The Housing Wealth Effect in the Post-Great Recession Period

June 2020

Evidence from Big Data

Abstract

In this report, we leverage de-identified banking data, including transaction-level deposit account and credit card data and loan-level mortgage data, in order to measure the increase in household consumption as a result of the 50 percent increase in house prices after the Great Recession. Our results suggest that the marginal propensity to consume (MPC) out of each dollar increase in housing wealth for the years 2012 to 2018 is much smaller than estimates for prior periods and is in fact between 0 and 1.6 cents. We also find near zero MPCs for each year between 2012 and 2018 and for subgroups with greater access to liquidity—more home equity, more available credit on credit cards, and more liquid assets. We reconcile this near zero MPC out of housing wealth in the post-Great Recession period with a larger MPC during the preceding periods by noting that the volume of home equity withdrawal in the post-Great Recession period was much lower than during the housing boom. Our findings have important implications, particularly in light of the COVID-19 pandemic and its unprecedented economic impacts. Efforts to boost consumption that focus on increasing homeowners' liquidity, such as reducing frictions to accessing home equity, would be most successful but also carry risks in a recession when home prices are likely to depreciate and increased income volatility may translate into more credit risk. A smaller housing wealth effect diminishes the ability of conventional monetary policy to affect the real economy through the housing market, resulting in lower consumption and GDP growth than might otherwise be expected. Policymakers may need to lean more heavily on other channels of monetary policy and unconventional measures, as well as fiscal policies that provide households with liquidity.

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Executive Summary

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Despite evidence that the marginal propensity to consume out of increasing housing wealth was significant prior to the Great Recession, causal evidence suggests that between 2012 and 2018 it was near zero.

Roughly two-thirds of families in the U.S. own a home. Rising home prices, and therefore housing wealth, can fuel household consumption. As such, the housing market can have a significant impact on the broader economy. From the late 1990s up to the Great Recession, estimates of the marginal propensity to consume (MPC) out of housing wealth range from approximately 4 cents to 9 cents, and studies covering the Great Recession period have found MPCs as high as 11 cents.[1] However, evidence of slower-than-expected consumption and GDP growth in combination with relatively low levels of home equity extraction after the Great Recession suggest that the housing wealth effect may be much smaller after the financial crisis than for prior periods. Indeed, some recent studies suggest that the MPC may be as low as zero, but these studies do not provide precise causal estimates.

In this report, we answer the following research question: *What was the household consumption response to the 50 percent increase in housing wealth in the post-Great Recession period?* We link de-identified banking data, including transaction-level deposit account and credit card data, to loan-level mortgage data to estimate the MPC out of housing wealth for the period between 2012 and 2018. Our large sample and direct measure of consumption allow us to derive more precise MPC estimates than otherwise available.

Our research examines whether homeowners increased their consumption in response to increasing housing wealth after the Great Recession.

Data Asset

From a universe of over 16 million Chase mortgage customers between 2012 and 2018, we created a sample of 1.7 million customers who had both a Chase mortgage and Chase deposit account during that period and who fulfilled other criteria described below.

Our loan-level mortgage data allow us to observe details of each homeowner's loan (e.g., current levels of equity). In a robustness check, we also examined a sample of over 5 million Chase credit card customers who are likely to be homeowners according to information on their credit card application. Following similar studies that estimate housing wealth effect MPCs for prior periods, we use an instrumental variables strategy with housing supply elasticity as the instrument to derive causal estimates.

From a universe of over **16 MILLION** Chase mortgage customers (2012 to 2018)

Requirements for Monthly Sample

Include each month where the Chase mortgage customer is also:

- A Chase deposit core customer: had at least five transactions in their Chase deposit account
- A resident of a metropolitan statistical area (MSA) for which the Saiz housing supply elasticity measure is available
- A resident of a zip code where Zillow Home Value Index (ZHVI) data is available

Homeowners with a Mortgage Monthly Sample
1.7 million

Additional Requirements for Annual Sample

Include each year where the Chase customer:

- Had both Chase mortgage and deposit account data for all twelve months of the year

Homeowners with a Mortgage Annual Sample
865,000

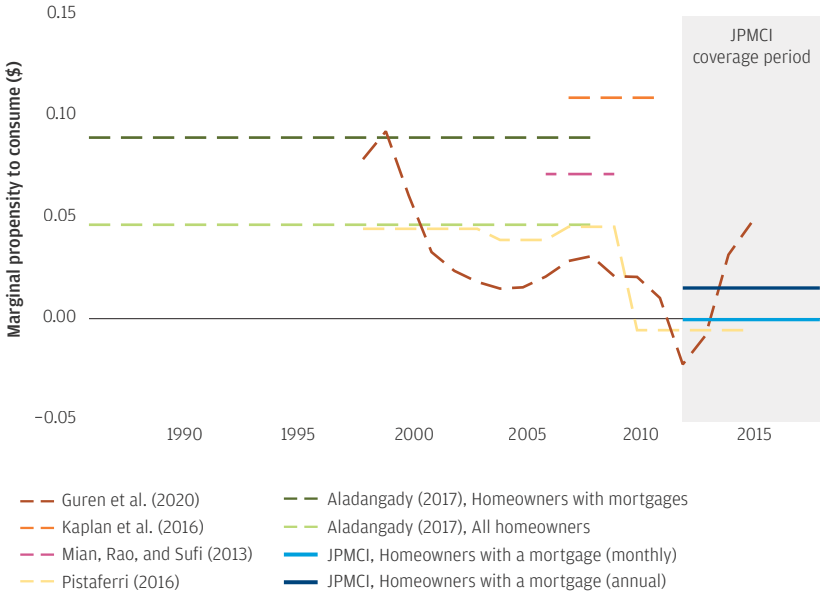
Source: JPMorgan Chase Institute

Finding One

The MPC out of increasing housing wealth from 2012 to 2018 ranges from 0 to 1.6 cents—much lower than most estimates for prior periods.

We find that the MPC out of increasing housing wealth from 2012 to 2018 is 0 cents for our monthly sample and 1.6 cents for our annual sample, both of which are significantly lower than most estimates in the literature for prior periods. Studies find MPCs as high as 11 cents for the period from the late 1990s through the Great Recession.

Estimates of marginal propensity to consume out of a $1 increase in housing wealth



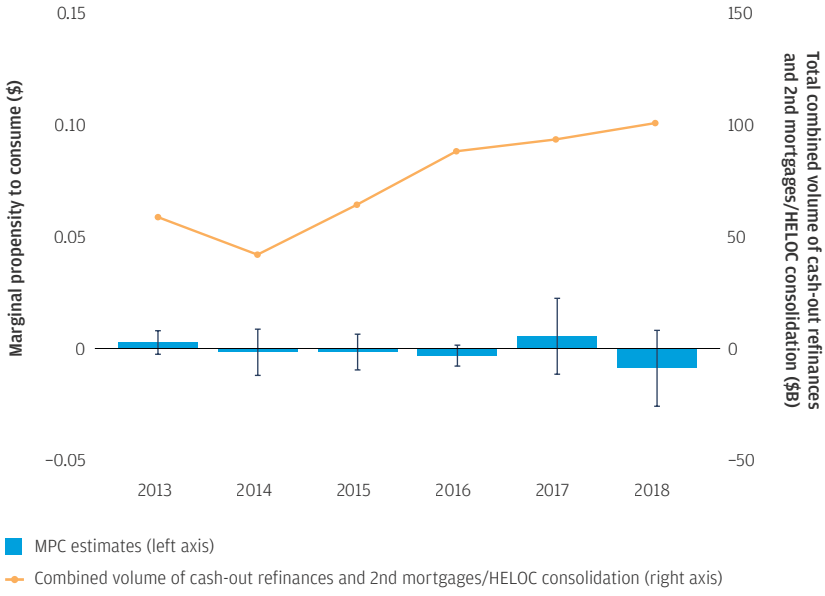
Source: JPMorgan Chase Institute

Finding Two

We estimate a housing wealth effect MPC of near zero for each year between 2013 and 2018.

For each year between 2013 and 2018, our estimated housing wealth effect MPC is both very small and statistically insignificant, implying the same MPC of zero for each year. This is consistent with data on equity extraction, which show that for the latter years in the range, equity extraction activity increased slightly but remained far below the historically high levels seen prior to the Great Recession.

Marginal propensity to consume out of a $1 increase in housing wealth by year

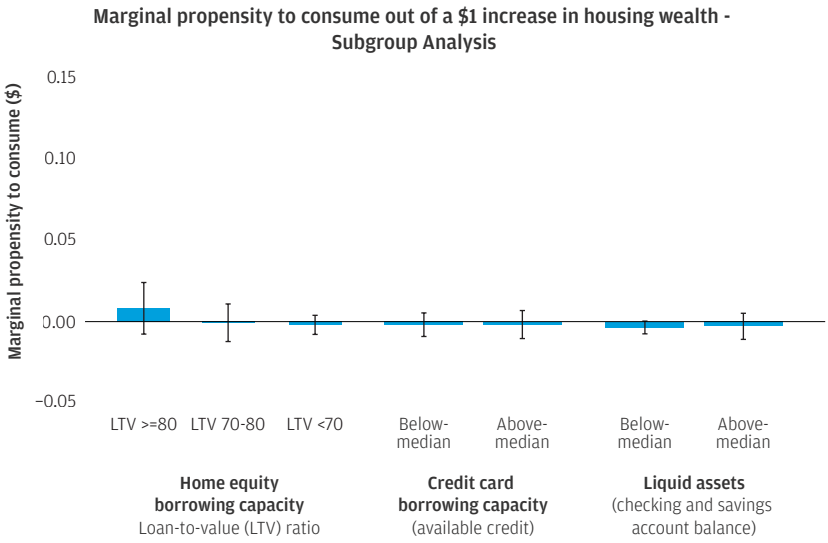


Source: Federal Reserve Flow of Funds (accessed via FRED), JPMorgan Chase Institute

Finding Three

The MPC out of housing wealth is close to zero even for segments of the population with greater access to liquidity, through which they could finance increased consumption.

Even among homeowners with greater capacity to borrow against their homes (i.e. those with more equity in their homes), more available credit on credit cards, and higher liquid assets, the marginal propensity to consume out of housing wealth was near zero.



Source: JPMorgan Chase Institute

Implications

How do we reconcile the much smaller MPC out of housing wealth in the post-Great Recession period with a larger MPC during the preceding periods? We find that the volume of equity withdrawal in the post-Great Recession period was much lower than during the housing boom. Research suggests there are both demand and supply factors at play. After the financial crisis, a larger share of equity became concentrated in the hands of older and less credit-constrained borrowers who tend to have a lower demand for equity extraction. At the same time, tightened lending standards have reduced the supply of credit to more credit-constrained mortgage holders who may have greater demand for equity extraction. We contribute new evidence that a lack of demand to borrow against home equity contributed to a low marginal propensity to consume out of housing wealth: even homeowners with more equity (for whom it should be easy to borrow) did not consume more when housing wealth rose.

This research has several implications for policymakers and is particularly relevant as the economy comes to face a severe recession induced by the COVID-19 pandemic. First, homeowners entered the COVID-19 crisis with a substantial amount of illiquid wealth in the form of home equity. Given the importance of cash flow dynamics and liquidity as determinants of consumption and the ability to stay current on housing payments, measures that allow homeowners to preserve or increase liquidity in the face of financial distress, such as through forbearance or maintaining access to this home equity, could provide an important financial cushion. These types of measures carry risks, however, as home prices could depreciate in a recession, eroding the equity position of homeowners—and increased income volatility could make it more difficult for borrowers to meet debt obligations.

Second, a much smaller housing wealth effect diminishes the ability of conventional monetary policy—changes to short-term interest rates—to affect the real economy through the housing market, resulting in lower consumption and GDP growth than policymakers might have expected or hoped to stimulate. Had the housing wealth effect MPC remained at estimated pre-recession levels, we find that consumption and GDP would have been 0.1 to 1.5 percent and 0.1 to 1 percent higher, respectively, in each of the years from 2012 to 2018.[2] As such, policymakers may need to lean more heavily on other channels of monetary policy and unconventional measures, as well as fiscal policies that provide households with liquidity during an economic downturn.

Introduction

Roughly two-thirds of families in the U.S. own a home. Rising home prices, and therefore housing wealth, can fuel household consumption. As such, the housing market can have a significant impact on the broader economy. Monetary policy aims to affect the real economy through several channels that rely on the housing market. Examples include stimulating home purchases, incentivizing homeowners to refinance existing mortgages, resetting monthly payments for those with adjustable-rate mortgages (ARMs), and increasing housing wealth in order to boost homeowners' consumption. In this report, we examine this last channel—the housing wealth effect. We ask how much consumption increased as a result of the 50 percent increase in house prices after the Great Recession.

We leverage de-identified banking data, including transaction-level deposit account and credit card data linked to loan-level mortgage data, to estimate the causal impact of house price appreciation on consumption between 2012 and 2018. These data allow us to measure consumption more comprehensively and directly for a larger sample of homeowners than most prior studies and produce precise estimates of the marginal propensity to consume (MPC) on a year-by-year basis and for subgroups with more access to liquidity.

We find that between 2012 and 2018, the MPC out of housing wealth was near zero—specifically, between 0 and 1.6 cents per dollar of increasing housing wealth. This is much smaller than most estimates for periods prior to the Great Recession, which typically range between 4 and 9 cents (Finding 1). In fact, the MPC is near zero for each year within our timeframe (Finding 2). We estimate a near zero MPC even for segments of the population who have greater access to liquidity via home equity withdrawal, available credit on credit cards, or existing savings (Finding 3).

Home equity could serve as an important financial cushion, especially as the economy faces a severe recession induced by COVID-19.

How do we reconcile the much smaller MPC out of housing wealth in the post-Great Recession period with a larger MPC during the preceding periods? Given the evidence that the primary mechanism to spend out of housing wealth increases is through home equity withdrawal (Mian and Sufi 2014), we turn to data on equity extraction. We find that the volume of equity withdrawal in the post-Great Recession period was much lower than during the housing boom. Research suggests there are both demand and supply factors at play (Fuster et al. 2017). After the financial crisis, a larger share of equity became concentrated in the hands of older and less credit-constrained borrowers who tend to have a lower demand for equity extraction. At the same time, tightened lending standards have reduced the supply of this type of credit to more credit-constrained mortgage holders who may have greater demand for equity extraction. We contribute new evidence that a lack of demand to borrow against home equity contributed to a low marginal propensity to consume out of housing wealth: even homeowners with more equity (for whom it should be easier to borrow) do not consume more when housing wealth rises.

There are several key implications of this research. First, because families did not increase their spending as their home values appreciated, they now have built a form of illiquid savings: substantially higher home equity than was had leading up to the Great Recession. Given the importance of cash flow dynamics and liquidity as determinants of consumption and the ability to stay current on housing payments, measures that allow homeowners to preserve or increase liquidity in the face of financial distress, such as through forbearance or maintaining access to this home equity, could provide an important financial cushion.

In the context of an economic downturn, forbearance policies in connection with COVID-19 that allow borrowers to postpone mortgage payments could help families build up a liquid cash buffer to prevent

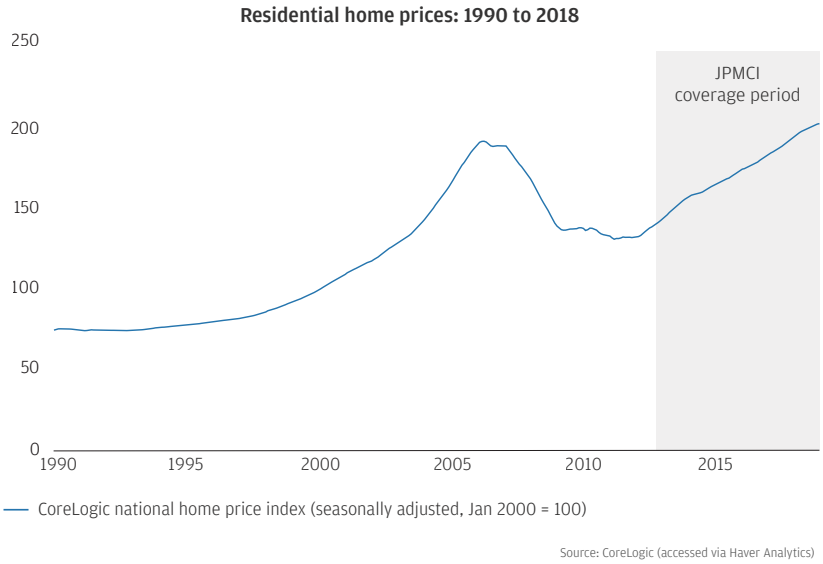
future mortgage delinquencies and maintain consumption, while accessing home equity could also provide an opportunity to take advantage of lower interest rates on a first lien. These types of measures carry potential risks, however. Home prices could depreciate in a recession, eroding the equity position of homeowners. Job losses and pay disruptions in a recession could also make it more difficult for borrowers to meet debt obligations.

Second, a much smaller housing wealth effect diminishes the ability of conventional monetary policy—changes to short-term interest rates—to affect the real economy through the housing market. The difference between an MPC of 0 to 1.6 cents versus 4 to 9 cents is economically significant. Had the housing wealth effect MPC stayed within this 4 to 9 cent range after the Great Recession, as policymakers might have expected, we estimate that consumption would have been 0.1 to 1.5 percent higher, and GDP 0.1 to 1 percent higher, in each of the years from 2012 to 2018. As such, policymakers may need to lean more heavily on other channels of monetary policy and unconventional measures as well as fiscal policies which provide households with liquidity during an economic downturn.

Macroeconomic Backdrop Post-Great Recession

Our interest in the housing wealth effect is motivated by a steep upward trend in house prices after the Great Recession. Residential home prices dropped precipitously during the Great Recession and bottomed out in late 2011. During the latter part of the past decade, there was a dramatic recovery in home prices nationally. As shown in Figure 1, by the end of 2018, home prices had recovered to their pre-recession highs and were up about 50 percent from their troughs. This implies that many homeowners experienced significant increases in housing wealth over this period of time.

Figure 1. National residential home prices increased by around 50 percent from 2012 to 2018.



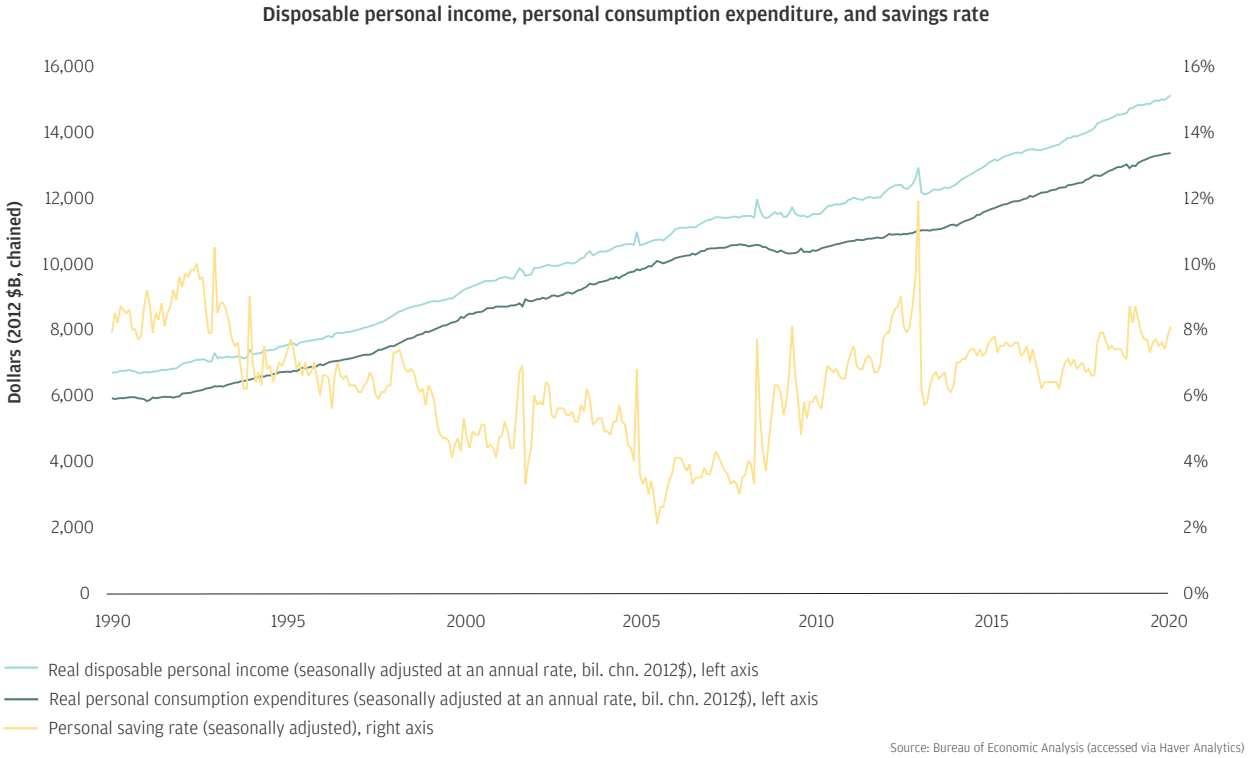
Source: CoreLogic (accessed via Haver Analytics)

During the same period of time, consumption did not grow nearly as dramatically as housing wealth, however. Figure 2 shows Personal Consumption Expenditures (PCE) and Disposable Personal Income (DPI) data from the Bureau of Economic Analysis. Historically, consumption tracks income well but between the Great Recession and early 2020, there is a larger gap between the two and the savings rate (the inverse of the consumption to income ratio) increased. This gap between income growth and consumption growth is also documented by Aladangady and Feiveson (2018), who calculate predicted personal consumption growth based on trends in income and consumption as well as historical estimates of the average propensity to consume out of income and wealth. They find that predicted consumption levels track actual consumption levels very well until the post-Great Recession period, after which actual consumption starts to lag far below predicted consumption.

There are many potential explanations for this documented gap (e.g., household balance sheet effects, increased uncertainty, increased inequality, and demographic changes) but one possible contributor that economists have put forth is that the housing wealth effect may have fallen after the Great Recession (Aladangady and Feiveson 2018; Pistaferri 2016). In particular, families may be less likely to borrow against their home equity and consume out of housing wealth in the post-Great Recession era. This is the possibility that we investigate in this report.

Our research question is: *What is the household consumption response to the increase in housing wealth in the post-Great Recession period? Specifically, did the roughly 50 percent increase in house prices nationally between 2012 and 2018 stimulate household consumption?*

Figure 2. Consumption tracks income well until the Great Recession, after which there is a larger gap between the two.



Source: Bureau of Economic Analysis (accessed via Haver Analytics)

The Housing Wealth Effect: Existing Literature

Economists and policymakers have long been interested in the effect of rising home prices on household consumption—the so-called housing wealth effect. Economic theory does not provide a clear prediction for the size or direction of the housing wealth effect. Since greater housing wealth also implies higher future living costs—in the sense that a region which sees growth in housing costs will also see growth in overall living costs—the degree to which one offsets the other determines the predicted impact of housing wealth on consumption in many economic models (Buiter 2008; Sinai and Souleles 2005). However, models that allow for collateralized lending predict large consumption effects as the result of rising home prices because additional home equity can loosen borrowing constraints and therefore increase the homeowner's ability to access liquidity. Also, to the extent credit constrained households have discount rates that make them more reactive to their current change in wealth versus future changes in cost of living, a higher housing wealth effect may be expected (Berger et al. 2015).

Several studies have tried to measure the causal impact of increasing housing wealth on consumption for the period leading up to the Great Recession, finding economically significant effects. Mian, Rao, and Sufi (2013) and Aladangady (2017) find housing wealth MPCs that range from approximately 4 cents to 9 cents between the late 1990s up through the Great Recession. Kaplan (2016) suggests that the MPC may have been as high as 11 cents during the Great Recession. Pistaferri (2016) documents a decline in the MPC from approximately 4 cents prior to and including the Great Recession (1998 to 2009) to 0 cents for the period after the Great Recession (2010 to 2015). Due to data limitations, he was unable to find a causal estimate for the post-Great Recession period but his analyses suggest that a decline in the housing wealth effect does appear after the housing market collapse during the financial crisis. Finally, Guren et al. (2020) estimates the housing wealth effect from the 1980s to mid-2010s and finds lower MPCs in certain years than other studies have found but the average MPC they estimate for the entire period from the late 1990s to the Great Recession is about 4 cents, which is in line with other studies. They also find that the MPC declined to below zero immediately after the Great Recession but has increased since (see Figure 4 in Finding 1 for a comparison).

In summary, prior literature has found MPC estimates out of increasing housing wealth that range from approximately 4 to 9 cents leading up to the Great Recession. Studies looking at the post-Great Recession period suggest that the MPC may have declined to as low as zero.

Our Data and Analysis

To measure the consumption response out of housing wealth, we link de-identified account-level mortgage, deposit account, and credit card data from October 2012 through December 2018. We create a sample of homeowners with a Chase mortgage as well as a second sample of homeowners more nationally representative as a robustness check.

Our sample of ***homeowners with a mortgage*** is comprised of Chase mortgage customers who also have a Chase deposit account (see the Data section of this report for full description). We apply a primacy screen to filter for customers who use their Chase account as their primary deposit account. We have a high level of confidence that these households are homeowners because they have a Chase mortgage, and our loan-level mortgage data allow us to observe details regarding their loan (e.g., how much equity they currently have). On the other hand, this sample skews in favor of more affluent and older mortgage borrowers.

As a robustness check (see the Methodology section for details and results), we also examine a second sample, a sample of ***all homeowners***, who are more representative of homeowners nationally. This sample is based on Chase credit card customers who indicated on their credit card application that they do not rent and, therefore, includes homeowners with a mortgage with any financial institution as well as those who own their home outright and do not have a mortgage. Notwithstanding the fact that this sample includes homeowners with no mortgage, this sample tends to be considerably younger and less affluent than the Chase mortgage sample. Although the sample of *all homeowners* is larger and potentially more nationally representative, insofar as the information on the credit card application could be outdated or incorrect, we have less confidence that this sample only includes homeowners. For this reason, in our exposition we prioritize the results on the *homeowners with a mortgage* sample and present the results on the *all homeowners* sample in the Data Asset and Methodology section.[3]

Studies examining the post-Great Recession period suggest that the housing wealth effect MPC may have declined to as low as zero.

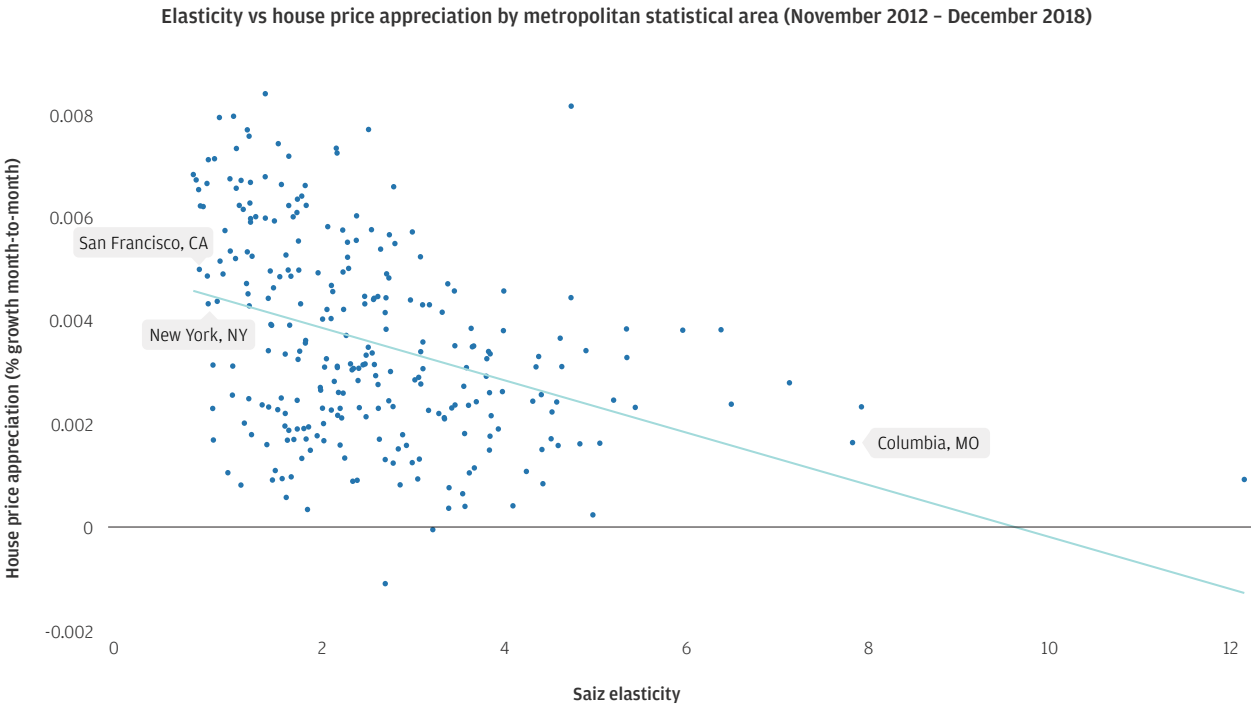
Our analysis is different from the prior studies mentioned above in that we use deposit account data to measure consumption. Specifically, our measure of consumption is all deposit account outflows minus transfers to savings and investment accounts.[4] Other studies in the literature have generally measured consumption using consumption data such as Nielsen scanner data (Kaplan et al. 2016), household survey data (Aladangady 2017), zip code-level auto purchase and county-level credit card data (Mian, Rao, and Sufi 2013), or retail employment (Guren et al. 2020). We arguably capture a more complete and accurate picture of consumption using deposit account data compared to these other sources. We also have the benefit of very large sample sizes, which enable us to derive precise estimates for each year in our sample and for interesting subgroups.

We measure house price appreciation using zip code level data from Zillow.[5] We match the households in our data to Zillow data based on their zip code and apply Zillow's estimate of home price appreciation for that zip code. This means that all homeowners in the same zip code experience the same percentage home price appreciation in our analysis, but not the same dollar amount.

In our most basic ordinary least squares (OLS) regression, we estimate the relationship between changes in home prices and changes in consumption. Our preferred specification includes controls for age, the dollar change in income, entry year fixed effects (the year that the customer first appears in our data), and monthly fixed effects. However, there are many reasons why this relationship is purely correlational. For example, local area expectations about economic prospects may affect both house prices and consumption.[6]

For this reason, we use an instrumental variables (IV) strategy to estimate the causal effect of increasing housing wealth on consumption.[7] Similar to many prior studies, we instrument for changes in housing wealth using Saiz elasticity, which measures the elasticity of home prices with respect to housing demand. This elasticity varies by city insofar as local natural land features (such as bodies of water or mountains) and stricter zoning regulations can make the housing supply less responsive to price changes in certain places (see the Data and Methodology sections for a full description). The intuition behind this methodology is that the more inelastic housing supply is in a given geographic area, the more house prices are likely to increase in response to the same demand shock.

Figure 3. Cities with greater home price appreciation also had lower Saiz elasticity, representing more inelastic housing supply.



Source: Saiz (2010), JPMorgan Chase Institute

Figure 3 shows that lower Saiz elasticity (more inelastic housing supply) is correlated with greater home price appreciation from October 2012 to December 2018. For example, San Francisco has a Saiz elasticity measure of 0.6 and home prices increased by 0.5 percent, whereas Columbia, Missouri has a Saiz elasticity measure of 7.84 and home prices only increased by 0.16 percent. This is the relationship that we rely on for our instrumental variables strategy.

We conduct our analysis at both the monthly level and annual level. Specifically, our monthly analysis estimates the monthly change in consumption that results from a monthly change in housing wealth, whereas our annual analysis estimates the same effect based on an annual change in consumption and housing wealth. Our month-level analysis allows us to include customers for whom we do not observe their mortgage and deposit account data for the entire year (which could include, for example, customers who refinance midway through the year from another bank to Chase).[8] We think these observations are especially interesting to include in our analysis because, to the extent households exhibit most of their spending response when they liquidate equity (Mian and Sufi 2014), for example, through a cash-out refinance, we could miss the consumption response to increasing housing wealth if we run our analysis only at the annual level.

Notably, the number of households in our monthly analysis is 1.7 million, representing 71 million observations, compared to our annual analysis which has 865,000 households, representing 2.8 million observations. However, monthly data may be noisier than annual data and, therefore, introduce attenuation bias.[9] For this reason, we present the results of both our monthly and annual analyses to provide a range of MPC estimates. Our three findings are the result of these analyses. Given these findings and the evidence that the primary mechanism to spend out of increasing housing wealth is likely equity withdrawal, we also discuss public data on equity withdrawal and home equity ownership in the Discussion and Implications section.

Finding

One

The MPC out of increasing housing wealth from 2012 to 2018 ranges from 0 to 1.6 cents—much lower than most estimates for prior periods.

Using our sample of *homeowners with a mortgage*, we find MPCs out of increasing housing wealth from 2012 to 2018 that are significantly lower than most estimates in the literature for prior periods, which generally range from 4 to 9 cents.[10] Our MPC estimates range from 0 to 1.6 cents.

In Table 1, we show the effect of monthly and annual changes in housing wealth on monthly and annual changes in consumption. Starting with the monthly OLS results, we observe a statistically significant but economically insignificant estimate of 0.4 cents. The annual OLS results are statistically significant, but still very small (1.7 cents). These results are similar to those found in Pistaferri (2016) for the period 2010 to 2016 and suggest that the marginal propensity to consume (MPC) out of increasing housing wealth is near zero—much lower than estimates prior to the Great Recession.

Next we turn to our IV results.[11] From the first stage results in Table 1, we can see that for both monthly and annual analysis, the instrument (Saiz elasticity) predicts housing wealth changes and is a strong instrument. Saiz elasticity and housing wealth changes are positively correlated as expected—the more inelastic (or the lower the Saiz elasticity) housing supply is, the greater the change in housing wealth.

In the second stage results, we see that our estimate of the MPC out of increasing housing wealth for the monthly analysis is 0 for the *homeowners with a mortgage* sample (a statistically insignificant point estimate of 0.02 cents). For our annual analysis, we estimate a statistically significant MPC of 1.6 cents. Taken together, we conclude that the MPC out of increasing housing wealth for this time period ranges from 0 to 1.6 cents.

We find MPCs out of increasing housing wealth from 2012 to 2018 that are significantly lower than most estimates in the literature for prior periods.

Table 1. The estimated MPC out of increasing housing wealth for 2012 to 2018 is between 0 and 1.6 cents for our sample of homeowners with a mortgage.

Outcome Variable:	Changes in Spending (Deposit Account Outflows)		Changes in Housing Wealth		Changes in Spending (Deposit Account Outflows)	
Analysis:	**OLS**		**IV-First Stage**		**IV-Second Stage**	
Frequency:	Monthly	Annual	Monthly	Annual	Monthly	Annual
Saiz Elasticity			-581.629***	-7,179.973***		
			184.844	2,251.892		
Housing Wealth	0.004***	0.017***			0.000	0.016***
	0.001	0.003			0.003	0.008
Age	-0.325***	-61.454***	6.795***	115.533***	-0.297***	-61.359***
	0.033	2.570	2.346	31.718	0.047	2.834
Homeowner Income Change	0.265***	0.482***	0.001***	0.022***	0.265***	0.482***
	0.003	0.003	0.000	0.003	0.003	0.003
Entry Year Fixed Effects	x	x	x	x	x	x
Monthly Fixed Effects	x		x		x	
Adjusted R-squared	0.044	0.134	0.045	0.079	0.044	0.134
Observations (Household-Months)	70,988,738	2,758,794	70,988,738	2,758,794	70,988,738	2,758,794
Number of Homeowners	1,746,492	864,969	1,746,492	864,969	1,746,492	864,969

Note: The top number is the estimated coefficient and the bottom number is the standard error. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Source: JPMorgan Chase Institute

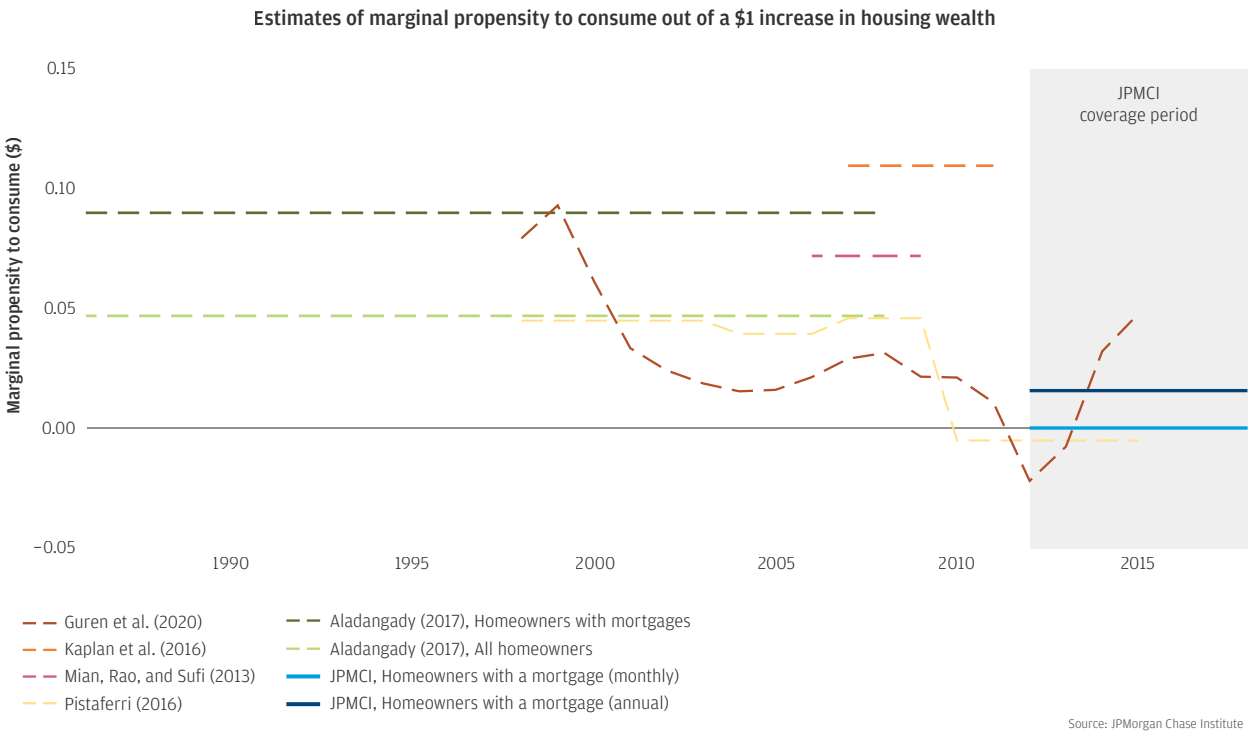
As shown in Figure 4 and described above, causal estimates of the housing wealth effect for the late 1990s and early 2000s generally found MPCs out of housing wealth ranging between 4 and 9 cents. Guren et al. (2020) estimates lower implied MPCs for certain years between 1998 and 2015 but the average over the entire period is within the lower end of this 4 to 9 cent range.

To our knowledge, our results represent one of the first causal estimates of the housing wealth effect using post-Great Recession data. Two other studies have examined the post-crisis period specifically, both of which estimate a lower housing wealth effect after the Great Recession. Pistaferri (2016) finds lower OLS estimates of the housing wealth effect MPC for the post-Great Recession period than in earlier years. Though these estimates are non-causal, they also suggest a downward trend in the MPC since the Great Recession.

The second study examining the MPC out of housing wealth in the post-Great Recession period is Guren et al. (2020), which uses two identification strategies (one of which is Saiz elasticity). They find that the implied MPC for this period varies substantially by year, ranging from 0 to as high as 5 cents. While Guren et al. use retail employment as the outcome variable to proxy for consumption, we are able to directly measure consumption using deposit and checking account outflows at the household level. In addition, our large sample size allows for results that are more precise than most other estimates in the literature, excluding most of the MPC range that has been estimated for prior periods. (See Methodology Section, Figure 13 for a chart that includes the confidence intervals associated with each estimate.)

A drop in the housing wealth effect from the 4 to 9 cent range to near zero is economically significant. Mian and Sufi (2014) estimate that spending against home equity increased GDP by 0.08 percent in 2003, 0.8 percent in 2004, and 1.3 percent in both 2005 and 2006. As we discuss in the Implications section in this report, our MPC estimate of 0 to 1.6 cents after the Great Recession implies that house price appreciation contributed little to consumption and GDP growth during the recovery period.

Figure 4. The marginal propensity to consume out of increasing housing wealth is lower after the Great Recession than before the Great Recession.



Source: JPMorgan Chase Institute

Finding
Two

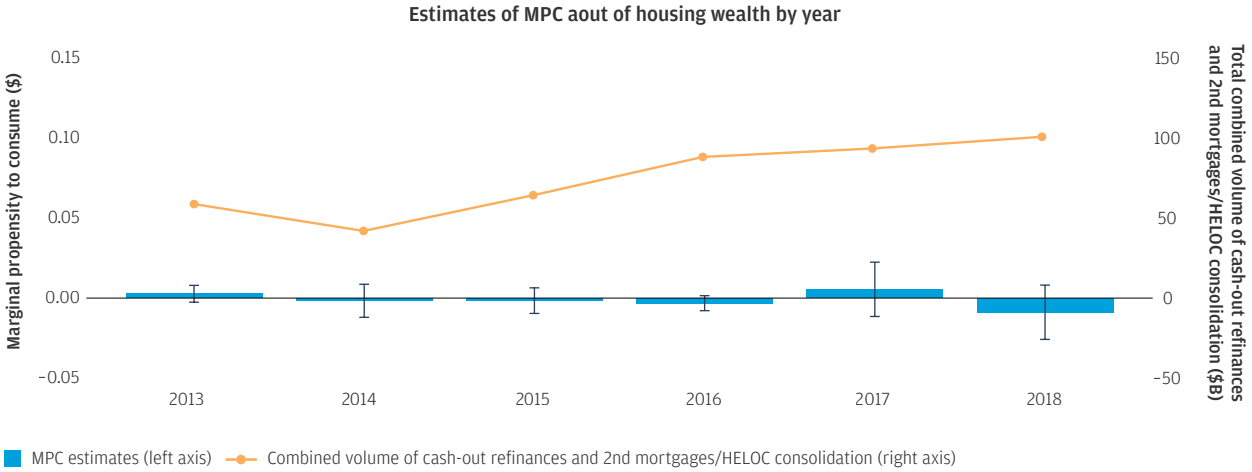
We estimate a housing wealth effect MPC of near zero for each year between 2013 and 2018.

In Figure 5, we turn to the question of whether the housing wealth effect differed by year in our coverage period. Data on the volume of cash-out refinances and junior liens (see Implications section) suggest that equity withdrawal activity increased slightly from $40 billion in 2014 to $100 billion in 2018. This might lead us to expect a higher and more economically significant MPC in the later years within our timeframe since home equity withdrawal—via cash-out refinances or second liens—is likely the primary mechanism by which housing wealth leads to increased consumption.

To examine this question, we use the same IV strategy and regression specification as in the previous analysis but this time we run our analysis separately for each year from 2013 to 2018.[12] Since the monthly and annual analysis in Finding 1 both yield very small MPCs, we run this analysis on a monthly basis to maximize our number of observations.

Figure 5 shows that our MPC estimates are 0 and our narrow confidence intervals rule out economically significant ranges for each year. This is true even for the later years in the range where, in Figure 6, the blue line shows that equity extraction activity increased slightly.

Figure 5. The marginal propensity to consume out of increasing housing wealth is near zero for every year between 2013 and 2018.



Source: Federal Reserve Flow of Funds (accessed via FRED), JPMorgan Chase Institute

Finding
Three

The MPC out of increasing housing wealth is close to zero even for segments of the population with greater access to liquidity, through which they could finance increased consumption.

Since we find that the overall MPC out of increasing housing wealth for the post-Great Recession period is very small (0 to 1.6 cents), we next examine subgroups in our sample who have greater access to liquidity and, therefore, have a greater ability to increase their consumption when their housing wealth increases. Overall, we find that the housing wealth effect MPC is near zero for the post-Great Recession period even for those with greater access to liquidity.

A household might be able to increase consumption after their housing wealth increases (assuming no increase in income) through three potential mechanisms: (1) accessing equity in their home through a home equity line of credit (HELOC) or cash-out refinance; (2) spending out of available credit on a credit card; or (3) spending out of liquid savings. We examine each of those mechanisms in turn in this section.

First, we compare those households with greater ability to access equity in their homes to other households who are likely less able to do so. One of the main determinants of whether a borrower is able to access home equity is the borrower's loan-to-value ratio (LTV), or the level of equity in their home. We use current LTV as a measure of borrowing constraint as it incorporates increases in house price as well as any previous payments that the borrower has made on their mortgage. Therefore, we split our sample of *homeowners with a mortgage* into three groups by current LTV: LTV above 80, LTV from 70 to 80, and LTV below 70.[13]

For both Federal Housing Administration (FHA) and conventional loans, mortgage holders can borrow up to 80 percent of their home's value. As such, we would expect to see limited equity extraction (and zero MPC out of housing wealth) for the group of homeowners with an LTV above 80 as they are restricted in their access to a HELOC or second lien.[14] Among homeowners with LTVs below 80, those who further have LTVs below 70 have the most home equity to borrow against but also might be the least credit constrained of these three groups. Therefore, those most likely to spend out of housing wealth might be the middle group of homeowners with LTVs between 70 and 80, as compared to homeowners with LTVs below 70.

The results for this subgroup analysis are shown in Figure 6. As in Finding 2, for these and all subsequent subgroup analyses, we leverage the monthly analysis and control for age, monthly dollar change in income, entry year fixed effects, and monthly fixed effects. We find point estimates for the MPC for all three LTV groups that are less than 1 cent and statistically insignificant—that is, the housing wealth effect MPC is close to 0 for all three groups.

Next, we ask whether households with more credit available in the form of credit cards increased their consumption following an increase in housing wealth. It may be the case that households do not access home equity because of the frictions associated with obtaining a HELOC or second lien and do not spend out of savings because they want to maintain a certain cash buffer. Of course, revolving credit card balances typically have higher interest rates than HELOCs or mortgages, which may deter households from using this channel of liquidity unless thought necessary.

To answer this question, we find those in the *homeowners with a mortgage* sample who also have a Chase credit card and separate the sample into two groups: those with above-median credit available on their credit cards

and those with below-median available credit.[15] Available credit is calculated as the difference between credit limit and revolving balance. Similar to the results thus far in our report, as shown in Figure 7, we find statistically insignificant MPCs, or MPCs of 0, for both groups.[16]

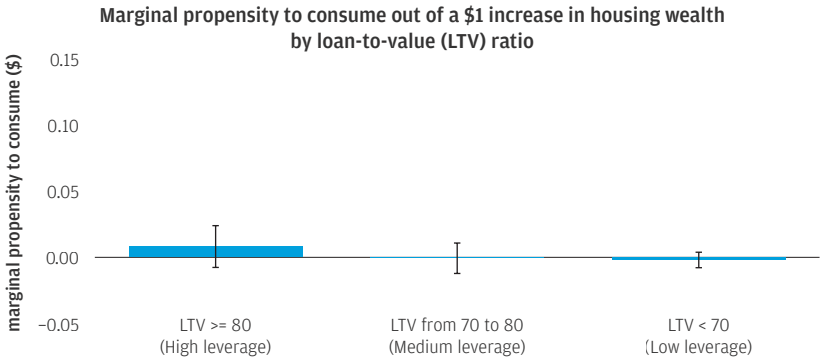
Finally, we ask whether households with more liquid savings increased their consumption following an increase in housing wealth since they have direct access to liquidity that would allow them to spend more. Unlike the previous analyses in which households, to spend more, would need to either borrow through their home or on a credit card (involving frictions such as fees, paperwork, or interest payments), there are no frictions associated with spending out of savings. For this reason, we might expect a higher MPC for those homeowners in our sample with higher levels of savings.

We split our sample of *homeowners with a mortgage* into two groups: those with above-median savings and those with below-median savings.[17] We measure savings as the average total balance of checking and savings accounts.[18] As shown in Figure 8, we find MPCs of near zero, for both the above- and below-median savings groups.[19]

All in all, these subgroups show that even households with greater access to liquidity through home equity, credit card borrowing, or savings on hand did not increase their consumption as their housing wealth rose during the post-financial crisis time period. Our analysis implies that homeowners did not increase consumption more in places where house prices went up a lot than in places where house prices went up a little. We do not see a spending response even among those who had the liquidity—through either credit or savings on hand—to increase consumption. Put simply, those who had greater ability to spend out of housing wealth chose not to do so.[20]

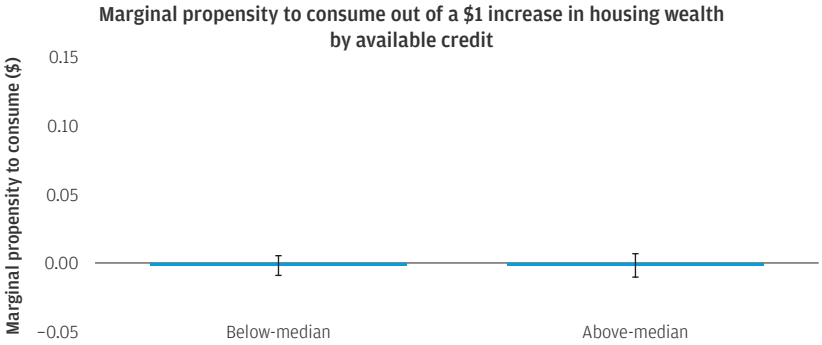
These results support our suggestion that, relative to prior periods, decreased demand for borrowing could potentially help explain the lower housing wealth effect MPC we observe. In the next section, we discuss ways in which lower demand for, and supply of, credit may have contributed to the lower housing wealth effect.

Figure 6. The marginal propensity to consume out of increasing housing wealth for 2012 to 2018 is near zero even for homeowners with more home equity (a lower loan-to-value ratio).



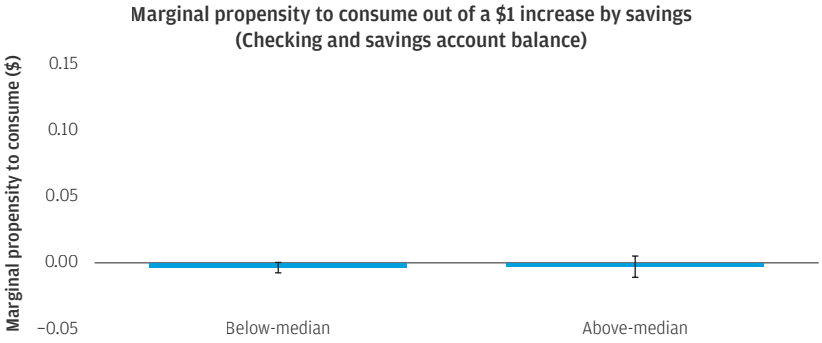
Source: JPMorgan Chase Institute

Figure 7. The marginal propensity to consume out of increasing housing wealth for 2012 to 2018 is near zero, regardless of available credit on a homeowner's credit card.



Source: JPMorgan Chase Institute

Figure 8. The marginal propensity to consume out of increasing housing wealth for 2012 to 2018 is near zero, regardless of a homeowner's available savings.



Source: JPMorgan Chase Institute

Discussion and Implications

Home equity ownership and withdrawal after the Great Recession

While housing wealth more than recovered nationally after the Great Recession, equity extraction levels remained relatively low.

In the findings above, we provide evidence that the MPC out of increasing housing wealth was near zero after the Great Recession, in each year we examine, and even for those subgroups with the greatest access to liquidity. This is a departure from estimates for the periods prior to the Great Recession. For estimates during the housing boom period, however, Mian and Sufi (2014) find that "[t]he entire effect of housing wealth on spending is through borrowing." We consider this and turn to external data on equity withdrawal for the post-crisis period. These data show that while the amount of home equity owned by U.S. households has increased to levels that match pre-Great Recession highs, the volume of home equity extracted has remained relatively low. That is, while it is likely that those homeowners who successfully liquidate their home equity increase their consumption, the number of homeowners who do so was much smaller than during the housing boom.

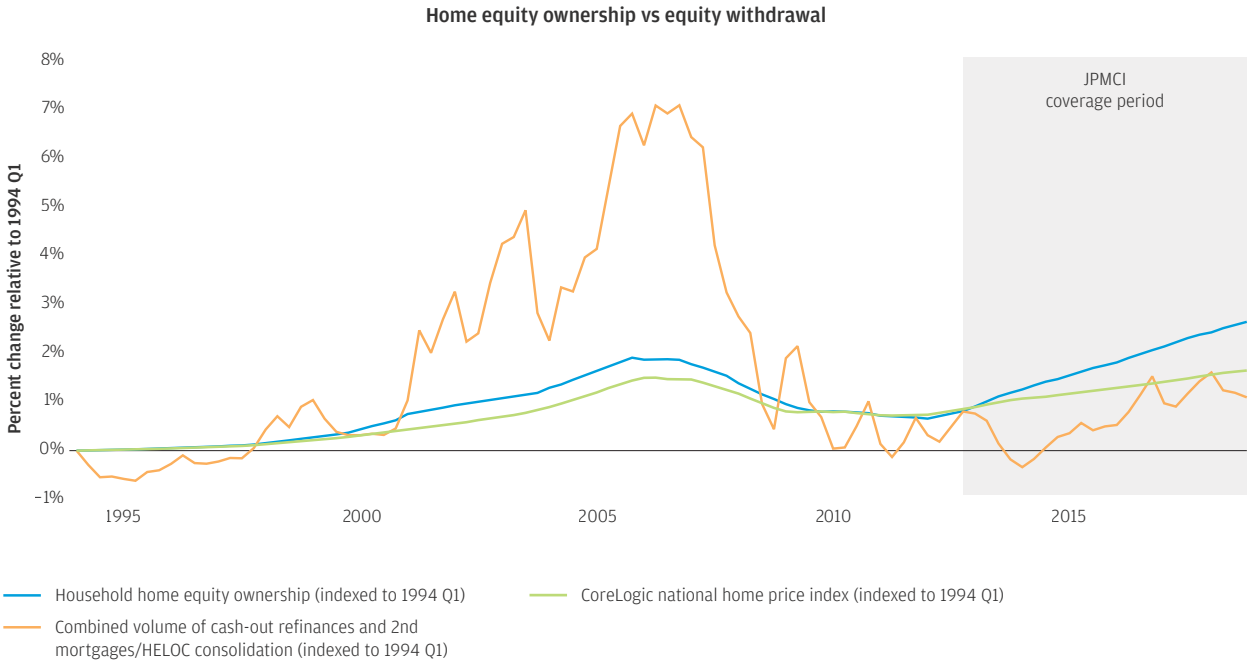
In Figure 9, we examine the relationship between home equity ownership, home prices, and the volume of home equity extraction seen in the post-Great Recession period. The first variable, as demonstrated by the blue line in Figure 9, is household ownership of equity in real estate from the Federal Reserve's Flow of Fund Household and Nonprofit Balance Sheet. From the mid-1990s to the mid-2000's—the height of the housing boom—home equity trended up slowly at first and then more quickly beginning in the early 2000's, driven by appreciation in home prices. Home equity nationally reached a local maximum in 2006 Q3 before declining rapidly, starting in 2006 Q4, as home prices fell.

From 2012 Q1 to 2018 Q4 when home equity had increased 120 percent, Freddie Mac's estimate of equity withdrawal had increased only 59 percent, from $14.6 billion to $23.3 billion.

Similar to home prices, home equity, represented in Figure 9 by the yellow line, reached a bottom in 2012 Q1 and then started climbing again as home prices increased. From 2012 Q1 to 2018 Q4, home equity increased from $8.2 trillion to $18.1 trillion, an increase of 120 percent, much more than the roughly 50 percent increase in home prices over the same period. Furthermore, the 2018 Q4 level of $18.1 trillion far exceeds the previous high of $14.3 trillion in 2006 Q3, reached prior to the housing market crash.

Trends in equity extraction, the orange line in Figure 9, help us understand why growth in home equity outpaced home price appreciation after the financial crisis. The orange line reflects the combined volume of cash-out refinances and second liens or HELOC consolidations, as reported by Freddie Mac.[21] Similar to home equity ownership, the volume of equity extraction increased steadily as house prices rose from the mid-1990's to the mid-2000's, reaching a peak in 2006 Q4 before declining rapidly from 2007 Q1 to 2008 Q4. After 2008, the volume of equity extraction then fluctuated at low levels before starting to increase in late 2014. From 2012 Q1 to 2018 Q4 when home equity had increased 120 percent, Freddie Mac's estimate of equity withdrawal had increased only 59 percent, from $14.6 billion to $23.3 billion. In contrast, during the housing boom, equity extraction reached a high of $89.9 billion in 2006 Q4.

Figure 9. While home equity more than recovered nationally after the Great Recession, equity extraction levels remained relatively low.



Source: Federal Reserve Flow of Funds (accessed via FRED); Freddie Mac Quarterly Refinance Statistics; CoreLogic (accessed via Haver Analytics)

Taken together, Figure 9 shows that before the Great Recession, when home prices rose and home equity increased, homeowners extracted much of that equity in increasing quantities. However, after the Great Recession, while home prices increased and home equity surpassed even pre-recession highs, the volume of equity withdrawal did not increase at the same pace.[22] This potentially helps explain why, as described in Finding 2, even in the most recent years within our timeframe (2017 and 2018) we still see a near-zero MPC. It is likely that those homeowners who do extract equity also increase their consumption in response (Beraja et al. 2018) but the number of those homeowners who extract equity is too low to result in a significant housing wealth effect MPC.

Naturally, the next question to ask is why equity extraction remained so low in the years during the housing market recovery while home equity built up. One might presume that a steady rise in house prices would have spurred a rise in consumption but it did not. Why not? Was a lack of supply, demand, or both responsible?

To date, the literature has suggested that there are both supply and demand factors at play (Fuster et al. 2017). Credit supply factors during the recovery likely contributed to a low equity extraction in recent years in part due to stricter mortgage underwriting standards implemented after the financial crisis, such as the Ability-to-Repay and Qualified Mortgage (ATR/QM) Rule. These rules sought to protect both lenders and borrowers from riskier loans and likely led to a smaller market of borrowers considered creditworthy at a time when credit was already tight.[23] As another example, underwriting standards have tightened even more for HELOCs than for primary mortgages, where the average FICO score for home equity borrowers has exceeded that for mortgages which was not the case prior to the Great Recession.

On the demand side, a larger share of home equity ownership now lies with older and higher-credit score homeowners, who generally have less demand for equity withdrawal than younger and lower-credit score homeowners who have greater demand for equity withdrawal but are encountering less available credit supply.[24] However, Fuster et al. (2017) estimates that the shift in home equity ownership to borrowers with lower demand for credit only accounts for one-third of the aggregate decline in equity extraction.

We contribute new evidence that a lack of demand to borrow against home equity contributed to a low marginal propensity to consume out of housing wealth.

The heterogeneity analysis in Finding 3 shows clear evidence of a lack of demand. Even homeowners with more equity (for whom it should be easier to borrow) do not consume more when housing wealth rises. If those who can borrow easily when house prices go up do not do so, this further confirms that a key reason for a low housing wealth MPC is a lack of demand to borrow.

Why do homeowners have less demand for borrowing against their home equity? We offer three possible explanations. First, borrowers may have changed their preferences regarding housing debt. Perhaps mortgage holders have less confidence in the housing market in the years since the housing market boom, after loose borrowing behavior led many Americans to experience default and foreclosure. Borrowers may have internalized this experience and become more reluctant to borrow against their homes.

Second, the extended period of lower interest rates since the Great Recession could make refinancing worthwhile for fewer borrowers because the interest rate differential is not significant enough to lower monthly payment substantially. To the extent that the decision to cash-out refinance is driven first by a desire to take advantage of lower mortgage rates and a lower monthly payment rather than a desire to extract equity, this would result in fewer cash-out refinances.

Third, upstream supply side factors—changes in underwriting standards and credit availability for mortgages after the financial crisis—may have resulted in a stronger selection effect whereby the current typical homeowner is older, more creditworthy, and has a lower marginal propensity to consume out of housing wealth than the typical homeowner prior to the Great Recession. Lower income, more credit-constrained homeowners who drove much of the equity extraction activity before the Great Recession now have less home equity to borrow against because fewer hold mortgages. This underscores the point that efforts to make homeownership and housing wealth more accessible to those who have a larger marginal propensity to consume could increase the housing wealth effect. Such efforts might take the form of increased investment, lending, and refinancing in more distressed communities.

Implications

Using loan-level mortgage data linked to deposit account and credit card data, we examine the housing wealth effect in the post-Great Recession period. We find that the marginal propensity to consume out of increasing housing wealth was lower between 2012 and 2018 than for prior periods and is close to zero. We find this to be true for all of the years in our data and even for the subgroups of homeowners with greatest access to liquidity to facilitate increased consumption. A possible contributor to this lower MPC is that the volume of equity withdrawal in the post-Great Recession period is much lower than levels seen during the prior housing boom. These findings have important implications for policymakers and financial institutions, particularly in light of the COVID-19 pandemic and its unprecedented economic impacts.

Homeowners entered the COVID-19 crisis with a substantial amount of illiquid wealth, which, if liquidated, could be helpful for maintaining consumption levels in the event of income disruptions.

A silver lining to the low demand for home equity borrowing in recent years alongside growth in home prices is that homeowners have been building a form of illiquid savings—their home. In fact, the median LTV among mortgage holders nationally decreased from 71 percent in 2011 to 59 percent in 2018.[25] How can families use this to fuel consumption during and after the COVID-19 crisis if they experience financial distress?

Our results here and in prior research underscore that cash flow dynamics and liquidity are potentially more important determinants of consumption than equity or wealth. Here, we show that in the recent economic expansion, homeowners increased consumption very little as their home values appreciated. In contrast, our prior research finds that homeowners with adjustable-rate mortgages (ARMs) increase their consumption considerably in response to interest rate resets that result in lower monthly payments (Farrell et al. 2017). Similarly, we have shown that household spending is closely tied to income fluctuations, such as job loss and the arrival of the tax refund, particularly for families with fewer liquid assets (Farrell et al. 2016; Farrell et al. 2018).

Therefore, solutions that allow homeowners to turn home equity into liquidity could provide an important financial cushion to sustain consumption should they experience an income drop. As such, with deteriorating economic conditions,

demand for equity extraction might increase. Often, however, supply also decreases during these times as businesses naturally grapple with increased credit risk. In an economic downturn, households experience other sources of financial stress, such as increased income volatility or job loss, making it more difficult for borrowers to meet their debt obligations. Also, home prices are likely to drop in a recession and this would erode some of the home equity that homeowners have built. A simultaneous increase in equity extraction and home price depreciation could potentially put some homeowners in danger of being underwater on their mortgages (owing more on their mortgage than their home is worth). Though, it is important to note that it is unlikely this recession will cause home prices to drop as much as they did in the Great Recession, as the crisis did not originate in the housing sector and, with a median LTV of 59 percent, homeowners have a large cushion of home equity before they would be underwater. Also, even if some homeowners did end up with negative equity in their homes, recent research shows little evidence of strategic default among underwater homeowners during the Great Recession (Ganong and Noel 2020).

With these competing forces, policies that enable homeowners to preserve and increase liquidity, such as accessing illiquid wealth in their home, while also taking into account increased credit risk could help with both maintaining consumption levels and staying current on mortgage payments (as we suggest in previous research, Trading Equity for Liquidity). As an example, in the context of an economic downturn, forbearance policies in connection with COVID-19 that allow borrowers to postpone mortgage payments for up to twelve months without impacts to their credit score could help families build up a liquid cash buffer to prevent future mortgage delinquencies and maintain current consumption levels. In terms of accessing home equity, which can be accomplished via a cash-out refinance or second lien, cash-out refinancing may be the preferred route to the extent this allows homeowners to simultaneously take advantage of lower interest rates on their first lien.

Solutions that allow homeowners to turn home equity into liquidity could provide an important financial cushion should they experience an income drop.

A near zero housing wealth effect diminishes the ability of conventional monetary policy to boost consumption through the housing market, creating a need for other measures to stabilize the economy.

Conventional monetary policy uses short-term interest rates as a lever to affect the real economy through many channels, some of which flow through the housing market. For example, central banks can reduce short-term interest rates with the hopes that mortgage rates also decline to stimulate purchases of homes, incentivize homeowners to refinance their mortgages, and reduce mortgage payments for homeowners with adjustable rate mortgages (ARMs). In turn, these effects are thought to impact household consumption.

However, there are frictions in the housing market that weaken the power of these transmission channels to impact consumption. Very few mortgage holders benefit automatically from lower interest rates because the share of mortgage holders with an ARM is very low.[26] This means that most borrowers have to originate a new loan—by purchasing, refinancing, or extracting equity from their home—in order to take advantage of lower interest rates.

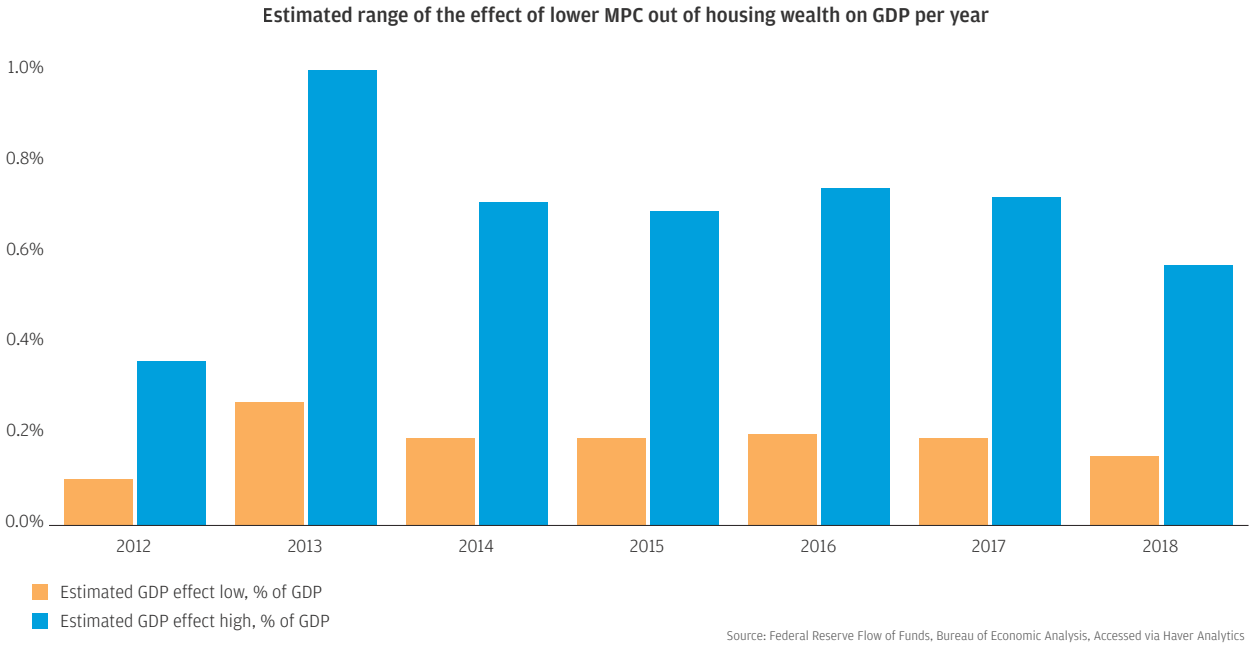
It is not always the case, however, that homeowners refinance their mortgage when interest rates drop or borrow against home equity as home values appreciate. Our results in Finding 3 suggest that even homeowners who could have extracted home equity did not. Additionally, households who refinance when interest rates drop may be less credit-constrained and have a lower marginal propensity to consume (Mian and Sufi 2014).

Supply side factors can also dilute the impact of conventional monetary policy on consumption. Cuts to the federal funds rate do not directly translate into lower mortgage rates, especially as short-term rates approach zero. Refinancing and new loans involve paperwork, fees, and underwriting criteria, which may have prevented homeowners from extracting home equity even as housing wealth increased.

A near zero MPC has macroeconomic implications. In Figure 11, we produce a back-of-the-envelope estimate of the impact on consumption and GDP were the marginal propensity to consume out of housing wealth to have been in the range observed prior to the Great Recession, when equity extraction was more prevalent. We use the MPC range from the literature estimated for the housing boom period (4 to 9 cents) and our estimated MPC range for the post-Great Recession period (0 to 1.6 cents)

to calculate the smallest and largest difference in MPCs, 2.6 and 9.0 cents, respectively. We apply this difference in MPC to the change in household equity in real estate for 2012 to 2018 to determine how much additional consumption policymakers might have expected had they assumed similar levels of equity extraction observed in the pre-crisis era.[27] We find that consumption would have been 0.1 to 1.5 percent higher and the level of GDP would have been 0.1 to 1 percent higher in each of the given years.

Figure 10. Had the housing wealth effect MPC been the same as it was prior to the Great Recession, GDP would have been higher in each of the years between 2012 and 2018.



Source: Federal Reserve Flow of Funds, Bureau of Economic Analysis, Accessed via Haver Analytics

Looking forward, an important question for macroeconomists and central banks, particularly in light of the recession induced by COVID-19, is which channels of monetary policy are relevant in various contexts. Specifically, will we continue to see a near zero housing wealth effect were house prices to fall as a result of the current pandemic? What policies will be effective in stabilizing consumption?

Our results indicate that long-term illiquid wealth alone does not enable consumption and the housing market as a monetary policy transmission mechanism may be less effective at stabilizing the economy than some might have thought based on estimates of wealth effects for prior periods. Monetary policy may need to lean more heavily on other channels and more unconventional measures. In addition, fiscal measures that directly increase the liquidity of households will also be critical and perhaps more effective in some instances. These could include measures that increase income, such as expanding unemployment insurance or providing direct stimulus payments, or measures to reduce expenses, such as providing forbearance on loans or subsidizing other major household expenses.

Taken together, our results suggest that the ability of conventional monetary policy to affect the economy through the housing market may be diminished relative to prior periods. However, homeowners are in a relatively healthy position with a historically high quantity of untapped home equity. Interventions that more directly target the cash flow picture of borrowers, including by providing opportunity to liquidate some home equity, could help to stabilize borrowers' consumption. The implications above could be relevant for policymakers and financial institutions not only in the U.S. but in other countries with similar housing finance systems.

Data Asset and Methodology

Data Asset

For this report, the JPMorgan Chase Institute assembled a de-identified data asset of Chase customers to measure how a change in housing wealth impacted consumption. In conducting this research, we went to great lengths to ensure the privacy of customer data.

Box 1: JPMC Institute—Public Data Privacy Notice

The JPMorgan Chase Institute utilizes rigorous security protocols to ensure all customer information is kept confidential and secure. Our strict protocols and standards are based on those employed by government agencies and we work with technology, data privacy, and security experts to maintain industry leading standards.

There are several key steps the Institute takes to ensure customer data are safe, secure, and anonymous, including:

- Removing all unique identifiable information—including names, account numbers, addresses, dates of birth, and Social Security Numbers—before the Institute receives the data.
- Putting in place privacy protocols for researchers, including rigorous background checks and strict confidentiality agreements. Researchers are contractually obligated to use the data solely for approved research and may not re-identify any individual represented in the data.
- Disallowing the publication of any information about an individual, consumer, or business. Any data point included in any publication based on the Institute's data may only reflect aggregate information.
- Storing data on secure servers and under strict security procedures such that data cannot be exported outside of JPMorgan Chase's systems. The data are stored on systems that prevent them from being exported to other drivers or sent to outside email addresses.

The Institute prides itself on providing valuable insights to policymakers, businesses, and nonprofit leaders. But these insights do not come at the expense of JPMorgan Chase customer privacy or security.

Constructing our Samples

Sample of Homeowners with a Mortgage

From a universe of over 16 million Chase mortgage customers between 2012 and 2018, we created a sample composed of 1.7 million customers who had both a Chase mortgage product (on a primary, secondary, or investment property) and Chase deposit account at any point between October 2012 and December 2018 and who fulfilled other criteria as described below. Mortgages in this sample were originated between August 1970 and December 2017. Based on the zip code of the property associated with the mortgage product, we dropped homeowners who reside in an MSA for which the Saiz housing elasticity measure is unavailable. We also restricted our sample to only those customer-months where the customer had at least five transactions in their deposit account, in an effort to capture only those customers who use their Chase accounts as their primary checking account.

For this sample of *homeowners with a mortgage*, we observe a number of financial and demographic attributes. From their checking account we observe total checking account outflows. We use this to construct a measure of consumption as checking account outflows excluding transfers to savings or investment accounts. We also observe a broad measure of homeowner income, which includes all checking account inflows. As such, it combines labor and capital income, government support, and transfers from savings or retirement accounts, family members, or friends. Income includes inflows from all channels, including electronic transfers, paper check deposits, cash deposits, etc. From their mortgage account data we observe a range of mortgage attributes (see Table 2), including the LTV and the zip code on the property of their mortgage. Finally we observe demographic attributes of the mortgage holder, such as the age of the primary account holder.

We calculated the monthly change in housing wealth for each homeowner as the dollar change in their home value. We began with the purchase price of the home at origination. For each month between the purchase date and January 2013, we inflated the origination purchase price using CoreLogic HPI, a repeat-sales index that tracks changes in the same home's sale price over time and that follows a zip code / state / national waterfall.[28] For each month between February 2013 and December 2018, we adjusted each home value on a monthly basis using the Zillow Home Value Index (ZHVI). The ZHVI is a time series tracking the monthly median home value in each zip code.[29] While using the ZHVI to adjust home values during our period of observation did create an inconsistency in how house values were adjusted before and after January 2013, we chose to use the ZHVI because it was consistently available at a more granular (zip code) level than the CoreLogic HPI. Importantly, our estimates of the housing wealth effect MPC calculated using CoreLogic HPI to adjust house values between 2013 and 2017 were not materially different from the estimates reported here.

We calculated the monthly and annual change in spending for each homeowner as the dollar change in their checking account outflows.

For the monthly analysis, changes were calculated as the month-over-month dollar change. For the annual analysis, customers were required to be in the sample for the entirety of the year. An alternative approach would have been to keep customers that exist within the sample for just part of the year and to impute their HPI change and consumption response for the remainder of the year. We chose not to take this approach since it would have required accounting for seasonality in home prices and spending. Changes in housing wealth were calculated as the dollar difference in average housing wealth levels in a given year from year-to-year. Similarly, changes in consumption were calculated as the dollar difference in average consumption in a given year from the prior year.

Sample of All Homeowners

Since the previous sample of homeowners were required to have a mortgage, we conducted a robustness check using a second sample of *all homeowners*, which includes homeowners who own their homes outright.

From a universe of over 52 million Chase credit card customers, we created a sample composed of over 5 million customers who had a Chase credit card and Chase deposit accounts between October 2012 and December 2018 and fulfilled the other criteria described below. We restricted this sample to homeowners by including only those customers who either (1) indicated on their credit card application that they had no rent payments or had no mortgage balance or (2) had a Chase mortgage. Overall, using this method, we found that roughly two-thirds of Chase credit card customers were homeowners using our method, which lined up well with national homeownership data. However, it could be the case that even though the overall homeownership rate in our data lines up well with external benchmarks, we are still categorizing some renters as homeowners and some homeowners as renters because of measurement error in the credit card application form or the data in the application form has become outdated over time. For this reason, we leave the results of the analysis on the sample as a robustness check rather than reporting them in our findings.

Table 2. Summary statistics for the *homeowners with a mortgage* and *all homeowners* samples

	Homeowners with a Mortgage		All Homeowners	
Variable	**Mean**	**Median**	**Mean**	**Median**
Age	54	54	43	41
Checking Account Outflows	7,015	4,722	5,536	3,548
Total Checking Inflows	9,785	6,012	7,658	4,678
Origination Housing to Income Ratio	0.25	0.24		
Origination LTV	0.65	0.72		
Origination Monthly Payment	1,059	860		
Origination Total Debt to Income Ratio	0.36	0.36		
Origination interest Rate	0.05	0.05		
Origination Loan Amount	188,485	144,341		
Origination Term Length	321	360		
Origination Property Value	337,840	251,899		
Zillow Weighted HPI	379,125	278,606	385,490	301,044
Saiz Elasticity	1.47	1.10	1.41	1.00
Wharton Regulation Index	0.22	0.27	0.24	0.31
Land Unavailability	0.34	0.38	0.35	0.40
Credit Limit			13,199	8,250
Revolving Balance			1,697	215

Source: JPMorgan Chase Institute

We require the customers in this sample to have deposit accounts so that we can control for income and implement the same core customer requirement we implement for the *homeowners with a mortgage* sample. We also implement the same Saiz elasticity requirement and measure consumption and income the same way for this sample as we did for the previous sample. We calculated the monthly change in housing wealth for each homeowner as the dollar change in the ZHVI for the zip code that matched the zip code on their credit card billing address because we are unable to observe the value of their home.

Unlike the previous sample, for this sample of *all homeowners*, we observe their age, credit card limit, and credit card revolving balance.

Table 2 above shows summary statistics for these two samples. In general, our *homeowners with a mortgage* sample is older and more affluent than our *all homeowners* sample. However, the *all homeowners* sample appears to have more valuable homes—but this could be due to the differences in how we calculate housing wealth between the two samples as described above.

Because we are observing a snapshot of mortgages being serviced during a particular period and the most useful external mortgage data are available by origination year, in Table 3 below, we have summarized our sample according to origination year.

Table 4 compares origination statistics of our homeowners with a mortgage sample for 2013 and 2017 to those from various sources.30 We find this comparison yields similar results for each year, so we only show benchmark comparisons for 2013 and 2017. We find that our homeowners with a mortgage sample had a slightly higher LTV and DTI in 2013. Median term lengths tend to be several months shorter, which could be attributed to alternative housing products also included in the sample, such as home equity lines and loans. The sample also had a more volatile number of refinances, with much higher rates in 2013 and lower rates in 2017. Loan amounts and other origination variables trend closely with external data sources.

Table 3. Number of loans in the *homeowners with a mortgage* sample by origination year

Year	Percent Loans Originated
2017	4.48%
2016	4.35%
2015	4.17%
2014	3.99%
2013	8.03%
2012	9.40%
2011	7.23%
2010	5.88%
2009	4.82%
2008	4.14%
2007	8.60%
2006	8.63%
2005	8.16%
2004	6.27%
2003	6.92%
2002	2.34%
2001	1.06%
Before 2000	0.39%

Source: JPMorgan Chase Institute

Table 4. JPMC data compared to external benchmarks

	Origination Year	JMPCI Homeowners with a Mortgage Sample	JPMC Total Population	Benchmark	Source
Number of Mortgages	2013	165,253	834,915	2,084,409	Fannie Mae
				6,090	NSMO
				17,016,159	HMDA
	2017	92,360	410,330	1,717,065	Fannie Mae
				14,285,496	HMDA
Origination Variables					
Median LTV	2013	0.84	0.71	0.75	Fannie Mae
	2017	0.64	0.80	0.80	Fannie Mae
Median Interest Rate	2013	0.04	0.04	0.04	Fannie Mae
	2017	0.04	0.04	0.04	Fannie Mae
Median Loan Amount	2013	177,851	195,540	195,000	Fannie Mae
				160,000	HDMA
	2017	327,603	297,670	205,000	Fannie Mae
				186,000	HDMA
Median DTI	2013	0.43	0.32	0.33	Fannie Mae
				0.35	NSMO
	2017	0.35	0.33	0.36	Fannie Mae
Median Term (Months)	2013	300	348	360	Fannie Mae
				360	NSMO
	2017	342	360	360	Fannie Mae
% Refis	2013	60.52%	60.01%	40.58%	Fannie Mae
	2017	33.70%	32.43%	57.22%	Fannie Mae
% Jumbo	2013	3.79%	3.79%	3.05%	NSMO
% First-time Homebuyers	2013	18.34%	18.02%	85.78%	Fannie Mae
	2017	19.44%	16.74%	76.27%	Fannie Mae
Borrower Characteristics					
% Female	2013	22%	19%	25%	HMDA
	2017	4%	3%	26%	HMDA
Borrower Age	2013	46	45	50	NSMO
Property Type					
Primary Resident	2013	90%	87%	86%	Fannie Mae
	2017	94%	90%	87%	Fannie Mae
Second Home	2013	2%	4%	5%	Fannie Mae
	2017	2%	4%	5%	Fannie Mae
Investor Property	2013	7%	9%	9%	Fannie Mae
	2017	4%	6%	8%	Fannie Mae

Sources: JPMorgan Chase Institute, Fannie Mae Loan Performance Data, Home Mortgage Disclosure Act data from the Consumer Financial Protection Board (CFPB), and National Survey of Mortgage Originations from the Federal Housing Finance Agency (FHFA).

Geographic Coverage

Our two samples are subject to Chase's footprint in terms of geographic coverage. Overall, both the *homeowners with a mortgage* sample and the *all homeowners* sample include homeowners in 267 MSAs and 50 states plus the District of Columbia. This provides enough variation for us to apply our instrumental variables strategy.

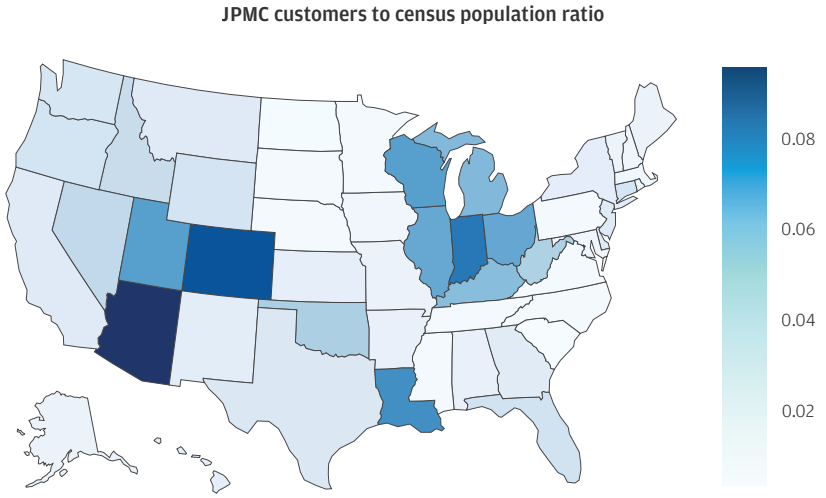
Housing Supply Elasticity Measure

We measure housing supply elasticity using the measure provided in Saiz (2010). This includes two measures related to housing supply elasticity.

The first is the proportion of unavailable land in an MSA due to geographic factors. In MSAs with higher levels of unavailable land, construction is constrained by geographic variation (such as steep slopes or bodies of water) and housing supply is more inelastic (less sensitive to changes in prices). In MSAs where geographic features do not inhibit construction, housing supply is more elastic and rising prices will lead to more new construction.

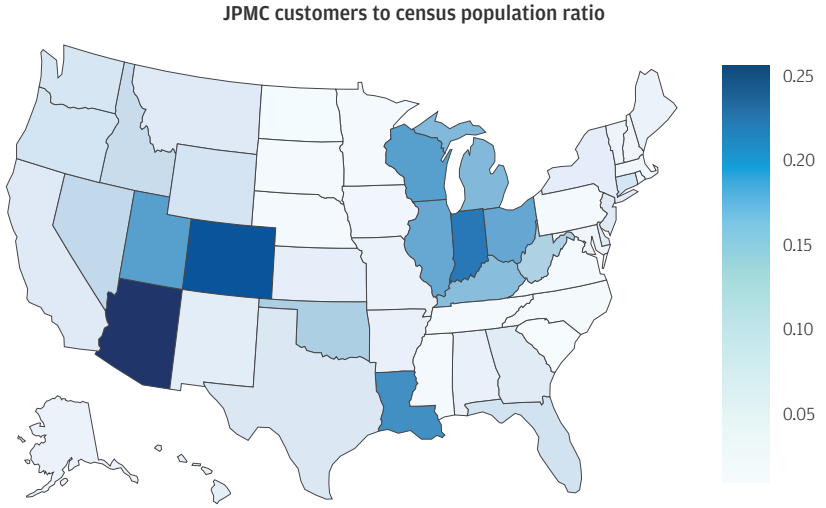
Our second measure of housing supply elasticity is the Wharton Residential Land Use Regulation Index (WRLURI), which captures the degree to which local regulatory environments constrain residential housing development at the MSA level, as developed in Gyourko et al. (2008). In MSAs in which the zoning regulations are more restrictive and/or the cost of acquiring building permits is higher, housing supply is more inelastic. In contrast, in MSAs where the regulatory burden of residential construction is lower, housing supply is more elastic.

Figure 11a. Coverage map for *homeowners with a mortgage* sample



Source: U.S. Census Bureau, JPMorgan Chase Institute

Figure 11b. Coverage map for *all homeowners* sample



Source: U.S. Census Bureau, JPMorgan Chase Institute

Saiz estimates a system of simultaneous equations relating housing price to housing quantity. He instruments for both demand and supply factors and obtains MSA specific measures via non-linear combinations of the MSA specific available data on physical and regulatory constraints. As shown in Figure 3, housing supply elasticities correlate with changes in housing prices.

Methodology

Instrumental variables identification strategy–Saiz elasticity

To measure the impact of a change in housing wealth on consumption, we employ an instrumental variables (IV) approach. Our identification strategy is similar to the approach used in recent academic research to study the link between house values and spending, such as Aladangady (2017), Kaplan et al. (2016), and Mian et al. (2013). That is, we use a measure of housing supply elasticity from Saiz (2010) as an instrument for house prices.

The Saiz elasticity measure is composed of two measures of MSA-level housing supply elasticity: the proportion of land that is unavailable due to natural geographic features and the Wharton Land Use Regulation Index, developed in Gyourko et al. (2008), that quantifies the time and cost of acquiring permits and constructing a new home. When combined, these two measures explain most of the variation in housing supply elasticity at the MSA level, as described in Saiz (2010). As described above, MSAs with a higher housing supply elasticity (fewer geographic features that inhibit construction and less restrictive land use regulations) allow more new construction, and should therefore exhibit less house price variation when house prices are generally rising relative to MSAs with a lower housing supply elasticity. Aladangady (2017) provides a more complete description of the underlying identifying assumption and the criticisms of this approach.

Our specification can be described in the equations below:

In the first stage regression (Equation 1), we measure the relationship between the Saiz elasticity measure at the MSA level and the annual change in house values to generate a predicted change in house values for each MSA. In the second stage (Equation 2), we estimate the impact of predicted house value change on the change in spending.

In both equations, $\mathbf{X}_{i,t}$ refers to a vector of controls which include the homeowner's age, change in take-home income, and fixed effects for entry year and month.

Errors are clustered at the MSA level. Our instrumental variables strategy relies on the normal assumptions about the validity of the instrument associated with this estimation method—that is, the instrument is strong and satisfies the exclusion restriction. It is important to note that the use of the Saiz housing elasticity measure as an instrument for house prices has received criticism (Davidoff 2016). However, given the similarity of our identification strategy to the strategy employed in Aladangady (2017) and others in the literature, we refer the reader to those papers for a more complete discussion of the validity of our identifying assumptions. Note, however, that Aladangady (2017) and Guren et al. (2020) both interacted Saiz elasticity with housing demand measures—in particular, the yield on 10-year U.S. Treasury notes and national home price indices. While those strategies worked for the time periods examined in those papers, they exhibit much less variation during the period of time we are studying, so we did not employ the exact same strategy here.

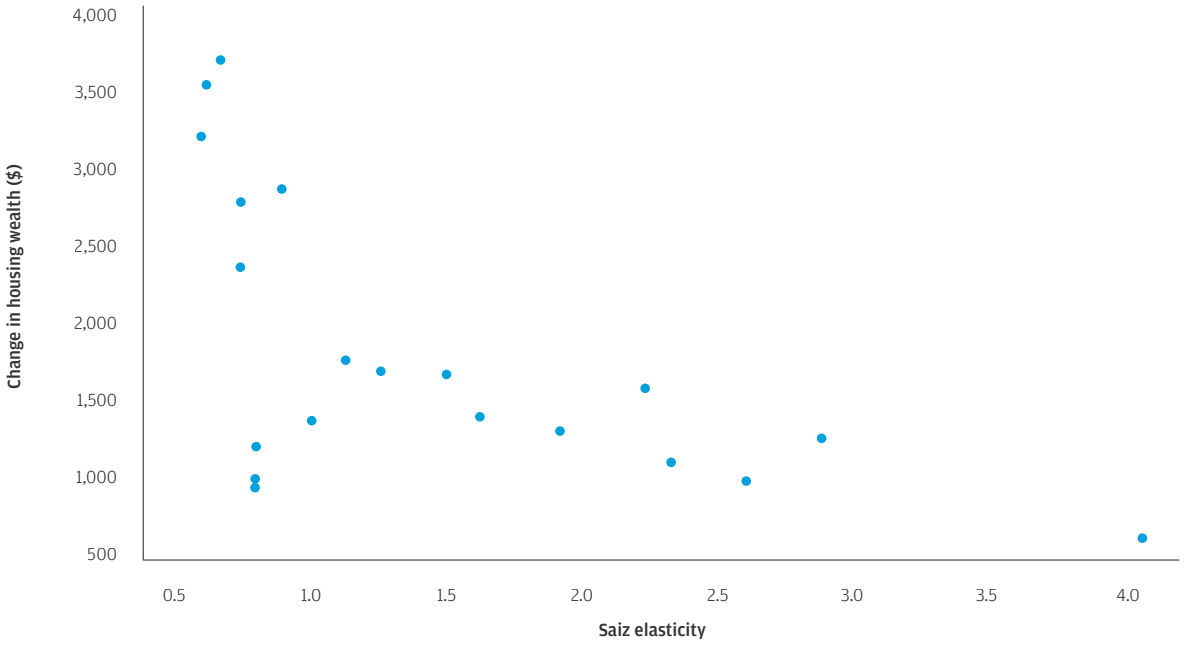
$$(1)\quad \Delta \textit{House Prices}_{i,t} = \beta_0 + \beta_{1,i,t} * \textit{Saiz Elasticity Measure}_i + \beta_2 * X_{i,t} + \varepsilon$$

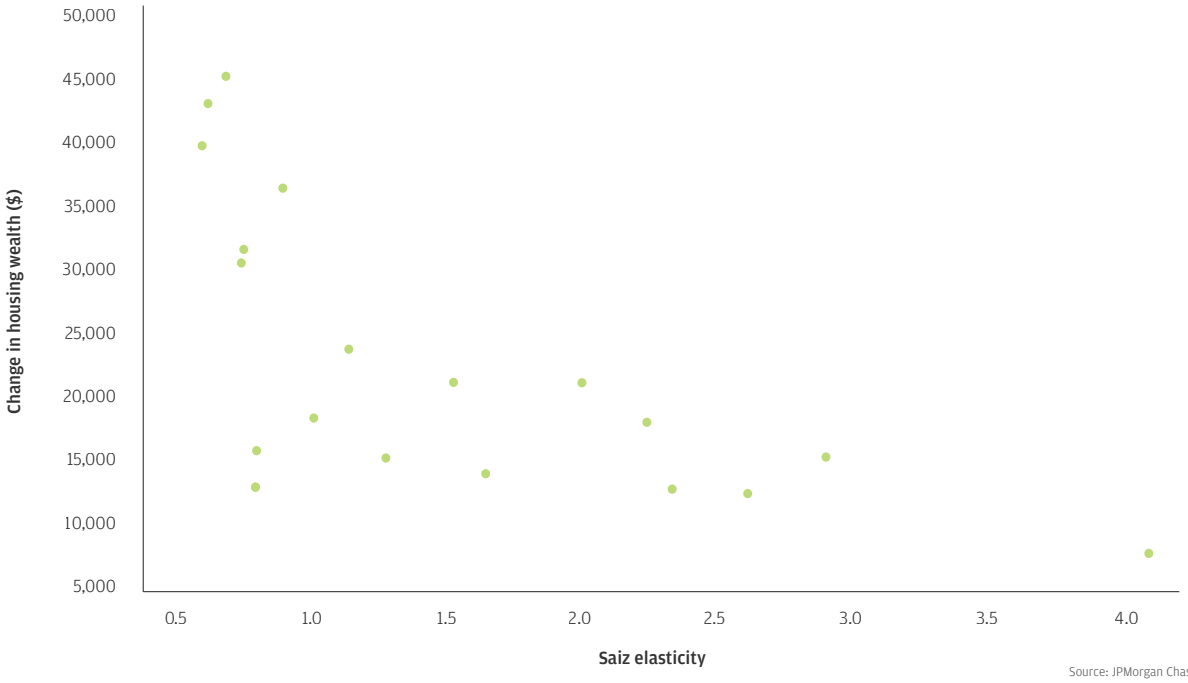
$$(2)\quad \Delta \textit{Spending}_{i,t} = \varsigma_0 + \varsigma_{1,i,t} * \widehat{\Delta \textit{House Prices}_{i,t}} + \varsigma_{2,i,t} * X_{i,t} + \eta$$

Bin scatters for IV regressions

The following Figures 12a through 12c show the bin scatter charts for our main monthly\level specifications for the *homeowners with a mortgage* sample.

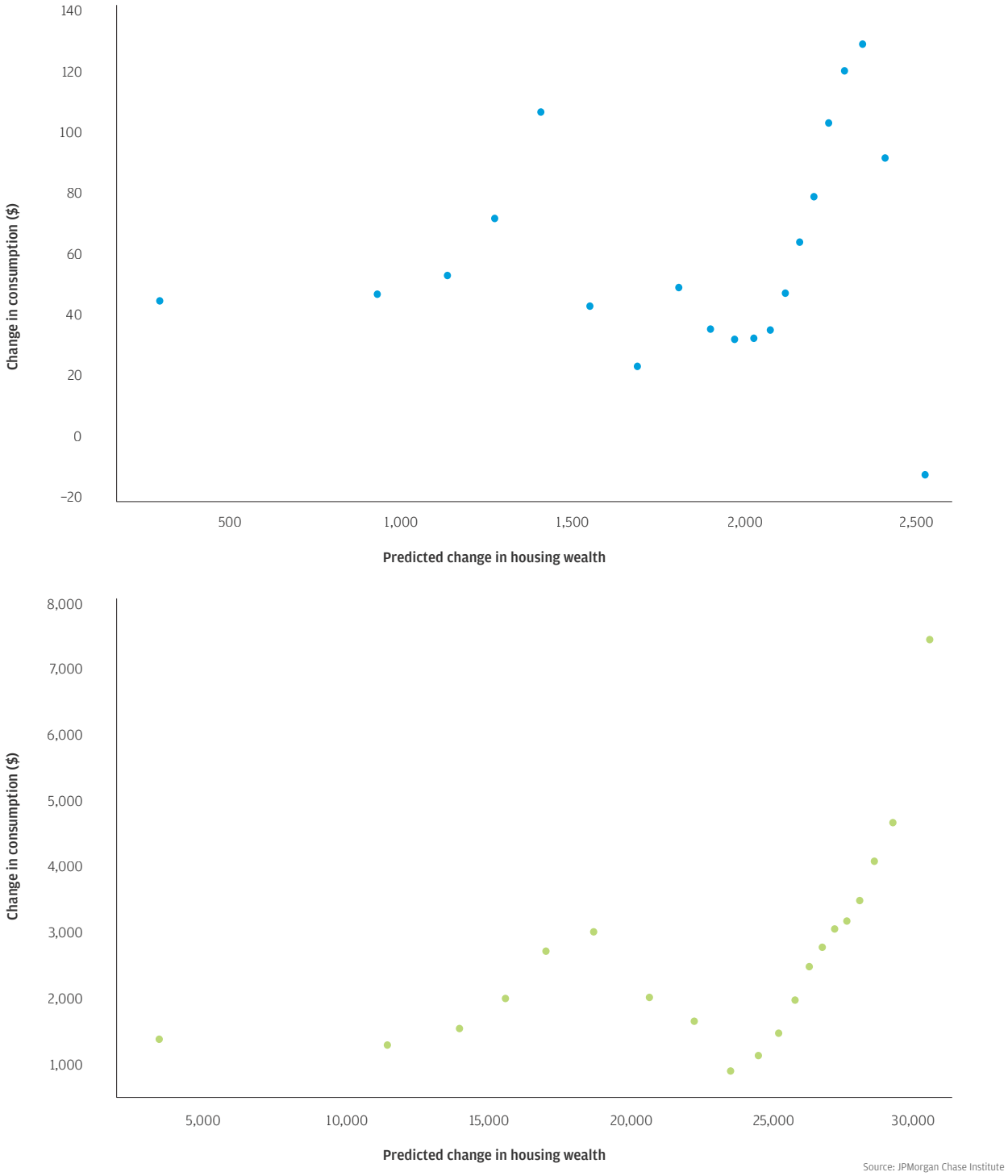
Figure 12a. First stage regression (monthly on top, annual on bottom)





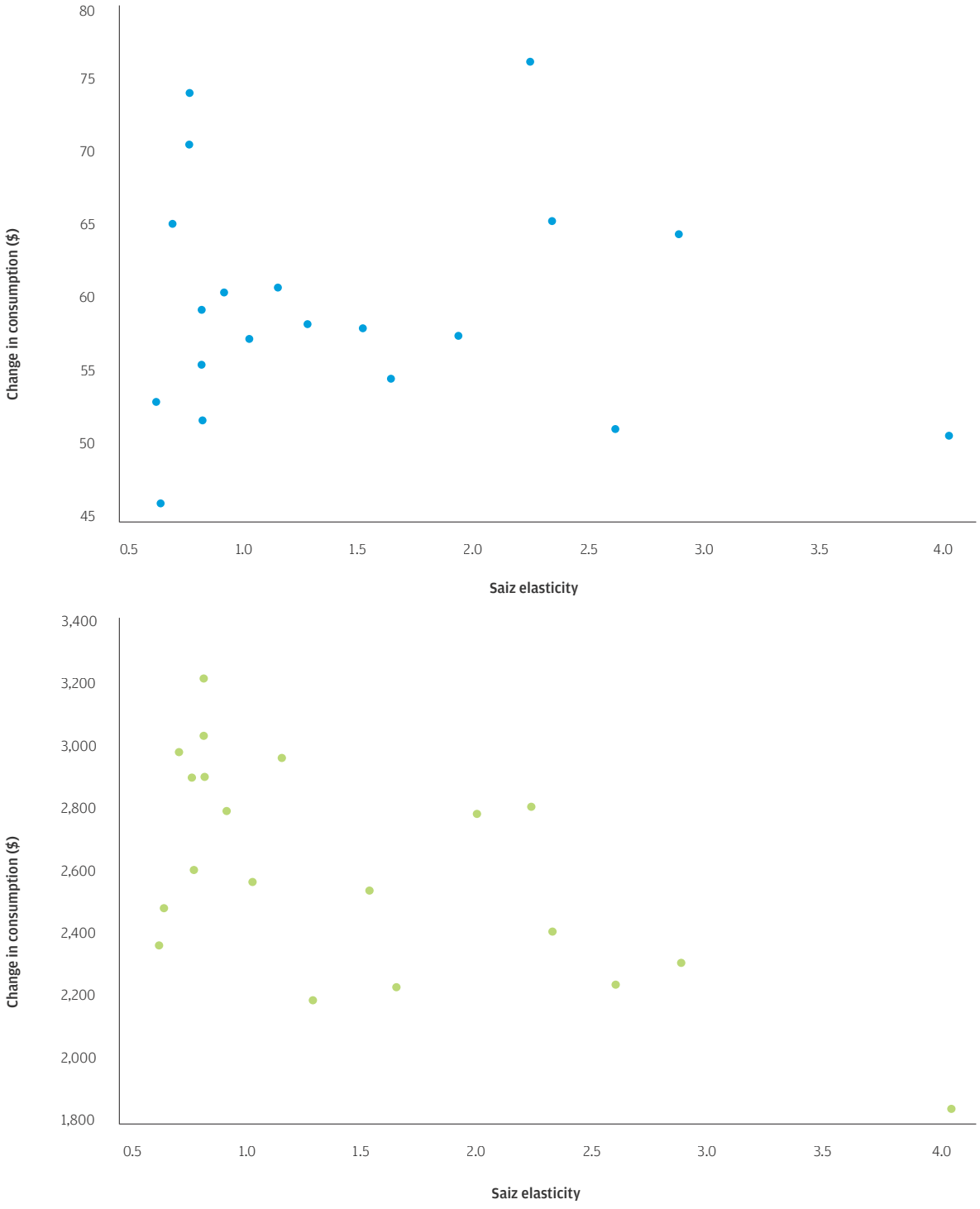
Source: JPMorgan Chase Institute

Figure 12b. Second stage regression (monthly on top, annual on bottom)



Source: JPMorgan Chase Institute

Figure 12c. Reduced form regression (monthly on top, annual on bottom)

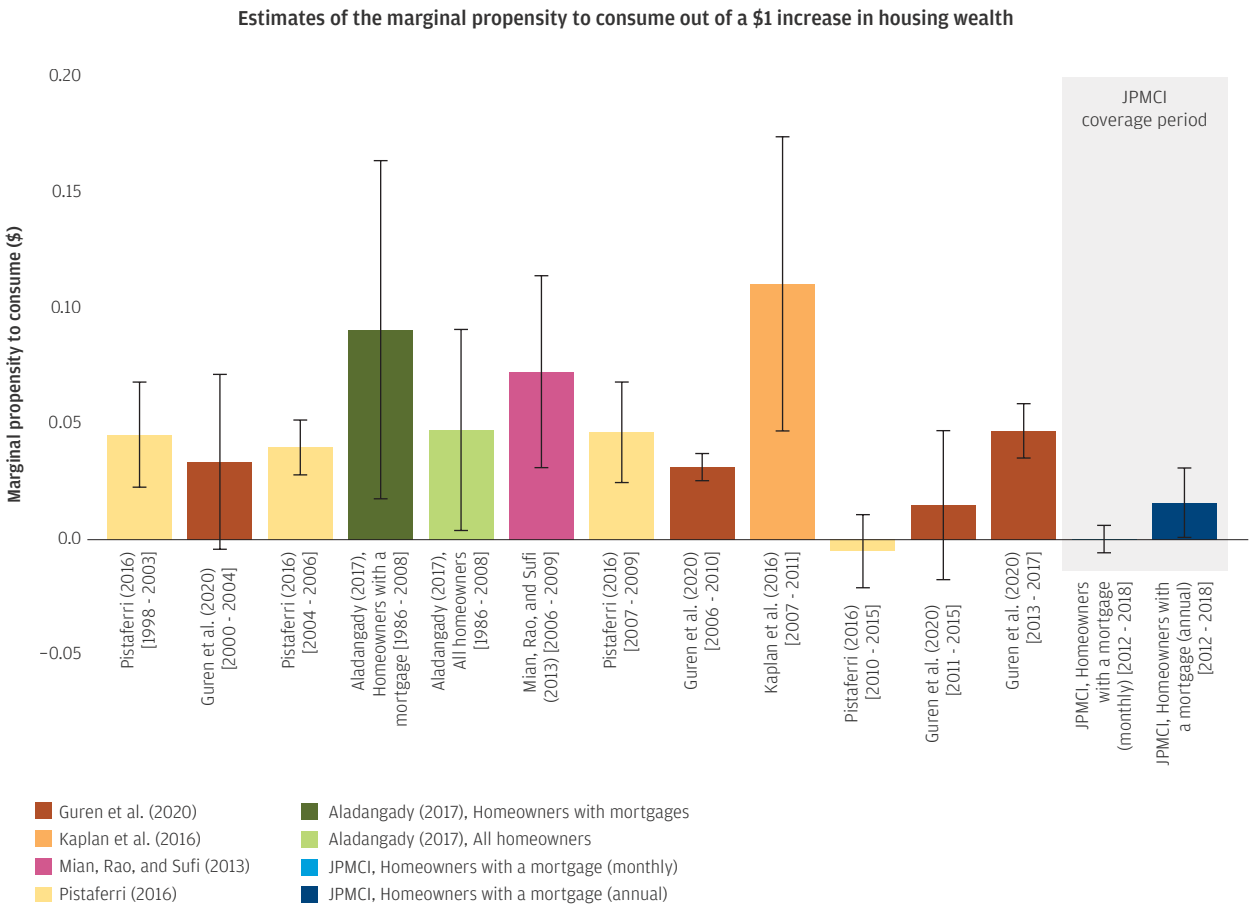


Source: JPMorgan Chase Institute

Comparing our results to other studies

In Figure 4 (Finding 1), we show our results in the context of other studies that also estimate the housing wealth effect MPC in the U.S. Here, we show the same studies and results with confidence intervals included.

Figure 13. Results of our study compared to other similar studies on the marginal propensity to consume out of housing wealth



Source: Aladangady (2017), Pistaferri (2016), Guren et al. (2020), Mian, Rao, and Sufi (2013), Kaplan et al. (2016), JPMorgan Chase Institute

Robustness Checks

We conduct a few robustness checks of our main results as shown in Figure 4. In the first set of robustness checks, we use a different sample of homeowners (the *all homeowners* sample) and run our monthly analysis on this sample.

The *all homeowners* sample includes Chase credit card customers who have a Chase deposit account and who either indicated that they are not renters on their application or have a Chase mortgage (see Data section for full description). We apply a primacy screen to this sample so that we are finding Chase customers who use their Chase credit card as their primary credit card and their Chase deposit account as their primary deposit account. This sample is more comprehensive than the *homeowners with a mortgage* sample used for our main results because this sample includes those who own their home outright, though we have less confidence that they are homeowners. For example, their homeowner status could have changed over time since their credit card application or there could be measurement error if the applicant did not fill the form out correctly. Given these trade offs between the two samples, we conduct our analysis on both and present the results as a robustness check.

Table 5: OLS and IV results for *all homeowners* sample

Outcome Variable:	Change in Spending (Deposit Account Outflows)	Changes in Housing Wealth	Changes in Spending (Deposit account Outflows)
Analysis:	**OLS**	**IV-First Stage**	**IV-Second Stage**
Saiz Elasticity		-11,27.942***	
		338.161	
Housing Wealth Change	0.002***		0.002***
	0.000		0.001
Age	-0.722***	1.371	-0.723***
	0.031	2.567	0.030
Homeowner Income Change	0.283***	0.006***	0.283***
	0.004	0.001	0.004
Entry Year Fixed Effects	x	x	x
Monthly Fixed Effects	x	x	x
Adjusted R-squared	0.044	0.028	0.044
Observations (Household-Months)	94,463,609	94,463,609	94,463,609
Number of Homeowners	5,124,636	5,124,636	5,124,636

Note: The top number is the estimated coefficient and the bottom number is the standard error. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Source: JPMorgan Chase Institute

In the second set of robustness checks, shown in Table 6 below, we present results of an alternative specification using land unavailability as the instrument instead of Saiz elasticity. As described above, land unavailability is one of the two components of Saiz elasticity. We felt that this was plausibly a more exogenous variable than the other component: zoning regulations. These results are quantitatively very similar and qualitatively identical to the main results we present in Figure 4.

Table 6. Instrument: Land Unavailability

Outcome Variable:	Changes in Spending (Deposit Account Outflows)		Changes in Housing Wealth		Changes in Spending (Deposit Account Outflows)	
Analysis:	OLS		IV-First Stage		IV-Second Stage	
Sample:	Homeowners with a Mortgage	Homeowners	Homeowners with a Mortgage	Homeowners	Homeowners with a Mortgage	Homeowners
			Monthly Analysis			
Land Unavailability			2,628.159***	5,258.892***		
			707.600	1,280.998		
Housing Wealth Change	0.004***	0.002***			-0.002	0.001
	0.001	0.000			0.003	0.001
Age	-0.325***	-0.722***	5.574	-0.642	-0.282***	-0.723***
	0.033	0.031	1.953	2.804	0.045	0.030
Homeowner Income Change	0.265***	0.283***	0.001***	1192.211***	0.265***	0.283***
	0.003	0.004	250.010	409.633	0.003	0.004
Entry Year Fixed Effects	x	x	x	x	x	x
Monthly Fixed Effects	x	x	x	x	x	x
Adjusted R-squared	0.044	0.044	0.049	0.034	0.044	0.044
Observations (Household-Months)	70,988,738	94,463,609	70,988,738	94,463,609	70,988,738	94,463,609
Number of Homeowners	1,746,492	5,124,636	1,746,492	5,124,636	1,746,492	5,124,636
			Annual Analysis			
Land Unavailability			32,629.840***			
			8,983.538			
Housing Wealth Change	0.017***				0.010	
	0.003				0.006	
Age	-61.454***		102.306***		-60.574	
	2.570		26.666		2.681	
Homeowner Income Change	0.482***		0.023***		0.482***	
	0.003		0.004		0.003	
Entry Year Fixed Effects	x		x		x	
Adjusted R-squared	0.134		0.084		0.134	
Observations (Household-Months)	2,758,794		2,758,794		2,758,794	
Number of Homeowners	864,969		864,969		864,969	

Note: The top number is the estimated coefficient and the bottom number is the standard error. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Source: JPMorgan Chase Institute

In this second set of robustness checks, we also present results using three-year differences. In the monthly analysis presented in Figure 4, one of the concerns with monthly level data is attenuation bias resulting from noisy monthly-level data. Here we start with the monthly sample, keeping only those observed in the data for at least three years, and look at the three-year change in consumption and housing wealth, which should help to address the concerns around noisy data. We find results that are quantitatively similar and qualitatively identical to our monthly results in Figure 4.

Table 7. 3-Year Results for *Homeowners with a Mortgage* sample

Outcome Variable:	Changes in Spending (Deposit Account Outflows)	Changes in Housing Wealth	Changes in Spending (Deposit Account Outflows)
Analysis:	**OLS**	**IV-First Stage**	**IV-Second Stage**
		3-Year Analysis - Saiz Elasticity	
Saiz Elasticity		18,696.450***	
		5,702.243	
Housing Wealth Change	0.001***		0.002**
	0.000		0.001
Age	-14.930***	211.769***	-15.055***
	0.796	79.445	0.726
Homeowner Income Change	0.402***	0.263***	0.402***
	0.006	0.045	0.006
Entry Year Fixed Effects	x	x	x
Adjusted R-squared	0.085	0.097	0.085
Observations	911,649	911,649	911,649
		3-Year Analysis - Land Unavailability	
Land Unavailability		81,248.460***	
		22,272.530	
Housing Wealth Change	0.001***		0.001
	0.000		0.001
Age	-14.930***	174.286***	-14.919***
	0.796	66.022	0.764
Homeowner Income Change	0.402***	0.274***	0.402***
	0.006	0.046	0.006
Entry Year Fixed Effects	x	x	x
Adjusted R-squared	0.085	0.098	0.085
Observations	911,649	911,649	911,649

Note: The top number is the estimated coefficient and the bottom number is the standard error. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Source: JPMorgan Chase Institute

Renters Analysis

For the credit card sample, we were also able to identify renters as those we did not identify as homeowners—that is, those who did not have a Chase mortgage and indicated that their rent was greater than 0 on their credit card application. Table 8 below shows the results when we run the same monthly analysis as in Figure 4 using both Saiz elasticity and land unavailability as instruments for this sample. Theoretically, it is difficult to predict what the expected housing wealth effect MPC for renters should be since renters do not have houses that appreciate in value but also are short housing since they may be homeowners in the future. Our results indicate that we find a very small MPC for renters.

Table 8. Renters Sample Results

Outcome Variable:	Changes in Spending (Deposit Account Outflows)	Changes in Housing Wealth	Changes in Spending (Deposit Account Outflows)
Analysis:	**OLS**	**IV-First Stage**	**IV-Second Stage**
		Monthly Analysis - Saiz Elasticity	
Saiz Elasticity		-1,499.830***	
		437.731	
Housing Wealth Change	0.003***		0.002***
	0.000		0.001
Age	-0.608***	20.529***	-0.602***
	0.027	6.929	0.037
Homeowner Income Change	0.292***	0.017***	0.292***
	0.004	0.003	0.004
Entry Year Fixed Effects	x	x	x
Monthly Fixed Effects	x	x	x
Adjusted R-Squared	0.071	0.035	0.071
Observations (Household-Months)	17,456,675	17,456,675	17,456,675
Number of Renters	1,392,918	1,392,918	1,392,918
		Monthly Analysis - Land Unavailability	
Land Unavailability		7,040.654***	
		1,589.207	
Housing Wealth Change	0.003***		0.002**
	0.000		0.001
Age	-0.608***	18.620***	-0.592***
	0.027	6.271	0.035
Homeowner Income Change	0.292***	0.017***	0.292***
	0.004	0.003	0.004
Entry Year Fixed Effects	x	x	x
Monthly Fixed Effects	x	x	x
Adjusted R-Squared	0.071	0.045	0.071
Observations (Household-Months)	17,456,675	17,456,675	17,456,675
Number of Renters	1,392,918	1,392,918	1,392,918

Note: The top number is the estimated coefficient and the bottom number is the standard error. *, **, and *** denote statistical significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Source: JPMorgan Chase Institute

Estimating the Effect of Lower Housing Wealth Effect MPC on Consumption and GDP

Table 9 shows the calculation of consumption and GDP data that went into our back-of-the-envelope calculation on the effect of the lower housing wealth effect MPC on consumption and GDP from 2012 to 2018. We use MPC range from the literature estimated for the housing boom period and calculate the smallest and largest difference between those MPCs and our estimated range. We then apply these high and low MPCs to the change in household ownership of real estate equity from the Federal Reserve Flow of Funds data to estimate the highest and lowest additional consumption that would have resulted had the MPC stayed at the levels estimated for the housing boom period. We divide these estimates by actual personal consumption expenditures and GDP for 2012 through 2018 to find the impact on consumption and GDP.

These estimates are a simple back-of-the-envelope calculation that are simply meant to convey the importance of the housing wealth effect as a channel of monetary policy. There are almost certainly general equilibrium effects that we are not taking into account, some of which may offset the impact that we are estimating.

Table 9. Calculating the effect of the lower housing wealth effect MPC on consumption and GDP

	2012	2013	2014	2015	2016	2017	2018
Housing Wealth Effect MPC Difference Low	0.024	0.024	0.024	0.024	0.024	0.024	0.024
Housing Wealth Effect MPC Difference High	0.090	0.090	0.090	0.090	0.090	0.090	0.090
Change in Household Equity in Real Estate, $B	655.51	1,860.05	1,389.22	1,406.74	1,545.23	1,571.58	1,310.04
Estimated Consumption Effect Low, $B	15.73	44.64	33.34	33.76	37.09	37.72	31.44
Estimated Consumption Effect High, $B	59.00	167.40	125.03	126.61	139.07	141.44	117.90
Personal Consumption Expenditures (PCE), $B	11,006.80	11,317.20	11,822.75	12,284.28	12,748.50	13,312.08	13,998.68
Estimated Consumption Effect Low, % of PCE	0.1%	0.4%	0.3%	0.3%	0.3%	0.3%	0.2%
Estimated Consumption Effect High, % of PCE	0.5%	1.5%	1.1%	1.0%	1.1%	1.1%	0.8%
Gross Domestic Product (GDP), $B	16,197.05	16,784.83	17,527.28	18,224.78	18,715.05	19,519.40	20,580.25
Estimated GDP Effect Low, % of GDP	0.1%	0.3%	0.2%	0.2%	0.2%	0.2%	0.2%
Estimated GDP Effect High, % of GDP	0.4%	1.0%	0.7%	0.7%	0.7%	0.7%	0.6%

Source: Federal Reserve Flow of Funds, Bureau of Economic Analysis, Accessed via Haver Analytics

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Endnotes

1 The marginal propensity to consume is the proportion of an increase in income or wealth that a consumer chooses to spend on goods and services rather than save.

2 Our estimates are very much a back-of-the-envelope calculation meant to convey the importance of this channel of monetary policy. We acknowledge that we have not taken into account general equilibrium effects, some of which may offset part of the impact on consumption and GDP.

3 Even though homeowners who have a mortgage would have less equity overall than homeowners who own their homes outright, a dollar increase in housing wealth adds a dollar of equity for both types of homeowners, so we would expect the housing wealth effect MPC to be similar for both the *homeowners with a mortgage* and *all homeowners* samples.

4 Our measure of consumption could include debt payments, as we are unable to disentangle those from other deposit account outflows. We repeat the analysis in Figure 4 with credit card spending as the measure of consumption where we screened for core Chase credit card customers by filtering for those who had at least five transactions per month. We present the deposit account outflows results as our main results because we felt that captured a more complete picture of consumption. However, the credit card spending results, which are less likely to include debt payments, were qualitatively identical.

5 We chose to use the Zillow Home Value Index (ZHVI) because it was consistently available at a more granular (zip code) level than CoreLogic Home Price Index (HPI). Importantly, our estimates of the housing wealth effect calculated using CoreLogic HPI to adjust house values between 2013 and 2017 were not materially different from the estimates reported here.

6 In addition, for example, changes over time in demographics and preferences for housing relative to other consumption may cause these two variables to move in opposite directions.

7 An instrument is an exogenous variable that is correlated with housing wealth changes but that only affects consumption through its effect on housing wealth changes.

8 We require customers to be in the data for the entire year for our analysis at the annual level because missing months are difficult to impute due to seasonality issues.

9 When independent variables are measured with error, estimated coefficients will always be smaller than the true coefficient and thus biased toward zero. This is known as attenuation bias.

10 One potential exception is Guren et al. (2020), which estimates housing wealth effect elasticities for rolling ten- and five-year windows back to the 1980s. They do find some periods prior to the Great Recession with implied MPCs as low as 1.6 cents but also much higher implied MPCs for other periods.

11 Our preferred specification includes controls for age, the dollar change in income, entry year fixed effects (the year that the customer first appears in our data), and monthly fixed effects.

12 As we only had three months of data for 2012 (October to December), we did not include 2012 in this analysis.

13 Specifically, for this subgroup analysis, we divide the person-month observations in our sample into three LTV groups using the following algorithm: For the above 80 LTV subsample, we take all months before the first month that the LTV dips below 80 (this also subsumes cases where LTV goes from above 80 to below 70 in consecutive months). For the 70 to 80 LTV subsample, we consider all months after the first month that the borrower's LTV is below 80 and before the first month that the borrower's LTV goes below 70. For the below 70 subsample, we consider all months after the first month that LTV falls below 70. Additionally, if LTV rises above the 70 threshold after a decline, we group all months before crossing into the below 70 category and all months after crossing into the 70 to 80 category.

14 For example, see https://www.experian.com/blogs/ask-experian/what-is-a-conventional-loan/

15 We screen for Chase core credit card customers by requiring five credit card transactions for each month a homeowner is in the data. The median level of available credit in our sample is $11,900.

16 Since income is likely to be correlated with credit limit, it is likely that some of what we capture by looking for those with more available credit is higher income.

17 The median level of savings is $3,200.

18 Since we are limited in our data to deposit accounts at Chase, we would miss savings in accounts away from Chase. This would likely disproportionately affect homeowners with greater savings.

19 Similar to available credit, savings is likely correlated with income, so some of what we capture by looking for those with more savings is higher income.

20 Our analysis, however, does not enable us to draw conclusions about supply factors. We cannot provide evidence of the importance of supply changes or exclude these factors.

21 According to Freddie Mac, this represents "the total increase in the principal balances of refinanced first-lien mortgages, inclusive of cash-out amounts, the consolidation of existing second mortgages or home equity lines of credit into the first lien, and loan origination costs that are rolled into the principal balances. It is calculated using Freddie Mac's estimate of prime, conventional mortgage originations volume, the refinance of originations, and of the average increase in the principal balance from refinanced loans." These data can be found at http://www.freddiemac.com/news/finance/refi_archives.htm.

22 The analysis above mirrors the findings in Fuster et al. (2017), which uses the Federal Reserve Bank of New York's Consumer Credit Panel to find that during the housing boom, household equity and equity extraction (in the form of cash-out refinances and second liens) rose rapidly together but that during the most recent home price and home equity rally, equity withdrawal has remained muted even as aggregate equity has surpassed the previous peak in 2005.

23 See https://files.consumerfinance.gov/f/documents/cfpb_ability-to-repay-qualified-mortgage_assessment-report.pdf

24 Also, Mian and Sufi (2014) document a higher marginal propensity to borrow for individuals with lower credit scores and individuals with lower incomes.

25 See 2017 American Housing Survey, Mortgage Characteristics table.

26 For example, see https://www.newyorkfed.org/medialibrary/media/research/current_issues/ci16-8.pdf

27 We provide a low and high estimate due to the large range on estimated MPCs. We then divide this expected consumption due to increasing housing wealth by realized published data on personal consumption expenditures (PCE) and GDP for 2012 to 2018.

28 For additional detail on the CoreLogic HPI, see https://www.corelogic.com/products/corelogic-hpi.aspx.

29 For additional detail on the construction of the ZHVI, see https://www.zillow.com/research/zhvi-methodology-6032/.

30 These years cover 12.5 percent of our sample and have more external data to benchmark against.

31 Take-home income is calculated as the sum of all checking account inflows as described in the Data Asset section of this report.

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