Do Family Wealth Shocks Affect Fertility Choices? Evidence from the Housing Market Boom and Bust

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Abstract

While there is a great deal of literature focusing on the relationship between income and fertility, little is known about how wealth affects fertility decisions of the household. This paper fills this gap in the literature by investigating how changes in housing wealth affect fertility. In particular, we use the wealth variation supplied by the recent housing boom and bust to generate exogenous variation in household wealth. We first conduct a state-level aggregate analysis to investigate how the birth rate is related to housing prices using differences in the timing and size of the housing market boom and bust across different states over time. We then conduct an analysis using restricted-use data from the Panel Study of Income Dynamics that allows us to track how women's fertility behavior is related to individual-level housing price growth. The demographic and geographic controls in the PSID allow us to control extensively for any confounding effects driven by household selection across different cities or neighborhoods, and we find that for homeowners, a $10,000 increase in real housing wealth causes a 0.07 percent increase in fertility. We find little effects of MSA-level housing price growth on the fertility of renters, which supports our identification strategy. That increases in housing wealth are strongly associated with increases in fertility is consistent with some recent work showing a positive income effect on births, and our estimates are suggestive that the large recent variation in the housing market could have sizeable demographic effects that are driven by the positive effect of housing wealth on fertility.

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1 Introduction

A long literature in economics dating back to Malthus (1798) has focused on the fertility decisions of households and how these decisions are influenced by financial incentives. Becker (1960) introduced children into economic models as a durable good in the utility function of the parents. Because there are few substitutes for children, they generally are assumed to be normal goods, implying that fertility should respond positively to an increase in household income or wealth.

The empirical evidence to date is largely inconsistent with this assumption. Across countries, there is a strong negative correlation between GDP and fertility. Within countries, there is cross-sectional evidence of a negative correlation between income and fertility across households (see Jones, Schoonbroodt and Tertilt (2008)). For example, in the United States, Jones and Tertilt (2008) estimate an income elasticity for fertility of about -0.38 using data from the U.S. Census over the last century and a half. Time series data yield similar findings; household income has increased while fertility has decreased. A large number of papers also link the higher incomes that came with the industrial revolution to the demographic transition of industrial countries (recent examples include Clark (2005), Galor (2005), and Bar and Leukhina (forthcoming)).

Becker (1960) assumed that children were normal goods, but then had to reconcile this assumption with the observed negative correlation between income and fertility. He added child quality to his model, which created a quantity-quality trade-off, to generate the negative relationship between income and fertility.[1] Other authors point to the importance of female time-use in the decision to have a child. Butz and Ward (1979), Schultz (1985), and Heckman and Walker (1990) all find evidence that fertility is decreasing in female wage rates and argue that the negative correlation between income and fertility is a substitution effect due to higher wages. However, even controlling for female wages, the negative correlation between income

[1] Jones, Schoonbroodt and Tertilt (2008) show that adding a quality choice by itself does not generate a negative income-fertility relationship without also assuming a high elasticity of substitution between children and consumption.

and fertility generally remains.

Most of the evidence documenting the negative income elasticity of fertility employs cross-sectional data across households or locations within the United States. Such data are problematic for identifying the income elasticity of fertility because wages and the cost of living vary systematically with income and both should negatively affect fertility. Higher wages implies a higher value on the time cost of raising a child. Higher cost of living implies a higher cost of goods that are complementary to raising a child. If income growth over time has been met with even larger increases in the cost of living, particularly in urban areas, income elasticity of fertility estimates that fail to account for the rising cost of living will be negatively biased. Furthermore, if women with lower preferences for children sort into areas with a higher cost of living (and thus a higher cost of raising a child), this selection could drive the negative relationship between income and fertility found in cross-sectional data.

Several recent studies have sought to overcome these problem by using arguably exogenous income shocks to identify income effects on fertility. These analyses tend to show that households fertility responds positively to such shocks. Lindo (forthcoming) and Amilachuk (2006) both show that fertility is negatively affected by shocks to family income brought about by job loss. However, these authors face difficulties in disentangling the effect of job loss *per se* on fertility from the effect on family income. Black et al. (2009) find that the 1970s West Virginia coal boom created a large positive shock to male income and subsequently increased fertility. While this evidence is suggestive that fertility and family resources are positively linked, it is restricted to a specific region and time period that make the findings hard to generalize to the rest of the United States.[2]

[2] There also is evidence that fertility responds positively to exogenous changes to the financial incentives of having a child. Baughman and Dickert-Conlin (2003) find some evidence of a positive fertility response to Earned Income Tax Credit (EITC) expansions in the 1990s, primarily for married non-white women. Goda and Mumford (2009) show that the long-run effect of child tax benefits in the U.S. on fertility is small but positive, primarily operating through the timing of births. Internationally, Milligan (2005) finds a large fertility response to a temporary child subsidy program in Quebec, however Parent and Wang (2007) show that women in Quebec may have had children earlier in order to claim the subsidy with no change in their completed fertility. Cohen, Dehejia and Romanov (2007) estimate a strong positive effect of financial incentives on fertility among low-income populations in Israel.

Despite this recent evidence from income shocks that children may indeed be normal goods, no study to date has identified how household fertility responds to the wealth of the household rather than simply the income of the household. Excluding household wealth may be particularly problematic because it can cause one to mis-characterize the financial resources of the household. If household fertility is a function of total resources, using income as a proxy for these resources may yield an incomplete picture of how resources affect fertility. By focusing on household wealth, we also are able to examine the relationship between household resources and fertility using variation that is more plausibly unrelated to the relative tradeoff between home and market production than the wage and employment shocks that have been studied previously.

The lack of information on the fertility response to household wealth variation likely is due to the fact that households make joint labor supply, savings, and fertility decisions that make identifying causal effects very difficult. In this paper, we seek to overcome this identification problem by using the wealth variation supplied by the recent housing boom and bust. We analyze housing wealth for several reasons. First, about 50% of women of child-bearing age in the Panel Study of Income Dynamics, which are the data we use in this analysis, own a home. Second, for these women, and for the United States as a whole, housing wealth represents the vast majority of total household wealth. Indeed, for most households, it is the only form of household wealth. Finally, we are able to use the most recent housing boom and subsequent bust to generate exogenous variation in household wealth in order to identify the causal effect of wealth shocks on fertility decisions. The housing boom, which began in the late 1990s, was characterized by large increases in home prices that occurred differentially across cities and by an increased liquidity of home equity. Homeowners who lived in high growth areas experienced a large increase in their liquid wealth relative to homeowners in other lower-growth areas and relative to renters throughout the United States.

The housing boom and the associated bust provide a unique opportunity to study how wealth fluctuations affect fertility choices. Our empirical strategy is to examine how the likelihood a woman gives birth is influenced by short-run variation in the value of her home. Lovenheim (2009) uses a similar method for identifying the causal effect of housing wealth on college attendance, and it is based on the fact that the geographic variation in the strength and timing of the housing boom was conditionally exogenous to individual household behavior. Because of the large recent busts in the housing market, we are able to include both positive and negative wealth shocks in our analysis; previous studies of the relationship between income and fertility have been restricted to examining only positive or negative shocks, not both.

We employ two types of data to analyze the effect of housing wealth on fertility. First, we examine aggregate state-level vital statistics data on births combined with state home price indices from 1976-2008 and shown that once one controls for state fixed effects, there is evidence of a positive and significant relationship between income and fertility. These results are consistent with a positive wealth shock causing an increase in fertility and are large despite the fact that only about half of women of child-bearing age own homes. Only homeowners experience the positive wealth shock, while both homeowners and renters experience the substitution effect from the increase in housing costs. It is not clear from such aggregate data whether the results are being driven solely by homeowners or whether renters play some role. In addition, the identification is susceptible to the claim of an unobserved correlated shock at the state level that is driving both fertility decisions and home prices (such as unobserved economic shocks).

To more credibly identify the effect of wealth on fertility, we turn to micro panel data to examine how individual women's fertility respond to short-run variation in their home value. We use data from the Panel Study of Income Dynamics from 1990-2007 that allow us to identify homeownership status as well as the city of residence. We use wealth variation over time within cities to examine whether families in higher-growth areas made different fertility decisions than families in lower-growth areas. Similar to the state-level effects, we find that a short-run increase in one's home value is associated with a positive and significant increase in the likelihood of having a child. The marginal effects are small: a $10,000 increase in the value of a home is associated with a 0.07 percent increase in the likelihood of having a child. However, given the large recent variation in housing prices, even such small marginal effects are economically meaningful. Among renters, housing price increases have little effect and even may reduce the likelihood of giving birth, which suggests our estimates are not being driven by unobserved economic shocks at the state or local level.

The remainder of this paper is organized as follows. Section 2 presents the state-level evidence that the fertility rate is positively influenced by an increase in housing prices. Section 3 presents the individual-level evidence that fertility is positively influence by an increase in housing wealth for homeowners. Section 4 concludes.

2 State-Level Evidence

2.1 Data

We construct a quarterly state birthrate measure using data on the number of births per thousand women age 15 to 44 from the CDC National Vital Statistics Reports from 1976 to 2008.[3] We use the unemployment rate and income per capita for each state as our indicators of overall economic conditions, which are obtained from the U.S. Bureau of Labor Statistics. Our state-level housing price measure is the Federal Housing Finance Agency Housing Price Index (HPI).[4] This index is constructed from all repeat-sale single-family homes whose mortgages have been securitized by Fannie Mae or Freddie Mac in each year. This index previously was known as the Office of Federal Housing Enterprise Oversight (OFHEO) index and is widely used in the housing literature. In order to make the index comparable across several years, we scale it by the CPI-U to put it into constant 2008 dollars.

The summary statistics are given in Table 1 for both the 1976-2008 and 2000-2008 time

[3]These data are available at http://www.cdc.gov/nchs/nvss.htm.

[4]These data are available at http://www.fhfa.gov.

periods. The means in Table 1 show that births per 1,000 women has remained largely stable over time at 16.7-16.8. However, consistent with the 2000s housing boom, the level and variation in housing prices both grew over time. For example, between 1976 and 2008, average real home prices grew by 3.9% over each two-year period. Between 2000-2008, real home price increases over two years averaged 9.9%.

The correlation between housing price changes and birth rates over time is shown in Figure 1. This figure plots the births per 1,000 women age 15-44 in the country as the solid line and the dashed line is the percentage change in real housing price. Although on different scales, these data are consistent with there being a negative relationship between housing price variation and fertility. In times of high housing price growth, fertility appears to fall and vice versa. Thus, at least in the aggregate, this figure is suggestive that housing prices negatively affect fertility. However, this figure also shows evidence of a delayed positive fertility response to an increase in real housing price, which is what we examine below empirically.

Figure 2 demonstrates the difficulty with using aggregate cross-sectional measures in attempting to identify the causal effect of income or wealth on fertility. In Panel A, we show further aggregate evidence of a strong negative cross-sectional relationship between home prices and fertility. The panel shows the average birth rate by state between 1976 and 2008 plotted against the average home price index. States with high home prices have lower fertility in the raw data. In Panel B, we show a similar graph, but for births per 1,000 women aged 15-44 and log real per capita income at the state level. A negative correlation similar to the one in panel A is present. Panel C presents a graph of log real income per capita versus our housing price index and demonstrates the difficulty in interpreting the evidence in panels A and B as causal. This panel shows a strong positive relationship between housing prices and income, which means that the places with the highest incomes (and thus the lowest fertility), also have the highest cost of living. Without accounting for the fact that high-income households may have low cost-of-living-adjusted real incomes and that households with different underlying fertility rates can select into areas with different housing prices, cross-sectional estimates of the relationship of income and housing prices on fertility potentially contain large negative biases. The remainder of this paper seeks to generate more rigorous empirical estimates of the causal role of housing wealth on household fertility decisions that are more robust to such criticisms.

2.2 Estimation Strategy and Results

In order to obtain baseline estimates of the relationship between housing prices and fertility, we estimate variations of the following model at the quarterly level from 1976 to 2008

$$\ln(birthrate)_{sqt} = \beta_0 + \beta_1 HPI_{sqt} + \beta_2 unemployment_{sqt} + \beta_3 income_{sqt} + \delta_q + \theta_s + \phi_t + \epsilon_{sqt}, \quad (1)$$

where s indexes state, q indexes quarter and t indexes year. The variable HPI is the home price index discussed in the previous section, and $\ln(birthrate)$ is the log of the birthrate per 1,000 women aged 15-44. The model includes controls for the unemployment rate, real income per capita, as well as state, quarter and year fixed effects. The coefficient of interest in this model is β_1, which shows how variation in home prices is related to birth rates. In order for β_1 to identify the causal effect of home prices on birth rates, home price changes, conditional on the observables in the model, must be uncorrelated with unobserved, secular trends in birth rates. While we believe this is a reasonable assumption given our control variables, particularly because we control for state-level macroeconomic conditions using unemployment rates and per-capita income, below we present models that are identified under less stringent assumptions.

Table 2 reports our estimates from equation (1) using quarterly state-level observations, with Washington D.C. included along with each U.S. state. The regression is estimated using weights that are proportional to the female population, and standard errors are clustered at the state level.

As reported in Column (1) of Table 2, Panel A and consistent with Figure 2, fertility is negatively associated with real housing price controlling for the state unemployment rate, state real income per-capita, and quarter fixed effects. As shown in Column (2), adding year fixed effects does not change this result, although neither estimate is statistically significant at even the 10% level. However, when we include state fixed effects in Column (3), we find positive and significant evidence that higher housing prices lead to higher fertility rates. Because state fixed effects control for the underlying composition of individuals living in the state and control for average cost of living in each state, β_1 in this specification is being identified off of changes within states over time in housing prices. Once one eliminates the cross-sectional variation in housing prices in the sample, a 1 unit increase in the housing price index is associated with a 0.23 percent increase in the birth rate. As Column (4) shows, the estimate is still positive, though not significant, when controlling for year fixed effects as well.

Although we see evidence in Table 2, Panel A that once one includes state fixed effects the effect of housing price levels on fertility is positive, examining the *change* in housing prices within states likely is a better method for identifying the causal effect of housing wealth on fertility because housing prices and housing wealth are potentially very different. This difference arises because one can own an expensive home and have no equity (and vice versa). However, changes in housing prices translate fully into wealth changes for homeowners. In Table 2, Panel B, we show results from estimation of a variant of equation (1) in which we use the lagged two-year percentage change in the housing price index rather than the index level. As suggested by Figure 1, fertility may respond to a change in housing price with a lag. So we define the percentage change in real housing price as:

$$\%\Delta HPI_t = \frac{HPI_{t-8} - HPI_{t-16}}{HPI_{t-16}}, \tag{2}$$

where t is time measured in quarters. Again, each observation is weighted by the size of the female population of the state in that quarter. While the choice of both the two-year lag used to calculate $\%\Delta HPI_t$ is arbitrary, the use of a lag is necessary both to identify housing wealth effects and because the birth of a child will lag the decision to have a child by at least nine months and frequently longer.[5]

Because we are analyzing changes in housing prices rather than the housing price level, we can be less concerned about the negative correlation between states with high housing prices and fertility because here, we are just measuring the percentage change in the home price index. As Lovenheim (2009) shows, home price increases, particularly during the housing boom, were not limited simply to high housing-price states or cities. Rather, many historically lower-price cities and many lower-income individuals in those cities experienced large wealth increases from the housing boom (and therefore a large wealth decline from the bust).

Column (1) of Table 2, Panel B indicates a large fertility response to state-level housing price changes, even absent state fixed effects. When we include state fixed effects in Column (3), the estimate is similar in magnitude to that from Column (1) and is now statistically significantly different from zero at the 5% level. However, when we control for year fixed effects as in Columns (2) and (4), the estimated effect shrinks in magnitude. This result stems from the fact that high housing growth years tend also to be high fertility years in all states (as suggested by Figure 1), not just in the states with high housing growth. Positive economic conditions that are correlated with housing price growth likely are responsible for this effect and are removed through the year fixed effects. Controlling for both year and state fixed effects in Column (4) yields an estimate of 0.0360, which is statistically different from zero at the 10 percent level. This estimate suggests a 10 percent increase in housing prices corresponds to a 0.36 percent increase in the fertility rate. A 10 percent increase in real housing price is an approximate $16,000 increase for the mean housing price, which is

[5]Estimating a distributed lag model, where we do not need to choose a specific lag but allow the model to estimate the relevant impact of the lags, results in a long run propensity that is positive, similar in magnitude, and statistically significant.

suggestive of a sizable response of fertility to housing wealth changes. Furthermore, there is evidence this effect is increasing: estimation of equation (1) for years 2000 through 2008 and including state and year fixed effects yield an estimate on the lagged percentage housing price change of 0.0685, which is significantly different from zero at the 5% level. Thus, as housing prices became more volatile during the housing boom and bust, fertility became more responsive to this variation.

One of the drawbacks from using aggregate state-level evidence is that one cannot distinguish between homeowners and renters. Home price changes should have opposite effects on homeowners and renters: a given positive home price shock increases the price of housing for both homeowners and renters, but makes only homeowners wealthier. Thus, the state-level regressions may be understating the income effect of housing price changes on fertility because they average together the home owner and the renter responses, which likely have opposite signs. Furthermore, as previously discussed, the aggregate responses could be driven at least in part by changing selection over time across states or by unobserved state-specific economic shocks that are driving both the fertility behavior and the housing price changes. We next turn to micro data in order to generate estimates of the fertility effect of housing wealth changes that are more robust to these confounding influences.

3 Individual-Level Evidence

3.1 Data

We use restricted-use data from the Panel Study of Income Dynamics (PSID), a longitudinal data set that began with a representative set of households in 1968. Since that time, it has followed these respondents and their descendants continually. The main advantages of the PSID over other available survey data is that the PSID is a long panel that allows us to track changes in the family's home price prior to a child's birth. The data also contain a rich set of individual and family background information that are instrumental in controlling for selection of families with different fertility patterns into cities with different housing growth rates. We use the restricted-use geocode files that allow us to identify the metropolitan statistical area (MSA), or city, in which each woman lives. These geographic identifiers allow us to control in a very detailed manner for such selection.

The PSID sample is comprised of women age 15-44 who are descendants of original PSID members and who therefore are followed continuously regardless of marital status.[6] Using the PSID natality files, which contain a detailed record of all births to sample participants, we construct the variable *birth*, which is a dummy variable equal to 1 if a woman gives birth within a year prior to the survey date. We use the reported market value of the home as our home price measure. This value is reported by the respondent in each survey and thus is consistently measured over time. Lovenheim (2009) shows that these self-reported housing values match up closely with national trends in housing prices, suggesting self-reports contain little systematic bias. Homeownership status is calculated throughout as of the survey year.[7] For renters, the market housing price is the mean housing price in their MSA and survey year from all homeowners in the sample. We also control for women's age categories, women's education attainment levels, real family income, marital status and the number of other children in the home.[8]

Table 3 contains summary statistics of the PSID data we use, separately for homeowners and renters. Predictably, the table shows that renters have higher fertility rates than homeowners, at 6.9% versus 4.9%. Renters also tend to live in areas with higher housing prices, are less likely to be married, are younger and are less educated. The mean home value

[6]Many women appear in the sample because they marry or co-habitate with an original PSID member descendant. If the relationship ends, the woman no longer is in the sample. Thus, we focus on the sample of women whom we can follow continuously over time to avoid sample selection biases driven by divorce and breakups.

[7]A possible objection to measuring homeownership in the survey year is that it is endogenous. When we define homeownership with a two or four-year lag, our results are quantitatively and qualitatively similar. These results are available from the authors upon request.

[8]We cannot determine in our data whether a child living in a home with a woman is that woman's child. We use the number of other children who were not just born as a proxy for the number of children to which a woman has given birth. Given the data, this method is a reasonable one for controlling for the fact that the fertility hazard declines with number of existing children.

among homeowners is about $166,000, but the variance of this variable is large. Similarly, the average home price increase over two years is about $35,000 and over four years is over $60,000, and both measures exhibit a large amount of variation in the data with standard deviations significantly larger than the means. Furthermore, housing price changes are both positive and negative; over two years, over 21% of the changes are negative and over four years 17% are negative. Examining housing price effects on fertility over this time period thus allows us to use both wealth increases and decreases to identify the effects of interest, whereas past work in this area has only been able to examine positive or negative income shocks.

3.2 Estimation Strategy and Results

We estimate linear probability models of the following form for homeowners on the PSID data described in the previous section from 1990-2007:[9]

$$birth_{ist} = \beta_0 + \beta_1 House\_Value_{ist} + \gamma X_{ist} + \theta_s + \phi_t + \eta_{ist}, \quad (3)$$

where i indexes women, s indexes state or MSA (depending on the specification) and t indexes survey year. The vector X is the set of observable characteristics shown in Table 3 as well as the state-by-year average unemployment rate and log real income per capita. The θ_s are state or MSA fixed effects and ϕ_t are year fixed effects. The coefficient of interest in equation (3) is β_1, which shows how the likelihood of having a child in the previous year is associated with home prices.[10] We measure home prices in 3 ways: real home price level,

[9] Given low likelihood of birth in each year, it is not clear a linear model is appropriate. However, marginal effects from a logit model yield very similar results. These estimates are available from the authors upon request, but we report linear probability model coefficients due to their ease of interpretation.

[10] Note that equation (3) will not allow us to disentangle the effects of housing wealth on fertility timing from the effect on total fertility. Using an event study framework surrounding men's job losses, Lindo (2009) shows the job loss first accelerates and then decelerates fertility, with a long-run negative effect. Much of this timing effect likely can be attributed to the fact that fertility increases when the father's opportunity cost of time decreases in the short-run. Because housing wealth changes do not alter the opportunity cost of time, timing effects are unlikely to be substantively large in this analysis. However, even if the whole effect we estimate is a change in the timing of fertility, in the long-run such changes manifest themselves similarly

two-year change in real home prices and four-year change in real home prices.

The identification assumption underlying equation (3) is that housing price changes are conditionally exogenous to the fertility decision. In other words, but for the fact that housing prices increase household wealth, home prices changes and fertility should be uncorrelated conditional on the observables in the model. There are two main threats to this assumption. The first is a positive correlation between housing prices and local macroeconomic conditions. If fertility responds positively to macroeconomic conditions,[11] our housing price change measures simply may be picking up this relationship rather than identifying the effect of housing wealth changes on fertility decisions. To guard against this possibility, we control for the state-average unemployment rate and real income per capita, which are direct measures of state-level macroeconomic conditions. We also estimate a model using state-by-year fixed effects, which will control for all unobservable factors common within state and year. With such fixed effects, β_1 is identified off of housing price growth differences among homeowners within a state and year. While it still is possible for these within state and year differences to be driven by economic shocks, the local dynamics of housing price changes is more likely driven by exogenous factors such as local supply constraints than is the variation within states over time (Gyourko, Mayer and Sinai (2006) and Glaeser, Gyourko and Saks (2005)). Most notably, this method controls for uniform state-year-level economic shocks. The estimates using state-by-year fixed effects (reported in Table A-1 of the Appendix) are very similar to the baseline models discussed below, which is suggestive that macroeconomic shocks are not confounding our estimates.

The second potential threat to identification is selection of households across states, across MSAs within states, or across neighborhoods within MSAs. If women who are planning to have children purchase homes in places that are most likely to experience high housing price growth in the near future, our estimates will be biased upward. In order to address this

in the macroeconomy to a total fertility change.

[11]Note that there is no evidence in the literature that such a relationship exists. In fact, aggregate trends of macroeconomic conditions and fertility would suggest that they are negatively correlated.

problem, we use successively more restrictive housing price growth variation to estimate equation (3). First, we employ state fixed effects, which allow for housing price growth across time within states as well as cross-sectionally across MSAS and neighborhoods within an MSA. We then include MSA fixed effects using the restricted-access geocodes from the PSID. This specification allows for differential growth rates across time within MSAs and across neighborhoods cross-sectionally within an MSA. Finally, we use what Lovenheim (2009) terms "simulated housing price growth." Household i's simulated home price in MSA s at time t conditional on its $t-4$ home price is:

$$\hat{P_{ist}} = P_{is,t-4} * \frac{hpi_{st}}{hpi_{j,t-4}}. \tag{4}$$

This simulated home price forces all growth between $t-4$ and t to be due to MSA-level housing price growth, which we calculate using the MSA-level housing price index described in Section 2. We calculate the simulated housing price growth for two and four years, which are defined as $\hat{P_{ist}} - P_{ist-2}$ and $\hat{P_{ist}} - P_{ist-4}$, respectively. Conditional on MSA fixed effects, these home price growth measures allow for only within-MSA variation in housing price growth rates over time. In this specification, our estimates of β_1 only will be biased upward if household selection patterns change over time across MSAs in such a way that families that are *more* likely to have a child in the near future begin moving disproportionately into MSAs where the housing price growth will be the highest. We believe such selection changes are implausible, and we know of no evidence suggesting that migration patterns changed in this way over the past 15-20 years.

Because home price changes, birth rates, and other demographics likely are highly correlated over time within MSAs, we cluster our standard errors at the MSA-level throughout. For respondents who do not live in an MSA, we create a separate non-MSA cluster for each state. This method allows for arbitrary correlation of the errors within each state for rural respondents and within each MSA for those living in an identifiable city.

Results from estimation of equation 3 are shown in Table 4. Each column of the table presents results from a separate regression, and all estimates include the full set of controls shown in Table 3 as well as state macroeconomic controls. The first three columns show our estimates when state and year fixed effects are included in the model. In the first column, there is a negative and weak association between housing price levels and the likelihood of giving birth. This finding either could be because there is little relationship between housing wealth and fertility or because housing prices are a poor measure of housing wealth. In Columns (2) and (3), respectively, we show the effect of a 2-year and 4-year change in housing values among homeowners on the likelihood of giving birth. In both columns, a \$10,000 change in home prices leads to a 0.0007 percentage point change in the likelihood of having a child in the last year. These estimates are significantly different from zero at the 5% level.

This marginal effect is admittedly small. However, during the housing boom from 1999-2005, the average two-year home price increase among homeowners was \$48,024 and the average four-year home price increase was \$77,911. These increases translate into total increases in the likelihood of having a child among homeowners of 0.34 and 0.55 percent, respectively. Compared to the baseline fertility rate of 5.61 percent during this time period, housing wealth increases in the early 2000s increased fertility by 6.1 percent (=0.34/5.61) for the two-year change and 9.8 percent (=0.55/5.61) for the four-year change. Thus, the recent variation in housing prices has been large enough to generate economically meaningful changes in fertility among homeowners.

As discussed above, the assumption underlying the identification of β_1 in equation (3) is that households with higher underlying fertility rates are not sorting into regions in which housing prices are growing the fastest.[12] In columns (4)-(6) of Table 4, we include MSA fixed effects that control for the systematic differences among households across MSAs within states in underlying fertility rates. Although these fixed effects significantly reduce the

[12] Note that the majority of estimates of the effect of household income on fertility suggest such selection will bias us against finding positive results, because higher income families have fewer children.

housing price change variation, the estimates are virtually identical to those using state fixed effects.

In every column of Table 4, the income coefficient is negative and significant at the 5% level. The magnitudes range from -0.0004 to -0.0006 for a $10,0000 change in family income. While these estimates can be interpreted as indicating a negative effect of family income on fertility, we urge caution in such an interpretation because we lack an instrument to generate exogenous income variation in our sample. These negative coefficients likely are driven by many of the same biases that drive the negative cross-sectional correlation between fertility and income at the aggregate level. We include income in our models as a control variable that provides an important measure of each woman's economic circumstances, but the coefficient on income likely does not identify a causal effect. Importantly, all of our estimates are robust to excluding family income from our models.

Even with MSA fixed effects, it still is possible our housing price growth estimates are biased due to selection of households with different fertility patterns into different neighborhoods with systematically different housing price growth within an MSA. To account for this possibility, we estimate equation (3) using simulated price changes within MSAs. As previously discussed, this method restricts housing price growth to be the same in each year in each MSA. The only variation in simulated price growth is within MSA over time, not across households in an MSA. Table 5 shows the results using these price changes. The estimates are slightly below those in Table 4: a $10,000 increase in home prices in the previous two or four years is associated with a 0.0005 percentage point increase in the likelihood of giving birth. Though these estimates are smaller, they still are statistically different from zero at the 5% level and indicate a sizeable effect of housing wealth on fertility given the large variation in home prices experienced recently in many cities in the United States.

The estimates thus far show positive and significant effects of housing wealth increases on fertility decisions of the household for homeowners. These results are suggestive that children are normal goods and that it is the added wealth from the home price increase that is driving this behavior. One test of whether the effects we are estimating can be attributed to wealth rather than to an MSA-level shock that is correlated both with housing prices and fertility is to estimate our model for renters. For renters, the association between housing price and fertility is likely negative (or at least non-positive). Higher home prices do not provide a wealth increase to renters, but may increase rental prices and cause a substitution effect. We therefore estimate a version of equation (3) using MSA-by-year average home prices for homeowners as the measure of housing price for renters. Analyzing renters' fertility behavior when MSA-level home prices increase also can be viewed as a means to estimate the substitution effect only, where the estimates for homeowners combine both the income and substitution effects.

Table 6 presents the estimates for renters. In column (1), there is a positive but not significant relationship between MSA-level prices and fertility among renters, but when we switch our independent variable to be housing prices changes, the estimates become negative. In no column is the home price estimate statistically significantly different from zero at even the 10% level, but the negative coefficient on home price changes in columns (2) and (3) are suggestive of a small substitution effect. Under the assumption that the renter estimates of the fertility response to a housing price change identify the substitution effect for homeowners as well, these results implies that the income effect for homeowners is up to twice as large, particularly for the two year changes, than Tables 4 and 5 suggest. While these results indicate a potentially large income effect, they should be taken with caution because as Table 3 shows, renters are quite different along several dimensions than homeowners, and the renter estimates are not precisely estimated. However, even without a significant substitution effect, our results using the PSID data among homeowners unequivocally reject a negative relationship between housing wealth and fertility and strongly suggest that those who experience housing wealth increases are more likely to have children.

4 Conclusion

We use the housing market boom and bust to estimate the fertility response to a change in housing wealth using state-level aggregate data as well as individual-level data from the Panel Study of Income Dynamics. We show that at the state-aggregate level, housing prices are negatively correlated with birth rates, but when one includes state fixed effects the effect becomes positive. In particular, there is a strong positive relationship between short-run housing price growth and fertility at the state-level that suggests fertility responds positively to wealth.

In order to delve more deeply into this relationship, we use micro-level data from the Panel Study of Income Dynamics (PSID) that allows us to examine fertility responses to housing price changes separately by homeowner status and to more credibly control for selection. We find a positive and significant effect of both two-year and four-year housing price growth on the likelihood that a woman has a child in the preceding year. Though the marginal effect of a $10,000 increase is small at about 0.0007, we argue this partial effect is large enough to be economically relevant given the large variation in housing prices experienced over the past decade. Furthermore, our estimates are robust to using successively more restrictive housing price growth measures, which suggests that selection of households across MSAs or across areas within MSAs is not driving our results. We also find little evidence of a commensurate fertility response among renters; though our point estimates are negative, they are not statistically significantly different from zero at conventional levels.

Our results are consistent with a small but growing body of literature that calls into question the conventional wisdom that fertility and family resources are negatively linked. Our focus on wealth in general and housing wealth in particular is unique in this literature, and it allows us to generate estimates of the effect of family resources on fertility without using wage shock measures that could affect the relative tradeoff of home versus market work. Given the large and persistent declines in the housing market that have occurred recently in many areas of the country, our results also have increasing policy relevance for potential policies affecting both housing markets and the cost of raising children, including child subsidies.

This paper also contributes to the literature on the effects of housing market fluctuations by demonstrating that fertility choices are among the set of behaviors that are influenced by changes in the housing market. Other work that has shown housing market effects includes Davidoff (2009), who shows that the demand for long-term care insurance is negatively affected by housing wealth. Lovenheim (2009) shows that housing market changes affect college attendance and Lovenheim and Reynolds (2010) present evidence that this variation impacts college choice and graduation likelihood as well. Many authors, including Campbell and Cocco (2007), Case, Quigley and Shiller (2005), Hurst and Stafford (2004), and Lehnert (2003), have found that housing wealth affects consumption.[13] Our results add to this literature by showing that the recent severe declines in the housing market will also have important fertility consequences.

[13] Attanasio et al. (2005) take issue with this interpretation of this literature, however, and argue this relationship is incidental.

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Figure 1: National Birth Rate and Real Housing Price Percent Change, 1976-2008

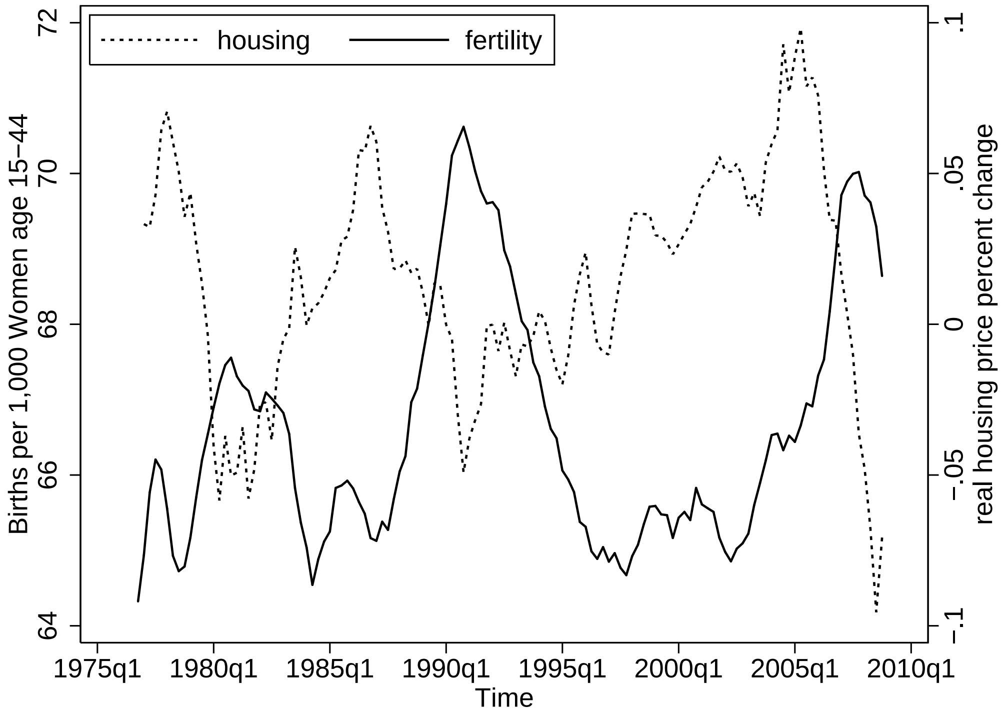

Figure 2: Cross-sectional Relationships Between State Birth Rates, Real Housing Prices and Log Per Capita Income, 1976-2008

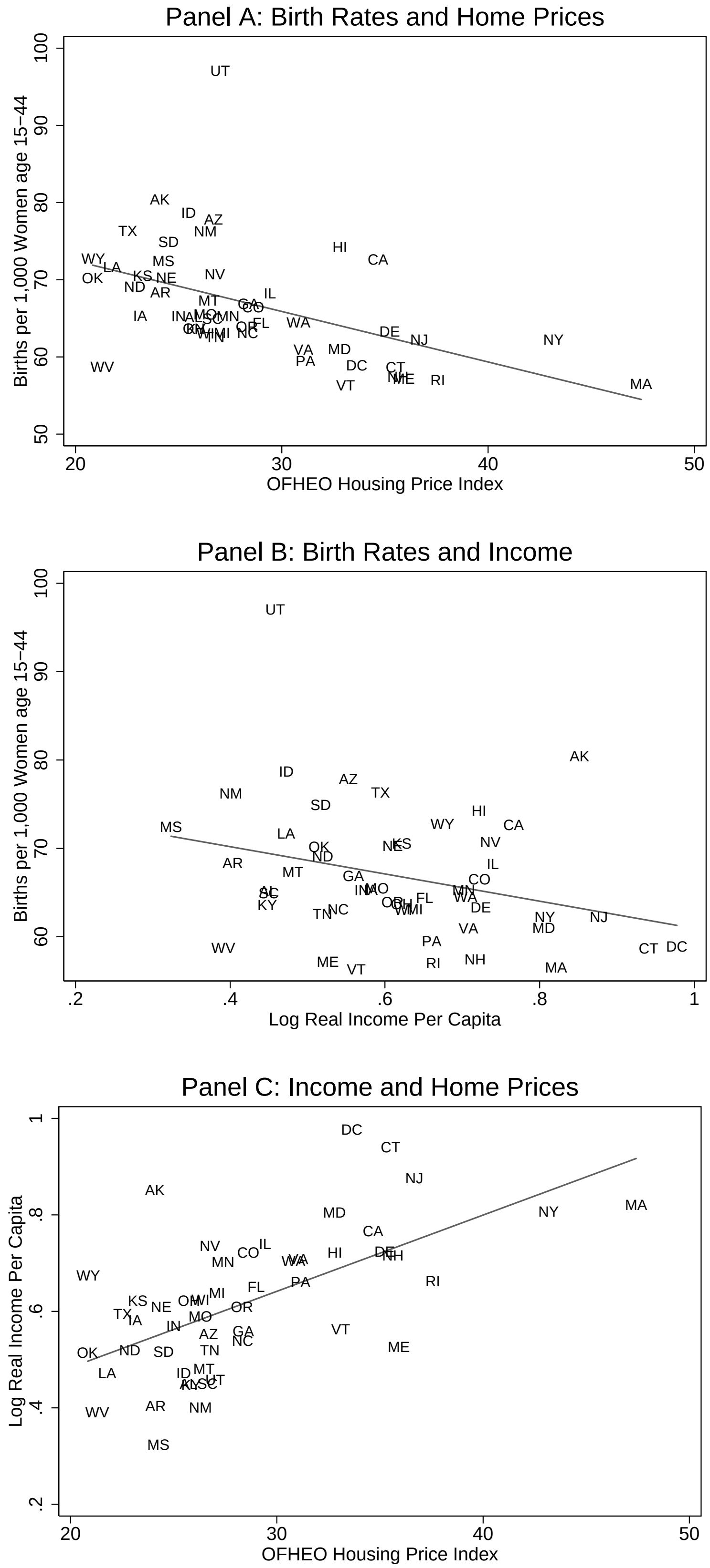

Table 1: State-Level Summary Statistics (weighted by state population)

Panel A: 1976-2008 measured quarterly

Variable	Obs.	Mean	Std. Dev.	Min	Max
birthrate	6732	16.654	1.887	11.085	31.741
housing price index (HPI)	6732	30.483	9.982	11.511	78.494
unemployment rate	6732	6.086	1.892	2.033	18.1
real per capita income	6732	2.281	1.035	0.458	7.027

Panel B: 2000-2008 measured quarterly

Variable	Obs.	Mean	Std. Dev.	Min	Max
birthrate	1836	16.742	1.694	11.661	24.573
housing price index (HPI)	1836	37.441	13.054	18.388	78.494
unemployment rate	1836	5.147	1.107	2.133	9.667
real per capita income	1836	3.470	0.578	2.125	7.027

[1] The birthrate is births per 1,000 women age 15-44, calculated from the CDC National Vital Statistics Report. The HPI is the Federal Housing Finance Agency Housing Price Index (formerly the OFHEO index), which is constructed from all repeat-sales single-family homes whose mortgages have been securitized by Fannie Mae or Freddie Mac in each year. The unemployment rate and real income per capita are calculated from BLS employment and income statistics combined with state-level U.S. Census population estimates.

Table 2: OLS Estimates of the Effect of Housing Prices on Birthrate Using Quarterly Aggregate State-level Measures, 1976-2008

Panel A: Current Home Price

Dependent Variable: Log(Birth Rate)				
Independent Variable	(1)	(2)	(3)	(4)
Housing Price Index (HPI)	-0.0020	-0.0021	0.0023**	0.0006
	(0.0018)	(0.0019)	(0.0006)	(0.0004)
Unemployment Rate	0.0038	0.0052	0.0039**	0.0038*
	(0.0052)	(0.0083)	(0.0008)	(0.0022)
Real Per-capita Income	0.0165*	-0.0130	-0.0025	0.0846**
	(0.0085)	(0.0345)	(0.0043)	(0.0225)
Year Fixed Effects	No	Yes	No	Yes
State Fixed Effects	No	No	Yes	Yes
Observations	6732	6732	6732	6732
R-squared	0.118	0.187	0.746	0.795

Panel B: Lagged Percentage Change in Home Price

Dependent Variable: Log(Birth Rate)				
Independent Variable	(1)	(2)	(3)	(4)
Lagged Percentage Change HPI	0.1077	0.0953	0.1091**	0.0360*
	(0.0747)	(0.0756)	(0.0238)	(0.0185)
Unemployment Rate	0.0073	0.0120	0.0075**	0.0085**
	(0.0055)	(0.0091)	(0.0012)	(0.0025)
Real Per-capita Income	0.0003	-0.0537	0.0055	0.0461**
	(0.0057)	(0.0327)	(0.0048)	(0.0224)
Year Fixed Effects	No	Yes	No	Yes
State Fixed Effects	No	No	Yes	Yes
Observations	6732	6732	6732	6732
R-squared	0.116	0.197	0.765	0.813

[1] Source: Authors' estimation of equation (1) as described in the text. All regressions include quarter of year fixed effects and are weighted by the female population in each state and year.

[2] Standard errors are clustered at the state level and are reported in parentheses: ** indicates significance at the 5% level and * indicates significance at the 10% level.

Table 3: PSID Summary Statistics

Panel A: Homeowners

Variable	Obs.	Mean	Std. Dev.	Min	Max
Birth	36245	0.049	0.216	0	1
Home Value ($10,000)	36245	16.559	15.373	.104	332.274
2-Year Home Value Change ($10,000)	36245	3.493	7.433	-29.765	49.609
4-Year Home Value Change ($10,000)	36245	6.052	10.100	-29.982	145.370
Married	36245	0.597	0.491	0	1
Real Family Income ($10,000)	36245	8.962	8.555	-11.615	348.368
Children	36245	1.468	1.212	0	9
Age 15-19	36245	0.179	0.384	0	1
Age 20-24	36245	0.118	0.323	0	1
Age 25-29	36245	0.128	0.334	0	1
Age 30-34	36245	0.173	0.378	0	1
Age 35-39	36245	0.203	0.403	0	1
Age 40-44	36245	0.199	0.399	0	1
High School Drop Out	36245	0.192	0.394	0	1
High School Diploma	36245	0.323	0.468	0	1
Some College	36245	0.238	0.426	0	1
College Grad	36245	0.165	0.371	0	1
Education Missing	36245	0.082	0.274	0	1

Panel B: Renters

Variable	Obs.	Mean	Std. Dev.	Min	Max
Birth	36162	0.069	0.254	0	1
Market Average Home Price ($10,000)	36162	16.946	8.663	0.819	69.224
2-Year Market Home Value Change ($10,000)	36162	0.809	4.541	-136.809	112.708
4-Year Market Home Value Change ($10,000)	36162	2.153	6.471	-144.120	134.970
Married	36162	0.372	0.403	0	1
Real Family Income ($10,000)	36162	3.972	3.538	-8.652	155.748
Children	36162	1.4883	1.404	0	9
Age 15-19	36162	0.150	0.357	0	1
Age 20-24	36162	0.203	0.402	0	1
Age 25-29	36162	0.207	0.405	0	1
Age 30-34	36162	0.181	0.385	0	1
Age 35-39	36162	0.145	0.352	0	1
Age 40-44	36162	0.114	0.318	0	1
High School Drop Out	36162	0.294	0.456	0	1
High School Diploma	36162	0.343	0.475	0	1
Some College	36162	0.196	0.397	0	1
College Grad	36162	0.083	0.276	0	1
Education Missing	36162	0.084	0.277	0	1

[1] Source: Authors' calculations from the 1980-2007 Panel Study of Income Dynamics as described in the text. Negative income values indicate net losses for the family in that year. All monetary means are in real $2008, and were inflated using the CPI-U.

[2] In Panel A, all home values are self-reported and apply to the homeowner. In Panel B, housing values are averages among homeowners in the sample at the MSA-by-year level. We the calculate means of these average over all renters, which are what is shown in Panel B.

Table 4: Linear Probability Model Estimates of the Effect Housing Prices on Birth Probability for Homeowners

	Dependent Variable: Dummy=1 if Give Birth in the Previous Year					
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)
Home Value ($10,000)	-0.0001*	.	.	-0.0002*	.	.
	(0.0001)	.	.	(0.0001)	.	.
2-Year Home Value Change ($10,000)	.	0.0007**	.	.	0.0006**	.
	.	(0.0002)	.	.	(0.0002)	.
4-Year Home Value Change ($10,000)	.	.	0.0007**	.	.	0.0007**
	.	.	(0.0002)	.	.	(0.0002)
Real Family Income ($10,000)	-0.0004**	-0.0006**	-0.0006**	-0.0004**	-0.0005**	-0.0006**
	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
MSA Fixed Effects?	No	No	No	Yes	Yes	Yes
R^2	0.050	0.050	0.051	0.064	0.064	0.064

[1] Source: Authors' estimation of equation (3) using the 1980-2007 Panel Study of Income Dynamics as described in the text. All estimates include state and year fixed effects, age group dummies (with 15-19 as the excluded category), educational attainment dummies (with no high school diploma as the excluded category), and controls for marital status, the number of other children in the household, state-by-year unemployment rates and state-by-year real income per capita.

[2] Estimates in columns (4)-(6) use only those respondents who live in an identifiable MSA at the time of the interview.

[3] Standard errors clustered at the MSA-level are in parentheses. In columns (1)-(3), respondents not in an MSA are assigned to a non-MSA state-specific cluster. ** indicates significance at the 5% level and * indicates significance at the 10% level.

Table 5: Linear Probability Model Estimates of the Effect Housing Prices on Birth Probability for Homeowners Using Simulated MSA-level Housing Price Changes

Dependent Variable: Dummy=1 if Give Birth in the Previous Year		
Independent Variable	(1)	(2)
2-Year Home Value Change ($10,000)	0.0005**	.
	(0.0002)	.
4-Year Home Value Change ($10,000)	.	0.0005**
	.	(0.0001)
Real Family Income ($10,000)	-0.0005**	-0.0006**
	(0.0002)	(0.0002)
R^2	0.064	0.064

[1] Source: Authors' estimation of equation (3) using the 1980-2007 Panel Study of Income Dynamics and simulated housing price changes as described in the text. All estimates include MSA and year fixed effects, age group dummies (with 15-19 as the excluded category), educational attainment dummies (with no high school diploma as the excluded category), and controls for marital status, the number of other children in the household, state-by-year unemployment rates and state-by-year real income per capita.

[2] The estimation sample includes only those respondents who live in an identifiable MSA at the time of the interview and who own a home.

[3] Standard errors clustered at the MSA-level are in parentheses: ** indicates significance at the 5% level and * indicates significance at the 10% level.

Table 6: Linear Probability Model Estimates of the Effect Housing Prices on Birth Probability for Renters Using MSA-average Home Price Measures Among Homeowners

Dependent Variable: Dummy=1 if Give Birth in the Previous Year			
Independent Variable	(1)	(2)	(3)
Home Value ($10,000)	0.0002	.	.
	(0.0004)	.	.
2-Year Home Value Change ($10,000)	.	-0.0004	.
	.	(0.0004)	.
4-Year Home Value Change ($10,000)	.	.	-0.0001
	.	.	(0.0003)
Real Family Income ($10,000)	-0.0019**	-0.0018**	-0.0014**
	(0.0006)	(0.0006)	(0.0007)
R^2	0.051	0.052	0.056

[1] Source: Authors' estimation of equation (3) using the 1980-2007 Panel Study of Income Dynamics and housing price measures calculated using homeowners within each MSA and year as described in the text. All estimates include MSA and year fixed effects, age group dummies (with 15-19 as the excluded category), educational attainment dummies (with no high school diploma as the excluded category), and controls for marital status, the number of other children in the household, state-by-year unemployment rates and state-by-year real income per capita.

[2] The estimation sample includes only those respondents who live in an identifiable MSA at the time of the interview and who do not own a home.

[3] Standard errors clustered at the MSA-level are in parentheses: ** indicates significance at the 5% level and * indicates significance at the 10% level.

Table A-1: Linear Probability Model Estimates of the Effect Housing Prices on Birth Probability for Homeowners With State-by-year Fixed Effects

Dependent Variable: Dummy=1 if Give Birth in the Previous Year			
Independent Variable	(1)	(2)	(3)
Home Value ($10,000)	-0.0001*	.	.
	(0.0001)	.	.
2-Year Home Value Change ($10,000)	.	0.0007**	.
	.	(0.0002)	.
4-Year Home Value Change ($10,000)	.	.	0.0007**
	.	.	(0.0002)
Real Family Income ($10,000)	-0.0004**	-0.0005**	-0.0006**
	(0.0001)	(0.0001)	(0.0002)
R^2	0.067	0.067	0.068

[1] Source: Authors' estimation of equation (3) using the 1980-2007 Panel Study of Income Dynamics as described in the text. All estimates include state-by-year fixed effects, age group dummies (with 15-19 as the excluded category), educational attainment dummies (with no high school diploma as the excluded category), and controls for marital status, and the number of other children in the household.

[2] Standard errors clustered at the MSA-level are in parentheses. Respondents not in an MSA are assigned to a non-MSA state-specific cluster. ** indicates significance at the 5% level and * indicates significance at the 10% level.