The Effect of the Social Security Earnings Test on the Earnings Distribution and Hours of Work

by
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Abstract:
In this paper, I analyze the effect of the Social Security earnings test on the labor supply of working Social Security beneficiaries, by focusing on the last two changes enacted in 1983 and 2000. These changes eliminated the earnings test entirely for individuals of age 70-71 in 1983 and of normal retirement age and older in 2000, so working beneficiaries after attaining the specified age in the law became entitled to the full amount of their Social Security benefits regardless of their wages and salaries earned. Statistical comparison of earnings distributions of the affected and unaffected groups before and after the change allows the response in earnings patterns to the alteration of the earnings test parameters rather than to other trends in labor supply. In this paper, I revisit Friedberg (2000) and extend her analysis to include women and the most recent law change enacted in 2000. Analysis of the earnings distributions, utilizing March Current Population Surveys on 62-75 year old individuals for periods of three years before and after the specified changes, indicates substantial and statistically significant clustering of working beneficiaries, both women and men, just below the exempt amount. In addition to graphical and statistical analysis of the raw data, I estimate a structural labor supply model by implementing a maximum likelihood method for piecewise-linear budget constraints. The estimation of the model yields rather large estimates of wage and income elasticities (0.371 and -0.436, respectively), which suggest high sensitivity of the hours supplied by workers to the changes in the parameters of the earnings test. Even though the earnings test is currently applicable only to the beneficiaries of age 62-66, popular attention to the earnings test will be reinforced as more baby boomers start reaching age 62, greatly increasing the number of workers affected by the earnings test. Also, the earnings test will grow more binding, as normal retirement age rises to 67.

I. Introduction

In this paper, I analyze the effect of the Social Security earnings test on labor supply of working Social Security beneficiaries. The focus of this study is on two changes to the earnings test rules, which took place in 1983 and 2000. These changes eliminated the earnings test entirely for individuals of age 70-71 in 1983 and of normal retirement age and older in 2000, so working beneficiaries after attaining the specified age in the law became entitled to the full amount of their Social Security benefits regardless of their wages and salaries earned. The gradual liberalization of the earnings test happening over the past several decades reflects popular perception of it as a penalty for working. Despite ongoing disputes around reformation of the structure of the earnings test, this topic has received little academic attention in recent years. Moreover, previous research draws mixed conclusions regarding the direction and degree of the impact of the earnings test and its alterations on labor supply. In this paper, I revisit Friedberg (2000) and extend her analysis to include the most recent change enacted in 2000. Before 1983, the earnings test reduced receipts of beneficiaries aged 62-71 by $1 for every $2 earned in wages in excess of the specified exempt amount (a 50% test tax rate). From 1983 until the 2000 change, the earnings test tax rate for the affected group was equivalent to a 33% tax rate on earnings above the threshold. Therefore, both eliminations of the earnings limit are substantial changes to the law that affected only one age category. Thus, the response of the affected group to the change of the earnings test rule can be analyzed, by comparing earnings distributions of the affected and unaffected groups before and after the change took place. Such comparison across groups allows me to isolate the response in earnings patterns to the change of the earnings test parameters rather than to other trends in labor supply. Analysis of the earnings distributions shows substantial and statistically significant responsiveness of elderly workers to the exempt amount defined by the earnings test rules. In addition to graphical and statistical analysis of the raw data, I estimate parameters of a labor supply model, by implementing a maximum likelihood method for piecewise-linear budget constraints. The estimation of the structural labor supply model yields rather large estimates of wage and income elasticities (0.371 and -0.436, respectively), which suggest high sensitivity of the hours supplied by workers to the changes in the parameters of the earnings test.

Also, the natural experiment analysis is extended to examine the effect of the Social Security earnings test on the labor supply decisions of women. Previous work in this area is generally concentrated on men, even though the employment share of women among older workers has grown substantially. As Gruber and Orszag (2000) pointed out, in 1970, 42 percent of all fully insured workers were women, and this number reached 47 by 1998.

This paper is organized as follows. Section II discusses the earnings test rules and major changes in them. Section III presents a brief overview of the literature. Theoretical specification and discussion of the descriptive and quantitative results are presented in Section IV. Section V concentrates on theoretical and empirical formulation of the structural approach to labor supply estimation as well as discussion of its findings. Section VI concludes this study.

II. Background on the Earnings Test

Currently, the Social Security earnings test applies to people below the normal retirement age who have claimed their Social Security benefits and earn wages and salaries in excess of an exempt amount.[1] In 2000, the Social Security Administration took $1 in benefits for every $2 in wages and salaries earned above the exempt amount of $10,080, which is equivalent to a 50% earnings test tax rate. Hence, the Social Security earnings test yields a high marginal tax rate that creates disincentives to work over a threshold number of hours. The earnings threshold applies only to wage and salary earnings, but not to pensions, dividends, or other non-labor income. Also, the exempt earnings amount is adjusted annually for average wage growth and was $9,120 in 1998, $9,600 in 1999 and $10,680 in 2000 for ages 62-64, and $13,500 in 1998, $14,500 in 1999, and $15,500 in 1999 for ages 65-71. Since the introduction of the earnings test in 1939, it has undergone major changes, as the underlying intent behind the Social Security earnings test shifted from pushing older workers out of the labor force towards encouraging later retirement. The earnings test evolved from withholding an entire month's benefits from 62-71 year olds with monthly earnings above $15 to a 50% earnings test tax rate for 62-64 year old beneficiaries earning wages above the exempt amount. Liberalization of the earnings test has been gradually implemented since the 1950s through easing the implicit tax on wages and raising the exempt amount on earnings mostly for those above the normal retirement age. First, in 1951, beneficiaries aged 75 or older ware exempted, and in 1955, the earnings test was reduced to beneficiaries aged 71 or younger. The parameters of the earnings test were uniform for all applicable ages until 1978, when a substantial rise in the threshold was enacted for those at or above 65. Since 1996, the exempt amount was scheduled gradually to increase in real terms for the same age category. In 1990, the implicit tax rate on earnings was also liberalized as well for beneficiaries aged above the normal retirement age, by reducing it from 50% to 33%. Also, among major recent changes are exempting from the test beneficiaries aged 70-71 in 1983 and aged at or above the normal retirement age in 2000. These last two changes are at the focus of this paper since they generate

[1] Higher exempt amount applies in the year of attaining normal retirement age.

significant variation in the net real wage and non-labor income needed to estimate parameters of a labor supply model.

The Social Security benefit reduction scheduled in the earnings test is paid back in the form of a future benefit increase. Such future benefit adjustment functions similarly to the delayed benefits claiming and is also intended to be actuarially fair. Even though subjects to the earnings test are rewarded with higher benefits in the future, the reduction of benefits today is seen by most recipients as pure taxation. As pointed in Gruber and Orszag (2000), this is a result of misinformation about the structure of the earnings test. Most tax guides, among which is *J.K. Lasser's Your Income Tax 1998*, do not mention the actuarial adjustment nor Delayed retirement credit in their discussion of the earnings test. Therefore, in this analysis of the effect of the earnings test, withholding of benefits is considered as a pure tax on earnings without subsequent adjustment.

III. Literature Review

The gradual liberalization of the earnings test happening over the past several decades reflects popular perception of it as a penalty for working. Despite ongoing disputes around reformation of the structure of the earnings test, this topic has received little academic attention in recent years. Moreover, previous research draws mixed conclusions regarding the direction and degree of the impact of the earnings test and its alterations on labor supply. One of the recent studies conducted on this subject is Friedberg (2000), which is revisited in this paper. Friedberg analyzes the effect of the Social Security earnings test on labor supply of working Social Security beneficiaries, by focusing on the 1978, 1983, and 1990 changes in the earnings test legislation. These changes altered the exempt amount or the earnings test tax rate for the beneficiaries of a particular age category and not for the other age groups. Friedberg exploits such selective changes in the earnings test rules in her analysis, by using March Current Population Surveys on 62-75 year old men for periods of three years before and after the specified changes. Her results for the period of 1975-77 demonstrate substantial clustering of working beneficiaries just below the earnings threshold, 8.1% of the sample for the 62-64 year olds and 9.6% of the sample for the 67-69 year olds fall into $2,000 interval below the kink versus 3.8% and 2.5% of the sample for the 62-64 year olds and the 67-69 year olds, respectively, belong to $2,000 interval above the kink. Hence, these findings demonstrate a visible reaction to the Social Security earnings test, and they are further supported by adjustments that took place after the 25 % increase in the exempt amount for the 65-71 year olds (in 1978) and elimination of the earnings test for 70-71 year olds (in 1983). She also conducts a quantitative analysis of the earnings patterns and concludes that the clustering behavior of working beneficiaries just below the exempt amount is statistically significant. Furthermore, Friedberg exploits the rule changes to estimate labor supply elasticities, by using a maximum likelihood estimation method to estimate the labor supply model with the piecewise budget constraint generated by the earnings test rules. Her results show relatively high income and substitution elasticities, which imply substantial deadweight loss from the earnings test. Also, she conducts policy simulations, such as elimination of the earnings test for 65-69 year olds, resulting in 5.3 percent increase in the hours of work for affected workers, or raising their exempt amount to $30,000, resulting in reduction of total hour of work.

In addition to findings reported in Friedberg (2000), there are a number of previous studies emphasizing the clustering effect of the earnings test on the earnings patterns. Among papers that found support for the bunching at the convex kink created by the earnings test are Burtless and Moffitt (1984), Vroman (1985), and Lingg (1986).

Burtless and Moffitt (1984) also estimated a model of the joint choice of retirement age and postretirement hours of work for 1969-77 years, by using maximum likelihood estimation techniques for piecewise-linear budget constraints. They found a statistically significant but relatively small wage elasticity on postretirement hours of work and a rather large income elasticity, but concluded that the earnings test has a relatively small effect on postretirement hours of work, since the proportion of the population affected is small. Moreover, Burtless and Moffitt (1984) simulated elimination of the earnings test and found little effect on hours worked.

Also, Gruber and Orszag (2000) analyzed the 1974-99 March CPS data to examine the effect of the changes in the earnings test, which took place during the considered years. Their graphical and regression analysis found no significant impact of these changes in the earnings test rules on aggregate employment, hours of work, or earnings for men.

IV. Earnings Distributions and the Earnings Test

Theoretical Model

If a Social Security beneficiary is subject to the Social Security Earnings Test, then the recipient faces a piecewise budget constraint with one convex kink corresponding to the exempt amount and one concave kink corresponding to the exhaustion of the benefit. This form of the budget constraint for a static model without savings is given by:

$$C = wH + Y + Y_{ss} \qquad \text{if} \qquad 0 \leq wH < E^*$$

$$C = wH + Y + Y_{ss} - \tau^s(wH - E^*) \qquad \text{if} \qquad E^* < wH < E`$$

$$C = wH + Y \qquad \text{if} \qquad E` < wH$$

where C is consumption, Y_{ss} is the SS benefit, Y is non-labor income, w is the gross wage, τ^s is the earnings test tax rate, H is hours of work, E* is the earnings test exempt amount, and E` is the level of earnings at which the entire benefit has been taxed away (E` = E*+Y_{ss} / τ). The point of interest of the "bunching" analysis is the behavior of working beneficieriaries at a convex kink, where labor income is just at the exempt amount (E* = wH_1). At a convex kink on the budget constraint, a Social Security beneficiary faces distinct net wage rates for hours worked slightly more and less than H_1. Working individuals are expected to mass at a kink point since choosing hours on the kink corresponds to a range of indifference curve slopes. If the Social Security earnings test influences the labor supply choices of the elderly, we will detect their response to the exempt amount in the raw data.

Sample Definition

The quantitative and graphical analysis of the earnings patterns is conducted employing data from the March Current Population Surveys for the three years before and after the1983 abolition of the earnings test for 70-71 year olds and the 2000 change that eliminated the earnings test for 65-69 year olds. The years when the changes were enacted are omitted from the analysis to allow a year for labor force adjustments to take place.[2] Table 1 presents descriptive statistics on older men belonging to one of the three age categories for three years before and after 1983: 67-69, 71-72, and 73-75 year olds. Table 1 also includes summary statistics on men aged 63-64, 67-69, and 72-74 three years before and after 2000.

Age groups are narrowed compared to the age categories specified in the law since the March CPS reports age at the survey date rather than exact birthday. For instance, 62 year olds as well as 66 year olds are excluded from the 2000 analysis, since these are demographic characteristics relevant for the survey date, whereas employment information the March supplement used in this study is on the previous year. Therefore, individuals who are 62 or 66 (lower boundaries of two age groups) at the survey date could be 61 and 65 for the most part of the previous year and even 60 and 64 for some part of the previous year.[3] Labor income is defined as annual earnings including wages, salaries and self-employment income.Table 1 summarizes the annual employment rate for the elderly, and demonstrates the expected decline in employment rates with age. It also shows a tendency for earned income to decline with age as well.

[2] In the case of the 1983 rule change, 1982 is also excluded from the analysis since the change was scheduled to take place in 1982, but was postponed by one year (Friedberg (2000)).

[3] Also, 65 year olds as well as 70 year olds (upper boundaries of two groups) are omitted from 62-64 age group and 65-69 age group, respectively, since these individuals could be 65 years old and 70 years old for the most part of the previous year and 64 years old and 69 years old only for some part of the previous year.

Table 1	*Summary Statistics*							
	1980-81		1984-86		1997-99		2001-03	
	all	working	all	working	all	working	all	working
No. observations	7,030	1,954	10,530	2,523	8,780	2,467	11,206	3,348
Number aged:								
63-64	3,111	1,084	4,689	1,426	2,347	1,102	3,325	1,583
67-69	1,669	404	2,598	520	3,435	887	4,179	1,151
72-74	2,250	466	3,243	577	2,998	478	3,702	614
Annual earnings	-	8,154	-	12,083	-	31955	-	32,755
By age group:								
63-64	-	9,404	-	13,362	-	37,608	-	44,299
67-69	-	8,106	-	11,043	-	28,552	-	35,646
72-74	-	4,995	-	9,804	-	25,309	-	27,721
Employment	0.267	-	0.235	-	0.28	-	0.29	-
By age group:								
63-64	0.342	-	0.296	-	0.47	-	0.47	-
67-69	0.224	-	0.192	-	0.26	-	0.27	-
72-74	0.191	-	0.177	-	0.16	-	0.16	-

Quantitative and Visual Analysis

Figures 1a-1d show the earnings distribution relative to the exempt amount aggregated over two years period before and three years after the 1983 change, which abolished the earnings test for working individuals aged 70-71. The earnings distributions are constructed in $1,000 intervals around the respective threshold amount for both affected and unaffected groups. The reactions to the changes in the exempt amount and the tax rate are traced by comparing the earnings distributions before and after the change for the affected group. To control for other time effects on the earnings outcomes of the Social Security beneficiaries, the distributions of earnings are compared across groups and over time to isolate changes unrelated to the one under consideration. Figures 1a and 1b present separately a comparison of earnings patterns of the affected group to each unaffected group before 1983. Figure 1a compares the proportion of the 71-72 year olds to the proportion of the 67-69 year olds with earnings in each $1000 interval above and below the convex kink, corresponding to the earnings test exempt amount. Before 1983, both 67-69 and 71-72 year olds faced the earnings test with the same implicit tax rate and exempt amount. The proportion of the individuals in each interval is defined relatively to the total number of the people in the respective age group. The earnings distribution of both age groups demonstrates strong clustering of workers at the exempt amount that is consistent with the findings presented in

Friedberg (2000). Being close for several intervals below the exempt amount, the proportion of individuals drops substantially above the exempt amount and this decline in the number of workers is more sizable for the younger group (almost 4 times fewer workers above the threshold as compared to immediately below). It also appears that labor market exhibit rigidities since there is a relatively high proportion of the working population are observed to have earnings in all four intervals below the test limit. Therefore, the consideration of only one interval below might potentially result in underestimation of the distorting effect of the earnings test on labor supply.

Figure 1a.

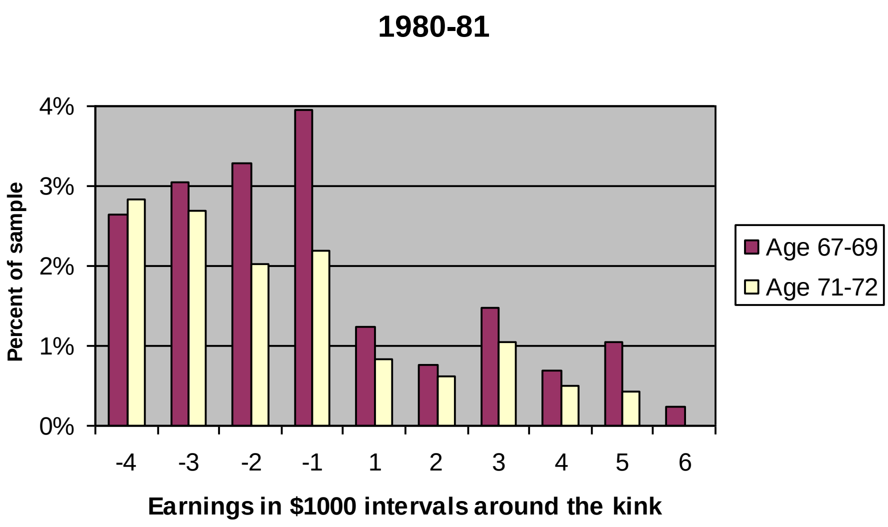


Figure 1b.

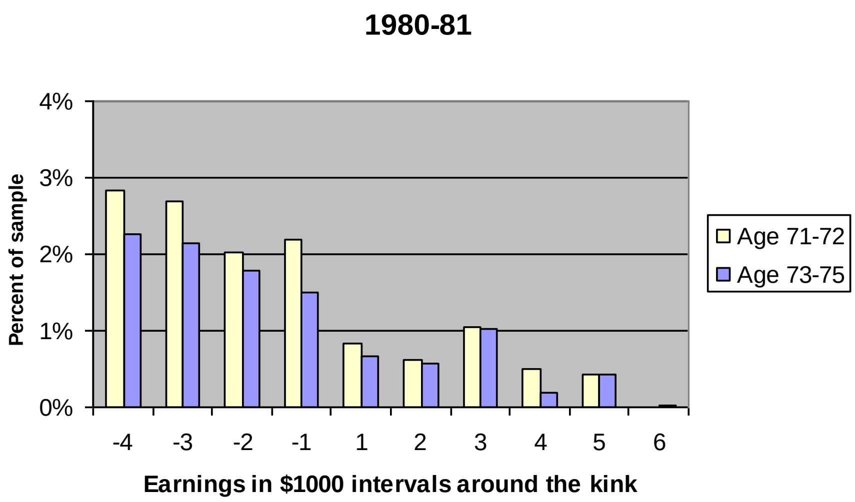


Figure 1b illustrates the earnings distributions of the 71-72 year-old men and the 73-75 year-old men relative to the exempt amount for the former before the change. The affected younger group comparing to the unaffected older group, who do not face the earnings test, demonstrates bunching at the kink. On the other hand, the earnings of the 73-75 year olds decline relatively smoothly over the presented range.

Figure 1c and 1d presents the same comparison of the earnings distributions after 1983. According to Figure 1c, the 67-69 year-old men continue to cluster at their earnings test exempt amount, whereas the earnings of the 71-72 year-old men, no longer affected by the law, exhibit downward trend without significant jumps. Also, comparison of the affected group to the 73-75 year olds demonstrate resemblance of the earnings patterns of the 67-69 year olds to the earnings of the unaffected older group that emphasizes the role of the earnings test in the bunching of aged 71-72 before its elimination. These findings show support for a significant impact of the earnings test rules and their changes on the labor supply behavior of the elderly.

Figure 1c.

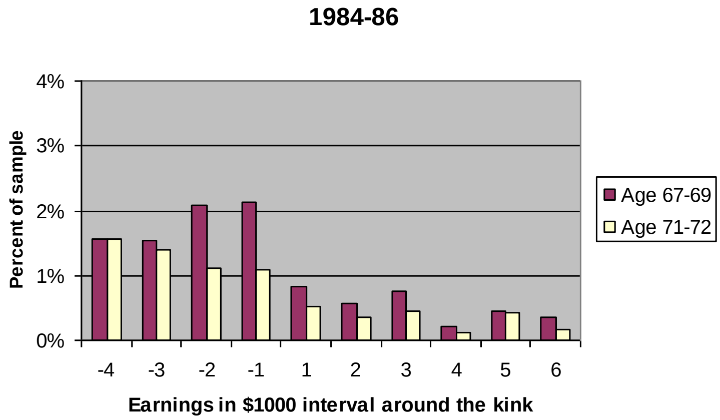


Figure 1d.

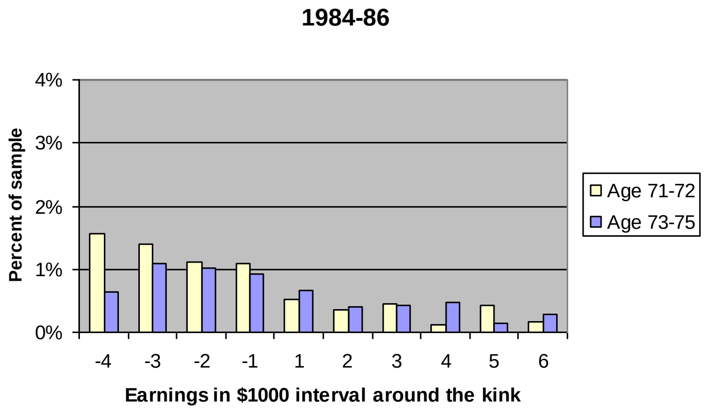


Table 2 reports aggregated earnings distributions for three age groups in $1,000 intervals around the exempt amount across the two years before and three after the 1983 change. The difference between the proportion of individuals in the earnings intervals just below and above the exempt amount is reported in the Table, as a measure of the clustering around the kink. The aggregated results demonstrate bunching below the kink of the 71-72 and 67-69 year olds for 1980-81 years: 2.2% of the affected group and 4.0% of the younger comparison group receive earned income in the $1000 interval just below the kink falling by almost 35% for both groups above the kink. The difference at the kink is reported to be statistically significant (standard error 0.005 for 71-72 year olds and standard error 0.006 for 67-69 year olds) and different from the behavior across any other intervals for both ages. After the earnings test is eliminated for 70-71 year-old men, the percentage of them earning in the $1000 interval below the kink falls to 1.1% with a substantially smaller difference between the proportion of people just below and above the exempt amount (0.6%). On the other hand, the proportion of the 67-69 year olds located just below the kink decreases as well, but this fall can be attributed to the noticeable downward trend in the percentage of people of all age groups with earnings in each interval analyzed here. Hence, the comparison of the two younger groups is somewhat inconclusive. The existence of the second comparison group as a control group for the aggregate trends is important in this case. Comparing the affected group to the 73-75 year-old men after the change shows the emerged resemblance of the earnings distribution of both groups. Hence, the visual and quantitative analysis demonstrates responsiveness of the labor supply behavior to the Social Security earnings test and to its changes.[4]

Table 2 also presents the percentage differences at the kink and their standard errors estimated in Friedberg (2000). Her estimates lie within 0.003 points range of those estimated in this study and are the same for the affected group.

Also, the analysis of the earnings distribution is extended by including one more year before and after the change and, thereby, increasing number of the observations. Difference at the kink as a measurement of clustering does not appear to be sensitive for the 71-72 aged and the 73-75 aged to the extension of years analyzed (see Table 2). On the other hand, difference at the kink changes by 0.5 percentage points before and after the change as a result of inclusion of 1979 and1987 years that exacerbates drop in the difference between two periods. Close comparison of the proportion of people in each $1000 interval across two periods shows that such decline in the number of the earners is not unique to the interval just below and above the kink.[5] It is evidence of more general time trend in the earnings pattern that embraces the entire range of the earnings considered.

[4] Table 2 also presents the percentage differences at the kink and their standard errors estimated in Friedberg (2000). Her estimates lie within 0.003 points range of those estimated in this study and are the same for the affected group.

[5] Refer to Table A2 in the Appendix for the earnings distributions for the extended sample.

Table 2	*Percentage with Earnings in Each Earnings Interval ($1000)*					
	67-69 year olds		71-72 year olds		73-75 year olds	
Earnings intervals	before	after	before	after	before	after
-$4000 to -$3000	0.026	0.016	0.028	0.016	0.023	0.006
-$3000 to -$2000	0.03	0.015	0.027	0.014	0.022	0.011
-$2000 to -$1000	0.033	0.021	0.02	0.011	0.018	0.01
-$1000 to kink	0.04	0.021	0.022	0.011	0.015	0.009
kink to +$1000	0.012	0.008	0.008	0.005	0.007	0.007
+$1000 to +$2000	0.008	0.006	0.006	0.004	0.006	0.004
+$2000 to +$3000	0.015	0.008	0.011	0.005	0.01	0.004
+$3000 to +$4000	0.007	0.002	0.005	0.001	0.002	0.005
+$4000 to +$5000	0.01	0.005	0.004	0.004	0.004	0.002
+$5000 to +$6000	0.002	0.004	0	0.002	0	0.003
Difference at kink	0.027	0.013	0.014	0.006	0.008	0.002
	-0.006	-0.003	-0.005	-0.003	-0.004	-0.003
No. of observations	3111	4689	1669	2598	2250	3243
	Friedberg's results[6]					
Difference at kink	0.028	0.016	0.014	0.006	0.005	0.001
	-0.006	-0.003	-0.006	-0.004	-0.004	-0.003
	Extended sample to include 1979 and 1987					
Difference at kink	0.033	0.011	0.016	0.006	0.006	0.002
	-0.004	-0.002	-0.004	-0.002	-0.003	-0.003
No. of observations	4756	6347	2588	3498	3434	4372

Note: Standard errors are reported in parentheses.

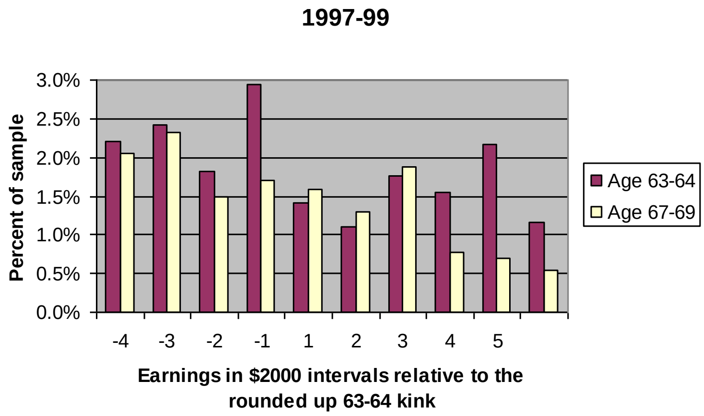
Figures 2a-2f show the same comparison of the earnings distribution relative to the exempt amount before and after the 2000 change, which completely eliminated the earnings test for working individuals of the normal retirement age and older. The exempt amount used in the analysis is rounded up to the nearest thousand. The rounding up method is employed to account for possible rounding in the reported labor income, and small rigidities in labor supply. The rounding up procedure is also used to test whether rounding up is responsible for a sharp drop in the percentage of the aged 63-64 and 67-69 with earnings in the second $1000 interval above the threshold relatively to the percentage in the previous interval (0.8% vs. 1.3% for 63-64 year olds and 0.4% vs. 0.8% for 67-69 year olds)[7]. Small rigidities in the hours of work, especially among

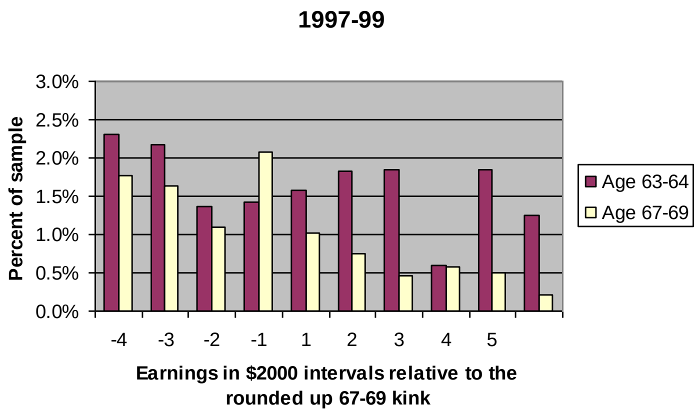
[6] Refer to Table A1 in the Appendix for the complete set of results.
[7] Table A3 in the Appendix

the younger group, can be contributing to the spread of the bunching over $1000 interval below and above the exempt amount.

Figures 2a-2c present separately comparison of earnings patterns of the affected group to each unaffected group before 2000. Figure 2a compares the proportion of the 62-64 year olds to the proportion of the 67-69 year olds with earnings in each $2000 intervals above and below the convex kink corresponding to the exempt amount for the aged 62-64.[8] Figure 2a demonstrates strong clustering of the younger group at the exempt amount for 62-64 year olds and roughly the same proportion of the 67-69 year-old men over two intervals below and above the exempt amount for 62-64 year olds. Figure 2b shows substantial bunching of the affected group around its exempt amount and smooth and even slightly increasing distribution of earnings for the younger group over several intervals around the exempt amount of 67-69 year-old men. Therefore, both groups, to which the earnings test is applicable, confirm the sensitivity of labor supply behavior to the parameters of the retirement earnings test and show no responsiveness to the exempt amount of the other group.

Figures 2a-2b.

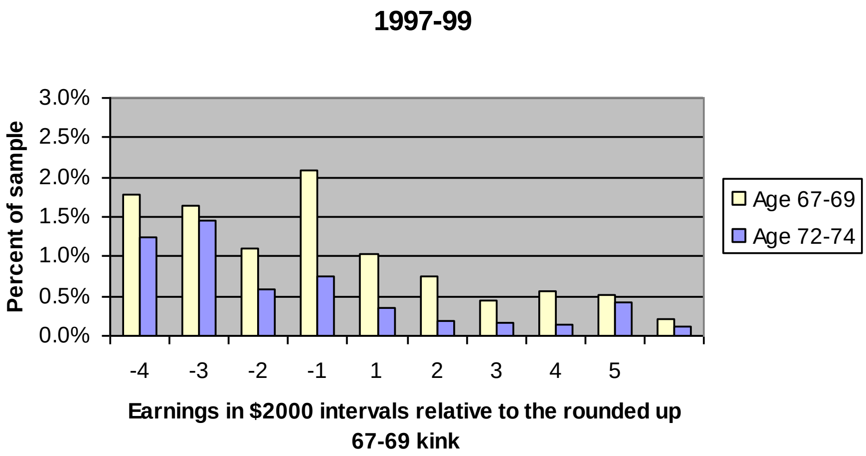




[8] The interval length of $2000 is chosen instead of $1000 (as in the analysis for 1983) since the proportion of people belonging to each $1000 interval in the considered range of earnings declined substantially from 1983.

Figure 2c illustrates the earnings distributions of the 67-69 and the 72-74 year olds relative to the exempt amount for 67-69 year olds, before the change. The affected younger group relative to the comparison older group, who do not face the earnings test, demonstrates substantial bunching at the kink. On the other hand, the earnings of the 72-74 year olds go down ratively smoothly over the presented range.

Figure 2c.



Figures 2d and 2e present the same comparison of the earnings distributions after 2000. According to Figure 2d, the 63-64 year olds continue to cluster at their earnings test exempt amount, whereas the earnings of the 67-69 year olds exhibit downward trend without significant jumps. Also, comparison of the affected group to the 72-74 year olds demonstrate resemblance of the earnings patterns of the 67-69 year olds to the earnings of the unaffected older group.

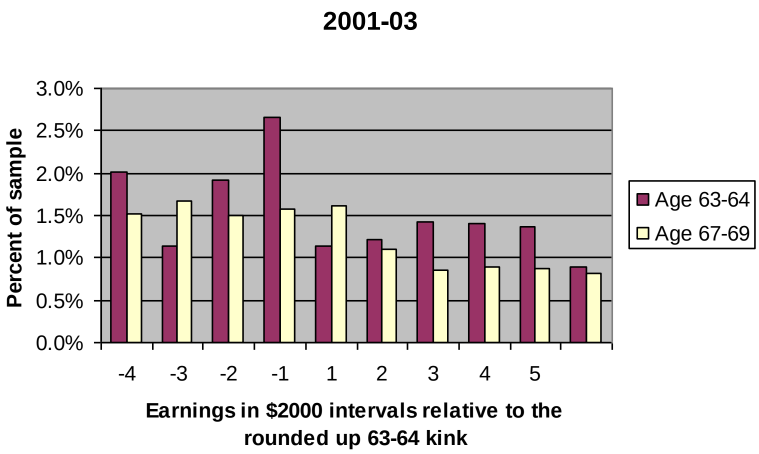


Figure 2d.

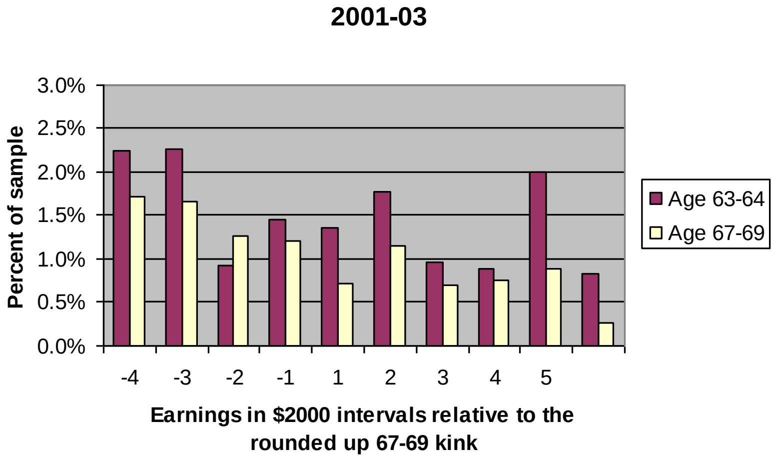


Figure 2e.

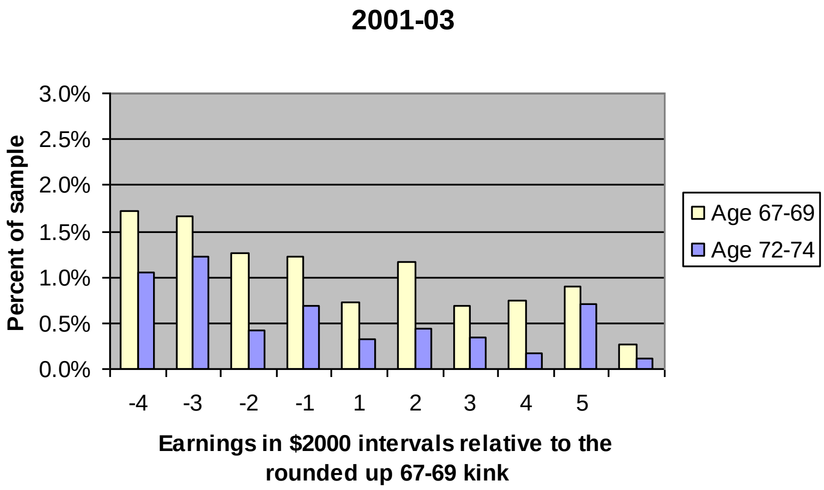


Figure 2f.

Table 3 reports aggregated earnings distributions for three age groups in $2,000 intervals around the respective exempt amounts across the three years before and after 2000. The quantitative results demonstrate bunching below the kink for 67-69 year olds for 1997-99 years: 2.1% of the age category receives earned income in the $2000 interval just below the kink with a 1.1% difference between the percentages of the 67-69 aged with earnings just below and above the kink. The difference at the kink is reported to be statistically significant (standard error = 0.003). Moreover, the bunching appears to be significantly different from the behavior across any other interval, including the exempt amount of 63-64 year-old men, at which the difference is only 0.1% with standard error being 0.003. After the earnings test is eliminated for 67-69 olds, the percentage of 67-69 year olds earning in the $2000 interval below the kink falls to 1.2% with a substantially smaller difference between the proportion of people just below and above the exempt amount

(0.5%). The difference at the kink is part of the declining pattern in the percentage of people with higher earnings. The decrease of similar magnitude occurs between third and second interval below the kink and also between second and third interval above the kink.

Table 3	*Percentage with Earnings in Each $2000 Earnings Interval*									
	63-64 year olds				67-69 year olds				72-74 year olds	
Earnings intervals	before		after		before		after		before	after
	63-64 kink	67-69 kink	63-64 kink	67-69 kink	67-69 kink	63-64 kink	67-69 kink	63-64 kink	67-69 kink	67-69 kink
-$8000 to -$6000	0.022	0.023	0.02	0.022	0.018	0.02	0.017	0.015	0.013	0.011
-$6000 to -$4000	0.024	0.022	0.011	0.023	0.016	0.023	0.017	0.017	0.015	0.012
-$4000 to -$2000	0.018	0.014	0.019	0.009	0.011	0.015	0.013	0.015	0.006	0.004
-$2000 to kink	0.029	0.014	0.027	0.015	0.021	0.017	0.012	0.016	0.008	0.007
kink to +$2000	0.014	0.016	0.011	0.014	0.01	0.016	0.007	0.016	0.003	0.003
+$2000 to +$4000	0.011	0.018	0.012	0.018	0.007	0.013	0.012	0.011	0.002	0.004
+$4000 to +$6000	0.018	0.018	0.014	0.01	0.005	0.019	0.007	0.009	0.002	0.003
+$6000 to +$8000	0.015	0.006	0.014	0.009	0.006	0.008	0.007	0.009	0.001	0.002
Diff. at kink	0.015	-0.002	0.015	0.001	0.011	0.001	0.005	0	0.004	0.004
	(.004)*	-0.004	(.003)*	-0.003	(.003)*	-0.003	(.002)**	-0.003	(.002)***	(.002)**
N	2347	2347	3325	3325	3435	3435	4179	4179	2998	3702
	Extended sample to include 1996 and 2004									
Difference at kink	0.017	-0.002	0.014	0	0.009	-0.001	0.004	-0.001	0.004	0.003
	-0.008	-0.004	-0.006	-0.003	-0.001	-0.003	-0.006	-0.003	-0.011	-0.008
N	3125	3125	3325	3325	4621	4621	4179	4179	4002	3702

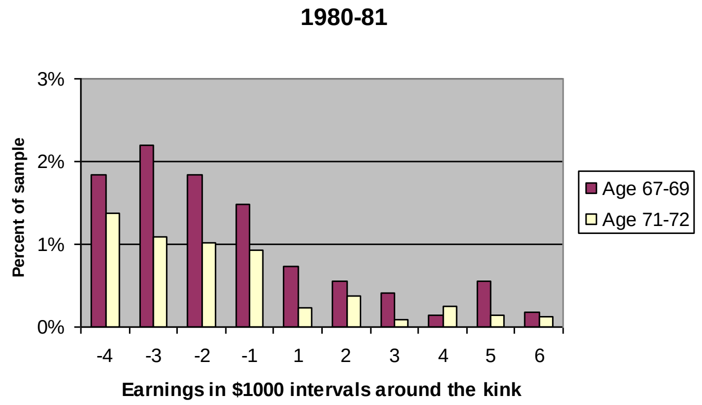
Note: Standard errors are reported in parentheses.
Superscripts * , ** , and *** denote statistical significance at the 1%, 5%, and 10% levels, respectively.

According to Table 3, there is a substantial and significant drop in the percentage of 63-64 year olds with earnings above the exempt amount compared to the percentage of individuals with earnings just below the interval (1.5% difference at the kink with 0.004 standard error) that supports bunching at the kink hypothesis. After the change, the difference (1.5%) at the exempt amount for the younger unaffected group is not influenced. In both periods, earnings distribution of aged 63-64 shows no responsiveness to the exempt amount of the affected group with difference being -0.2% and 0.1% before and after 2000, respectively. The analysis of the extended sample of four years before and after the change provides evidence of the reaction of the labor supply behavior to the applicable exempt amount but not the exempt amount effective for the other group. The visual and quantitative analysis of the raw data for the 2000 change is consistent with the findings for the 1983 change reported both in this study.

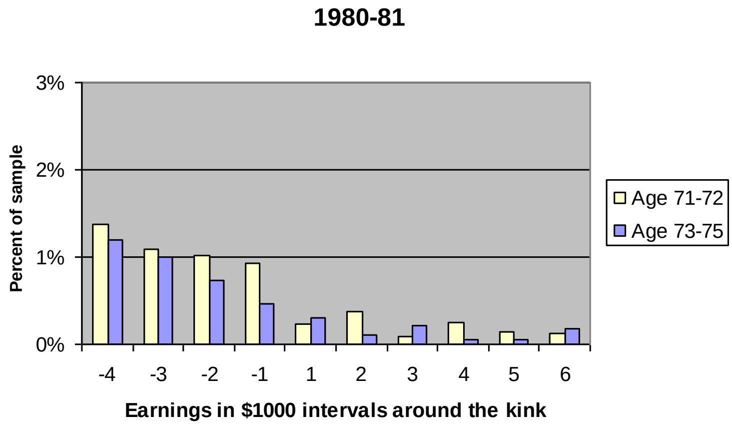
The same raw data analysis is applied to study females' reaction to the earnings test and its liberalization in 1983.[9] Figures 3a-3d suggest that a significant percentage of women react to the

[9] The summary statistics are reported in Table A4 in the Appendix

high implicit tax that becomes effective above the exempt amount, by holding down their hours of work. Roughly the same number of women, to whom the earnings test applied, earn in the several intervals below the threshold. As earnings exceed the specified exempt amount, the number of women falls significantly and stays at the lower level. The earnings distribution of the 73-75 year-old women, who do not face the earnings test in both periods, appears to decline evenly over the range presented in Figures 3b-3d. After the 1983 change, Figure 3d suggests close resemblance of earnings patterns of the affected group and the older comparison group. Hence, the scheduled withholding of the benefits is likely to be responsible for clustering of female workers at the intervals below the kink. Moreover, the quantitative results reported in Table A5 confirm the graphical evidence.[10] The computed difference between the percentage of individuals below and above the kink ranges within 0.7-0.9% (with standard errors within 0.002-0.003 range) for earners who face the earnings test, and within 0.2-0.3% for those who don't.



Figures 3a-3b.



[10] Refer to Table A5 in the Appendix.

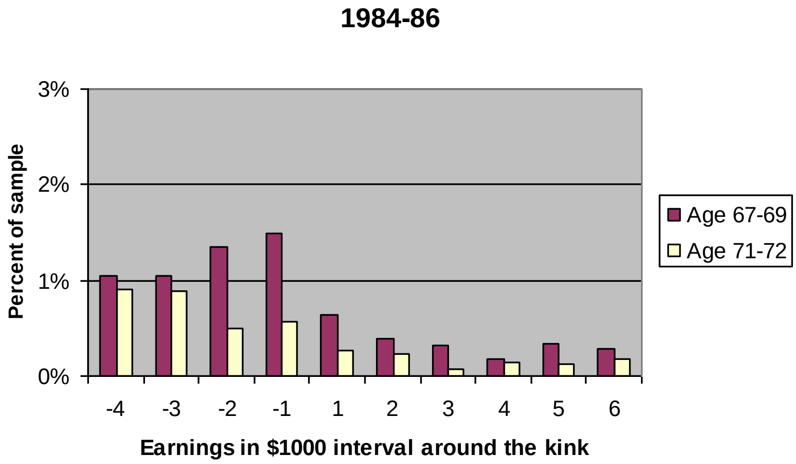


Figure 3c.

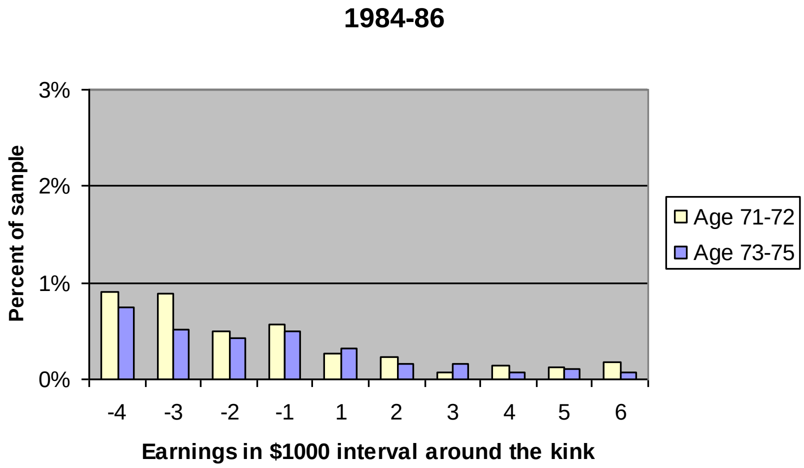


Figure 3d.

V. The Structural Labor Supply Model

Data Definition

The data used to estimate the econometric model of labor supply are obtained from the 1981-83 and 1984-87 March Supplements to the Current Population Survey. The focus of the estimation is on the three years before and after the 1983 change that enacted the elimination of the social security earnings test for 70-71 year olds. The sample is restricted to working men of 66-75 years old. Hence, it includes one affected group, 71-72 year olds, which experienced significant variation in the parameters of its budget constraint over the studied period, and two control groups, 66-70 and 73-75 year olds. Working beneficiaries with self-employment income, negative non-labor non-Social Security income, earning real wage outside $1-$100 range, or annual hours exceeding 4,500 are excluded from the study. Also, individuals with earnings below the Social Security earnings test exempt amount and no Social Security receipts are eliminated from the sample, since their decision not to claim their Social Security benefits is not connected to the earnings test.

The dependent variable in the labor supply model, annual hours worked, is defined as a product of hours worked per week in the previous year and number of weeks worked in the previous year. The real hourly wage is computed based on total wage and salary earnings last year and annual hours worked and deflated by the CPI in 1987 dollars. Non-labor income is derived as total annual family income minus total individual earned income, deflated by the CPI in 1987 dollars. Also, other income is defined as real non-labor non-Social Security income. Virtual income is represented by the vertical intercept of each budget constraint segment and discussed in more detail in the next section.

Through the following variables, the income tax system is incorporated in the model – payroll tax rate, initial tax rate, and initial tax kink. Payroll tax rate is employee's share of the OASHDI payroll tax, which is a sum of Social Security's Old-Age, Survivors, and Disability Insurance (OASDI) tax and Medicare's Hospital Insurance (HI) tax. The payroll tax rate is assumed to be constant over all earnings range, and the taxable maximum is ignored.[11] A simplified version of the federal income tax is also introduced to the analysis. Working individuals are assumed to face the lowest federal income tax rate, as soon as their earnings exceed the initial tax kink corresponding to the lowest income bracket.[12] Such implication of the federal income tax system ignores all higher kinks, consideration of which would increase measurement error significantly. Also, the increase in the marginal tax rate is considerably higher at the first tax kink than at any other kinks, and the initial tax kink is the only one of comparable magnitude to the Social Security earnings test kink. Hence, initial tax rate is the marginal federal income tax associated with the first tax bracket. Initial tax kink is computed by taking maximum of zero or the standard deduction plus the personal exemption minus other income, where the standard deduction depends on the marital status and the personal exemption depends on both marital status and age.[13] [14]

[11] OASHDI tax rate was 6.13% in 1980, 6.65% in 1981, 6.70% in 1982-83, 7.00% in 1984, and 7.05% in 1985 (http://www.ssa.gov/OACT/ProgData/taxRates.html).

[12] The federal income tax rate is 14.0% in 1980, 13.825% in 1981, 12.0% in 1982, and 11.0% in 1983-85 (http://www.irs.gov/pub/irs-soi/histaba.pdf).

[13] The personal exemption is multiplied by two if married and if age over 65 and by three if both.

[14] This simplification of the tax code also appears in Burtless and Moffitt (1985).

Demographic characteristics such education, marital status, age, and race are specified in the analysis. Education related dummy variable, completed high school, takes on one if an individual completed high school or more and zero otherwise. A participant is considered to be married if he is married or separated. Nonwhite dummy variable controls for race and takes on one if an individual is black or other. To capture age effect, age-65 variable is created to count years over age 65. Table 4 reports descriptive statistics of the variables introduced above for the entire population of 66-72 year olds beneficiaries and for the sub-sample of workers. It also reports the relevant summary statistics presented in Friedberg (2000). According to the computed statistics, almost 80% of the sample does not work. Among workers, 57.6% have earnings below the earnings test kink. For 16.8% of the working subsample, the Social Security benefits are being withheld partially. 17.2% have earnings above the earnings exempt amount and receive no benefits. Finally, 8.4% of the working beneficiaries are located on the kink, where the earnings test kink is defined by the exempt amount and $1000 interval below it. This particular range is chosen to include people clustering around the kink. Based on the earnings distribution analysis, it was shown that bunching occurs within $1000 below the exempt amount. Similarly, people located within $1000 interval below the initial tax kink are assigned to the kink itself.[15]

Given this specification, there are two possible convex kinks in the budget constraint: the earnings test kink and the initial tax kink. The shape of the budget constraint will depend on the presence and the order of these kinks. 1195 low non-labor income people face the budget constraint with the initial tax kink less than the earnings kink. There are 34 low non-labor income individuals for whom the initial tax kink is higher than the earnings kink. For 294, the two kinks coincide within $1000 with 22 located at the kink. There are three more types of the budget constraints faced by some workers in the sample with either one or no convex kinks. High non-labor income workers face zero initial tax kink. In the studied sample, 639 high non-labor income workers are not subjects to the earnings test, and, therefore, their budget constraint has only one segment. 2330 high non-labor income individuals face the earnings test. The last group of working beneficiaries consists of low non-labor income people who are not subject to the earnings test (452 workers). The total number of working men located at the initial tax kink is 185, which is approximately one third of those located at the earnings kink. Hence, bunching at the initial tax kink is minor and only a small proportion of the sample is observed at the overlap of two kinks within $1000. Also, the presence of the comparison groups will control for the possible reaction of the working men to the initial tax kink since it does not vary with age. Therefore, neither clustering

[15] Burtless and Moffitt (1985) also allow for a range of hours to be assigned to the kink (2 hours per week on both sides of the Social Security kink and 0.5 hours on both sides of the federal income tax kink)

around the federal income tax kink nor location of it will interfere with the analysis of the impact of the earnings test kink.

Table 4 *Summary Statistics*

			Friedberg (2000)	
	All	Working	All	Working
No. of observations	23413	4944	23889	4876
Number Aged:				
66-70	13168	3463	13453	3435
71-72	4544	714	4544	676
73-75	5701	767	5892	765
Completed High School	0.466	0.576	0.471	0.579
Nonwhite	0.098	0.094	0.097	0.093
Married	0.827	0.864	0.811	0.842
Annual hours	247	1170	237	1162
	(613)	(838)	(604)	(844)
Gross hourly wage	-	10.81	-	10.68
		(10.6)		(10.34)
Net hourly wage	-	7.74	-	7.69
		(8.07)		(8.04)
Non-Labor income	20794	20699	21052	20802
	(17347)	(18812)	(17773)	(19131)
Social Security income	5920	5208	6080	5201
	(2598)	(3359)	(2692)	(3339)
Location on the budget set:zero hours:	0.789	-	0.796	-
below earnings test kink	0.122	0.576	0.117	0.572
earnings test kink	0.018	0.084	0.018	0.089
above earnings test kink, benefit>0	0.035	0.168	0.034	0.166
above earnings test kink, benefit=0	0.036	0.172	0.035	0.173
inititial tax kink	0.008	0.037		

Theoretical Model

If a Social Security beneficiary is subject to the Social Security Earnings Test and the OASHDI tax as well as the federal income tax, then the recipient faces a piecewise budget constraint with two convex kinks corresponding to the earnings test exempt amount and the initial tax kink, and one concave kink corresponding to the exhaustion of the benefit. This form of the budget constraint reflects dependency of the Social Security benefit on hours worked or labor income earned. A model to be presented considers one particular type of the budget constraint with the nonzero initial tax kink being less than the earnings exempt amount.[16] Budget equations and labor supply functions for the other five categories of people are presented in the Appendix.

$$
\begin{array}{lll}
C = (1-\tau^{o})\, wH + Y + Y_{ss} & \text{if} & 0 \le wH \le E_1 \quad (1) \\
C = (1-\tau^{o})\, wH + Y + Y_{ss} - \tau^{i}(wH - E_1) & \text{if} & E_1 < wH \le E_2 \\
C = (1-\tau^{o})\, wH + Y + Y_{ss} - \tau^{i}(wH - E_1) - \tau^{s}(wH - E_2) & \text{if} & E_2 < wH \le E_3 \\
C = (1-\tau^{o})\, wH + Y - \tau^{i}(wH - E_1) & \text{if} & E_3 < wH
\end{array}
$$

where C is consumption, Y_{ss} is the SS benefit, Y is the other income, w is the gross wage, and H is annual hours of work. τ^{o} is the OASHDI tax rate, which an individual pays starting from the first hour at work place. τ^{i} is the federal income tax rate, which is applicable to earnings in excess of the initial tax kink, denoted by E_1. τ^{s} is the earnings test tax rate at which benefit is reduced per dollar of earnings above the earnings test exempt amount, denoted by E_2. E_3 is the level of earnings at which the entire benefit has been taxed away ($E_3 = E_2 + Y_{ss} / \tau^{s}$).

The budget constraint can be written as

$$
\begin{array}{lll}
C - (1-\tau^{o})\, wH = Y + Y_{ss} & \text{if} & 0 \le wH \le E_1 \quad (2) \\
C - (1-\tau^{o} - \tau^{i})\, wH = Y + Y_{ss} + \tau^{i} E_1 & \text{if} & E_1 < wH \le E_2 \\
C - (1-\tau^{o} - \tau^{i} - \tau^{s})\, wH = Y + Y_{ss} + \tau^{i} E_1 + \tau^{s} E_2 & \text{if} & E_2 < wH \le E_3 \\
C - (1-\tau^{o} - \tau^{i})\, wH = Y + \tau^{i} E_1 & \text{if} & E_3 < wH\,.
\end{array}
$$

where the right hand side is virtual income (Y_v), which in Figure 4 is represented as the vertical intercept of the corresponding linearized segment.

With the piecewise linear shape of the budget constraint, it is ambiguous which net wage and non-labor income should be used as explanatory variables in the labor supply function. As Hall (1973) points out, a worker on each segment can be considered to be facing a linear budget constraint with the corresponding slope and intercept. For example, if a worker earns total annual earnings (wH) below the exempt amount yet exceeding the initial tax kink (segment 2), he can be seen as facing a linear budget constraint with slope $-(1-\tau^{o}-\tau^{i})\, w$ and intercept $Y + Y_{ss} + \tau^{i} E_1$.

Figure 4 makes apparent the avenues of the impact of the policy parameters on the budget constraint, in particular, on the net wage and the virtual income, as a result on the desired hours of work or earnings. Moreover, this figure emphasizes that changes to the earnings test rules will affect all beneficiaries located on the entire budget constraint. For instance, a reduction in the tax

[16] The derivation of consumer demand function for the case of nonlinear budget constraints is presented in Moffitt (1986).

rate would encourage people at the earnings test kink to work more hours because of a higher marginal wage. This change would have an ambiguous impact on people who locate on the segment above the exempt amount. They would experience improvement in their marginal wage (upward rotation of their segment) and decline of their virtual income (downward shift of the segment) that sets both income and substitution effects in motion. Individuals located on the upper segment just above the noncovex kink would work less because of a negative substitution effect. Therefore, the effect of the earnings test tax reduction proves to be more complex, by demonstrating a wide range of labor supply responses.

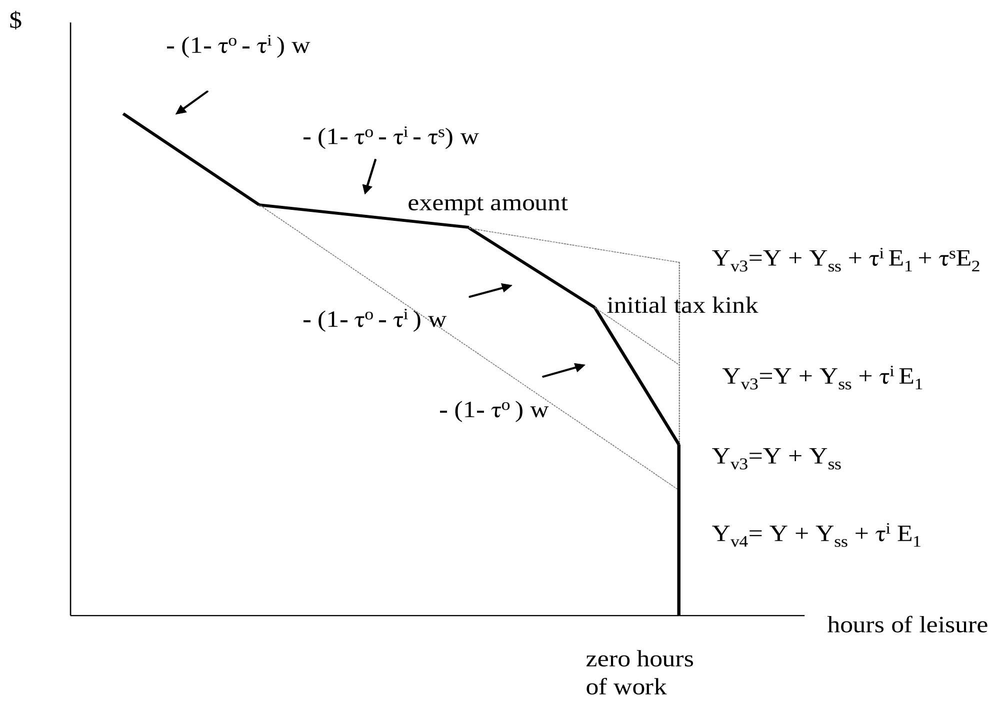


Figure 4.

Under the assumption of linearity of the labor supply function, the conditional labor supply function can be stated now:[17]

$$H(w, Y_v, X, \alpha) = k + X\beta + \gamma w(1 - t) + \delta Y_v + \alpha \qquad (3)$$

where X are relevant demographic characteristics, w(1 - t) is the net wage, Y_v is virtual income, and α is an unobserved individual taste heterogeneity. It is called conditional since it describes a

[17] Within the context of the piecewise linear budget constraint, the linearity of the labor supply function is widely assumed in the labor supply literature (e.g. Burtless and Moffitt (1985), Hausman (1981), and Moffitt (1983))

beneficiary's choice of hours conditional on his decision to locate on a particular segment or kink. In accordance with the above kinked budget constraint, the net wage and virtual income are defined as follows:

$t = \tau^o$, $w(1 - t) = (1- \tau^o) w$, and $Y_v = Y + Y_{ss}$ if $0 \le wH < E_1$ (4)
$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$,
and $Y_v = Y + Y_{ss} + \tau^i E_1$ if $E_1 < wH < E_2$
$t = \tau^o + \tau^i + \tau^s$, $w(1 - t) = (1- \tau^o - \tau^i - \tau^s) w$,
and $Y_v = Y + Y_{ss} + \tau^i E_1 + \tau^s E_2$ if $E_2 < wH < E_2+Y_{ss} / \tau^s$
$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$,
and $Y_v = Y + \tau^i E_1$ if $E_2+Y_{ss} / \tau^s < wH$

The indirect utility function, which corresponds to the above labor supply function, is[18]

$$V(w(1\text{-}t), Y_v) = e^{\delta w(1-t)}\left(Y_v+\frac{\gamma}{\delta}w(1-t)-\frac{\gamma}{\delta^2}+\frac{k+X\beta+\alpha}{\delta}\right). \qquad (5)$$

Now, as the conditional labor supply function and indirect utility function are defined, how the individual decides between different segments and kinks can be discussed.[19] For simplicity, I will concentrate first on the two first segments and the convex kink between them. Given all parameters of the labor supply function, including the individual heterogeneity of preferences term, preferred hours of work can be computed for each segment from equation (3). Only one of the following preferred hours, $H((1- \tau^o) w, Y_{v1}, X, \alpha)$ and $H((1- \tau^o - \tau^i) w, Y_{v2}, X, \alpha)$ can be feasible. If one of them is feasible than the individual selects the corresponding segment as optimal. The feasibility condition is sufficient in this case of the concavity of the utility function and the convexity of the budget set. If neither $H((1- \tau^o) w, Y_{v1}, X, \alpha)$ or $H((1- \tau^o - \tau^i) w, Y_{v2}, X, \alpha)$ is feasible then utility maximization occurs in the extended or unattainable portions of the segment 1 and 2. In this case location at the kink is optimal. Hence, the optimal-segment choice can be formally summarized, as follows:

If $H((1- \tau^o) w, Y_{v1}, X, \alpha) = H^*$, segment 1 is optimal (6)
If $H((1- \tau^o - \tau^i) w, Y_{v2}, X, \alpha) =H^*$, segment 2 is optimal
If $H((1- \tau^o - \tau^i) w, Y_{v2}, X, \alpha) \le H^* <H((1- \tau^o) w, Y_{v1}, X, \alpha)$, the kink is optimal.

[18] For derivation of the indirect utility function, refer to Hausman (1981).
[19] Decision making within the context of nonlinear budget sets is outlined in Burtless and Hausman (1978).

It can also be written in terms of α:

Segment 1 is preferred if $\alpha = H^* - (k + X\beta + \gamma(1- \tau^{o})\, w + \delta Y_{v1})$ (7)

Segment 2 is preferred if $\alpha = H^* - (k + X\beta + \gamma(1- \tau^{o} - \tau^{i})\, w + \delta Y_{v2})$

Kink is preferred if

$H^* - (k + X\beta + \gamma(1- \tau^{o})\, w + \delta Y_{v1}) < \alpha \leq (H^* - k + X\beta + \gamma(1- \tau^{o} - \tau^{i})\, w + \delta Y_{v2})$

Next segments 3 and 4 and the nonconvex kink, which form nonconvex budget constraint, are considered separately. Given all parameters of the labor supply function, including the policy parameters and the individual heterogeneity of preferences, the value of the indirect utility function can be computed for each segment, using equations (4) and (5). The optimal segment choice depends on the comparison of the values of the indirect utility function for both segments. Greater value determines the utility-maximizing location, at which the respective preferred hours will lie on the boundary of the budget set. In the case of the equality of the values of both indirect utility functions, the segment corresponding to less hours of work is selected. Also, it is important to note that no one will find it optimal to locate at the nonconvex kink, but its location is highly individual because of its dependency on the amount of the Social Security benefits. The discussed above utility maximizing conditions for nonconvex budget sets can now be expressed in terms of the heterogeneity error that will facilitate derivation of the likelihood function. For every individual, α\` can be defined as a particular value of α, which makes the individual indifferent between two segments or, in other words, sets equal the values of indirect utility function evaluated at two segments. Based on the conclusions drawn from the comparison of two indirect utility functions, the relationship between α and the choice of the optimal segment can be formulated:

If $\alpha \leq \alpha`$, segment 3 is optimal (8)

If $\alpha > \alpha`$, segment 4 is optimal.

The discussion of two segments convex and nonconvex budget sets can be easily extended to more segment cases along the same lines.

Assuming α is distributed over the population as $N(0, \sigma_{\alpha}^{2})$, the probability of jointly observing realized hours of work and a segment choice is expressed in the following log likelihood function:

$$\text{Log L} = \sum_{i\in Seg.1} \log\left[\frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i = \text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o)\,\text{w}_\text{i} + \delta \text{Y}_{v1i})}{\sigma_\alpha}\right)\right] \qquad (9)$$

$$+ \sum_{\substack{i\in initial \\ tax\,kink}} \log\left[\int_{\text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o)\,\text{w}_\text{i} + \delta\text{Y}_{v1i})}^{\text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o - \tau^i)\,\text{w}_\text{i} + \delta\text{Y}_{v2i})} \frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right]$$

$$+ \sum_{i\in Seg.2} \log\left[\frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i = \text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o - \tau^i)\,\text{w}_\text{i} + \delta \text{Y}_{v2i})}{\sigma_\alpha}\right)\right]$$

$$+ \sum_{\substack{i\in earnings \\ test\,kink}} \log\left[\int_{\text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o - \tau^i)\,\text{w}_\text{i} + \delta\text{Y}_{v2i})}^{\text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o - \tau^i - \tau^s)\,\text{w}_\text{i} + \delta\text{Y}_{v3i})} \frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right]$$

$$+ \sum_{i\in Seg..3} \log\left[\frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i = \text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o - \tau^i - \tau^s)\,\text{w}_\text{i} + \delta \text{Y}_{v3i})}{\sigma_\alpha}\right) * \Phi\left(\frac{\alpha`}{\sigma_\alpha}\right)\right]$$

$$+ \sum_{i\in Seg..4} \log\left[\frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i = \text{H}_i - (\kappa + X_i\beta + \gamma(1-\tau^o - \tau^i)\,\text{w}_\text{i} + \delta \text{Y}_{v4i})}{\sigma_\alpha}\right) * \left\{1 - \Phi\left(\frac{\alpha`}{\sigma_\alpha}\right)\right\}\right]$$

$$- \sum_{\forall i} \log\left[\int_{-\infty}^{-(\kappa + X_i\beta + \gamma(1-\tau^o)\,\text{w}_\text{i} + \delta\text{Y}_{v1i})} \frac{1}{\sigma_\alpha}\phi\left(\frac{\alpha_i}{\sigma_\alpha}\right) d\alpha_i\right]$$

where φ(.) and Φ(.) are the standard normal probability density and cumulative functions. According to the specification of the hours of work equation, the only source of variation among otherwise identical individuals is the heterogeneity of preferences; therefore, the observed hours worked on the segments and location picked on the budget constraint are true and optimal. As it is apparent from previous discussion, desired hours are not feasible for the workers located on the convex kinks and, therefore, not observed. Boundaries of the heterogeneity term for people at the kink agree with conditions formulated in (7). The terms for segments 3 and 4 incorporate conditions described in (8) for the nonconvex budget sets.

The last term conditions the hours observed on the probability that positive hours are chosen. Therefore, the estimation of the labor supply function is conditional on working, and it does not incorporate effect of the earnings test on the decision to work. Gruber and Orszag (2000) points that such sample truncation can result in biasing findings trough compositional changes in the sample after the earnings test elimination in this case. In the same study, Gruber and Orszag find no aggregate response in employment among those 70 and above to the 1983 elimination of the earnings test. Furthermore, the studies on the elimination of the earnings test in the U.K. and

Canada find no impact of the earnings test and its abolition on the decision to work. Hence, exclusion of the retired from the sample studied should not interfere with the earnings test analysis.

Up to this point, the log likelihood function is stated only for one group, but its structure can easily be adjusted to embrace other forms of the labor supply functions.[20] The log likelihood function estimated is composed of six groups of workers and maximized with respect to eight parameters: k, β (a vector of four elements), γ, δ, and σ_α.

Estimation Results

The estimates of the structural labor supply model are reported in the first column in Table 5. The second column of the same Table shows the results presented in Friedberg (2000). All estimated parameters have the expected signs, and the coefficients on the net wage and virtual income are highly significant. The results of the maximization of the likelihood function show strong responsiveness to the net wage change and virtual income fluctuation. The effect of $1.00 increase in the net real wage is estimated to be an increase in the hours worked per year by 56, corresponding to an uncompensated wage elasticity of 0.371 computed at the sample mean. The estimated coefficient on the virtual income suggests that a decline in non-wage income by $1000 would raise the hours worked by 23, corresponding to an income elasticity of -0.436 calculated at the mean. Both estimated elasticities indicate larger sensitivity to variation in the net wage and non-labor income than those reported in Friedberg (2000): 0.316 for wage elasticity and -0.332 for income elasticity.

Five exogenous variables are also included in the estimation to control for education, marital status, race, and age. The estimated parameters indicate that people with at least high school education work significantly more, on average by 677 hours more. Married men work slightly longer hours what contradicts Friedberg's results for 1983. On the other hand, in the same paper, she reports positive relationship between hours of work and marital status for 1978 with estimated coefficient being 119. Also, nonwhites are estimated to work more. As expected, age has a negative relationship with labor supply, such that, on average, every year above 65 reduces desired hours of work by 146 hours per year. The estimates show some sensitivity to the sample definition, in particular, treatment of extreme values of annual hours of work. If hours worked are allowed to take on all possible values, then, for instance, the estimated coefficient on education rises to 716, on marital status declines to 57, and on race goes to 343. Also, log likelihood value increases in absolute value and becomes equal to -38045. Therefore, difference between maximum

[20] Labor supply functions for the remaining five categories are derived in the Appendix.

likelihood estimates found in Friedberg (2000) and in this analysis could be a result of different sample specifications. Overall, the estimated coefficients on demographic characteristics are not significantly different from those presented in Friedberg (2000).

Table 5 *Maximum Likelihood Estimates for 1983 rule change*

Dependent Variable: Annual Hours	Coefficient estimates	Friedberg (2000) estimates
Completed High School	677	577
	(104)	(67)
Nonwhite	351	362
	(101)	(91)
Married	67	-79
	(82)	(40)
Age-65	-147	-156
	(14)	(12)
Net wage	56	48
	(3)	(3)
Virtual income, $1000	-24	-17
	(2)	(2)
Constant	147	963
	(104)	(92)
Standard deviation	1538	1356
	(26)	(29)
Uncompensated wage elasticity	0.371	0.3116
Income elasticity	-0.436	-0.332
Log likelihood	-37887	-17726
Number of observations	4944	4876

VI. Conclusions

This paper provides results that demonstrate a substantial response to the earnings test exempt amount and its elimination for the group of 70-71 year olds in 1983 and 67-69 year olds in 2000. The data shows that working men respond to the Social Security earnings test, by bunching at the exempt amount, and their labor supply behavior is sensitive to changes in the earnings test regulations. In response to the abolishing of the earnings test, the earnings distribution of the affected group starts to decline smoothly over the range around the kink without any signs of clustering. The same conclusions can be extended to the labor supply behavior of women.

The estimation of the structural labor supply model yields rather large estimates of wage and income elasticities, which suggest high sensitivity of the hours supplied by workers to the changes in the parameters of the earnings test. Also, the estimated elasticities have meaning outside of the context of the earnings test. These elasticities characterize the responsiveness of older workers to wage taxes and income transfers, conditional on working.

Even though the earnings test is currently applicable only to the beneficiaries of age 62-66, popular attention to the earnings test will not cease in the coming years. The earnings test will grow more binding, as normal retirement rises to 67. Also, baby boom generation is reaching 62 increasing the number of workers affected by the earnings test greatly.

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Appendix:

Table A1

Friedberg's results for 1983 change	Percentage with Earnings in Each Earnings Interval ($1000), aggregated					
	67-69 year olds		71-72 year olds		73-75 year olds	
Earnings intervals	before	after	before	after	before	after
-$3000 to -$2000	0.027	0.016	0.028	0.011	0.022	0.010
-$2000 to -$1000	0.031	0.021	0.019	0.009	0.018	0.010
-$1000 to kink	0.041	0.022	0.023	0.012	0.013	0.008
kink to +$1000	0.013	0.008	0.009	0.005	0.008	0.007
+$1000 to +$2000	0.007	0.006	0.005	0.004	0.006	0.003
+$2000 to +$3000	0.012	0.006	0.010	0.005	0.010	0.004
Difference at kink	0.028	0.016	0.014	0.006	0.005	0.001
	(.006)	(.003)	(0.006)	(0.004)	(.004)	(.003)

Table A2	Percentage with Earnings in Each Earnings Interval ($1000), aggregated over extended sample					
	67-69 year olds		71-72 year olds		73-75 year olds	
Earnings intervals	before	after	before	after	before	after
-$3000 to -$2000	0.032	0.017	0.026	0.013	0.022	0.012
-$2000 to -$1000	0.034	0.018	0.024	0.011	0.020	0.009
-$1000 to kink	0.046	0.020	0.025	0.012	0.014	0.008
kink to +$1000	0.013	0.009	0.010	0.005	0.009	0.006
+$1000 to +$2000	0.008	0.005	0.006	0.004	0.006	0.004
+$2000 to +$3000	0.012	0.007	0.009	0.005	0.009	0.004
+$3000 to +$4000	0.008	0.003	0.005	0.003	0.003	0.004
+$4000 to +$5000	0.009	0.004	0.005	0.003	0.004	0.002
Difference at kink	0.033	0.011	0.016	0.006	0.006	0.002
	(.004)	(.002)	(.004)	(.002)	(.003)	(.003)
N	4756	6347	2588	3498	3434	4372

Table A3	Percentage with Earnings in Each Earnings Interval ($1000) for 2000 change					
	63-64 year olds		67-69 year olds		72-74 year olds	
Earnings intervals	before	after	before	after	before	after
-$5000 to -$4000	0.013	0.005	0.006	0.006	0.007	0.003
-$4000 to -$3000	0.012	0.007	0.009	0.011	0.004	0.006
-$3000 to -$2000	0.006	0.008	0.006	0.007	0.002	0.002
-$2000 to -$1000	0.011	0.013	0.005	0.005	0.004	0.002
-$1000 to kink	0.015	0.014	0.014	0.008	0.002	0.006
kink to +$1000	0.013	0.011	0.008	0.003	0.005	0.002
+$1000 to +$2000	0.008	0.004	0.004	0.004	0.002	0.001
+$2000 to +$3000	0.006	0.006	0.005	0.004	0.001	0.001
+$3000 to +$4000	0.007	0.006	0.003	0.002	0.001	0.001
+$4000 to +$5000	0.003	0.006	0.003	0.009	0.001	0.004
Difference at kink	0.002	0.004	0.006	0.005	-0.002	0.003
	(.003)	(.004)	(.003)	(.002)	(.002)	(.002)
N	2347	3325	3435	4179	2998	3702

Table A4	Summary Statistics for women			
	1980-81		1984-86	
	all	working	all	working
No. observations	9282	1207	14056	1729
Number aged:				
67-69	4006	704	5708	949
71-72	2359	251	3577	400
73-75	2917	252	4771	380
Annual earnings	–	4,202	–	5,798
By age group:				
67-69	–	4,748	–	6,667
71-72	–	3,843	–	4,720
73-75	–	3,028	–	4,717
Employment	0.124	–	0.123	–
By age group:				
67-69	0.168	–	0.164	–
71-72	0.099	–	0.111	–
73-75	0.083	–	0.081	–

Table A5	Percentage with Earnings in Each Earnings Interval ($1000) for women					
	67-69 year olds		71-72 year olds		73-75 year olds	
Earnings intervals	before	after	before	after	before	after
-$3000 to -$2000	0.022	0.010	0.011	0.009	0.010	0.005
-$2000 to -$1000	0.018	0.014	0.010	0.005	0.007	0.004
-$1000 to kink	0.015	0.015	0.009	0.006	0.005	0.005
kink to +$1000	0.007	0.006	0.002	0.003	0.003	0.003
+$1000 to +$2000	0.006	0.004	0.004	0.002	0.001	0.002
+$2000 to +$3000	0.004	0.003	0.001	0.001	0.002	0.002
+$3000 to +$4000	0.001	0.002	0.002	0.001	0.001	0.001
Difference at kink state	0.008 (.003)	0.009 (.002)	0.007 (.002)	0.003 (.001)	0.002 (.002)	0.002 (.002)
N	4006	5710	2359	3578	2917	4771

Definition of Labor Supply Function

Conditional labor supply function has a common form for all five groups of workers discussed here with the only difference in the definition of the net wage and virtual income:

$H(w, Y_v, X, \alpha) = k + X\beta + \gamma w(1 - t) + \delta Y_v + \alpha$

For low nonlabor income people, who are subjects to the earnings test with the exempt amount being lower than the initial income tax, the net wage and virtual income are:

$t = \tau^o$, $w(1 - t) = (1- \tau^o) w$, and $Y_v = Y + Y_{ss}$ if $0 \leq wH < E_2$

$t = \tau^o + \tau^s$, $w(1 - t) = (1- \tau^o - \tau^s) w$,

and $Y_v = Y + Y_{ss} + \tau^s E_2$ if $E_2 < wH < E_1$

$t = \tau^o + \tau^i + \tau^s$, $w(1 - t) = (1- \tau^o - \tau^i - \tau^s) w$,

and $Y_v = Y + Y_{ss} + \tau^i E_1 + \tau^s E_2$ if $E_1 < wH < E_2 + Y_{ss} / \tau^s$

$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$,

and $Y_v = Y + \tau^i E_1$ if $E_2 + Y_{ss} / \tau^s < wH$

For low nonlabor income people, who are not subjects to the earnings test with, the net wage and virtual income are defined as follows:

$t = \tau^o$, $w(1 - t) = (1- \tau^o) w$, and $Y_v = Y + Y_{ss}$ if $0 \leq wH < E_1$

$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$,

and $Y_v = Y + Y_{ss} + \tau^i E_1$ if $E_1 < wH$

For low nonlabor income people, who are subjects to the earnings test with the exempt amount coinciding within \$1000 with the initial income tax, the net wage and virtual income are given by:

$t = \tau^o$, $w(1 - t) = (1- \tau^o) w$, and $Y_v = Y + Y_{ss}$ if $0 \leq wH < E_1 = E_2$

$t = \tau^o + \tau^i + \tau^s$, $w(1 - t) = (1- \tau^o - \tau^i - \tau^s) w$,

and $Y_v = Y + Y_{ss} + \tau^i E_1 + \tau^s E_2$ if $E_1 = E_2 < wH < E_2 + Y_{ss} / \tau^s$

$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$, and $Y_v = Y + \tau^i E_1$ if $E_2+Y_{ss} / \tau^s < wH$

For high nonlabor income people (the initial tax kink is zero), who are subjects to the earnings test, the net wage and virtual income are defined as follows:

$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$,

and $Y_v = Y + Y_{ss}$ if $0 < wH \leq E_2$

$t = \tau^o + \tau^i + \tau^s$, $w(1 - t) = (1- \tau^o - \tau^i - \tau^s) w$,

and $Y_v = Y + Y_{ss} + \tau^s E_2$ if $E_2 < wH \leq E_2+Y_{ss} / \tau^s$

$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$,

and $Y_v = Y$ if $E_2+Y_{ss} / \tau^s < wH$

Finally, for high nonlabor income people (the initial tax kink is zero), who are not subjects to the earnings test, the net wage and virtual income are given by

$t = \tau^o + \tau^i$, $w(1 - t) = (1- \tau^o - \tau^i) w$,

and $Y_v = Y + Y_{ss}$ if $0 < wH$