The Housing Wealth Effect: Identification after a Tragedy*

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Preliminary

Abstract

Identifying a causal channel from changes in housing wealth to consumption is challenging. This is rooted in the difficulties in finding truly exogenous sources of variation in house prices, as well as onerous individual-level data requirements. This paper offers a framework that meets both challenges. Central to our research design is the tragic school shooting in Newtown on December 14, 2012, which provided a large negative shock to the local real estate market, the magnitude of which varied discontinuously at the boundary of the Sandy Hook Elementary School attendance zone. We combine this information on the exogenous change in housing values with individual-level credit card expenditure data to identify the magnitude of the wealth-effect from housing to consumption. Our results, suggest that the marginal propensity to consume from a $1 change in housing wealth is about 10-14 cents. However, household demographics are key to understanding the magnitude of these effects. We find no evidence that changes in housing wealth affect behavior of young (18-30) or old (65+) consumers; instead, the effect is driven entirely by the 30-65 cohort. Consistent with these results, we find that lower income households, who are more-often renters, are short in housing, while higher-income households react positively to changes in housing wealth.

JEL classification:

Key words: Housing Wealth, Wealth Effect, Consumption, Identification, GIS.

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1. Introduction

In many countries, savers concentrate their capital-holdings in housing wealth, at the same time housing wealth and household consumption tend to move in the same direction (Figure 1). This leads to a natural question: when house prices decrease, do consumers respond by lowering their expenditure and vice versa? If the answer is yes, then housing market trends can potentially play a critical role in the propagation mechanisms that underlie the business cycles.

There are certainly good theoretical reasons for believing that the housing market and household consumption are linked. The most fundamental of these is rooted in the permanent income hypothesis (Poterba and Samwick, 1996; Lettau and Ludvigson, 2004). However, there are other explanations. For instance, shocks to housing wealth can alter borrowing constraints, or they can affect incentives to save in consumers with a precautionary motive (Carroll et al., 1992; Gourinchas and Parker, 2002), either of these can impact household expenditures. Recently, dual boom-bust cycles in US real estate and consumer expenditures have focused attention on consumption-wealth channels; research has focused in particular on the establishing the empirical relevance of these channels (Case, et. al., 2005, Campbell and Coco, 2007; Bostic et. al., 2009; Gan, 2010; Mian et. al., 2013). Unfortunately, distinguishing between different mechanisms in the data, or even doing the "simpler" thing—drawing a line from housing wealth to household consumption—has proven difficult.

Broadly classified, the empirical literature on housing wealth effects, can be grouped into papers that have a macro focus, i.e., papers that exploit aggregate or regional variation in consumption (and house prices), and papers that rely on more granular data. Unfortunately, the econometric evidence that emerges from macro-centric studies has yielded widely varying estimates. This reflects some of the acute empirical challenges at higher levels of aggregation. Since housing wealth and consumption are driven by many of the same common factors, at the crux, is an omitted variables problem that is nigh on impossible to address convincingly in aggregate data. Also important is the narrow scope for disentangling the different mechanisms through which shocks to housing are communicated to consumption within the limited variation provided in aggregate data.

Moving to a finer level of disaggregation can help glean more nuanced conclusions from the data. A common source for individual-level consumption data are household surveys such as the Panel Study of Income Dynamics (PSID) in the US, or the UK family Expenditure Survey (FES). However, research relying on these micro-datasets, have run up against their own sets of challenges. Often these reflect the limitations of the data, which were not collected with the specific aim of throwing light on the consumption-wealth effect

question. Thus for instance a major drawback of the PSID is that it only consistently reports information on household food expenditures. By contrast, the FES, utilized by Campbell and Cocco (2007), reports data on expenditures on a wide array of items, however, these data are not a panel, as each household is only interviewed once, at each point in time. The Consumer Expenditure Survey (CEX), provides a similar level of detail on US-expenditures, as well as a host of other valuable data on household characteristics and incomes. Unfortunately, the CEX does not provide information on financial or housing wealth. Given these limitations, existing research has sought to find workarounds that come with caveats. For instance, Cooper (2009) imputes household consumption using data on income and saving from the PSID. Campbell and Cocco (2007) attempt to circumvent the absence of longitudinal data in the FES, by constructing a pseudo panel from a time series of cross sections. While Bostic et. al. (2007) join consumer expenditure data from the CEX with data on household wealth from the Survey of Consumer Finances, even though these surveys do not target the same households. Compounding these difficulties, are the measurement biases and non-response biases inherent in survey-based data collection (Runkle, 1991), which are plagued by inaccurate recollection of expenditures.

By contrast, spending-information synthesized from proprietary datasets on individual-level card-expenditures, can mitigate some of these problems. Very little research however has taken this approach, in part, because it is difficult to link expenditures information with changes in housing wealth. These difficulties arise since individual-identifiers are almost always scrambled by purveyors of these data. One paper that is able to connect credit-card expenditures with financial information from mortgage applications is Gan (2010). Using a panel of roughly 12,000 homeowners, Gan (2010), finds that the MPC out of housing wealth between 3 and 5 cents.

In a number of respects, the microeconomic evidence on consumption wealth effects, represents a significant improvement over studies which have relied on aggregate data. First, when individuals are tracked over time, we can control for individual-level unobserved household heterogeneity within the data. Second, micro-data provides more scope for shedding light on the channels by which housing wealth and expenditure are linked. However, critically, access to these data does not, in itself, resolve the main identification challenge that confronts this research, since the same national or regional factors that are driving the business cycle, and therefore house prices and consumption in macro data, are also present in microeconomic data.

In order to isolate the housing wealth effect, what we require are "…data on spending by individual households [as well as data on their housing wealth] before and after some truly exogenous change in their

house values, caused for example by the unexpected discovery of neighborhood sources of pollution" (Carroll et al., 2011). What Carroll et al. (2011) are alluding to is a natural experiment that can provide relative certainty about the direction of causality. That is some natural variation within the data that allows us to assert that the root cause of the changes in house prices are not innovations in consumption, and therefore make a case that the channel of causation operates the other way around. However, natural experiments do not offer researchers experimental control over the assignment of units to treatment or control groups. Thus in the absence of a naturally occurring mechanism that randomizes the assignment of units to different comparative groups, questions about internal validity will remain. The critical question then that must be addressed by researchers is whether the composition of the treated group is orthogonal to the outcome variable. In what follows, we discuss an event where it is difficult to argue that it is not.

In particular, we examine the consumption-response of households in the aftermath of a heartbreaking tragedy in which 20 children and 6 adults lost their lives in an act of senseless gun violence. The Sandy Hook Elementary School (SHES) massacre took place on December 14, 2012, in a neighborhood of Newtown, in Fairfield County, CT. The rampage took place between 9.35am and 9.40am, during which time the shooter fired 153 rounds. We provide evidence that the shooting precipitated a (relative) downturn in the local real estate market. Although house prices in all of Newtown (and perhaps beyond) may have declined following the shooting, our identifying assumption is that the magnitude of this shock varied discontinuously at the boundary of the Sandy Hook School Attendance Zone. A comprehensive dataset on real estate transactions in Newtown, before and after the shooting, provide evidence consistent with this assumption. Further, the size of the effects appear to be quite large: on average, houses with 3+ bedrooms, located within the Sandy Hook Elementary Attendance Zone (SHAZ), declined by over 5% relative to the control-group, i.e., 3+ bedroom properties in the neighborhood of Sandy Hook, located outside the attendance zone. When we restrict our analysis to larger houses, 4+ bedrooms, the effects are even stronger—house prices declined by nearly 7% relative to their control in the aftermath of the shooting.

We pair these exogenous variations in house prices with individual-level card-based expenditures data to identify the structural component in households'' expenditures associated with changes in house prices. In addition to information on expenditures, which are estimated using information on account balances and payments, our data provide a great deal of information on household demographics, as well as information on income and overall levels of indebtedness. These detailed data provide sufficient variation to unpack some of the heterogeneity in housing wealth effect across consumers with different age, income and wealth characteristics.

In recent years, the "big data" revolution has changed the face of macroeconomic research, with increasing reliance on large and very detailed proprietary databases, including data on expenditures from credit card companies and other financial institutions (see for instance Gross and Souleles, 2002). Yet, to our knowledge, there are only two studies, which have used credit card data to examine the relationship between housing wealth and consumption (Gan, 2010; Mian et.al. 2013).

Our objectives are similar to both of these seminal contributions, however our data and approach are quite different. In particular, our data provide information on individual-level expenditures and demographics. This contrasts with Mian et.al (2013), who utilize a random sample of the universe of card-based transactions at the county level. The finer level of granularity in our data offers greater flexibility in answering nuanced questions about the mechanisms by which the consumption-response to wealth operates. Gan (2010) also utilizes individual-level expenditure data, however her data are for Hong Kong households. Additionally, unlike Gan (2010), we employ some natural variation in house prices located on either side of a school boundary that arguably provides a cleaner identification of the housing wealth effect.

The rest of the paper proceeds as follow. Section 2 describes our methodology and data. Section 3 presents our findings. In section 4, we present our estimates of the consumption wealth effect. Finally, section 5, concludes with some remarks.

2. Data

Our empirical strategy is comprised of two distinct parts. In the first part, we estimate a model that quantifies the impact of the Sandy Hook massacre on local real estate. In part two, we shift our focus to the estimation of a consumption equation. In order to accomplish these dual goals, we need data from two very different sources informing on two very different quantities. The first of these data are publically available, but nonetheless difficult to compile and subject to various problems that require considerable scrutiny. The second set of data are highly confidential, highly regulated, proprietary and therefore difficult to obtain. However, once obtained we found them to be well organized and largely problem free. In this section we discuss these two datasets—the variables on which they inform, the approaches that we took in computing quantities of interest, as well as the challenges we faced in compiling some of the data.

2.1. A Dataset on Real Estate Characteristics and Transactions

The data requirements to estimate our housing price model, and develop forecasts of the wealth shock to Sandy Hook residents, can be classified into two broad categories. (1) Data gleaned from assessors' records, specifically house transactions and house-attributes; and (2) GIS information on the school attendance

boundaries, as well as the location of each parcel in Newtown relative to those boundaries.

For a number of townships in Connecticut, including Newtown, assessors' records are available in a single location (http://www.vgsi.com/vision/applications/parceldata/CT/Home.aspx). Though these data are public record, only certain information, such as sale prices of homes, are downloadable in bulk, while other data on house-attributes, are not. These are instead available through a searchable portal. To obtain information on a specific parcel, the user must enter a unique ID assigned to every parcel (PID), or a street address. Information is then posted back in the form of a link to a url, which contains very detailed information on over 100 house characteristics. Included are the usual suspects, such as the style of house, lot size, living area, the numbers of rooms, bedrooms and bathrooms, as well as indicators for finished basements, porches, decks, central air, along with many other characteristics.

Given this extent of detail, it was not feasible to compile these data manually for all 12,103 parcels recorded in the Newtown assessor database. Instead, we automated this process, by coding a visual basic web scarper which was designed to navigate to each of the 12,103 urls corresponding to every parcel PID, before parsing those pages for data on housing attributes and compiling them in a spreadsheet. This was feasible since much of the housing information contained in the assessor database, followed one of two templates. This enabled us to target keywords within the databases, such as "bedrooms" or "lot size" and extract the information bracketed by HTML tags.

In addition to housing data, to estimate the impact of shooting, it is important to code whether a parcel belongs to SHAZ. This information was obtained in two steps. First, we geocoded (obtained latitude and longitude information for) each parcel in our housing database using a GIS software package. Next, we compared this information to data on the geographical extent of the Sandy Hook attendance boundary.[4]

In order to estimate the shock to property values post 12/14, we looked at all sales between January 1, 2003—ten years prior to Sandy Hook massacre—and July 2016. During this period there were 6527 recorded sales of residential properties excluding sales of manufactured homes, which were omitted from our data. The number of transaction recorded in the assessor database is inflated for various reasons which we discuss below. A number of properties appear more than once in these data because they were bought and sold multiple times. Although in many cases, a single transaction was listed in duplicate or triplicate. These transactions were collapsed into a single row in our data. Additionally, there are 1773 recorded

[4] A comprehensive database on geocoded school boundaries is maintained by, the National Center for Education Statistics, which compiled these data in the recent Schooling Attendance Boundary Survey.

transactions with a sale price of $0 or $1. This can happen for many reasons, including mortgage-refinancing and transfer of ownership, or other non-taxable changes to a deed. Since none of these records correspond to actual sales, they were removed from our data. Finally, a number of properties were sold to real estate developers who incorporated significant capital improvements into the properties. Unfortunately there is no way to track what these changes were, since our information on housing characteristics refer to data obtained following the latest assessor appraisal conducted in 2014. Thus sales prior to capital improvements cannot be paired with accurate information on house characteristics and are omitted from our data. Similarly properties acquired by developers after 2014, that were subsequently resold, were also omitted for similar reasons.

After eliminating these sales from our data, our sample was comprised of 4416 transactions, of which 1823 were sales of parcels located in Sandy Hook, and 1189 of these sales were of properties located insider the SHAZ-area-.

2.2. Individual Level Tradeline Data

Individual-level financial data were obtained from a major repository of financial information that provides data analytic services in addition to credit information to its customers. The data that were made available to us, records monthly balances and payments information on all financial accounts from January 2010 to July 2016. This includes revolving installment tradelines such as credit cards, store charge cards, but also other lines of financing, including personal loans and home equity lines of credit. Included also are debit cards backed by checking accounts. Our data are inclusive of inactive or closed accounts that are less than seven years old. In addition to balance and payment information, our data include data on credit worthiness, incomes, age, marital status, and the size of households (measured by number of adults and children), along with various other financial and non-financial data.

Critically also, these data provide relatively precise information on the location of each individual in our sample. To maintain confidentiality of their customers, street addresses were omitted from the data that were transmitted to us. However, each individual in our sample was geocoded using a nine digit zip code. Generally, a single zip+4 is assigned to a narrow set of delivery points, such as an apartment complex, or one side of a city block between intersections. Thus even while maintaining an individual's anonymity, we have fairly precise information on each individual's location. As will become clear, these geographical data are critical to our empirical design.

Importantly however our data do not report monthly expenditures; either debit expenditures backed

by checking account funds, or expenditures incurred against lines of credit. However, we were able to calculate a gross expenditure series (gross of interest charges), by adding lagged payments to the first differences in monthly balances, i.e.

$$\text{expenditures}_i = \left(B_{i,t} - B_{i,t-1}\right) + P_{i,t-1}$$

where $B_{i,t}$ and $P_{i,t}$ represent balance and payment data on account on i at time-t.

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3. Estimating the Impact on Local Real Estate

Although of school shootings are the subject of an extensive academic literature in both psychology and sociology (Muschert, 2007), outside these fields, the topic has generated little traction. Thus surprisingly little is known about the economic costs of these events. One channel that has not been explored, but that may provide a means of measuring some of these costs, is the impact school shootings have on property values. Despite the dearth of formal evidence, there at least two important empirical channels, which when connected, provide a compelling reason for thinking that school shootings negatively impact local real estate.

The first of these has to do with the psychological impact on both students and faculty after a school shooting. Aside from eliciting behavioral changes within the student population, psychological stresses following a shooting can manifest in the form of lower achievement outcomes. Ding et. al. (2009) for instance find that depression is associated with lower student achievement, while McEwen and Sapolsky (1995) argue that stress can adversely affect declarative memory. More relevant to the current context, in a recent paper, Beland and Kim (2015) find that enrollment for entering-high-school-students decreases in the aftermath of a homicidal shooting (see also Abouk and Adams, 2013). Further, using information on school report cards and Common Core data, they find that performance on standardized tests in English and Mathematics is lower in affected schools up to three years following the shooting.

The second empirical channel, connects school quality with house prices. There is an extensive literature that finds the quality of neighborhood schools (measured using indicators of academic performance) are capitalized into house prices (see Bogart and Cromwell, 1997, 2000; Black, 1999; Weimer and Wolkoff, 2001; Kane et. al., 2003; Figlio and Lucas, 2004). Without a thorough assessment of student report cards and other metrics of student performance, before and after the shooting, it is difficult to know whether the quality of schooling at Sandy Hook Elementary was negatively impacted by the events on 12/14. It is likely however that perceptions about Sandy Hook Elementary changed in the wake of the shooting. Moreover, starting in January 2013, SHES students were relocated to the adjacent district of Monroe. The new location,

a former middle school which had been vacant since the 2011 academic year, was over 7 miles from the old school. Although the move to Chalk Hill was envisioned as temporary, it took nearly four years to finalize the construction of a new school at the site of the old one. Thus for a time, for parcels located within the SHAZ, an important variable in the determination of property values—the proximity to a school—changed and in most cases increased.[5]

Although there is certainly a strong case to be made that the impact on local schooling options was the most important channel through which home values were affected post 12/14, it may have not been the only channel. For instance, the stigma of a horrific crime, or elevated perceptions of crime-risk, may have had knock-on effects on local real estate that impacted a broader area. This poses a challenge when attempting to identify the impact of the shooting on home values, since the perimeter at which these effects end, even if such a discrete boundary exists, is unclear.

However, crucially important to our empirical design is the "districtization" of elementary schooling in Newtown. Unlike Newtown middle schools, or high schools, which draw their students from anywhere in the township, the four Newtown elementary schools—Hawley Elementary, Head O' Meadow Elementary, Middle Gate Elementary and Sandy Hook Elementary—draw their students from a partition of four non-overlapping attendance zones, that remained unchanged even in the period following the shooting (Figure 2).

The existence of these attendance boundaries provides a potential "crease" within the data with which to identify the impact of 12/14 on Sandy Hook real estate prices. This boundary discontinuity design is not new. It was pioneered in the literature on school quality by Black in 1999. However, importantly an additional time dimension in our data, allows us to compare the difference between house prices in SHAZ and houses in other attendance areas, before the shooting, with the difference in house prices across school attendance boundaries after the shooting. This difference-in-differences approach eliminates both unobserved neighborhood quality characteristics (as in Black, 1999) and other unobserved heterogeneity in household preferences across school zone boundaries, as well as unobserved common factors in house prices over time, and so mitigates many of the econometric problems in measuring the impact of the shooting on real estate values.

Our baseline econometric model is organized around generalizations of the following hedonic price regression:

$$\ln(p_{i,j,t}) = x'_{i,j}\beta + I(j = \text{SHAZ})I(\tau > \bar{\tau})\gamma + \mu_j + \tau_t + u_{i,j,t} \qquad (1)$$

[5] In a 2013 survey The National Association of Realtors found that 22 percent of home buyers listed a school-proximity as part of their buying decision.

Here dependent variable, $p_{i,j,t}$, is the log of the sale price of house i, located in attendance district j, sold on date t. Various structural characteristics of the house, such as the lot size, living area, the number of bedrooms, bathrooms and total rooms, are measured in the vector $x_{i,j}$. Locational characteristics are modelled through the inclusion of a location dummy, μ_j, which takes the value one if a property is located within the SHAZ, and zero otherwise. We control for the time dimension in our data through a set of annual dummies, τ_t.

The important variable in equation (1) is the interaction between an indicator for whether a parcel is located in the Sandy Hook Attendance Zone, $I(j = SHAZ)$, and a post shooting dummy, $I(\tau > \bar{\tau})$. Accordingly, γ, the coefficient of interest, measures the difference-in-differences in house prices between real estate in Sandy Hook (the treatment group) and real estate outside of Sandy Hook (the control), prior to and in the aftermath of the shooting.

In Table 1, column (1), we present a benchmark regression, where we regress the log of home sale prices against a number of physical characteristics, as well as an indicator for the Sandy Hook attendance zone membership. Also included is a dummy for parcels located within the Sandy Hook neighborhood—properties with a 06482 zip code—that are located outside SHAZ. This benchmark regression utilizes all sales of single family homes and condos between January 2003 and July 2016.

The housing characteristics enter our pricing model with the expected signs. For instance larger houses, with larger lot sizes and more square footage, sell for more. However, after controlling these factors, the number of rooms and bedrooms do not matter. Additional bathrooms, as well finished basements, do, however, positively influence price. The age of the property also matters—newer houses sell for more than older ones—as does the overall quality of the property. Amenities such as central air and fireplaces also have a positive statistically significant impact on the sale price. Another important factor is location. Properties located in the Sandy Hook neighborhood, on either side of the school attendance zone, sell for a 4-5 percent discount relative to properties in Newtown as a whole.

In column (2), we examine whether the shooting negatively impacted real estate prices inside SHAZ, after 12/14. Interesting the coefficient on the interaction between the SHAZ indicator and the post-shooting dummy is statistically equal to zero. However, this result holds when we examine the pricing effects on all properties. This includes condos and 1-2 bedroom properties, primarily duplexes, which were not negatively affected in the post-12/14 period. In fact, our results suggest, that the market for condos and duplexes in SHAZ may have improved in the years since the shooting, though this finding is not significant at accepted levels of significance (column 3).

Although the real estate market for condos and duplexes in SHAZ may not have softened in the wake of the shootings, the story is quite different for single family homes with three or more bedrooms. This classification of properties composes the majority of parcels in Sandy Hook (about 74% of properties inside SHAZ and 76% of properties outside SHAZ). Our results suggest that after the shooting the average price of homes with at least three bedrooms declined by about 2.5 percent relative to similar properties in the Newtown area, located outside SHAZ. The results are more striking when we restrict attention to houses with four or more bedrooms. On average the relative price of these properties fell by 4.67 percent.

This evidence is consistent with what we may expect if real estate prices in Sandy Hook were impacted through a schooling channel. Condos or duplexes are attractive to young people without children, as well as retirees and "empty nesters." As such the quality of, or proximity to, neighborhood schools may not be capitalized into their prices. By contrast, stand-alone properties, with three or more bedrooms, are the most popular option for families with children. Recent census data suggest that approximately 70 percent of families with children, live in this type of dwelling. As such, we would expect neighborhood schooling options to be an important determinant in their pricing.

The question remains however whether the price of 3+ or 4+ bedroom houses in SHAZ declined because of the disruption to local schooling services, or whether local real estate was being impacted through other channels. It is possible for instance that our regressions are capturing price movements in a real estate market that was stigmatized in the aftermath of the shootings, though if this were the case, there would be no reason to expect these negative price movements to stop at the border of the Sandy Hook attendance boundary. Our results suggest however that is exactly what happened. In column (5) we present results from a regression where we include an interaction between an indicator for Sandy Hook parcels located outside SHAZ and a post-shooting dummy. If the real estate market in Sandy Hook was being negatively affected through other channels, besides the schooling channel, we would expect this coefficient to be negative. In fact the coefficient is positive and suggestive (even if not significant) that prices of four bedroom houses in Sandy Hook outside SHAZ increased by about 3.7 percent relative to other Newtown properties in the aftermath of the shooting.

Below, we examine some of these differences in Sandy Hook real estate trends across both sides of the attendance zone boundary. Table 2 essentially reproduces Table 1, but uses Sandy Hook properties outside SHAZ as a control group. The results from Table 2, are largely consistent with those reported in Table 1. The relative decline in real estate values within SHAZ is limited to single family homes with three or more bedrooms. The market for 1-2 bedroom houses—duplexes—as well as condos were unaffected by the events

on 12/14. By contrast, our sales data reveal that prices of houses with at least three bedrooms fell on average by nearly 5.5 percent after 12/14. If we restrict our attention to houses with four bedrooms or more, then the relative decline in prices was closer to 7 percent.

Together the findings in Tables 1 and 2, reinforce the conclusion that the market for single family homes inside SHAZ was negatively impacted by the events on 12/14. However, the size of the coefficients on the interaction term are just sufficiently different, to pose a question: what was the size of the shock to real estate values in SHAZ after 12/14, was it between 3.9 and 4.7 percent (for 4+ bedroom houses), as suggested in our first set of results, or was the effect larger, closer to 7 percent, as implied by our results in Table 2? The answer to this question depends on whether the real estate trends in the three attendance areas outside SHAZ, or the more localized changes in Sandy Hook, better "reconstruct" the counterfactual in which the shooting never happened. Unfortunately, without observing the counterfactual we cannot know for sure which one of the control groups better identifies this hypothetical variation in real estate values inside the attendance zone. We can, however, compare the real estate market in the treatment and control groups in the years prior to the shooting, and in the event that house prices in the treatment and control groups mirror each other, we would certainly be more confident in our assumption.

Below we present two pieces of evidence. First in Table 3A and 3B, we report some statistics that summarize different aspects of the housing stock in the two control areas. Second, in Figure 3, we plot the average annual sale price of properties with four or more bedrooms in the treatment and both control areas. Panel A of Figure 3, corresponds to the Newtown control area, and Panel B corresponds to the Sandy Hook control.

From Table 3, we can see that properties in the Newtown control area have slightly larger lots and greater square footage, and higher tax assessments, relative to houses located in SHAZ. The average grade or quality of the properties however are comparable to houses inside the Sandy Hook attendance zone. Overall the average differences between (4+ bedroom) houses in treatment group and the Newtown control group are not very significant. Though these differences are even less significant for the Sandy Hook control group. On average assessment of properties in Sandy Hook located outside SHAZ, are almost identical to similar properties located inside SHAZ. Further, the houses in the Sandy Hook control group are also closer in age and size to houses in the treatment group.

By contrast the summary statistics for properties located in Sandy Hook are almost identical to those of the SHAZ properties.

Prior to the shootings, the average house price in Sandy Hook closely tracked the average house

price in other attendance zones in Newtown (Figure 3). After the shooting, however, a gap opened between the real estate market in SHAZ, and the real estate markets in other parts of Newtown. This effect was not immediate, though this is not a surprise given the downward stickiness of prices in the real estate market.[6] During the pre-treatment period, there is one year—2008—when we observe a significant disparity between the average sale price of 4+ bedroom houses in SHAZ versus the two control areas. However the gap between the treatment and control groups in 2008 is essentially meaningless due to the low number of sales that year. There were eight 4+ bedroom houses located inside the SHAZ area that sold that year. One property, which sold for $130,000—77% below its listing. Additionally, there were three sales in Sandy Hook control area and six sales in the Newtown control group..

Although prices in both control groups track the real estate trends inside SHAZ fairly well, the association is certainly closer for the Sandy Hook control group during the pre-treatment period. This is not surprising since, as suggested in Table 3, the real estate in a single neighborhood of Newtown is more homogenous than the township as a whole.

Thus in forming our estimates of the housing wealth shock to SHAZ, we use the gap between the real estate prices in Sandy Hook outside the SHES attendance area and real estate prices inside SHAZ.

Although our house price-data are only available for parcels that sold during the period of investigation, we can estimate the size of the wealth shock to each household in SHAZ, as out-of-sample predictions formed from our estimated models. Our results however for all parcels, corresponding to Table 2, column (1), and 1-2 bedroom houses—Table 2, column (2)—are statistically zero. Similarly, when we restrict our attention to 3 (as opposed to 3+) bedroom houses, the negative effect on housing stock cannot be estimated at accepted levels of statistical significance (results not shown). For houses with four or more bedrooms however our estimates of the impact on housing wealth are precise. Below we use these estimates to form in-sample and out-of-sample estimates of the exogenous change in housing values for 4+ bedroom housing stock.

By construction, for every house, with four or more bedrooms, the impact is the same—a 6.9% decline in prices relative to the counterfactual. By construction also, the impact on housing stock with three or fewer bedrooms is zero, as is the impact on houses located outside the SHAZ area.

Unfortunately, we cannot find a one-to-one mapping from these estimates of the housing wealth shock to the individual-level data on expenditures, since address information for individuals was not available.

[6] Typically real estate markets are slow to clear, and any drop in prices is initially proceeded by a decline in transaction volumes. The simple plot in Figure 3, suggests that it took over a year for a gap to open between the real estate market in Sandy Hook and elsewhere.

However, every individual in our expenditure dataset is tagged with a 9-digit zip code. This allowed us to attach an estimate of the average wealth shock within that 9-digit zip area to that individual.

Before this could be done, it is necessary to convert the very specific (6 digit latitude-longitude) geographic information on all the parcels in the SHAZ area, into zip+4 codes. Unfortunately, the various address databases linked to GIS software, only report zip codes at the 5-digit level. Hence zip+4 information was obtained using the US Postal Service's zip-lookup facility. While the number of lookups was large, this task was automated using visual basic script.

Once zip+4 information was obtained for every parcel in SHAZ, we formed an average of the individual shocks to housing wealth, for each zip+4 area. Naturally, the size of the average wealth shock in a zip+4 area was higher if it was comprised mainly of 4+ bedroom housing stock. By contrast in a zip+4-area composed of 1-3 bedroom housing stock, the constructed wealth shock was zero.

4. Consumption Wealth Effect

In this section, we outline our method for estimating the MPC out of housing wealth along with our main findings. Our estimation strategy is organized around variations of a simple linear regression model:

$$\Delta c_{i,j} = I(\tau > \bar{\tau})\Delta W_j \omega_1 + x_i' \omega_2 + \mu_j + \tau_t + u_{.,j,t} \qquad (2)$$

Here the dependent variable, $\Delta c_{i,j,t}$, is the first difference of the average expenditures by individual i in zip+4 area j, between 2016 and 2012. The variable $\Delta W_{j,t}$ measures the aggregate shock to housing wealth for households residing in zip(+4) code j. To be clear, here the notation "Δ" does not represent the first difference operator, instead "Δ" denotes the difference between the realized value of housing wealth and the counterfactual level of housing wealth absent the shooting. Note that by definition $\Delta W_{j,t} = 0$ for households outside the Sandy Hook attendance zone and also for zip codes where there were no 4+ bedroom houses. The variable x_i is a vector of financial and demographic information on individuals. Finally, μ_j is a location dummy, that assumes the value one if an individual resides inside the SHAZ area. The coefficient of interest, ω_1, is the estimate of the marginal propensity to consume out of housing wealth.

In Table 4, we present our results from a number of specifications. Columns (1) to (3) report a baseline model where we regress simply the difference in average monthly consumption patterns between 2016 and 2012 against the size of the shock to housing wealth. In column (1), we examine how consumption responds to the mean change in housing wealth in zip code area j. This is simply an average (in each zip+4 area) of the differences between the fitted value of the house price in July 2016 and December 2012. To be sure this is distinct from our measure of the exogenous shock to housing wealth, which we discussed in the

previous section.

Based on our estimated housing price regressions, between December 2012 and July 2016, house values remained largely unchanged (an average increase of $280). This is consistent with the broader data on housing stock for Connecticut as a whole (see All-Transactions House Price Index for Connecticut, US Federal Housing Finance Agency). Our results from column (1) of Table 4, suggest little evidence of a relationship between the change individual consumption and the change in house prices. The estimated MPC out of housing wealth—0.011—is neither economically nor statistically significant.

However, in columns (2) & (3), where we regress the change in average monthly consumption against the exogenous shock to house prices (which is zero everywhere except in SHAZ), the result is strikingly different. The MPC out of housing wealth is about 0.19, i.e., consumption decreases by 19 cents for every one dollar decline in house prices.

Controlling for a number of demographic factors, such as age, marital status, and family size does not meaningfully affect this coefficient (column 4). However, controlling for income in 2012 does. Though our results suggest that the MPC out of housing wealth is still quite large—every one dollar decrease in housing wealth corresponds with roughly a 11 cent decrease in consumption. Our estimates suggests a stronger relationship between consumption and housing wealth than implied by many previous studies. For instance, for a panel of U.S. states, Case et. al.(2005) estimate the MPC from housing wealth between 0.04 and 0.06. Also using U.S. data, Carroll et al. (2011) report a figure closer to 2 cents on the dollar, though this effect is stronger (9 cents) in the long run. Other studies, which have relied on more microeconomic data, such as Gan (2010 and Mian et. al. (2013) also report a smaller effect, between 3 cents (Gan, 2010) and 7 cents (Mian et. al., 2013) on the dollar.

One hypothesis that has received a lot of attention is that older households are long in housing, while younger and retired households, who are more often renters, are short in housing. This hypothesis has received some support in the data. For instance, Campbell and Cocco (2007) find a small, positive, consumption response to home prices for young homeowners—the effect is about 0.6 cents out of every dollar. By contrast the consumption response of older households is much larger—about 11 cents on the dollar. In Table 5, we examine whether the housing wealth effect varies across different age groups. We split out sample into three groups—young individuals between the ages of 18 and 30, people between 30 and 65 and retirees, above 65. Our results are very similar to the earlier findings reported in Campbell and Cocco (2007). For young group, as well as retirees, the MPC out of housing wealth is effectively zero. However, for the mid-life group, the consumption response is about 13 cents on the dollar.

5. Conclusion

Understanding how consumption responds to changing wealth, is a question that has, for good reason, received considerable attention in recent years. Of particular note, are studies that have attempted to marshal larger and more sophisticated micro-level data, in an attempt to provide more nuanced answers to this question. However, despite this considerable progress, the fundamental identification issue has remained largely unresolved. We address this identification challenge in a convincing way. Our results suggest a strong consumption response to the changes in the housing wealth. The results also indicates that the effects of housing wealth shock on consumption vary with age groups. This paper is still under progress. The extraordinarily detailed financial data offer a rich source of variation from which to answer many nuanced questions. For example, our data allows to separate expenditures into types—durables, non-durables, as well as specific categories of spending, such as clothing, automobile-related and son on. Our data also contain information on the mortgages and home equity lines of credit, which offers the opportunity to verify the role of credit- or collateral-based channels that underlie the correlation in house prices and household expenditures. These extensions are parts of our ongoing research agenda.

References

Abouk, R., & Adams, S. (2013). School shootings and private school enrollment. *Economics Letters*, *118*(2), 297-299.

Beland, L-P., Kim, D., (2015). "The Effect of High School Shootings on Schools and Student Performance," *Educational Evaluation and Policy Analysis*, forthcoming.

Black, S.E. (1999). "Do Better Schools Matter? Parental Valuation of Elementary Education," *The Quarterly Journal of Economics* 114(2), 577-599.

Bogart, W. T., & Cromwell, B. A. (1997). How much more is a good school district worth?. *National Tax Journal*, 215-232.

Bogart, W. T., & Cromwell, B. A. (2000). How much is a neighborhood school worth?. *Journal of urban Economics*, *47*(2), 280-305.

Bostic, R. W., Longhofer, S. D., & Redfearn, C. L. (2007). Land leverage: decomposing home price dynamics. *Real Estate Economics*, *35*(2), 183-208.

Campbell, J., Cocco, J.F. (2007), "How do House Prices Affect Consumption? Evidence from Micro Data," *Journal of Monetary Economics* 54(3), 591-621.

Carroll, C. D. (1992). "The Buffer-Stock Theory of Saving: Some Macroeconomic Evidence," *Brookings Papers on Economic Activity* 23(2), 61–156.

Carroll, C., Otsuka, M., Slacalek, J. (2011). "How Large Are Housing and Financial Wealth Effects? A New Approach," *Journal of Money Credit and Banking* 43(1), 55-79.

Case, K., Quigley, J. Shiller, R. (2005). "Comparing Wealth Effects: The Stock Market versus the Housing Market," *The B.E. Journal of Macroeconomics* 5(1), 1-34.

Cooper, D. (2009). Impending US spending bust? The role of housing wealth as borrowing collateral.

Ding, W., Lehrer, S. F., Rosenquist, J. N., & Audrain-McGovern, J. (2009). The impact of poor health on academic performance: New evidence using genetic markers. *Journal of health economics*, *28*(3), 578-597.

Figlio, D. N., & Lucas, M. E. (2004). What's in a grade? School report cards and the housing market. *American economic review*, *94*(3), 591-604.

Gan, J. (2010). "Housing Wealth and Consumption Growth: Evidence from a Large Panel of Households," *Review of Financial Studies* 23(6), 2229-2267.

Gourinchas, P.O., Parker, J. A. (2002). "Consumption Over the Life Cycle," *Econometrica* 70 (1), 47-89.

Gross, D. B. Souleles, N.S. (2002), "Do Liquidity Constraints and Interest Rates Matter for Consumer Behavior? Evidence from Credit Card Data," *The Quarterly Journal of Economics* 117(1), 149-185.

Kane, T. J., Staiger, D. O., Samms, G., Hill, E. W., & Weimer, D. L. (2003). School accountability ratings and housing values [with comments]. *Brookings-Wharton papers on urban Affairs*, 83-137.

Lettau, M., & Ludvigson, S. C. (2004). Understanding trend and cycle in asset values: Reevaluating the wealth effect on consumption. *american economic review*, *94*(1), 276-299.

McEwen, B. S., & Sapolsky, R. M. (1995). Stress and cognitive function. *Current opinion in neurobiology*, *5*(2), 205-216.

Mian, A., Rao, K., Sufi, A. (2013). "Household Balance Sheets, Consumption, and the Economic Slump," *The Quarterly Journal of Economics* 128(4), 1687-1726.

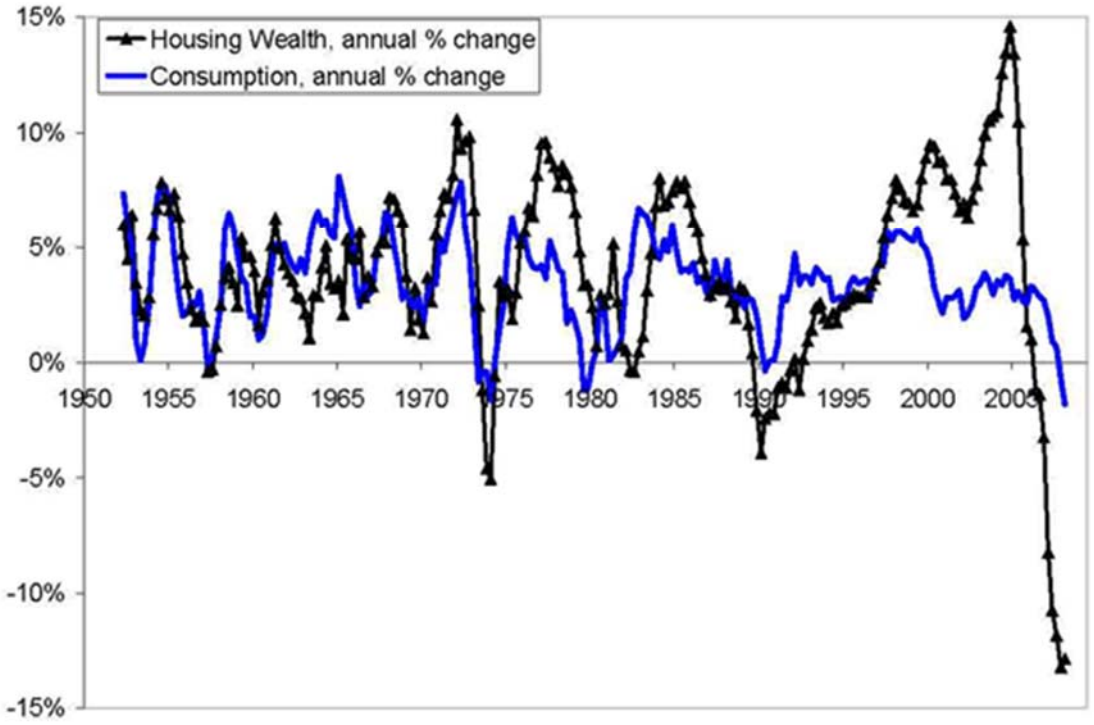
Muschert, G. W. (2007). Research in school shootings. *Sociology Compass*, *1*(1), 60-80.

Poterba, James M. and Samwick, Andrew A. (1996). "Stock Ownership Patterns, Stock Market Fluctuations, and Consumption" NBER Working Paper No. R2027.

Runkle, D. E. (1991). Liquidity constraints and the permanent-income hypothesis: Evidence from panel data. *Journal of monetary Economics*, *27*(1), 73-98.

Weimer, D. L., & Wolkoff, M. J. (2001). School performance and housing values: Using non-contiguous district and incorporation boundaries to identify school effects. *National Tax Journal*, 231-253.

Figure 1. Annual Changes in Housing Wealth and Consumption



Source: Iacoviello (2011).

Figure 2. Newtown Public Elementary Schools' Attendance Boundaries

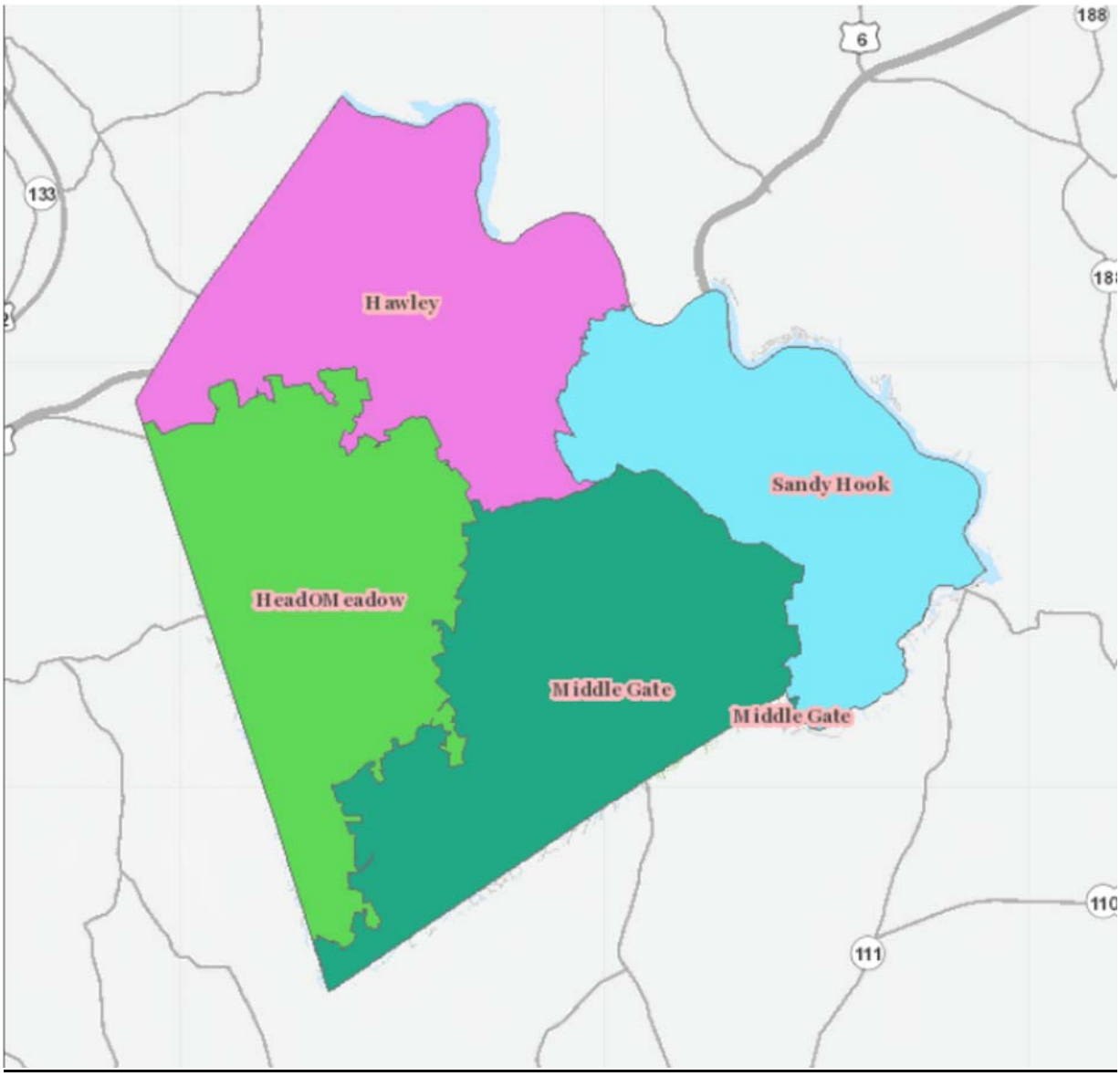


Figure 3 A. Average Price of 4+ Bedroom Houses in SHAZ and Newtown outside SHAZ, 2003-2016

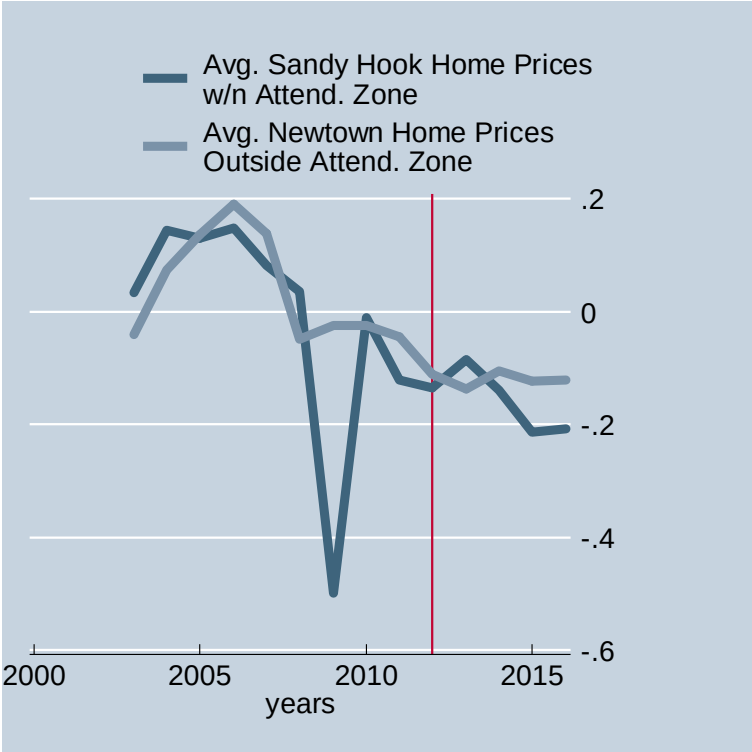


Figure 3 B. Average Price of 4+ Bedroom Houses in SHAZ and Sandy Hook outside SHAZ, 2003-2016

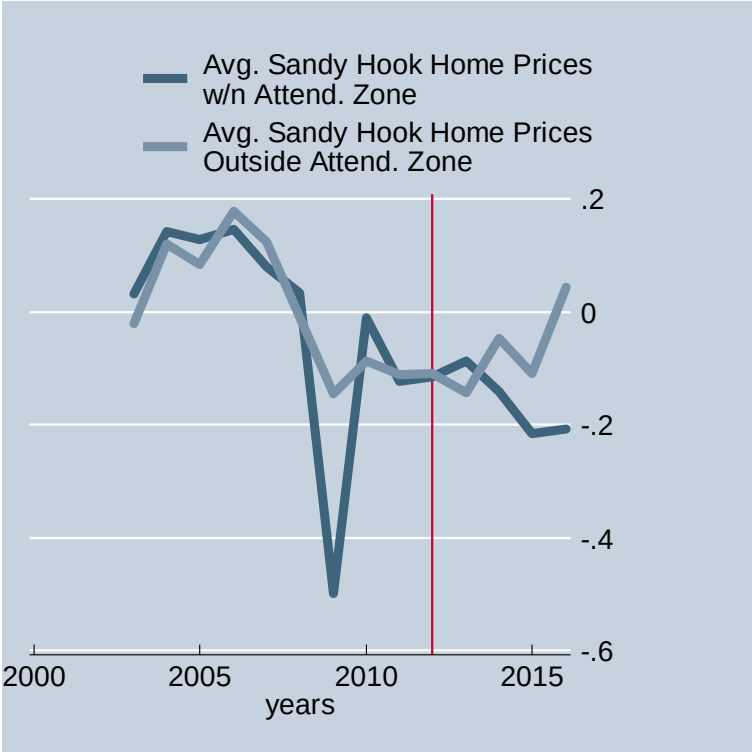


Table 1. Impact on SHAZ Real Estate; Control Other Newtown Attendance Zones

	All Houses	1-2 Beds / Condo	3 Bedrooms	4+ Bedrooms	Effect in 06482
SHAZ	-0.0497***	-0.1375***	-0.0190	-0.0043	-0.0062
	(0.0129)	(0.0526)	(0.0116)	(0.0120)	(0.0123)
Sandy Hook Outisde SHAZ	-0.0455***	-0.0323	-0.0347***	-0.0390***	-0.0496***
	(0.0109)	(0.0391)	(0.0116)	(0.0139)	(0.0175)
Post Shooting	-0.0312	-0.0451	-0.0138	0.0151	0.0080
	(0.0346)	(0.0598)	(0.0413)	(0.0397)	(0.0415)
SHAZ * Post Shooting *	0.0006	0.0580	-0.0245	-0.0466**	-0.0390*
	(0.0202)	(0.0709)	(0.0190)	(0.0198)	(0.0208)
Sandy Hook * Post Shooting*					0.0369
					(0.0250)
Log Lot Size (Acres)	0.0717***	0.1265***	0.0930***	0.0736***	0.0742***
	(0.0122)	(0.0368)	(0.0139)	(0.0161)	(0.0161)
Log Living Area (SQF)	0.5105***	0.3401***	0.4454***	0.4896***	0.4879***
	(0.0272)	(0.0796)	(0.0296)	(0.0309)	(0.0309)
Property Grade	0.0082***	0.0094**	0.0152***	0.0141***	0.0141***
	(0.0013)	(0.0038)	(0.0017)	(0.0017)	(0.0017)
Log Age (Yrs)	-0.0483***	-0.0889***	-0.0267***	-0.0232***	-0.0236***
	(0.0057)	(0.0151)	(0.0069)	(0.0076)	(0.0076)
Rooms	-0.0034	0.0182	0.0077*	0.0061	0.0063
	(0.0046)	(0.0187)	(0.0046)	(0.0052)	(0.0052)
Bedrooms	-0.0121	0.0584	-0.0253**	-0.0695***	-0.0691***
	(0.0100)	(0.0594)	(0.0115)	(0.0198)	(0.0199)
Baths	0.0369***	0.1022***	0.0289***	0.0224**	0.0223*
	(0.0101)	(0.0365)	(0.0097)	(0.0114)	(0.0114)
Log Fin. Bsmt. (SQF)	0.0117***	0.0085	0.0108***	0.0086***	0.0085***
	(0.0016)	(0.0057)	(0.0016)	(0.0018)	(0.0018)
Log Garage(SQF)	0.0040***	-0.0107**	0.0060***	0.0065***	0.0066***
	(0.0013)	(0.0054)	(0.0013)	(0.0013)	(0.0013)
Central Air	0.0875***	0.1358***	0.0758***	0.0738***	0.0733***
	(0.0102)	(0.0433)	(0.0104)	(0.0135)	(0.0135)
Hardwood Floors	0.0023	-0.0309	0.0160	0.0180	0.0184
	(0.0107)	(0.0305)	(0.0110)	(0.0138)	(0.0138)
Fireplaces	0.0384***	0.0649**	0.0283***	0.0293***	0.0295***
	(0.0082)	(0.0315)	(0.0083)	(0.0089)	(0.0090)
Constant	8.2165***	9.0253***	8.0501***	8.0207***	8.0319***
	(0.1821)	(0.6616)	(0.1744)	(0.2069)	(0.2075)
N	4226	713	3519	2189	2189
adj. R-sq	0.676	0.545	0.677	0.648	0.648

Table 2. Impact on SHAZ Real Estate; Control Other Sandy Hook Attendance Zones

	All Houses	1-2 Beds / Condo	3 Bedrooms	4+ Bedrooms
SHAZ	0.0033	-0.1288*	0.0259*	0.0361**
	(0.0157)	(0.0766)	(0.0146)	(0.0167)
Post Shooting	-0.0323	-0.1401*	-0.0007	0.0271
	(0.0350)	(0.0846)	(0.0402)	(0.0507)
SHAZ * Post Shooting	-0.0253	0.1275	-0.0543**	-0.0691***
	(0.0240)	(0.0909)	(0.0234)	(0.0260)
Log Lot Size (Acres)	0.0799***	0.1824**	0.0834***	0.0562**
	(0.0198)	(0.0767)	(0.0210)	(0.0270)
Log Living Area (SQF)	0.4595***	0.2863***	0.4820***	0.5159***
	(0.0418)	(0.1090)	(0.0375)	(0.0436)
Property Grade	0.0106***	0.0113**	0.0140***	0.0174***
	(0.0020)	(0.0052)	(0.0024)	(0.0028)
Log Age (Yrs)	-0.0544***	-0.0713***	-0.0375***	-0.0250***
	(0.0084)	(0.0215)	(0.0076)	(0.0094)
Rooms	0.0004	0.0253	0.0027	0.0081
	(0.0078)	(0.0283)	(0.0064)	(0.0074)
Bedrooms	0.0037	0.0576	-0.0276*	-0.0719***
	(0.0146)	(0.0725)	(0.0146)	(0.0230)
Baths	0.0320**	0.0265	0.0289**	0.0131
	(0.0160)	(0.0592)	(0.0138)	(0.0169)
Log Fin. Bsmt. (SQF)	0.0103***	0.0166**	0.0092***	0.0066**
	(0.0024)	(0.0077)	(0.0022)	(0.0026)
Log Garage(SQF)	0.0069***	0.0062	0.0050***	0.0057***
	(0.0019)	(0.0121)	(0.0018)	(0.0019)
Central Air	0.0920***	0.1876**	0.0744***	0.0674***
	(0.0152)	(0.0796)	(0.0147)	(0.0205)
Fireplaces	0.0599***	0.0914**	0.0477***	0.0313*
	(0.0136)	(0.0442)	(0.0121)	(0.0164)
Hardwood Floors	-0.0022	-0.0947*	0.0347**	0.0590**
	(0.0196)	(0.0522)	(0.0176)	(0.0259)
Constant	8.2565***	9.1556***	7.8924***	7.4966***
	(0.2892)	(0.8325)	(0.2162)	(0.2810)
N	1804	381	1426	879
adj. R-sq	0.699	0.392	0.756	0.716

Table 3. Comparison of Properties in the Treatment and Two Control Groups

	SHAZ	Sandy Hook Control	Newtown Control
assessment	307261	299157	327279
lot size	2.03	2.29	2.67
living area sqf	2818	2714	2956
number of rooms	9.12	9.02	9.33
grade	84.47	84.09	84.25
year built	1983	1978	1973
number of parcels	1,018	622	3,432

Table 4. MPC out of Housing Wealth: Benchmark Regressions

	(1)	(2)	(3)	(4)	(5)
change in house prices	0.0116				
	(0.0088)				
exogenous shock to house prices		0.1938***	0.1938***	0.1851***	0.1075***
		(0.0343)	(0.0343)	(0.0354)	(0.0333)
incomr 2012					-0.0279***
					(0.0048)
credit score (300-850)					-0.0106***
					(0.0037)
age				-0.3517***	-0.1320
				(0.0882)	(0.0892)
age square				0.0032***	0.0014
				(0.0009)	(0.0009)
married				-0.9145*	-0.3901
				(0.4868)	(0.4935)
family size				0.1508	0.0754
				(0.1548)	(0.1512)
SHAZ	-0.2755	2.1068***			
	(0.3974)	(0.4442)			
Sandy Hook Outside SHAZ	-0.4646	-0.2006			
	(0.4896)	(0.4528)			
Constant	-6.9504***	-7.0135***	-4.9067***	4.3209**	8.8847**
	(0.1963)	(0.2019)	(0.3964)	(2.0830)	(3.7717)
N	7382	7382	1875	1855	1855
adj. R-sq	0.000	0.008	0.032	0.040	0.077

Table 5. MPC out of Housing Wealth: By Age

	18-30	30-65	>65	married	single
exogenous shock to house prices	0.0093	0.1206***	-0.0013	0.1375***	0.0582
	(0.0875)	(0.0370)	(0.0722)	(0.0442)	(0.0743)
income 2012	-0.0971**	-0.0265***	-0.0325**	-0.0279***	-0.0305**
	(0.0415)	(0.0051)	(0.0132)	(0.0073)	(0.0138)
credit score (300-850)	-0.0095	-0.0105***	-0.0071	-0.0146***	-0.0050
	(0.0072)	(0.0040)	(0.0087)	(0.0050)	(0.0085)
age	-2.8671	-0.7866**	-2.6162	-1.0324**	0.3751
	(4.7936)	(0.3537)	(1.9133)	(0.4668)	(0.5381)
age square	0.0664	0.0080**	0.0172	0.0109**	-0.0047
	(0.0965)	(0.0036)	(0.0124)	(0.0047)	(0.0056)
married	-1.4415	-0.1170	-0.0672		
	(1.5732)	(0.6457)	(1.0703)		
family size	-0.4596	0.1815	-0.6142	0.2326	0.0438
	(0.4039)	(0.1650)	(0.3729)	(0.3207)	(0.3657)
kids				-0.1478	0.6439
				(0.4755)	(0.6437)
constant	41.0431	23.9170**	104.2744	31.9032***	-5.1748
	(60.1507)	(9.4373)	(73.0238)	(11.8424)	(13.3198)
N	103	1480	310	1232	272
adj. R-sq	0.079	0.074	0.047	0.081	0.048