US. Moreover, drawing on evidence in Silva and Toledo (n.d.), Elsby and Michaels (2013) require expected hiring costs to equal 14% of quarterly worker compensation. Here, expected hiring costs are given by $c/(q(\theta)\cdot a)$, where a denotes the unconditional probability that an offer is accepted, and we target the same number. Since cannot measure the macro moments separately before and after the reform due to business cycle effects, we will take an average of the simulated values before and after the reform.

The exit rates in Figure 10 are based on $N = 4374$ observations ($N_0 = 2813$ before the reform and $N_1 = 1561$ after the reform) of workers in firms in the last two years before firm closure. For every given set of parameters, we solve for the equilibrium defined in Definition 6.1 by iterating on the equilibrium conditions pre- and post-reform. This allows us to simulate aggregate variables as well as policy functions *contingent on being in a firm about to close down*. Using these policy functions, we then simulate H datasets of size N_0 and N_1 for the period before and after the reform, respectively, and calculate the exit rates and macro moments based on them.

In total, we target 97 moments (23 monthly exit rates for JTU and JTJ pre- and post-reform plus five macro moments). Call $\boldsymbol{\beta} \equiv (\lambda, \sigma_\varepsilon, \xi, m_0, c)$ the parameters to be estimated and $\tilde{m}(\boldsymbol{\beta}, e)$ the simulated moments given parameters $\boldsymbol{\beta}$ and a set of shocks e. Call m the corresponding vector of empirical moments. We choose $\boldsymbol{\beta}$ by

[4]In order to keep the model from choosing a zero probability, we target the log of this probability.

solving

$$\min_{\beta} \left(\tilde{m}(\boldsymbol{\beta}, e) - m\right)' W \left(\tilde{m}(\boldsymbol{\beta}, e) - m\right),$$

where W is a weighting matrix. Efficient GMM requires setting W equal to the inverse of variance-covariance matrix of m. Instead, we choose W equal to the identity matrix. The reason is that we view the model rather as a description of firms about to close down than as a representation of the entire economy. We include macro moments to ensure that the parameters are identified and not unrealistic but do not expect the model to reproduce macro moments perfectly in line with aggregate data solely using data from firms about to close down. In other words, we do not expect the parameters describing the behavior of these firms to be perfectly in line with the entire economy. Since the macro moments are measured with much less variance, efficient GMM will put much more weight on the macro moments, while our primary interest lies in explaining worker mobility in declining firms.

A well known problem with Method of Simulated Moments is that the simulated moments are a discontinuous function of the underlying parameters for a given set of random shocks, as we have a finite number of observations and discrete outcomes. This can pose problems to optimization algorithms, leading to non-convergence or convergence to local optima. Keane and Smith (2003) propose a remedy for this problem in the context of a random utility model: Suppose that a binary variable y_i is 1 if a simulated latent utility given parameters β, $u_i(\beta)$, is positive and zero otherwise. Instead of using y_i to calculate the simulated moments, they propose using a continuous function of the latent utility, $g(u_i; \zeta)$, where $g(u_i; \zeta) \to y_i$ as $\zeta \to 0$. Our choice for $g(u; \zeta)$ is

$$g(u; \zeta) = \Phi(u/\zeta),$$

where $\Phi(\cdot)$ denotes the c.d.f. of the standard normal distribution. Paralleling this strategy, we apply this smoothing procedure to all discrete outcomes of the model, i.e. to the policy functions $\gamma_0(p)$, $\gamma_1(p)$, $\mu_0(p, p^o)$, and $\mu_1(p, p^o)$, as well as in the estimator for the empirical exit rates, which we choose to be

$$F(t) = \frac{1}{N} \sum_{i=1}^{N} \Phi((d_i - t)/\zeta),$$

where d_i denotes time until exit for the ith worker.

There is no clear rule as to which value should be chosen for the smoothing parameter ζ and the number of simulated datasets H. Larger values of ζ and H lead to a smoother surface of the objective function, decreasing the risk of local optima where the optimization algorithm could get stuck. At the same time, increasing ζ increases the bias, while a higher H is more computationally expensive. For the

results reported here, we choose $H = 5$, which still leads to manageable computation time. We then chose ζ so that the objective function is reasonably smooth[5].

7.2 Informal Discussion of Identification

In this section we briefly comment on the structural features of the model and the variation in the data that help pin down the parameters to be estimated.

- Exogenous separation rate: The exogenous separation rate is primarily identified by the exit rates into unemployment as well as equilibrium unemployment conditional on the average job-finding rate.
- Standard deviation of innovations: The volatility of firm shocks is primarily pinned down by the probability to close down a firm, i.e. the probability that the stochastic process hits a lower threshold.
- Moving costs: Conditional on the job-finding rate, moving costs are pinned down by the exits into new jobs.
- Meeting efficiency: Meeting efficiency is pinned down by labor market tightness and the job-finding rate.
- Hiring costs: Conditional on the vacancy filling rate, hiring costs are identified by expected hiring costs per quarter.

While this intuition helps in understanding where the identification comes from, this is of course no formal criterion. In the subsequent section, we present results of Monte-Carlo tests that demonstrate that the estimation usually succeeds in recovering the true structural parameters.

8 Estimation Results

8.1 Parameter Estimates

The estimated parameter values are presented in Table 3. We estimate a monthly exogenous separation rate of 3.76%, which implies an average job duration in the absence of job-to-job transitions of approximately 27 months. While this estimate might appear quite high, it has to be kept in mind that it is estimated solely on the subsample of firms about to close down. Thus, it might also capture an increased probability of layoffs prior to actual firm closures. Moreover, we estimate a standard deviation of innovations in idiosyncratic firm heterogeneity of 1.72%. Moving costs are substantial – around 1.3 monthly wages. At the estimated meeting efficiency,

[5]We choose ζ as low as possible. It turned out that the policy functions μ and γ require more smoothing than the rules used in simulating individual data. We hence set $\zeta = 0.2$ for the policy functions, while 0.1 turns out to be sufficient for the simulation of individual data and the calculation of the exit rates.

around 10.7% of all workers sample a job offer every month, or about every nine months on average. Eventually, hiring costs are estimated to be around 18% of a monthly wage.

Parameter	Definition	Estimate	Standard Error	95% Confidence Interval
λ	Exogenous separation rate	0.0375	0.0027	(0.0325, 0.0433)
σ_ε	Standard deviation of innovations	0.0173	0.0025	(0.0129, 0.0230)
ξ	Moving Costs	1.2672	0.2101	(0.9157, 1.7537)
m_0	Meeting Efficiency	0.4314	0.0138	(0.4052, 0.4593)
c	Hiring Costs	0.1735	0.0136	(0.1488, 0.2023)

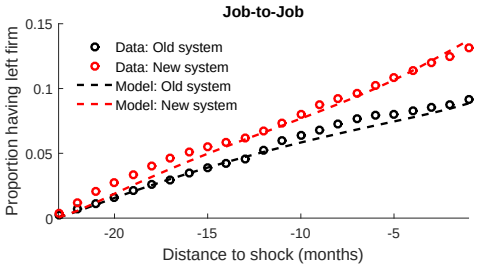
Table 3: Estimates

While estimated moving costs appear large, they are more or less in line previous estimates in the literature. For instance, Kambourov and Manovskii (2009) note that estimates reported in Heckman, Lalonde, and Smith (1999) imply direct costs of the average vocational training program of close to two monthly wages for the median worker.

8.2 Model Fit

In Figure 10 we plot the simulated exit rates into unemployment and to a new job against their observed counterparts. In Table 4, we additionally compare the simulated macro moments to their empirical counterparts. Overall, the fit is quite good. The estimated model captures well the qualitative finding that there is no observable difference in the job-to-unemployment transitions, while also matching changes in the transitions to a new job between the old and the new system. The fit of the macro moments is decent but not quite as good as for the exit rates. This is not surprising given the fact that we have to extrapolate to the entire economy from the sample of firms about to close down. The highest relative discrepancy is in the unemployment rate, which is a direct consequence of the high estimated exogenous separation rate. As argued above, this estimate is arguably not representative for the entire economy.

(a) Cumulative exit rates (JTU)



(b) Cumulative exit rates (JTJ)

Figure 10: Cumulative share of workers leaving into unemployment and to another job, simulated values vs. data

Variable	Data	Simulated
Probability of Firm Closure	0.0023	0.0025
Unemployment Rate	0.0680	0.1060
Labor Market Tightness	0.6340	0.6340
Job-Finding Rate	0.2900	0.3595
Hiring Cost Share	0.1400	0.1251

Table 4: Model fit: macro variables

8.3 Robustness

The parameters $\boldsymbol{\beta} \equiv (\lambda, \sigma_\varepsilon, \xi, m_0, c)$ are identified if there is only one set of parameters leading to a maximization of the GMM criterion given the data. One way of testing this is by means of Monte-Carlo simulations: We specify some value for $\boldsymbol{\beta}$ and simulate data from the model using a different set of shocks than in the previous estimation. We then re-estimate the parameters on the simulated data to check whether GMM can recover the true parameters. This robustness check can discover problems related to different questions:

- Does the GMM criterion attain its unique maximum at the true parameters or are there other parameters that could also have generated the data?
- Given the model is identified, does the algorithm succeed in finding the optimum?

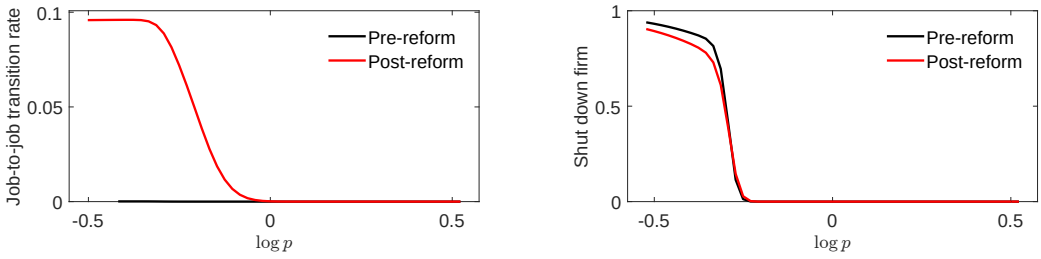
In Figure 13, we report the results of some first Monte-Carlo tests. Each line of graphs corresponds to a new set of simulations, where we vary one parameter at a time. For instance, in the first line six different values of λ are chosen while all other parameters are kept constant. We plot the true structural parameters along with

their estimated values and their 95% confidence interval. Overall, identification seems to be decent as the estimated parameter values align well with the true estimates. There are very few exceptions where we are not able to recover the true parameters. Inspections of these cases reveals that the algorithm converged to a local minimum. However, we also found that experimenting with different start values yields the true optimum in most of the cases. Mirroring this finding, we also tried different start values for our estimation procedure and obtained the same results.

8.4 Discussion

The estimated model predicts that workers react very strongly to the changed incentives due to the reform. In Figure 11a, we plot the estimated quit probability of eligible workers, $\chi f \mu_1(p)$, for different values of price p before and after the reform. We find that before the reform, eligible workers only quit to extremely good outside offers, which have very low probability, basically yielding zero probability of a quit. By contrast, once firms are hit by adverse shocks, workers are much more likely to accept outside offers. The acceptance probability approaches 90% as conditions deteriorate – only the positive moving costs keep workers from accepting every outside offer even at the lower end of realizations.

In Section 6.2, we discussed that it is not a-priori clear whether the reform increases or decreases the incentives to shut down a firm. In Figure 11b, we plot the estimated probability of a firm with an eligible worker to shut down, $\gamma_1(p)$, before and after the reform. We find that the positive and the negative effect on the joint surplus almost cancel out at the estimated parameter values. The smoothing procedure we apply reveals some minor differences mirroring differential slopes of the surplus functions around the cutoff, which are hard to interpret. Overall, the model implies that the reform has little effect on firm closures.



(a) Job-to-job transition (eligible worker)

(b) Firm closure (eligible worker)

Figure 11: Policy functions before and after the reform

Workers' changed on-the-job search implies that there is more reallocation from "bad" to "good" firms, as can be seen from Figure 12, where we plot the change in the stationary number of workers in every bin of the price grid. Clearly, we observe workers in below-average firms reallocating to above-average firms. However, the aggregate effect is moderate – aggregate output only increases by around 0.1%. The reason is that job-to-job transitions are still too rare for average firms where almost all workers are employed, which is due to the moving costs. On the other hand, aggregate welfare, which is given by

$$\mathcal{W} = U + \int_{\underline{p}}^{\overline{p}} n_0(p)S_0(p) + n_1(p)S_1(p)\,dp,$$

increases by 0.7%. The additional increase is due to the general equilibrium effect through the change in the labor market tightness. Given the higher acceptance probability, firms have higher incentives to create vacancies, increasing the job-finding rate slightly from 35.8 to 36.1%, which affects the value of being unemployed, U.

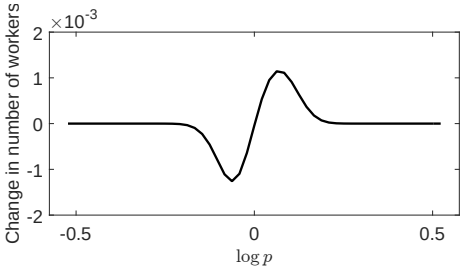


Figure 12: Change in number of workers per price bin

The fact that our model only predicts moderate aggregate reform effects does not surprise us. While the model is well suited to approximate the reform incentives, it is too simple to capture the Schumpeterian forces of the reform. In particular, allowing for worker-specific productivity which is portable across firms should increase the aggregate implications of the reform. An extension of the model into this direction is ongoing work.

9 Conclusion

In this paper we have looked at a major change in Austrian labor market regulations: the introduction of an occupational pension scheme based on separation payments for private sector workers and the simultaneous abolition of a previous system of severance payment. The new policy change brought about two major changes. While only laid-off workers were eligible to severance pay under the old system, both quitters and laid-off workers can keep their accumulated savings/payment

on the pension account (and transfer it to a new employer once they have a new job) in the new system. The policy change abolished a discontinuous schedule of severance pay (with jumps at tenure thresholds) to a continuous (with the balance of the pension account monthly increasing smoothly with employer's monthly contributions). The new policy increases the incentive to quit an employment relation when employed in a distressed firm. By contrast, workers employed under the old system had no such incentive but rather benefited from waiting for their layoff (to cash in the severance payment).

This paper uses data from the Austrian social security register (ASSD) to study how the policy change from severance payment to occupational pensions / separation payment affected job mobility. We indeed find that job mobility in distressed firms is substantially higher under the new system than the old one. The probability that a worker is still employed at a distressed firm (that is about to experience a plant closure within the next two years) at the date of plant closure is 6.1 percentage points (or 22 percent) lower then the corresponding probability for workers employed under the old system. Such results suggest that a system in which quits are discouraged or even penalized leads to inefficiently long job durations compared with a system in which quits do not suffer from such a penalty. Put differently, the new system encourages moves from ”bad” to ”good” firms with potentially important consequences for the allocation of workers and total factor productivity.

The paper also addresses the argument that employment reductions by firms are endogenous and might react to the reform itself. To explore the reform's aggregate implications, we propose an equilibrium search model featuring endogenous layoffs and job-to-job mobility. In the model, firms face demand- (or productivity-) shocks, changing the likelihood that a worker in a distressed firm will experience a layoff. When the layoff probability is high, a worker who might lose her severance payment optimally waits for the layoff to occur under the old system (rather than search hard for a new job and accept reasonable job offers). Under the new system, a worker – with a separation payment transferred to the new employer – is much more likely to move on to a new and more efficient employment relationship.

We estimate the model by Simulated Method of Moments and show that, under realistic parameter values, it generates differences in mobility behavior of similar magnitude as those found in the empirical analysis. The model predicts a moderately positive effect on aggregate welfare (0.6%). However, we argue that the model in its current form is too simplistic to capture the Schumpeterian forces behind the reform. In ongoing work, we want to allow for individual worker heterogeneity to make more realistic statements about the aggregate implications of the reform.

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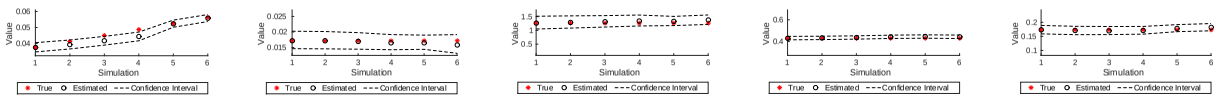
A Monte-Carlo Tests



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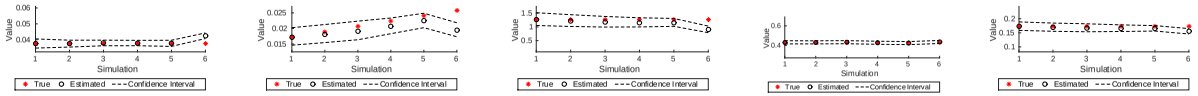

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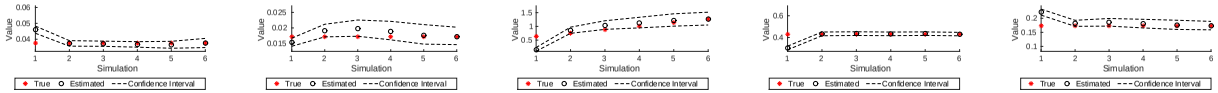

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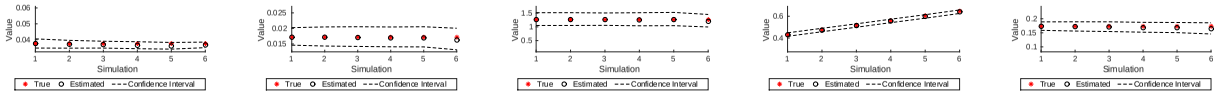

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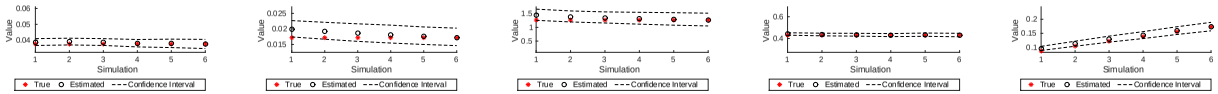

(u) λ (v) σ_ε (w) ξ (x) m_0 (y) c

Figure 13: Monte-Carlo tests