Data Shop

Data Shop, a department of Cityscape*, presents short articles or notes on the uses of data in housing and urban research. Through this department, PD&R introduces readers to new and overlooked data sources and to improved techniques in using well-known data. The emphasis is on sources and methods that analysts can use in their own work. Researchers often run into knotty data problems involving data interpretation or manipulation that must be solved before a project can proceed, but they seldom get to focus in detail on the solutions to such problems. If you have an idea for an applied, data-centric note of no more than 3,000 words, please send a one-paragraph abstract to david.a.vandenbroucke@hud.gov for consideration.*

Home Maintenance and Investment Decisions

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Any opinions and conclusions expressed herein are those of the authors and do not necessarily represent the views of the U.S. Census Bureau or the Bureau of Labor Statistics. The research in this article does not use any confidential Census Bureau information.

Abstract

The owned home is often the largest asset in a household's portfolio. To maintain its value, the home requires continual reinvestment, and a homeowner can increase its value through renovations and additions. Empirical research on these home maintenance and investment decisions of the household has relied almost exclusively on the American Housing Survey (AHS). The research presented in this article added a new data set to this literature, the Consumer Expenditure (CE) Survey, using quarterly household data from 1984 to the first quarter of 2005. In the article, we first compare results between the AHS and CE Survey using some stylized facts identified in the literature. Then we move beyond this comparison and highlight some strengths of the CE Survey, including the distinct time-series patterns observed in the quarterly data.

Introduction

In the typical homeowner's financial portfolio, the home is a singular beast. Owned homes are part consumption good and part investment good. Unlike purely financial assets, the home requires periodic maintenance to retain both its consumption and asset values, and the home can be expanded as necessary in lieu of incurring the substantial transaction costs associated with selling the current home, purchasing a new home, and moving.

In the research presented in this article, we constructed a new data set from the Consumer Expenditure (CE) Survey that enables researchers to investigate the household's housing maintenance and additions decisions, confirming some of the stylized facts already in the housing literature, and expanding the results to take advantage of the long time-series of higher frequency data. This article falls into the category of literature that investigates the microeconomic determinants of maintenance and investment decisions; at the same time, it adds to the literature by using a new, complementary data set that has different strengths (and weaknesses). Understanding home maintenance and additions behavior is an important component in understanding household borrowing, saving, and investment decisions. Because routine maintenance can be forgone (for a time) without substantial depreciation of the consumption and asset values, the owned home provides an internal capital market for homeowners and a means of short-term borrowing. Conversely, additions expenditures may be a means of saving—in that these expenditures increase the home's capital stock.

Most research on the microeconomic determinants literature has relied on a single data set, the American Housing Survey (AHS). As the first pass at the data set created using the CE Survey, the research presented in this article took a fresh look at a number of the stylized facts, which have emerged from the microeconomic approach to analyzing homeowners' additions and maintenance expenditures, described in the following paragraphs. Because this research uses a new data set, we decided to compare results in the CE Survey with the existing literature. This article also highlights some of the strengths of the CE Survey, mainly by showing the interesting time-series properties of the homeowners' maintenance and additions expenditure data.

Data

The CE Survey consists of two surveys—the Interview Survey and the Diary Survey. The Interview Survey is a quarterly survey of consumer units. This research only uses the Interview Survey. A consumer unit consists of members of a household who are related or share at least two out of three major expenditures. Interviews occur on a rotating quarterly basis; after one household leaves the sample after four interviews, a new household is drawn to replace it, which results in one-fourth of the sample being refreshed every 3 months. Although interviews are conducted on a quarterly basis per household, they are staggered so that households are surveyed every month. In each interview, respondents are asked about expenditures during the past 3 months.

For our research, we used quarterly data from 1984 to the first quarter of 2005; our unit of observation was an owned primary residence. From 1984 to 1998, our sample had 3,100 observations per quarter on average, and, after 1998, we had approximately 5,000 observations per quarter.

The CE Survey provides detailed characteristics for the home and the people living there. The data contain statistics from both the state and metropolitan statistical area (MSA). The home characteristics data include the year the home was built, the type of building (for example, single-family residence), and number of rooms. The respondents also provide the self-assessed home value and details about all outstanding mortgages. Finally, the CE Survey primarily has detailed expenditure data.

As part of collecting the detailed expenditure data, the CE Survey asks questions regarding expenditures related to investments in the home. The CE Survey asks about expenses that occurred during the previous 3 months and creates a separate line item for each improvement project. Some consumer units reported 10 or more separate jobs in a given quarter.[1] The CE Survey asks whether each improvement project is considered to be new construction, an addition, an alteration, maintenance and repair, or a replacement.

We follow Reschovsky (1992) in our general classification of expenditures as either maintenance or additions. Maintenance expenditures affect the quality of the existing capital stock of housing. Additions expenditures add to the capital stock. As Reschovsky noted, this classification is not as clean as one would hope. For example, the replacement of a refrigerator could be classified as maintenance if the new one is of comparable quality. Alternatively, a household may purchase a new state-of-the-art refrigerator that significantly improves the capital stock. We resolve this problem in part by using the consumer unit's own classification. We classify anything that is coded as new construction or an addition as additions, and we classify anything coded as an alteration, maintenance and repair, or replacement as maintenance.

Summary Statistics

Because the CE Survey and AHS have different survey designs, comparisons between the two surveys are not straightforward.[2] The biggest difference is that the AHS reports spending on maintenance in a typical year and reports spending on additions over a 2-year period. To get closer to the AHS, we aggregated our quarterly observations and report summary statistics for households that appeared in all four interviews.[3]

Using the AHS from 1985 to 1993, Gyourko and Tracy (2006) reported that 77 percent of households reported positive maintenance expenditures in a typical year. Exhibit 1 shows that 79.5 percent of households that appear in all four quarters of the CE Interview Survey from 1984 to 2005 reported positive maintenance expenditures.

Using the AHS from 1993 to 1997, Baker and Kaul (2002) found that 16.7 percent of households conducted an expansion project. Our percentage of households spending on additions in a given quarter includes more types of projects than Baker and Kaul included, and we found that a higher percentage of our sample—52.1 percent—spends on additions. This percentage may seem high, but a household can spend $10 on a can of paint that is part of a larger project to add a bedroom

[1] The CE Survey asks about the nature of the job and keeps track of the differences over time to help avoid double counting.

[2] See also Rappaport and Cole (2003) for a comparison of the two surveys.

[3] For this comparison, we lose 40.4 percent of consumer units (but only 18.7 percent of quarterly observations) by restricting the sample to households that appeared in all four interviews.

Exhibit 1

Summary Statistics

	Consumer Expenditure Survey		American Housing Survey
	Quarterly Observations	**Yearly Observations**	**Yearly Observations**[a]
Maintenance			
Fraction with positive expenditures (%)	0.469	0.795	0.770
Conditional mean ($)	616	1,400	—
Unconditional mean ($)	289	1,110	553
Additions			
Fraction with positive expenditures (%)	0.202	0.521	—
Conditional mean ($)	1,591	2,224	—
Unconditional mean ($)	322	1,147	1,793
Observations	324,442	60,744	—

[a] American Housing Survey (AHS) result for the percent with positive maintenance expenditures comes from Gyuorko and Tracy (2006), exhibit 1, which used data from 1985–1993. The unconditional mean values come from Davidoff (2006), exhibit 1, which used data from 1985–2001. The additions value is divided by two because Davidoff reports a value over 2 years, as it is reported in the AHS.

Notes: The Consumer Expenditure (CE) Survey results are based on authors' calculations using data from the first quarter of 1984 to the first quarter of 2005. The yearly observations column for the CE Survey restricts the sample to those households that appeared in all four interviews. The rest of the article uses the quarterly data.

and have it count as an addition if the household identifies it as such. If a household is slowly performing a project, the costs can be spread out over time.[4]

Using the AHS from 1985 to 2001, Davidoff (2006) found that households spent $553 and $1,793 per year on average on routine maintenance and additions, respectively. Exhibit 1 shows that our sample spent $1,110 and $1,147 per year on average on maintenance and additions, respectively.[5] Summing over the two categories, Davidoff found that households spend $2,346 per year on maintenance and additions (in 2003 dollars), and we found that households spend $2,257 per year on maintenance and additions (in 2004 dollars).

These cross-sectional values in the AHS and CE Survey mask considerable time-series variation. Returning to our sample of quarterly observations, the percent spending on maintenance peaks in 1984 at 52 percent per quarter and declines to 42 percent by 2004 (exhibit 2).[6] The percent spending on additions shows a different pattern, starting at 23 percent in 1984 and declining to 17.5 percent in 2000 before increasing to more than 21 percent in 2004 (exhibit 3).

Although fewer households spent on maintenance and additions over time, mean quarterly expenditures were constant or increasing. Real mean maintenance expenditures increased from $230 to $320 between 1984 and 2004 (exhibit 4), suggesting that households were doing fewer but larger projects. There is considerable variation in mean additions expenditures, with a noticeable

[4] We censored the data and only counted additions if the household spent at least $1,000, and the trend in additions did not change.

[5] The expenditure data are in real 2004 dollars, using the Consumer Price Index research series.

[6] The data are seasonal. We smooth the figures using a simple four-quarter moving average.

decrease in mean expenditures after 1988, and then a gradual increase after 1995 and a dramatic increase after 2000. The first 4 years of the 2000s is particularly interesting for additions, because the proportion spending on additions increased dramatically (from 18 to 21 percent per quarter) and mean spending increased $300 to $450 per quarter. Households were more likely to spend money on an addition and, conditional on spending, to spend more as well.

Exhibit 2

Fraction With Maintenance Expenditures, First Quarter of 1984 to First Quarter of 2005

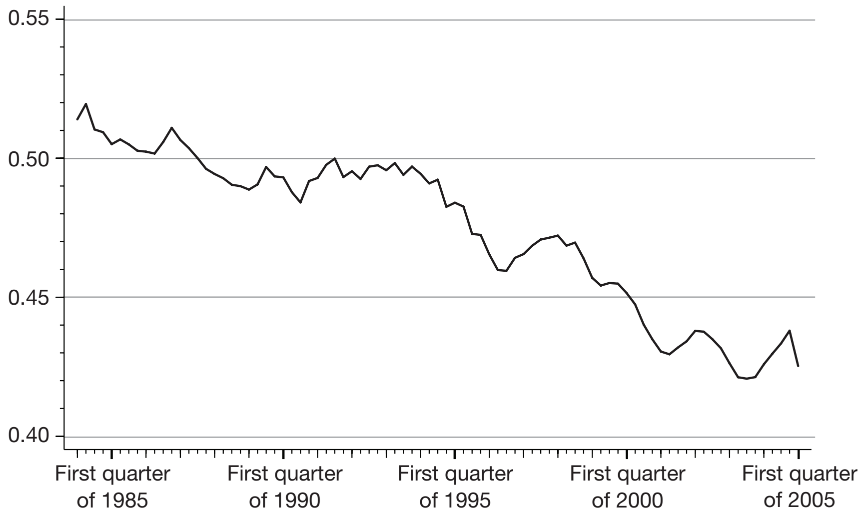
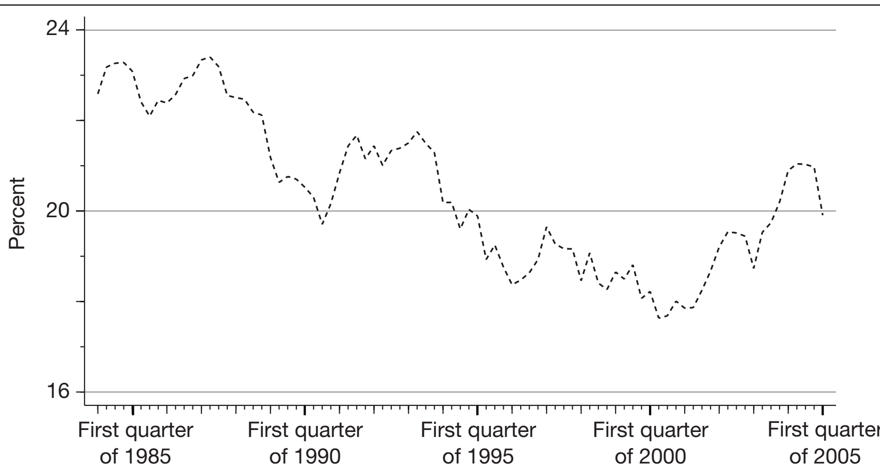


Exhibit 3

Fraction With Additions Expenditures, First Quarter of 1984 to First Quarter of 2005

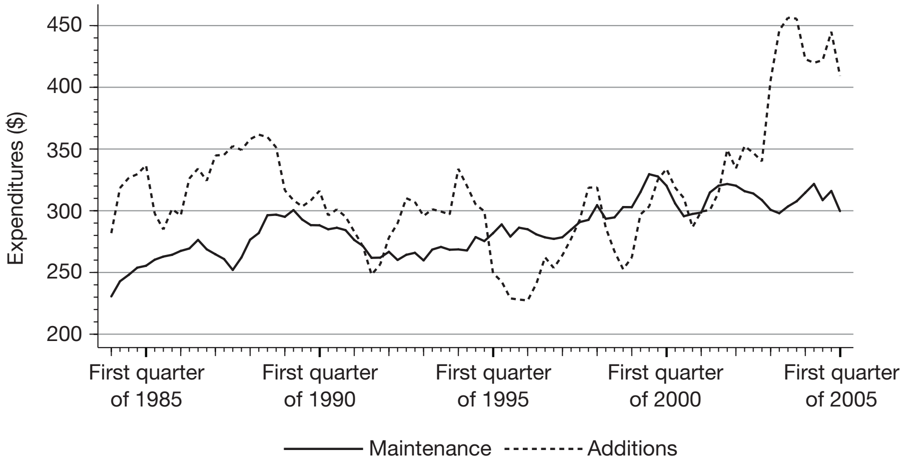


Note: The data are seasonal. We smooth the figures using a simple four-quarter-moving average.

Source: Authors' calculations based on the Consumer Expenditure Survey: 1984–2005.

Exhibit 4

Unconditional Mean Quarterly Maintenance and Additions Expenditures, First Quarter of 1984 to First Quarter of 2005



Note: The data are seasonal. We smooth the figures using a simple four-quarter-moving average.
Source: Authors' calculations based on the Consumer Expenditure Survey: 1984–2005.

Empirical Methodology

To explore the stylized facts of the literature with the CE Survey, ideally we would match the empirical methods used in existing research. In the broadest sense, following the existing literature means we would estimate reduced form models, studying the determinants of the decision to spend and the determinants of the level of spending. Given that we are estimating reduced form models, the first methodological challenge posed is that observations with zero expenditures are numerous. The specific methods employed differ across authors, including ordinary least square (OLS), independent two-stage estimation, and two-stage Heckman selection correction.

In this study, we used an independent two-stage estimation strategy. We first used a probit to model whether the household spent during the quarter, and then we model log expenditures as a linear function via OLS. Estimating the two stages separately required the assumption that the errors from the probit model and those from the OLS model are independent. A large portion of both maintenance and additions expenditures in our data represent large and lasting projects with a significant durable-goods character. Such long-term investments are not likely to be considered anew by the household every period. Instead, many of the expenses are likely to be triggered by some exogenous process (for example, the roof leaks), which forces the household to make a maintenance decision. These external factors are likely to be uncorrelated with the cost of the maintenance.

One important way our study differs methodologically from the existing research is that we estimated the extent of maintenance and additions expenditures separately but estimated the decisions simultaneously. Most research pools maintenance and additions expenditures together, while, in this study, we allowed the independent variables to affect the two expenditures differently. We believe that the decision to maintain the capital stock can be different from the decision to add to the capital stock. For example, a large addition project might be more sensitive to the interest rate than a routine maintenance expenditure.

We estimated a bivariate probit model for maintenance and additions; then we estimated an independent, seemingly unrelated regression for log expenditures. The dependent variables in our bivariate probit model are whether the household spent a positive amount on maintenance and whether the household spent a positive amount on additions. The dependent variables in our reduced form demand model are log of maintenance expenditures and log of additions expenditures.

Independent Variables

The independent variables in each regression are identical.[7] For the demographic characteristics, we included log before-tax income, family size, and age of the respondent. For characteristics of the home, we included dummy variables for home age, rooms, urban or rural status, and MSA status. We augmented the CE Survey data with additional macrolevel variables. The regressions included month dummy variables to capture the seasonality of expenditures and three aggregate variables to capture possible macroeconomic effects. We included the 30-year fixed mortgage interest rate for each quarter from Freddie Mac to capture differences in borrowing costs.[8] To capture changes in housing markets, we used the Office of Federal Housing Enterprise Oversight (OFHEO) (now the Federal Housing Finance Agency), repeat sales house price index at the state level. We also included the state employment rate to capture the potential effect of labor market conditions.

Empirical Results

Exhibits 5 and 6 present the results. We first discuss our results relative to the stylized facts.

Interest Rates

The first stylized fact is that interest rates play a role in the maintenance and addition decisions. Many papers model the household's decision to increase the size of its home as a choice between making additions to the current home or moving to a different home (for example, Potepan, 1989). In these models, a household finds itself with extra demand for housing services as the result of some exogenous shock and meets that demand either by adding to its current house or by moving. Because most houses are financed, interest rates play a critical role in the relative costs and benefits of each option.

Potepan (1989) creates a model of household choice in which a household stays put when prevailing mortgage rates are high relative to the household's mortgage rate. Potepan describes it as the mortgage lock-in effect, indicating that a household with an interest rate lower than the current market rate is locked into its current home because it would be too expensive to move to a new home at the prevailing interest rates. Thus, a higher interest rate may lead to a higher probability of an owner staying in the home and spending money on maintenance and additions, although the maintenance and additions may also need to be financed with a loan.

[7] See the appendix table for summary statistics for the independent variables.

[8] http://www.freddiemac.com/pmms/pmms30.htm.

We found that an increase in the 30-year OFHEO mortgage interest rate increases the probability of maintenance and additions expenditures (exhibit 5). Thus, we found evidence for the mortgage lock-in effect. Similarly, an increase in interest rates increases the level of spending on maintenance and additions projects (exhibit 6).

Exhibit 5

Bivariate Probit for Maintenance and Additions (1 of 2)

	Maintenance			Additions		
	Marginal Effect	Std. Error	P-value	Marginal Effect	Std. Error	P-value
Characteristics of the household						
Log income—all	0.01551	0.00026	0.000	0.00792	0.00021	0.000
Log income—incomplete reporters	– 0.00677	0.00048	0.000	– 0.00374	0.00039	0.000
Age dummy variables (omitted is less than age 26)						
Age 26–28	– 0.06834	0.00729	0.000	0.01239	0.00547	0.024
Age 29–31	– 0.02430	0.00624	0.000	0.02808	0.00466	0.000
Age 32–34	– 0.00978	0.00539	0.070	0.02104	0.00406	0.000
Age 35–37	– 0.00892	0.00506	0.078	0.01125	0.00383	0.003
Age 38–40	– 0.00492	0.00488	0.314	0.00578	0.00370	0.118
Age 41–43	– 0.00169	0.00476	0.723	– 0.00863	0.00363	0.018
Age 44–46	– 0.00705	0.00482	0.144	– 0.00993	0.00369	0.007
Age 47–49	0.00108	0.00492	0.825	– 0.01711	0.00378	0.000
Age 50–52	– 0.00672	0.00499	0.178	– 0.01736	0.00384	0.000
Age 53–55	– 0.00576	0.00515	0.264	– 0.02109	0.00398	0.000
Age 56–58	0.00523	0.00532	0.326	– 0.02010	0.00412	0.000
Age 59–61	0.00311	0.00542	0.566	– 0.02448	0.00422	0.000
Age 62–64	0.01705	0.00549	0.002	– 0.03171	0.00430	0.000
Age 65–67	0.03021	0.00550	0.000	– 0.03058	0.00432	0.000
Age 68–70	0.04034	0.00563	0.000	– 0.04943	0.00450	0.000
Age 71–73	0.05183	0.00579	0.000	– 0.05856	0.00469	0.000
Age 74–76	0.06576	0.00598	0.000	– 0.06368	0.00490	0.000
Age 77–79	0.06927	0.00637	0.000	– 0.07751	0.00533	0.000
Age 80 or older	0.08162	0.00537	0.000	– 0.08791	0.00449	0.000
Family size dummy variables (omitted is one-person family)						
Two people	– 0.03480	0.00262	0.000	0.03902	0.00215	0.000
Three people	– 0.07448	0.00317	0.000	0.03262	0.00254	0.000
Four people	– 0.07972	0.00333	0.000	0.03798	0.00264	0.000
Five people	– 0.09975	0.00412	0.000	0.03636	0.00321	0.000
Six people	– 0.11567	0.00612	0.000	0.02921	0.00473	0.000
Seven or more people	– 0.15485	0.00739	0.000	0.04053	0.00561	0.000

Exhibit 5

Bivariate Probit for Maintenance and Additions (2 of 2)

	Maintenance			Additions		
	Marginal Effect	Std. Error	P-value	Marginal Effect	Std. Error	P-value
Home age dummy variables (omitted is less than 1 year)						
2–5 years	0.03569	0.01573	2.270	– 0.08092	0.01109	– 7.290
6–10 years	0.08532	0.01552	5.500	– 0.11116	0.01096	– 10.140
11–15 years	0.08356	0.01545	5.410	– 0.10862	0.01091	– 9.960
16–20 years	0.07519	0.01550	4.850	– 0.10054	0.01094	– 9.190
21–30 years	0.05767	0.01533	3.760	– 0.10323	0.01081	– 9.550
31–40 years	0.03484	0.01538	2.270	– 0.11452	0.01085	– 10.560
41–50 years	0.01229	0.01546	0.790	– 0.12104	0.01093	– 11.080
51–60 years	– 0.01601	0.01562	– 1.020	– 0.12462	0.01107	– 11.250
61–70 years	– 0.00666	0.01596	– 0.420	– 0.12199	0.01138	– 10.720
71 or more years	– 0.02226	0.01546	– 1.440	– 0.12327	0.01092	– 11.290
Home age missing	– 0.03491	0.01534	– 2.280	– 0.13012	0.01081	– 12.040
Number of rooms dummy variables (omitted is 10 rooms or more)						
3 or fewer rooms	– 0.18995	0.00697	0.000	– 0.05491	0.00553	0.000
4 rooms	– 0.17845	0.00499	0.000	– 0.04239	0.00383	0.000
5 rooms	– 0.17585	0.00436	0.000	– 0.04867	0.00330	0.000
6 rooms	– 0.15345	0.00423	0.000	– 0.04671	0.00319	0.000
7 rooms	– 0.11137	0.00432	0.000	– 0.03572	0.00326	0.000
8 rooms	– 0.07061	0.00453	0.000	– 0.02613	0.00341	0.000
9 rooms	– 0.02495	0.00518	0.000	– 0.01318	0.00388	0.001
Number of rooms missing	– 0.14388	0.00926	0.000	– 0.05055	0.00747	0.000
Metropolitan statistical area (MSA) status (omitted is not in MSA)						
MSA central city	0.05402	0.00313	0.000	0.01190	0.00249	0.000
MSA not central city	0.07487	0.00259	0.000	0.02248	0.00205	0.000
Urban	0.08478	0.00229	0.000	0.00059	0.00179	0.740
Characteristics of the economy						
Log 30-year mortgage interest rate	0.12168	0.00421	0.000	0.04531	0.00330	0.000
OFHEO state home price index	0.00000	0.00001	0.946	0.00007	0.00001	0.000
State employment rate	0.22319	0.03275	0.000	0.19824	0.02561	0.000
Month dummy variables	Yes			Yes		
Number of observations	324,442			324,442		
Log likelihood	– 214,739			– 159,775		

OFHEO = Office of Federal Housing Enterprise Oversight.

Notes: CE Survey from the first quarter of 1984 to the first quarter of 2005. Robust standard errors are presented because there are up to four quarterly observations per household. The exhibit presents the results of a bivariate probit for whether the household spent money on maintenance and whether the household spent money on additions.

Exhibit 6

Seemingly Unrelated Regression for Maintenance and Additions (1 of 2)

	Log Maintenance			Log Additions		
	Marginal Effect	Std. Error	P-value	Marginal Effect	Std. Error	P-value
Characteristics of the household						
Log income—all	0.07786	0.00135	0.000	0.04393	0.00123	0.000
Log income—incomplete reporters	– 0.03438	0.00259	0.000	– 0.01954	0.00236	0.000
Age dummy variables (omitted is less than age 26)						
Age 26–28	– 0.38876	0.03857	0.000	0.01095	0.03508	0.755
Age 29–31	– 0.18744	0.03356	0.000	0.15181	0.03052	0.000
Age 32–34	– 0.09739	0.02911	0.001	0.11675	0.02647	0.000
Age 35–37	– 0.06949	0.02736	0.011	0.05602	0.02488	0.024
Age 38–40	– 0.04783	0.02639	0.070	0.03155	0.02400	0.189
Age 41–43	0.00613	0.02572	0.812	– 0.05928	0.02339	0.011
Age 44–46	– 0.02568	0.02604	0.324	– 0.06191	0.02368	0.009
Age 47–49	0.01347	0.02657	0.612	– 0.10838	0.02416	0.000
Age 50–52	0.00148	0.02693	0.956	– 0.12171	0.02450	0.000
Age 53–55	0.00215	0.02783	0.938	– 0.12406	0.02531	0.000
Age 56–58	0.07641	0.02874	0.008	– 0.12892	0.02614	0.000
Age 59–61	0.03135	0.02928	0.284	– 0.15473	0.02663	0.000
Age 62–64	0.12326	0.02970	0.000	– 0.20254	0.02701	0.000
Age 65–67	0.21605	0.02979	0.000	– 0.20172	0.02710	0.000
Age 68–70	0.23372	0.03053	0.000	– 0.31919	0.02777	0.000
Age 71–73	0.29235	0.03144	0.000	– 0.34806	0.02859	0.000
Age 74–76	0.37196	0.03248	0.000	– 0.39044	0.02954	0.000
Age 77–79	0.39544	0.03458	0.000	– 0.45582	0.03145	0.000
Age 80 or older	0.44988	0.02916	0.000	– 0.48814	0.02652	0.000
Family size dummy variables (omitted is one-person family)						
Two people	– 0.13988	0.01416	0.000	0.24117	0.01288	0.000
Three people	– 0.37726	0.01711	0.000	0.20664	0.01556	0.000
Four people	– 0.40742	0.01797	0.000	0.24916	0.01634	0.000
Five people	– 0.54180	0.02221	0.000	0.21971	0.02020	0.000
Six people	– 0.65163	0.03294	0.000	0.17001	0.02996	0.000
Seven or more people	– 0.83683	0.03949	0.000	0.24309	0.03592	0.000
Home age dummy variables (omitted is less than 1 year)						
2–5 years	0.14749	0.08514	0.083	– 0.86207	0.07744	0.000
6–10 years	0.47385	0.08406	0.000	– 1.13772	0.07646	0.000
11–15 years	0.51204	0.08370	0.000	– 1.11549	0.07613	0.000
16–20 years	0.48979	0.08392	0.000	– 1.06311	0.07633	0.000
21–30 years	0.39692	0.08303	0.000	– 1.06062	0.07552	0.000
31–40 years	0.26726	0.08326	0.001	– 1.10806	0.07573	0.000
41–50 years	0.15975	0.08372	0.056	– 1.12963	0.07614	0.000
51–60 years	– 0.01066	0.08454	0.900	– 1.14636	0.07690	0.000

Exhibit 6

Seemingly Unrelated Regression for Maintenance and Additions (2 of 2)

	Log Maintenance			Log Additions		
	Marginal Effect	Std. Error	P-value	Marginal Effect	Std. Error	P-value
61–70 years	0.03794	0.08642	0.661	– 1.15313	0.07860	0.000
71 or more years	– 0.06510	0.08365	0.436	– 1.17004	0.07609	0.000
Home age missing	– 0.12495	0.08298	0.132	– 1.19517	0.07548	0.000
Number of rooms dummy variables (omitted is 10 rooms or more)						
3 or fewer rooms	– 1.26444	0.03741	0.000	– 0.53993	0.03403	0.000
4 rooms	– 1.26559	0.02685	0.000	– 0.46786	0.02442	0.000
5 rooms	– 1.21785	0.02348	0.000	– 0.46495	0.02136	0.000
6 rooms	– 1.07604	0.02281	0.000	– 0.42384	0.02075	0.000
7 rooms	– 0.80440	0.02336	0.000	– 0.34459	0.02125	0.000
8 rooms	– 0.53511	0.02451	0.000	– 0.25510	0.02230	0.000
9 rooms	– 0.23274	0.02797	0.000	– 0.13839	0.02544	0.000
Number of rooms missing	– 0.90875	0.04910	0.000	– 0.38074	0.04466	0.000
Metropolitan statistical area (MSA) status (omitted is not in MSA)						
MSA central city	0.36734	0.01687	0.000	0.08272	0.01534	0.000
MSA not central city	0.45983	0.01391	0.000	0.13722	0.01265	0.000
Urban	0.45068	0.01236	0.000	– 0.02479	0.01124	0.027
Characteristics of the economy						
Log 30-year mortgage interest rate	0.58740	0.02278	0.000	0.34209	0.02072	0.000
OFHEO state home price index	0.00067	0.00007	0.000	0.00069	0.00007	0.000
State employment rate	0.62203	0.17709	0.000	0.94513	0.16107	0.000
Month dummy variables	Yes			Yes		
Constant	0.12571	0.14031	0.370	0.74567	0.12762	0.000
Number of observations	324,442			324,442		
Pseudo R^2	0.0638			0.0238		

OFHEO = Office of Federal Housing Enterprise Oversight.

Notes: CE Survey from the first quarter of 1984 to the first quarter of 2005. Robust standard errors are presented because there are up to four quarterly observations per household. The results use a seemingly unrelated regression with log maintenance expenditures and with log additions expenditures as the dependent variables. For households with zero dollar expenditures, we assigned them a value of $1 in order to take the natural log.

Income

The effect income has on maintenance and additions expenditures is complicated by the decision to move. Because housing is a normal good, one might assume that maintenance and additions might be normal goods as well. A large amount of the research that includes income as a variable found that an increase in income leads to an increase in maintenance and additions expenditures. This simple explanation ignores the more complicated relationship that occurs when a household moves to alter its housing. Montgomery (1992) found that an increase in income increases the likelihood of moving and the likelihood of improving its current home relative to doing nothing.

We do not explicitly include the decision to move from or stay in a home as a variable, so we have to be careful in interpreting our results in light of this omission. As with the existing literature, the results of this study suggest that an increase in income increases the likelihood and level of maintenance and additions expenditures. The effects are larger for maintenance, especially for the dollar value of maintenance expenditures.

Life-Cycle Pattern

Davidoff (2006) found that maintenance and additions spending peaks around age 40 to 45. Exhibit 7 suggests that the life-cycle profiles of maintenance and additions expenditures are not identical. Our definition of additions expenditures follows a similar pattern as Davidoff's definition of maintenance and additions expenditures, but our measure of maintenance spending is much flatter after age 50. Maintenance spending appears to be constant or slightly declines after age 50, but additions expenditures fall dramatically after age 45. Exhibit 7 reinforces the necessity to run separate models for maintenance and additions expenditures.

The question remains as to whether this shape will be evident in a multivariate regression analysis when controlling for other variables, such as income, that might also have this hump shape. Exhibit 5 suggests that the probability of maintenance spending increases with the age of the homeowner after age 60, and a similar pattern is seen in the level of maintenance expenditures. The likelihood of additions spending exhibits the more familiar life-cycle pattern, with a decrease seen after age 40.

Exhibit 7

Mean Maintenance and Additions by Age of Household Head

Model Fit

The last common thread in the literature is that the explanatory power of the maintenance and additions models is low, and our household-level results are no exception; our R^2 values are .06 and .02 (exhibit 6). These results should not come as a surprise; the idiosyncratic factors that drive a particular household to spend on their home are very likely to dominate the effects of any of the variables we observed. The data set does not include, for instance, a variable for leaky roofs.

Given that the cross-sectional models have low explanatory power, the question becomes—Do we care about explaining this cross-sectional variation? In the aggregate, home maintenance and additions expenditures are important to the economy. Thus, the dynamics that explain aggregate housing maintenance and investment spending decisions are important to the capital stock. Therefore, it might be more useful to determine whether our household-level cross-section models explain the variation in aggregate-level home maintenance and investment spending. This approach avoids attempting to answer the impossible question of whether the Smiths decided to buy a new water heater, but instead addresses the question of why the likelihood of additions expenditures and the level of additions expenditures have increased dramatically since 2000.

To determine the quality of fit at the aggregate level, we found the cross-sectional fitted values for each household and calculated the quarterly mean to match the time-series patterns seen in the earlier exhibits. The goodness-of-fit statistic then is equivalent to an R^2 value, which is defined as 1 minus the ratio of the residual (time-series) variance to the data's (time-series) variance. In contrast to the cross-sectional results, we found that our household-level model has fairly strong explanatory power for the aggregate series of data. Exhibits 8, 9, 10, and 11 present the quarterly average of our models' fitted values along with the data they model.

The model in exhibit 8 provides information that can be used to explain the long-run downward trend in the percentage of households with nonzero maintenance expenditures. Overall, our model explains 82.3 percent of the variance in the probability of a nonzero maintenance expenditures series.[9] For the probability of nonzero additions expenditures, shown in exhibit 11, the model fares well in the long run, but it misses some of the shorter run dynamics, most notably the apparent turning point in additions in 2001. The R^2 for additions expenditures is 66.4 percent.

Exhibits 10 and 11 display the fitted values for the seemingly unrelated regressions for maintenance and additions expenditures, respectively. The maintenance expenditure series is less challenging, and the model captures the slow downward trend well, with an R^2 of 84.1 percent. As was the case with the probit models, the reduced form demand model for additions expenditures does relatively well in the long run and relatively poorly in the short run, missing the 1991-to-1992 and 2001 drops. The R^2 for additions expenditures is 72.6 percent.

[9] Both series exhibit strong downward trends, which may explain the high explanatory power of the model. When differencing the data, the explanatory power does not diminish.

Exhibit 8

Fraction With Maintenance and Fitted Values

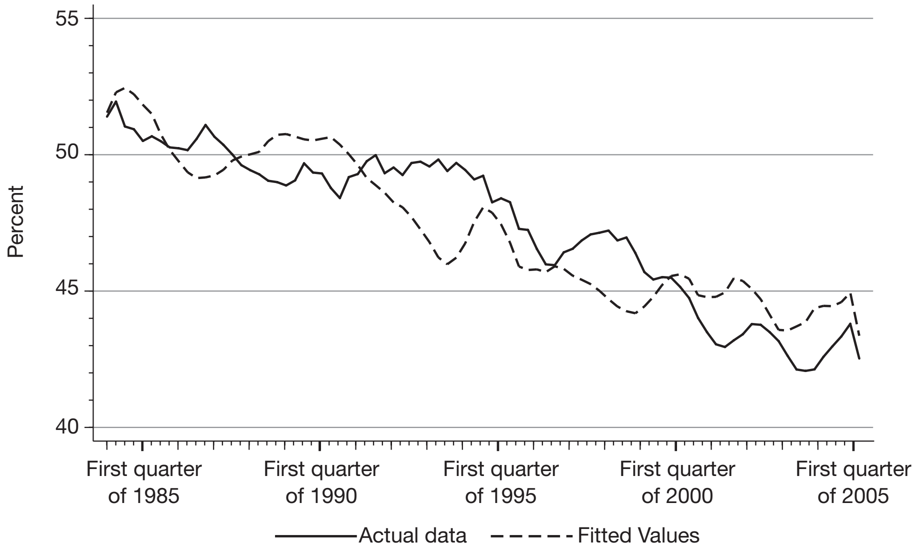


Exhibit 9

Fraction With Additions and Fitted Values

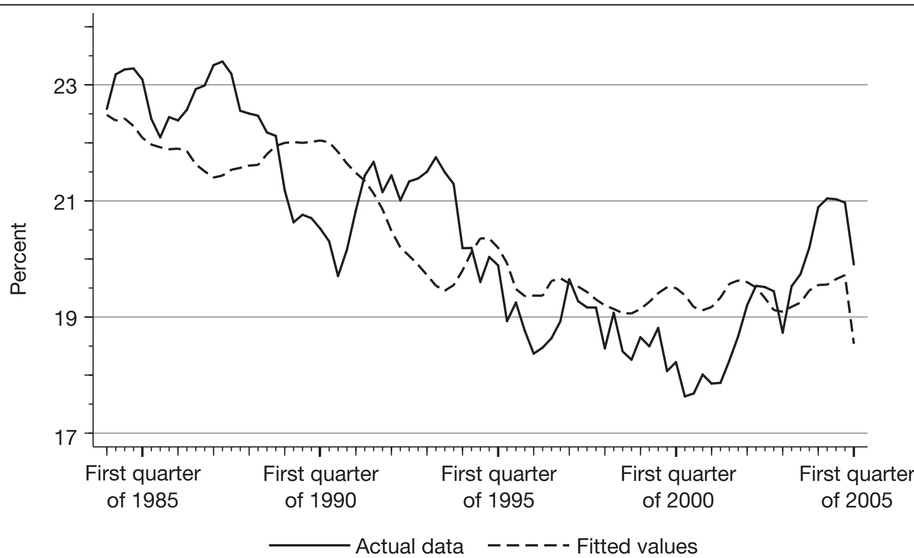


Exhibit 10

Mean Log Maintenance Expenditures and Fitted Values

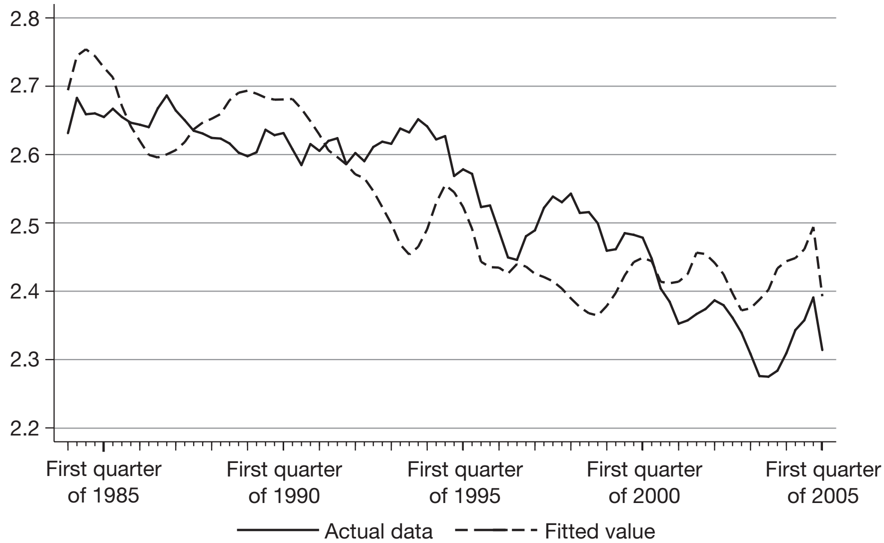
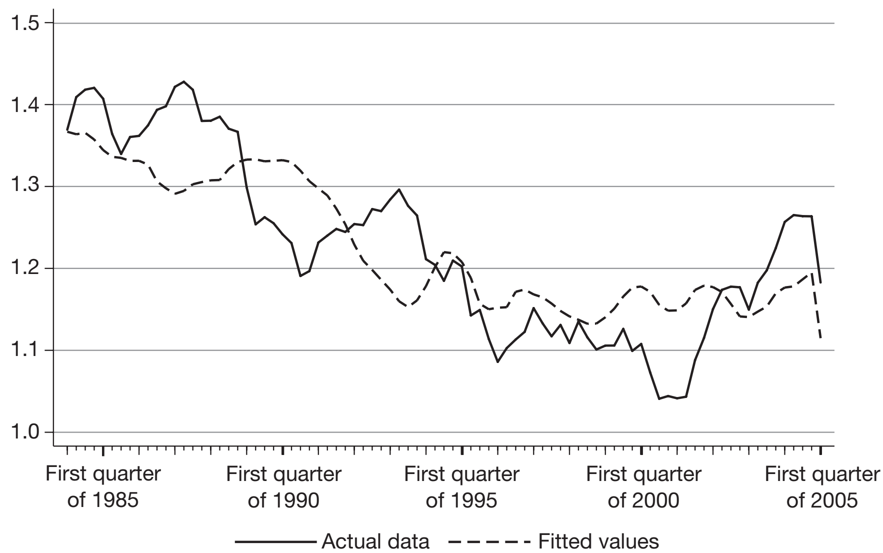


Exhibit 11

Mean Log Additions Expenditures and Fitted Values



Additional Household-Level Results

Using a data set new to the literature, our results reinforce many of the basic facts from the existing literature that uses the AHS. In addition to the results already described, we also included other variables in the model. For household characteristics, we found that larger families are less likely to spend on maintenance but more likely to spend on additions, which suggests that larger families focus more on increasing the stock of housing and foregoing some upkeep. The same is true for the level of spending.

Regarding home characteristics, the CE Survey asks for the year the home was built, and we converted that date to a series of dummy variables representing the home's age. Our results indicate that owners in new homes are less likely to spend on maintenance than those that have owned the home for 2 to 40 years, and the same pattern is seen for the level of maintenance expenditures. For additions expenditures, owners of new homes are the most likely of all the respondents to spend on additions. Families that live in larger homes spend more on maintenance and additions, as do those that live in an MSA. Those in urban areas spend more on maintenance but less on additions.

The last variable of interest is the OFHEO state home price index. The results shown in exhibit 5 suggest that home price appreciation affects the likelihood of maintenance expenditures but not the likelihood of additions expenditures, indicating that appreciation leads to households being less likely to spend on maintenance. Homeowners may believe that if property values are rising that they do not need to do as much maintenance.

Conclusion

The study described in this article has documented some of the stylized facts about home maintenance and investment decisions using a new data set to this literature, the Consumer Expenditure Survey. A replication study on this topic is important because of the importance of the home in the household's financial portfolio and because of the importance of residential investment in the macroeconomy.

Further, this study has documented new findings, in part, because the CE Survey data has different strengths than the AHS. The quarterly CE Survey data can be better used to highlight the time-series patterns in maintenance and additions expenditures. For example, the data show a constant decline in the percentage of households spending per quarter between 1984 and 2000. Since 2000, there has been an increase in the percentage of households spending for additions. These time series patterns have not been previously documented, in part, because the AHS is not designed to capture these trends.