The Spending and Debt Response to Minimum Wage Hikes

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Abstract

Following a minimum wage hike, households with minimum wage workers often buy vehicles. On average, vehicles spending increases more than income among impacted households. The size, timing, persistence, composition, and distribution of the spending response is inconsistent with the basic certainty equivalent life cycle model. However, the response is consistent with a model in which impacted households face collateral constraints.

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1 Introduction

Many U.S. social insurance programs provide economic assistance to low-income households. Yet, there is little evidence on the spending response to income fluctuations among these households. In this paper, we provide new evidence based on the income increase caused by minimum wage changes. Using data from the Consumer Expenditure Survey (CEX), Survey of Income and Program Participation (SIPP), Survey of Consumer Finances (SCF), Current Population Survey (CPS), and administrative bank and credit bureau records, we document the magnitude, timing, composition, and distribution of spending and debt responses among households with minimum wage workers after a minimum wage hike.

We present four key empirical findings that are inconsistent with the basic certainty equivalent Life Cycle/Permanent Income Hypothesis. However, they are consistent with an augmented buffer stock model in which households are collateral constrained (i.e., they can borrow against part, but not all, of the value of their durable goods).

First, the spending response is too large to be consistent with the permanent income hypothesis. Following a $1 minimum wage hike, total spending increases by over $800 per quarter in the near term. This exceeds the roughly $300 per quarter increase in family income following a minimum wage hike of similar size. The high spending levels are corroborated by other data showing that debt rises substantially after a minimum wage hike, indicating that spending increases more than income. These results are particularly surprising given that most individuals earning the minimum wage at a point in time make well above the minimum two years later. All told, minimum wage hikes increase lifetime income by roughly $1,500. If households were spreading that income gain over their lifetimes, the short-run spending increase should be an order of magnitude smaller than what we observe in the data.

The majority of this additional spending is in durable goods, in particular vehicles. While augmenting the permanent income model to account for durables raises the predicted short-term spending response, it is still far smaller than what our empirical estimates imply. Rather, our estimates are consistent with a model in which households face collateral constraints. If households face collateral constraints, small income increases can generate small down payments, which in turn can be used for large durable goods purchases. With a 20% downpayment, each additional dollar of income can be used to purchase five dollars of durable goods. We find that, consistent with this model, most of the debt increase is in collateralized debt,

such as auto loans.

Second, we find that the total spending response begins to rise within one quarter of a minimum wage increase. But minimum wage legislation is typically passed 6 to 18 months prior to its effective date.[1] The permanent income hypothesis implies that spending should rise when households learn about the hike. So long as minimum wages hikes are known in advance, the permanent income hypothesis implies that minimum wage households should increase spending before the hike. However, if households are unable to borrow against future income in order to finance current spending, their spending will not rise until the minimum wage increases.

Third, the composition of pre-hike spending is altered in a way that is consistent with forward-looking behavior and borrowing constraints. Prior to the minimum wage hike, durables spending falls and non-durables spending rises by roughly equal amounts, so the total spending response is almost 0. After the minimum wage hike, non-durables spending barely increases further, but durables spending increases significantly. In the face of borrowing constraints, fluctuations in durables spending is optimal because a short-run decline in durables spending has a small effect on the durables stock and its corresponding service flow. Put simply, it is easier to postpone buying a car than food.

Finally, high levels of durables spending and debt accumulation persist for several quarters after a minimum wage hike. This result is inconsistent with models that allow for unlimited borrowing, but is consistent with a model where households face a collateral constraint that potentially binds for several periods.

A large response in durable spending is consistent with many papers that focus on sizable disposable income changes, including those based on tax refunds (Parker 1999, Souleles 1999), the EITC (Barrow and McGrannahan 2000, Adams, Einav, and Levin 2008), job loss (Browning and Crossley 2008), and other large income changes (Krueger and Perri 2008). Moreover, Adams, Einav, and Levin (2008) and Souleles (1999) also find evidence that much of this response in durable spending is for vehicles.[2] Our reading of the literature is that big-

[1]For example, of the 19 state minimum wage changes between 2000 and 2004 (excluding CPI adjustments), the median time between legislation and enactment date is 9 months. Only two increases (California in 2001 and Rhode Island in 2000) occurred less than five months after the bill's passage. Even among those, legislative debate began well before passage.

[2]However, other papers find no response in durable spending (e.g., Browning and Collado 2001, Hsieh 2003) or a highly imprecise response (e.g., Coulibaly and Li 2006).

ger responses in durable spending tend to be found in papers based on large relative income gains among more liquidity constrained households.

Models where households can borrow against durable goods are increasingly common for understanding the dynamics of consumer durables (Fernandez-Villaverde and Krueger 2002, Campbell and Hercowitz 2003), housing (Carroll and Dunn 1997, Attanasio et al. 2008, Hryshko et al. 2008) and entrepreneurship (Kaboski and Townsend 2008). However, there is little direct micro evidence on the quantitative importance of the constraint. Our paper provides such direct evidence.

We also consider how alternative models can fit these spending patterns. In particular, a model with an adjustment cost to durables transactions, as in Grossman and LaRoque (1990) and Eberly (1994), cannot by itself explain the size, timing, or composition of spending responses after a minimum wage hike. However, augmented with borrowing constraints, adjustment cost models can match the heavily skewed distribution of the spending responses, as well as the magnitude of those responses at the right tail of the minimum wage household spending distribution.

Our identification strategy is attractive relative to previous tests of the permanent income hypothesis. First and foremost, we use compelling, albeit standard, treatment and control groups from the minimum wage literature. That is, we compare households with minimum wage workers in states that experience minimum wage increases to households with minimum wage workers in states that do not experience minimum wage hikes.

Additionally, we take advantage of the fact that minimum wage hikes should not affect income of workers making well above the minimum wage. We find that the minimum wage has small effects on the income and spending of workers making 120 to 200 percent of the minimum wage and no effect on workers that are at least double the minimum. Interestingly, this spending gradient provides new indirect evidence of the extent to which minimum wage increases spill over into the wage distribution.

The second attractive feature of our identification strategy is that minimum wage increases have large effects on the income of minimum wage workers, at least in the short-run. Some previous scholars have argued that rejection of the permanent income hypothesis is often a result of an income change that is too small in size or irregular in frequency.[3] To such a

[3]See, e.g., Browning and Collado (2001) and Hsieh (2003).

small intervention, "households will not bother to change their consumption paths when the computational costs are large relative to the utility gains" (Hsieh 2003). Although minimum wage hikes are irregular, which helps us overcome the seasonality issue, they typically increase hourly wages by 5 to 20 percent. Specifically, we show that income in households with adult minimum wage workers rises by roughly $1,500 in the two years after a $1 increase in the minimum wage.[4]

It is important to underscore our focus on households that had a minimum wage job prior to an increase in the minimum wage. It is possible that a minimum wage increase reduces the odds that those without a job will be able to find one. Moreover, we ignore most teenagers, where the evidence of disemployment is most compelling. Consequently, our estimates are silent about the aggregate effects of minimum wage hikes. However, for those adults who had a minimum wage job prior to a minimum wage hike, consumption, income, and debt rise afterward.

The rest of the paper is organized as follows. Section 2 provides a description of the CEX, SIPP, and credit card data sets used to estimate the spending, income, and debt responses. Section 3 describes the empirical results. Section 4 outlines a calibrated model of household spending responses to a minimum wage increase when borrowing constraints are present versus absent and links these results to the empirical findings. Section 5 concludes.

2 Data

This section briefly describes the three datasets that we rely on to measure spending, income, and debt responses to minimum wage changes.

2.1 Consumer Expenditure Survey (CEX)

The CEX is a representative sample of U.S. consumer units, providing detailed information on household spending.[5] We use surveys from 1982 through 2005, enabling us to study the impact from four federal and numerous state minimum wage increases.[6]

[4]Many minimum wage hikes are closer to 50 cents, but this still means a $750 income gain over two years.

[5]For ease of exposition, we refer to consumer units as households from here on out.

[6]Minimum wage histories are taken from various issues of the Monthly Labor Review. See, for example, Aaronson (2001).

Households are interviewed up to four times, spaced three months apart. In each interview, households are asked about detailed spending patterns for the previous three months. While this design provides monthly data, we take the standard approach to CEX data and aggregate to the quarterly frequency.

In the first interview, households are also asked about individual income and hours worked over the previous year. We use this information to calculate the hourly wage of the first two adult (older than 18) members of the household and construct w^*, minimum wage labor's share of total household income:

$$w^* = (E_{11} \times I\{w_{11} \leq w_{min,i1} \times L\} + E_{21} \times I\{w_{21} \leq w_{min,i1} \times L\})/F_{.1}, \tag{1}$$

where E_{11} and E_{21} are the salary income for persons 1 and 2 (typically, the head and spouse) in time period 1, $F_{.1}$ is total pre-tax non-asset income in the first period that the household is observed in the data, and $I\{w_{11} \leq w_{min,i1} \times L\}$ and $I\{w_{21} \leq w_{min,i1} \times L\}$ are indicators of whether persons 1 and 2 are adult minimum wage workers in the initial period. Previous research has shown that minimum wage hikes increase the wages of workers that make slightly above the minimum wage. Thus we set L to be 1.2 in equation (1) (i.e. 120 percent of the minimum wage) for most of our analysis.

The requirements to compute w^* cause some households to be dropped. This is particularly important in two cases. The CEX does not report actual state of residence for those residing in smaller states. Because state codes are needed to know effective minimum wage levels, 19.9 percent of the full CEX sample is cut. Another 16.7 percent of the remaining sample must be dropped because their income responses are incomplete. We ultimately use 192,114 household-surveys, representing 58,404 households, that meet criterion on age, family composition, hourly wages, and self-employment status.[7] Of these, 11.3 percent, or 21,695

[7]In particular, we exclude the self-employed (6.5 percent), households headed by those under 18 or over 64 (20.7 percent), households in the survey for only one period (11.4 percent), households without an initial wage for the head and spouse (13.7 percent), and households where either of the two member's hourly wage is only 60 percent (that is, implausibly low) or 40 times greater than the effective minimum wage in the initial survey (4.2 percent). We also exclude 2.5 percent of the remaining sample because of large changes in family composition (either the number of kids or the number of adults changes by more than 2), head's age (greater than two years) or head's gender. Finally, we exclude just over 3 percent of the remaining household-survey observations because of large (log change of 1.5 of greater) changes in log hourly wages between the initial survey and the last survey. At a wage of $4 per hour in the first survey, this would require that hourly wages not rise beyond $18 nine months later in the last survey. Many of these restrictions are meant to reduce the impact of measurement error or to exclude large and hard to model changes in circumstances likely unrelated

household-surveys, are from households with some minimum wage income in the initial period (i.e. $w^* > 0$). Just under 15,200 are from families where minimum wage income makes up over 20 percent of total pre-tax income (i.e. $w^* \geq 0.2$).

Table A1 includes descriptive statistics of the key variables, including real total, durables, and nondurables and services spending, real family income, and selected demographics. The income measures for the $w^* \geq 0.2$ group line-up well with the SIPP, a survey that is specifically designed to measure income of low-wage populations and that we rely on for our estimates of income responses.[8]

2.2 Credit Card and Credit Bureau Data

We also use a proprietary dataset from a large financial institution that issues credit cards nationally. The dataset contains two and half year overlapping panels of over 200,000 credit card accounts from 1995 to 2003. We are able to track spending, payments, balances, and debt levels, as well as APR and credit limits, at the monthly frequency. To this basic information, this institution appended credit bureau data about the card holders' mortgage, auto, home equity, and other credit card balances, as well as the credit risk (FICO) scores of the borrower. These credit bureau data are available quarterly. To identify longer spending and debt responses, we also use a separate sample of credit card accounts that begin in January 2000 and run for four years.

Besides providing an independent source of spending information, there are advantages to the credit card data relative to the CEX. Measurement error is less of a concern,[9] panels are longer, and, perhaps most important, high quality debt and credit limit information are available.

However, there are some drawbacks as well. Only one-third of spending appears on credit cards (Gross and Souleles 2002, Agarwal et al. 2007). Moreover, minimum wage workers with credit cards are a selected sample of all minimum wage workers. According to the Survey

to changes in the minimum wage. The percentages reported in this footnote are ordered in that each one reflects the share of excluded observations relative to the sample that remains up to that point.

[8]For $w^* \geq 0.2$, average real total family income before taxes in the SIPP is \$20,382 (in 2000 dollars), or 8.8 percent higher than in the CEX. Real salary income for the top two adult members of the household is only 1 percent higher in the SIPP. Nonsalary income is also quite close. The majority of the roughly \$1,500 difference is from salary of other household members.

[9]See footnote 2 in Gross and Souleles (2002).

of Consumer Finances, only 43 percent of households in the bottom quintile of the income distribution own a credit card (Johnson 2007).

Finally, wage and demographic information are limited. We only have information for individual card-holders, not the unit of interest, the household.[10] Even among card-holders, we do not have earnings and hours information necessary to compute hourly wages. The only income data available is self-reported annual earnings of the account holder at the time of the credit card application.

In order to compute the probability, P_i, that an account holder is a minimum wage worker, we use the CPS to estimate a probit model of whether a worker was within 120 percent of the minimum wage. Covariates are a quartic in annual earnings, a quartic in age, an age times annual earnings quartic, female, married, and female times married. The estimated probit model reveals that 70 percent of all individuals earning less than $15,000 per year are minimum wage workers, whereas virtually no one earning over $20,000 per year is a minimum wage worker.

Table A1 provides summary statistics for the main credit card variables. For a more complete data description, see Agarwal et al. (2007).

2.3 The Survey of Income and Program Participation (SIPP)

We estimate the income response to minimum wage hikes primarily using the SIPP. Besides providing larger samples and longer panels, the main advantage to the SIPP is that it is specifically designed to collect high-quality earnings and income information, including an hourly wage measure for workers paid by the hour. The first SIPP panel we use begins in 1986 and the last ends in 2003. Each panel lasts between two and four years and provides interviews with between 12 and 40 thousand households. Households are interviewed every four months during the time they remain in a panel. While they are asked to recall labor market information for each month between interviews, we only use the current month information. Nevertheless, this still allows us to collect long panels of 4 month increments for thousands of households.

Variables are coded, and wage, self-employment, and family composition restrictions are

[10] We partially circumvent this limitation when using the debt data, since debt contracts are typically written at the household level. Therefore, the credit bureau data are often, but not always, at the household level.

introduced, to be as close as possible to the CEX sample.[11] Like the CEX analysis, the numerator on w^* (total income from minimum wage earners) is also computed on the household head and, when applicable, spouse, only in the first period that we observe them.

Based on a computed wage measure (monthly earnings divided by monthly hours), there are 80,700 households, and 546,474 household-survey observations remaining after our sample restrictions,[12] of which 11.1 percent report some minimum wage earnings and 8.7 percent report at least 20 percent of their total household nonproperty income from minimum wage earners. About 390,000 household-survey observations are available when we use the hourly wage measure from workers paid by the hour. Table A1 provides summary statistics for the key variables.

3 Empirical Results

3.1 Estimating Equations

Our empirical strategy is standard. We estimate equations of the form:

$$Z_{it} = f_i + \sum_{k=-K}^{K} \phi_k w_{min,it+k} + \omega' X_{it} + u_{it} \tag{2}$$

where Z_{it} is either spending in non-durables or durables, income or change in debt, and $w_{min,it+k}$ is the minimum wage rate for the state that individual i resides in at time $t+k$.[13] X_{it} includes year and quarter dummies or a full set of month dummies.[14]

The credit card and debt data do not include detailed wage information. To overcome this problem, we predict the probability P_i that an individual is a minimum wage worker using the CPS and the methods described in section 2.2. Thus for the credit card and debt regressions, we weight the minimum wage variable $w_{min,it+k}$ in equation (2) by the probability that the

[11] Because the CEX does not follow households after they move, we provide results that include and exclude movers.

[12] The definition of a household is not as straightforward as in the CEX. We rely on the variable *ppentry* to define households. Experimentation with other methods, such as holding composition fixed (stable households), does not qualitatively change the results.

[13] When using quarterly CEX data, $w_{min,it+k}$ is the average value of the minimum wage over the quarter.

[14] In our SIPP and CEX estimates, we also condition on the number of adults and the number of kids in the household in order to be consistent with other research (e.g. Johnson, Parker, and Souleles 2006). However, once the household fixed effect, f_i, is included, we find no observable covariates in the CEX or the credit card data that substantively impact our coefficient of interest, ϕ_k.

holder is a minimum wage worker.[15] The regression becomes

$$Z_{it} = f_i + \sum_{k=-K}^{K} P_i \phi_k w_{min,it+k} + \omega' X_{it} + u_{it}. \quad (3)$$

3.2 The Income Response

Before turning to spending effects, we begin by describing the size of the household income response to a minimum wage change. These results ignore dynamics, i.e. set $K = 0$ in equation (2). Table 1 reports the results stratified in rows by w^*, the share of household income from minimum wage workers. Each cell represents a different regression. The top number is the point estimate, the second number is the standard error corrected for within-household serial correlation, and the third is the sample size.

As expected, we find that income rises for households with minimum wage workers but not for households without such earners.[16] In particular, using the sample of SIPP workers that report an hourly wage for hourly earnings, quarterly household income increases by $255 (with a standard error of $177) for minimum wage households where minimum wage labor is the source of at least 20 percent of total income ($w^* \geq 0.2$). Columns 2 and 3 establish that the earnings response declines for higher waged workers. For example, quarterly income increases by only $36 ($105) for households that include someone making 200 to 300 percent of the minimum wage. The next four columns show that the results are reasonably similar when we exclude households that move in order to be analogous to the CEX sample design (column 4), exclude households headed by someone with a college education (column 5), and use an alternative wage measure based on monthly earnings and hours (columns 6 and 7).

Virtually identical results are found among CPS respondents, displayed in the final two columns of the table.[17] Again, we find a large total income response in households with minimum wage earnings but no impact on non-minimum wage households.[18] We also estimated

[15] In other words, we assume spending is as in equation (2) with probability P_i and is equal to $f_i + \omega' X_{it} + u_{it}$ with probability $(1 - P_i)$, which gives rise to equation (3).

[16] A handful of studies have also estimated similar income equations. Recent examples include Draca, Machin, and Van Reenen (2008), Addison, Blackburn, and Cotti (2008), and Neumark, Schweitzer, and Wascher (2004, 2005). Each of these studies finds evidence that minimum wage hikes increase household income in the short-run.

[17] This sample is also constructed to be as analogous as possible to the CEX, as described in section 2.

[18] Again, there are smaller effects among CPS households with earners just above the minimum. Defining earnings between 120 to 200 and 200 to 300 percent as minimum wage earnings, as in columns 2 and 3, the income response for CPS households with $w^* \geq 0.2$ are $139 ($77) and $-22 ($84).

(unreported) income responses with the CEX. Quarterly income rises by $241 ($262) in that data but there are measurement issues that lead us to put less faith in estimates derived from the CEX than from the SIPP or CPS.[19]

Of course, we can combine the datasets to compute a weighted average income response, where the weights are based on the precision of the estimates. This analysis suggests that, in the near-term, household quarterly income rises by $309 with a standard error, calculated using standard GMM formulas, of $103.

The long-run effect of the minimum wage on income is more difficult to measure. Neumark et al. (2004, 2005) find that any income gain from a minimum wage increase dissipates substantially, perhaps even evaporates, within two years. This result is consistent with the empirical finding that most individuals who earn the minimum wage at a point in time will earn well above the minimum wage two years later (Smith and Vavrichek 1992; Carrington and Fallick 2001). Indeed, only 38 percent of SIPP workers within 120 percent of their state's effective minimum wage are still within that range a year later. Two years later, only 28 percent are within 120 percent of the minimum wage.

Disemployment effects could potentially cause an increase in the probability of having zero income after minimum wage hikes. To test this we estimate the probability of zero income, given that $w^* \geq 0.2$ (i.e., the household had significant minimum wage income when first interviewed) and the household had positive income in the previous interview. The probability of having zero income given these conditions and no minimum wage increase is 0.0417, not statistically different from 0.0413, which is the probability of zero income given a minimum wage increase.[20]

3.3 The Magnitude of the Total Spending Response

Next, we quantify the size of the spending response to a minimum wage increase. We begin with the average spending response, ignoring dynamics. Findings from both the CEX

[19]The CEX asks about annual income, earnings, and hours twice – at the beginning and end of the sample, which are nine months apart. Because the surveys are nine months apart, there is a one quarter overlap of income. Thus income differs between households that received hikes and those that did not by a maximum of three quarters (and thus we divide the minimum wage coefficient by on annual income by 3). In addition, the longer panels, higher response frequency of the SIPP, and specific attention to collecting high quality earnings and income information makes the SIPP a more reliable source of income information than the CEX.

[20]Relative to the literature on disemployment and the minimum wage, keep in mind that these results are based on household heads and spouses, not teenagers. The results are the same when we look at zero income conditions two interviews (8 months) hence.

and the credit card data are presented in turn.

3.3.1 CEX

Table 2 reports the basic CEX results. Although the magnitudes and precision vary across samples, the qualitative response is robust. Total spending increases by an economically and usually statistically significant amount for households that derive income from minimum wage labor. For example, total spending in households where minimum wage labor is the source of at least 20 percent of total income ($w^* \geq 0.2$) rises by \$885 (standard error of \$537) per quarter, representing 15 percent of an average quarter's spending level. Consistent with attenuation bias introduced by mismeasurement, the effects from the non-college sample are even larger.[21] These basic patterns are robust to many perturbations of the statistical model, including controlling for other covariates such as time trends (rather than year dummies), the age of the head, survey fixed effects, or state unemployment rates, deleting a small number of negative expenditure values, removing all data restrictions on family composition, age, and wage levels and changes, or running the regressions in first differences.[22] In contrast, for households without minimum wage workers ($w^* = 0$), spending rises by a statistically insignificant \$123 (\$171) per quarter, representing less than 2 percent of average quarterly spending, as shown in the final two columns.

As expected, the results are stronger for households with low wealth. Column 3 shows that spending increases by \$981 (\$464) among minimum wage households with liquid assets below \$5,000.[23]

Columns 4 and 5 display the spending response among households where adults earn just above the new minimum wage in the initial period. The spending effect recedes quickly once we get beyond 120 percent of the minimum. Spending falls from our baseline of \$885 for households with someone making less than 120 percent of the minimum wage to \$393 (\$264) and -\$145 (\$267) when using the 120 to 200 percent and 200 to 300 percent minimum wage definitions, respectively. That is, without a household member that is very close to the minimum wage, the spending effects dwindle, to the point where they are nonexistent

[21] We have also run the models with only high school dropouts. The point estimates are quantitatively similar although less precisely estimated.

[22] One noteworthy exception is the use of some nonlinear specifications, such as quantile regressions; see section 4.7.

[23] Liquid assets are defined as balances in checking and savings accounts, as in Johnson et al. (2006).

when wages are at least twice the minimum. These results are generally consistent with the income patterns described above and corroborate the comparison between households with and without minimum wage earners by showing that they are likely not confounded by state-specific unobservable trends in consumption that are specific to low-wage families.[24]

3.3.2 Credit Cards

We find an economically and statistically significant spending response in the credit card accounts as well. Table 3 shows that a $1 minimum wage increase results in a $176 ($60) increase in average quarterly credit card spending for the quarters that follow the minimum wage increase.[25] Again, we find no spending response for account holders with annual income above $20,000, virtually all of whom earn above the minimum wage.[26] The second column in the table shows the spending response for credit card holders with credit lines of $2,000 or less, who are more likely to be borrowing constrained.[27] For this group, the spending response to the minimum wage increase is $247 ($78), about 40 percent larger than the $176 effect for all low earners.

Since the above analysis only looks at credit card spending on one card and a typical low income consumer has 2.1 cards, we follow Agarwal, Liu, and Souleles (2007) and try to determine the response of the minimum wage change on all credit cards. We define a balance ratio as the balance on our card relative to the balance on all other cards held by the account-holder, as reported by the credit bureau. We only focus on credit card holders that have a significantly high balance ratio and therefore predominantly use our card. The last column in Table 3 presents such results for card holders with a balance ratio greater than 2. In this case, the spending response to a $1 minimum wage increase is $248 ($219), an estimate that we interpret as being consistent with the total credit card spending response, at least for the subset of account holders that heavily use cards from the financial institution

[24]The results also provide new evidence on the extent to which minimum wage increases cause wage (and spending) spillovers for those making slightly above the minimum, as in, for example, Wellington (1991), Card and Krueger (1995), and Lee (1999).

[25]We multiply all monthly estimates by 3 for comparability with the quarterly CEX results.

[26]Based on the CPS regressions, an individual earning $20,000 annually is essentially assigned a 0 percent probability of being a minimum wage worker. The results are also robust to using a $15,000 cutoff instead. For comparison, the 120 percent wage to minimum wage threshold that we use with the CEX data would include similar workers to those used here.

[27]A credit line is the maximum that an accountholder can withdraw. The results are similar if we use $3,000 or $1,000.

to which we have data.

On the whole, both the CEX and the credit card data depict similar qualitative, if not quantitative, spending responses to a minimum wage change, despite clear differences in sample composition, time period, available conditioning covariates, and data instrument (administrative data versus self-reported survey). If we assume that credit cards represent one-third of total spending,[28] our estimates suggest that a $1 minimum wage hike increases spending by $248 \times 3 = \$744$ per quarter. By comparison, the total CEX spending response shown in Table 2 is $885. There are some differences in spending composition, particularly in the inability of vehicle purchases to be financed by credit cards, which could lead to higher effects in the CEX. We return to this issue below. Nevertheless, in both datasets, there appears to be an economically significant increase in average near-term spending after a minimum wage increase that is likely at least $700 per quarter.

3.4 Composition and Timing of Spending

Next, we show the composition and timing of spending. Here, we take advantage of the detailed spending breakdown in the CEX and corroborate these findings with evidence from the credit card and credit bureau data.

3.4.1 Composition of Spending Responses

Table 4 shows that durables spending spikes following a minimum wage increase. Households with $w^* \geq 0.2$ increase durables spending by $894 ($463) per quarter following a $1 increase in the minimum wage, an amount that, on average, doubles the typical household's quarterly spending on durables. Again, households with no minimum wage income report no additional durables spending after the minimum wage hike.

By contrast, the impact on nondurables and services is close to 0. The results are particularly striking when considering that non-durables and services comprises 85 percent of total spending, on average.

Since most of the spending response is in durables, the rest of the table decomposes this category more finely. In particular, we classify goods into eight categories: furniture, floors

[28] Although Gross and Souleles (2002) estimate that one-third of aggregate consumer spending is on credit cards, they do not estimate this parameter for a population like ours.

and windows, household items, large appliances, electronics, leisure activities, miscellaneous household equipment, and net outlays on transportation (measured as the difference between the price of the vehicle purchased and the vehicle sold).[29] At the bottom of the table, we report the average amount spent by category.

For most categories, the impact is small and hard to distinguish from zero. The notable exception is transportation goods. For example, households in the full sample with $w^* \geq 0.2$ spend an additional \$764 (\$457) on transportation durables, representing 85 percent of the total spending response. The importance of transportation durables shows up in near identical fashion among non-college households and different thresholds of w^* (not reported).

Table 5 further decomposes transportation spending. For households with $w^* \geq 0.2$, spending on new cars, used cars, new trucks, used trucks, and all other transportation goods rises by \$123, \$25, \$308, -\$6, and \$314. Thus, most of the spending is on new vehicles, which are relatively easy to debt finance. The final 5 columns of table 5 present estimates from linear probability models that show the increased probability of a transportation purchase after a minimum wage hike. For example, the probability of purchasing a new truck rises by 0.014, and the increased probability of purchasing any vehicle rises by 0.029 per quarter after a minimum wage increase. The additional 2.9 percent of households purchasing vehicles drives the large spike in total spending following a minimum wage increase.

Rough breakdowns on durables, nondurables, and services spending can be derived in the credit card data for a shorter sample (2000 to 2003) as well.[30] Of course, the largest component of durables, vehicles, are typically ineligible for credit card purchase. Nevertheless, we find that durables spending rises by \$52 (\$33) per quarter, a substantial increase compared to baseline credit card spending on durables of about \$22.

[29] Floors and windows include carpets, rugs, curtains, drapes, blinds. Household items include clocks, lamps, linens, silverware, plates, glasses, decorative items, and outdoor equipment. Large appliances include kitchen and laundry appliances. Electronics includes televisions, VCRS, DVDs, stereo and sound equipment, computers, telephones, PDAs, antennas, and satellite dishes. Leisure activities include musical instruments, sports equipment, bikes, camping equipment, toys, games, playground equipment, arts and crafts, CDs, and DVDs. Miscellaneous household equipment includes small appliances, smoke alarms, cleaning equipment, tools, lawn equipment, window air conditioners, and portable heaters and coolers. Transportation includes cars, trucks, vans, motorcycles, and boats. These purchases are net of trade-ins.

[30] We assign durables or nondurable status to most stores based on their sales codes. For big box retailers, we use 10-k annual reports to designate the fraction of purchases from each spending category. To take two examples, approximately 35 and 43 percent of Walmart and Costco sales are in durables.

3.4.2 Timing of Spending

Figure 1 shows the timing of the spending response. These plots are based on equation (2) where we allow for three quarters of lags and leads of the minimum wage (K=3). Figure 1 shows three key facts that are consistent with the borrowing constraint model that we describe in section 4.

First, the initial spending increase happens primarily in the contemporaneous quarter of the minimum wage change. There is little evidence that total spending increases prior to the minimum wage change, even though the new minimum wage is typically passed months in advance.

Second, total spending is flat prior to the minimum wage increase. However, this masks an offsetting increase in nondurables and services and a decline in durables spending. But when the hike occurs, durables spending spikes up. Meanwhile, nondurables and service spending increases two quarters before the hike but does not increase further during the quarter of the hike.

Third, spending does not revert back to pre-hike levels after that initial increase. It bounces around $1,000 per quarter for several quarters, before starting to decline by quarter 4. By comparison, there is no increase in spending among the non-minimum wage households ($w^* = 0$).

Similar patterns arise in the credit card data, displayed in figure 2, when we estimate the model with three quarters of lags and leads. Again, we find that the most of the spending response occurs during the quarter (and even month, albeit not shown here) of the minimum wage change and the quarters that immediately follow. We find no evidence that spending increases prior to the minimum wage change or among account holders with income well beyond minimum wage levels (i.e., $20,000). Spending starts to revert to its original level three quarters after the hike.

3.5 Debt

If spending rises more than income after a minimum wage increase, it follows that net worth declines. Although we do not have panel data on assets, the credit bureau supplies panels on household debt. Table 6 shows quarterly changes in debt after a minimum wage hike, broken into subcategories: vehicle loans, home equity loans, mortgages, and credit card

debt. The final two columns provide sums of total and collateralized (vehicle and home) debt.[31] In each category, debt increases after a minimum wage increase, but particularly in collaterized loans tied to vehicles and homes. We estimate that a $1 minimum wage increase causes auto loan balances to increase by $184 ($76). Furthermore, home equity lines, which can be used to purchase vehicles, rise $125 ($75).[32] Total collateralized debt increases by $460 ($285) and total debt by $565 ($299).[33] There is no increase in debt among higher income individuals.

These numbers are consistent with the income and spending results presented thus far, even though each comes from independent datasets. Assuming that financial assets do not change after a minimum wage hike, rearranging the asset accumulation equation (5) below shows that spending is equal to the sum of the debt and income response. Taking the mean income response to be $309, the weighted average of the SIPP and CPS results, and the debt response to be $565, implies an imputed spending response of $874 (with a standard error of $316, calculated using GMM), nearly identical to the $885 we actually estimate from the CEX. The auto loan results are also consistent with spending specifically on autos, as described in table 5.

Figure 3 displays the dynamics of total household debt in the nine quarters that follow a minimum wage increase. This figure is based on the sole cohort of accounts that are followed for four years starting in January 2000. Three series are plotted: auto and home equity debt, those two debt instruments plus mortgage debt (or total collateralized debt), and those three instruments plus credit card debt (or total debt). The figures show total debt rising by $550 per quarter in the first year after a minimum wage increase. Over 80 percent of this increase comes from collaterized sources. In subsequent quarters, debt rises by less, to the point that by the ninth quarter, debt is beginning to fall slightly. This provides direct evidence that much of the early consumption response is in fact debt-financed, as the completely independent measures of income and consumption from the SIPP and CEX suggest.

[31] The rise in debt comes from both the increase in current spending relative to payments and interest accumulation on debt.

[32] According to CNW Research, home equity lines were used in 12 to 14 percent of vehicle purchases made between 2003 and 2007. These data were generously provided to us by CNW. They are based on monthly phone and mail interviews of more than 14,000 households.

[33] The estimated credit card debt response of $105 ($80) is based only on our institution. However, if we use accounts where the balance ratio is high, and therefore the individual relies primarily on only our card, the change in debt following a minimum wage increase is similar ($125 ($206)) but less precisely estimated. Our total debt also excludes loans not recorded by the credit bureau, including educational debt.

Despite the rise in debt, we find no evidence of an increase in default following a minimum wage increase. Default rates actually fall from 5.90 to 5.71 percent (with a standard error of 0.11 percent). This result is again based on a single cohort of credit bureau accounts, but the cohort is large, followed for four years, and the logit model estimates control for typical predictors of default, including FICO scores, debt levels, credit limits, the APR on outstanding loans, and time dummies.

3.6 Summary of Empirical Results

We identify several stylized facts about income, spending, and debt following a minimum wage increase.

First, spending increases substantially after a minimum wage hike. Moreover, the magnitude of this spending increase far exceeds the average income gain among minimum wage households following a hike. Consequently, we should see debt rising fairly dramatically, a pattern that we document with the credit bureau data.

Second, the majority of the spending response is in durable goods.

Third, the total spending response begins to rise within one quarter of a minimum wage increase not at the legislation's passage, which typically occurs 6 to 18 months prior. Moreover, there are some compositional differences in the timing. Prior to the minimum wage hike, durables spending falls and non-durables spending rises by roughly equal amounts, so the total spending response is almost zero. After the minimum wage hike, non-durables spending barely increases further, but durables spending immediately spikes upward.

Finally, high levels of durables spending and debt accumulation persist for several quarters after a minimum wage hike.

4 A Model with Durable Goods and Borrowing Limits

In this section, we describe a model that can explain many of these key empirical findings. The model critically involves durable goods and how those durable goods are financed.

Define C_t as consumption of non-durable goods at time t and S_t as the durables stock at

time t. The household maximizes

$$E_{t_0} \sum_{t=t_0}^{T} \beta^t (C_t^{1-\theta} S_t^{\theta})^{1-\gamma} / (1-\gamma) \tag{4}$$

subject to the constraints below. Within period preferences are Cobb-Douglas between durables and non-durables. Thus, consistent with the evidence, expenditure shares are assumed constant.[34] The asset accumulation equation is:

$$A_{t+1} = (1+r)A_t + Y_t - C_t - I_t \tag{5}$$

where A_t denotes assets, r the interest rate, I_t investment in consumer durables, and Y_t income. The law of motion for durables is

$$S_{t+1} = (1-\delta)S_t + I_t \tag{6}$$

where δ is the depreciation rate.

In contrast to much of the literature, but often observed in practice, we allow individuals to borrow against durable goods. Assets must satisfy the borrowing constraint

$$-A_t \leq (1-\pi)S_t \tag{7}$$

where π is the downpayment rate, or the fraction of the value of newly purchased durable goods that do not serve as collateral. Such a constraint may exist because of limited enforcement, where collateral guards against the temptation to default (e.g. Kiyotaki and Moore 1997).

Finally, the income process is:

$$\ln Y_t = \alpha_t + P_t + u_t \tag{8}$$

where α_t is the life cycle profile of income. We assume that $\alpha_t = \alpha_{t_0} + \alpha_1 t$ for the first

[34]For example, among CEX households with no adult minimum wage earners, the durables share of expenditures is roughly 17 percent. Among those households where income comes entirely from minimum wage labor, it is 12 percent. Fernandez-Villaverde and Krueger (2002) review the evidence on the substitutability of durables and non-durables and conclude that Cobb-Douglas is consistent with the evidence.

80 quarters of an individual's life, and is constant at $\alpha_t = \alpha_{t_0} + \alpha_1 \times 80$ afterwards. The stochastic components of income are the white noise term u_t and the AR(1) term P_t:

$$P_{t+1} = \rho P_t + \epsilon_{t+1} \tag{9}$$

where $\epsilon_t \sim N(0, \sigma_\epsilon^2)$ and $u_t \sim N(0, \sigma_u^2)$.

The model is complex and thus we solve it numerically. We describe our calibration and results immediately below and the solution techniques in appendix A.

4.1 Calibration of the model

To calibrate the model, parameters are set to the values listed in table 7. Here, we highlight those that are less standard.

First, we pick θ to match the CEX's estimate of non-residential durables share of aggregate non-residential expenditure, $I_t/(I_t + C_t)$. Second, for δ, we use Campbell and Hercowitz's (2003) estimate of quarterly depreciation rates for non-residential durable goods, which is similar to those in Adda and Cooper (2000).[35] Third, we assume the downpayment rate, π, is 0.4. The Federal Reserve's G19 Consumer Credit release reports that the loan-to-value ratio, (1-π), on new cars averaged 90 percent between 1982 and 2005, the years in our CEX sample. However, new vehicles make up only 17 percent of non-housing durable spending for CEX households with minimum wage earnings.[36] The rest of durables spending likely requires larger downpayments, including some products for which collateralized financing may not be readily available (e.g., small applicances).

Finally, we estimate the parameters of the income process using the SIPP. We define the time of the minimum wage hike as $t = 0$. Average quarterly income among minimum wage households, ($E(Y_0)$) is \$2,900.[37] We estimate $\alpha_1 = 0.0108$ through a household fixed effects regression of log income on age for households with minimum wage workers.[38] Income growth

[35] We focus only on non-durables and non-residential durables because our estimated residential spending responses were fairly small and imprecise.

[36] Used vehicles make up roughly 44 percent and the remainder is non-transportation durables. Note, however, that table 5 shows that about half the spending response to minimum wage hikes is in new vehicles.

[37] We choose α_{t_0} to match the average income of SIPP minimum wage households. Because $E(Y_0) = \exp(\alpha_0 + (\sigma_P^2 + \sigma_u^2)/2)$, and earnings variance varies across specifications, we adjust α_0, and thus α_{t_0}, across specifications. Because we simulate the model for 30 periods before the minimum wage hike (i.e., $t_0 = -30$), we set $\alpha_{t_0} = \alpha_0 - 30(0.0108)$.

[38] This translates into 4 percent average annual income growth, close to estimates for early career low-skill workers (e.g. French, Mazumder, and Taber 2006).

of this magnitude is similar to income growth among other low skill workers of the same age. Thus we assume that the deterministic component of income growth for minimum wage household is similar to the profile for households headed by someone without any college. Because income growth tapers off after 20 years in the labor force for these households (Gourinchas and Parker 2002), we assume that income grows at rate α_1=0.0108 for 80 quarters and then does not grow thereafter.

4.2 Initial Joint Distribution of the State Variables

We draw the initial joint distribution of the three state variables – the permanent component of income, financial assets less durables debt,[39] and the stock of durable goods – from the 2004 Survey of Consumer Finances (SCF). Appendix C and table A2 present some key descriptive statistics. Unsurprisingly, many minimum wage households have very little in the way of financial assets and are therefore likely to face binding borrowing constraints. For example, median financial assets less durables debt are $18.

4.3 Modeling Minimum Wage Hikes

In order to assess the impact of the minimum wage, we simulate the model with and without a minimum wage hike. The hike is modeled as an innovation to the deterministic component of income, α_t. In particular, we assume that a minimum wage hike causes α_t to immediately increase by 10 percent, bumping average income from $2,900 to $3,200 per quarter. This is consistent with the income response we find using the SIPP and the CPS, and with other research as well.

Figure 4 plots the difference in income profiles between simulated individuals who received a minimum wage hike and those who did not. The immediate $300 gain is assumed to dissipate over time. In particular, rather than grow at 1.08 percent, we assume α_t remains constant in the first ten periods after the hike for households receiving a minimum wage increase. This allows any income gain from the minimum wage to be eroded after $2\frac{1}{2}$ years, as in figure 4. After 10 quarters, income once again grows by 1.08 percent per period. Consequently, in total, a 10 percent minimum wage hike increases total discounted lifetime income by just over $1,500.

[39] More precisely, the state variable is cash-on-hand, which is the sum of assets and current income.

Finally, we assume that households learn about the minimum wage hike three quarters before it occurs (t=-3). This is consistent with the observation that minimum wage legislation is typically passed into law at least three quarters before the minimum wage hike is implemented.

4.4 Model Results without Uncertainty and Borrowing Constraints

We first describe the calibration results for the case when households face neither borrowing constraints (so the down payment constraint parameter π is unimportant) nor income uncertainty ($\sigma_\epsilon^2 = 0$) to clarify the dimensions on which this model succeeds in describing the empirical facts. We use the parameters in table 7, with the exception that time discount factor β is set to 1 to allow the model to generate a more plausible wealth distribution. When $\beta = \sqrt[4]{0.95}$, median assets at the time of the minimum wage hike are implausibly low.[40]

Figure 5 shows the predicted spending response to a minimum wage hike, i.e., the predicted difference between spending of those who received a minimum wage hike and those who did not. Three key features of the figure are worth highlighting.

First, the initial spending increase is \$60, followed by \$15 spending per quarter thereafter. The present value of this stream of spending is roughly \$1,500, the lifetime income gain from the minimum wage hike. These estimates are substantially smaller in the near-term than what we observe in the spending data. To better understand the size of the spending responses, we use the parameter values in table 7 and formulas in appendix B to show that if T is large or there is a resale market for durables, the marginal propensity to spend on non-durables and durables is well below 1:

$$\left.\frac{\partial C_0}{\partial A_0}\right|_{S_0} = (1-\theta)\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right] = 0.01, \tag{10}$$

$$\left.\frac{\partial I_0}{\partial A_0}\right|_{S_0} = (\beta(1+r))^{\frac{1}{\gamma}}\left(\frac{\theta}{r+\delta}\right)\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right] = 0.04 \tag{11}$$

[40] When $\beta = \sqrt[4]{0.95}$, households are more impatient, and spend more in the short-run. For example, the short-run spending response increases from \$60 when $\beta = 1$ to \$90 when $\beta = \sqrt[4]{0.95}$.

where θ and $1-\theta$ are the shares of lifetime expenditure devoted to non-durables and durables, respectively. The term $r+\delta$ is a user cost, or the per period price of durables relative to non-durables, and $\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right]$ is an annuitization factor.

Second, the household purchases large quantities of durables and more modest quantities of non-durables upon learning about the minimum wage hike. The reason for the durables increase is that if the household wishes to permanently increase the *service flow* of durables by a small amount, she must increase durables *spending* by a larger amount. After an initial jump, durables spending can decline again as the household only spends to maintain the new higher durables stock (Mankiw 1982).

Third, the spending response occurs when the household learns about minimum wage hike in quarter -3, not when the hike occurs in quarter 0.

The magnitude, composition, and timing of these predictions are inconsistent with the empirical findings described in section 3.

4.5 Model Results with Borrowing Constraints and Income Uncertainty

Next, we introduce collateral constraints and income uncertainty to the model. Figure 6 plots the spending response to a minimum wage hike that emerges from this model. It illustrates several noteworthy, and ultimately testable, implications.

The first is the sheer magnitude of the spending increase. Total spending increases by over $300 per quarter, or $1,200 in the year after the minimum wage hike. This increase in spending is larger than the gain in income in the first year, and it is an order of magnitude larger than the response in the no borrowing constraint case.

The second finding relates to timing. Much of the spending increase occurs at the date of the minimum wage change, not when the household learns about the impending hike in quarter -3. Between quarters -1 and 0, the total spending response increases from under $100 to almost $400.

The last two features of the results that we highlight have to do with the composition of spending before and after the minimum wage increase. Prior to its implementation but after its legislative enactment (quarters -3 to -1), there is a small increase in spending. This spending increase is heavily skewed toward nondurables. Indeed, durables spending declines slightly. However, once the minimum wage is implemented in quarter 0, durables spending

soars by almost $250, while nondurables spending continues along a relatively stable path that began at quarter -3.

That leads us to our final notable result - the persistence of durables spending. Although durables spending begins to decline after period 0, it remains elevated and is as high as the nondurables response at least a year later.

One of the striking features of this model is that spending exceeds income in the near-term. To see the intuition behind this result, and why spending may be concentrated in durables expenditures, assume that the borrowing constraint (7) always binds, i.e. $A_t = -(1-\pi)S_t$. Combining it with the asset accumulation equation (5) and the law of motion for durables, equation (6), it can be shown that:

$$\pi I_t + C_t + (1-\pi)(r+\delta)S_t = Y_t. \tag{12}$$

Households spend income on durables I_t, nondurables C_t, and interest payments on durables S_t. Since the household only needs $\$\pi$ to purchase $1 worth of durables, spending gains can temporarily exceed income gains.

The magnitude, timing, composition, and persistence of spending following a minimum wage increase observed in the data are consistent with the model with borrowing constraints and income uncertainty but inconsistent with a model without these features.

4.6 Robustness Checks

Table 8 describes a number of checks of our model predictions. In particular, we report how spending responses vary with the size of the downpayment constraint and the income process. The particular way parameters are adjusted for each of these tests is explained in the first column. The next three columns report non-durables, durables, and total spending responses to minimum wage hikes with the new parameter values. These are estimated on the simulated data using a household fixed effects regression similar to equation (2). In order to be consistent with the empirical methods and CEX data, we use simulated spending data three quarters before to three quarters after the minimum wage hike.[41] The fifth column reports assets, A_{it}. The final column reports resources for spending, $A_{it}+(1-\pi)S_{it}$, a measure of how

[41] To further match the empirical methodology, we assume the share of minimum wage households that receive minimum wage hikes is similar to that in the data.

borrowing constrained the agent is. Equation (7) shows that this term must be non-negative.

For convenience, the first row reviews our estimated spending response. The second row reviews our baseline borrowing constraint model, as described in section 4.5, table 7, and figure 6. Non-durables and durables spending rise by \$113 and \$196 per quarter or \$309 in total per quarter.

The next two rows explore the sensitivity of the results to changes in the downpayment rate, π. Reducing the downpayment rate from 40 to 20 percent leaves the total spending response largely unchanged at \$299. However, increasing the downpayment rate to 100 percent, as in the standard buffer stock model, reduces the spending response to \$221. The lower the downpayment rate, the more goods can be purchased with a given level of income. Thus, spending is more sensitive to income when the downpayment is lower.

The next two rows explore the sensitivity of the results to differences in the income process. When there is no income uncertainty, the total spending response rises to \$359 per quarter. However, allowing for moderately higher innovation variance (σ_ϵ^2=0.005 and σ_u^2=0.05), as in Meghir and Pistaferri (2004) or Gourinchas and Parker (2002), leads to a reduced spending response of \$89.

The sensitivity of the spending response to the income process arises from the extent to which precautionary motives are important. When there is no income risk, there is little incentive for agents to hold precautionary wealth. With little precautionary wealth, the borrowing constraint is more likely to bind. When the borrowing constraint binds, equation (12) shows that we should expect large spending responses. For example, in the absence of income uncertainty, median assets "resources" available for spending (defined as $A_{it} + (1 - \pi)S_{it}$) is \$81. Because agents are borrowing constrained in this framework, the spending response is \$59 per quarter.

But when income risk is high, agents hold larger amounts of wealth and, consequently, borrowing constraints do not bind. Consequently, these households behave as if they are unconstrained and spend less in response to a minimum wage hike.

Note that the intuition of equation (12) – that \$1 can be used to purchase $\frac{1}{\pi}$ worth of durables – suggests that the simulated spending response can be very large. For example, if $\pi = 0.1$, an extra \$300 in income can generate \$3,000 in extra durables spending. Our predicted responses are much smaller for three reasons. First, we set π at 0.4, which we believe

is a more plausible level. Second, income uncertainty means the borrowing constraint does not always bind, creating smaller spending responses. Third, much of the spending increase is devoted to non-durables, and non-durables cannot be leveraged. To better assess the importance of these issues, the next two rows show the results under two alternative scenarios: (i): $\theta = 0.4$ (simulated households have a high preference for durables), $\pi = 0.1$ (simulated households can heavily leverage those durables), and there is no income uncertainty (so the borrowing constraint is more likely to bind); and (ii): $\theta = 1, \pi = 0.2$, and no income uncertainty. In both simulations, the spending responses are much larger than our baseline. However, the model generates implausibly high debt levels.

The next row shows spending responses when there are adjustment costs, which we discuss in greater detail in section 4.7. For completeness, the final two rows report spending responses in the model without borrowing constraints, as in section 4.4.[42] As noted earlier, spending barely responds under this version of the model.

4.7 Adjustment Costs and the Distribution of Spending Responses

Because much of the spending increase comes from vehicles, there is considerable heterogeneity in spending after a minimum wage increase. This point is displayed in figure 7, which graphs a set of quantile regressions of total spending, ranging from 0.10 to 0.95 (the quantile is shown on the x-axis) for households where either $w^* = 0$ (connected by the dashed line) or $w^* \geq 0.2$ (solid line).[43] The key insight is that, for minimum wage households, the mean response is much bigger than the median response, the latter of which is not statistically or economically different from 0. In particular, the average effect reported in earlier tables appears to be substantially driven by the tails of the spending response distribution, especially households beyond the 90^{th} percentile of the distribution.[44]

[42] As in section 4.4, we set $\beta = 1$ to generate a plausible wealth level.

[43] The estimates are presented without leads or lags of the minimum wage (i.e., $K = 0$ in equation (2)). In order to remove the fixed effect, we first demeaned all variables, then used standard quantile estimation techniques. Because a quantile estimator is not a linear model, demeaning the data will generate inconsistent estimates. However, when we performed our procedure on our simulated data, we found that this problem is very minor. More importantly, we perform the same procedures on the simulated data, so the estimates on actual and simulated data are comparable.

[44] The spending effects are also large at the 10th percentile. However, that result does not appear to be robust to alternative ways to control for family size. Recall that we follow Johnson et al. (2006) by excluding households where the number of adults or children changed by more than two and then directly controlling for the number of adults and children in the regression. Instead, if we exclude any household with a change in family composition during the survey time period, the 10th percentile spending response goes away. The 90th and 95th percentile response declines but is still large and positive, albeit less precisely estimated.

Contrast these results to the spending response predicted by our model. Figure 8 plots the quantile spending response for minimum wage households. Concentrate first on the solid pink line labeled baseline. The baseline model predicts roughly the same sized effect throughout the spending distribution and thus underpredicts the spending response at the 90^{th} and 95^{th} percentile relative to what is seen in the data.

Now, consider the possibility that households face a cost of adjusting their durables stock, as in Carroll and Dunn (1997) and Kaboski and Townsend (2008). Households might face transactions costs of adjusting their durables stock because, for example, it takes time to shop for a new car or the trade-in-value of a used car is less than the price of buying the same car off a used car lot. We follow Grossman and LaRoque (1990) and Eberly (1994) by assuming that in order to increase the durables stock, five percent of the previous stock would be lost.[45] This adjustment cost transforms equation (5) into:

$$A_{t+1} = (1+r)A_t + Y_t - C_t - I_t - 0.05S_t \times 1\{I_t \neq 0\} \tag{13}$$

where $1\{I_t \neq 0\}$ is an indicator of when the individual either purchases or sells a durable good.

When we make this modification, but leave other parameters at the baseline, the average total spending response falls from \$309 to \$188 per quarter (see table 8). Part of the reason for the decline is an artifact of timing. As pointed out by Caballero (1993) and others, short-run spending is sluggish in models with adjustment costs. Recall that to be consistent with the methods to obtain our estimates, we estimate the calibrated model's spending response using data only through the third quarter after the minimum wage hike. Because some of the spending response is delayed to later quarters, the mean effect looks smaller when allowing for adjustment costs. Regardless, the model with adjustment costs does no better in terms of explaining large mean spending responses in the data.

That said, adjustment costs, combined with the baseline borrowing constraint model, have important implications for heterogeneity in spending responses. This is displayed in the green dotted line in figure 8. The baseline model with adjustment costs displays a significant spike in spending at the top end of the spending distribution. In particular, for those at the 95^{th} percentile, the spending response is \$1,700 per quarter, almost identical to what is

[45] See also Attanasio (2000) and Bertola, Guiso, and Pistaferri (2005) for more evidence.

observed in the data.

This result comes about because households upgrade their durables stock periodically in the adjustment cost model. The model predicts that purchases occur every 12 quarters, which is consistent with actual vehicle expenditures in the CEX. Thus, for the majority of households, the durables spending response is 0 in any given quarter. Conditional on a minimum wage increase, the probability of a durables purchase, as well as the amount spent conditional on a purchase, rises. This causes the spending response to be very large at the 95^{th} percentile but small below that. Consequently, the model with adjustment costs better matches the right tail of the spending distribution than the model without them.

5 Discussion

We estimate the spending, income and debt responses to minimum wage hikes. We show that a life cycle consumption model in which households face collateral constraints fits the data better than a standard permanent income model, for the following reasons.

First, spending increases substantially after the hike, with most of the spending occurring on durable goods, and in particular transportation goods. This near-run spending increase, perhaps in the order of $800, exceeds the $300 or so per quarter of additional family income caused by a minimum wage hike. Using different data, we find that debt rises about $550 per quarter, which corroborates the spending and income evidence. This is particularly surprising given that minimum wage hikes likely increase income of minimum wage workers for a short period, about two to three years according to some research. If households were spreading the income gain over their entire lifespan, the spending increases should be far smaller than what we observe in the data. Augmenting the permanent income model to account for durable goods increases the short term spending response, but is still far smaller than what our estimates imply. As we show, however, our estimates are consistent with a model in which households must make a small downpayment for their durables. Thus small increases in income can generate small downpayments and thus large increases in durables spending.

Second, we find that the spending response occurs within one quarter of the actual increase in the minimum wage, although minimum wage increases are typically passed into law 6 to 18 months prior to their effective date. This result is found in both the CEX and credit

card accounts. We interpret this finding as evidence that households respond to current, not lifetime, income, a result that can be reconciled with models that allow for borrowing constraints.

Third, the composition of spending is consistent with forward looking behavior and borrowing constraints. Prior to the minimum wage hike, durables spending falls and non-durables spending rises by roughly equal amounts, so the total spending response is almost 0. After the minimum wage hike, non-durables spending barely increases further, but durables spending increases significantly.

Fourth, the high levels of spending and debt appear to persist for longer than the permanent income hypothesis would imply. Again, this persistence is consistent with a model in which households are borrowing constrained for several periods after the minimum wage hike.

Finally, we show that the borrowing constraint model augmented with an adjustment cost to durables transactions can help explain the distribution of spending responses.

It is appropriate to emphasize that we focus only on households who had a minimum wage job before the minimum wage went up. It is possible, perhaps even likely, that a minimum wage increase reduces the odds that those without a job will be able to find one. Moreover, we ignore teenagers, where there is some evidence of disemployment. Consequently, our estimates are silent about the aggregate effects of minimum wage hikes. However, for those adults who had a minimum wage job before the minimum wage went up, there is compelling evidence that consumption, income, and debt rise afterwards, and that these responses are consistent with the existence of borrowing constraints and the important role of durables in the borrowing process.

Appendix A: Solving the model (not for publication)

In order to reduce the number of state variables, we follow Deaton (1991) and redefine the problem in terms of cash-on-hand:[46]

$$X_t = (1+r)A_t + Y_t. \tag{14}$$

Assets and cash-on-hand follow:

$$\begin{aligned} A_{t+1} &= X_t - C_t, & (15)\\ X_{t+1} &= (1+r)(X_t - C_t - I_t) + Y_{t+1}. & (16) \end{aligned}$$

Thus, the borrowing constraint becomes

$$-\left(\frac{X_t - Y_t}{1+r}\right) \leq (1-\pi)S_t. \tag{17}$$

Note that all of the variables in X_t are known at the beginning of period t. We can thus write the individual's problem recursively, using cash-on-hand as a state variable. In recursive form, the household's problem is to choose non-durables consumption and durables investment to maximize :

$$V_t(Z_t) = \max_{C_t, I_t}\{(C_t^{1-\theta}S_t^{\theta})^{1-\gamma}/(1-\gamma) + \beta \int V_{t+1}(Z_{t+1})dF(Z_{t+1}|Z_t, C_t, I_t, t)\} \tag{18}$$

subject to the constraint in equation (17), where the state variables of the model are $Z_t = (X_t, S_t, P_t)$, and $F(.|.)$ gives the conditional cdf of the state variables, using equations (6), (8), (9), and (16). Solving the model gives optimal consumption and durables investment decision rules.

The source of uncertainty in the model is from income. We integrate over the distribution of income by discretizing P_t using discrete state Markov Chains (Tauchen 1986).

To simulate the model, we take the initial joint distribution of the state variables from the data. We then take draws of income from the data generating process of income. Given the initial joint distribution of (X_0, S_0, P_0) that we observe in the data, we use the decision

[46] Using cash-on-hand allows us to combine assets and the transitory component of income u_t into a single state variable.

rules to obtain C_0, I_0, which gives us a value of (X_1, S_1). We take a draw for P_1, which then gives income. We repeat this for $T = 200$ periods. The figures presented are based on 5,000 simulations of the model.

Appendix B: Certainty and no borrowing constraints (not for publication)

Using assets instead of cash on hand as the state variable, Bellman's equation (18) without uncertainty is:

$$V_t(A_t, S_t, P_t) = \max_{C_t, I_t} \{U(C_t, S_t) + \beta V_{t+1}(A_{t+1}, S_{t+1}, P_{t+1})\}. \tag{19}$$

The only constraints in this case are the law of motion for assets (equation 5) and durables (equation 6) and that final period assets must be non-negative. The first order conditions for non-durables consumption and durables investment are, respectively:

$$\frac{\partial U_t}{\partial C_t} = \beta \frac{\partial V_{t+1}}{\partial A_{t+1}} \tag{20}$$

$$\frac{\partial V_{t+1}}{\partial A_{t+1}} = \frac{\partial V_{t+1}}{\partial S_{t+1}}. \tag{21}$$

Differentiating with respect to assets and the durables stock and using the envelope condition yields, respectively:

$$\frac{\partial V_t}{\partial A_t} = \beta(1 + r) \frac{\partial V_{t+1}}{\partial A_{t+1}} \tag{22}$$

$$\frac{\partial V_t}{\partial S_t} = \frac{\partial U_t}{\partial S_t} + \beta \frac{\partial V_{t+1}}{\partial S_{t+1}}(1 - \delta). \tag{23}$$

Combining equations (21), (22), and (23) yields

$$\beta(1 + r) \frac{\partial V_{t+1}}{\partial A_{t+1}} = \frac{\partial U_t}{\partial S_t} + \beta \frac{\partial V_{t+1}}{\partial A_{t+1}}(1 - \delta). \tag{24}$$

Combining equations (20) and (24) yields

$$(r + \delta) \frac{\partial U_t}{\partial C_t} = \frac{\partial U_t}{\partial S_t}. \tag{25}$$

Inserting the specific functional forms for the utility function from equation (4) into equation (25) yields

$$(r+\delta)\left(\frac{1-\theta}{\theta}\right)S_t = C_t. \tag{26}$$

Combining equations (20), (22), and (26) yields the Euler Equation

$$C_{t+1} = C_t(\beta(1+r))^{\frac{1}{\gamma}}. \tag{27}$$

Define

$$PV \equiv A_0 + \sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t Y_t \tag{28}$$

as "full wealth", i.e., the present value of lifetime income plus wealth. Given that the present value of lifetime spending is equal to full wealth (and given that the annual cost of durables is $(r+\delta)$), the lifetime budget constraint is

$$\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t (C_t + (r+\delta)S_t) = PV. \tag{29}$$

Inserting equation (26) into equation (29) yields

$$\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t \left(C_t + \left(\frac{\theta}{1-\theta}\right)C_t\right) = PV. \tag{30}$$

Combining equation (27) with equation (30) yields

$$\sum_{t=0}^{T}\left(\frac{1}{1+r}\right)^t \left(\left(1+\left(\frac{\theta}{1-\theta}\right)\right)C_0(\beta(1+r))^{t/\gamma}\right) = PV. \tag{31}$$

Using the formula for an infinite sum and rearranging yields

$$C_0 = (1-\theta)\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right]PV \tag{32}$$

where $(1-\theta)\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right]$ is the marginal propensity to consume non-durables. Inserting equation (26) into equation (32) yields

$$S_0 = (\frac{\theta}{r+\delta})\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right]PV. \tag{33}$$

Holding last period's durables stock fixed, increases in this period's durables stock can only come from increases in investment. Thus

$$\left.\frac{\partial I_0}{\partial PV}\right|_{S_0} = \left.\frac{\partial S_1}{\partial PV}\right|_{S_0} = (\beta(1+r))^{\frac{1}{\gamma}}(\frac{\theta}{r+\delta})\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right] \tag{34}$$

is the marginal propensity to spend on durables. Inspection of equation (29) shows that the marginal propensity to spend is the same for increases in assets and the present value of lifetime income. In order to get time period 1 non-durables and durables spending, note that equation (27) shows that consumption grows at rate $(\beta(1+r))^{\frac{1}{\gamma}}$, and thus the marginal propensity to consume non-durables at time 1, given an increase in full wealth at time 0, is $(\beta(1+r))^{\frac{1}{\gamma}}(1-\theta)\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right]$. To derive the time 1 durables spending response, note that the ratio of durables to non-durables is a constant, and thus the durables stock grows at a rate $(\beta(1+r))^{\frac{1}{\gamma}}$. Using this result, the law of motion for durables, and equation (34) yields the marginal propensity to spend on durables at time 1:

$$\begin{aligned}
\left.\frac{\partial I_1}{\partial PV}\right|_{S_0} &= \left.\frac{\partial S_2}{\partial PV}\right|_{S_0} - (1-\delta)\left.\frac{\partial S_1}{\partial PV}\right|_{S_0} \\
&= (\beta(1+r))^{\frac{1}{\gamma}}\left.\frac{\partial S_1}{\partial PV}\right|_{S_0} - (1-\delta)\left.\frac{\partial S_1}{\partial PV}\right|_{S_0} \\
&= \left[(\beta(1+r))^{\frac{1}{\gamma}} - (1-\delta)\right]\left.\frac{\partial S_1}{\partial PV}\right|_{S_0} \\
&= \left[(\beta(1+r))^{\frac{1}{\gamma}} - (1-\delta)\right](\beta(1+r))^{\frac{1}{\gamma}}(\frac{\theta}{r+\delta})\left[\frac{1-\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}}{1-\left(\frac{(\beta(1+r))^{\frac{1}{\gamma}}}{1+r}\right)^{T+1}}\right].
\end{aligned} \tag{35}$$

Solving for time period 2 spending propensities is straightforward.

Appendix C: The Survey of Consumer Finances (not for publication)

This appendix provides descriptive information on the initial joint distribution of the state variables used in the dynamic programming problem. The three state variables are the permanent component of income P_{it}, cash on hand (which is the sum on income and assets net of durable goods A_{it}), and the stock of durable goods S_{it}. We assume that permanent income is the same as current income, and define the durables stock as the sum of vehicles plus the stock of non-vehicle durables. We define assets net of durables as net financial assets less debt against durable goods.

Table A2 shows key descriptives about these three variables from the 2004 SCF. The table also includes total debt and assets (last two rows) which contain other assets, such as housing and business wealth, to provide a more complete picture of household balance sheets.

We present means for both minimum wage households (w^*=0) and above minimum wage households ($w^* \geq .2$). To compute w^*, we use a methodology very similar to the CEX (described in section 3.1). First, we define someone as a minimum wage worker if that individual makes between 60 and 120 percent of the minimum wage. Next, if an individual is a minimum wage worker, we multiply that individual's hourly wage by hours per week times weeks per year. Because the SCF reports pay at frequencies chosen by the respondent, we compute the wage using given pay and frequency of pay, adjusted appropiately by hours per year. Finally, we take total household income from minimum wage workers and divide through by total household wage income (where wage income is the income of respondent and spouse and is derived using the procedure described above) which gives w^*, the share of income from minimum wage workers.

Table A2 shows that for minimum wage households[47], mean income, durables, debt, and financial wealth are all about one third as large as for non-minimum wage households. Although, on average, financial assets are high, the distribution is skewed. Median financial wealth for minimum wage households is $359. Another thing to note is that our definition of assets and durables excludes housing and business wealth. Roughly 35 percent of all minimum wage households own their home. For these households, housing represents close to 50 percent of all wealth and over 50 percent of all debt.

[47]Similar to the CEX, the unit of observation in the SCF is the "primary economic unit," which is usually a household. In order to preserve confidentiality of respondents, noise is added to SCF data. Each responding economic unit is turned into five observations.

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Table 1
Total Household Nonproperty Income Response to Change in the Minimum Wage

	SIPP, 1986-2003							CPS, 1979-2006	
	Hourly wage of hourly workers							hourly workers	
	All, by minimum wage cutoff				HS dropouts and grads	Computed wage[4] All		All	HS dropouts and grads
w*									
0	-42	-168	-261	-69	6	-36	-21	-36	-25
	(69)	(93)	(153)	(81)	(78)	(60)	(66)	(52)	(64)
	347,514	203,856	91,389	280,544	183,714	486,018	420,720	566,602	316,920
>0	156	195	-72	198	1	69	48	419	250
	(159)	(99)	(108)	(183)	(180)	(117)	(126)	(123)	(140)
	43,474	138,972	110,360	32,639	29,533	60,472	50,396	100,034	65,766
>=0.2	255	210	36	462	222	177	249	336	313
	(177)	(99)	(105)	(198)	(189)	(117)	(135)	(126)	(138)
	33,716	119,471	104,062	24,769	23,993	47,674	39,107	79,140	54,266
Minimum Wage theshold used[1]:	<120%	120-200%[2]	200-300%[3]	<120%	<120%	<120%	<120%	<120%	<120%
Includes movers where households remain intact:	yes	yes	yes	no	yes	yes	no	no	no

Notes:
Each cell represents a separate regression. w* is the share of pre-tax total household income from near minimum wage salaries earned by the top two adults in the household. Near minimum wage is defined in the last row.
See the text for details. All standard errors are cluster corrected by household.

[1] The minimum wage threshold is based on the gap between the wage (of the top 2 earners in each household) and the minimum wage at the beginning of the sample. For example, "<=120%" means that we assume labor income for a household member is minimum wage income if their wage is within 120 percent of the state's effective minimum at the beginning of the sample.

[2] This sample throws out households with a worker less than or equal to 120 percent of the minimum wage at the beginning of the period.

[3] This sample throws out households with a worker less than or equal to 200 percent of the minimum wage at the beginning of the period.

[4] The computed wage is monthly earnings divided by monthly hours worked.

Table 2
Total Spending Response to Change in the Minimum Wage
CEX, 1983-2005

w*	All	HS dropouts and grads	Liquid assets[1] <$5,000	All, by "minimum wage cutoff"		Real average quarterly spending: All	Real average quarterly spending: HS dropouts and grads
0	123	36	162	69	244	9,865	8,533
	(171)	(231)	(186)	(209)	(294)		
	170,419	64,073	79,562	122,878	70,951		
>0	869	1249	780	312	-226	6,878	6,538
	(469)	(603)	(401)	(263)	(268)		
	21,695	12,976	13,041	47,485	51,927		
>=0.2	885	1330	981	393	-145	5,795	5,819
	(537)	(713)	(464)	(264)	(267)		
	15,192	9,524	9,467	40,506	48,813		
Minimum Wage theshold used[2]:	<=120%	<=120%	<=120%	120-200%[3]	200-300%[4]		

Notes:
Each cell represents a separate regression. w* is the share of pre-tax total consumer unit income from near minimum wage salaries earned by the top two adults in the consumer unit. Near minimum wage is defined in the last row. See the text for details. All standard errors are cluster corrected by consumer unit.

[1] Liquid assets are defined as savings plus checking accounts, as in Johnson et al. (2006).

[2] The minimum wage threshold is based on the gap between the wage (of the top 2 earners in each consumer unit) and the minimum wage at the beginning of the sample. For example, "<=120%" means that we assume labor income for a CU member is minimum wage income if their wage is within 120 percent of the state's effective minimum at the beginning of the sample (typically, survey 2).

[3] This sample throws out units with a worker less than or equal to 120 percent of the minimum wage at the beginning of the period.

[4] This sample throws out units with a worker less than or equal to 200 percent of the minimum wage at the beginning of the period.

Table 3
Total Credit Card Spending Response to Change in the Minimum Wage
Credit Card Data, 1995-2003

Income at credit card application	All	Credit Limit <$2,000	Balance ratio>2
>=$20,000	3	8	11
	(26)	(30)	(18)
	2,528,372	173,019	684,197
<$20,000	176	247	248
	(60)	(78)	(219)
	308,117	47,911	30,882

Notes:
Each cell represents a separate regression. All standard errors are cluster corrected by account holder. For income < $20,000, observations are weighted by P, the probability that an individual account holder is a minimum wage worker. See text for details.

Table 4
Decomposition of Spending Response
CEX, 1983-2005

			Durables subcomponents								
w*	**Nondurables & Services**	**Durables**	**Furniture**	**Floors and windows**	**HH items**	**Big appls.**	**Electr.**	**Leisure activities**	**Misc HH equip.**	**Transp.**	**Non-Transp.**
0	93	30	3	1	-7	5	-3	-4	-4	38	86
	(84)	(144)	(21)	(8)	(7)	(8)	(13)	(10)	(6)	(139)	(94)
>0	130	739	7	13	-1	54	12	-19	30	642	227
	(176)	(419)	(37)	(11)	(11)	(43)	(32)	(45)	(14)	(406)	(199)
>=0.2	-9	894	-4	11	6	8	35	16	58	764	121
	(212)	(463)	(40)	(10)	(8)	(15)	(35)	(15)	(17)	(457)	(220)
Real average amount spent (2000$):											
0	8,209	1,656	150	33	90	42	202	101	51	987	8,878
>=0.2	4,995	800	61	8	33	21	109	49	22	498	5,297
Conditional on purchase (2000$):											
0		1,772	543	314	162	612	269	157	186	10,511	
>=0.2		963	338	137	84	389	196	101	127	5,967	

Notes
Each cell represents a separate regression. All standard errors are cluster corrected by consumer unit.

Table 5
Decomposition of Transportation Spending Response
CEX, 1983-2005

	Amount of purchase					Probability of a purchase				
w*	New cars	Used cars	New trucks	Used trucks	Other transp.	New cars	Used cars	New trucks	Used trucks	Other transp.
0	-12	52	36	30	-69	0.000	0.009	-0.001	0.005	-0.001
	(82)	(54)	(73)	(43)	(50)	(0.004)	(0.006)	(0.003)	(0.004)	(0.003)
>0	204	178	277	-14	-3	0.018	0.017	0.013	-0.002	-0.006
	(132)	(175)	(161)	(100)	(276)	(0.009)	(0.024)	(0.008)	(0.013)	(0.009)
>=0.2	123	25	308	-6	314	0.012	0.009	0.014	-0.003	-0.003
	(144)	(218)	(184)	(115)	(322)	(0.010)	(0.032)	(0.008)	(0.016)	(0.008)
Real average amount spent (2000$):										
0	319	277	189	138	64	0.018	0.044	0.009	0.016	0.011
>=0.2	82	239	51	98	29	0.006	0.056	0.003	0.016	0.005
Conditional on purchase (2000$):										
0	17,475	6,332	20,220	8,611	6,031					
>=0.2	13,767	4,226	18,579	6,071	5,544					

Notes
Probability of a purchase is estimated with a linear probability model with individual fixed effects.
Each cell represents a separate regression. All standard errors are cluster corrected by consumer unit.

Table 6
Debt Response to Change in the Minimum Wage
Credit Bureau and Credit Card Data, 1995-2003

Income at credit card application	Auto debt	Home equity debt	Mortgage debt	Credit card debt	Total debt	Collateralized debt
>=$20,000	18	11	7	-12	24	36
	(103)	(91)	(139)	(8)	(117)	(124)
<$20,000	184	125	151	105	565	460
	(76)	(75)	(351)	(80)	(299)	(285)

Notes:
Collateralized debt (auto+home equity+mortgage) are from the credit bureau. Credit card debt is based on cards from our institution.
All observations are weighted by P, the probability that an individual account holder is a minimum wage worker. See text for details.
Sample sizes are 2,528,372 and 308,117 for account holders with income of at least $20,000 and income less than $20,000.
Each cell represents a separate regression. All standard errors are cluster corrected by account holder.

Parameter	Quarterly value	Definition
β	$\sqrt[4]{0.95}$	Discount factor
γ	2	Coefficient of relative risk aversion
θ	0.15	Utility weight on durables
$T - t_0$	200	Number of time periods
r	$\sqrt[4]{1.03} - 1$	Quarterly interest rate
δ	0.034	Durables depreciation rate
π	0.4	Downpayment rate
$E(Y_0)$	\$2,900	Average income of minimum wage households
α_1	0.0108	Income growth
ρ	0.995	Autocorrelation of income
σ_ϵ^2	0.002	Variance of AR(1) innovations
σ_u^2	0.000	Variance of transitory innovations

Table 7: Parameters Used for Calibration

Parameters	Non-durables Spending	Durables Spending	Total Spending	Median assets	Median resources***
Estimates*	-9	894	885	18	1,992
Baseline**	113	196	309	-5,298	262
$\pi = 0.2$	134	165	299	-7,367	352
$\pi = 1.0$	81	140	221	241	241
$\sigma^2_\epsilon = 0$	73	286	359	-6,302	81
$\sigma^2_\epsilon = 0.005$, $\sigma^2_u = 0.05$	81	98	179	-4,193	456
$\sigma^2_\epsilon = 0, \theta = 0.4, \pi = .1$	137	413	550	-27,509	104
$\sigma^2_\epsilon = 0, \theta = 1, \pi = .2$	0	1,080	1,080	-65,746	31
Adjustment cost = 0.05	73	116	188	-4,199	700
$\beta = 1.0$, $\sigma^2_\epsilon = 0$, no borrowing constraints	9	17	26	-20,999	na
$\beta = 1.0$, $\sigma^2_\epsilon = 0$, adjustment cost = 0.05, no borrowing constraints	11	-10	1	-22,798	na

* Spending estimates from table 4, assets and resources from table A2
** Baseline parameters shown in table 7
*** Median resources defined as $A_{it} + (1 - \pi)S_{it}$

Table 8: Robustness Checks

Figure 1
Spending Response to a Change in the Minimum Wage , CEX

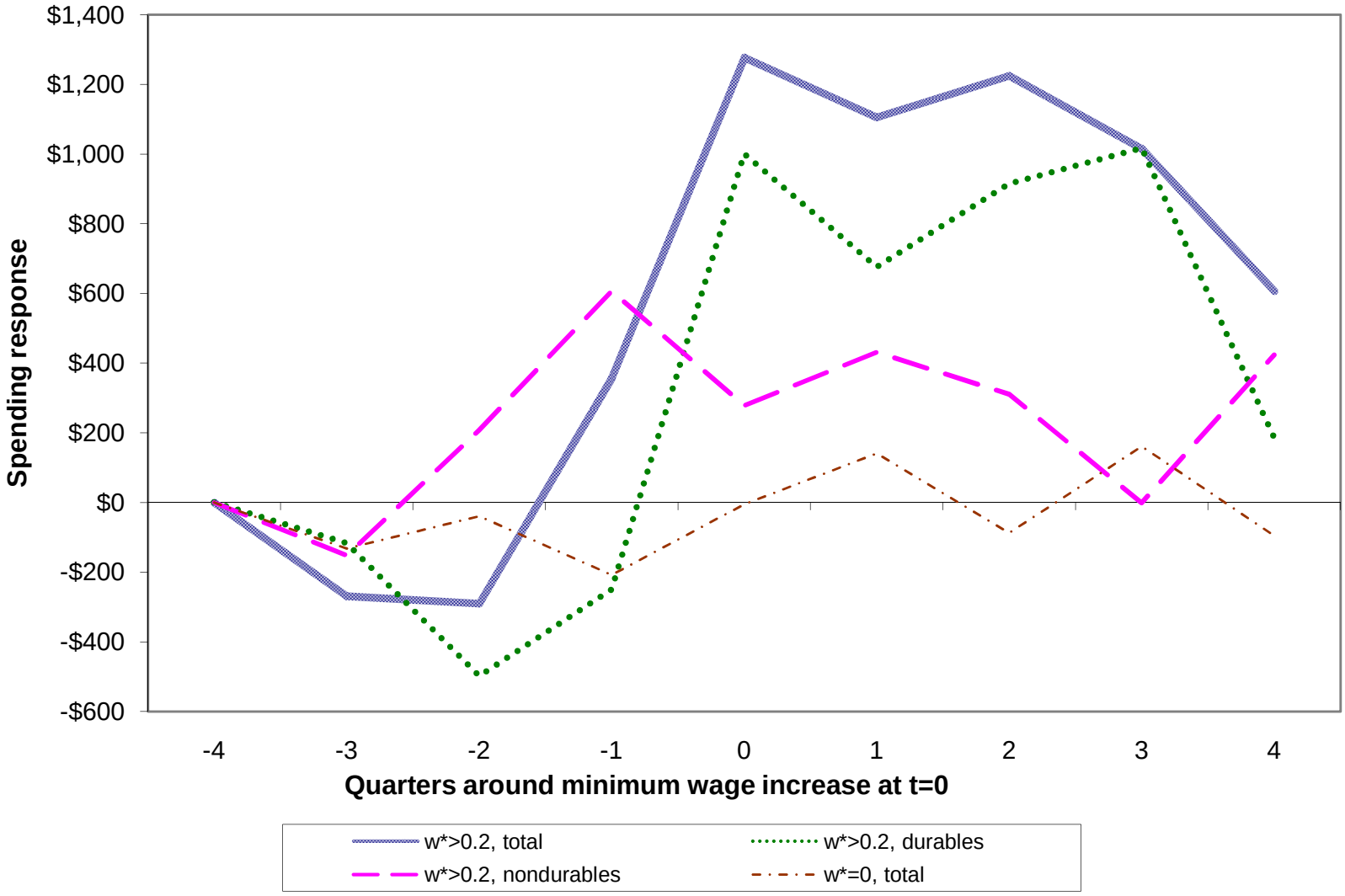

Figure 2
Spending Response to Change in the Minimum Wage, Credit Card Data

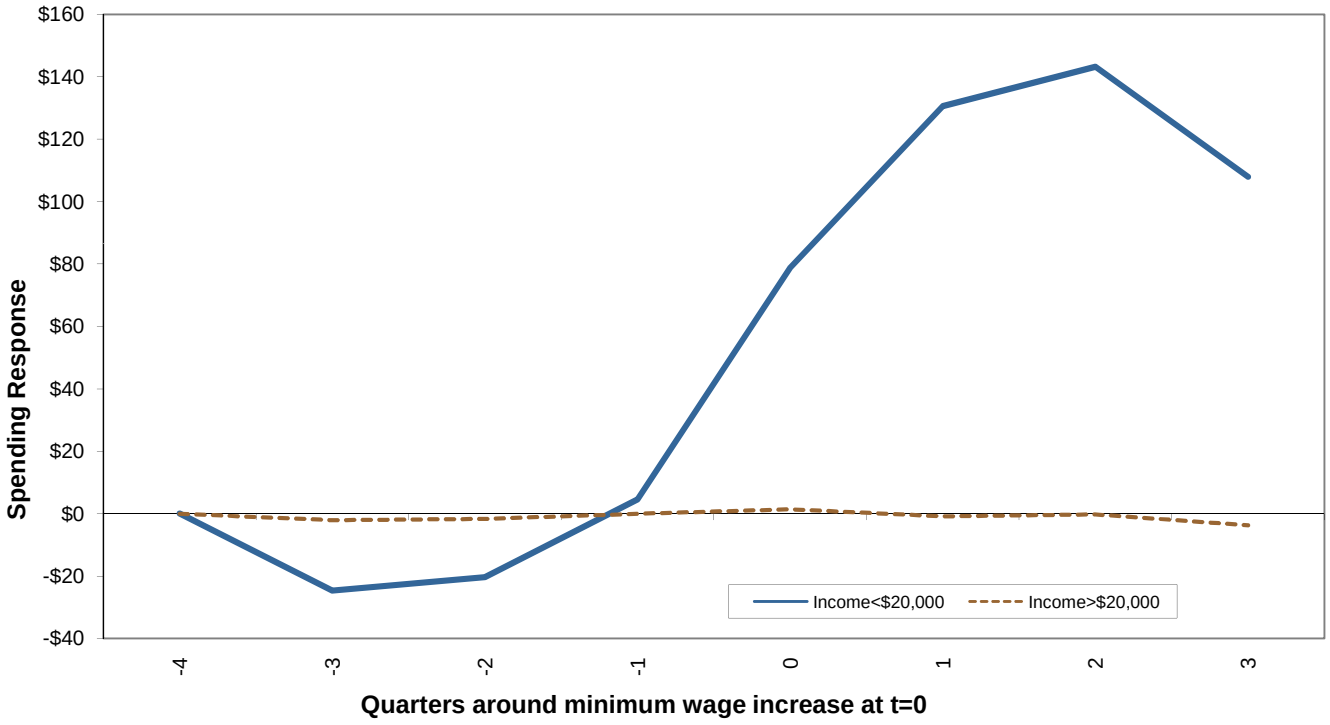

Figure 3
Debt Response to a Change in the Minimum Wage
Credit Card and Credit Bureau Data

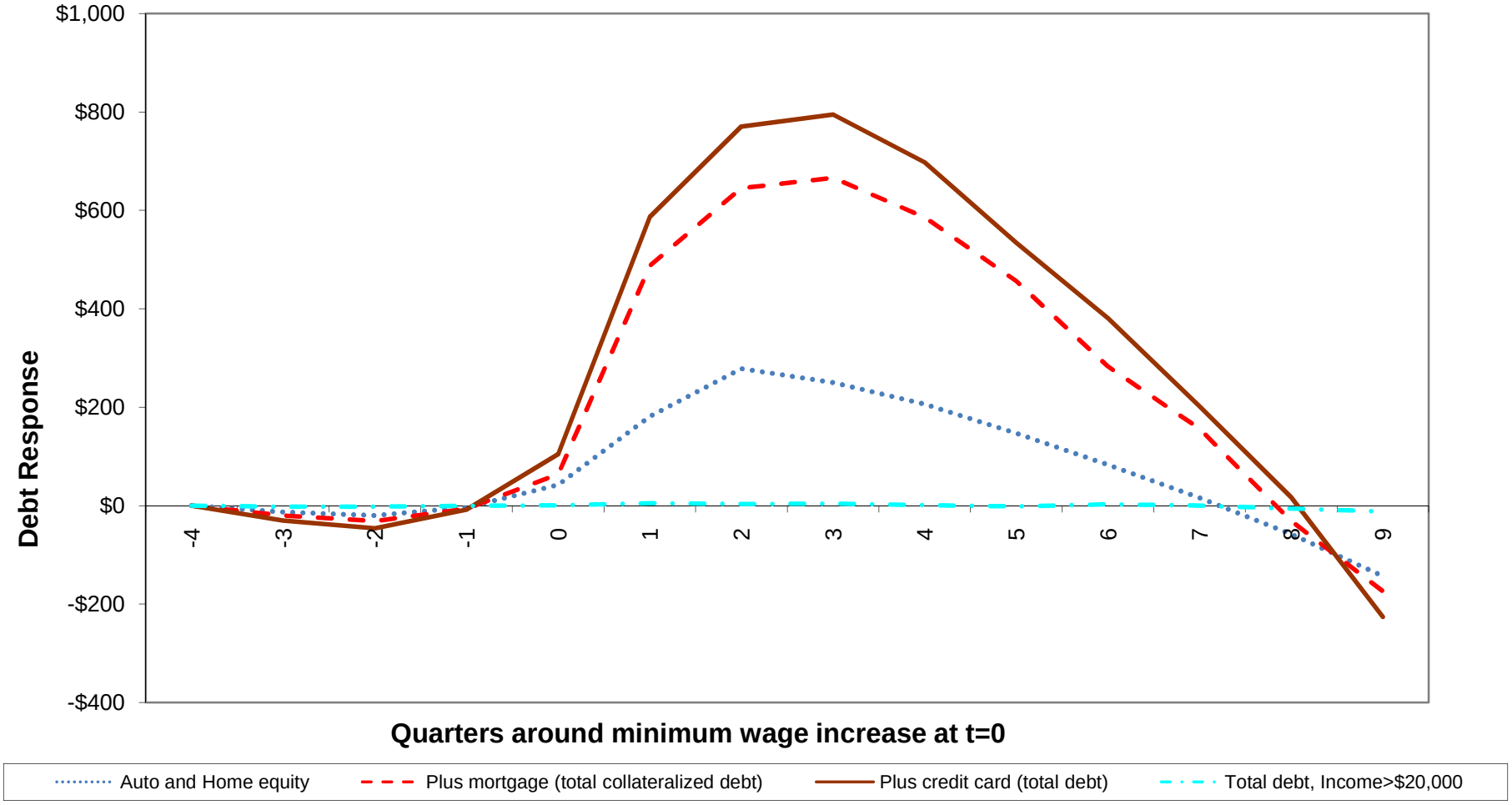

Figure 4
Simulated Income Change Around a Minimum Wage Increase

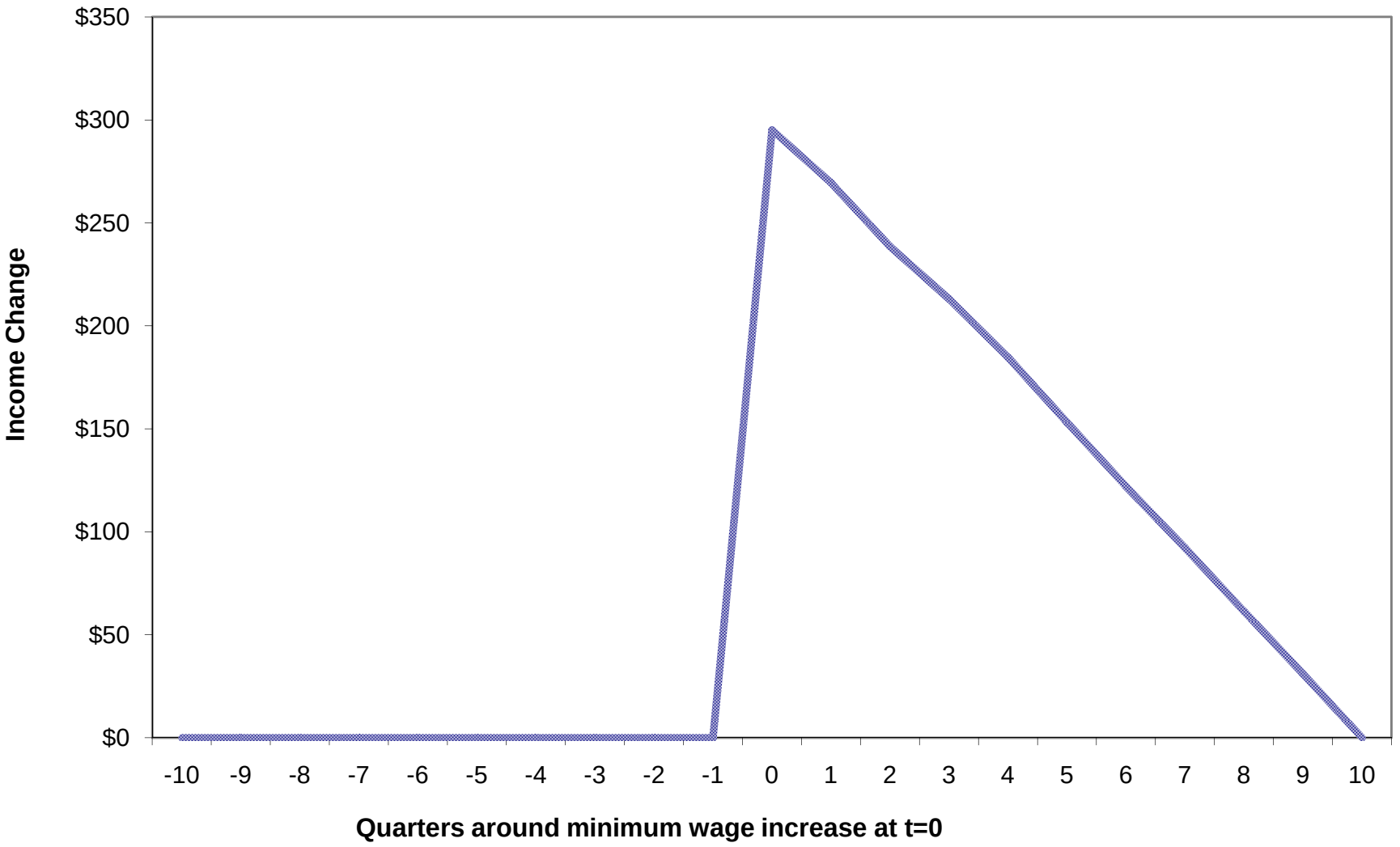

Figure 5
Spending Change Around a Minimum Wage Increase
Simulation without Borrowing Constraints

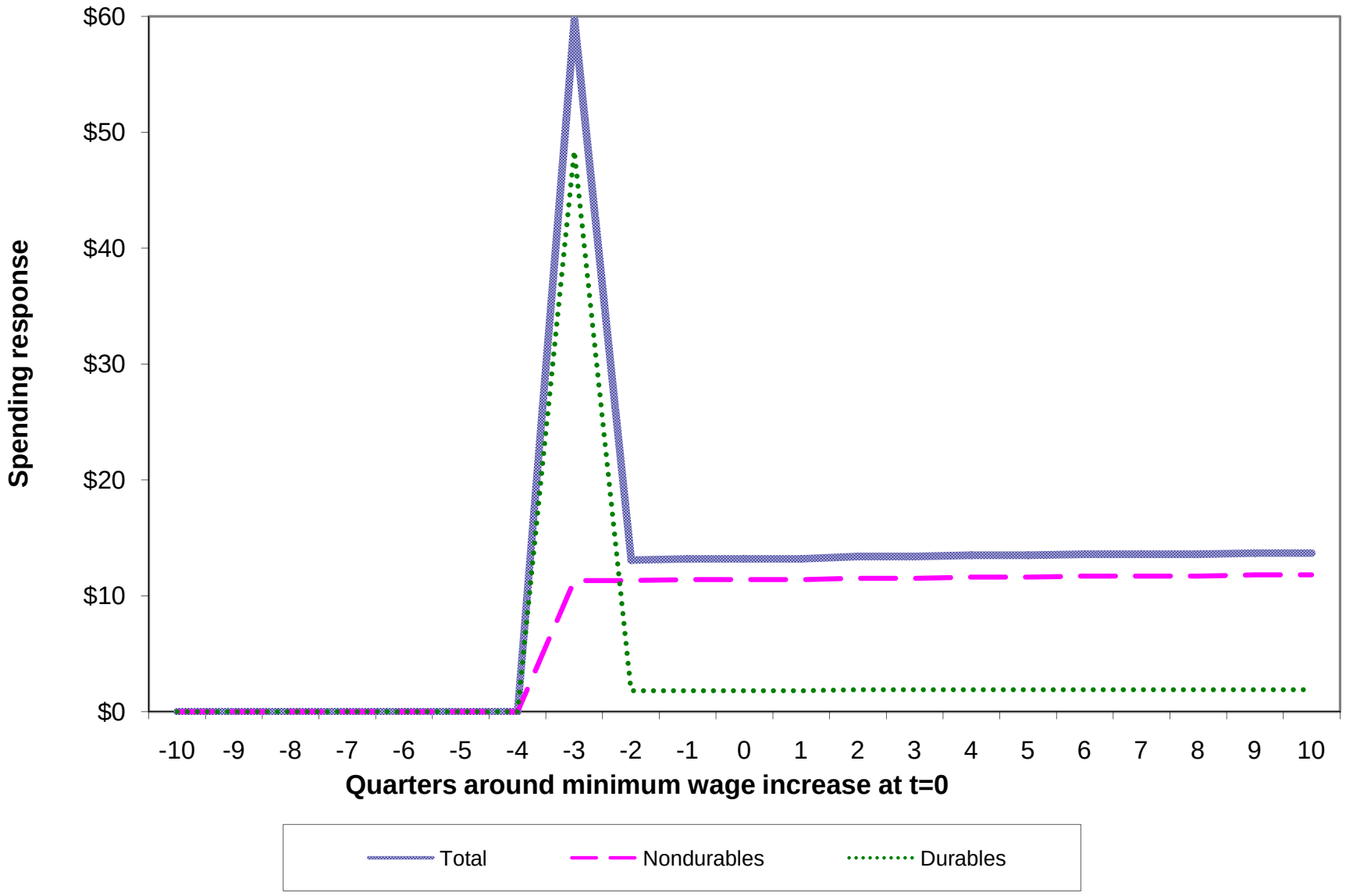

Figure 6
Spending Change Around a Minimum Wage Increase
Simulation with Borrowing Constraints

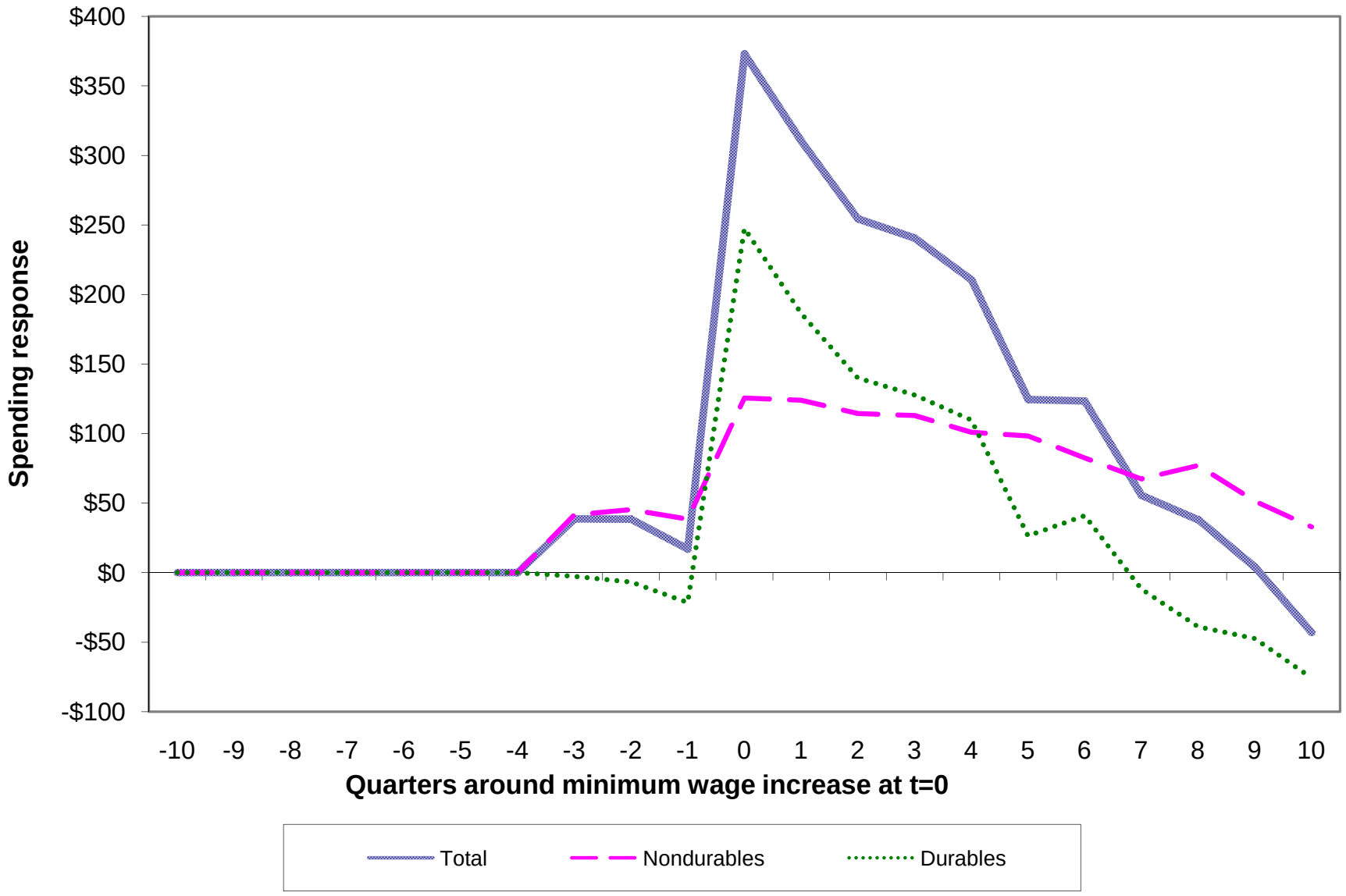

Figure 7
Spending Response to Change in Minimum Wage, CEX
Quantile Regression

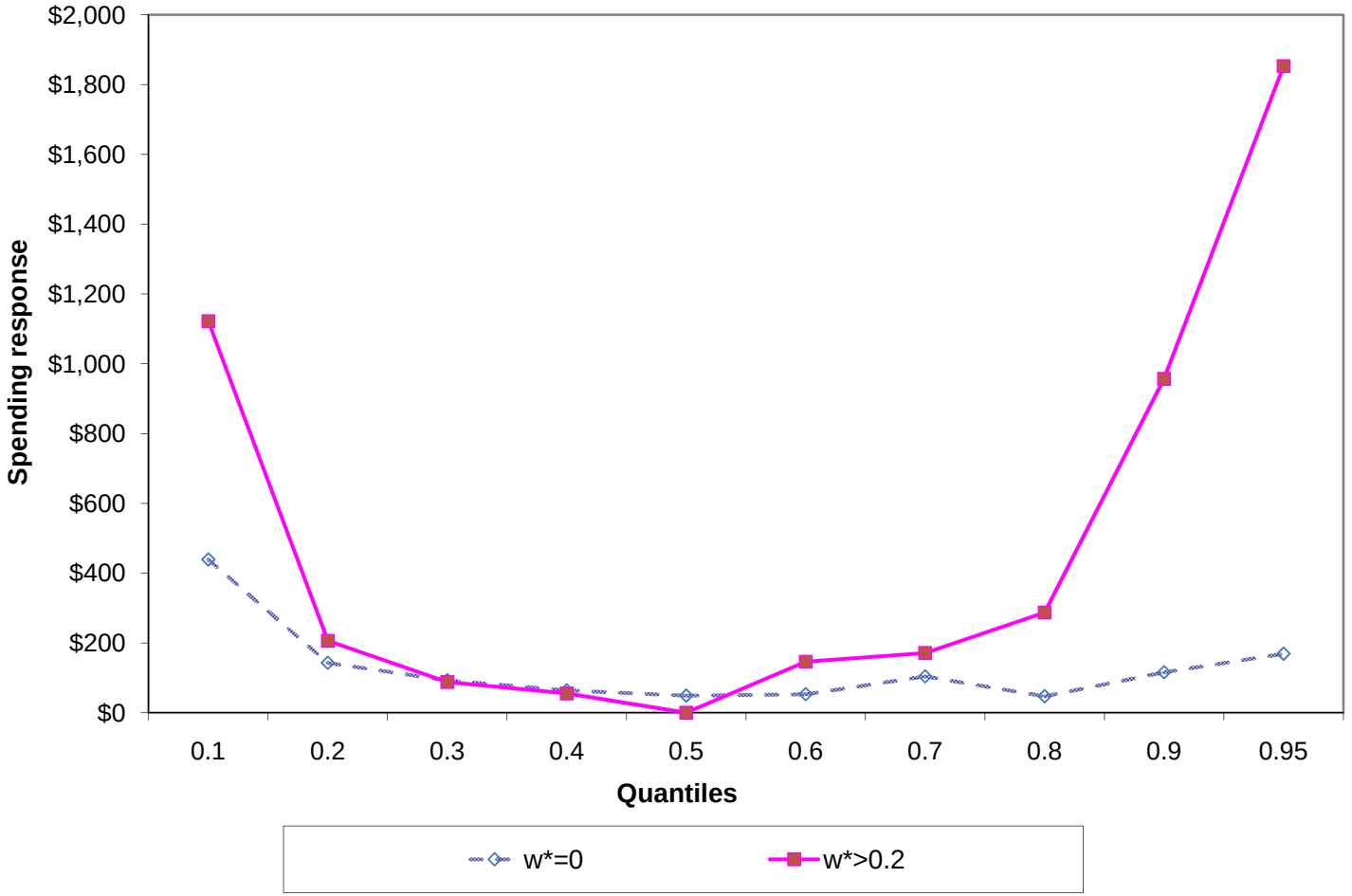

Figure 8
Model Predicted Spending Response to Change in Minimum Wage with and without Adjustment Costs
Quantile Regressions

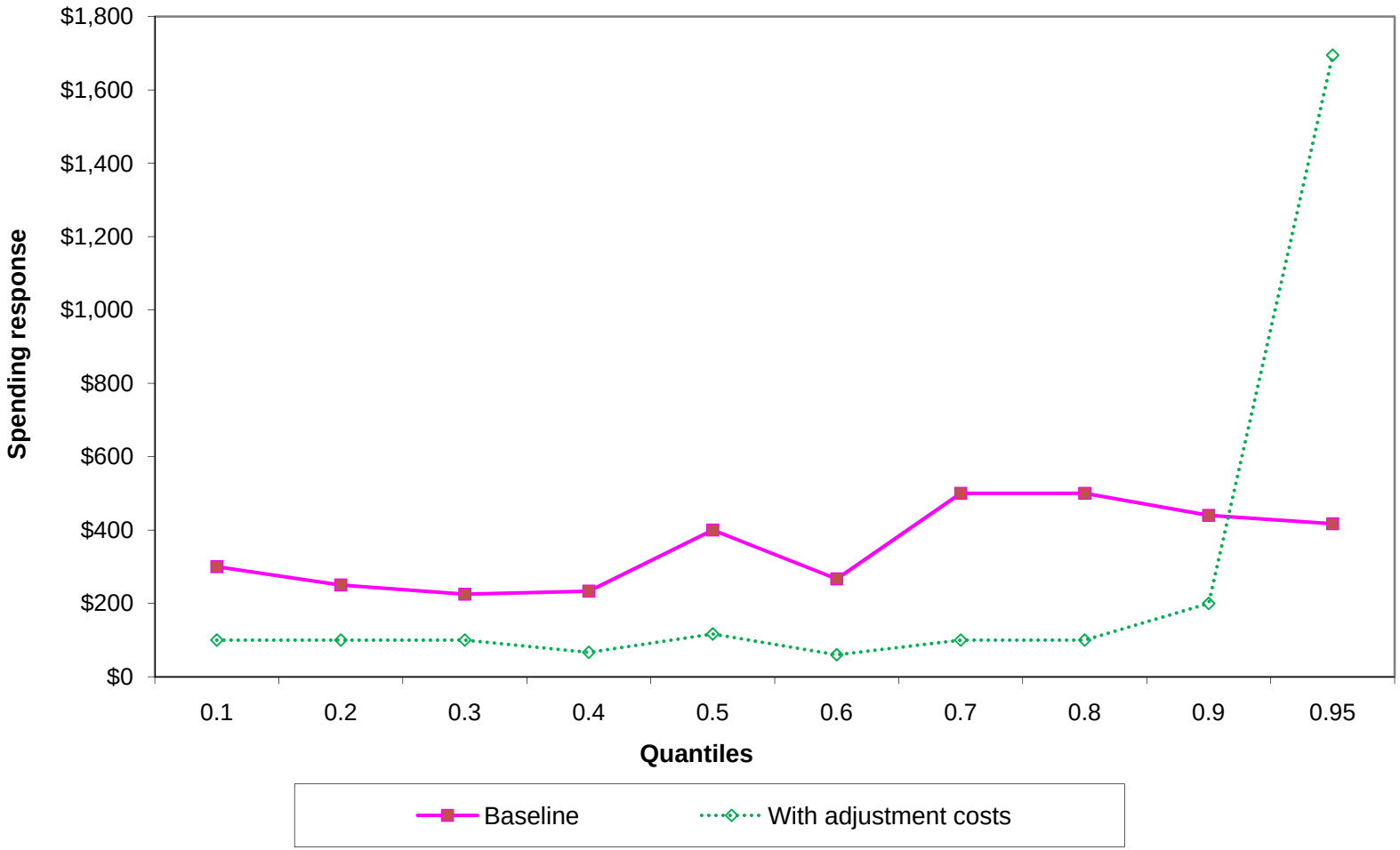

Table A1
Summary Statistics

Variable	Units with w*=0 in initial survey		Units with w*>=0.2 in initial survey		Income >= $20,000 at application		Income < $20,000 at application	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
A. Consumer Expenditure Survey, 1983-2005								
Real average quarterly spending in survey 2	9,865	7,001	5,795	4,235				
Real Durables	1,656	4,441	800	2,779				
Real Nondurables and services	8,209	4,708	4,995	2,733				
Real before tax family nonasset annual income in survey 2	55,761	38,983	18,737	14,217				
Share of income from MW earners	0.00	0.00	0.68	0.31				
Share with no college experience (member 1)	0.38	0.49	0.63	0.48				
Member 1 age	40.3	11.1	35.5	12.7				
Number of adults	1.92	0.81	1.80	0.85				
Number of kids under 18	0.84	1.12	0.88	1.22				
Number of unit-surveys	170,419		15,192					
Number of units	51,445		5,001					
B. Survey of Income and Program Participation, 1986-2005								
Real before tax family nonproperty annual income in initial survey	50,581	35,133	20,382	13,262				
Share of income from MW earners	0.00	0.00	0.67	0.31				
Share with no college experience (Head)	0.44	0.50	0.69	0.46				
Head age	40.1	11.0	36.9	12.2				
Number of adults	1.80	0.78	1.71	0.74				
Number of kids under 18	0.86	1.11	1.01	1.24				
Number of household-surveys	486,018		47,674					
Number of households	71,264		7,719					

Table A1
Summary Statistics

Variable	Units with w*=0 in initial survey		Units with w*>=0.2 in initial survey		Income >= $20,000 at application		Income < $20,000 at application	
	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
C. Credit Card and Credit Bureau, 1995-2003					69,625	45,625	12,906	8,774
Salary income at application					8,538	3,447	5,577	3,230
Credit line					2,324	3,653	2,040	3,132
Current balance					310	553	146	459
Monthly purchases					336	1,044	184	635
Monthly payments					1,907	2,041	1,068	2,476
Debt					15.2	2.6	18.3	6.2
APR								
Fico Score					736	82	699	67
Active Credit Cards					2.8	2.4	2.1	2.6
Credit Bureau Balance					5,632	7,285	4,488	4,355
Home Equity Balance					672	5,312	717	7,869
Mortgage Balance					19,050	158,489	27,816	110,607
Auto Balance					3,163	8,197	3,189	6,795
Number of observations					2,528,372		308,117	
Number of consumers					183,053		18,882	

Notes: Real spending and income in 2000 dollars. All CEX and SIPP descriptive statistics are weighted.

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Table A2

Summary Statistics, 2004 Survey of Consumer Finances

Variable	Households with w*=0		Households with w*>=0.2	
	Mean	Median	Mean	Median
Family income	53,241	38,755	16,188	11,996
Value of durables (S(it))	19,585	13,000	8,852	4,800
Value of loans against durables	6,483	0	2,646	0
Net financial assets	125,485	13,657	32,281	369
Assets net of durables debt (A(it))	119,002	8,397	29,635	18
Resources (A(it)+(1-pi)S(it))	130,753	17,954	34,946	1,922
Homeowner (=1 if yes)	0.64	1.00	0.35	0.00
Age of head	42.3	42.0	36.3	34.0
Number of households	12,642		568	

Notes: Real income, assets, and debt in 2000 dollars. All descriptive statistics are weighted. Income variable is pre-tax earnings of husband and wife. Net financial wealth includes stocks, bonds, checking and money market accounts, less liabilities against these. Net financial wealth excludes business and housing, and durables wealth, as well as liabilities against these.