Income and the Use of Prescription Drugs by the Elderly: Evidence from the Notch Cohorts*

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Abstract

We use exogenous variation in Social Security payments created by the Social Security benefits notch to estimate how retirees' use of prescription medications responds to changes in their incomes. Using data from the 1993 Wave of the AHEAD, we obtain instrumental variables estimates of the income elasticity of prescription drug use that are uniformly above 1.00, with a middle estimate of 1.32. Simulations based on our estimates suggest that reductions in Social Security benefits similar to those incorporated in recent reform proposals would significantly reduce prescription drug use among the elderly.

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1. Introduction

The affordability of prescription drugs has become an increasingly important issue for the elderly, who spend about a fifth of their income on health care (Crystal et al., 2000) and consume a disproportionate share of pharmaceuticals. Using data from 1996, Moxley et al. (2003) found that 88 percent of seniors used prescription medications during a 12 month period, with 58 percent taking three or more different drugs over the course of a year. Anecdotes concerning the use of potentially harmful cost-saving measures, such as ad-hoc dosing adjustments and foregoing medications, have been widely discussed in the popular press and in several recent studies. For example, Safran et. al (2002) found that nearly one in four low-income elderly failed to fill a prescription due to cost concerns, while Tamblyn et al. (2001) present evidence that the imposition of cost-sharing for prescription drugs in Quebec resulted in significant increases in hospitalizations, nursing home admissions, and mortality among elderly Canadians.

Such findings raise the possibility that future reductions in Social Security benefits could exacerbate the difficulties seniors face in obtaining prescription medications or adhering to costly drug regimens.[1] Despite its significance for a variety of public policy issues, little is known about how income influences prescription drug use. Most research has instead focused on the impact of cost-sharing provisions in private and public insurance plans (Federman et al., 2001; Yang, Gilleskie and Norton, 2004). An exception is a recent study by Stuart and Grana (1998), who found that Medicare beneficiaries with annual incomes above $18,000 were 18 percent more likely than those with incomes below $6000 to use prescription drugs to treat their health conditions. A fundamental challenge faced by such studies is isolating the underlying causal relationship between income and prescription drug use from a large number of inherently unobservable characteristics that influence both an individual's lifetime earnings (and therefore the amount of income available after retirement), and their propensity to use prescription medications.

In this paper, we seek to circumvent these endogeneity problems by relying on a natural experiment that generated large, exogenous differences in Social Security payments for otherwise identical individuals based on their year of birth. The aptly-named Social Security benefits "notch," which we describe in the next section, has been used by others to estimate the effect of income on retirement behavior (Krueger and Pischke, 1992), mortality (Snyder and Evans, forthcoming) and elderly living arrangements (Engelhardt, Gruber and Perry, 2005).

Using data from the 1993 wave of the Study of Asset and Health Dynamics Among the Oldest Old (AHEAD), we find small and statistically insignificant effects of income on prescription drug use when Social Security payments are treated as exogenous. However, when the benefits notch is used as an instrument for Social Security income, a larger and statistically significant effect of income on drug utilization emerges for households headed by beneficiaries with less than a high school education (approximately 44 percent of our sample) or with incomes below the 75th percentile of the household income distribution in our sample. Our estimates indicate that a $1,000 increase in post-retirement income (in 1993/1994 dollars) for those in our low-education (lower-income) group would increase the number of prescription medications used in a typical month by approximately 0.55 prescriptions per household; similar results are obtained when the sample is truncated at the 75th percentile of household income. Evaluated at the mean levels of drug utilization and Social Security income in the low-education sample, this translates into an elasticity of roughly 1.32, suggesting that retirees exhibit considerable income sensitivity in their use of prescription drugs.

The paper proceeds as follows. In Section 2, we provide a brief overview of the Social Security benefits notch. In Section 3, we discuss our data and empirical strategy. In Section 4, we present our main results, along with several specification checks. In Section 5, we discuss the implications of our findings for future changes in Social Security benefits. Concluding remarks are offered in Section 6.

2. The Social Security Benefits Notch

Detailed accounts of the legislation that led to the benefits notch can be found in any of the existing papers that have made use of the notch. Here, we provide a brief overview, referring the reader to the papers listed in the Introduction for a more in depth discussion.

Prior to 1972, neither credited earnings nor post-retirement Social Security payments were indexed for inflation. Instead, Congress periodically adjusted benefits, enacting large increases in 1967, 1969, 1971 and 1972. In 1972, Congress amended the Social Security Act to provide explicit indexation of credited earnings for workers who had not yet retired. The 1972 Amendments inadvertently conferred a windfall on these workers by altering the benefits formula in a manner which over indexed wages for the effects of inflation, an error commonly referred to as "double indexation." The high rates of inflation that occurred shortly thereafter resulted in large increases in benefits for individuals born after 1907, creating a potential threat to the solvency of the system.

In 1977, Congress eliminated double indexation by correcting the error in the benefits formula. Importantly, workers near retirement in 1977 (those born prior to 1917) retained doubly-indexed benefits under a grandfather provision. This created a sizeable reduction in benefits for those born in 1917 or later, relative to earlier cohorts. Set against a gradual upward trend in benefits for successive birth cohorts, the rapid run-up in benefits created by double indexation, coupled with the abrupt decline in benefits mandated by the 1977 Amendments, generated what has come to be known as the Social Security "benefits notch," depicted in Figure

1.[2] As others have noted, the differences in benefits engendered by these changes in the Social Security Act were both large and unanticipated, making them well suited for the analysis of income/wealth effects among the elderly.[3] In the next section, we describe our data and identification strategy in more detail.

3. Data and Empirical Strategy

3.1. *Data*

The AHEAD is a longitudinal survey of individuals aged 70 or older in 1993 and their spouses, regardless of age. The first wave of the AHEAD, fielded in 1993/1994, provides extensive information on 8,222 individuals in 6,047 households. African Americans, Hispanics, and residents of the state of Florida were over-sampled, with sample weights available to adjust for this and other non-representative elements of the sample design. A response rate of just over 80 percent was obtained in the first wave of the survey. One follow-up survey was conducted in 1995 and the surviving AHEAD respondents were integrated into the HRS in 1998.

Although the AHEAD is structured longitudinally, we were unable to take advantage of this feature in our work because respondents were only asked about the number of prescription drugs they use in the first wave of the survey. The drug questions that were repeated in later waves either pertain to out-of-pocket spending, which is difficult to interpret when expenditures are filtered through supplemental insurance plans of varying generosity, or are discrete outcomes that did not exhibit sufficient variation to generate estimates with any reasonable degree of precision; e.g., whether the respondent took any prescription medicines versus none.

3.2. *Estimation Sample*

The unit of observation for our analysis is the household because it seems likely that married or cohabiting individuals pool resources and make joint decisions when it comes to purchasing items like prescription drugs. Approximately 46 percent of our sample is made up of two-person households (in the vast majority of cases, a husband and a wife), with 54 percent of households having only one member.

Our first task is to assign a primary Social Security beneficiary to each household. This will allow us to determine the extent to which different households benefited from double indexation, with those benefiting the most serving as our treatment group. Because the majority of married women in these birth cohorts qualified for benefits based on their husband's earnings history (Snyder and Evans, forthcoming), we follow previous work in designating the male member of two-person households as the primary Social Security beneficiary; thus, for all households containing a male member, we use the male's year of birth to assign each household to our treatment and control groups. Households with no male members can be divided into two categories: never-married females and widowed/divorced females. In the case of never-married females, we designate the female as the primary beneficiary and use her year of birth to determine treatment-control status for the household. In the case of widowed/divorced females, we designate the deceased or former husband as the primary beneficiary and subtract three years from the female's year of birth to generate a birth year for the deceased/former husband, three years being the median difference in spousal ages for widowed/divorced elderly as calculated by Engelhardt, Gruber and Perry (2005) using the 1982 New Beneficiary Survey.

In creating our estimation sample, we restrict attention to the birth cohorts studied by Krueger and Pischke (1992); namely, households whose primary Social Security beneficiary was born between 1901 and 1930. We also drop a small number of households that report no Social Security income, or that report Social Security income of less than $100 per month (in 1993 / 1994 dollars). These restrictions, coupled with observations lost from missing or incomplete data, yield a final sample of 4,007 households.

3.3. *Empirical Specification*

To estimate the impact of Social Security income on prescription drug use, we estimate equations of the form shown below.

$$D_h = \alpha + \beta SSIncome_h + \delta \mathbf{X}_h + \varepsilon_h \quad (1)$$

where h indexes households. D_h is the typical number of prescription medications that each household uses in a month, $SSIncome_h$ is annual household Social Security income (measured in thousands of 1993/1994 dollars), $\mathbf{X}_h$ is a vector of control variables and ε_h is the error term. We use Social Security income in our analysis, rather than total income, for two reasons. First, a substantial number of respondents in the AHEAD were unable to accurately report their total income. This was much less of a problem for Social Security income, which respondents were able to report on a monthly basis, i.e., the amount they receive in their monthly check. Second, the notch may have led to other behavioral changes that affected total income, e.g. a change in post-retirement work (Snyder and Evans, forthcoming), that would appear to offset the permanent increase in wealth created by the notch if total income were used in our regressions.

The vector of covariates, $\mathbf{X}_h$, includes a standard set of demographic variables for each household: indicator variables for the type of household (male head - married or cohabiting; male head - single; female head - never-married; female head - widowed; and female head - divorced), age of the head, race of the head (white, African American, or other), Hispanic ethnicity of the head, whether the household is located in an MSA, and location (indicators for each of the nine Census regions). Other variables, such as measures of health status or insurance coverage, are not included as controls because they represent additional outcome variables that are likely to be affected by changes in Social Security income, including changes induced by the benefits notch.

As a result, β provides an estimate of the total effect of a change in income on prescription drug use, incorporating all of the behavioral responses precipitated by the income change, e.g., changes in labor force participation, health status, or insurance coverage. From a policy perspective, one would want this type of estimate – one that takes all of the aforementioned adjustments into account, rather than holding them constant - when calculating the likely impact of a change in income on drug utilization. Nonetheless, we have re-estimated our baseline specifications including controls for health and insurance status, with little change in the results.

Equation (1) will be estimated twice for each model specification; first by ordinary least squares, and second using an instrumental variables estimator that accounts for the endogeneity of income. The first-stage regression is displayed in equation (2) below.

$$SSIncome_h = \gamma + \theta Notch_h + \phi \mathbf{X}_h + u_h \qquad (2)$$

Our instrument, labeled $Notch_h$, is an indicator variable that takes the value "one" for households whose primary Social Security beneficiary was born during the notch years of 1915-1917, and "zero" for households whose primary beneficiary was born in any other year between 1901 and 1930. The years 1915-1917 were selected because they represent the peak of the benefits notch and provide the strongest first-stage relationship between Social Security income and notch status for the cohorts in our sample. Table 1 provides descriptive information on the main variables used in our analysis, separated into two sub-samples based on the educational attainment of the primary Social Security beneficiary: 1,755 households whose primary beneficiary had less than a high school education and 2,252 households whose primary beneficiary had a high school diploma or better.[4]

As mentioned previously, respondents were only asked about the number of prescription drugs they use in the first wave of the survey. This is potentially problematic because the benefits notch is based on year of birth and is collinear with age in a single cross section. Previous studies have addressed this problem either by relying on extremely large datasets to compare individuals that differ only slightly in age (Snyder and Evans, forthcoming), or by exploiting age by year-of-birth variation (Krueger and Pischke, 1992; Engelhardt, Gruber and Perry, 2005). Because we have a relatively small number of observations, and do not have age by year-of-birth variation in the data, we attempt to address this issue by showing that our results are not sensitive to the inclusion of a progressively more flexible specification of the age variable; in particular, we enter age as a polynomial function whose order ranges from one (linear) to three (cubic).[5] It is also worth noting that the average age among those receiving higher Social Security benefits due to the notch (our treatment group) is lower than the average age of those in adjacent cohorts (our control group). Thus, if younger households are healthier on average, any residual effect of age not captured by our age variables should impart a downward bias to the estimated relationship between Social Security income and prescription drug use.

3.4. *Effect of the Notch by Education Group*

The size of the benefits notch varies substantially by income because an increase in the covered earnings maximum enacted in 1977 resulted in a larger increase in the fraction of earnings subject to Social Security taxes for high-income workers relative to low-income workers (Englehardt, Gruber and Perry, 2005). Thus, when looking at real benefit levels across birth cohorts, the size of the benefits notch created by double indexation is larger for lower-income retirees than for higher-income retirees due to the offsetting increase in benefits among post-notch birth cohorts with higher incomes. This difference is evident in Table 2, where separate estimates of equation (2) are presented based on the educational attainment of the primary Social Security beneficiary. We split the sample based on educational attainment, rather than income, because income is directly affected by the notch and serves as the dependent variable in our first-stage regressions. In each case, three model specifications are estimated to examine the sensitivity of our findings to alternative methods of controlling for the effects of age. All specifications include the full set of demographic variables described in the previous section and all are weighted using the AHEAD household weights. We adjust our (robust) standard errors for clustering on birth year.

For the low-education (lower-income) group, having been born at the peak of the notch years increases household Social Security income by between $1,000 and $1,400 per year in 1993 / 1994 dollars. Relative to a mean household Social Security income of $9,625 for this group, this translates into an increase of between 10 and 14.5 percent. These regressions provide a strong first stage for our IV estimation strategy, with partial F-statistics for the notch indicator ranging from 16.80 to 33.18 in our baseline specification (Staiger and Stock, 1997).

By contrast, the relationship between notch status and Social Security income is much weaker for households whose primary beneficiary has a high school diploma or better. For these households, having been born during the notch years only increases household Social Security income by between $72 (0.6 percent) and $301 (2.7 percent) per year. Moreover, the partial F-statistics from these regressions are all below 1.00, suggesting that there is not a strong enough first-stage relationship present to support an IV estimation strategy for this group.

As a result, we focus on the 1,755 households from the low-education sub-sample (approximately 44 percent of the full sample) to obtain estimates of the effect of income on prescription drug utilization. In Section 5, we discuss how our estimates are likely to apply to elderly households based on their position in the income distribution.

4. Results

4.1. *Baseline Estimates*

Our main estimates of the effect of income on prescription drug utilization are presented in Table 3. Looking across the three age specifications, we find small and statistically insignificant effects of income on the number of prescriptions used by each household when these effects are estimated by ordinary least squares. By contrast, when the benefits notch is used as an instrument for household Social Security income, we find large and statistically significant effects of income on drug use across all three model specifications. Focusing on the quadratic age specification, our coefficient estimate indicates that a $1000 increase in Social Security income (in 1993/1994 dollars) would increase the number of prescription medications used in a typical month by approximately 0.55 per household. Evaluated at the mean levels of drug utilization and Social Security income in the sample (shown in Table 1),[6] this translates into an elasticity of approximately 1.32, implying a high degree of income sensitivity on the part of retirees.

If higher incomes do increase prescription use, a reduced-form relationship between the benefits notch and prescription drug utilization should emerge. In particular, this relationship will exist regardless of which income measure is used in the construction of the IV estimates, thus providing a means of examining whether our use of the more reliably reported Social Security income measure has generated a spurious finding that would not have emerged if we instead used total household income. At the bottom of Table 3, we present estimates of this reduced-form relationship, finding that households whose primary Social Security beneficiary was born during the notch consume approximately 0.60 more prescription medications in a typical month than households whose primary beneficiary was born in adjacent (non-notch) years. The estimated effect of notch status on drug use is quite similar across the three age specifications and is statistically significant at better than the 0.01 level in each case. This relationship is depicted graphically in Figure 2, using the same procedure that was used to create Figure 1.

4.2. *Sensitivity Analysis*

To economize on space, we report results for several specification checks in an online Appendix: [insert JHR link]. There, we demonstrate that our baseline results are robust to: (a) measurement error induced by imputing a birth year to husbands of widowed or divorced females; (b) pure cohort effects, such as those arising from the 1918 influenza epidemic or the time period considered; and (c) the use of an empirical specification for count data.

5. Policy Implications

To the extent that future retirees can be expected to behave like earlier cohorts, our estimates predict how future changes in Social Security are likely to affect drug utilization among the elderly. In this section, we simulate the effects of three hypothetical cuts in Social Security benefits, corresponding in magnitude to three recently proposed reforms of the OASI program. We estimate the effects of these cuts on household-level prescription drug utilization, overall demand for prescription drugs and, more speculatively, adverse health events.

The estimates presented earlier were obtained from a sample of low-education (lower-income) elderly households and the degree to which they apply to seniors with higher incomes is unclear. As an informal check on this, we experimented with splitting the sample based on reported household income rather than educational attainment, obtaining estimates similar to those in Table 3 when the sample was truncated at the 75th percentile of household income. Thus, for the purpose of our policy simulations, we will assume that our estimates apply to all elderly households with incomes below this level, minus the 29 percent of elderly households whose incomes were less than 150 percent of the FPL in 2003,[7] and who would therefore qualify for full or partial cost-sharing waivers under the MMA. Calculations using 2003 Census data (available from the authors) indicate that there were roughly 10,600,000 elderly households with incomes between the 29th and 75th percentiles of household income in 2003, containing approximately 15,476,000 individuals.

In Table 4, we illustrate the impact of three hypothetical reductions in Social Security benefits: a 5 percent cut, similar in magnitude to a cut proposed by the "Boskin Commission" in the mid 1990s (see Snyder and Evans, forthcoming, for details); a 10 percent cut, similar in magnitude to the benefit reduction arising in the year 2015 from the switch to price indexing considered by the President's Commission to Strengthen Social Security (see Biggs et. al, 2005, for details); and a 20 percent cut, which is similar in magnitude to the benefit reduction in the year 2025 arising from a switch to price indexing .[8]

In predicting the impact of the policy changes described above, we use the regression coefficient from column 2 of Table 3 (0.552), rather than the associated income elasticity, so that our projections can be based on prescription drug use and Social Security income in 2005. To transform our coefficient estimate to one that measures the response to a $1000 change in Social Security income in 2005 dollars, we divide the regression coefficient by 1.35, the cumulative change in the CPI between 1993 and 2005 (http://www.bls.gov/cpi/home.htm). Thus, the response to a $1000 change in Social Security income in 2005 dollars would be 0.409 and the projected change in household prescription utilization is given by

$$\Delta D_h = 0.409 \times \Delta SSIncome_h \tag{3}$$

where $\Delta SSIncome_h$ is measured in thousands of 2005 dollars.

The predicted effects on prescription drug use arising from the hypothesized reductions in Social Security benefits are displayed in Table 4. Average household Social Security benefits in

2005 were $15,002 (authors' calculations using the 2003 March Current Population Survey, inflated to 2005 dollars). Thus, the projected reduction in household prescription drug use following a 10 percent decline in Social Security benefits would be equal to 0.409 × 1.50, or 0.61 prescriptions, with proportional declines following a 5 or 20 percent cut (Table 4, row 1). When aggregated across the 10,600,000 elderly households to whom our estimates apply, a reduction of this size translates into an aggregate decline in the demand for prescription drugs of 6,466,000 medications (Table 4, row 2). Given that the average elderly household used approximately 6.12 prescription medications in 2003,[9] this corresponds to a reduction in prescription drug use of roughly 10 percent.

Although it's not possible to gauge the health consequences of reduced drug utilization using our data, some tentative projections can be made by combining our estimates with those from other studies that have examined the health effects of cost-induced reductions in prescription drug use among the elderly. Of particular note is a study by Tamblyn et al. (2001), who were able to exploit a natural experiment in which cost sharing for prescription drugs was imposed by the Canadian province of Quebec in 1996. For the elderly, the new coinsurance and deductible provisions created a significant increase in the level of out-of-pocket spending that would be required to maintain drug utilization at existing levels. In response, elderly Quebecers reduced their use of essential medications by 9.12 percent, which led to an increase in adverse medical events (defined as hospitalizations, nursing home admissions, and deaths) of 6.8 events per 10,000 persons per month, or roughly 8000 events per million persons annually. This corresponds to approximately 877 events per million persons for each one percent reduction in prescription drug use. Thus, the 10 percent decline in prescription drug use that would follow a 10 percent reduction in Social Security benefits in the United States could result in over 135,000 adverse medical events each year (877 events per million for each one percent decline in prescription drug use × 10 percent reduction × 15.476 million individuals), with proportional increases following benefit reductions of 5 and 20 percent (Table 4, row 3).

6. Conclusions

In this paper, we made use of a unique natural experiment that led otherwise identical retirees to receive substantially different payments from the Social Security system. The benefits notch is unique because it constitutes the only break in an otherwise upward trend in the real value of benefits in the history of the Social Security program. By comparing those households that enjoyed artificially high benefits to adjacent cohorts whose benefit levels were lower, ceteris paribus, we were able to construct instrumental variable estimates of the income sensitivity of prescription drug use among low and moderate income retirees. The large income elasticities we found are potentially important when considering policy changes that affect transfer payments to the elderly, such as changes in Social Security benefits, and may also be useful for assessing the protective effect of the new Medicare prescription drug benefit.

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Table 1. Summary Statistics

	Low Education Group: Less than High School (N = 1755)			High Education Group: High School Diploma or More (N = 2252)		
	Mean (Std. Dev.)	Min.	Max.	Mean (Std. Dev.)	Min.	Max.
Household Prescriptions (Usual number of medications taken per month)	4.01 (3.00)	0.00	22.00	3.85 (2.92)	0.00	26.00
Household Social Security Income (1993 dollars)	9625 (4305)	1620	30,756	11,085 (5206)	1392	48,000
Social Security Beneficiary Born Between 1915-1917	0.18 (0.39)	0.00	1.00	0.18 (0.39)	0.00	1.00
Head is a Single Male	0.13 (0.34)	0.00	1.00	0.10 (0.31)	0.00	1.00
Head is a Never-Married Female	0.02 (0.13)	0.00	1.00	0.03 (0.16)	0.00	1.00
Head is a Female Widow	0.36 (0.48)	0.00	1.00	0.34 (0.47)	0.00	1.00
Head is a Divorced Female	0.03 (0.16)	0.00	1.00	0.03 (0.17)	0.00	1.00
Age of Head	77.43 (5.40)	63.00	93.00	76.35 (5.06)	64.00	92.00
Head's Race is African American	0.11 (0.31)	0.00	1.00	0.03 (0.17)	0.00	1.00
Head's Race is Other	0.03 (0.16)	0.00	1.00	0.01 (0.09)	0.00	1.00
Head's Ethnicity is Hispanic	0.08 (0.27)	0.00	1.00	0.02 (0.14)	0.00	1.00
Household is located in a MSA	0.64 (0.48)	0.00	1.00	0.78 (0.42)	0.00	1.00

Notes: Summary statistics are weighted using the AHEAD household weights. The omitted category for the head-of-household variable is married male. All regression models also contain indicators for the nine Census regions.

Table 2. Effect of the Benefits Notch on Social Security Income by Educational Attainment

	Low Education Group: Less than High School			High Education Group: High School Diploma or More		
	Linear Age Specification	Quadratic Age Specification	Cubic Age Specification	Linear Age Specification	Quadratic Age Specification	Cubic Age Specification
Notch Indicator - Effect on household Social Security income (thousands of 1993dollars)	1.402 (0.243) [0.000]	1.064 (0.236) [0.000]	1.044 (0.255) [0.000]	0.301 (0.423) [0.482]	0.072 (0.432) [0.869]	0.116 (0.440) [0.794]
R-Squared	0.434	0.443	0.443	0.321	0.322	0.323
N	1755	1755	1755	2252	2252	2252
F-Statistic on Notch Indicator	33.18	20.40	16.80	0.51	0.03	0.07

Notes: The dependent variable is annual household Social Security income measured in thousands of 1993 dollars. The notch indicator equals “one” if the head of the household was born in 1915, 1916, or 1917, and “zero” otherwise. The age variable used in each specification is the age of the head. All models also include controls for the type of household (male head – married or cohabiting; male head – single; female head - never-married; female head – widowed; and female head - divorced), race of the head (white, African American, or other), Hispanic ethnicity of the head, whether the household is located in a MSA, and region (indicators for each of the nine Census regions). All regressions are weighted using the AHEAD household weights. Robust standard errors, adjusted for clustering on birth year, are displayed in parentheses; p-values are displayed in brackets.

Table 3. Effect of Social Security Income on Number of Prescriptions: Baseline Estimates

	Linear Age Specification		Quadratic Age Specification		Cubic Age Specification	
	OLS	IV	OLS	IV	OLS	IV
Household Social Security Income (thousands of 1993 dollars)	0.013 (0.026) [0.626]	0.489 (0.129) [0.001]	0.003 (0.024) [0.896]	0.552 (0.174) [0.004]	0.003 (0.024) [0.903]	0.583 (0.203) [0.008]
Elasticity	0.03	1.17	0.01	1.32	0.01	1.40
R-Squared	0.138	--	0.142	--	0.142	--
N	1755	1755	1755	1755	1755	1755
Reduced-Form Regression						
Notch Indicator - Effect of benefits notch on number of prescriptions	--	0.686 (0.180) [0.001]	--	0.588 (0.182) [0.003]	--	0.609 (0.193) [0.004]
R-Squared	--	0.145	--	0.147	--	0.147

Notes: The dependent variable is the usual number of prescription medications taken per month by the respondent and his/her spouse. The age variable used in each specification is the age of the head. All models also include controls for the type of household (male head – married or cohabiting; male head – single; female head - never-married; female head – widowed; and female head - divorced), race of the head (white, African American, or other), Hispanic ethnicity of the head, whether the household is located in a MSA, and region (indicators for each of the nine Census regions). All regressions are weighted using the AHEAD household weights. Robust standard errors, adjusted for clustering on birth year, are displayed in parentheses; p-values are displayed in brackets.

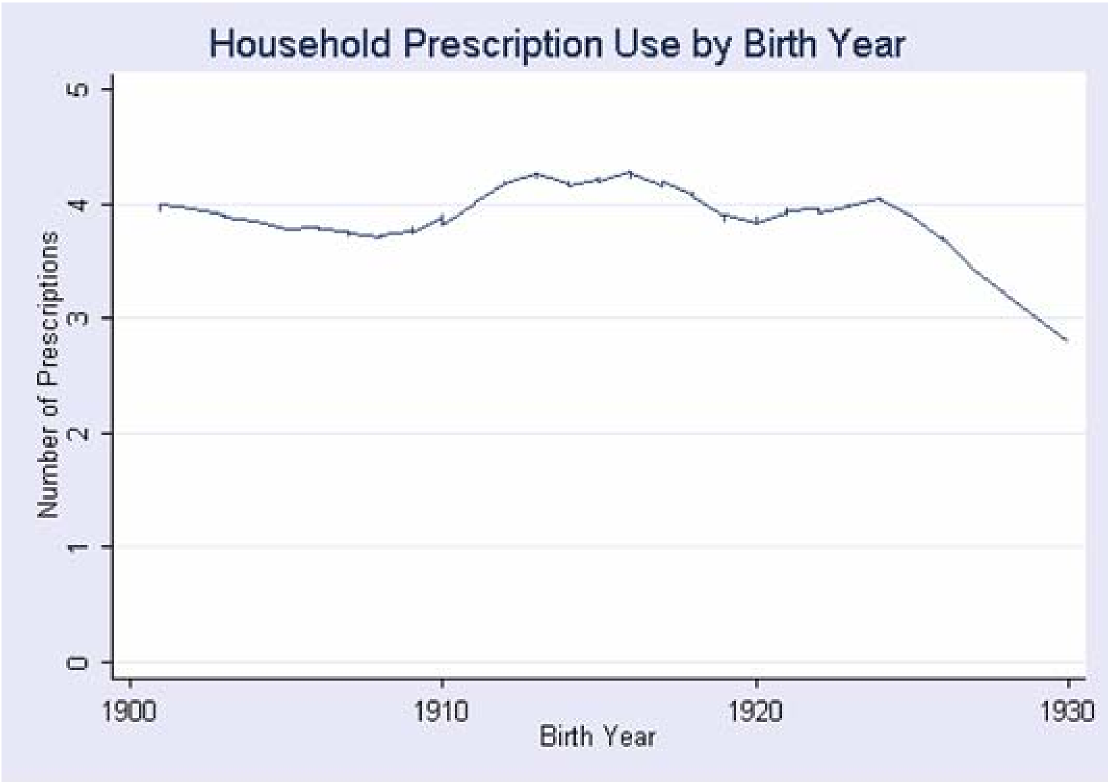
Table 4. Projected Effect of Hypothetical Social Security Benefit Cuts on Prescription Drug Utilization and Adverse Medical Events

	5 Percent Cut in Social Security Benefits	10 Percent Cut in Social Security Benefits	20 Percent Cut in Social Security Benefits
Average Per-Household Reduction in the Number of Medications Used by Elderly Households	-0.31 medications per household	-0.61 medications per household	-1.22 medications Per household
Total Reduction in Demand for Prescription Medications by Elderly Households	-3,233,000 medications	-6,466,000 medications	-12,932,000 medications
Effect on Annual Adverse Medical Events	+67,877 adverse events	+135,754 adverse events	+271,508 adverse events

Notes: Authors' calculations using the IV regression coefficient from column 2 of Table 3, transformed to measure the effect of a $1000 change in household Social Security income in 2005 dollars. Given average household Social Security income of $15,002 in 2005, a 10 percent reduction in Social Security benefits corresponds to $1500, which results in a predicted decline in household prescription use of 0.409×1.50, or 0.61 prescriptions per household. Calculations for a 5 or 20 percent benefit reduction are similar. The aggregate reductions listed in the second row were obtained by multiplying the corresponding household-level reduction by 10,600,000 households. This is the number of elderly households with incomes falling between the 29th and 75th percentiles of the income distribution for households headed by someone aged 65 or over. The effect on adverse medical events (hospitalizations, nursing home admissions, and deaths) were obtained by multiplying estimates of the effect of a 10 percent reduction in prescription drug use on adverse event rates per million population (Tamblyn et al., 2001) by the number of elderly individuals in the household income range cited above (15.476 million in 2003).

Figure 1

Figure 2



APPENDIX

In this Appendix we perform specification checks for measurement error, the existence of cohort effects which could bias our results, and possible misspecification from the use of a linear model.

A. *Exclusion of Widowed and Divorced Females*

In assigning a birth year to households headed by divorced or widowed females, it was necessary to rely on the assumption that the former husbands of these women were born three years earlier than their wives (Engelhardt, Gruber and Perry, 2005). Although this assumption would appear to be innocuous, we provide a quick check by re-estimating equation (1) with these households omitted from the sample. The results, reported in Appendix Table A1, are quite similar to our baseline estimates from Table 3.

B. *Cohort Effects*

To examine the sensitivity of our results to possible cohort effects, we focus on two that seem especially plausible. The first involves individuals born during 1918 and 1919, who may have had *in utero* exposure to the flu virus that was present in epidemic proportions during those years. Almond (2003) presents evidence that such individuals may suffer from poorer health throughout their lives, suggesting that our instrument may be correlated with unmeasured differences in prescription drug utilization. We investigate this possibility by dropping households whose primary Social Security beneficiary was born during the flu years of 1918 and 1919. Results from this sensitivity check, which are displayed in Appendix Table A2, indicate little change relative to our baseline estimates.

A more general issue relates to the overall comparability of our treatment and control groups given that our control group is made up of households whose primary beneficiaries were born over a period spanning 30 years. As one compares the notch households to households that are further removed in time, the likelihood of there being systematic differences in prescription drug use, for reasons unrelated to (notch-induced) differences in Social Security income, increases. We examine this possibility by re-estimating equation (1) using only households whose primary Social Security beneficiary was born between 1910 and 1920, reducing by almost two decades the range of cohorts compared. As can be seen from Appendix Table A3, restricting attention to a narrower range of birth cohorts slightly increases the estimated effect of Social Security income on prescription use in our IV regressions (and this effect remains statistically significant at conventional levels), while the OLS estimates are again small and statistically insignificant.

C. *Count Data Specification*

As a final robustness check, we explore the sensitivity of our baseline estimates to possible misspecification arising from our use of linear IV methods in conjunction with a dependent variable that is measured as a count. To check for possible misspecification, we re-estimate equation (1) using a two-stage quasi maximum likelihood procedure (detailed in Wooldridge, pp. 663-666) in which the natural log of Social Security income[10] is regressed on the notch and other covariates and the resulting residuals are included in a Poisson or negative binomial model estimated by maximum likelihood. This approach is similar to the methods developed by Smith and Blundell (1986) and Rivers and Vuong (1988) for conducting IV estimation in other limited dependent variable settings.[11] In Appendix Table A4, we report results for the negative binomial model only, but estimates (available from the authors) are extremely similar when a Poisson model is used. For the IV specifications, the standard errors are based on a bootstrap of the combined two-stage procedure involving 1000 repetitions of both stages, allowing for clustering on birth year. As can be seen from a comparison of Tables 3 and A4, both the ordinary and IV negative binomial estimates are similar to the corresponding estimates from Table 3.

Table A1. Excluding Households Headed By Widows and Divorced Females

	Linear Age Specification		Quadratic Age Specification		Cubic Age Specification	
	OLS	IV	OLS	IV	OLS	IV
Household Social Security Income (thousands of 1993 dollars)	0.029 (0.030) [0.342]	0.436 (0.132) [0.002]	0.016 (0.028) [0.571]	0.437 (0.181) [0.022]	0.016 (0.028) [0.571]	0.443 (0.187) [0.025]
Elasticity	0.07	1.06	0.04	1.06	0.04	1.07
R-Squared	0.092	--	0.099	--	0.099	--
N	1069	1069	1069	1069	1069	1069
First-Stage Regression						
Notch Indicator - Effect of benefits notch on household Social Security income (thousands of 1993dollars)	--	2.214 (0.465) [0.000]	--	1.821 (0.481) [0.001]	--	1.808 (0.486) [0.001]
F-Statistic on Instrument	--	22.67	--	14.35	--	13.82

Notes: The dependent variable is the usual number of prescription medications taken per month by the respondent and his/her spouse. All regressions include the controls listed at the bottom of Table 3 and are weighted using the AHEAD household weights. Robust standard errors, adjusted for clustering on birth year, are displayed in parentheses; p-values are displayed in brackets.

Table A2. Excluding Cohorts Born During the 1918 Flu Epidemic: Birth Cohorts 1918 and 1919

	Linear Age Specification		Quadratic Age Specification		Cubic Age Specification	
	OLS	IV	OLS	IV	OLS	IV
Household Social Security Income (thousands of 1993 dollars)	0.020	0.455	0.008	0.497	0.007	0.518
	(0.026)	(0.136)	(0.025)	(0.181)	(0.024)	(0.232)
	[0.458]	[0.002]	[0.750]	[0.011]	[0.767]	[0.034]
Elasticity	0.05	1.08	0.02	1.18	0.02	1.23
R-Squared	0.138	--	0.143	--	0.143	--
N	1534	1534	1534	1534	1534	1534
First-Stage Regression						
Notch Indicator - Effect of benefits notch on household Social Security income (thousands of 1993dollars)	--	1.457	--	1.084	--	1.065
		(0.273)		(0.253)		(0.298)
		[0.000]		[0.000]		[0.001]
F-Statistic on Instrument	--	28.49	--	18.33	--	12.74

Notes: The dependent variable is the usual number of prescription medications taken per month by the respondent and his/her spouse. All regressions include the controls listed at the bottom of Table 3 and are weighted using the AHEAD household weights. Robust standard errors, adjusted for clustering on birth year, are displayed in parentheses; p-values are displayed in brackets.

Table A3. Utilizing A Narrower Range of Birth Cohorts: 1910 – 1920

	Linear Age Specification		Quadratic Age Specification		Cubic Age Specification	
	OLS	IV	OLS	IV	OLS	IV
Household Social Security Income (thousands of 1993 dollars)	0.007 (0.034) [0.848]	0.507 (0.143) [0.005]	0.003 (0.030) [0.931]	0.606 (0.225) [0.022]	0.002 (0.031) [0.961]	0.586 (0.222) [0.025]
Elasticity	0.02	1.24	0.01	1.48	0.00	1.43
R-Squared	0.191	--	0.192	--	0.192	--
N	1062	1062	1062	1062	1062	1062
First-Stage Regression						
Notch Indicator - Effect of benefits notch on household Social Security income (thousands of 1993dollars)	--	1.202 (0.236) [0.000]	--	1.000 (0.246) [0.002]	--	1.072 (0.261) [0.002]
F-Statistic on Instrument	--	26.00	--	16.49	--	16.89

Notes: The dependent variable is the usual number of prescription medications taken per month by the respondent and his/her spouse. All regressions include the controls listed at the bottom of Table 3 and are weighted using the AHEAD household weights. Robust standard errors, adjusted for clustering on birth year, are displayed in parentheses; p-values are displayed in brackets.

Table A4. Negative Binomial Models

	Linear Age Specification		Quadratic Age Specification		Cubic Age Specification	
	Ordinary Negative Binomial	IV Negative Binomial	Ordinary Negative Binomial	IV Negative Binomial	Ordinary Negative Binomial	IV Negative Binomial
Natural Log of Household Social Security Income (thousands of 1993 dollars)	-0.022 (0.052) [0.675]	1.272 (0.485) [0.009]	-0.041 (0.052) [0.429]	1.586 (0.718) [0.027]	-0.041 (0.052) [0.427]	1.708 (0.856) [0.046]
N	1755	1755	1755	1755	1755	1755
First-Stage Regression						
Notch Indicator - Effect of benefits notch on natural log of household Social Security income (thousands of 1993dollars)	--	0.118 (0.017) [0.000]	--	0.080 (0.016) [0.000]	--	0.078 (0.019) [0.000]
F-Statistic on Instrument	--	45.58	--	23.99	--	17.42

Notes: The dependent variable is the usual number of prescription medications taken per month by the respondent and his/her spouse. All regressions include the controls listed at the bottom of Table 3 and are weighted using the AHEAD household weights. Bootstrapped standard errors, allowing for clustering on birth year, are displayed in parentheses; p-values are displayed in brackets.

[1] Concerns about the affordability of prescription drugs will be addressed, in part, by the recently enacted Medicare Prescription Drug Improvement and Modernization Act of 2003 (MMA), but income will still be an important factor in determining drug utilization for many Americans due to the incomplete nature of the coverage provided by the Medicare drug benefit. Most retirees will face a $250 annual deductible, a 25% coinsurance rate on their first $2250 of drug expenses, and no coverage for prescription expenses between $2250 and $5100 (corresponding to $3600 in out-of-pocket spending), with a 5% coinsurance rate being applied to expenditures above $5100. Factoring in premiums of $420 per year, beneficiaries will pay roughly $4000 out of pocket on their first $5100 of drug expenses. An additional feature of the MMA, which has received little attention to date, is the indexing of the cost-sharing thresholds, many of which are expected to rise more rapidly than inflation. For example, the initial $3600 stop-loss amount is scheduled to rise to $6400 by the year 2013, a cumulative increase of 78 percent over seven years (see Altman, 2004 for details).

[2] Figure 1 was obtained from our estimation sample by conditioning out all relevant covariates except birth year, taking the residuals as the new variable, and normalizing the diagram around mean Social Security income. We then used the LOWESS command in STATA to smooth the series.

[3] One might argue that the ensuing reduction in benefits created by the 1977 Amendments could have been anticipated, but this does not seem to have been the case. As Snyder and Evans (forthcoming) note, it was actually the interaction between double indexation and the accelerating inflation of the 1970s that made the initial mistake so costly, and which led

Congress to abruptly modify the law in 1977 - a change which most accounts suggest went unnoticed until after the affected cohorts began to retire.

[4] Although the AHEAD does not provide information on the birth year of deceased or former husbands, it does provide data on their level of education. We use this variable to form the sample split depicted in Table 1.

[5] Results were also generally unchanged when age was entered as a quartic. Unfortunately, allowing this level of flexibility in the age variable induced a near singularity in the **X** matrix due to the high degree of collinearity among the age terms.

[6] Note that the Social Security income figure reported in Table 1 must be converted into thousands of dollars before performing the elasticity calculation.

[7] This figure comes from the table, POV01: Age and Sex of All People, Family Members and Unrelated Individuals Iterated by Income-to-Poverty Ratio and Race: 2003 Below 150% of Poverty – All Races," available online at: http://pubdb3.census.gov/macro/032004/pov/new01_150_01.htm. Information on households by age of householder is contained in the last set of rows.

[8] The specific form of price indexing we consider is one detailed in the 2001 report of the President's Commission to Strengthen Social Security, termed "PIA Factor Indexing" by Biggs, Brown and Springstead (2005). Simply put, this proposal would reduce each PIA factor (the 3 earnings replacement rates, currently set at 90, 32, and 15 percent) by the ratio of the change in prices to the change in wages. Note that because this procedure holds real benefits fixed, the comparison being made is relative to current law, which allows real benefits to keep pace with overall living standards. Thus, the calculations shown in Table 4 provide an estimate of how

much prescription use would decline if the current law were modified to incorporate this form of price indexing.

[9] Authors' calculations using data on household prescription drug use from Safran et al. (2005) combined with 2003 Census data on the fraction of single vs. two-person elderly households.

[10] Because both the Poisson and negative binomial models are based on an exponential regression function, replacing Social Security income with its natural log yields a coefficient on the log of Social Security income that is directly interpretable as an elasticity (Wooldridge, p. 648).

[11] Mullahy (1997) derives a more computationally demanding GMM estimator that can be applied when the first stage is potentially nonlinear, e.g., when the endogenous explanatory variable is discrete.