Unemployment Insurance and the Duration of Employment: Evidence from a Regression Kink Design

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Abstract

This paper studies the existence of a causal link between the availability of unemployment insurance (UI) and the duration of employment spells. After discussing few straightforward reasons why and how UI may affect employment duration, I apply a regression kink design to address this question using linked employer-employee data from the whole Brazilian labor market. Exploiting kinks in the Brazilian UI schedule, I find a statistically significant effect of benefit level on the duration of employment spells which is robust to a number of falsification tests. I also propose the use of a RKD in triple differences with two placebo points for robustness. Surprisingly, the results indicate that the elasticity of employment duration to benefit level is positive and as large as 1. To assess the economic relevance of this result, I extend the reduced welfare formula from Chetty (2008) to deal with this effect on employment duration and show that this elasticity is as relevant for welfare as the elasticity of unemployment duration to benefit level.

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1 Introduction

There is a large body of both theoretical and empirical literature studying a number of issues related to unemployment insurance (UI). Perhaps its most well-established result is that more generous UI creates a moral hazard problem on search which increases the duration of unemployment spells. Instead, the question of whether (or how) unemployment insurance affects the duration of employment spells has been much less studied. In this paper, by applying a regression kink design (RKD) using Brazilian data, I present evidence that the level of unemployment benefits significantly affects the duration of employment spells, with a positive elasticity of around 1. To assess whether the size of this effect is of any relevance for welfare, I provide a welfare formula based on sufficient statistics and show that its impact on welfare has the same magnitude of the distortion caused by moral hazard on search.

Even though we have little evidence on the issue, there are at least few straight forward reasons for one to suspect that the availability of UI may affect the duration of employment positively or negatively. The question of whether the magnitude of this effect is relevant will be addressed in the data. First, higher unemployment benefit increases the value of unemployment for employed workers. Therefore, it decreases the incentives for employed workers to put effort in keeping their jobs, decreasing the duration of employment. Second, in the vast majority of UI systems, only workers laid-off against their will are eligible to unemployment benefits. Therefore, it decreases the incentives for workers to quit because it means giving up unemployment benefits, especially if the reason for quitting is not engaging in a new job. Differently from the first, this mechanism would increase the duration of employment. Third, most UI systems have a minimum eligibility requirement (MER) in which only workers which are employed for a minimum length of time are eligible to benefits in the case of a lay-off. Such a feature creates incentives for workers to put effort in holding up their jobs until the minimum required period, and thus should increase the duration of the employment. Fourth, in many systems potential duration of benefits is an increasing function, often times discontinuous, of the duration of the employment spell prior to the dismissal. Similarly to MER, this provides an incentive for workers to put effort in holding their jobs for longer periods, increasing the duration of employment.

All these are simple theoretical predictions which can be made without the need to rely on any extreme assumption whatsoever. The real question however is whether one or more of these mechanisms are able to create any economically sizeable effects on the duration of employment spells. Notice that, in principle, such effect could be positive or negative. To answer to this question avoiding the interference of confounding factors, I exploit the assignment rule for benefit level in the Brazilian UI system by implementing a regression kink design. By taking advantage of four years of linked employer-employee data from the whole Brazilian formal market, I find that the elascity of employment duration to benefit level is surprisingly positive and as large as one. Even though the RKD is extremely data demanding, the very sizeable dataset containing more than 50 millions observations per year allows me to have enough precision on the estimates. Moreover, on the top of the standard tests on the validity of the RKD, I provide robustness tests on placebo variables and estimates of a RKD in triple differences. To the best of my knowledge, this is the first paper to address the question of how UI affects the duration of employment spells with a credible quasi-experimental setup.

The remaining issue though is whether this result is of any relevance for welfare. To address this question, I modify the reduced-form welfare formula provided by Chetty (2008) in a way that it can deal with UI distortions on the duration of employment. I show that the latter affects welfare with the same order of magnitude as the well-known distortion on search, measured by the elasticity of unemployment duration to benefit level. Therefore, this result suggests that the effect of benefit level of the duration of employment spells is as relevant for policy as the moral hazard of search.

The paper is organized as follows. In section 2, I present the model from which the reduced-form welfare formula is derived and discuss its key differences and results with respect to Chetty (2008). In section 3, I describe the institutional background and present the identification strategy. In section 4, I show the results and provide a variety of robustness checks such as placebo variables and the regression kink design in triple differences. In section 5, I discuss the results and how they link to welfare.

2 Theory

The goal of this model is to derive a reduced form welfare formula which can deal with potential distortions of benefit level on the duration of employment spells. It builds as close as possible to the setup proposed by Chetty (2008). It features incomplete markets where workers are not able to privately insure against unemployment and have a limited ability to borrow against the future. These elements provide the rational for government intervention with unemployment insurance policy. If, otherwise, credit and insurance markets were complete, workers would be able to perfectly insure against unemployment and would face no liquidity constrains. In such world, there would be no reason for the government to intervene. Below, I present the model setup and the agent's problem.

2.1 Model Setup and Agent's Problem

The model runs in discrete time and agents live for T periods {0, 1, ... , T-1}. For a matter of simplicity, I further assume that the agent's discounting rate and interest rates are equal to zero, as in Chetty (2008). In this economy, all agents start the model employed with a wage equal to w and have to pay a tax τ which finances the UI system. They face a lay-off risk which negatively depends on the level of effort e_t that they put in keeping their job. The idea is that workers can make costly decisions which may help them holding their jobs. For instance, workers can decide how punctual they are or how willing they are to make extra hours. It can also be understood under the framework of a standard shirking model: firms use the threatening of firing to motivate workers to exert effort. The more effort the worker puts in his job, the lower the probability of being fired. It is worth noticing, however, that this model is silent with respect to the fact that variations in effort may affect firm productivity. Work effort e_t is costly for the workers and its cost is given by the function $c(e_t)$, which is assumed to be continuous and convex ($c'(e_t) > 0$ and $c''(e_t) > 0$). Furthermore, without loss of generality, e_t is normalized in such a way that it directly represents the probability of a lay-off. The problem of the worker who keeps his job is given by:

$$V_t(A_t) = \max_{A_{t+1} \geq L} v(A_t - A_{t+1} + w_t - \tau) + J^V_{t+1}(A_{t+1}) \tag{1}$$

$$J^V_t(A_t) = \max_{e_t} e_t V_t(A_t) + (1 - e_t) U_t(A_t) - c(e_t) \tag{2}$$

V_t defines the value of the job the worker has at the beginning of the model. A_t defines the worker's asset level at period t. Such a level is constrained by a lower bound L, which defines the maximum amount the worker is able to borrow against the future. $v(.)$ defines the utility from consumption of the employed worker. With probability e_t he keeps his job, which yields the value V_t. With probability $(1 - e_t)$ he loses his job and becomes unemployed immediately at period t, which yields the value U_t.[1]

In the case where the worker is laid-off, he receives unemployment benefits equal to $b_t < w_t$, provided that he has worked for at least k periods; otherwise, $b_t = 0$. This characterizes a minimum eligibility requirement (MER) for UI, which is a typical feature of many UI systems.[2] Nevertheless, since k is a parameter which can take any value, the model is also able to suit the case of systems which do not have MER. At this point, the unemployed worker chooses his level of search effort s_t in order to find a new job. As for work effort, s_t is normalized to equal the probability that the worker finds a new job at period t. The cost of search effort is defined by $\psi(s_t)$ which is assumed to be continuous and convex ($\psi'(s_t) > 0$ and $\psi''(s_t) > 0$). Thus, with probability s_t the unemployed worker finds a new job which immediately starts at period t and yields value E_t. With probability $(1 - s_t)$ he fails to find a job at period t and remains unemployed, which yields him the value U_t. His problem is given by:

$$U_t(A_t) = \max_{A_{t+1} \geq L} u(A_t - A_{t+1} + b_t) + J^U_{t+1}(A_{t+1}) \tag{3}$$

$$J^U_t(A_t) = \max_{s_t} s_t E_t(A_t) + (1 - s_t) U_t(A_t) - \psi(s_t) \tag{4}$$

[1]A more intuitive and conventional assumption would be that a lay-off at period t leads to unemployment at period t+1. However, here I shall assume that unemployment comes immediately for a matter of tractability of the model.

[2]More precisely, to the best of my knowledge, I am not aware of any UI system which does not require a minimum number of working months for workers to be granted with UI benefits.

E_t is defined as the value of employment subsequent to unemployment. Following the same spirit of Chetty (2008), I assume this to be an absorbing state. It means that once an unemployed worker finds a new job, he remains employed indefinitely. Furthermore, once reemployed, workers no longer have to contribute for UI since his job now lasts forever.

$$E_t(A_t) = \max_{A_{t+1} \geq L} v(A_t - A_{t+1} + w_t) + E_{t+1}(A_{t+1}) \tag{5}$$

$$\tag{6}$$

The underlying idea of this setup is that the UI system can be properly represented by a initial period where employed workers contribute to the system, and a subsequent period where workers who have lost their jobs are benefited from the insurance. This also seems to be the appropriate order of facts because any UI system requires workers first to work and, only then, they can become eligible for UI. In other words, new entrants in the labor market are not entitled to benefits when they first start looking for a job. Therefore, in this model, for a matter of simplicity, the third state is neutral with respect to the UI system exactly because the initial employment and subsequent unemployment period are enough to capture the relevant features of the system. Making a link with the "real world", once workers are reemployed after enjoying UI benefits, it works as if they were starting their first employment again, for all that matters for UI.

In sum, the model defines an economy with incomplete credit and insurance markets. All workers are employed at $t = 0$ with a net wage of $w_t - \tau$ and face a lay-off risk which negatively depends on their choice level of work effort, period after period. If a worker becomes unemployed, he has to choose a level of search effort in order to find a new job. While unemployed, he is entitled to UI benefits b_t, which last for a maximum of B periods, provided that he has worked for more than k periods (MER), otherwise he receives zero benefits. Once the worker leaves unemployment, he falls into an absorbing state where his new job lasts indefinitely and he has no longer to contribute for the UI system.

2.2 The Reduced-Form Welfare Formula

I leave the solution for the worker's problem in each state of the model to appendix B.1 and B.2, and move to the social planner's problem to derive the welfare formula. The social planner aims to maximize expected utility by choosing the level of unemployment benefits and a tax level τ on employed workers in order to finance the system. In principle, the profile of benefit levels and duration could vary over time, however for a matter of simplicity I focus on "constant benefit, constant duration", as in Chetty(2008).[3] Therefore, I here assume b_t to be constant over time and that benefits last for a maximum of B periods.

[3] Chetty(2008) also remarks that most UI policies indeed provide constant benefits with finite duration. This is also the case for Brazil, which is analyzed in the empirical section.

The general social planner's problem is given below:

$$\max_{b,\tau} J_0^V(b,\tau) = e_0 V_0(b,\tau) + (1-e_0)U_0(b,\tau) - c(e_0) \tag{7}$$

$$s.t. \quad f^{UI} D_B b = D_E \tau \tag{8}$$

The goal of the social planner is to maximize J_0^V which defines the representative worker's expected utility, which is assumed to start the model employed. Since the choice of effort at period 0 can lead to a lay-off at the same period as discussed before, expected utility is the weighted sum of the expected utility of workers who keep their jobs at the initial period, V_0, and of those who enter unemployment already at period 0, U_0; minus the cost of effort. Weights are of course the probability of keeping the job at the initial period, and the probability of being dismissed, respectively.

The constraint assures that the government budget is balanced. D_E describes the expect duration of the agent's employment at the beginning of the model. Only this duration matters for the government budget's revenue because, as stated before, upon reemployment workers remain employed forever and no longer contribute to the system. D_B defines the agent's expected unemployment duration under UI benefits and f^{UI} is the fraction of workers meeting MER. The former differs from the simple unemployment duration because when the unemployment spell exceeds the maximum duration of benefits (B periods), workers no longer receive benefits. Thus, once the unemployment spell exceeds the maximum duration of benefits, its duration no longer matters for the government budget. Therefore, the left-hand-side of the budget constraint in (8) denotes the expected cost of the policy, while the right-hand-side represents the expected amount received in taxes, which are levied on employed workers.

At this point, it is possible to evaluate how a marginal change in the level of benefits impacts on welfare. In the same spirit of Chetty (2008), I assume that the consumption path during employment is constant since unemployment is unlikely to cause large losses on life cycle earnings. Furthermore, since there is no reason to believe that the liquidity to moral hazard ratio or the probability of finding a job at the initial period of unemployment should vary depending on when individuals have become unemployed, I assume these to be constant over time. Together with the results from the agent's optimal choice of work and search effort, it is possible to derive the final welfare formula (see Appendix B.4 for details):

$$\frac{dW}{db} = f^{UI}\frac{D_B}{D_E}\left\{\frac{1}{1-s_0}(\rho+1) - \left(1+\epsilon_{f^{UI},b}+\epsilon_{D_B,b}-\epsilon_{D_E,b}\right)\right\} \tag{9}$$

where $f^{UI} = \sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)$ is the share of laid-off workers eligible for UI due to MER and

$\rho = -\frac{\frac{\partial s_i}{\partial A_i}|B}{\frac{\partial s_i}{\partial W_i}|B}$ is the liquidity to moral hazard ratio for each i.

This formula shows the net welfare effect from increasing UI benefits by \$ 1. Welfare effects are a trade-off between the benefits from the liquidity provided to unemployed workers and the costs from higher taxes imposed on employed workers. The benefit from providing liquidity to the unemployed is captured by the liquidity-to-moral hazard ratio ρ. It is also weighted by the fraction of unemployed workers actually eligible for UI, since those not meeting MER are not entitled to benefits. On the cost side $\epsilon_{D_B,b}$ captures the behavioral response from higher benefits on the duration of unemployment under benefits; and $\epsilon_{D_E,b}$ captures the behavioral response from higher benefits on the duration of employment. Furthermore, there is also the behavioral response on the fraction of workers meeting MER, $\epsilon_{f^{UI},b}$. The last three terms captures exactly the distortionary effect of UI on employment and is the key difference from this result to the original formula provided by Chetty (2008).

The formula shows that $\epsilon_{D_E,b}$ affects welfare exactly with the same magnitude of $\epsilon_{D_B,b}$. In the empirical section, I show that $\epsilon_{D_E,b}$ can take values as large as one, which is similar to the size of $\epsilon_{D_B,b}$ found in other studies.

3 Institutional Background and Identification Strategy

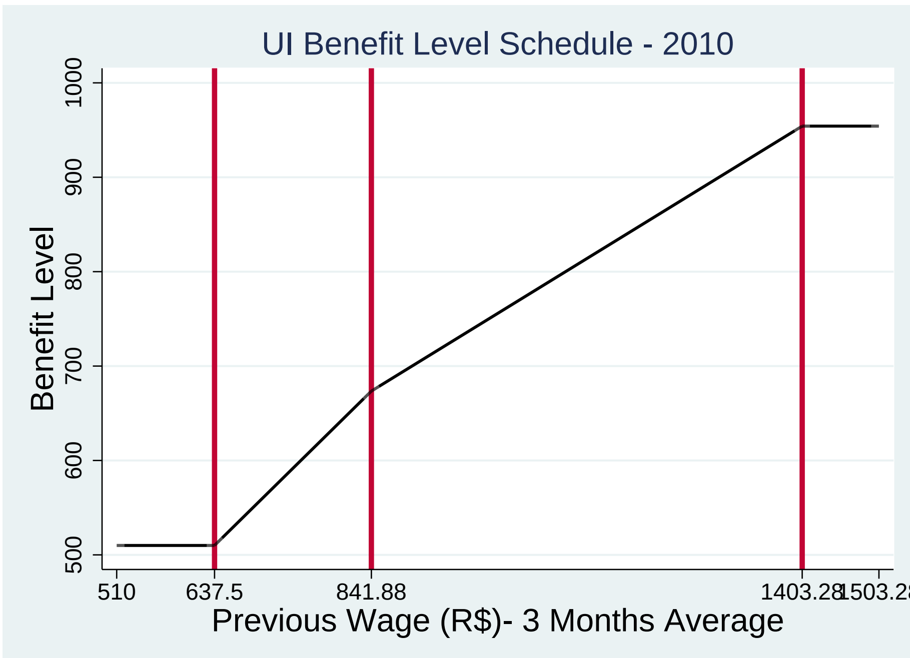
To recover the effect of benefit level on the duration of the employment spell without the interference of confounding factors, I implement a regression kink design to explore kinks on the policy rule which conditions benefit level on previous wage in Brazil. Throughout this section, I introduce the main characteristics of the UI system in Brazil and the benefit level schedule; explain the identification strategy - *the regression kink design*; and present the data.

3.1 UI Schedule in Brazil

The Brazilian unemployment insurance system is a federal program established in 1986. It offers temporary income for formal sector workers who are dismissed against their will and meet minimum eligibility requirements. These are: (i) have been employed in all the last 6 months prior to the lay-off; (ii) have no other source of income ; (iii) have not been granted with UI benefits for the last 16 months, couting from the date of the last lay-off which enacted benefits. It is important to notice that benefits are granted only for workers dismissed *without a just cause*. This is the most common type of dismissal in Brazil, since employers by law are free to dismiss workers without a just cause in the sense that they need no authorization from any tribunal or government agency to do so. Furthermore, even though dismissing *with a just cause* is less cost for employers, the conditions for this type of dismissal are very tight and it is very hard to collect enough proof to back up cause.[4] Also notice that workers quitting their jobs are not entitled to benefits.

The level of benefits is defined by a rule based on the 3-months average of previous wages prior to the dismissal. The schedule varies in values on a yearly basis, but its shape remains always the same. I choose to present the schedule with numbers from 2010 for illustrative purpose. The schedules for other years are follow the very same shape but are yearly increased by around 8%. Figure 1 shows the schedule for the year of 2010.

Figure 1: Benefit Level Assignment Rule - Year 2010



Monthly benefits are a function of a reference wage ($r.w.$) which is given by the average monthly wage in the last three months prior to the dismissal. Benefit level equals 80% of the reference wage if it is lower than R$ 841.88. However, benefits can never be lower than minimum wage, R$ 510 for the year of 2010. This generates the first kink in the assignment rule which can be seen by the red line at the left side of figure 1 (at R$ 637.50). When the reference wage is higher than R$841.88 but not larger than R$1403.28, benefits are given by $[(r.w. - 841.88) * 0.5 + 841.88 * 0.8]$. It defines the second kink present in the assignment rule, at R$841.88, which is indicated by the second red line in figure 1. For reference wages larger than R$1403.28, benefits are always equal to R$954.20. This cap defines the last kink in the assignment rule, which is indicated by the red line at the right side of figure 1. The values present in the schedule are updated every year, which changes the location of the three kinks from year to year.

[4] In general, workers can only be fired on cause only if they: (a) are continuously absent from work (usually more than 30 days) ; (b) commit serious misconduct ; (c) go to work under the effect of alcohol; or (d) commit a large number of small infractions.

These three kinks are the source of exogeneity which will be exploited by the empirical strategy which I implement. The details of the strategy are discussed in the next subsection.

As regards the maximum duration of benefits, it is a function of the number of months worked in the last 36 months prior to the lay-off. Table 1 presents the UI schedule of potential duration:

Table 1: Potential Duration Assignment Rule

Months worked in the last 36 months	Months of Benefit
from 6 to 11	3
from 12 to 23	4
More or equal 24	5

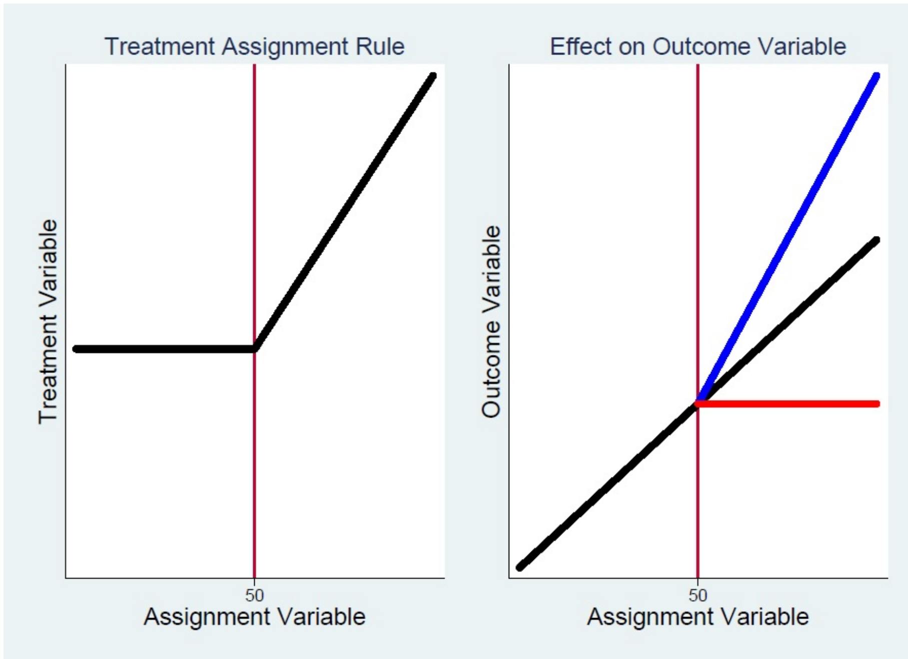
3.2 The Regression Kink Design

The idea of the regression kink design (RKD) is to exploit kinks in the relationship between an assignment variable and a treatment variable, which are previous wages and the level of unemployment benefits in this application, respectively. Such kinks are present in the relationship explained above and illustrated by figure 1. The intuition of the strategy is that if the treatment variable has a causal effect on a given outcome variable, there should also be a kink in the relationship between the outcome variable and the assignment variable. Therefore, in our context, if we expect that there is a causal relationship between UI benefit level and employment duration, there should also be a kink relationship between employment duration and previous wage (the assignment variable) at the same kink points marked in red in figure 1.

The idea of this design is similar to a regression discontinuity design (RDD), except that in this case there is not a discontinuity in the level of the assignment rule, but in its slope (or first derivative). The intuition of why it is able to identify the treatment causal effect is exactly that in the vicinity of the kink, subjects have the same pre-treatment characteristics but are however assigned to different levels of treatment *on the margin*.

In figure 2 it is possible to see a graphic example of the RKD. The graph on the left illustrates the kink relationship between the treatment and the assignment variable when it equals 50. It illustrates a hypothetical case in which individuals to the right of the kink receive a linearly increasing level of treatment. The graph on the right side shows the three possible results which can be found by analyzing the relationship between a given outcome variable and the assignment variable. If the treatment yields no effect on the outcome, one should find no kink in the relationship around the kink point, as shown by the black line. In case the treatment has a positive effect on the outcome, one should expect to find a positive change of slope around the kink point, as shown by the blue line. In the case where the treatment has a negative effect on the outcome, there should be a negative change in slope around the kink point, as shown by the red line.

Figure 2: RKD Graphic Example



The key assumption for the RKD is formalized by Card, Lee, Pei & Weber (2012) and requires that the density of the assignment variable is smooth conditional on unobserved characteristics around the kink point present in the policy assignment rule. As in the RDD, one crucial advantage for the credibility of this design is that its key assumption is testable in at least two ways. First, it is possible to test whether the empirical density function of the assignment variable is actually smooth around the kink point. I therefore provide evidence on whether the density of average previous wage is smooth around all the three kink points. Second, the key assumption described above implies that the conditional expectation function of any pre-determined characteristic is also smooth around the kink point. Therefore, I provide evidence on the smoothness of the conditional expectation function of pre-determined variables, such as age at hiring and years schooling, around all the three kink points.

In order to test and identify the presence of kinks in the data, I apply a local regression in the following parametric form:

$$Y_i = c_0 + [\sum_{p=1}^{P} \gamma_p (w-k)^p + \beta_p (w-k)^p.D] \text{ where } |w-k| \leq h \tag{10}$$

where w is the average previous wage in the year (the assignment variable) centered around the kink point k, P is the polynomial order of the regression, h is the bandwidth used, and D is a dummy variable taking value 1 for $(w - k) \geq 0$. The estimate of interest is the slope change at the kink point, which is identified by β_1. Since the size of the dataset allows me to get extremely close to the threshold while still have many observations, I choose to use a linear polynomial for this estimation and to present robustness results to a variety of bandwidth choices[5].

3.3 Data

The data I use in this paper comes from the *Relação Anual de Informações Sociais* - RAIS. It is an administrative dataset covering all the employment relationships from the formal Brazilian Labor Market. I have access from the year of 2009 to 2012. It contains detailed information on the characteristics of each labor contract such as start and end date, type of labor contract, type of termination, firm size, municipality and industry; as well as information on workers, such as age, schooling, gender and wage. Furthermore, it is possible to identify workers and firms through an identification number.

4 The Effect of Benefit Level on Employment Duration

To assess the effect of benefit level on employment duration, I separately explore all three kinks in the UI schedule for each year from 2009 to 2012. I consider all workers from the private sector which were employed at the first day of the year in which the schedule is introduced. Then, since the schedule is again updated at the first day of the subsequent year, the duration of employment is constructed as the spell between the first and last day in which a yearly UI schedule is in place. For instance, for the 2009 schedule, I consider all workers employed in January 1st (2009), and count for how long they were employed in the year. In case a worker keeps his job for the entire year, I set the duration to be equal to 12 months, since the UI schedule changes again at the end of the year.

A drawback from the dataset is that it provides only the worker's average monthly wage for each year, while the assignment variable for the UI schedule is based on the average monthly wage only in the three months previous to dismissal. Due to that limitation, I use the average wage in the year as assignment variable for the RKD and need to expect that wages do not change to fast within a given year. In case wage evolution over the year is too step, it is likely that the RKD design would be compromised and it would be hard to identify a kink in the data. Instead, I show not only that it is possible to identify a kink for employment duration at the precise kink present in the UI schedule, but that results are robust when assessed in differences with respect to placebo kink points where no slope change is expected to be found: *the rkd in triple-differences.*

[5]This choice is also consistent with Gelman and Imbens (2014) which suggest that higher order polynomial should be avoid in regression discontinuity designs.

I focus on the analysis of the first kink for two reasons. First, even if there is a large number of observation around all kinks, the precision of estimates on the second and third kink is too low. The only chance to reject the null of no effect, at the 5% significance level, is to have a elasticity of employment duration to benefits at least as high as 1.5 in the second kink and 2 in the third kink. Second, in these kinks, for all cases in which results are significant, robustness checks do not hold and point for the non validity of the design. Therefore, I focus on the results attained at the first kink which are robust to a variety of tests.

4.1 Density Smoothness and Data Heaping

To evaluate whether the necessary conditions for the RKD hold, the density function of wages must be smooth and continuous around each of the kink points. However, the raw data contains a number of heaping points which are not precisely in line with the baseline setup of the RKD. These heapings points might be caused by large firms with rigid wage policy and because wages are usually initially set at round numbers. To deal with this, I drop these heaping points of the data. To do so, I count the number of observations at each point of the data at the most disaggregate level (R$0.01), and compute the mean and the variance of the number of observations within a interval range of R$0.25, *for each point in the data*, without considering the point in question for the mean and variance calculation. I drop those points which statistically deviate from the mean at the 95% confidence level (more than 1.965 standard deviations). As indicated by Barreca et al (2014), this procedure allows one to identify the *local average treatment effect* (LATE) on the non-heaped types, even in the case in which sorting is endogenous. Since this procedure drops less than 25% of the data, the LATE recovered is still very meaningful for this population.

After this procedure, I first test for the continuity of the density function of wages around the kink, using McCrary (2008). Then, I extend the spirit of the test to check for the presence of a kink in the density of the assignment variable, as done in Landais (2014). The idea is to create bins of the assignment variable and count for the number of observations in each bin. Then, following Landais' specification, I run a regression as in equation (10) on the number of observations with a fourth order polynomial and allow for a slope change at each kink in order to test for the smoothness condition.

Figure 3 displays the density of average monthly wages and the test results for kink 1. From visual inspection, there seems not to be any evidence of slope changes around kink 1 for any of the years. This impression is supported by the first-derivative test reported in the graphs which does not allow us to reject the null hypothesis of no kink in any of the three cases. The same holds for the McCrary test on the discontinuity of the density function for the years of 2009 and 2010. In 2011 and 2012, the test detects a small but precise discontinuity. The latter results might be driven by the presence of remaining heaped observations around these kinks, ever after the procedure performed to deal with this issue. Even though visual inspection on the graphs does not suggest any clear jump in the density, it suggests caution and particular attention for further robustness checks around these years. Figure A1-A2 show the same test for the second and third kink.

4.2 Graphical Evidence

Figure 4 presents evidence on the kink relationship between previous wages and the duration of employment at kink 1. It displays evidence of a slope change around kink 1 for the years of 2009, 2011 and 2012. It suggests that there is positive slope change at kink 1 for the years of 2009 and 2012, while it points for a negative relationship for the year of 2011. For the year of 2010, the relationship seems much less clear. In contrast, Figures A5, A8, A11 and A14 in the appendix show that the evolution of covariates around kink 1 seems to be smooth [6]. I notice though that the graphical evaluation in the RKD seems to be a fairly harder enterprise with respect to its parallel in a regression discontinuity design for at least two closely related reasons. First, there is no clear way to display confidence intervals in these graphs. Second, the graphical evidence is fairly sensitive to the scale of the dependent variable. I therefore turn my attention to the regression analysis. Evidence on the evolution of employment duration and covariates for the other kinks are left to the appendix for the sake of brevity.

4.3 Estimation Results

Finally, tables 2 and 3 show the LLR results from equation (10) for employment duration, the probability of lay-off without cause and quitting, and covariates at kink 1. The first thing to notice from table 2 is that results barely change when the covariates are included as control in the regressions. This works as first test in favor of the hypothesis that covariates evolve smooth around the kink. For the analysis of covariates smoothness, I use as many as possible pre-treatment variables available in the data. For the sake of robustness, I also create a covariate indicating worker tenure at the day in which the UI schedule is introduce, in each year. This works as a sort of placebo variable to detect whether there is any pre-existing kink on employment duration around the kink, *prior to the introduction of the yearly UI schedule*. Results on covariates cannot detect any violation of the smoothness condition for the year of 2009 and 2012 at the 5% significance level, which strongly supports the validity of the design around these two thresholds. For the years of 2010 and 2011, the smoothness condition of covariates is violated twice at the 5% significance level, this suggests caution on the results deriving from these kinks.

Thus, I mostly rely on the results found for the year of 2009 and 2012 at kink 1. They point for an elasticity of employment duration to benefit level of around 1, at the 1% significance level. Results on the probability of a lay-off and quit suggest that the main channel for this effect is the earlier. This finding is also very robust to the choice of bandwidth, as shown by figure 5. Therefore, these results

[6] Worker's age at hiring date is not available for the years of 2011 and 2012.

based on the year of 2009 and 2012 are perfectly robust to all standard tests usually used in the RKD. Moreover, they cannot be explained by a pre-existing kinked relationship of employment duration since our placebo variable indicating tenure when the UI schedule is introduced displays smoothness.

Nevertheless, there could still be a concern that these results are capturing a simple pre-determined kinked or quadratic relationship between employment duration and average previous wage around the kink point. To address this issue, I propose a RKD in triple differences. First, for each year, instead of only considering the slope change around the true kink point, I consider the difference of the identified slope *vis-a-vis* the slope found in the data at the previous year, when there was no kink in assignment of benefit level. Notice that schedule increases from year to year, from 6 % to 12%, and thus one expect to find no kink at the previous year using the current schedule. Second, I estimate the difference of the *just described difference* with respect to the average slope change of two placebo points (from the year of the schedule to the previous year) placed just R$ 20 ahead and before the true kink point. Therefore, the proposed triple differences displays the (i) slope difference around the kink at the year of the schedule, *vis-a-vis* (ii) the same slope difference in the previous year, when there was no true kink in benefit level, *vis-a-vis* (iii) the average slope change of the two placebo points from the year of the UI schedule to the previous year. Since it requires data on the year previous to the schedule, I cannot perform this analysis to the year of 2009.

Results are shown in table 4. It is comforting to see that estimates for the year of 2012 almost do not change and remain very significant at the 1% level for the duration of employment and for the probability of lay-off and quit. Furthermore, the same estimates of the covariates indicate no change as it should be. The only exception is for the variable gender which displays a very small statistically significant change at the 5% level. I interpret this finding as extremely strongly evidence that the effect found is truly a result of the availability of increased benefit level. They cannot be explained by a simple quadratic evolution of employment or a pre-existent kinked relationship around the kink point. The fact that the effect survives when compared to the slope difference in the previous year (when was no true kink) and to the change of two placebo points very close to the kink is a very compelling evidence of that. In contrast, results in triple differences for the year of 2010 and 2011 display a number of very significant changes on covariates, indicating that one should not rely on them. I notice however that this evidence is silent to what regards the true effect of benefit level on duration for the years of 2010 and 2011.

Overall, I interpret the results on kink 1 for the years of 2009 and 2012 as strong evidence that the level UI benefits affects the duration of employment for workers around this kink. All tests and graphic inspection point in favor of the validity of RKD at this threshold. This estimates suggests that an 1% rise in the level of potential benefits increases the duration of employment by roughly 1%. This is definitely a sizeable result for welfare as it will be discussed in the next section. Unfortunately results on the second and third kink are either not robust or display standard errors which are too large to allows one to identify effects at a reasonable size.

5 Welfare Effects and Conclusion

Now I present a simple exercise on the evaluation of welfare effects based on the estimates of the previous section. Since estimates on the elasticity of UI covered unemployment duration to benefit level are not available for this data, I assume this to equal 1 which is line with the literature. For the liquidity to moral hazard ratio, I recover this estimate from Landais(2014). The goal of the exercise is to show that the size of the effect of UI on the duration of employment is clearly relevant for welfare.

The welfare formula as shown in (9) implies that are still gains from higher benefit level if:

$$\frac{dW}{db} > 0 \iff \frac{1}{1-s_0}(\rho+1) - \left(1 + \epsilon_{f^{UI},b} + \epsilon_{D_B,b} - \epsilon_{D_E,b}\right) > 0 \tag{11}$$

From estimates around kink 1, consider $\epsilon_{D_E,b} = 1$. Consider $\epsilon_{D_B,b} = 1$, which is line with the literature, and recover $\phi = 0.88$ from Landais(2014). Also, I estimate $\frac{1}{1-s_0} = \frac{1}{0.97} = 1.04$, where s_0 is the fraction of workers finding a new job within one week of unemployment. To be conservative, assume $\epsilon_{f^{UI},b}$ to equal zero. It implies that the effect of raising UI benefits on welfare by R$1 is given by:

$$\frac{dW}{db} > 0 \iff (0.88+1) - (1+0+1-1) = 0.88 > 0 \tag{12}$$

If these values recovered from Landais (2014) were the true elasticities at kink 1, the welfare formula suggests that there would still be gains from raising benefit level. If one instead neglects UI effects on the duration of employment, the result would point otherwise:

$$\frac{dW}{db} > 0 \iff (0.88+1) - (1+0.73-(\overset{0}{\not{1}})) = -0.12 < 0 \tag{13}$$

In any case, the main message from this simple exercise is that the effect found on the duration of employment is economically significant and clearly relevant for welfare. Recovering previous estimates from the literature on other elasticities, it becomes clear that it has at least the same magnitude of the other elements present in the welfare formula. Therefore, it strongly suggests that policy makers should be aware of such effect and take it into account in order to optimally set the level of unemployment benefits. Pherhaps the most surprising result from this analysis is that unemployment benefit increases the length of employment spells. Introducing this into welfare raises the marginal value for society of providing UI, at least in this partial equibrilum analysis. Whether there are further elements to consider once we accept this effect to be relevant is certainly a question for future research. Such effect could have implications on the optimal job turnover rate and affect worker productive since it distorts the incentives to keep a job.

Of course, the analysis presented in paper applies to Brazil and represents LATE on workers on the very left of the skill distribution. However, this may not only be the case of a developing country. For instance, Rebollo-Sanz (2012) analyzes data from the Spanish labor market and supports the hypothesis that UI is related to labor turnover in Spain. He also reports spikes in lay-off probabilities once workers qualify for unemployment benefits. To conclude, I believe that the findings here presented suggest that future research should aim at evaluating whether the same effects are sizeable for other groups of workers and in countries with different contexts.

6 Bibliography

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Figure 3: Density of Wages the Around Kink 1

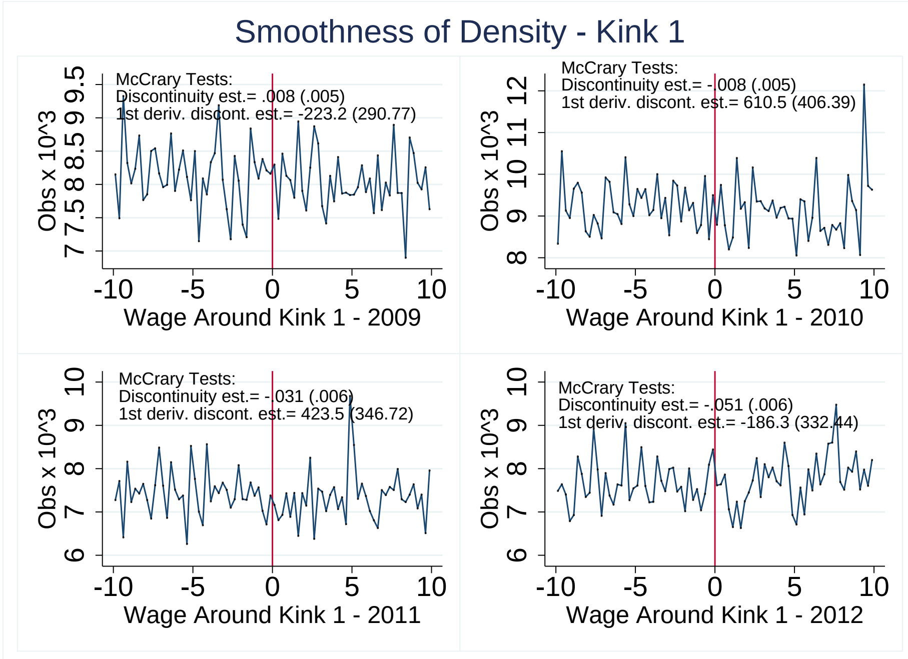


Figure 4: Employment Duration Around Kink 1

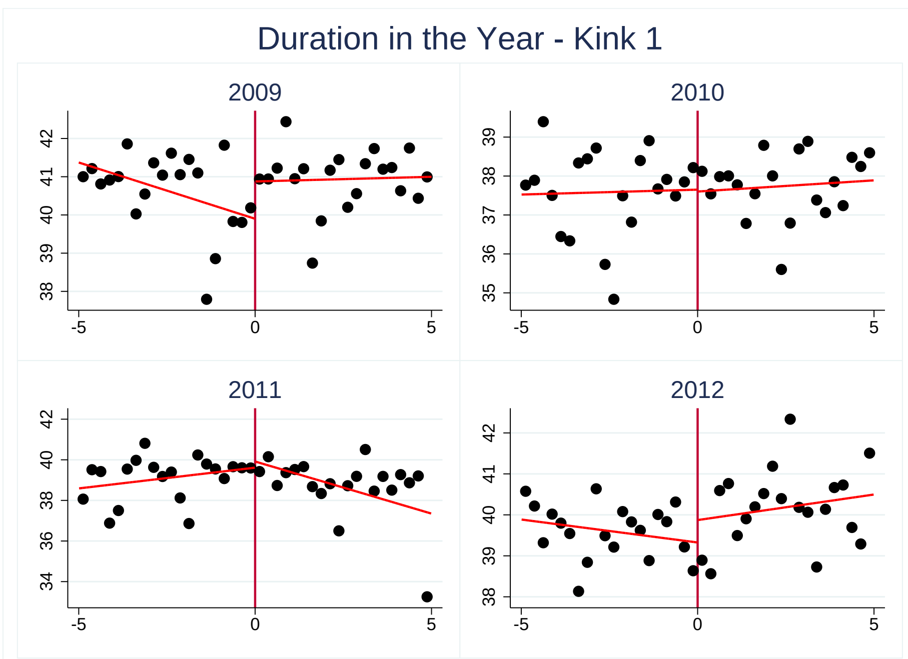
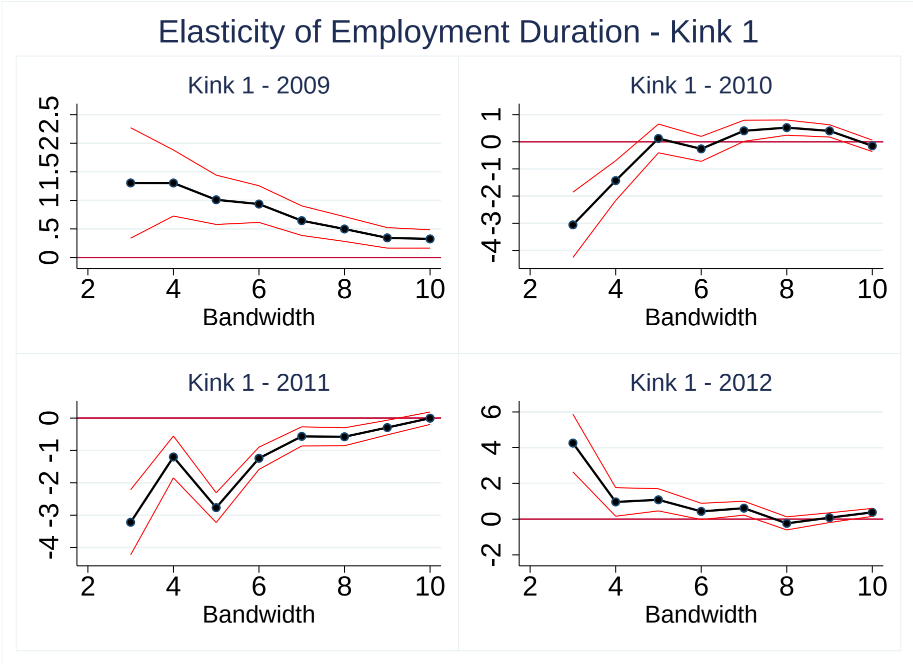


Figure 5: Robustness to Bandwidth Choice - Kink 1



The figure displays estimate of $\epsilon_{D_E,b}$ according to equation (10) and the setup from table 2 for a variety of bandwidths.

Table 2: The Effects of Benefit Level - Kink 1

	Employ. Duration	Employ. Duration	Prob(Lay-off)	Prob(Lay-off)	Prob(Quit)	Prob(Quit)
			2009			
ϵ	1.01***	1.057***				
	(0.219)	(0.231)				
α	0.38***	0.398***	-0.005***	-0.005***	-0.001*	-0.001*
	(0.082)	(0.087)	(0.001)	(0.001)	(0)	(0)
			2010			
ϵ	0.123	0.126				
	(0.269)	(0.283)				
α	0.039	0.04	-0.005**	-0.005**	0	0
	(0.085)	(0.09)	(0.002)	(0.002)	(0.001)	(0.001)
			2011			
ϵ	-2.767***	-2.863***				
	(0.233)	(0.242)				
α	-0.866***	-0.896***	0.011***	0.012***	0.002***	0.002***
	(0.073)	(0.075)	(0.001)	(0.001)	(0.001)	(0.001)
			2012			
ϵ	1.081***	1.111***				
	(0.315)	(0.35)				
α	0.295***	0.303***	-0.006***	-0.006***	0	0
	(0.086)	(0.095)	(0.001)	(0.002)	(0.001)	(0.001)
Controls	Y	N	Y	N	Y	N
Band	5	5	5	5	5	5

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table 3: Smoothness of Covariates - Kink 1

	Placebo Emp. Dur.	Age	Years Educ.	Gender	Firm Size 1	Firm Size 2	P(White)	Work Hours
				2009				
α	0.529	-0.006	0.018	0.001	-8.859	262.42	-0.004*	-0.008
	(0.833)	(0.039)	(0.011)	(0.002)	(11.847)	(208.858)	(0.002)	(0.019)
				2010				
α	0.978	-0.039	0.027**	-0.002	19.047	232.032	0.003	0.033**
	(0.652)	(0.039)	(0.013)	(0.002)	(19.079)	(209.888)	(0.002)	(0.016)
				2011				
α	-0.426	-	0.004	-0.001	-6.277	205.553	0.005***	0.033**
	(0.423)	-	(0.01)	(0.001)	(7.496)	(221.117)	(0.001)	(0.015)
				2012				
α	0.155	-	0	0.003	18.228	-641.183	0	0.03
	(0.582)	-	(0.011)	(0.002)	(26.576)	(543.271)	(0.002)	(0.02)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Band	5	5	5	5	5	5	5	5

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table 4: The Effects of Benefit Level - RKD in Triple Differences - Kink 1

	Employ. Duration	Prob(Lay-off)	Prob(Quit)
	2010		
ϵ	-0.191		
	(0.151)		
α	-0.06	0	0
	(0.048)	(0.001)	(0)
	2011		
ϵ	-0.35**		
	(0.17)		
α	-0.109**	0.002**	0
	(0.053)	(0.001)	(0)
	2012		
ϵ	0.895***		
	(0.182)		
α	0.244***	-0.005***	-0.001***
	(0.049)	(0.001)	(0)
Controls	Y	Y	Y
Band	10	10	10

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial in triple differences with respect to the previous year and the average slope change of two placebo points R$20 ahead and before the kink point, where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table for each kink point (two placebos and one actual) and year. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table 5: Smoothness of Covariates - RKD in Triple Differences - Kink 1

	Placebo Emp. Dur.	Age	Years Educ.	Gender	Firm Size 1	Firm Size 2	P(White)	Work Hours
				2010				
α	-0.99***	0.004	0.013*	-0.001	-10.308	145.199	0.003**	0.011
	(0.376)	(0.022)	(0.007)	(0.001)	(8.863)	(147.002)	(0.001)	(0.01)
				2011				
α	-0.422**	-	-0.015**	0.002**	-15.92**	-528.193	-0.001	-0.013
	(0.195)	-	(0.007)	(0.001)	(7.878)	(511.322)	(0.001)	(0.009)
				2012				
α	0.185	-	0.003	0.003**	-0.823	-629.558	-0.001	0.005
	(0.24)	-	(0.006)	(0.001)	(10.282)	(571.591)	(0.001)	(0.01)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Band	10	10	10	10	10	10	10	10

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial in triple differences with respect to the previous year and the average slope change of two placebo points R$20 ahead and before the kink point, where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table for each kink point (two placebos and one actual) and year. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

A Appendix

A.1 Tables

Table A1: The Effects of Benefit Level - Kink 2

	Employ. Duration	Employ. Duration	Prob(Lay-off)	Prob(Lay-off)	Prob(Quit)	Prob(Quit)
			2009			
ϵ	-2.232***	-2.611***				
	(0.71)	(0.728)				
α	-0.652***	-0.763***	0.012**	0.014***	0.002	0.003
	(0.207)	(0.212)	(0.004)	(0.004)	(0.002)	(0.002)
			2010			
ϵ	0.492	0.159				
	(0.861)	(0.892)				
α	0.124	0.04	-0.006	-0.004	0	0.001
	(0.217)	(0.225)	(0.005)	(0.005)	(0.003)	(0.003)
			2011			
ϵ	0.445	0.358				
	(0.751)	(0.78)				
α	0.111	0.089	0.002	0.001	-0.002	-0.002
	(0.188)	(0.195)	(0.005)	(0.005)	(0.002)	(0.002)
			2012			
ϵ	-0.95	-1.093				
	(0.889)	(0.945)				
α	-0.209	-0.241	0.003	0.004	-0.002	-0.002
	(0.196)	(0.208)	(0.005)	(0.005)	(0.002)	(0.002)
Controls	Y	N	Y	N	Y	N
Band	5	5	5	5	5	5

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table A2: The Effects of Benefit Level - Kink 3

	Employ. Duration	Employ. Duration	Prob(Lay-off)	Prob(Lay-off)	Prob(Quit)	Prob(Quit)
			2009			
ϵ	0.959	0.925				
	(0.753)	(0.759)				
α	0.209	0.201	-0.001	-0.001	0	0
	(0.164)	(0.165)	(0.004)	(0.004)	(0.001)	(0.001)
			2010			
ϵ	4.259***	4.848***				
	(1.104)	(1.125)				
α	0.802***	0.913***	-0.014***	-0.016***	-0.004	-0.004*
	(0.208)	(0.212)	(0.005)	(0.005)	(0.002)	(0.002)
			2011			
ϵ	-0.556	-0.555				
	(1.017)	(1.024)				
α	-0.103	-0.103	0.005	0.005	0	0
	(0.188)	(0.189)	(0.004)	(0.004)	(0.002)	(0.002)
			2012			
ϵ	0.822	0.826				
	(1.061)	(1.097)				
α	0.134	0.134	-0.004	-0.004	-0.002	-0.002
	(0.173)	(0.179)	(0.004)	(0.004)	(0.002)	(0.002)
Controls	Y	N	Y	N	Y	N
Band	5	5	5	5	5	5

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table A3: Smoothness of Covariates - Kink 2

	Placebo Emp. Dur.	Age	Years Educ.	Gender	Firm Size 1	Firm Size 2	P(White)	Work Hours
				2009				
α	-6.15***	-0.031	-0.04	-0.009*	9.428	-54.49	0.006	-0.022
	(1.983)	(0.097)	(0.032)	(0.004)	(21.251)	(131.234)	(0.005)	(0.044)
				2010				
α	-3.62*	-0.136	0	0.002	-82.197**	-540.417	0	0.047
	(2.026)	(0.104)	(0.038)	(0.005)	(35.515)	(602.736)	(0.005)	(0.067)
				2011				
α	-0.417	-	-0.049*	-0.008	72.338**	-858.443	0.003	-0.08
	(1.122)	-	(0.029)	(0.005)	(35.476)	(835.267)	(0.005)	(0.065)
				2012				
α	0.147	-	-0.015	-0.012**	-30.53	255.528	-0.003	-0.009
	(3.419)	-	(0.032)	(0.006)	(27.822)	(379.723)	(0.005)	(0.061)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Band	5	5	5	5	5	5	5	5

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table A4: Smoothness of Covariates - Kink 3

	Placebo Emp. Dur.	Age	Years Educ.	Gender	Firm Size 1	Firm Size 2	P(White)	Work Hours
				2009				
α	-1.409	-0.024	-0.07**	0.002	1.807	478.322	0.007	-0.076
	(2.686)	(0.101)	(0.03)	(0.004)	(15.239)	(458.681)	(0.004)	(0.056)
				2010				
α	5.847**	0	0.003	-0.006	39.398	-494.371	0	-0.106*
	(2.528)	(0.102)	(0.034)	(0.004)	(34.002)	(423.812)	(0.005)	(0.062)
				2011				
α	0.077	-	-0.004	-0.002	3.259	-663.958	0.009*	0.132**
	(1.306)	-	(0.034)	(0.004)	(17.276)	(677.446)	(0.005)	(0.063)
				2012				
α	-0.533	-	0.077**	0.004	-16.321	157.031	-0.002	-0.009
	(2.889)	-	(0.031)	(0.004)	(17.457)	(124.082)	(0.005)	(0.052)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Band	5	5	5	5	5	5	5	5

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table A5: The Effects of Benefit Level - RKD in Triple Differences - Kink 2

	Employ. Duration	Prob(Lay-off)	Prob(Quit)
	2010		
ϵ	-0.106		
	(0.605)		
α	-0.026	0.004	0.001
	(0.152)	(0.003)	(0.001)
	2011		
ϵ	0.469		
	(0.539)		
α	0.117	0	0
	(0.135)	(0.003)	(0.001)
	2012		
ϵ	-0.224		
	(0.533)		
α	-0.049	0	0.001
	(0.117)	(0.002)	(0.001)
Controls	Y	Y	Y
Band	10	10	10

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial in triple differences with respect to the previous year and the average slope change of two placebo points R$20 ahead and before the kink point, where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table for each kink point (two placebos and one actual) and year. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table A6: The Effects of Benefit Level - RKD in Triple Differences - Kink 3

	Employ. Duration	Prob(Lay-off)	Prob(Quit)
		2010	
ϵ	-1.48***		
	(0.573)		
α	-0.278***	0.002	0
	(0.107)	(0.002)	(0.001)
		2011	
ϵ	0.536		
	(0.649)		
α	0.099	0.001	-0.001
	(0.12)	(0.002)	(0.001)
		2012	
ϵ	-0.359		
	(0.638)		
α	-0.058	0.001	-0.001
	(0.104)	(0.002)	(0.001)
Controls	Y	Y	Y
Band	10	10	10

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial in triple differences with respect to the previous year and the average slope change of two placebo points R$20 ahead and before the kink point, where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table for each kink point (two placebos and one actual) and year. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table A7: Smoothness of Covariates - RKD in Triple Differences - Kink 2

	Placebo Emp. Dur.	Age	Years Educ.	Gender	Firm Size 1	Firm Size 2	P(White)	Work Hours
				2010				
α	0.153	0.012	0.031*	0.001	6.713	-2123.203	0.004	-0.006
	(1.177)	(0.061)	(0.018)	(0.003)	(15.085)	(2004.319)	(0.002)	(0.029)
				2011				
α	0.846	-	-0.002	-0.002	1.783	62.315	0.005*	0.029
	(0.542)	-	(0.018)	(0.003)	(19.61)	(133.351)	(0.003)	(0.027)
				2012				
α	0.598	-	-0.013	-0.001	-5.284	-133.388	-0.001	-0.011
	(0.586)	-	(0.02)	(0.003)	(19.06)	(170.414)	(0.003)	(0.025)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Band	10	10	10	10	10	10	10	10

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial in triple differences with respect to the previous year and the average slope change of two placebo points R$20 ahead and before the kink point, where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table for each kink point (two placebos and one actual) and year. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

Table A8: Smoothness of Covariates - RKD in Triple Differences - Kink 3

Smoothness of Covariates - RKD in Triple Differences - Kink 3

	Placebo Emp. Dur.	Age	Years Educ.	Gender	Firm Size 1	Firm Size 2	P(White)	Work Hours
				2010				
α	0.304	-0.098*	0.004	0.001	-22.878	62.502	-0.001	0.015
	(1.499)	(0.057)	(0.018)	(0.002)	(23.217)	(124.025)	(0.002)	(0.034)
				2011				
α	-0.334	-	0.01	-0.004	-4.138	419.056	-0.001	-0.065**
	(0.625)	-	(0.018)	(0.002)	(11.398)	(429.744)	(0.003)	(0.031)
				2012				
α	0.152	-	0.002	0.002	-33.19	649.152	0	-0.004
	(0.669)	-	(0.018)	(0.002)	(21.005)	(587.049)	(0.003)	(0.036)
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Band	10	10	10	10	10	10	10	10

Duration is expressed in weeks. The table report the estimates of equation (10) with a first-degree polynomial in triple differences with respect to the previous year and the average slope change of two placebo points R$20 ahead and before the kink point, where standard errors are clustered at firm level. Standard errors are reported in parentheses and p-values smaller than %10, %5 and %1 are indicated by *,**,***, respectively. Control variables are all variables present in the covariates table for each kink point (two placebos and one actual) and year. $\alpha = \frac{dY}{db}$ is the marginal effect of an extra R$ of benefit level. $\epsilon = \frac{dY}{db}\frac{b}{Y}$ is the elasticity with respect to the dependent variable.

A.2 Figures

Figure A1: Density of Wages the Around Kink 2

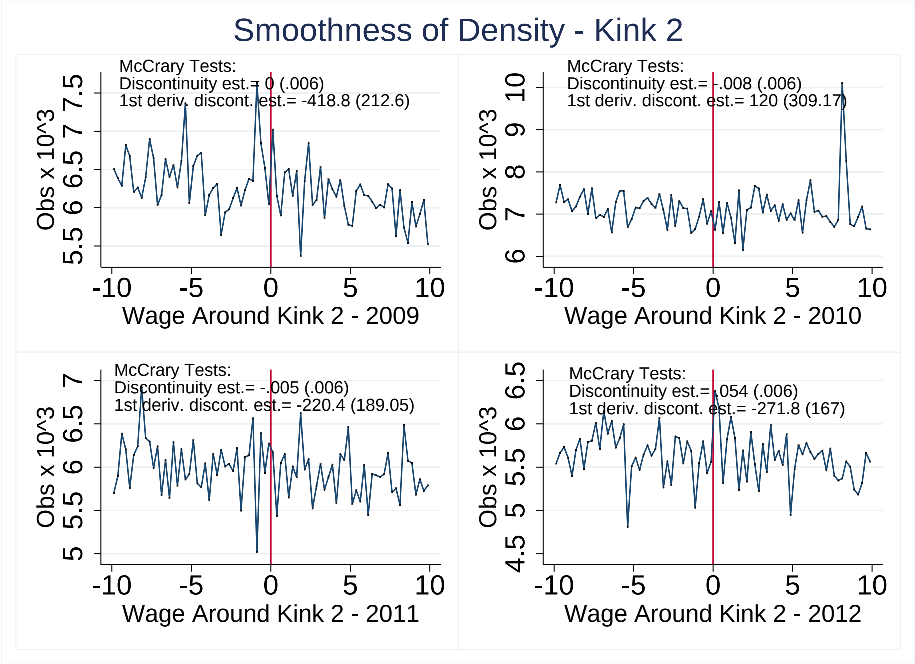


Figure A2: Density of Wages the Around Kink 3

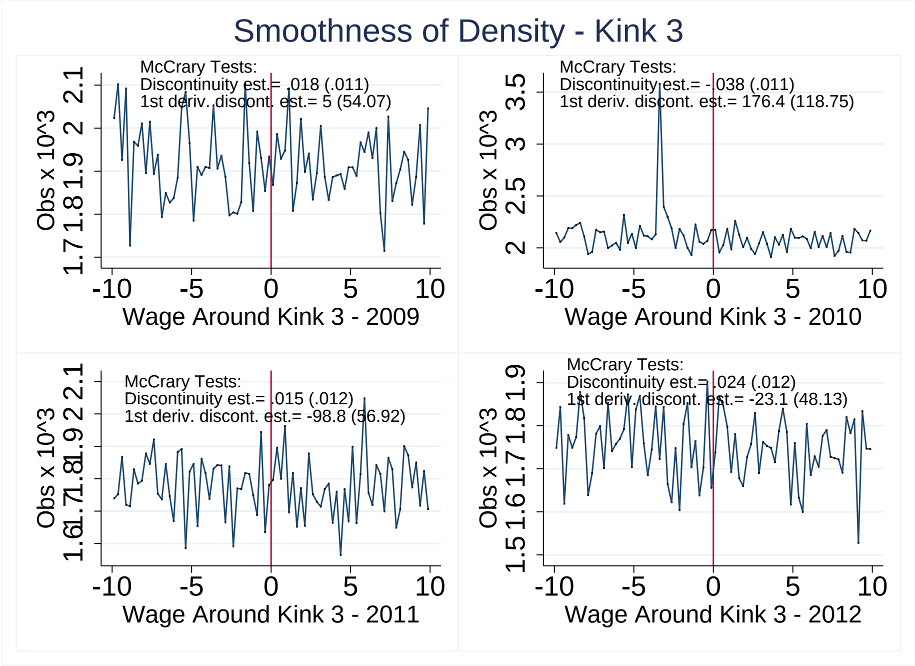


Figure A3: Employment Duration Around Kink 2

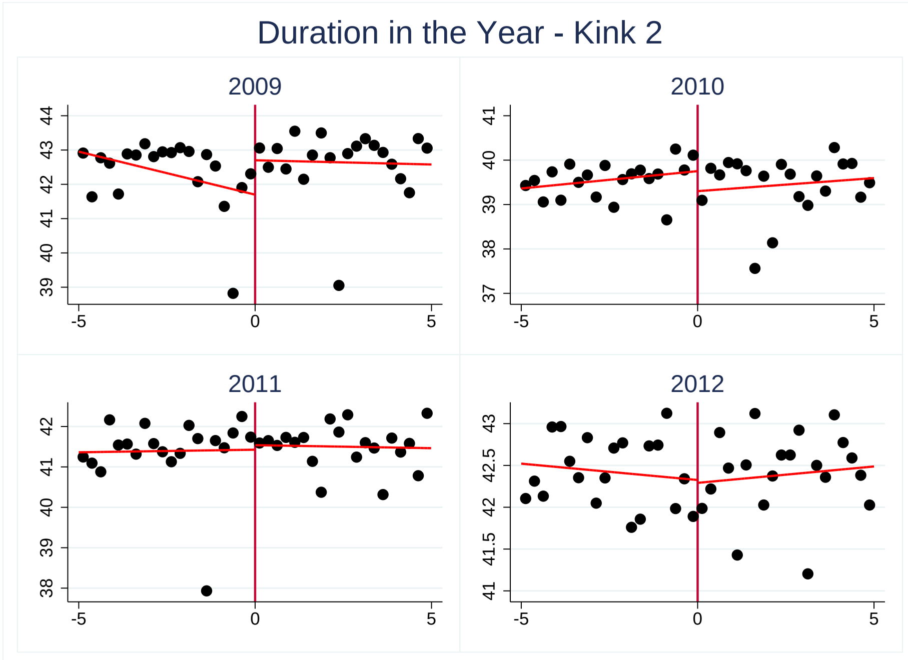


Figure A4: Employment Duration Around Kink 3

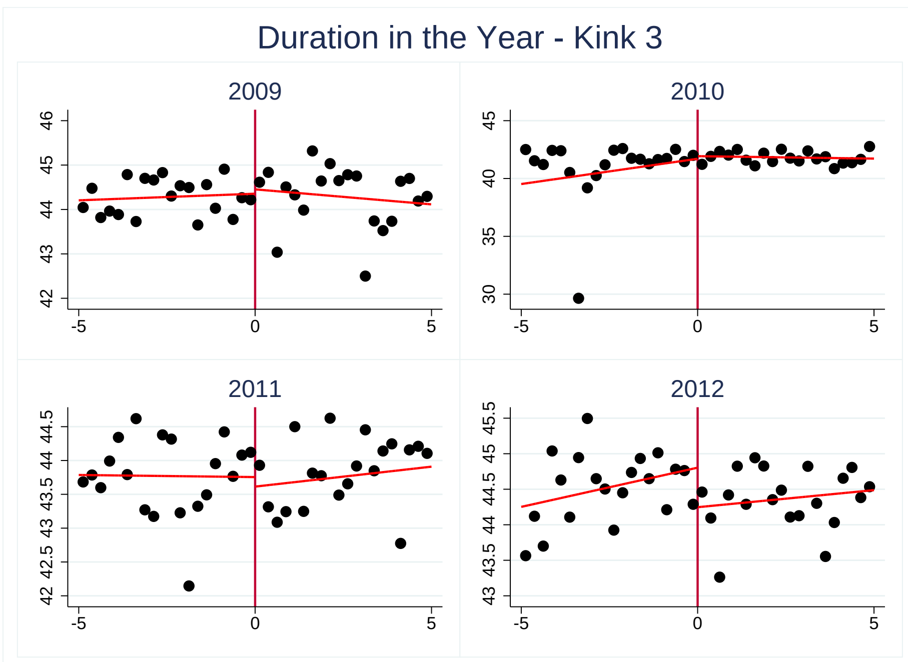


Figure A5

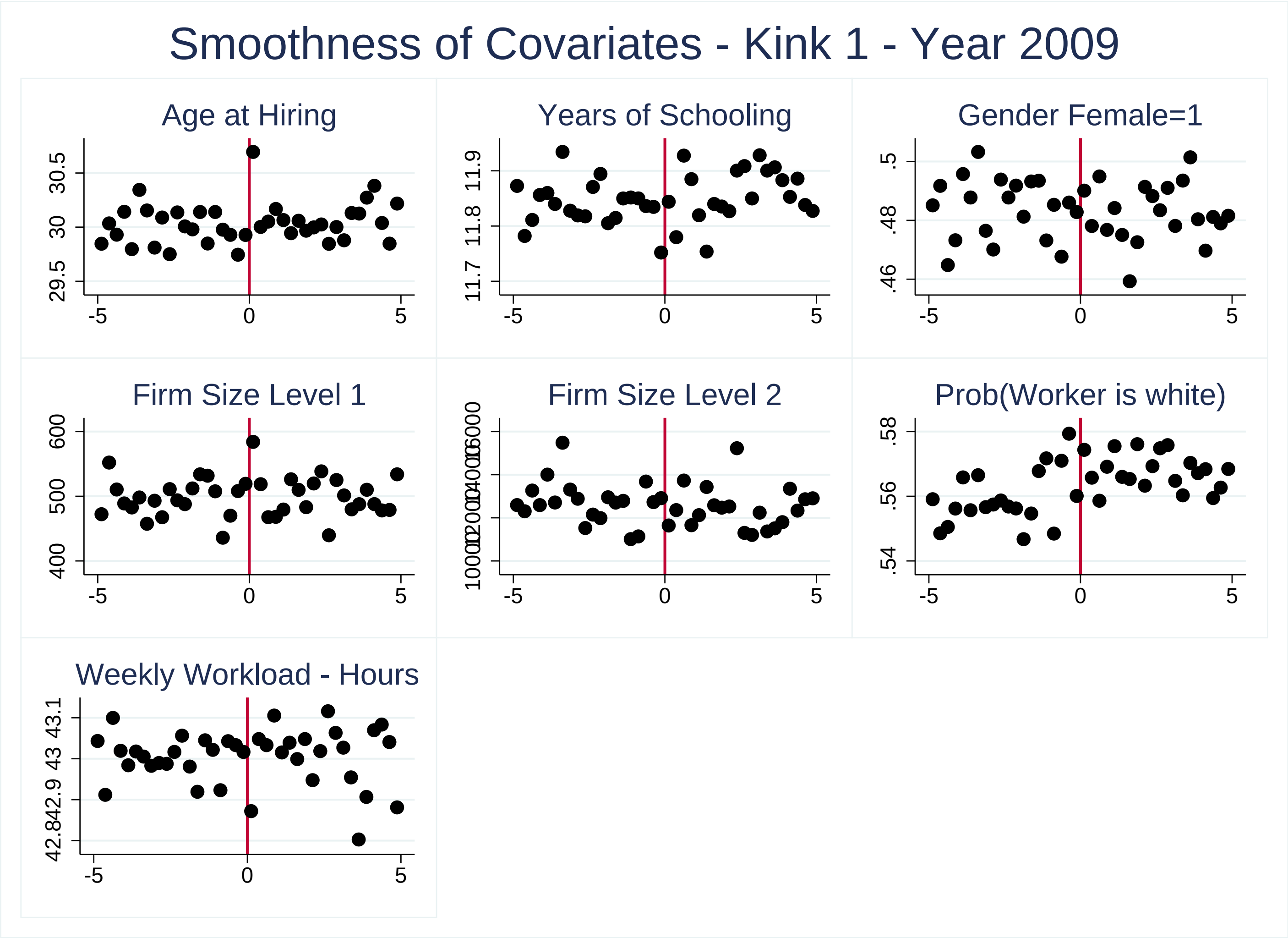
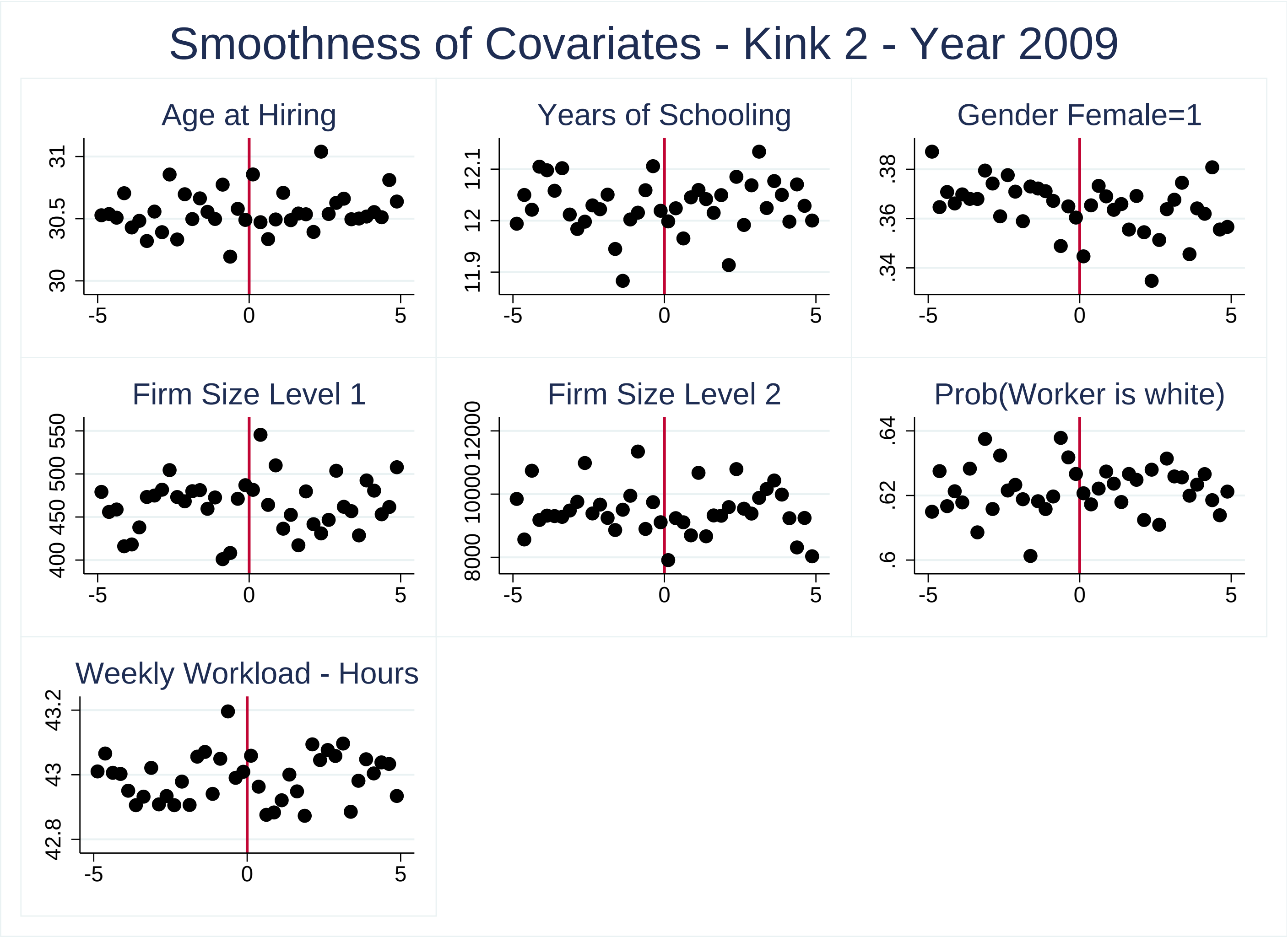

Smoothness of Covariates - Kink 1 - Year 2009
Age at Hiring
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours

Figure A6



Smoothness of Covariates - Kink 2 - Year 2009
Age at Hiring
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours

Figure A7

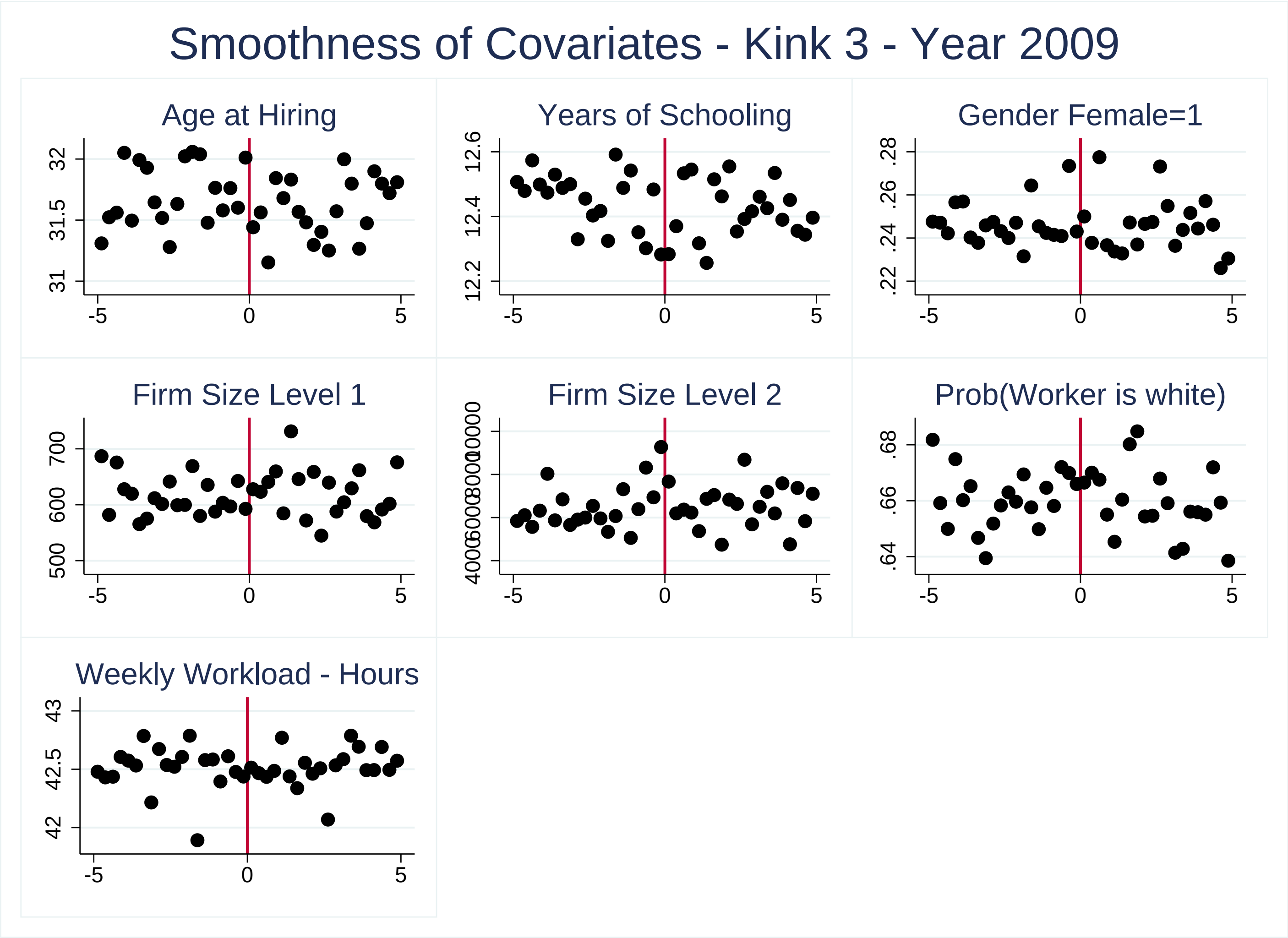

Smoothness of Covariates - Kink 3 - Year 2009
Age at Hiring
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours

Figure A8

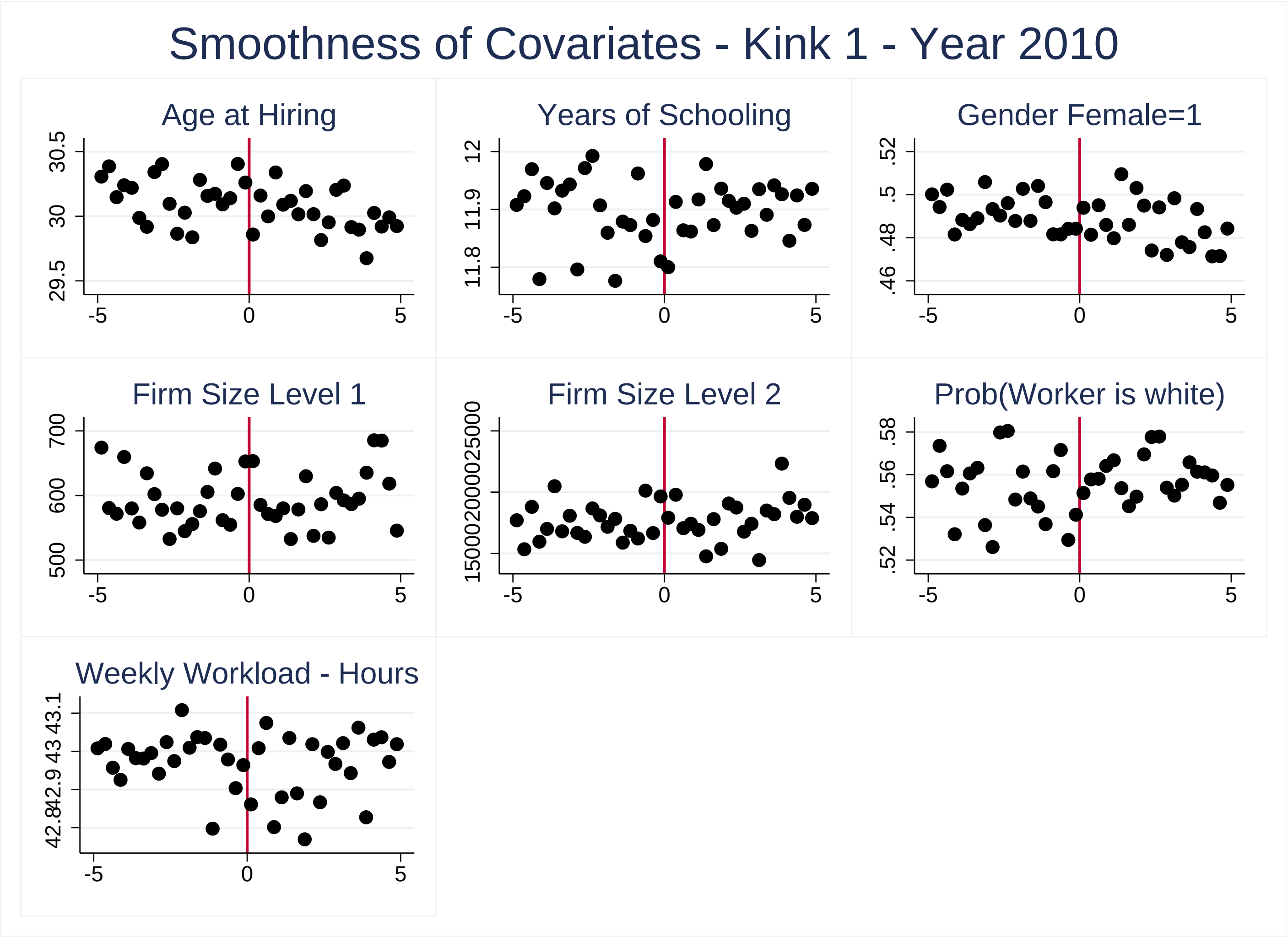
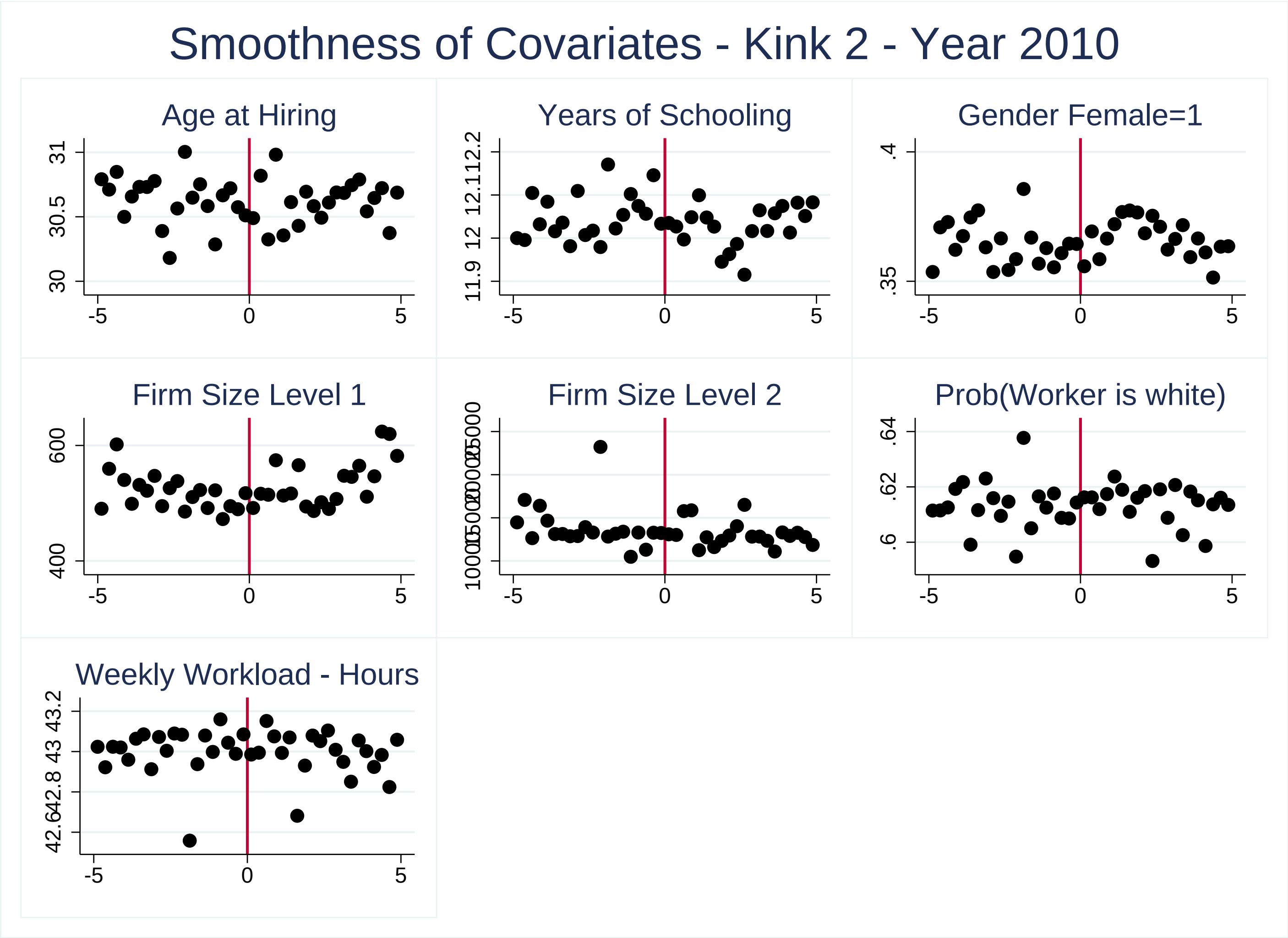

Smoothness of Covariates - Kink 1 - Year 2010
Age at Hiring
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours

Figure A9



Smoothness of Covariates - Kink 2 - Year 2010
Age at Hiring
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours

Figure A10

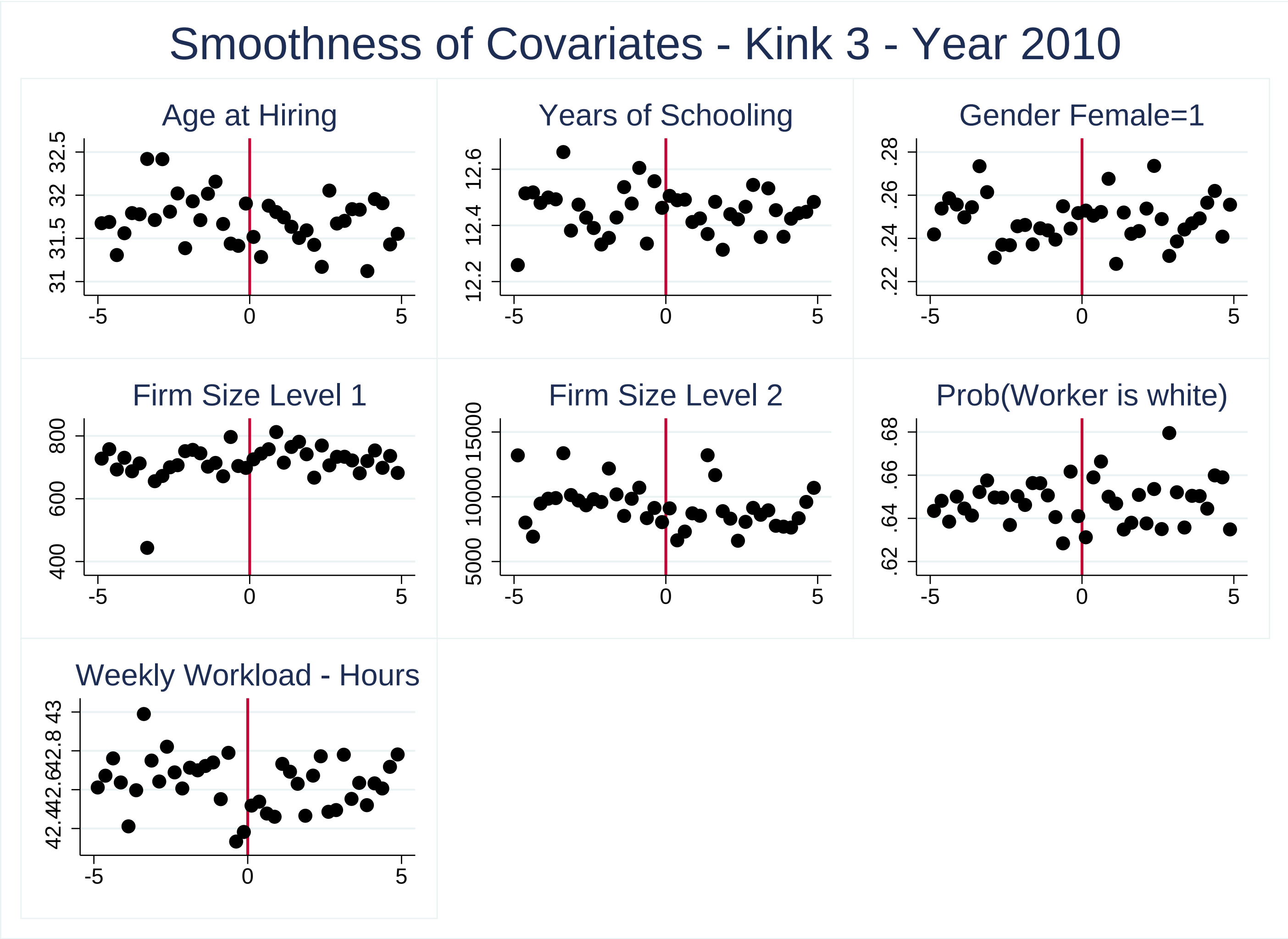

Smoothness of Covariates - Kink 3 - Year 2010
Age at Hiring
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours

Figure A11

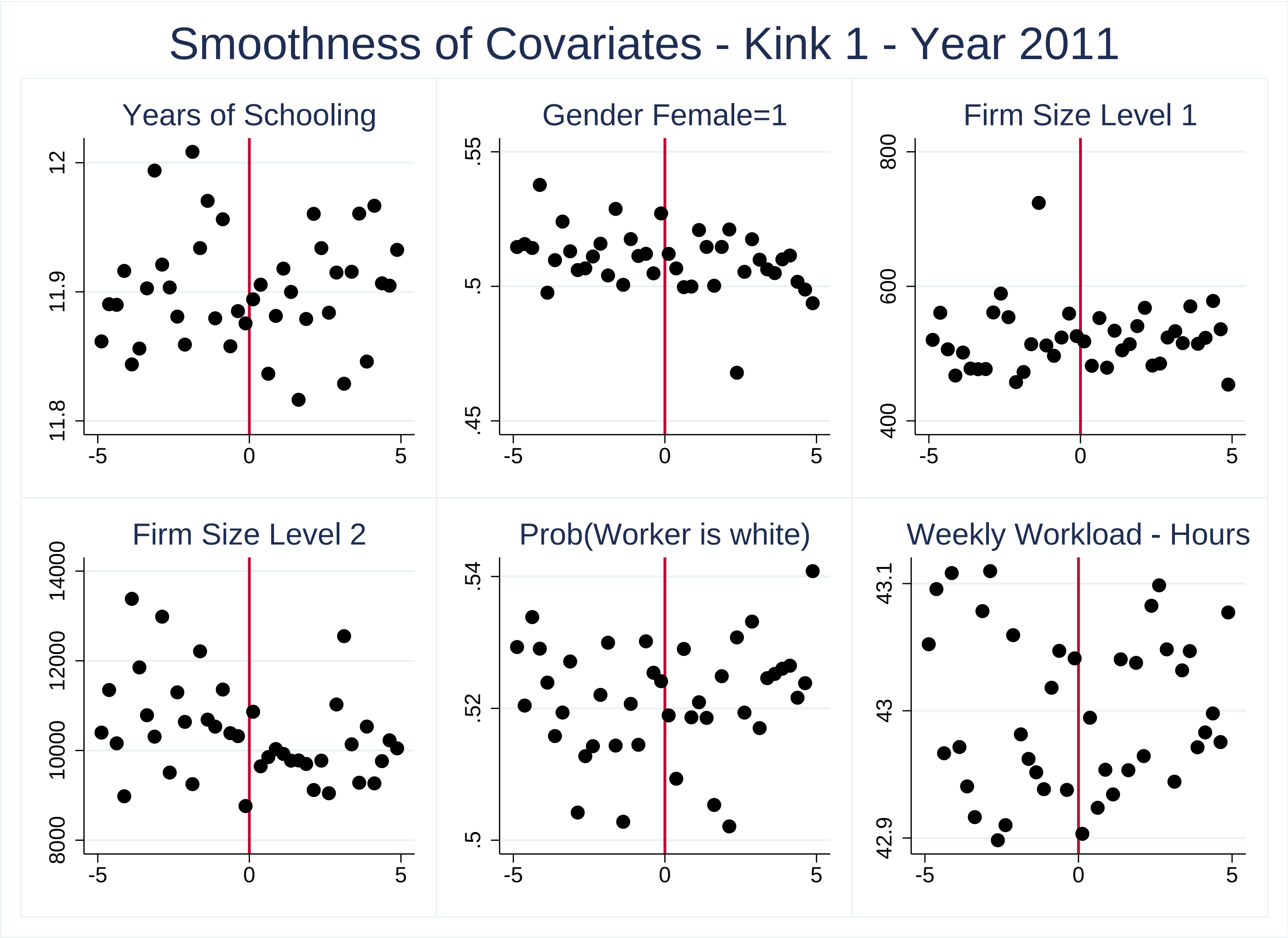

Smoothness of Covariates - Kink 1 - Year 2011
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours
12
11.9
11.8
.55
.5
.45
800
600
400
14000
12000
10000
8000
.54
.52
.5
43.1
43
42.9
-5
0
5

Figure A12

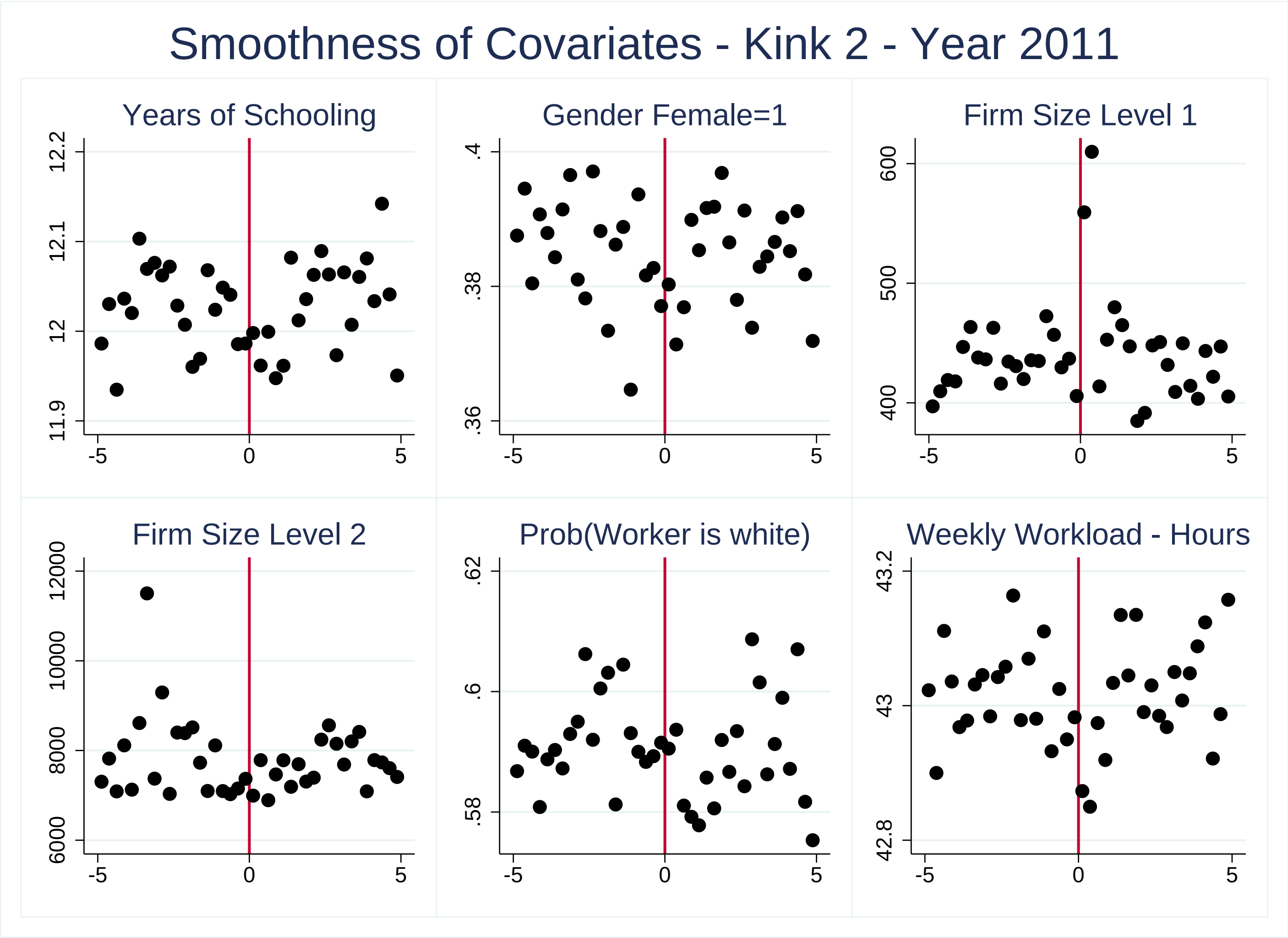

Smoothness of Covariates - Kink 2 - Year 2011
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours
-5
0
5
11.9
12
12.1
12.2
.36
.38
.4
400
500
600
6000
8000
10000
12000
.58
.6
.62
42.8
43
43.2

Figure A13

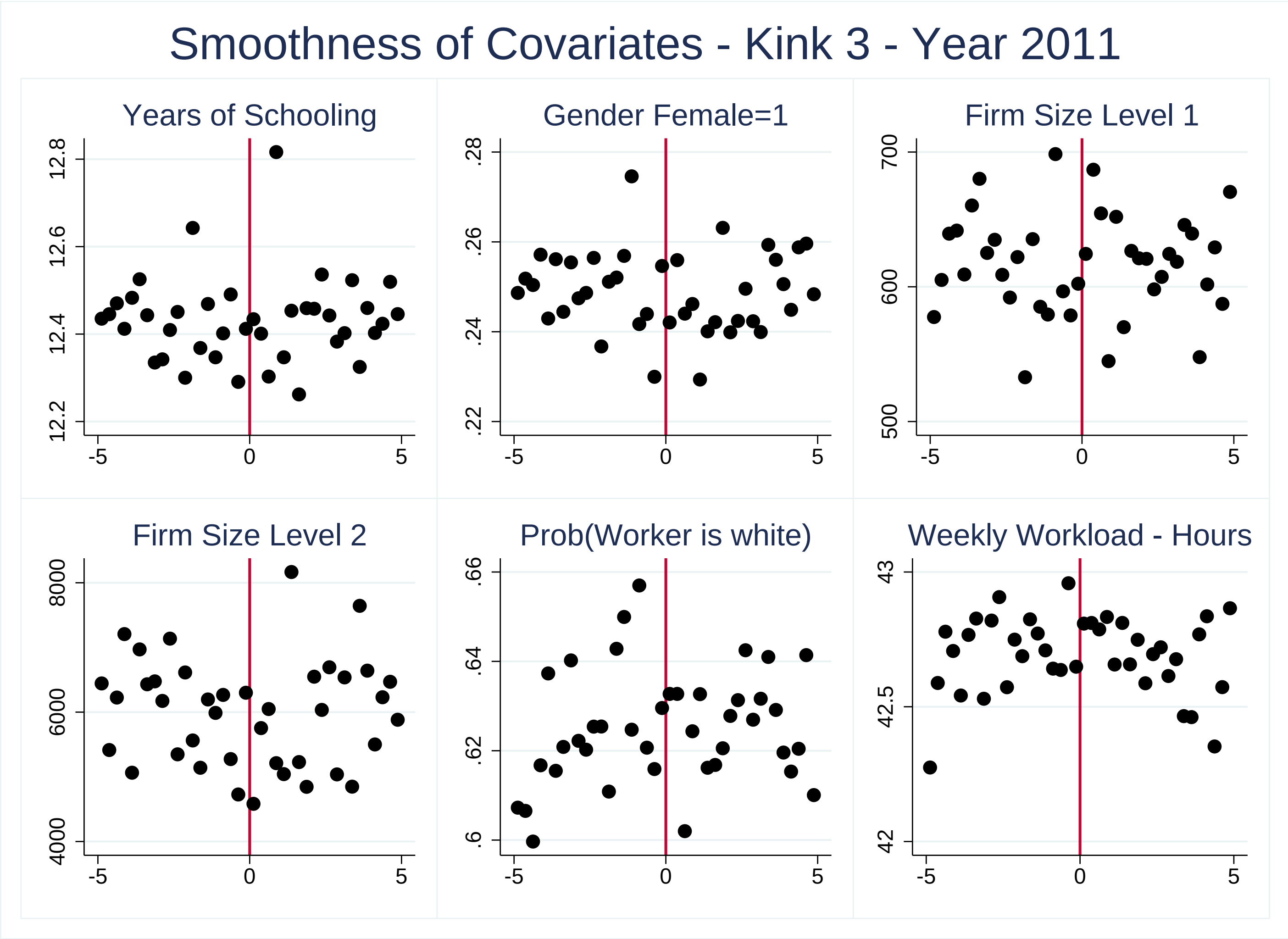

Smoothness of Covariates - Kink 3 - Year 2011
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours
12.2
12.4
12.6
12.8
.22
.24
.26
.28
500
600
700
4000
6000
8000
.6
.62
.64
.66
42
42.5
43
-5
0
5

Figure A14

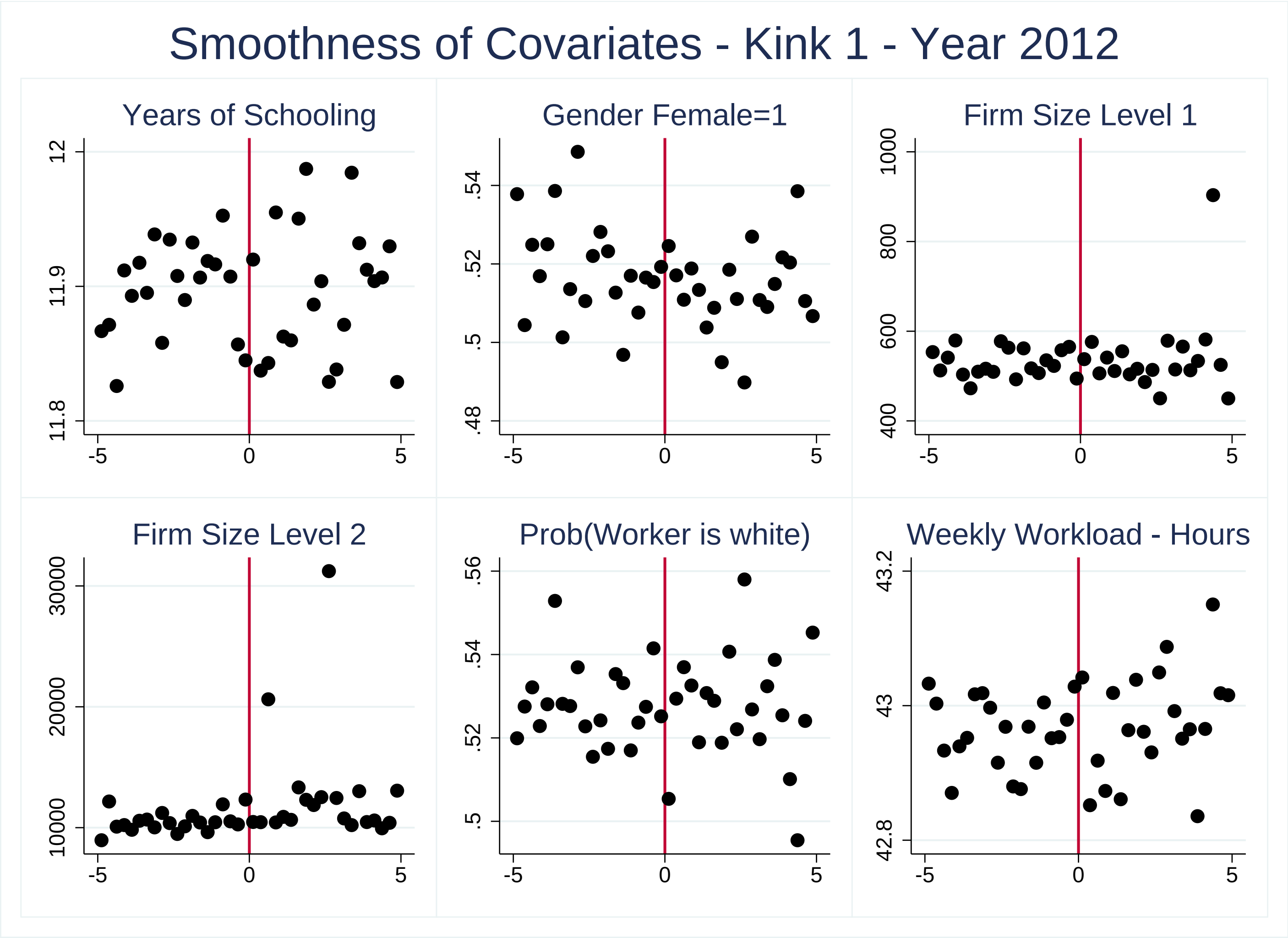
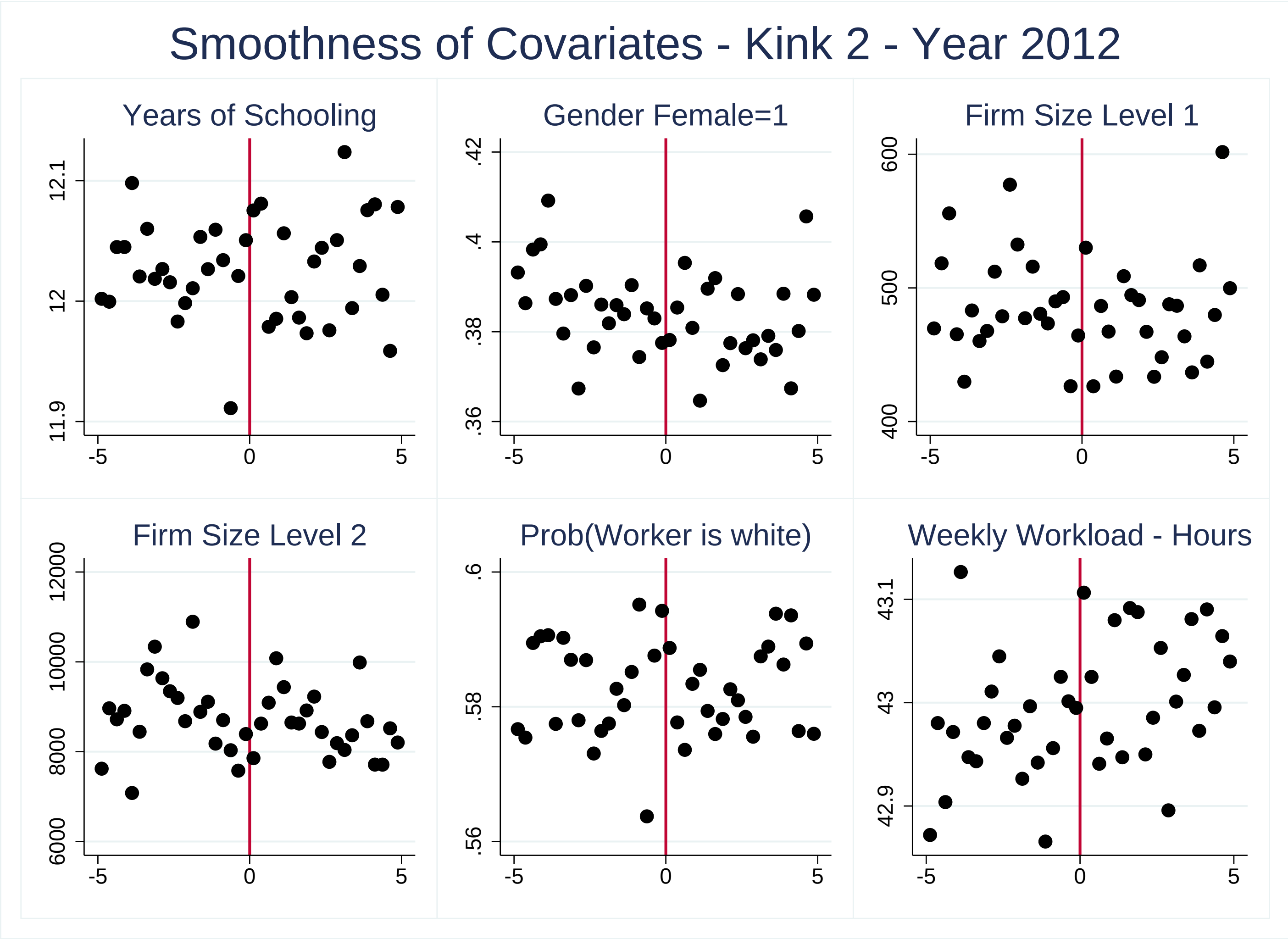
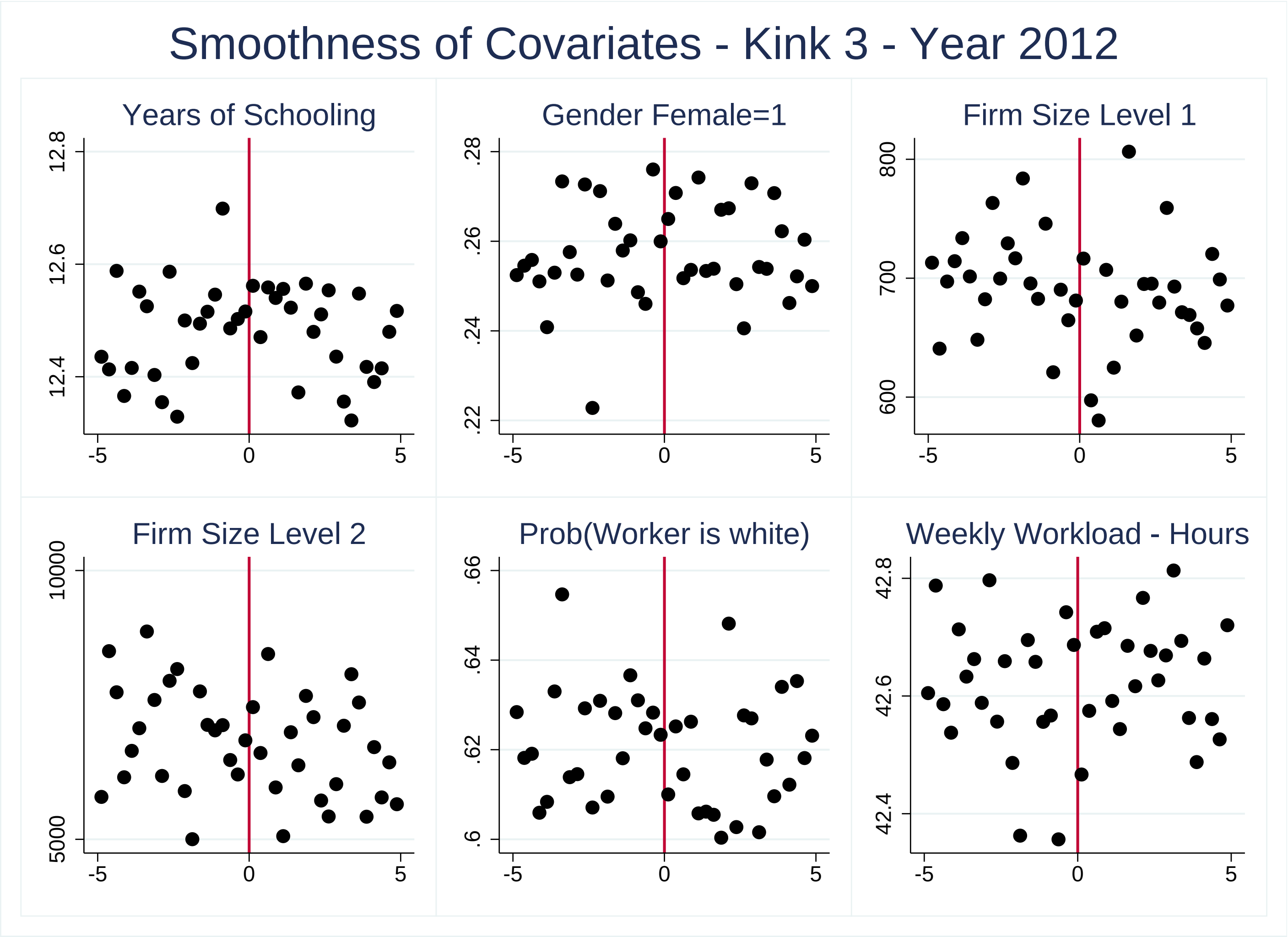

Smoothness of Covariates - Kink 1 - Year 2012
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours
12
11.9
11.8
.54
.52
.5
.48
1000
800
600
400
30000
20000
10000
.56
.54
.52
.5
43.2
43
42.8
-5
0
5

Figure A15



Smoothness of Covariates - Kink 2 - Year 2012
Years of Schooling
Gender Female=1
Firm Size Level 1
Firm Size Level 2
Prob(Worker is white)
Weekly Workload - Hours

Figure A16


Smoothness of Covariates - Kink 3 - Year 2012
Years of Schooling
12.8
12.6
12.4
-5
0
5
Gender Female=1
.28
.26
.24
.22
-5
0
5
Firm Size Level 1
800
700
600
-5
0
5
Firm Size Level 2
10000
5000
-5
0
5
Prob(Worker is white)
.66
.64
.62
.6
-5
0
5
Weekly Workload - Hours
42.8
42.6
42.4
-5
0
5

B Appendix

B.1 Benefit Level and the Choice of Search Effort by the Unemployed

I first characterize the agent's optimal choice of search effort and then analyze how this choice reacts to variations in the level of unemployment benefits. The analysis regards the case of unemployed workers who have to choose a level of search intensity for a given level of benefits as stated in equation (4). First-order conditions are given by: [7]

$$\psi'(s_t) = E_t(A_t) - U_t(A_t) \tag{14}$$

The optimal level of search intensity is simply the one where the marginal cost of search (left-hand-side of the equation) equals the net gain from finding a new job (right-hand-side of the equation). Such gains are given by the difference between the value of a new job $E_t(A_t)$ and the value of unemployment $U_t(A_t)$. The larger the value of finding a new job *vis-a-vis* the value of remaining unemployed, the greater the incentive to search.

At this point, it is possible to approach the question of how a small change in the level of benefits affects the incentives to search. From the previous first-order condition and by applying the envelope theorem we have: [8]

$$\frac{\partial s_t}{\partial b_t} = \frac{-u'(c_t^u)}{\psi''(s_t)} < 0 \tag{15}$$

It shows that an \$1 increase in UI benefits decreases search intensity by an amount which depends on the marginal utility of consumption of the unemployed worker adjusted by how the marginal cost of search is increasing at a given point. For instance, it means that if an unemployed worker is already enjoying a high level of consumption, his marginal utility of consumption is low and, thus, a small increase in benefits will not affect by much his level of search intensity.

As in Chetty (2008), it is possible to show that an increase in the level of benefits affects search through two distinct channels: a liquidity and a moral hazard effect. With this purpose, we notice that:

[7] Here we adopt the so-called "first-order approach" and assume $U_t(A_t)$ to be concave as in Chetty(2008), which shows that for plausible parameters non-concavity never arises.

[8] The envelope theorem states that for small changes of parameter values in an optimization problem, the relevant effects on the function of interest are the direct effects. It means that indirect effects should be ignored. In our case, b_t is the changing parameters of the optimization problem. The envelope condition allows us to ignore the effects of b_t on both $E_t(A_t)$ and $U_t(A_t)$. In other words, $\frac{\partial E_t(A_t)}{\partial b_t} = 0$ and $\frac{\partial U_t(A_t)}{\partial b_t} = 0$.

$$\frac{\partial s_t}{\partial A_t} = \frac{v'(c_t^e) - u'(c_t^u)}{\psi''(s_t)} \leq 0 \tag{16}$$

$$\frac{\partial s_t}{\partial w_t} = \frac{v'(c_t^e)}{\psi''(s_t)} \geq 0 \tag{17}$$

Equation (7) shows that the larger the gap between the marginal utilities of consumption when employed ($v'(c_t^e)$) and unemployed ($u'(c_t^u)$), the larger the effect of an increase in the agent's asset level on search intensity. This means that when unemployed workers are significantly liquidity constrained, and so the gap in consumption between unemployment and employment is sizeable, providing an extra small amount of liquidity to this agent will lower his search intensity significantly. Equation (8), instead, shows that an increase in the pay-off of finding a new job (higher w_t) positively affects search intensity. The magnitude of this effect depends on the marginal utility of consumption when employed adjusted by the slope of the marginal cost of search at a given point. The intuition is that if consumption when employed is already large, so marginal utility is low, an small increase of w_t does not change substantially the reward of finding a job and, thus, the change in search intensity is small.

By combining the results of (7) and (8) with (6), we can decompose the marginal distortion of unemployment benefits on search in two distinct elements: liquidity and moral hazard effect:

$$\frac{\partial s_t}{\partial b_t} = \frac{\partial s_t}{\partial A_t} - \frac{\partial s_t}{\partial w_t} < 0 \tag{18}$$

This is the core result provided by Chetty (2008). It highlights that the effect of UI benefits on search intensity is a mix between a moral hazard component ($\frac{\partial s_t}{\partial w_t}$) and a liquidity effect ($\frac{\partial s_t}{\partial A_t}$). The moral hazard regards the that fact unemployment benefits distort the pay-off from leaving unemployment because as soon as the worker finds a new job, his benefits are ceased. Therefore, it directly decreases the net benefits of search which are given by $(w_t - b_t)$ and characterizes a substitution effect.[9] The liquidity effect, on the other hand, has to do with the ability the agent has to smooth consumption across states. It means that when workers are liquidity constrained, they search more intensely than they would if credit markets were complete. Once you provide these workers with UI benefits, they decrease their search intensity because now they are less liquidity constrained and thus can better smooth consumption across states.

For example, suppose an unemployed worker has zero liquid assets, no access to credit markets and is not entitled to UI benefits in this model. This worker searches very intensely for a new job because he

[9]Technically, it also embodies a wealth effect as a variation in the net value of finding a job also affects life time wealth. However, in the context of unemployment benefits such effect is arguably very low since the total amount of benefits are only a very small fraction of lifetime earnings.

cannot borrow against the future and, thus, he experiences a very low (zero) level of consumption while unemployed. If he is granted with a lump sum cash grant, he will decrease search effort not because the net benefit of finding a job changes (as is the case for UI benefits), but simply because he is less liquidity constrained and can now better smooth consumption across states. Therefore, a hypothetical cash grant unveils the liquidity effects on search. Such effect is embodied in the total distortion caused by UI benefits because it also provides more liquidity to workers.

The other part of the distortion relates to the fact that when such a worker is granted with UI, the net benefit of finding a new job decreases. This happens because, differently from the cash grant, benefits cease as soon as he comes back to employment, representing a decrease in the reward of finding a new job.

Equation (18), however, shows how the effect of an *one period* increase in UI benefits on search can be decomposed into a liquidity and a moral hazard effect. The expression bellow shows how the decomposition applies for a B-periods increase in the level of UI benefits, as shown in Appendix B.3:

$$\frac{\partial s_t}{\partial b} = \frac{\partial s_t}{\partial a}|_B - \frac{\partial s_t}{\partial w}|_B \tag{19}$$

where $\frac{\partial s_t}{\partial b}$ denotes the effect on search at the initial period when the level of UI benefits increase for all the B periods. $\frac{\partial s_t}{\partial a}|B = \sum_{i=t}^{t+B-1} \frac{\partial s_t}{\partial a_i}$ and $\frac{\partial s_t}{\partial w}|B = \sum_{i=t}^{t+B-1} \frac{\partial s_t}{\partial w_i}$ describe, respectively, the liquidity and moral hazard effect on search in the first B periods of unemployment.

B.2 Benefit Level and the Choice of Work Effort by the Employed

Here I approach the problem of how variations in benefit levels affect the the choice of effort by the employed. This analysis is analytically symmetric to the one found in the previous subsection. Equation (2) states the problem faced by the employed worker. From there it is possible to derive the following first-order condition:[10]

$$c'(e_t) = V_t(A_t) - U_t(A_t) \tag{20}$$

It shows that employed workers decide their level of effort by adjusting the marginal cost of effort to keep his job (left-hand-side of the equation) to the net gain of keeping their jobs, which is given by the difference between the value of employment and unemployment.

[10] As for the problem of the unemployed worker, I take the "first-order" approach and assume $V_t(A_t)$ to be concave.

From the first-order condition above, it is possible to assess how work effort reacts to a small variation in the level of benefits:

$$\frac{\partial e_t}{\partial b_t} = \frac{-u'(c_t^u)}{c''(e_t)} < 0 \tag{21}$$

If the agent's level of consumption when unemployed is expected to be low, so that marginal utility is high, the distortion caused by a small variation in potential benefits will be large. Analogously to the case analyzed in the previous subsection, it is possible to decompose this distortion into a liquidity and a moral hazard problem. The derivatives below show how the level of work effort reacts to a small change in asset levels and wages, respectively:

$$\frac{\partial e_t}{\partial A_t} = \frac{v'(c_t^v) - u'(c_t^u)}{c''(e_t)} \leq 0 \tag{22}$$

$$\frac{\partial e_t}{\partial w_t} = \frac{v'(c_t^v)}{c''(e_t)} \geq 0 \tag{23}$$

By combining equation (12) and (13) with (11), we can decompose the effect of UI benefits on work effort as:

$$\frac{\partial e_t}{\partial b_t} = \frac{\partial e_t}{\partial A_t} - \frac{\partial e_t}{\partial w_t} < 0 \tag{24}$$

Similarly to the case of the unemployed, this equation shows that effects of benefits on work effort depends on two distinct factors: a liquidity ($\frac{\partial e_t}{\partial A_t}$) and a moral hazard ($\frac{\partial e_t}{\partial w_t}$) component. The moral hazard effect concerns the fact that UI benefits imply a decrease of the net loss caused by a lay-off. In other words, unemployment is less unattractive relatively to being employed. The liquidity effect, however, has to do with the fact that UI raises asset level and may help the worker to smooth consumption between employment and unemployment.

Once again, the decomposition above applies for a *one period* increase in benefit level. Below is the decomposition for a B periods increase in the level of benefits:

$$\frac{\partial e_t}{\partial b}|_B = \frac{\partial e_t}{\partial a}|_B - \frac{\partial e_t}{\partial w}|_B \tag{25}$$

where $\frac{\partial e_t}{\partial a}|B = \sum_{i=t}^{t+B-1} \frac{\partial e_t}{\partial a_i}$ and $\frac{\partial e_t}{\partial w}|B = \sum_{i=t}^{t+B-1} \frac{\partial e_t}{\partial w_i}$.

B.3 Liquidity and Moral Hazard in the T Periods Model

Let $x \in \{a, b, w\}$, $s \in \{0, 1, ..., T-1\}$, $\frac{\partial e_0}{\partial x}|s = \sum_{t=0}^{T-1} \frac{\partial e_0}{\partial x_t}$ and $\frac{\partial s_0}{\partial x}|s = \sum_{t=0}^{T-1} \frac{\partial s_0}{\partial x_t}$.
Exploiting the FOCs with envelope conditions, we have:

$$\frac{\partial e_0}{\partial x}|s = \frac{1}{c''(e_0)} \left\{ \frac{\partial V_0}{\partial x}|s - \frac{\partial U_0}{\partial x}|s \right\} \tag{26}$$

$$\frac{\partial s_0}{\partial x}|s = \frac{1}{\psi''(s_0)} \left\{ \frac{\partial E_0}{\partial x}|s - \frac{\partial U_0}{\partial x}|s \right\} \tag{27}$$

Notice that:

$$\frac{\partial E_0}{\partial a}|_B = \frac{\partial E_0}{\partial w}|_B$$

$$\frac{\partial U_0}{\partial a}|_B = \frac{\partial U_0}{\partial w}|_B + \frac{\partial U_0}{\partial b}|_B$$

$$\frac{\partial V_0}{\partial a}|_B = \frac{\partial V_0}{\partial w}|_B + \frac{\partial V_0}{\partial b}|_B$$

Combining these conditions, it follows that:

$$\frac{\partial e_0}{\partial b}|_B = \frac{\partial e_0}{\partial a}|_B - \frac{\partial e_0}{\partial w}|_B \tag{28}$$

$$\frac{\partial s_0}{\partial b}|_B = \frac{\partial s_0}{\partial a}|_B - \frac{\partial s_0}{\partial w}|_B \tag{29}$$

B.4 The Welfare Formula in the T Periods Model

$$\max_{b,\tau} J_0^V(b, \tau) = (1 - e_0)U_0(b, \tau) + e_0 V_0(b, \tau) - c(e_0) \tag{30}$$

$$s.t. D_B b = D_E \tau \tag{31}$$

Deriving with respect to the level of benefits:

$$\frac{dJ_0}{db} = (1 - e_0)\cancelto{0}{\frac{\partial U_0}{\partial b}} + e_0 \frac{\partial V_0}{\partial b} - \frac{d\tau}{db} \left[(1 - e_0)\frac{\partial U_0}{\partial w} + e_0 \frac{\partial V_0}{\partial w} \right] \tag{32}$$

Notice that $\frac{\partial U_0}{\partial b} = 0$ because workers laid-off in the first period are not eligible for UI. Let $E_{0,T-1} v'(c_t^V)$ denote the unconditional average marginal utility while employed and D_E the expected duration of (first) employment. Then:

$$E_{0,T-1}v'(c_t^V) = \frac{1}{D_E}\left[(1-e_0)\frac{\partial U_0}{\partial w} + e_0\frac{\partial V_0}{\partial w}\right] \tag{33}$$

Also:

$$e_0\frac{\partial V_0}{\partial b} = \sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\frac{\partial U_i}{\partial B_i} \tag{34}$$

Where $\frac{\partial U_i}{\partial B_i}$ is the effect of raising UI benefits for workers entering unemployment at period i. Then, it implies:

$$\frac{dJ_0}{db} = \sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\frac{\partial U_i}{\partial B_i} - \frac{d\tau}{db}(D_E)E_{0,T-1}v'(c_t^V) \tag{35}$$

Higher benefits increase the value of employment at $t = 0$ by raising the value of subsequent unemployment after minimum eligibility requirement, at period k.

Normalize welfare by the gain from raising wages by \$ 1:

$$\frac{dJ_0}{dw} = (1-e_0)\frac{\partial U_0}{\partial w} + e_0\frac{\partial V_0}{\partial w} = (D_E)E_{0,T-1}v'(c_t^V) \tag{36}$$

Therefore:

$$\frac{dW}{db} = \frac{\frac{dJ_0}{db}}{\frac{dJ_0}{dw}} = \frac{\sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\frac{\partial U_i}{\partial B_i}}{(D_E)E_{0,T-1}v'(c_t^V)} - \frac{d\tau}{db} \tag{37}$$

For workers becoming unemployed at period i, it is true that:

$$\frac{\partial s_i}{\partial B_i} = \frac{1}{\psi''(s_i)}\left\{\overbrace{\frac{\partial E_i}{\partial B_i}}^{0} - \frac{\partial U_i}{\partial B_i}\right\} \tag{38}$$

$$\implies \frac{\partial U_i}{\partial B_i} = -\psi''(s_i)\frac{\partial s_i}{\partial B_i} \tag{39}$$

Then, it follows that:

$$\frac{dW}{db} = \frac{\sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\left(-\psi''(s_i)\frac{\partial s_i}{\partial B_i}\right)}{(D_E)E_{0,T-1}v'(c_t^V)} - \frac{d\tau}{db} \tag{40}$$

Now since:

$$\frac{\partial s_i}{\partial B_i} = \frac{\partial s_i}{\partial A_i}|B - \frac{\partial s_i}{\partial W_i}|B \tag{41}$$

We have:

$$\frac{dW}{db} = \frac{\sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\left[-\psi''(s_i)\frac{\partial s_i}{\partial W_i}|B\left(\frac{\frac{\partial s_i}{\partial A_i}|B}{\frac{\partial s_i}{\partial W_i}|B}-1\right)\right]}{(D_E)E_{0,T-1}v'(c_t^V)} - \frac{d\tau}{db} \tag{42}$$

Let $E_{i,i+B-1}v'(c_t^E)$ be the average marginal utility over the first B periods while employed conditional on becoming unemployed at $t=i$, and notice that:

$$E_{i,i+B-1}v'(c_t^E) = \frac{1}{B-D_B}\left(s_i\frac{\partial E_i}{\partial W_i}|_B + (1-s_i)\frac{\partial U_i}{\partial W_i}|_B\right) \tag{43}$$

From (26) and (27), after some manipulation, it follows that:

$$\frac{\partial s_i}{\partial W_i}|B = \frac{1}{\psi''(s_i)}\frac{1}{1-s_i}\left\{\frac{\partial E_i}{\partial W_i}|_B - \left(s_i\frac{\partial E_i}{\partial W_i}|_B + (1-s_i)\frac{\partial U_i}{\partial W_i}|_B\right)\right\} \tag{44}$$

$$= \frac{1}{\psi''(s_i)}\frac{1}{1-s_i}\left\{Bv'(c_i^E) - (B-D_B)E_{i,i+B-1}v'(c_t^E)\right\} \tag{45}$$

$$\tag{46}$$

These results in $\frac{dW}{db}$ imply:

$$\frac{dW}{db} = \frac{\sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\left[\frac{1}{1-s_i}\left\{Bv'(c_i^E) - (B-D_B)E_{i,i+B-1}v'(c_t^E)\right\}(-\rho_i - 1)\right]}{(D_E)E_{0,T-1}v'(c_t^V)} - \frac{d\tau}{db} \tag{47}$$

where $\rho_i = -\frac{\frac{\partial s_i}{\partial A_i}|B}{\frac{\partial s_i}{\partial w_i}|B}$ is the liquidity to moral hazard ratio at period i.

Notice that from the government budget constraint:

$$\frac{d\tau}{db} = f^{UI}\frac{D_B}{D_E}\left\{1 + \epsilon_{f^{UI},b} + \epsilon_{D_B,b} - \epsilon_{D_E,b}\right\} \tag{48}$$

As in Chetty (2008), assume that the consumption path during employment is constant since unemployment is unlikely to cause large losses on life cycle earnings. This means that $E_{i,i+B-1}v'(c_t^E) = E_{0,T-1}v'(c_t^V) = v'(c_i^E)$, $\forall i$. Using this assumption and the budget constrain, it implies that:

$$\frac{dW}{db} = \frac{D_B}{D_E}\left\{\sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\frac{(\rho_i+1)}{1-s_i} - f^{UI}\left[1 + \epsilon_{f^{UI},b} + \epsilon_{D_B,b} - \epsilon_{D_E,b}\right]\right\} \tag{49}$$

The term $\sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)\frac{(\rho_i+1)}{1-s_i}$ is the weighted average of the liquidity-to-moral hazard ratio of a worker becoming unemployed at period $i > k$, divided by the probability that he does not find a job at the first period of the spell. If we assume that both the liquidity-to-moral ratio and s_i at the first period of the spell do not vary with respect to the period in which workers become unemployed, as is implicity in Chetty (2008), it is true that $\rho_i = \rho$ and $s_i = s_0$. Then it follows our final welfare formula:

$$\frac{dW}{db} = f^{UI}\frac{D_B}{D_E}\left\{\frac{1}{1-s_0}(\rho+1) - \left(1 + \epsilon_{f^{UI},b} + \epsilon_{D_B,b} - \epsilon_{D_E,b}\right)\right\} \tag{50}$$

where $f^{UI} = \sum_{i=k}^{T-1}\left[\Pi_{j=0}^{i-1}e_j\right](1-e_i)$ is the share of laid-off workers eligible for UI due to MER.