The housing crisis of the late 2000s
and causal paths between health and socioeconomic status

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Abstract: The health-wealth gradient, wherein the affluent are healthier than those with fewer financial resources, has been well-documented. However, the direction of this relationship is not as firmly established. We use plausibly exogenous changes in home prices during the recent housing crisis as a natural experiment for evaluating the effect of changes in wealth on health. Did health outcomes, such as chronic conditions, change due to large, rapid changes in home prices? Further, did patients curb their use of medical services like non-urgent hospitalizations, office visits, prescription drug use, and preventive care? We focus on the effects among the American elderly population using a random sample of nine-million Medicare beneficiaries, finding effects on costs and use of health care services as well as morbidity. Beneficiaries respond to decreases in wealth by increasing their use of health care and selected preventive services, which goes in hand with increases in Medicare costs as well as detection of chronic conditions.

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1. Introduction

The health-wealth gradient, wherein the affluent are healthier than those with fewer financial resources, has been well-established in the literature (Deaton 2002; Smith 1999). However, the direction of causality is less clear: does the direction of causality run from health to wealth or from wealth to health? Alternatively, are there factors which are driving both wealth *and* health? Prior work using a number of different methods, for example, instrumental variables estimation and dynamic panel data models, has found mixed results in the direction of causality of the gradient. Reverse causality makes this question particularly tricky to answer. In looking at the causal effect of wealth on health, the wealthy are likely to be able to afford better care and will thus be healthier. However, at the same time, individuals that are healthier are likely to be able to work longer, which may lead to increased wealth as well as better health.

Our contribution to this topic is to use the recent housing crisis as a natural experiment for evaluating the causal relationship between health and socioeconomic status (SES). We investigate whether health care costs, the use of health care services, such as doctor visits, hospital stays, and the use of preventive care, as well as health outcomes, such as chronic conditions, changed due to large, rapid changes in home prices. By analyzing the use of medical services like hospitalizations, office visits, prescription drug use, and preventive care, we shed light on potential mechanisms through which wealth may affect health.

How might home prices affect health? According to the 2010 Health and Retirement Survey, 80% of the near-old (55-64 year olds) and elderly (65 and older) own their homes. We focus on the elderly (those at least 65 years old). At the time of the housing crisis, they were not directly affected by ongoing changes in home prices unless they had been planning to sell. However, approximately 50% of the average older American's wealth was in the form of housing (Engelhardt, Eriksen, and Greenhalgh-Stanley, 2013) so that the observed drop in house prices had large effects on the elderly's wealth possibly causing stress. Elderly Americans may also have been affected by stress arising from observing family, friends, and neighbors experiencing hardship or stress arising from the uncertainty of markets and the value of their home. Seeman (1997) evaluates the effects of allostatic load – defined as "the strain on the body produced by repeated ups and downs of physiologic response, as well as by the elevated activity of physiologic systems under challenge, and changes in metabolism […] that can predispose the organism to disease" – on physical and cognitive functioning, finding that individuals with heightened allostatic loads faced elevated risks of cognitive and physical decline and cardiovascular disease. If the housing crisis subjected individuals to excessive stress, we may observe negative changes in health outcomes.

Grossman's model of the demand for health (1972) suggests two ways in which the housing crisis could have affected health outcomes. First, a home price shock is stressful, and increased stress levels lead one's health stock to depreciate more rapidly. Second, a direct effect on the budget constraint means fewer resources available to invest in the production of health. However, the empirical literature on the effect of wealth on health presents mixed results. The Whitehall studies I and II (Marmot, Shipley, and Rose 1984; Marmot et al. 1991) were early and incredibly thorough in collecting information on British civil servants that was used to document the health-wealth gradient. Marmot, Shipley, and Rose (1984) documented the positive relationship between health and employment status among British civil servants, while a subsequent study (Marmot et al. 1991) found that economic factors affect health through psycho-social mechanisms, such as stress due to work, which induce undesirable health behaviors both directly and indirectly.

Smith (1999) purports that households may respond to new health events by reducing planned bequests to heirs, instead of decreasing current or future consumption. He documents that wealth and income have statistically significant positive effects on (self-reported) health, though the effects are diminished by about 33% when behavioral risk factors are added to the model (for example, smoking, heavy alcohol consumption, physical activity, body mass index). Adams et al. (2003) use tests of Granger non-causality and do not find causal evidence that SES affects acute-onset conditions or mortality. They mention that the effect of wealth on chronic and mental health conditions remains unresolved. Stowasser et al. (2011) replicate the study on different data: the Health and Retirement Study (HRS), which contains the AHEAD data used by Adams et al. (2003). They find that they cannot reject the effects of SES on health for quite a few conditions, and note that causal inference is sensitive to the cohorts and time periods used.

Meer, Miller, and Rosen (2003) use the Panel Survey of Income Dynamics (PSID) to evaluate the effect of changes in wealth on one's health, with inheritances as instruments. Their measure of health is based on self-reports on a five-point scale. Their primary finding is that short run changes in wealth do not drive changes in health. Michaud and van Soest (2008) look among a slightly younger population and do not find evidence that wealth affects health. Using dynamic panel data methods and exploiting variation within-couples, they do find evidence that health affects wealth. Fichera and Gathergood (2013) analyse data from the United Kingdom to estimate the effect of housing value gains on health. They find that increases in housing wealth are associated with lower likelihoods of acute conditions among owners, while, as expected, there is no effect among renters.

There is an extensive literature that looks at changes in health outcomes in response to economic fluctuations that informs our work. Ruhm (1996) found that health is countercyclical: namely, that a negative relationship exists between the mortality rate and state unemployment rates. Using Behavioral Risk Factor Surveillance Survey (BRFSS) microdata, he conjectures this is due to the worsening of unhealthy behaviors during periods of higher unemployment. Schwandt (2011) focuses on wealthier, elderly Americans. He constructs wealth measures of stock-holding from the HRS, interacting stock holding with changes in the stock market. He looks at the incidence of new chronic conditions, finding the strongest effects for high blood pressure and moderate effects for cardiovascular problems. However, he finds no effect of negative wealth shocks on the incidence of cancers, as well as diabetes, arthritis, and lung diseases.

Two recent papers have looked at changes in the utilization of medical services during recent crises. Currie and Tekin (2015) investigate the relationship between hospitalizations and emergency department (ED) visits and foreclosures, using data from the Panel Survey of Income Dynamics (PSID), Zillow (home prices), RealtyTrac (foreclosures), administrative medical data, and the American Community Survey. Their analysis is done at the ZIP-code level, focusing on the effects felt in the four hardest-hit states: Arizona, California, Florida, and New Jersey.[1] Part of their analysis looks at the

[1] In contrast to Currie and Tekin (2015), we include all U.S. states in our analysis. When we restricted the estimation sample to these four most affected states, we found that the effects of house prices on outcomes were generally not strengthened.

elderly: they find that increases in foreclosures were associated with increases in emergency room and hospital visits for a number of conditions, including heart attack and hypertension. Their analysis that focuses specifically on the effect of foreclosure on the elderly finds larger effects than for younger populations, among non-elective hospitalizations, preventable hospitalizations, and cancer, cardiovascular, and respiratory-related hospitalizations. They attribute this to the generally more frail state of elderly patients and their heightened vulnerability to health shocks.

While many of the existing studies have looked primarily at the effect of the crisis on large groups, we focus specifically on the elderly, those sixty-five and older. The elderly are sicker than the younger population and are more susceptible to negative health shocks (Currie and Tekin 2015). Our results will not necessarily generalize to the younger population for a few reasons. The elderly are largely retired, while younger groups remain in the workforce. This means that fluctuations in employment due to the financial crisis did not affect them as much. However, McInerney and Mellor (2012) use the Medicare Current Beneficiary Survey and find that self-reported health among the elderly is worse and they utilize more inpatient care when unemployment increases, in contrast with studies looking at the general population which have found the opposite. They also conclude that mortality among the elderly is countercyclical between 1994 and 2008.

Our study builds on this literature to investigate the effects of economic distress on health outcomes and utilization and health care costs among elderly Americans. We use hospital, physician, and prescription drug claims data for a random twenty-percent sample of Medicare beneficiaries in combination with home price data from Zillow (Zillow 2014). Our study period begins in 2006 and lasts through 2011.

An advantage over previous studies is that the claims data contain administrative information on all contacts with the health care system that are paid for by Medicare, i.e. doctor visits, hospital stays, and prescription drugs used. We can thus not only evaluate effects on objective measures of health but also investigate possible channels that lead to health effects, such as changes in preventive care use. Our data contain detailed diagnosis and procedure information, as well as information on insurance coverage and prices paid for medical care. Home prices are available at the five-digit ZIP code level.

In addition to general health care use, we focus particularly on the use of preventive care. Understanding if patients change their use of preventive services when experiencing a wealth shock is crucial to understanding subsequent changes in health; increasing the use of preventive health care services has been featured as a way to improve Americans' health and decrease spending. The 2010 Patient Protection and Affordable Care Act (ACA) includes the National Prevention Strategy, a roadmap for improving the health in the United States for people of all ages by expanding access to preventive services, the elimination of disparities, and encouraging patients to live more healthful lives. During the study period, patients received free or highly subsidized preventive services.

To evaluate the effects of a negative wealth shock on health outcomes, we look at ZIP code-level health outcomes and the mechanisms by which health may be affected, including the utilization of preventive care and medical services. We focus on the Medicare fee-for-service (FFS) population. Our analyses are comprised of linear panel regressions at the ZIP code and year level that include ZIP and year fixed effects.

We find that decreases in house prices lead to increases in health care costs in both Medicare Part A (hospital care) and Medicare Part B (outpatient care). If house prices decrease by 10%, Part A costs increase by 0.7% and Part B by 0.3%. These cost increases are reflected by increases in use of most health care services: A decrease in house prices is related to increases in the number of doctor visits, the likelihood of a hospital stay and of an emergency room visit. Only the use of hospital outpatient care decreases with decreases in house prices.

In terms of health outcomes, we find that the prevalence of most conditions increases with decreases in house prices. This is true for the prevalence of stroke, hyperlipidemia, hypertension, diabetes, rheumatoid arthritis and of some types of cancers. At the same time, however, there is no significant relationship with the prevalence of hip fractures, depression and heart attack. An explanation for these findings could be that individuals increase their use of health services due to worse health after a house price shock. This increased use leads to an increase of disease detection, e.g. for diabetes and cancers, while more acute conditions, such as hip fracture or heart attack are not induced by house price shocks. This interpretation is also in line with our findings on the use of preventive services: The use of most check-ups and tests increases with decrease in house prices, which may explain the higher detection rates.

The rest of this paper is structured as follows. We discuss our data in the next section and the regression models in Section 3. The results are reported in Section 4 and discussed in Section 5. Section 6 concludes.

2. Data

We use a random sample of twenty percent of Medicare beneficiaries. Medicare provides health insurance to over forty-five million elderly and disabled individuals in the United States. The dataset links enrollment and Parts A and B claims (2002-2012) for traditional fee-for-service Medicare enrollees to Part D prescription drug claims (2006-2012). The Part A data include information about inpatient hospital stays, including length of stay, diagnosis-related group (DRG), department-specific charges, and up to ten individual procedure and diagnostic codes. Part B information includes claims submitted by physicians, and other health care providers and facilities for services reimbursed by Part B. Each claim contains diagnostic (ICD-9-CM) and procedure (CPT-4) codes, dates of service, demographic information on beneficiaries, and a physician identification number.

The enrollment file contains demographic information about each beneficiary including date of birth, date of death, gender, beneficiary type (e.g., recipient of the low-income subsidy), and ZIP code of residence. The Medicare data also include externally validated measures of race/ethnicity. Self-reported measures on race/ethnicity are refined using Research Triangle Institute estimates based on geography and first and last names.

Our main analysis is limited to patients ages sixty-seven and older with continuous traditional fee-for-service (FFS) coverage. The FFS requirement is due to the fact that we are unable to observe physician and hospital claims for individuals in Medicare Advantage. While individuals become eligible for Medicare on the basis of age at sixty-five, using the higher age threshold is necessary for our analysis of health outcomes, due to the required look-back period for certain conditions.[2] Since the health data for patients in Medicare

[2] Some chronic conditions have longer look-back windows than others to ensure proper measurement of disease. Ischemic heart disease, rheumatoid arthritis and osteoarthritis, and diabetes have two-year look-back periods. Hip fractures, strokes/transient ischemic attacks,

Advantage are not available; patients must remain in FFS Medicare for the duration of the study period, or until death.

As a first outcome, we focus on total costs in Medicare Part A (hospital) and Part B (outpatient). We take these as the most aggregated measures of health care use and morbidity that are available in our data. They thus reflect overall effects of house price shocks on morbidity and health care use, and are additionally important from a policy perspective.

Next, we investigate possible drivers of the changes in health care costs by concentrating on morbidity and health care use. To analyze morbidity, chronic conditions indicators constructed by the Centers for Medicare and Medicaid Services (CMS) Chronic Conditions Warehouse (CCW) are used. Diagnosis codes from hospitals, and home health and skilled nursing facilities are used to construct yearly indicators, as well as a variable for whether a beneficiary was ever diagnosed with the particular condition (Chronic Conditions Data Warehouse 2014).[3] We use the yearly variable to construct ZIP-level prevalence rates.

To evaluate changes in the utilization of medical services, we look at inpatient stays, inpatient days, outpatient visits, emergency department (ED) visits, and office visits, which come from the Beneficiary Summary File of Costs and Utilization. In addition, we focus on wellness exams, blood tests, lipid tests, diabetes tests, osteoporosis screenings, and cancer screenings to investigate how the use of preventive care is affected by shocks in house prices. Appendix Table 1 contains a list of procedure codes used to identify each of these preventive services.

We look at the ZIP-level prevalence of a number of chronic conditions which may be affected by rising stress levels (Currie and Tekin 2015) – hypertension, acute myocardial infarction, stroke/transient ischemic attack, hyperlipidemia, chronic heart failure. We also analyze the effects on hip fracture, diabetes, rheumatoid arthritis/osteoarthritis and a

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hyperlipidemia, hypertension, chronic heart failure, acute myocardial infarction, and lung, endometrial, breast, prostate cancer have one-year lookback periods.

[3] One may be concerned that identifying the chronically ill from claims data may be subject to measurement error, particularly the presence of false positives, if "rule-out" diagnoses are recorded. CCW addresses this potential problem by using stricter criteria in identifying chronic conditions: multiple hospitalizations or doctor visits are generally required as is appropriate for each condition.

number of cancers (individually: lung, endometrial, breast, and prostate). These conditions could be seen as placebos, as prevalence of either should not respond to changes in home prices (Ruhm 1996), although changes in health care use may trigger detection of some chronic conditions.

We use Zillow data for home prices, which are available at the ZIP-code level. The Zillow Home Value Index (ZHVI) is the median of all Zillow "Zestimates" within a region (here, ZIP code).[4] Annual ZIP averages of home prices are used. Figure 1 presents the median and inter-quartile range of yearly home prices over the period from 2006 to 2011. The Zillow data, when merged with the Medicare and sociodemographic data, cover about ten thousand ZIP codes. At the early part of the study period, the mean of ZIP-level average of home prices was $310,676 compared with $241,857 in 2011.

3. Regression models

To evaluate whether changes in health occur when home prices change, we undertake an intent-to-treat analysis, estimating linear panel regression models of costs, chronic conditions, hospitalizations, and utilization of medical services (including preventive care) on measures of home prices at the level of the ZIP code. All panel regressions contain ZIP code and year fixed effects, and standard errors are clustered at the ZIP code level.

The data are annual, covering the period 2006–2011. Several factors lead us to decide that the year level was most appropriate for this analysis. The chronic conditions and utilization measures from the Beneficiary Summary File are only available at the year-level. Patients are likely to use preventive screenings and flu shots only once per year. Given year-to-year changes in the Medicare benefit design, especially in 2010 and 2011 with the start of the implementation of the ACA, year fixed effects are especially appropriate.

[4] How does the ZHVI compare to the Case-Schiller index? "The Case-Shiller index is computed using a repeat sales methodology, which measures price change by collecting data on homes that have been resold in a given region. Case-Shiller limits itself to homes that have sold at least two times recently; it also excludes all new construction. Because homes across regions may appreciate differently and those segments are not represented proportionally in the sample limited to repeat sales, the index may suffer bias, which is particularly acute for smaller geographic regions with lower turnover." (Zillow 2013)

Interpreting the regression coefficients in these fixed-effects panel models as measuring causal effects hinges on the assumption that changes in housing prices across ZIP codes are exogenous. The crash in house prices was unanticipated, and more importantly, the extent of the crash across areas was impossible to foresee. Our key assumption is changes in price are exogenous (and unanticipated), though price levels may not be. This model assumes that there is no ZIP-specific time-variant unobserved heterogeneity. The ZIP fixed effects capture the baseline prevalence of chronic conditions in the area. Another necessary assumption that we find plausible is that other SES-related factors outside of home prices are not changing during this period in a way that affects health and the utilization of health care services. The ZIP fixed-effects will capture SES, as well as factors like whether the ZIP code is in a rural or urban area, assuming minimal changes over time occur within the neighborhood. Regressions are weighted using ZIP-level population weights.

One concern may be that changes in home prices are correlated with factors that determine home price levels: for example, homes in areas with better school districts may retain value better through the housing market crash and also be worth more. However, we observe that the correlation between the percent change in home prices between 2006 and 2011 versus the home price levels in 2006 is 4%. We therefore assume that changes in home prices as a result of the recession were unrelated to past health and past SES.

4. Results

In the regressions we report in the following, we focus on the log of the ZIP code average house prices. We report three different specifications for each outcome variable that use (1) log house prices, (2) lagged log house prices, and (3) changes in log house prices as the main regressor. Dummy variables for the years are included in all regressions. The regression tables report these coefficients.

We first present results for the effects of house prices on Medicare spending (Table 2). There is a statistically significant negative relation between house prices and spending in both Medicare Parts A and B. The logarithmic specification implies an elasticity of -0.07 of Part A spending. So a drop of house prices by ten percent in a ZIP code area implies an increase of Part A spending by 0.7 percent. The effect on Part B spending is also statistically significant but the estimated elasticity is only around -0.03. Qualitatively, the results are similar in columns (2) and (3), where we regress on house prices lagged by one year and estimating the relationship using first differences on both sides. But the estimated elasticities are smaller.

To illustrate that these results are not driven by outliers, Figures 2 and 3 shows scatter plots of residuals obtained from specification (1), separately for Part A and Part B costs. The residuals are grouped, and the sizes of the circles represent the total number individuals in the grouped ZIP codes. The top panels of both figures are based on all ZIP codes, while the bottom panels zoom in by dropping large (in absolute value) cost residuals. It is apparent that the negative association between log house prices and Medicare costs is based on virtually all larger ZIP codes.

Next, we focus on the health outcomes themselves. Table 3 reports the house price coefficients obtained in the regressions in which the outcomes are the measures of the incidence or prevalence of health conditions. Note that we measure these health outcomes from the Medicare claims data. An increase in a health condition can therefore be caused by either an increase of the true prevalence or a higher diagnosis rate.

Many of the health conditions have a significantly negative regression coefficient implying an increase of measured prevalence in ZIP code areas with a drop in house prices. Hypertension is an example. The coefficient of -0.01 implies an increase of hypertension prevalence by 0.1 percentage points in a ZIP code area that experienced a drop in housing prices by ten percent. Part of this might be due to additional diagnosis. But we also see a slight increase of strokes and TIAs which might be caused by stress-related hypertension.

We also observe a slight increase of health conditions for which we don't see an obvious causal relation to falling house prices other than increased diagnoses. Examples include hyperlipidemia, diabetes, and certain kinds of cancer.

The effects of wealth shocks on the utilization of medical services are displayed in Table 4. Most estimated coefficients are negative and statistically significant. A drop of house prices by ten percent increases the average number of impatient stays by 0.0026 and the number of inpatient days by 0.013, both corresponding to an increase of roughly 0.6 percent. Emergency room visits increase by 0.002 or 0.3 percent. Also doctor's office visits increase by 0.06 (or 0.8%) as house prices decrease by ten percent. Only hospital outpatient visits decrease by 0.032 (or 0.4%).

Table 5 presents the estimated effects of home prices on the use of preventive services. We find many negative and statistically significant coefficients. We again interpret them quantitatively by thinking of the effect of a drop in house prices by ten percent. This increases the share of cancer tests by 0.17 percentage points or 0.4 percent. This is a plausible explanation of the increased prevalence of cancer found in the health conditions regressions. We also see an increased share of diabetes tests by 0.26 percentage points or 0.4 percent. Most of the other tests and even flu shots increase as house prices drop with the exception of wellness exams.

5. Discussion

As our analysis is based on health insurance claims data, we only observe individuals' health if use of health services is non-zero (with the exception of mortality which we do not analyze in this paper). The question thus arises how large the role of patients is in determining the use of medical services. If it is small (Chandra, Cutler, and Song 2011) and patients do not use medical services excessively, we should expect to see minimal changes in the use of medical care – holding health constant – when patients are faced with a sizable wealth shock. Finkelstein, Gentzkow, and Williams (2014) exploit moving patterns among the elderly to find that 40-50% of geographic variation in health care expenditures is driven by factors on the demand-side, largely variation in the health of patients. 50-60% of geographic variation is supply-side driven. Thus, it seems plausible that patients may respond to wealth shocks by altering their use of medical care. In the absence of health shocks, patients may decrease their use of medical services. However, if acute or chronic stress due to negative wealth shocks leads to adverse health events, patients may need to use more medical services. This may put patients in a sub-optimal financial situation. While Medicare helps to shield patients from the full financial burden of a decline in health, beneficiaries are generally required to bear some amount of cost-sharing. Co-pays and co-insurance can be non-trivial: in 2010, average out-of-pocket spending for patients who reported being in poor health was $4,505, compared with $1,774 for patients who reported being in excellent health (Cubanski et al. 2014).

Increasing health costs due to worsening health will only decrease already-stressed patients' quality of life.

A final concern we should discuss is that the effects of wealth shocks are likely not immediate: particularly given that the housing crisis was a historical anomaly; the health effects of chronic stress do not manifest immediately (McEwen 1998). While we used one-year lags in some of the specifications reported above, two or more years may be necessary to capture the true effects of wealth on morbidity. Such results are not presented. With the currently available claims data, which run through 2011, using lags of two or more years would not fully capture the worst of the housing crisis and its effects on the elderly.

6. Conclusions

This paper uses plausibly exogenous variation in changes in home prices due to the housing crisis of the late 2000s as a natural experiment for evaluating mechanisms underlying the health-wealth gradient. We find that health care costs and use increase with decreases in house prices. Patients increase their use of most medical services and take up more preventive tests. At the same time, the prevalence of some stress-related as well as some chronic conditions that are not known to be directly related to stress, such as diabetes and cancers, increase. The latter increases may be the results of increased detection.

Future work should continue this analysis with a longer study period capturing the latter part of the Great Recession and the subsequent recovery. Use of the Health and Retirement Study-linked Medicare claims should be used to evaluate the effects of individuals' home prices on their health, as opposed to neighborhood home prices.

Furthermore, it is possible that ZIP-level home prices may not serve as sufficient proxies for wealth shocks. Other measures of housing distress besides home prices may better capture the extent to which individuals were affected by the crisis. In future work we will analyze effects on distress on costs, use and morbidity.

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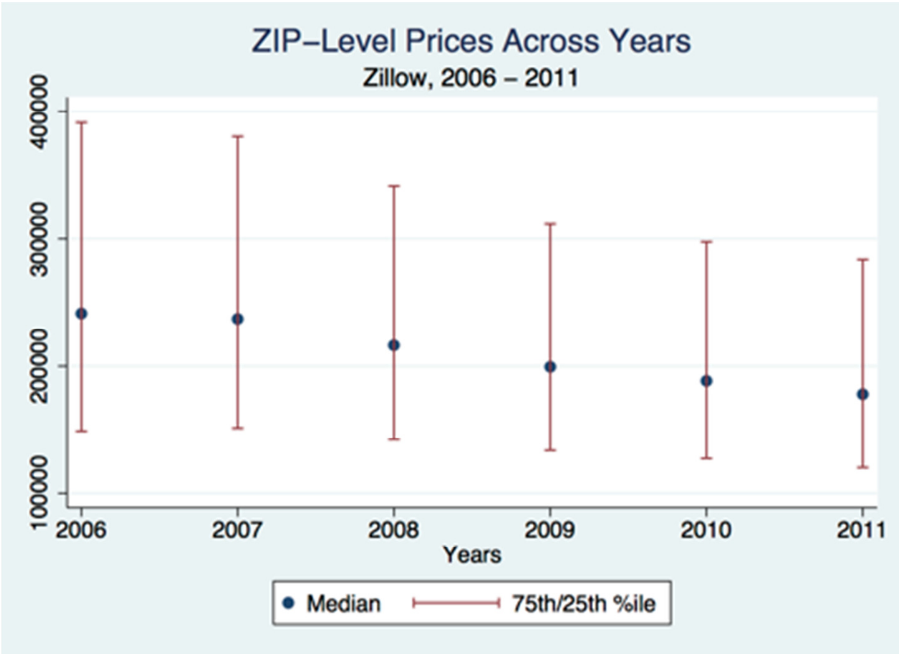
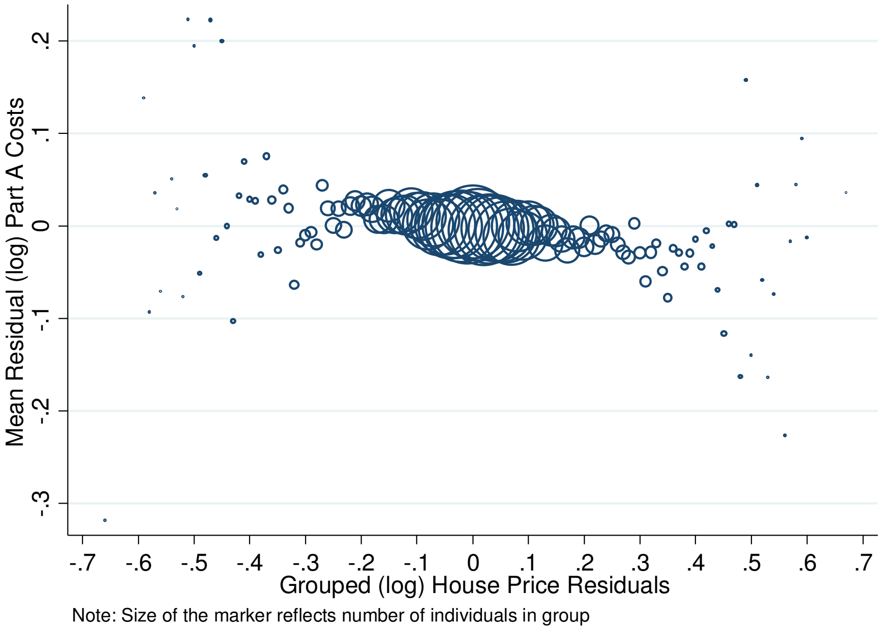
Tables and figures

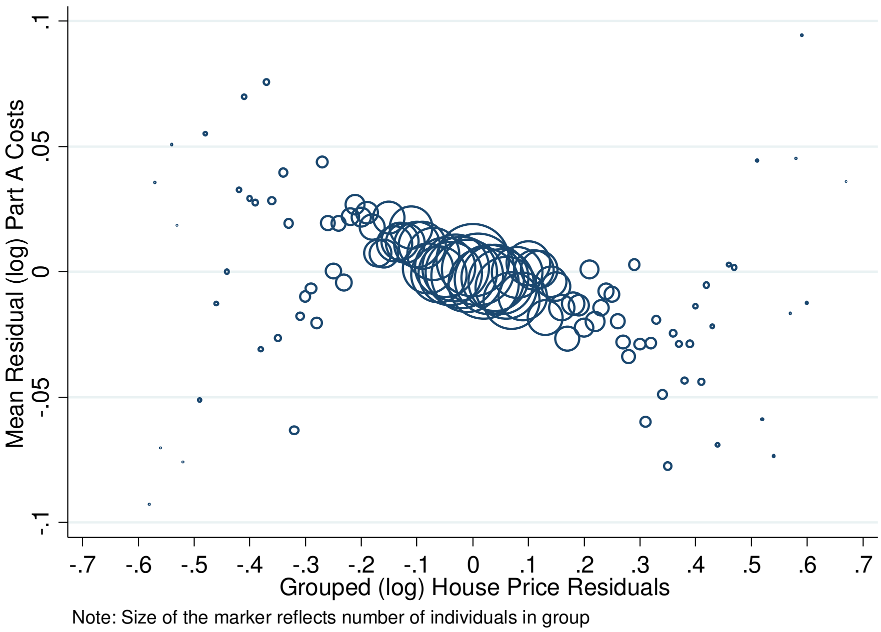
Figure 1: Home prices over time



Notes: Data on ZIP-level home prices come from Zillow's monthly home value index (ZHVI). ZHVI_SFR stands for ZHVI – single family residence.

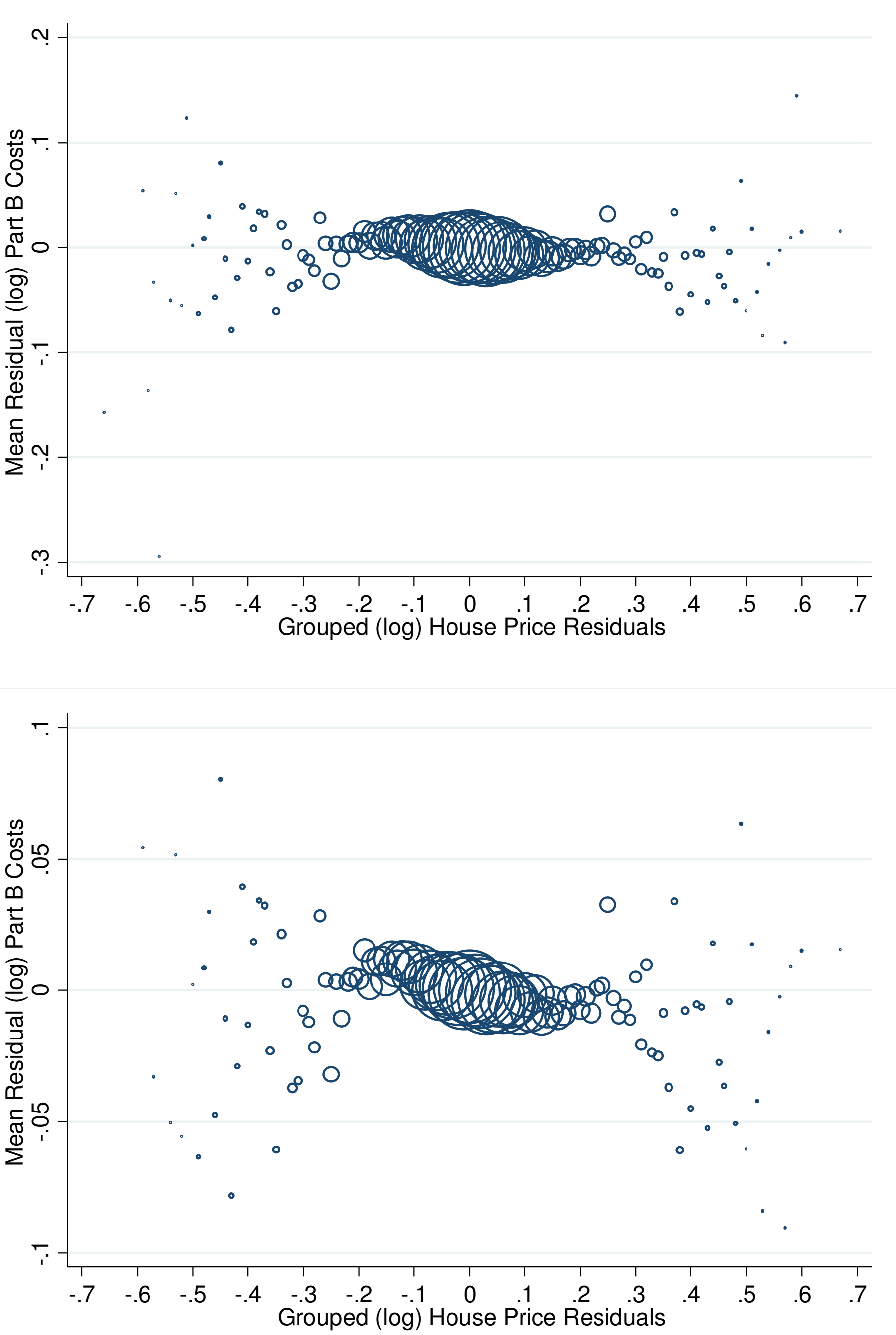
Figure 2: House prices vs. Medicare Part A costs at the ZIP code level





Notes: This figure shows scatter plots of average residuals of (log) Part A costs after a regression of the latter on year and ZIP code fixed effects, and the analogously constructed residuals of (log) house prices, which are grouped to increase the readability of the figure. The top panel includes all residuals, while the bottom panel restricts the scale of the ordinate to -0.1 to 0.1 to zoom in to the part of the figure that contains most individuals.

Figure 3: House prices vs. Medicare Part B costs at the ZIP code level



Notes: This figure shows scatter plots of average residuals in (log) Part B costs after a regression of the latter on year and ZIP code fixed effects, and the analogously constructed residuals of (log) house prices, which are grouped to increase the readability of the figure. The top panel includes all residuals, while the bottom panel restricts the scale of the ordinate to -0.1 to 0.1 to zoom in to the part of the figure that contains most individuals.

Table 1: Descriptive statistics at the level of ZIP codes and years

Variable	Mean	St.d.	Minimum	5%	Median	95%	Maximum
House prices (ZHVI)	278326	258083	32100	78000	208500	689700	7361000
Log house prices	12.2910	0.6689	10.3766	11.2645	12.2477	13.4440	15.8117
Log Part A costs	8.9126	0.3651	5.2362	8.3186	8.9294	9.4621	11.2884
Log Part B costs	8.3007	0.2666	6.6034	7.8642	8.2999	8.7295	9.6756
Hip Fractures	0.0131	0.0126	0.0000	0.0000	0.0117	0.0345	0.2000
Depression	0.1140	0.0465	0.0000	0.0455	0.1106	0.1932	0.5385
Stroke/TIA	0.0552	0.0274	0.0000	0.0094	0.0538	0.1000	0.3077
Hyperlipidemia	0.4692	0.1007	0.0000	0.3016	0.4713	0.6314	0.8810
Hypertension	0.6316	0.0930	0.0667	0.4667	0.6404	0.7692	1.0000
Diabetes	0.2715	0.0785	0.0000	0.1515	0.2667	0.4103	0.8000
Chronic Heart Failure	0.2082	0.0628	0.0000	0.1154	0.2034	0.3188	0.6250
Ischemic Heart Disease	0.3748	0.0930	0.0000	0.2347	0.3694	0.5375	0.9167
Acute Myocardial Infarction (AMI)	0.0119	0.0124	0.0000	0.0000	0.0099	0.0339	0.2143
Rheumatoid Arthritis (RA) /Osteoarthritis	0.3159	0.0756	0.0000	0.1976	0.3145	0.4396	0.8571
Lung Cancer	0.0129	0.0125	0.0000	0.0000	0.0114	0.0345	0.1667
Endometrial Cancer	0.0028	0.0057	0.0000	0.0000	0.0000	0.0124	0.1111
Colorectal Cancer	0.0173	0.0146	0.0000	0.0000	0.0159	0.0423	0.1765
Breast Cancer	0.0331	0.0201	0.0000	0.0000	0.0325	0.0659	0.2500
Prostate Cancer	0.0436	0.0239	0.0000	0.0000	0.0421	0.0833	0.3333
Hospital Days	2.1616	0.8535	0.0000	0.9286	2.0828	3.6543	9.8889
Office Visits	7.6175	1.6831	0.8993	4.9714	7.5529	10.4495	18.8775
Outpatient Visits	5.8375	2.4050	0.2308	2.6371	5.4490	10.2966	28.5714
Hospital Stays	0.3964	0.1184	0.0000	0.2180	0.3896	0.5978	1.3846
Emergency Room Visits	0.5906	0.1619	0.0000	0.3548	0.5778	0.8718	2.1667
Cancer Screening	0.4353	0.0885	0.0000	0.2889	0.4366	0.5784	0.8889
Blood Test	0.7933	0.0842	0.1429	0.6364	0.8080	0.8980	1.0000
Lipid Test	0.6109	0.0888	0.0526	0.4581	0.6154	0.7500	0.9545
Diabetes Test	0.3058	0.0827	0.0000	0.1852	0.2969	0.4545	0.7857
Flu Shots	0.5102	0.1158	0.0000	0.2925	0.5261	0.6707	1.0000
Osteoporosis Screening	0.0751	0.0483	0.0000	0.0000	0.0797	0.1489	0.4444
Depression Screening	0.0001	0.0016	0.0000	0.0000	0.0000	0.0000	0.1333
Wellness Exam	0.0552	0.0621	0.0000	0.0000	0.0337	0.1875	0.6429

Notes: The sample is comprised of Medicare enrollees ages 67 and older with continuous fee-for-service coverage starting in 2006 through the end of 2011 or until death. There are 59,754 ZIP-year level observations (10,257 ZIPs).

Table 2: Effects of house prices on Medicare Part A and B costs

	(1) Log House Price			(2) Lagged Log House Price			(3) Difference Specification		
Log Part A costs	-0.0712	***	(0.0080)	-0.0416	***	(0.0093)	-0.0442	***	(0.0108)
Log Part B costs	-0.0308	***	(0.0063)	-0.0175	**	(0.0062)	-0.0244	***	(0.0058)

*** p<0.001, ** p<0.01, * p<0.05

Notes: Coefficients and standard errors in parentheses. The sample is comprised of patients ages 67 and older with continuous fee-for-service coverage starting in 2006 through the end of 2011 or until death. Analysis is at the five-digit ZIP-year level for 2006-2011. Regressions are weighted using ZIP-level population weights. (1) relates log costs to log house prices in the same year. (2) relates log costs to log house prices lagged by one year. (3) relates changes in log costs across adjacent years to changes in log house prices. All models include ZIP and year-level fixed effects. N = 59,754 ZIP-year observations (10,257 ZIPs).

Table 3: Effects of house prices on major health conditions

	(1) Log House Price			(2) Lagged Log House Price			(3) Difference Specification		
Hip Fractures	-0.0004		(0.0003)	-0.0001		(0.0004)	-0.0010		(0.0005)
Depression	-0.0004		(0.0010)	0.0001		(0.0011)	0.0005		(0.0012)
Stroke/TIA	-0.0016	*	(0.0007)	-0.0002		(0.0008)	-0.0024	*	(0.0010)
Hyperlipidemia	-0.0119	***	(0.0017)	-0.0064	***	(0.0018)	-0.0082	***	(0.0018)
Hypertension	-0.0103	***	(0.0015)	-0.0064	***	(0.0016)	-0.0080	***	(0.0017)
Diabetes	-0.0142	***	(0.0014)	-0.0118	***	(0.0014)	-0.0064	***	(0.0012)
Chronic Heart Failure	-0.0035	*	(0.0014)	-0.0051	***	(0.0015)	-0.0012		(0.0014)
Ischemic Heart Disease	-0.0006		(0.0016)	0.0009		(0.0017)	-0.0018		(0.0015)
AMI	-0.0002		(0.0003)	-0.0006		(0.0004)	0.0006		(0.0005)
RA/Osteoarthritis	-0.0080	***	(0.0017)	-0.0051	**	(0.0018)	-0.0034	*	(0.0016)
Lung Cancer	-0.0008	*	(0.0003)	-0.0003		(0.0004)	-0.0006		(0.0004)
Endometrial Cancer	-0.0002		(0.0001)	0.0001		(0.0002)	-0.0002		(0.0002)
Colorectal Cancer	-0.0007	*	(0.0003)	-0.0003		(0.0004)	-0.0009	*	(0.0004)
Breast Cancer	-0.0015	***	(0.0004)	-0.0004		(0.0005)	-0.0010		(0.0005)
Prostate Cancer	-0.0025	***	(0.0005)	-0.0016	**	(0.0006)	-0.0016	**	(0.0005)

*** p<0.001, ** p<0.01, * p<0.05

Notes: Coefficients and standard errors in parentheses. The sample is comprised of patients ages 67 and older with continuous fee-for-service coverage starting in 2006 through the end of 2011 or until death. Analysis is at the five-digit ZIP-year level for 2006-2011. Regressions are weighted using ZIP-level population weights. (1) relates log costs to log house prices in the same year. (2) relates log costs to log house prices lagged by one year. (3) relates changes in log costs across adjacent years to changes in log house prices. All models include ZIP and year-level fixed effects. N = 59,754 ZIP-year observations (10,257 ZIPs).

Table 4: Effects of house prices on health-care use

	(1) Log House Price			(2) Lagged Log House Price			(3) Difference Specification		
Hospital Days	-0.1340	***	(0.0202)	-0.1177	***	(0.0231)	-0.0626	*	(0.0274)
Office Visits	-0.5953	***	(0.0315)	-0.4073	***	(0.0295)	-0.3438	***	(0.0268)
Outpatient Visits	0.3239	***	(0.0566)	0.6122	***	(0.0741)	0.1334	**	(0.0506)
Hospital Stays	-0.0258	***	(0.0028)	-0.0220	***	(0.0032)	-0.0126	***	(0.0037)
ER Visits	-0.0204	***	(0.0037)	-0.0160	***	(0.0041)	-0.0094	*	(0.0047)

*** p<0.001, ** p<0.01, * p<0.05

Notes: Coefficients and standard errors in parentheses. The sample is comprised of patients ages 67 and older with continuous fee-for-service coverage starting in 2006 through the end of 2011 or until death. Analysis is at the five-digit ZIP-year level for 2006-2011. Regressions are weighted using ZIP-level population weights. (1) relates log costs to log house prices in the same year. (2) relates log costs to log house prices lagged by one year. (3) relates changes in log costs across adjacent years to changes in log house prices. All models include ZIP and year-level fixed effects. N = 59,754 ZIP-year observations (10,257 ZIPs).

Table 5: Effects of house prices on preventive care

	(1) Log House Price			(2) Lagged Log House Price			(3) Difference Specification		
Cancer Screening	-0.0173	***	(0.0019)	-0.0155	***	(0.0018)	-0.0089	***	(0.0022)
Blood Test	-0.0157	***	(0.0017)	-0.0048	**	(0.0017)	-0.0081	***	(0.0019)
Lipid Test	-0.0090	***	(0.0017)	0.0003		(0.0017)	-0.0058	**	(0.0019)
Diabetes Test	-0.0258	***	(0.0021)	-0.0196	***	(0.0020)	-0.0136	***	(0.0019)
Flu Shots	-0.0104	***	(0.0021)	0.0017		(0.0023)	0.0014		(0.0026)
Osteoporosis Screening	-0.0105	***	(0.0011)	-0.0039	***	(0.0010)	-0.0141	***	(0.0017)
Depression Screening	-0.0001	***	(0.0000)	-0.0001	**	(0.0000)	0.0000		(0.0000)
Wellness Exam	-0.0025		(0.0015)	-0.0035		(0.0019)	0.0018		(0.0014)

*** p<0.001, ** p<0.01, * p<0.05

Notes: Coefficients and standard errors in parentheses. The sample is comprised of patients ages 67 and older with continuous fee-for-service coverage starting in 2006 through the end of 2011 or until death. Analysis is at the five-digit ZIP-year level for 2006-2011. Regressions are weighted using ZIP-level population weights. (1) relates log costs to log house prices in the same year. (2) relates log costs to log house prices lagged by one year. (3) relates changes in log costs across adjacent years to changes in log house prices. All models include ZIP and year-level fixed effects. N = 59,754 ZIP-year observations (10,257 ZIPs).

Appendix Table 1: Preventive Services Procedure Codes

Cancer screenings: G0101, G0123, G0124, G0141, G0143, G0144, G0145, G0147, G0148, Q0091, P3000, P3001, 88141, 88142, 88143, 88147, 88148, 88150, 88152, 88153, 88154, 88155, 88164, 88165, 88166, 88167, 88174, 88175, G0104, G0105, G0106, G0120, G0121, G0122, G0328, 44388, 44389, 44392, 44393, 44394, 45330, 45331, 45333, 45338, 45339, 45378, 45380, 45381, 45383, 45384, 45385, 82270, 82274, 74263, G0102, G0103, 84152, 84153, 84154, G0202, 77052, 77057

Lipid screenings: 80061, 82465, 83718, 83719, 83721, 84478

Diabetes tests: 82947, 82948, 82950, 82951, 82952, 83036

Influenza shots: 90654, 90655, 90656, 90657, 90658, 90660, 90661, 90662, 90664, 90666, 90667, 90668, 90672, 90673, 90685, 90686, 90688, Q2034, Q2035, Q2036, Q2037, Q2038, Q2039

Osteoporosis screenings: 76977, 77078, 77080, 77081, G0130

Depression screenings: 99420, G0444

Wellness exams: G0402, G0438, G0439, G0445, S0610, S0612, S0613, 99381, 99382, 99383, 99384, 99385, 99386, 99387, 99391, 99392, 99393, 99394, 99395, 99396, 99397, 99401, 99402, 99403, 99404, 99411, 99412, 99461

Source: (United Healthcare 2013)