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The Effect of Unemployment Benefits on the Duration of Unemployment Insurance Receipt: New Evidence from a Regression Kink Design in Missouri, 2003-2013
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ABSTRACT

We provide new evidence on the effect of the unemployment insurance (UI) weekly benefit amount on unemployment insurance spells based on administrative data from the state of Missouri covering the period 2003-2013. Identification comes from a regression kink design that exploits the quasi-experimental variation around the kink in the UI benefit schedule. We find that UI durations are more responsive to benefit levels during the recession and its aftermath, with an elasticity between 0.65 and 0.9 as compared to about 0.35 pre-recession.

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1 Introduction

Despite the consensus that higher unemployment benefits lead to longer durations of unemployment, the precise magnitude of the effect is uncertain. Recent studies based on experiences in Western Europe (summarized in Card et al. (2014)) find a very wide range of elasticities of unemployment duration with respect to the level of Unemployment Insurance (UI) benefits – in the range of 0.3 to 2. Studies from the U.S., mostly based on the Continuous Wage and Benefit History data set, find a somewhat narrower range of elasticities, though none of these estimates incorporates data from the past decade (see Chetty (2010); Landais (Forthcoming); and the summary by Krueger and Meyer (2002)).

In this paper, we provide new evidence on the UI benefit elasticity based on administrative data from the state of Missouri covering the period from 2003 to 2013. Our identification of the causal effect of UI benefit comes from a regression kink design (RKD) and relies on the quasi-experimental variation around the kink in the UI benefit schedule. A major advantage of the data set is that it affords us the opportunity to investigate the Great Recession period. Theoretical reasoning suggests that the responsiveness of unemployment durations to UI benefits could be larger or smaller in recessionary periods. Kroft and Notowidigdo (2014) use state and year variation in UI benefits and the unemployment rate over the 1985-2000 period and show that in the SIPP data the duration effects of UI benefits are stronger when the unemployment rate is lower. Using German data, Schmieder et al. (2012) find that the nonemployment effects of additional months of potential UI duration are only modestly lower during downturns.

In our setting, we find that the elasticity of UI duration with respect to the weekly benefit amount is around 0.35 during the pre-recession period (2003-2007), which is on the lower end of estimates in the US literature. In contrast, UI durations are more responsive to benefit levels during the recession and its aftermath, with the elasticity estimate in the range of 0.65-0.9.

2 Institutional Background

Unemployment benefit levels in the U.S., as in many other countries, are a function of earnings in the year prior to the claim. In Missouri, weekly benefits for eligible UI claimants are given by the formula

$$B \equiv \min(m \cdot Q, B_{max})$$

where Q is the highest quarter earnings in the "base period" (i.e., the first four of the preceding five calendar quarters),[1] $13 \cdot m$ is the replacement rate, and B_{max} is the UI benefit cap. The replacement rate was 52% for most years in our sample period, implying that $m = 4\%$.[2] The benefit cap, B_{max} ranged from \$250 to \$320 per week, depending on the claim year.

The total amount of benefits receivable per claim is also capped: it is equal to the smaller of $26 \cdot B$ and a third of the total earnings in the base period.[3] The ratio of the total UI benefits receivable to the weekly benefit amount is the "regular" potential claim duration, i.e. the maximum duration barring any UI extensions. During the Great Recession, the potential duration of benefits was increased in proportion to the regular potential duration, up to an unprecedented 99 weeks as a result of federal Extended Unemployment Compensation (EUC) and state Extended Benefit (EB) programs.

As described in section 3 below, our main identification strategy exploits the kink in the benefit level as a function of high quarter earnings. However, there is a confounding kink in potential durations. Specifically, regular potential durations are given by the expression:

$$\text{Regular Potential Duration } = \min(26, \frac{E}{3 \cdot B})$$

where E is a measure of total base year earnings.[4] The negative slope change in B at the threshold induces an offsetting *positive* slope change in potential durations for a subpopulation of claimants. This slope change complicates the interpretation of the estimated benefit elasticities at the kink point. If unemployment duration responds positively to potential duration, estimates of the effects of benefit levels will be biased downward. One way to mitigate the impact of potential durations is to artificially censor durations using a "smoothed" potential duration that does not kink upward at the threshold, as in Card et al. (2009). We describe this in further detail in section 5, and we conclude that to the extent that there is such bias, it is minimal.

[1] Beginning in 2008, the formula used the average of the two highest quarters.

[2] The exception took place between January and September 2006, where the replacement rate was 48.75% and $m = 3.75\%$.

[3] After April 15, 2011, total benefits were capped at the smaller of $20 \cdot B$ and a third of the total earnings.

[4] The definition of E is $E = \sum_{t=1}^{4} \min(Q_t, 26 \cdot B)$ where Q_t is t-th quarter earnings in the base period. After April 15, 2011, the formula is $\min(20, \frac{E}{3 \cdot B})$.

3 Empirical Strategy

Since the UI benefit is a function of past earnings, it is likely to be correlated with worker characteristics that determine unemployment durations. A regression kink design circumvents this endogeneity problem by using the quasi-experimental variation induced by the cap in the benefit formula. Specifically, let Y be the unemployment duration, B the UI benefit level, and V the normalized high quarter earnings.[5] Card et al. (2014) show that under smoothness conditions, the RK estimand

$$\frac{\lim\limits_{v_0\to 0^+} \frac{dE[Y|V=v]}{dv}\Big|_{v=v_0} - \lim\limits_{v_0\to 0^-} \frac{dE[Y|V=v]}{dv}\Big|_{v=v_0}}{\lim\limits_{v_0\to 0^+} \frac{dE[B|V=v]}{dv}\Big|_{v=v_0} - \lim\limits_{v_0\to 0^-} \frac{dE[B|V=v]}{dv}\Big|_{v=v_0}} \tag{1}$$

identifies a weighted average of the marginal effects of B on Y.[6] The identifying assumptions in Card et al. (2014) give rise to the testable implications that the distribution of V and the conditional expectation/quantile functions of any pre-determined characteristics are continuously differentiable at $V = 0$.

In a sharp RKD where all benefit assignments appear to follow the formula, B is a deterministic function of V and the denominator of (1) is a known constant. In reality, however, there appear to be small deviations from the formula. Therefore, it becomes necessary to apply a fuzzy RKD and estimate the slope change of the first stage function $E[B|V = v]$.

For estimation, we follow Card et al. (2014) and adopt local polynomial estimators for the slope changes in the numerator and denominator of (1). We present estimates of the UI benefit elasticity using alternative bandwidth selectors and polynomial orders, as well as bias-corrected estimates per Calonico et al. (Forthcoming) (henceforth CCT).

4 Data

We use data on UI claimants from the state of Missouri who initiated a claim from mid-2003 through mid-2013. We observe the weekly benefit amount, past and future earnings, and the date and amount of each UI payment. We also observe the industry of the pre-job-loss employer and are able to construct job tenure with that employer. Since our focus is on the comparison of benefit effects before and after the Great

[5]Formally, $V = Q - \frac{B_{max}}{m}$, and the kink threshold is at $V = 0$.

[6]In the empirical analysis, we use log(duration) as the dependent variable and log(benefit) as the endogenous variable in order to directly estimate the benefit elasticity.

Recession, we conduct all analyses separately for claims established in years 2003-2007 ("pre-recession" or "pre" period) and 2008-2013 ("post-recession" or "post" period).

Our analysis sample excludes workers who did not qualify for UI due to the nature of their job separation (e.g. workers who quit or were fired for cause). We also drop people with zero earnings in the base year or with missing claim information. Within each time period subsample, we exclude claimants whose high quarter earnings (the value of the assignment variable) are in the top and bottom 5%.[7] For workers with multiple claims, we include only the first claim in our sample, which eliminates the influence of left-censored claims.[8] Finally, we exclude claimants who were previously employed in the manufacturing sector, for reasons discussed in section 5 below. There are 295,639 and 409,753 observations in the pre- and post-recession analysis sample, respectively.

We focus on two outcomes of interest. The first is the duration of the initial UI spell, which is the number of weeks of UI claim before a no-claim gap of more than two weeks. The second outcome is the total number of weeks of UI claimed. The initial spell duration is an outcome generally examined in existing empirical studies, while the total weeks claimed may be more relevant to policy makers because it is directly related to program cost. In the pre-recession sample, the mean length of initial spell duration is 11.9 weeks, and the mean number of weeks claimed is 16.0. In the recession sample, both the initial spell duration and total weeks claimed are expectedly longer, at 24.3 and 31.9 weeks, respectively.

5 Results

The identifying assumptions in Card et al. (2014) for a valid RKD imply a continuously differentiable density of the running variable. However, we find a salient kink in the distribution of high quarter earnings in the pre period for workers previously employed in the manufacturing sector (Appendix Figure 1). This kink could be a coincidence or may represent strategic behavior of firms, but the reason for this is beyond the scope of this paper. To ensure that estimates are not influenced by this kink, we exclude manufacturing claimants in both periods.[9]

[7]Removing the tails of the distribution does not affect the local identification result described in section 3, but these "outliers" may exert a large influence on several bandwidth selectors as they rely on a global polynomial regression in the first step.

[8]Since a regular UI claim is only valid for one year, we observe many claims that occurred on or shortly after the one year anniversary of the last claim. While it is possible that many workers were laid off again exactly a year later, it seems more likely that they remained unemployed the entire year, and that the new claim was simply a continuation of the unemployment spell. Therefore, we drop subsequent claims in the sample for simplicity.

[9]Including manufacturing tends to result in smaller estimated elasticities both pre- and post-recession, with the pre-recession estimates close to zero.

Appendix 2a and 2b plot the frequency distributions of high quarter earnings in the two analysis subsamples using \$100 bins. The two histograms look quite smooth, and we formally tested the continuity of the density derivative by fitting polynomials to the histograms as in Card et al. (2014). Even though the polynomial models are formally rejected according to the goodness of fit statistics, which is driven by the "spikes" above the threshold, they appear to fit the data visually. In both sample periods, there is no statistical evidence indicating a kink at the threshold.

As a first step in the main RKD analysis, we graphically present the relationship between base period high quarter earnings and benefit levels (first stage) and initial UI durations (outcomes). Figures 1a and 1b plot binned averages of the observed weekly benefit amount against high quarter(s) earnings (V) for the two sample periods, respectively. There is a sharp kink in the relationship at $V = 0$ in both graphs that by and large represents the statutory replacement rate and the benefit cap. There are deviations from the piece-wise linear formula in both periods, but the deviations are minimal. Around 0.30% and 0.35% of observations lie off the benefit schedule with an average deviation of \$0.128 and \$0.13 in the pre and post period respectively.[10] Figures 2a and 2b depict the relationship between log initial UI spell duration and high quarter earnings for the two sample periods. In both graphs, the initial UI spell duration peaks at around $V = 0$, but the slope change around the threshold is more pronounced in the post period.

As another test of the design validity, we examine the patterns of the pre-determined covariates around the threshold. As with Card et al. (2014), we construct an index, the predicted log initial UI spell duration, by using all the covariates available in the data set: earnings in the quarter preceding job loss and indicators for industry, month of the year, calendar year and previous job tenure quintiles.[11] Figure 3a and 3b plot the mean values of the covariate indices for the two sample periods. The indices move reasonably smoothly across the threshold, and more formal tests are provided at the end of this section.

Table 1 presents estimated benefit elasticities for 2003-2007 (Panel A) and 2008-2013 (Panel B) for initial UI duration and total weeks of UI. Columns (1)-(4) correspond to local linear models while columns (5)-(8) correspond to local quadratic models. We present estimates using the analog of the Imbens and Kalyanaraman (2012) bandwidth for fuzzy RKD ("Fuzzy IK"), and a "rule-of-thumb" bandwidth based on Fan and Gijbels (1996) ("FG"). Across specifications, the estimated benefit elasticities from both local

[10] The seemingly larger fluctuation in Figure 1a is mainly due to the changing benefit cap level during the pre-recession period (\$250 between 2003 and 2005, \$270 in 2006 and \$280 in 2007) and the varying distribution of claim years conditional on V, as opposed to deviations from the schedule.

[11] As mentioned in section 2, the earnings in the quarter preceding job loss are not counted in calculating the running variable.

linear and local quadratic regressions corroborate the visual evidence. Using the Fuzzy IK bandwidth, the local linear conventional elasticity estimates for initial UI duration and total weeks of UI claimed are 0.37 and 0.21 in the pre period, which are statistically significant (column (2)). The corresponding estimates for the post period are 0.88 and 0.81, respectively. The quadratic specifications yields similar estimates for both periods; the exception is the elasticity of total weeks in the pre period, which becomes wrong-signed and insignificant. The FG bandwidth shows a generally similar pattern, though with smaller post period elasticities. In Appendix Table 1, we also present estimates under alternative bandwidth selectors: default CCT, CCT with no regularization, fuzzy CCT, which are based on Calonico et al. (Forthcoming).[12] Under the alternative bandwidths, the conventional local linear and quadratic estimates are similar to the fuzzy IK in the pre and post period.[13]

To visualize the relationship between the elasticity estimates and the bandwidth choice, we plot the local linear estimates for the pre and post samples associated with a range of potential bandwidths in Figure 4 (quadratic estimates are shown in Appendix Figure 4). For bandwidths between \$600 and \$8000, the local linear estimated elasticities in the post period are always larger than those in the pre period: the smallest elasticity in the post period is 0.55, and the largest in the pre period is 0.38. Appendix Figures 5a and 5b show the difference between the pre and post elasticities, with associated confidence intervals, for the linear and quadratic models respectively. We reject equality between pre and post point-wise for each bandwidth in the linear model, and for all but a narrow range of bandwidths in the quadratic model.

In addition to the robustness of estimates with respect to alternative bandwidth selectors, the fact that the kink in UI duration shifts with the changing benefit schedule bolsters our confidence that RKD identifies behavioral responses. Figure 5 overlays the relationships between UI durations and high quarter earnings for the years 2005 and 2008, between which the kink threshold increased from \$6250 to \$8000 as indicated by the vertical lines. The sharp peaks in UI durations coincide with these two thresholds.

Finally, the pre/post-recession comparison is made more granular in Figure 6, where we separately

[12]See Card et al. (2014) for description of the bandwidth selectors. As in Card et al. (2014), we conduct additional simulation exercises (not reported) to evaluate the performance of the estimators. In data generating processes that closely approximate the actual data, we find that the FG bandwidth generally delivers the lowest mean squared error (MSE) than alternative bandwidth selectors.

[13]Appendix Table 1 also presents CCT bias-corrected estimates and robust confidence intervals under alternative bandwidth selectors. The comparison of bias-corrected local linear estimates again points to larger elasticities in the post period. In contrast, the bias-corrected quadratic standard errors are at least three times as large as their conventional local linear counterparts, and as a result, the quadratic robust confidence intervals are uninformative in both periods. In our simulations, we find that the conventional local linear estimator generally yields the smallest MSE, and the bias-corrected local quadratic the largest. Therefore, we assign less weight to the bias-corrected local quadratic estimates in our interpretation.

estimate the elasticity by year and plot the estimates against the state-wide unemployment rate in Missouri. The local linear estimates and the corresponding conventional 95% confidence intervals using the fuzzy IK (Figure 6a) and FG (Figure 6b) bandwidth selectors are generally similar. The correlation between the elasticity point estimate and the unemployment rate is about 0.55 for fuzzy IK and 0.7 for FG, which provides stronger evidence that responsiveness to UI is negatively associated with labor market conditions.

One explanation for the lower responsiveness during the pre period is that regular potential duration is a kinked function of high quarter earnings at the same location as the benefit kink, as noted in section 2. Across the threshold, while the UI benefit replacement rate goes down, the potential duration becomes more generous. In order to mitigate the confounding effects of potential duration, we follow Card et al. (2009) and artificially censor the outcomes using a smoothed potential duration formula. Specifically, we let

$$\text{Regular Potential Duration}_{smoothed} = \min(26, \frac{\tilde{E}}{3 \cdot \tilde{B}})$$

where $\tilde{B} = m \cdot Q$ and $\tilde{E} = \sum_{t=1}^{4} \min(Q_t, 26 \cdot \tilde{B})$ smooth out the kink in B and E, respectively. By construction, Regular Potential Duration$_{smoothed}$ coincides with the actual regular potential duration below the threshold and is smaller above.

Another possible explanation for the differential responsiveness across the two periods is that UI potential durations were substantially extended during the Great Recession. Because of these extensions, workers were less likely to exhaust their UI benefits in the post period: 37% of claimants exhausted benefits in 2003-2007, while only 28% exhausted benefits after 2008. Since UI spells are right censored when claimants exhaust, the higher exhaustion rate in the pre-recession period may dampen duration effects. To see if this censoring is driving our results, we also censor the unemployment spells in the post period with Regular Potential Duration$_{smoothed}$.

The results for the censored outcomes are shown in the third and fourth rows within each panel of Table 1. In the pre-recession period, although the censoring removes the upward kink in potential duration at the threshold, estimates for the local linear models do not change much. The elasticity of censored initial claim duration in the pre period is 0.39 (s.e. = 0.06) using the fuzzy IK bandwidth and 0.36 (s.e. = 0.04) using the FG bandwidth. In the post-recession period, local linear estimates are still significantly positive, though they are smaller than their uncensored counterparts with elasticity estimates of 0.64 (s.e. = 0.16) for fuzzy IK and 0.49 (s.e. = 0.06) for FG. This comparison indicates that some of the differences in pre- and post-recession elasticities can be attributed to the exhaustion of benefits, but not entirely.

The last outcome we examine is the accepted wage of claimants who eventually find a new job. A basic McCall search model generates the prediction that higher UI benefits increases reservation wages, thereby increasing unemployment durations. We plot the log difference in the new and old wages in Appendix Figure 6, and we report the elasticity estimates in the fifth row of each panel of Table 1. In both periods, this elasticity is insignificant for all but the quadratic estimates with the FG bandwidth, and the estimates are not statistically different across the two periods.

Finally, we return to testing the smoothness of the pre-determined covariates. In Appendix Table 2, we present the estimated kinks in the covariate indices using a variety of estimators. Even though we do find significant kinks for both linear and quadratic models with the FG bandwidth, unlike for the outcome variables, the significance is not robust to alternative bandwidth selectors. Furthermore, the statistically significant kink magnitudes in the predicted log duration are small in comparison to those in the actual log duration. They account for at most 15% in the estimated elasticities in both periods, which does not alter our conclusion that responsiveness to UI is higher in the post period.[14]

6 Discussion and Conclusion

We have presented estimates of the elasticity of unemployment insurance duration with respect to the benefit level using the most recent data available in the U.S. Our estimated elasticity of initial UI durations with respect to the weekly benefit amount of 0.35 for the 2003-2007 period is on the low side relative to other estimates in the literature, and is close to the Meyer and Mok (2007) estimate which uses administrative data from New York. During the recession the estimated elasticity is higher and in the upper range of earlier estimates.

It is beyond the scope of this paper to pin down the precise explanation for the larger responsiveness to UI benefit generosity during a worse labor market. There are several candidate explanations. First, this is a prediction from simple one-sided search models (variants of McCall (1970); see e.g. Kroft and Notowidigdo (2011)). In these models, lower offer arrival rates or higher job destruction rates during a downturn make it

[14]Our results also pass a permutation test (e.g. Ganong and Jäger (2014)), where we perform local linear regressions with a bandwidth of $2,500 – close to the FG bandwidth in both samples – at the actual and placebo thresholds. As seen in Appendix Figure 7, the t-stats for the elasticity estimator at the actual kink (-8.81 for the pre period and -11.1 for the post period) are much more negative than their placebo counterparts, which are no smaller than -2.5. See Card et al. (2014) for concerns regarding the permutation test.

more likely that job seekers will be unemployed in future periods, making them more sensitive to UI generosity. By the same intuition, the longer UI potential durations during the recent recession may also render claimants more responsive to a change in benefit levels. Finally, we cannot rule out composition effects: unemployed workers in the recession might be more liquidity constrained and therefore more responsive to UI generosity.

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Figure 1a: First Stage, 2003-2007

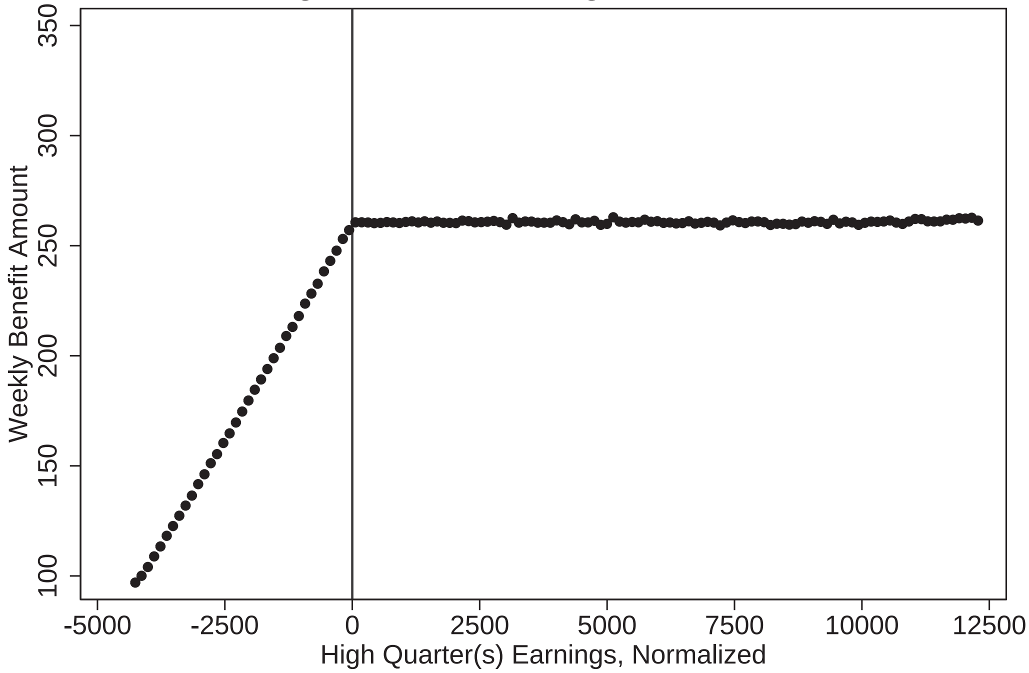


Figure 1b: First Stage, 2008-2013

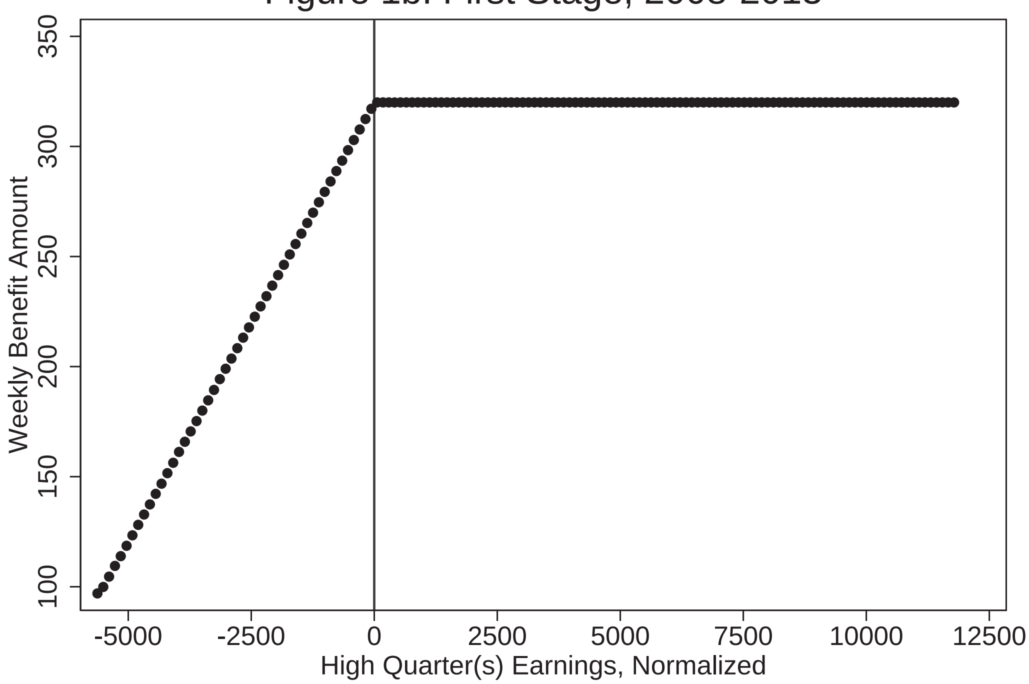


Figure 2a: Log Initial UI Spell Duration, 2003-2007

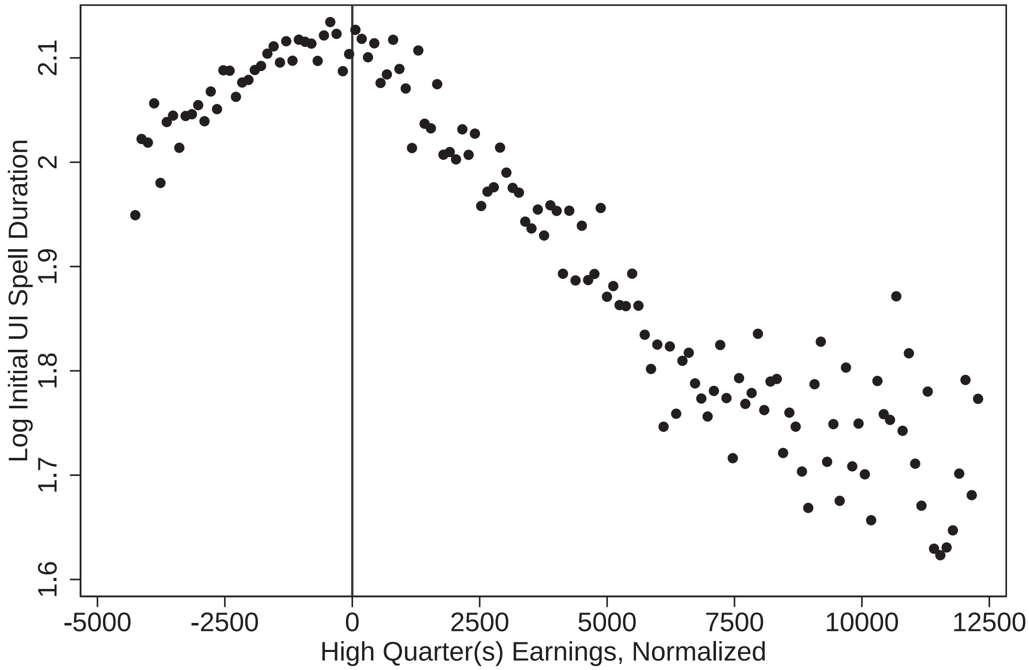


Figure 2b: Log Initial UI Spell Duration, 2008-2013

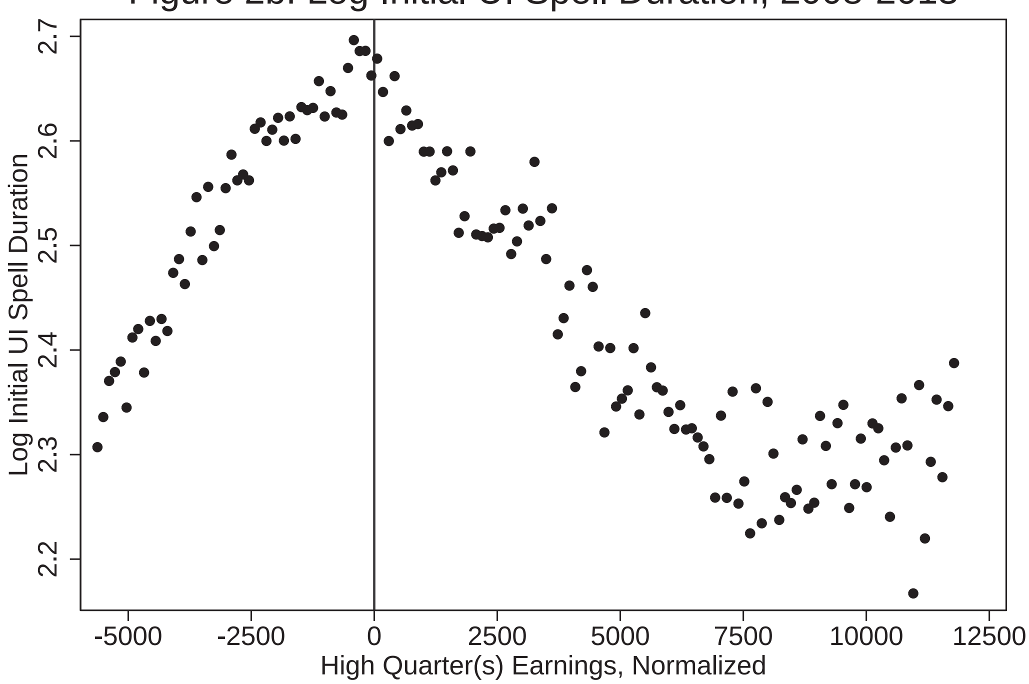


Figure 3a: Predicted Log Initial UI Spell Duration
2003-2007

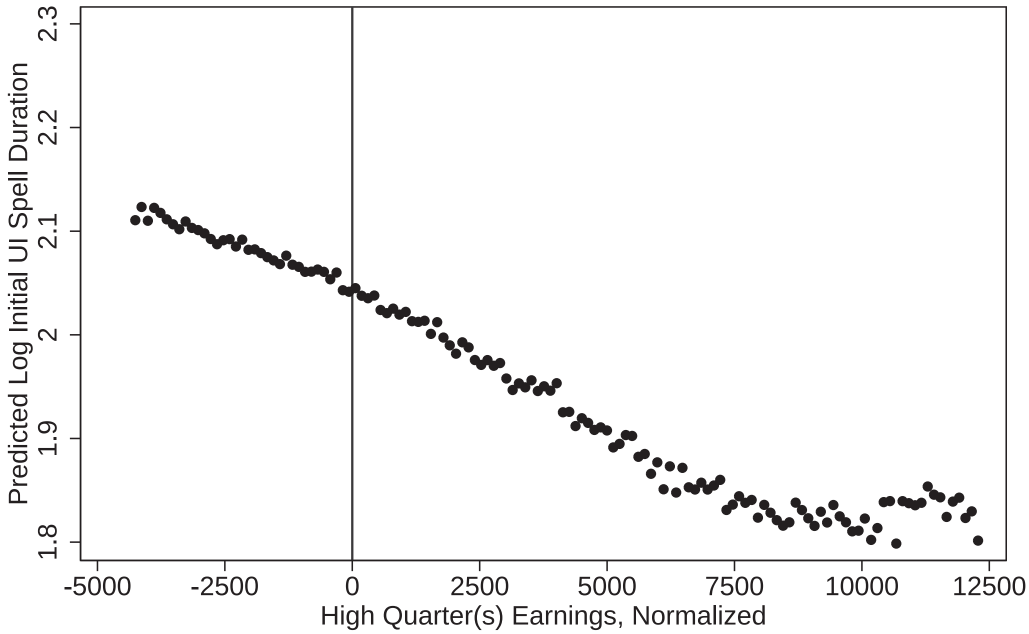


Figure 3b: Predicted Log Initial UI Spell Duration
2008-2013

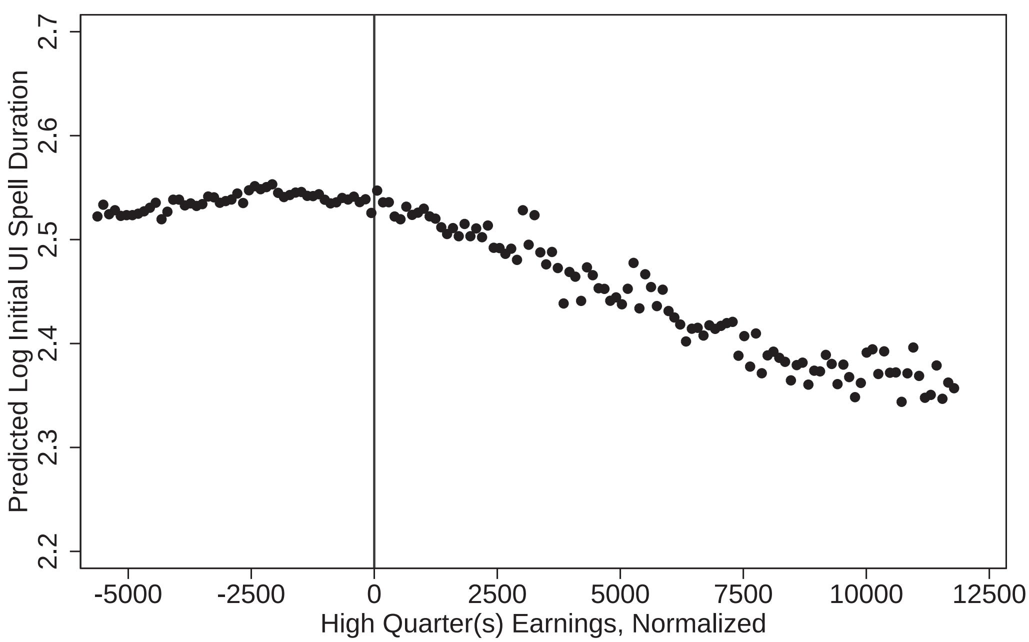
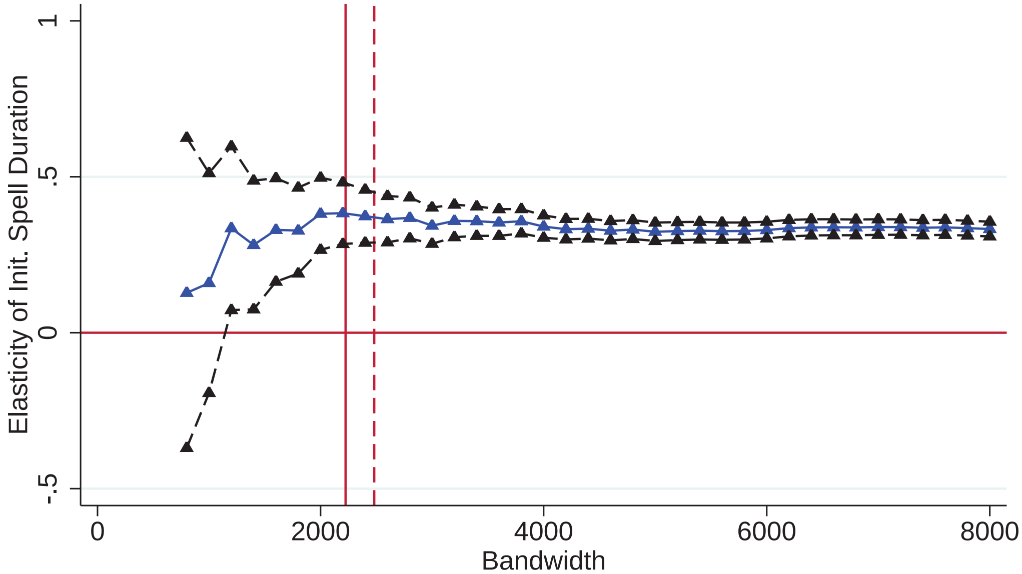
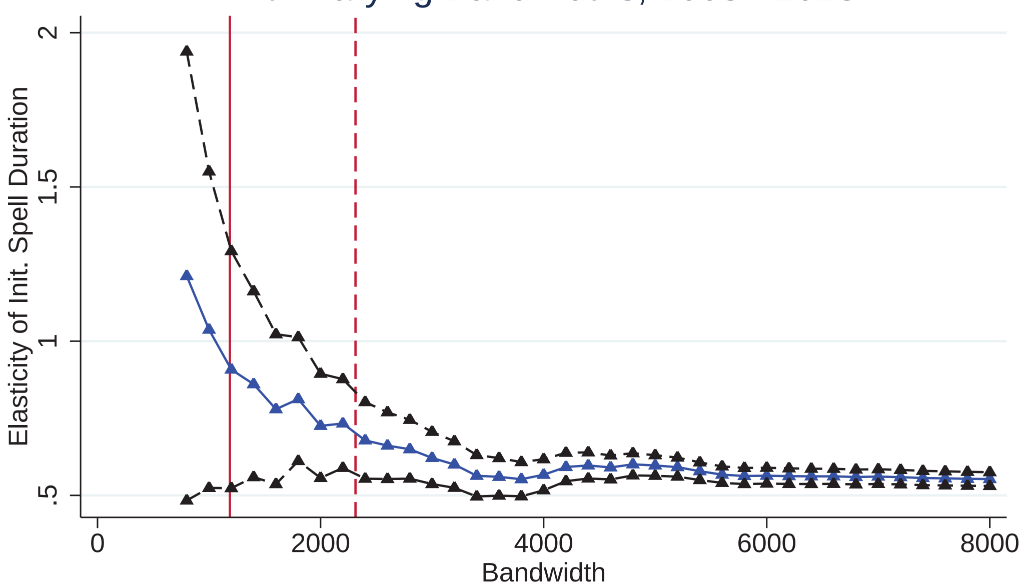


Figure 4a: Local Linear Fuzzy RK Estimates
with Varying Bandwidths, 2003 - 2007



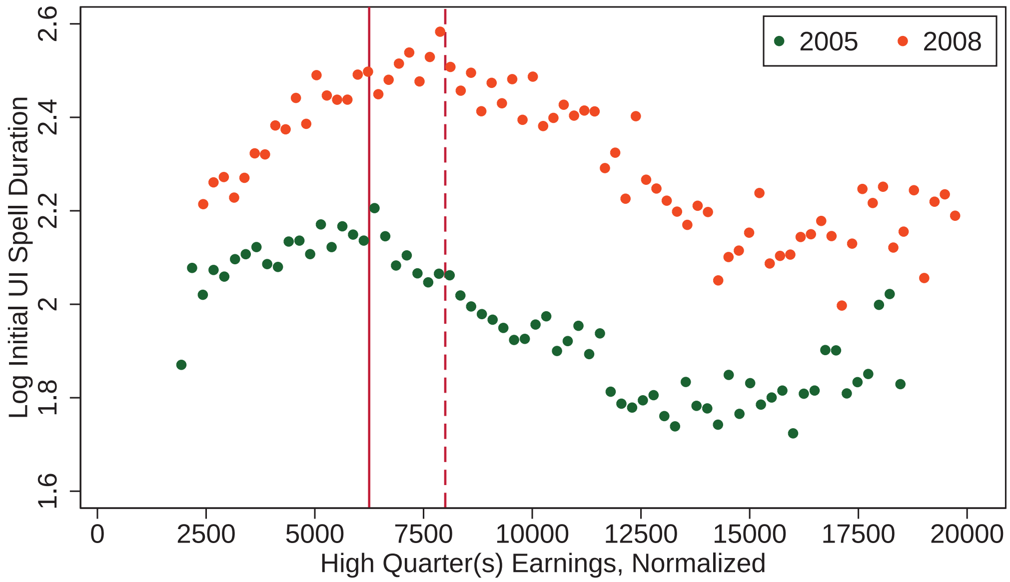
Fuzzy IK Bandwidth (Solid Vertical Line): Elasticity Estimate = 0.373 (s.e. = 0.049)
FG Bandwidth (Dashed Vertical Line): Elasticity Estimate = 0.356 (s.e. = 0.041)

Figure 4b: Local Linear Fuzzy RK Estimates
with Varying Bandwidths, 2008 - 2013



Fuzzy IK Bandwidth (Solid Vertical Line): Elasticity Estimate = 0.882 (s.e. = 0.200)
FG Bandwidth (Dashed Vertical Line): Elasticity Estimate = 0.684 (s.e. = 0.067)

Figure 5: Log Initial UI Spell Duration
2005 and 2008



Solid vertical line: 2005 Kink Threshold
Dashed vertical line: 2008 Kink Threshold

Figure 6a: Benefit Elasticity vs. Unemployment Rate
Fuzzy IK Bandwidth

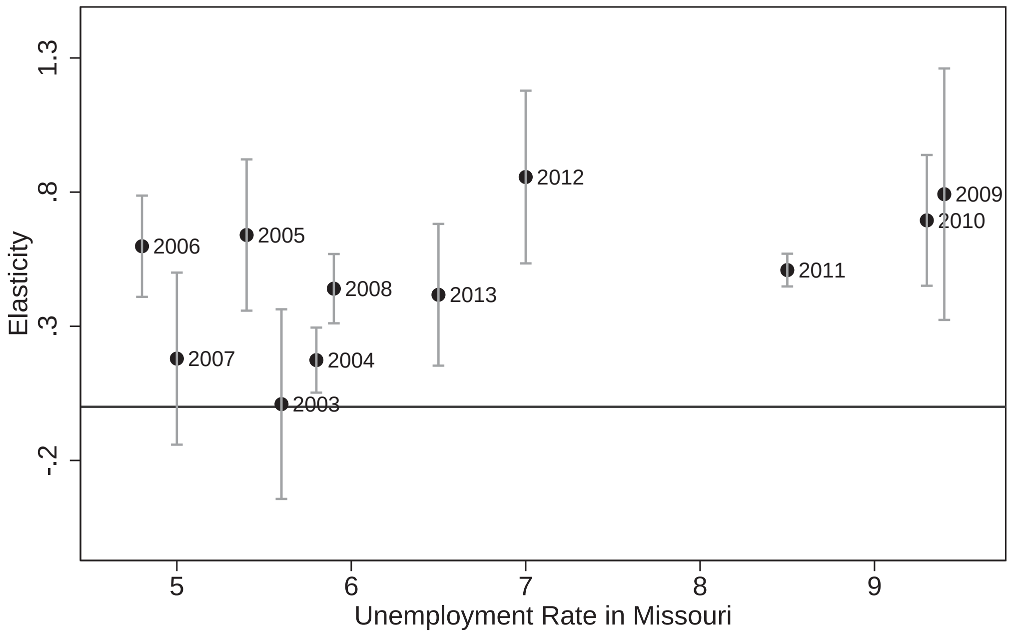


Figure 6b: Benefit Elasticity vs. Unemployment Rate
FG Bandwidth

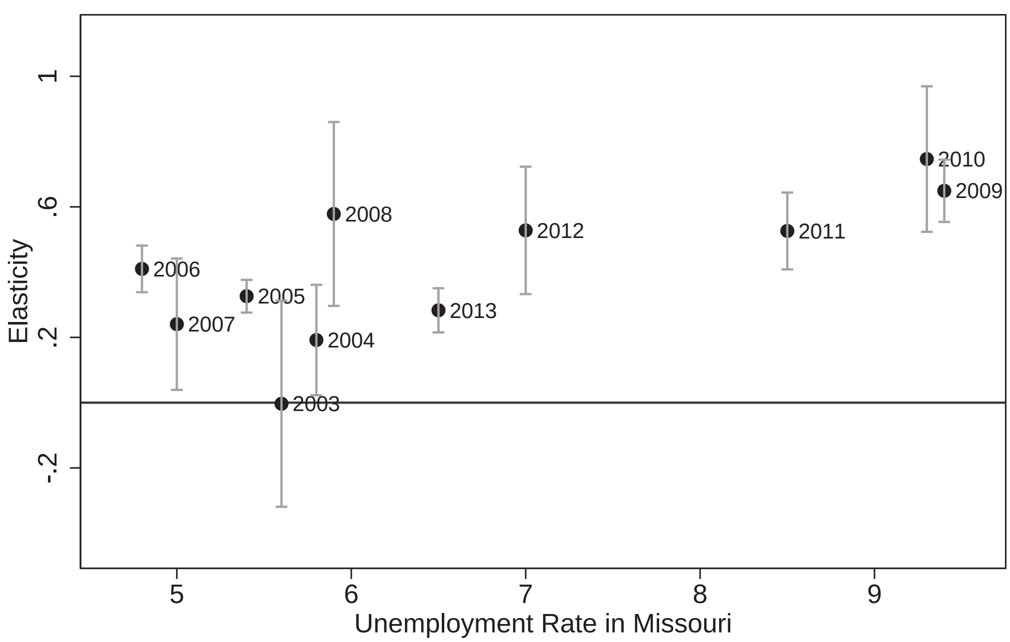
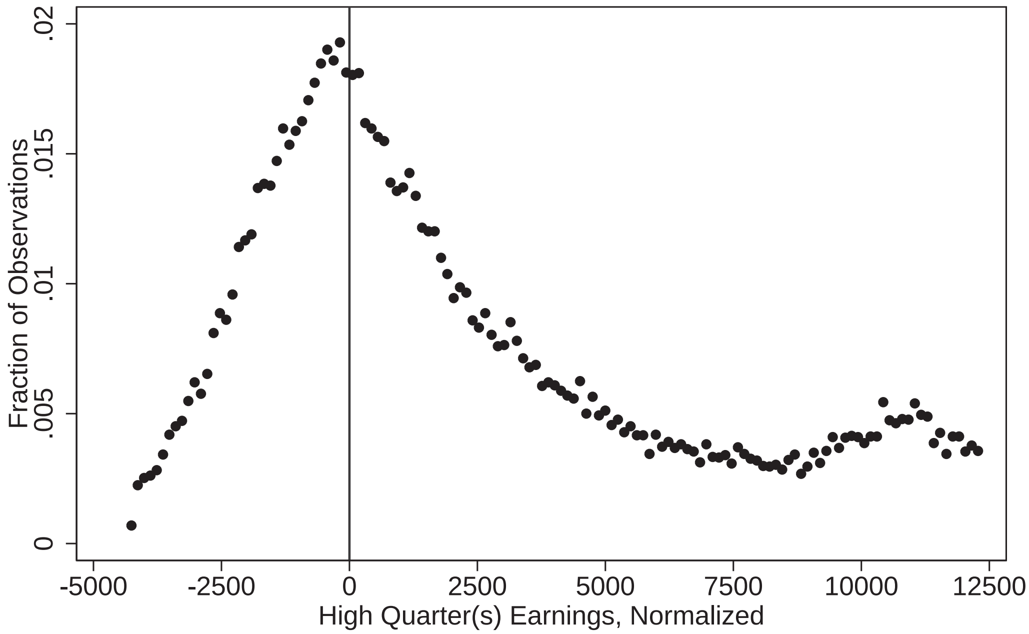


Table 1: Estimated Elasticities from Fuzzy Regression Kink Design

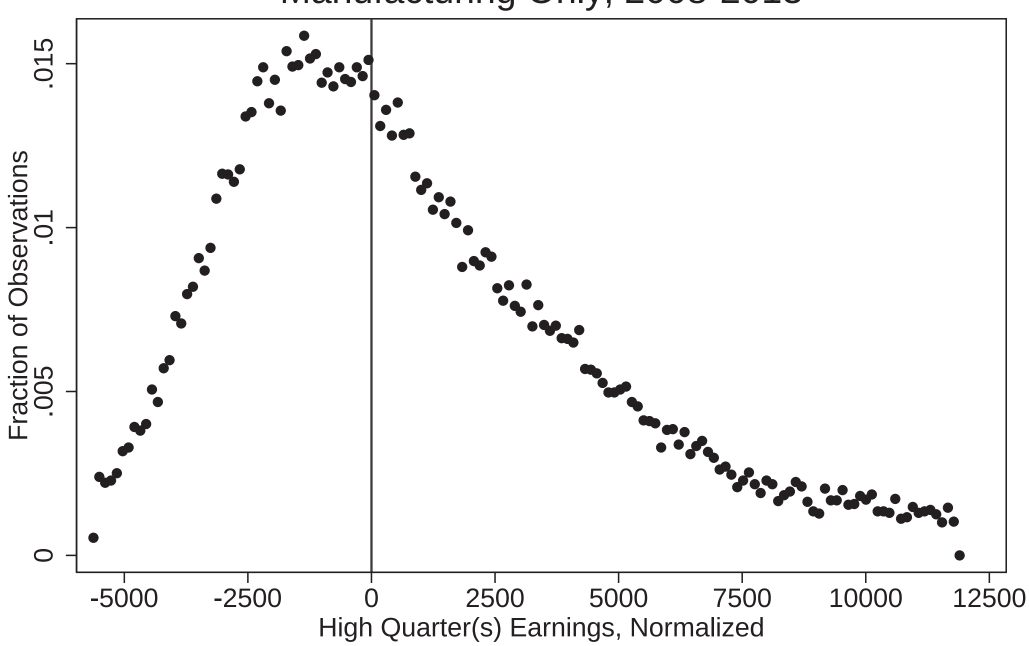
	Local Linear Models				Local Quadratic Models			
	Fuzzy IK Bandwidth		FG Bandwidth		Fuzzy IK Bandwidth		FG Bandwidth	
	Bandwidth (1)	Estimated Elasticity (std. error) (2)	Bandwidth (3)	Estimated Elasticity (std. error) (4)	Bandwidth (5)	Estimated Elasticity (std. error) (6)	Bandwidth (7)	Estimated Elasticity (std. error) (8)
A. 2003-2007 Sample:								
Log Initial UI Duration	2224	0.373	2481	0.356	2480	0.268	5121	0.506
		(0.049)		(0.041)		(0.213)		(0.102)
Log Total Weeks Claimed	1602	0.206	2797	0.305	1929	-0.145	4319	0.365
		(0.073)		(0.029)		(0.258)		(0.102)
Log Cens. Initial UI Duration	2039	0.392	2551	0.363	2187	0.082	4968	0.531
		(0.057)		(0.039)		(0.250)		(0.104)
Log Cens. Tot. Weeks Claimed	1555	0.210	2799	0.316	2022	-0.108	4090	0.381
		(0.073)		(0.028)		(0.231)		(0.100)
Log New Wage - Log Old Wage	1292	-0.122	1225	-0.218	2044	-0.272	3635	0.301
		(0.110)		(0.119)		(0.258)		(0.125)
B. 2008-2013 Sample:								
Log Initial UI Duration	1187	0.882	2313	0.684	2323	1.171	4746	0.579
		(0.200)		(0.067)		(0.326)		(0.138)
Log Total Weeks Claimed	1184	0.811	2526	0.514	2289	0.821	4706	0.379
		(0.184)		(0.053)		(0.305)		(0.128)
Log Cens. Initial UI Duration	1140	0.638	2168	0.489	2292	0.852	4995	0.362
		(0.164)		(0.058)		(0.257)		(0.104)
Log Cens. Tot. Weeks Claimed	1355	0.482	2328	0.345	2388	0.655	4819	0.186
		(0.105)		(0.043)		(0.204)		(0.090)
Log New Wage - Log Old Wage	1202	0.128	1508	-0.022	1742	0.405	4304	0.260
		(0.175)		(0.122)		(0.447)		(0.136)

Notes: Standard errors in parentheses. Point estimates and standard errors are obtained from 2SLS regressions described in Card et al (2012).

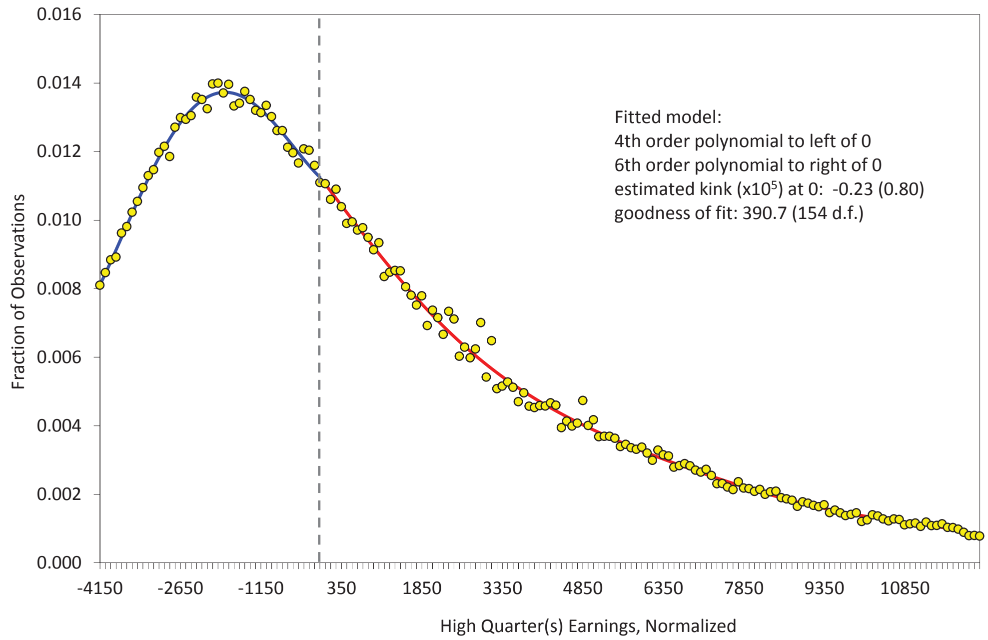
Appendix Figure 1a: Histogram of High Quarter Earnings
Manufacturing Only, 2003-2007



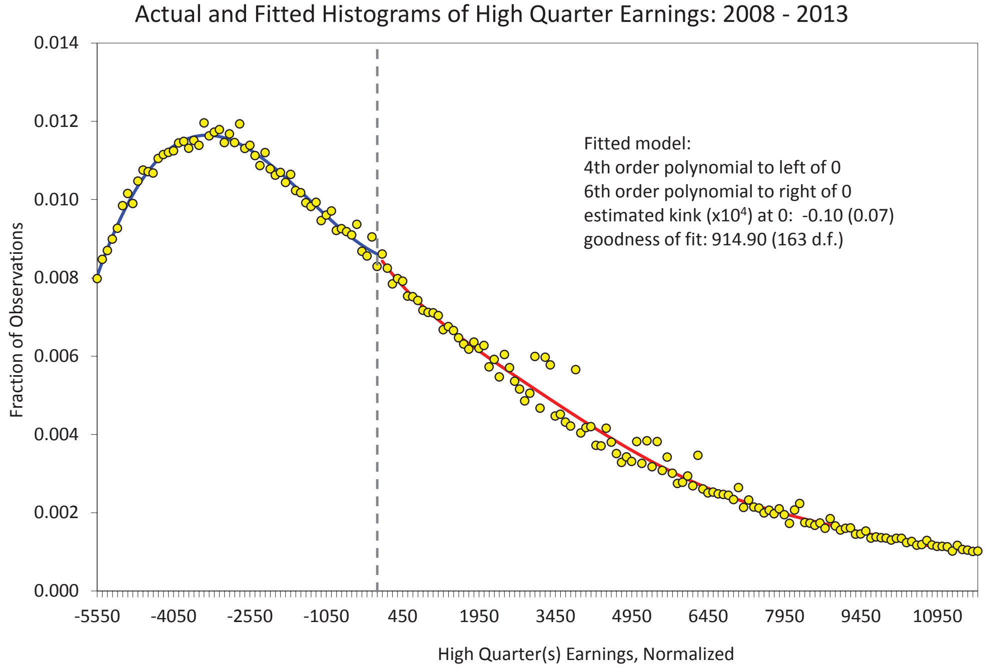
Appendix Figure 1b: Histogram of High Quarter Earnings
Manufacturing Only, 2008-2013



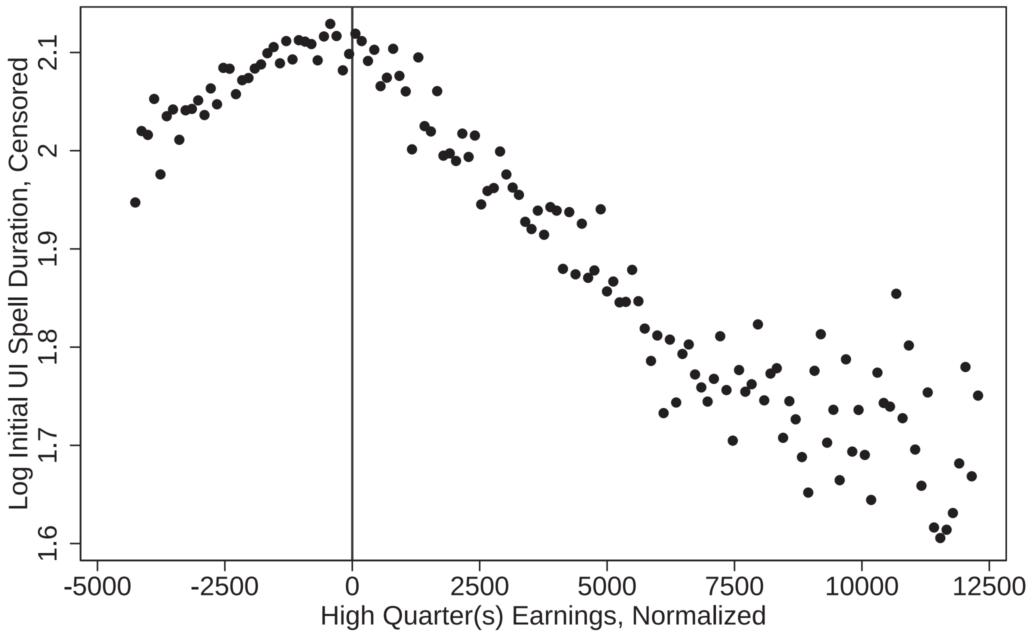
Appendix Figure 2a:
Actual and Fitted Histograms of High Quarter Earnings: 2003 - 2007



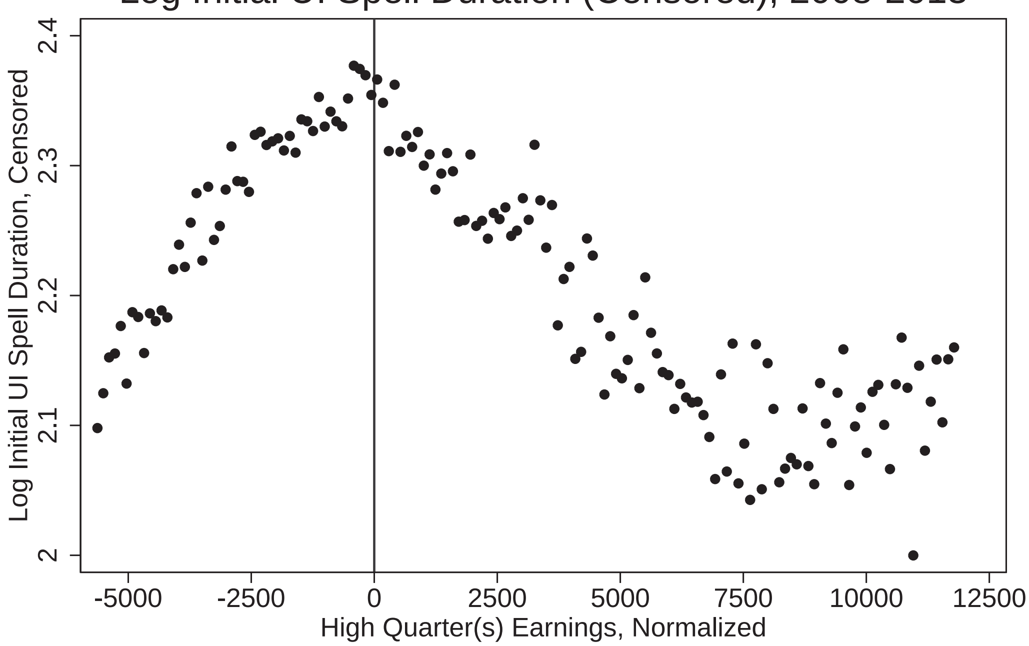
Appendix Figure 2b:
Actual and Fitted Histograms of High Quarter Earnings: 2008 - 2013



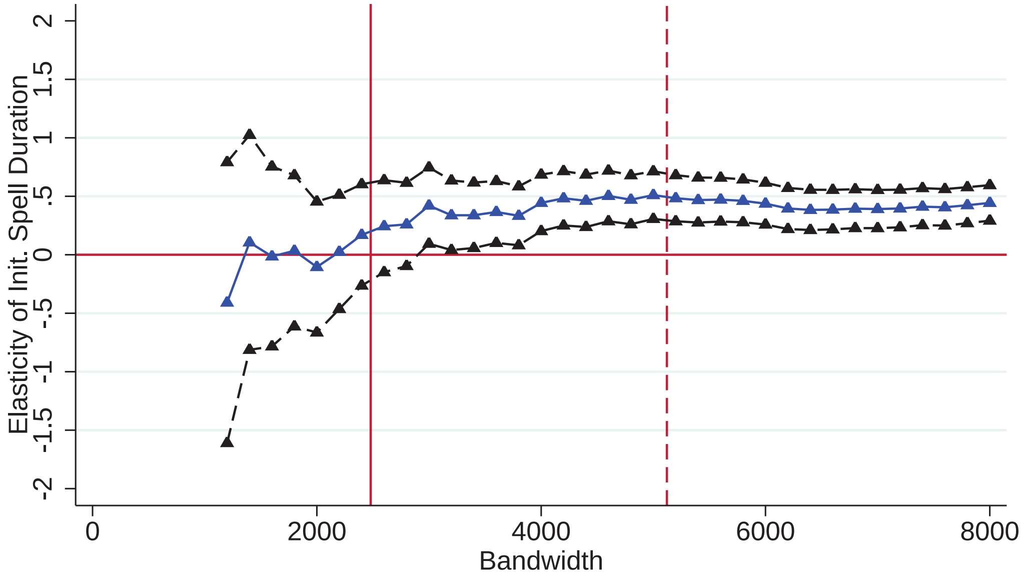
Appendix Figure 3a:
Log Initial UI Spell Duration (Censored), 2003-2007



Appendix Figure 3b:
Log Initial UI Spell Duration (Censored), 2008-2013

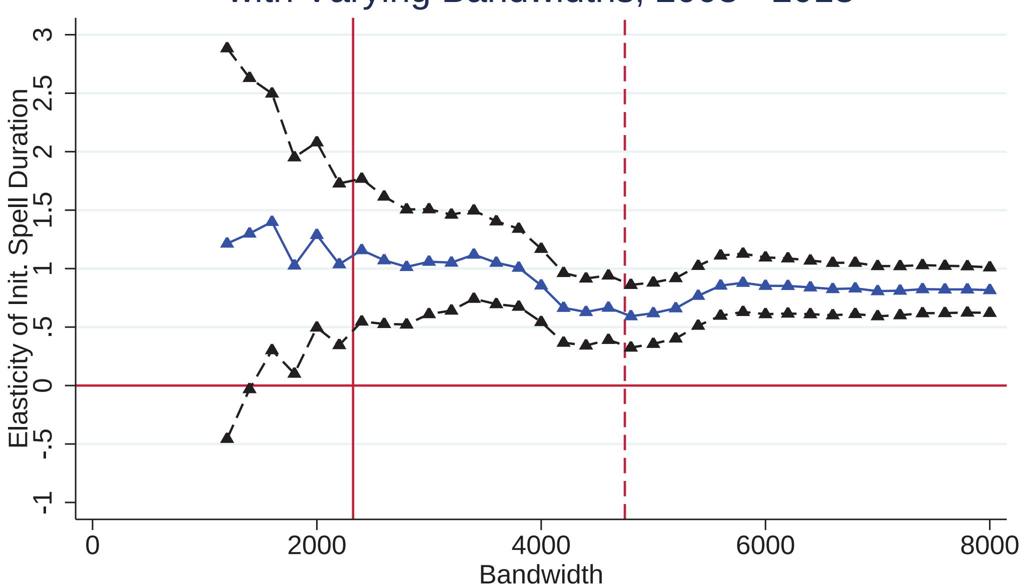


Appendix Figure 4a: Local Quadratic Fuzzy RK Estimates
with Varying Bandwidths, 2003 - 2007



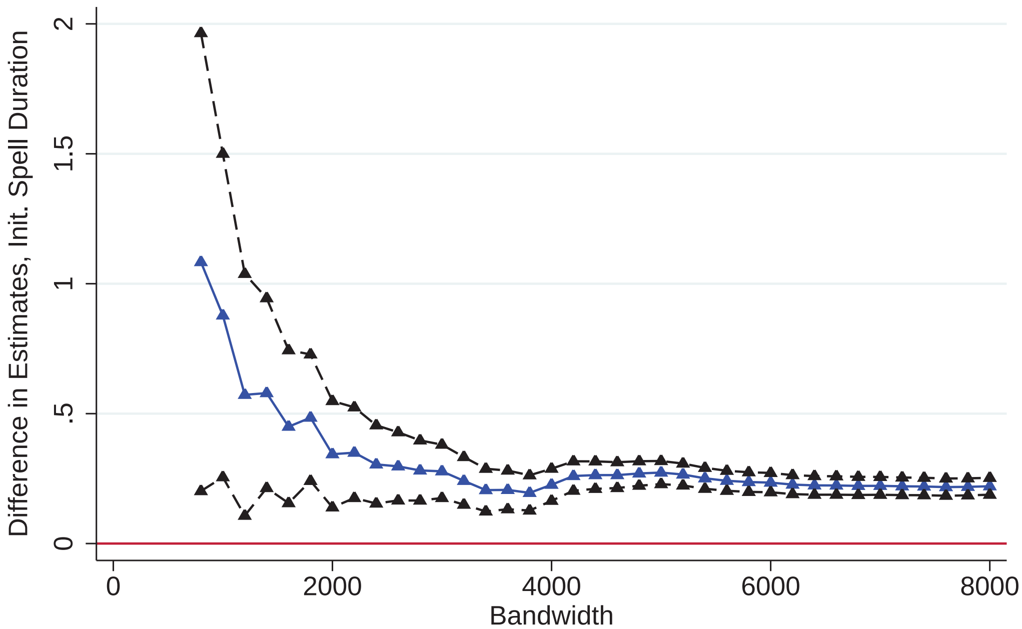
Fuzzy IK Bandwidth (Solid Vertical Line): Elasticity Estimate = 0.268 (s.e. = 0.213)
FG Bandwidth (Dashed Vertical Line): Elasticity Estimate = 0.506 (s.e. = 0.102)

Appendix Figure 4b: Local Quadratic Fuzzy RK Estimates
with Varying Bandwidths, 2008 - 2013

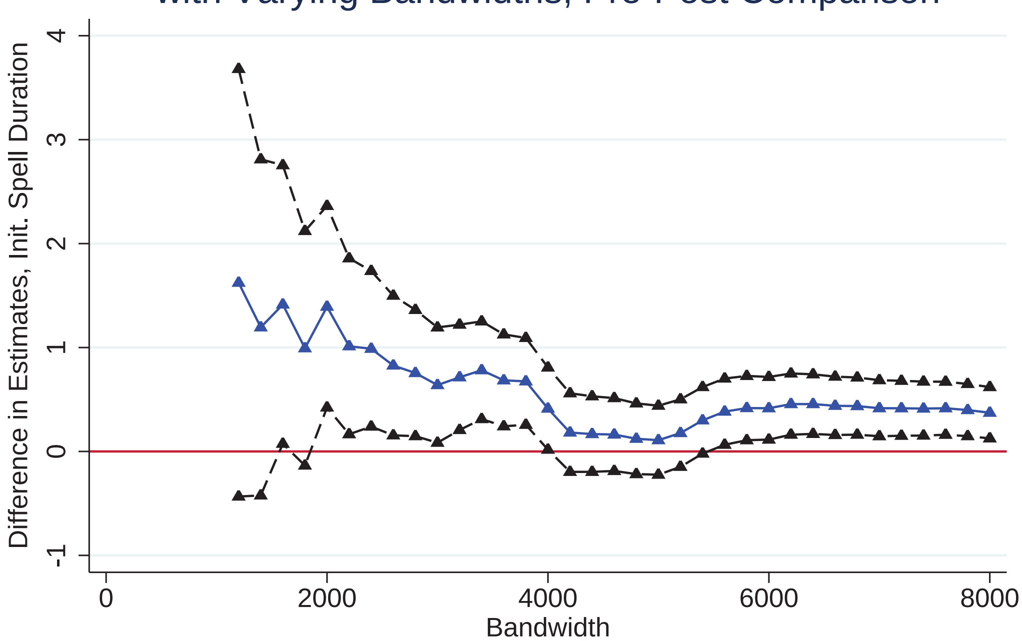


Fuzzy IK Bandwidth (Solid Vertical Line): Elasticity Estimate = 1.171 (s.e. = 0.326)
FG Bandwidth (Dashed Vertical Line): Elasticity Estimate = 0.579 (s.e. = 0.138)

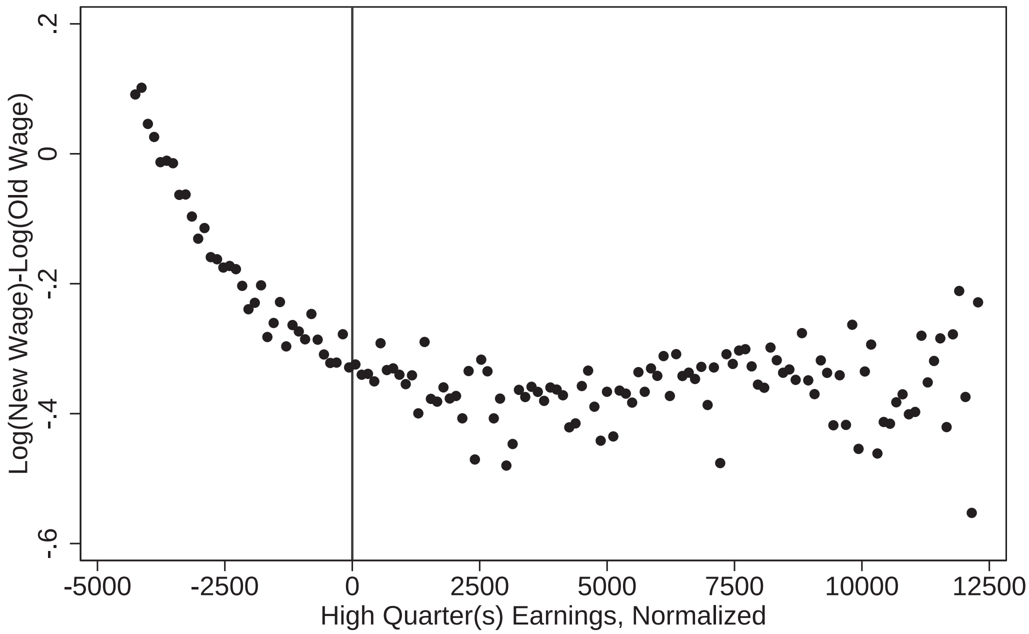
Appendix Figure 5a: Difference in Local Linear Estimates with Varying Bandwidths, Pre-Post Comparison



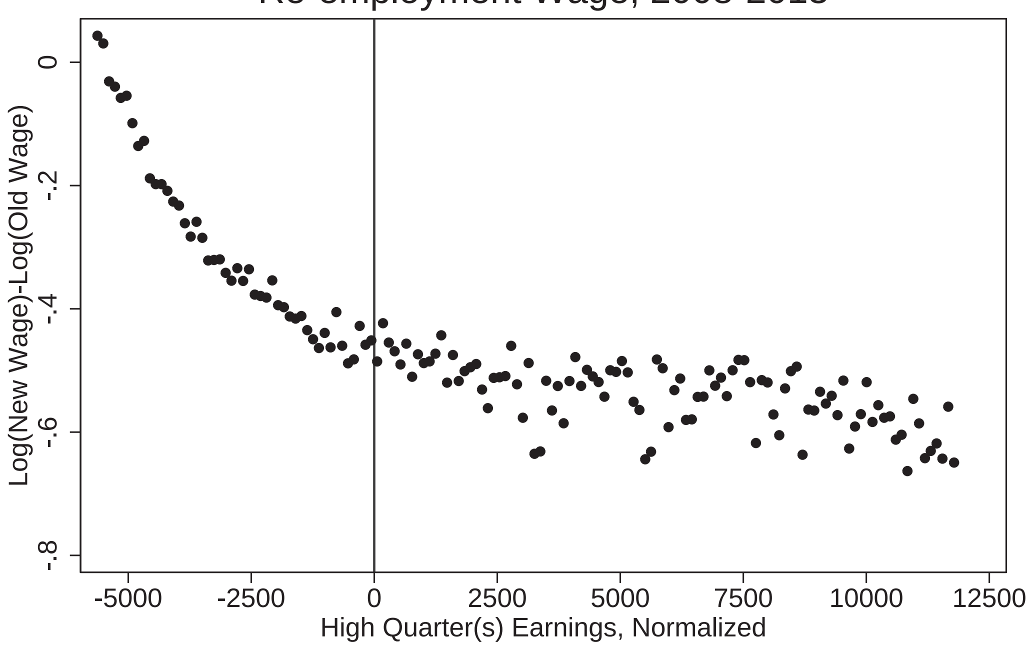
Appendix Figure 5b: Difference in Local Quadratic Estimates with Varying Bandwidths, Pre-Post Comparison

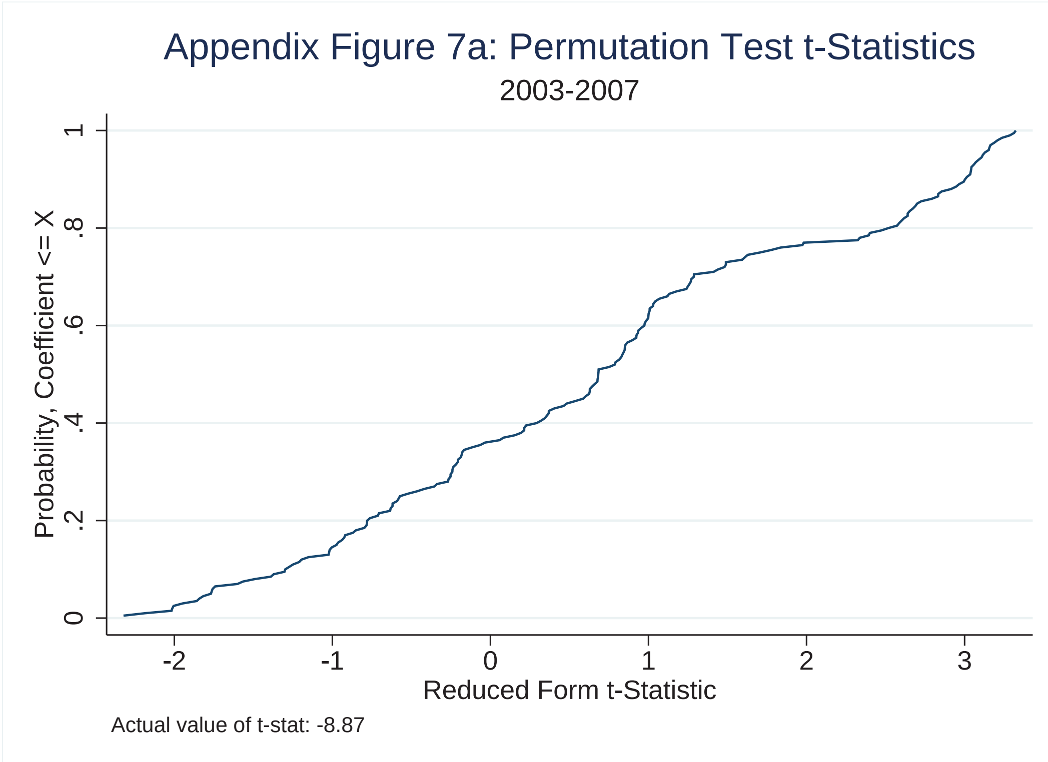


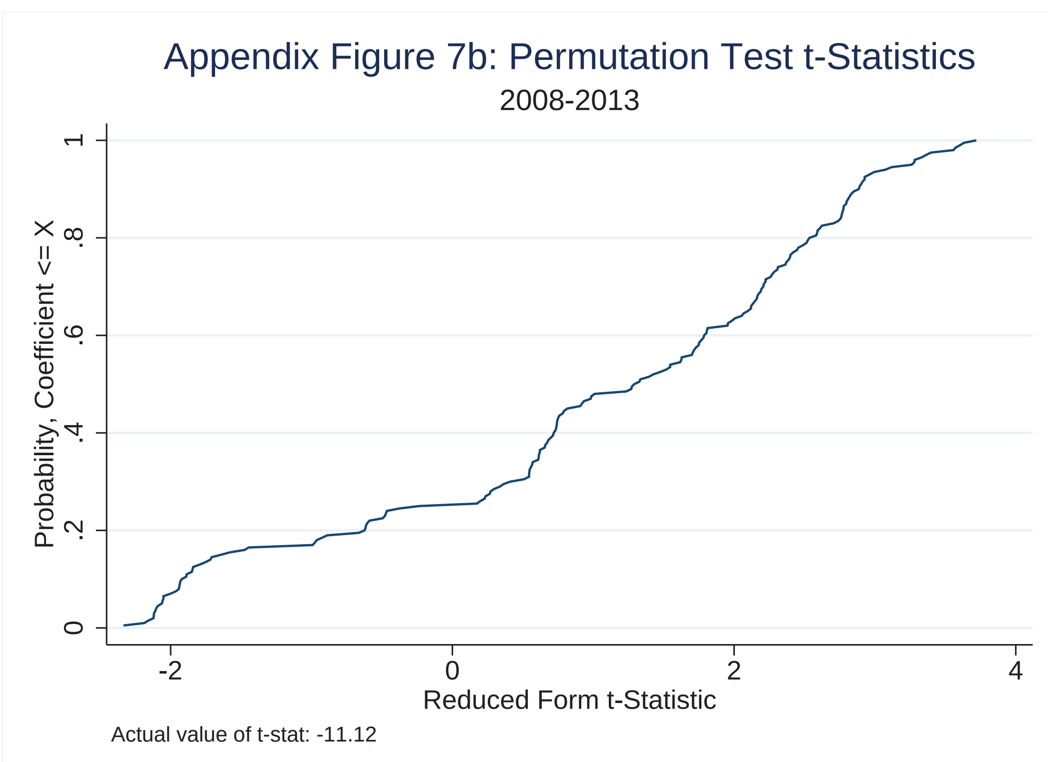
Appendix Figure 6a:
Re-employment Wage, 2003-2007



Appendix Figure 6b:
Re-employment Wage, 2008-2013




Appendix Figure 7a: Permutation Test t-Statistics
2003-2007
Probability, Coefficient <= X
0
.2
.4
.6
.8
1
-2
-1
0
1
2
3
Reduced Form t-Statistic
Actual value of t-stat: -8.87


Appendix Figure 7b: Permutation Test t-Statistics
2008-2013
Probability, Coefficient <= X
0
.2
.4
.6
.8
1
-2
0
2
4
Reduced Form t-Statistic
Actual value of t-stat: -11.12

Appendix Table 1: Estimates of Benefit Elasticity (Fuzzy RK), Alternative Estimators and Bandwidths

	2003-2007				2008-2013			
	Local Linear		Local Quadratic		Local Linear		Local Quadratic	
	Init. Spell	Init. Spell Cens.	Init. Spell	Init. Spell Cens.	Init. Spell	Init. Spell Cens.	Init. Spell	Init. Spell Cens.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Default CCT (with regularization)								
Main Bandwidth (Pilot)	958 (2197)	997 (2155)	1616 (2608)	1572 (2572)	976 (2086)	904 (2046)	1901 (3000)	1853 (2937)
Estimated Kink	0.189	0.187	0.144	0.084	1.016	0.740	1.056	0.669
(conventional std error)	(0.192)	(0.179)	(0.385)	(0.399)	(0.272)	(0.236)	(0.435)	(0.349)
Bias-corrected Estimate	0.048	0.086	0.022	-0.070	1.260	0.978	1.113	0.727
[robust conf. interval]	[-0.47,0.56]	[-0.42,0.59]	[-0.99,1.03]	[-1.10,0.96]	[0.48,2.04]	[0.34,1.61]	[-0.05,2.28]	[-0.20,1.66]
CCT with no regularization								
Main Bandwidth (Pilot)	1681 (2572)	1760 (2506)	2414 (3352)	3338 (3611)	1667 (3101)	1638 (2654)	4050 (3636)	3658 (3238)
Estimated Kink	0.286	0.319	0.288	0.407	0.772	0.511	0.813	0.740
(conventional std error)	(0.078)	(0.072)	(0.221)	(0.144)	(0.116)	(0.092)	(0.158)	(0.138)
Bias-corrected Estimate	0.246	0.291	0.114	0.241	1.010	0.681	0.859	0.635
[robust conf. interval]	[-0.09,0.58]	[-0.05,0.63]	[-0.58,0.81]	[-0.39,0.87]	[0.63,1.39]	[0.32,1.04]	[-0.20,1.92]	[-0.32,1.59]
Fuzzy CCT (no regularization)								
Main Bandwidth (Pilot)	1965 (2470)	1687 (2747)	2847 (3597)	2967 (4562)	1325 (3001)	2287 (4825)	3269 (3418)	2833 (3042)
Estimated Kink	0.345	0.296	0.217	0.395	0.939	0.477	1.093	0.745
(conventional std error)	(0.061)	(0.077)	(0.177)	(0.168)	(0.168)	(0.053)	(0.203)	(0.191)
Bias-corrected Estimate	0.305	0.226	0.080	0.233	1.123	0.466	0.956	0.889
[robust conf. interval]	[-0.04,0.65]	[-0.08,0.53]	[-0.55,0.71]	[-0.26,0.72]	[0.67,1.58]	[0.31,0.62]	[0.02,1.89]	[0.04,1.74]
Fuzzy IK (no regularization)								
Main Bandwidth (Pilot)	2224 (2171)	2039 (1934)	2480 (2764)	2187 (2668)	1187 (2034)	1140 (2007)	2323 (3069)	2292 (3550)
Estimated Kink	0.373	0.392	0.268	0.082	0.882	0.638	1.171	0.852
(conventional std error)	(0.049)	(0.057)	(0.213)	(0.250)	(0.200)	(0.164)	(0.326)	(0.257)
Bias-corrected Estimate	0.133	0.189	0.019	0.021	1.284	0.899	1.085	0.957
[robust conf. interval]	[-0.27,0.54]	[-0.31,0.69]	[-0.88,0.92]	[-0.91,0.95]	[0.55,2.02]	[0.32,1.48]	[0.01,2.16]	[0.25,1.66]
FG								
Main Bandwidth (Pilot)	2481 (4638)	2551 (4499)	5121 (11061)	4968 (10241)	2313 (4299)	2168 (4524)	4746 (10911)	4995 (15430)
Estimated Kink	0.356	0.363	0.506	0.531	0.684	0.489	0.579	0.362
(conventional std error)	(0.041)	(0.039)	(0.102)	(0.104)	(0.067)	(0.058)	(0.138)	(0.104)
Bias-corrected Estimate	0.428	0.435	0.018	0.062	0.704	0.515	0.216	0.108
[robust conf. interval]	[0.28,0.58]	[0.29,0.58]	[-0.37,0.41]	[-0.33,0.46]	[0.48,0.93]	[0.34,0.69]	[-0.19,0.62]	[-0.21,0.43]

Notes: Conventional point estimates and standard errors are obtained from 2SLS regressions described in Card et al (2012). The default CCT bandwidth, CCT with no regularization and the Robust CI's are obtained by a variant of the Stata package described in Calonico et al (in press). The fuzzy CCT and fuzzy IK bandwidths are authors' calculations.

Appendix Table 2: Estimated Kink in Covariate Index, Alternative Estimators and Bandwidths

	2003-2007		2008-2013	
	Local Linear (Coef x 10^6)	Local Quadratic (Coef x 10^6)	Local Linear (Coef x 10^6)	Local Quadratic (Coef x 10^6)
	(1)	(2)	(3)	(4)
Default CCT (with regularization)				
Main Bandwidth (Pilot)	825 (1665)	1437 (2311)	994 (1975)	1503 (2747)
Estimated Kink	0.444	-0.293	-1.730	-1.411
(conventional std error)	(1.014)	(1.777)	(0.871)	(1.866)
Bias-corrected Estimate	0.765	0.270	-1.859	-2.851
[robust conf. interval]	[-2.29,3.82]	[-4.40,4.94]	[-4.52,0.80]	[-7.24,1.54]
CCT with no regularization				
Main Bandwidth (Pilot)	1550 (2178)	3640 (2657)	1254 (2137)	1595 (2792)
Estimated Kink	-0.242	-0.338	-0.608	-2.106
(conventional std error)	(0.399)	(0.459)	(0.612)	(1.710)
Bias-corrected Estimate	0.263	-0.458	-1.387	-3.661
[robust conf. interval]	[-1.64,2.17]	[-6.38,5.46]	[-3.64,0.87]	[-7.81,0.49]
FG				
Main Bandwidth (Pilot)	4522 (7552)	8338 (7933)	1792 (5924)	6541 (9080)
Estimated Kink	-0.343	-0.907	-1.324	-0.586
(conventional std error)	(0.093)	(0.250)	(0.360)	(0.243)
Bias-corrected Estimate	-0.659	0.149	-1.010	0.925
[robust conf. interval]	[-1.19,-0.12]	[-1.16,1.46]	[-1.81,-0.21]	[-0.07,1.92]

Notes: Conventional point estimates and standard errors are obtained from regressions described in Card et al (2012). All estimates, standard errors, and CI's are multiplied by 10^6. The default CCT bandwidth, CCT with no regularization and the Robust CI's are obtained by a variant of the Stata package described in Calonico et al (in press).