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THE EFFECT OF HOUSING WEALTH ON COLLEGE CHOICE:
EVIDENCE FROM THE HOUSING BOOM

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ABSTRACT

The higher education system in the United States is characterized by a large degree of quality heterogeneity, and there is a growing literature suggesting students attending higher quality universities have better educational and labor market outcomes. In this paper, we use NLSY97 data combined with the difference in the timing and strength of the housing boom across cities to examine how short-run home price growth affects the quality of postsecondary schools chosen by students. Our findings indicate a \$10,000 increase in a family's housing wealth in the four years prior to a student becoming of college-age increases the likelihood she attends a flagship public university relative to a non-flagship public university by 2.0 percent and decreases the relative probability of attending a community college by 1.6 percent. These effects are driven by relatively lower and middle-income families. We show that these changes are due to the effect of housing wealth on where students apply, not on whether they are admitted. We also find that short-run increases in home prices lead to increases in direct quality measures of the institutions students attend. Finally, for the lower-income sample, we find home price increases reduce student labor supply and that each \$10,000 increase in home prices is associated with a 1.8% increase in the likelihood of completing college.

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1 Introduction

The higher education system in the United States is characterized by a large degree of stratification across sectors in both resources and student outcomes. The labor market returns to graduating from an elite public or private institution are high and have grown substantially over time (Brewer, Eide and Ehrenberg, 1999; Black and Smith, 2004, 2006; Hoekstra, 2009; Andrews, Li and Lovenheim, 2011).¹ The higher level of resources at elite public and private institutions also translate into more favorable student outcomes, including higher completion rates (Bound, Lovenheim and Turner, 2010) and lower time to degree (Bound, Lovenheim and Turner, forthcoming). Furthermore, there is considerable evidence that the type of institution in which students initially enter the postsecondary education system affects the likelihood of graduation and future wages.²

Given these large returns to college quality, little work has been done examining how students make decisions about which college to attend and, in particular, what role household finances play in this decision. There is ample evidence that low-income students are under-represented at elite private and state flagship universities (Bowen, Kurzweil and Tobin, 2005; Pallais and Turner, 2006 and 2007). Using the National Longitudinal Survey of Youth (NLSY), previous work has estimated sizable income gradients in the two-year, four-year decision as well as in four-year college quality (Belley and Lochner, 2007; Kinsler and Pavan, 2010)³ and has shown that higher income students attend schools with higher SAT scores (Light and Strayer, 2000). There also is evidence that students are highly responsive to college quality differences among institutions (Long, 2004; Avery and Hoxby, 2004). Though informative of many of the factors that influence college choices, there still is a poor understanding of the causal effect of household resources on the college quality decisions of students.

¹Dale and Krueger (2002) find no return to attending a higher average SAT university overall but show sizeable impacts for students from lower-income families. All of the studies estimating the returns to education quality are subject to identification concerns (Hoxby, 2009), but the identification assumptions across studies vary sufficiently that the sum total of the evidence points strongly to a significant earnings return to college quality.

²For evidence on the negative effect of beginning college at a two-year school, see Reynolds (2009), Kurlaender and Long (2009), and Rouse (1995). Bound, Lovenheim and Turner (2010) also show that even conditional on institutional resources, BA completion rates are much lower at community colleges and less selective four-year public schools than at elite public and private institutions. Light and Strayer (2000) show similar negative effects on the likelihood of graduating from attending schools lower in the SAT score distribution, although they additionally highlight the importance of “match quality” between the quality of the school and the academic preparation of the student.

³In contrast to Belley and Lochner (2007), Lovenheim and Reynolds (2011) show less evidence of income gradients in the two-year, four-year margin in the NLSY97. Much of this difference can be attributed to the different models used and the decision to include or exclude high school graduates from the analysis.

This paper examines how household resources influence the quality of postsecondary schools in which students enroll, focusing specifically on the role of housing wealth because of the central importance of this form of wealth to the majority of families. For most American families, the home is the largest single asset, and for many households it is their only substantial asset. For example, in the 2004 Survey of Consumer Finances, 48% of homeowners had less than \$10,000 in non-housing assets. Among homeowners with AGI less than \$75,000, the median non-housing wealth amount was \$6,300. Median home equity among these households was \$80,000. In contrast, for households with AGI over \$125,000, median non-housing wealth was \$146,600 and median home equity was \$293,500. Thus, for the lower and middle class, housing wealth is an extremely important component of total resources. An additional reason to focus on housing wealth is that there has been substantial variation in home prices in recent years that we argue generates exogenous variation in household finances.

We use a virtually identical source of variation in home prices as Lovenheim (2011) and Lovenheim and Mumford (forthcoming), which exploits differences across cities over time in the size and timing of the housing boom to identify how housing wealth influences postsecondary choices. Lovenheim (2011) shows that students who came of college age in areas that experienced recent large home price increases are more likely to go to college, while Lovenheim and Mumford show that female homeowners who experience home price growth are more likely to have a child. Although both of these papers exploit the same source of home price variation as used in this analysis, we make several contributions to the existing literature. First, we focus on identifying the impact of housing wealth on the quality of schools students attend (i.e., the intensive margin) rather than on the extensive margin. We estimate the effect of housing wealth on the likelihood a student attends a flagship public university, a private university or a two-year college, all relative to the likelihood of enrolling in a non-flagship public university. This is the first paper to explicitly estimate how family resources affect students' choices between all of the different types of schools available to them, rather than focusing only on the two-year, four-year margin or on the extensive margin of college enrollment. Second, both Lovenheim (2011) and Lovenheim and Mumford (forthcoming) use the Panel Study of Income Dynamics (PSID). While the PSID has detailed housing wealth data, it does not contain rich information

on college enrollment timing or on pre-collegiate academic ability. The current analysis uses the NLSY97, which allows us to examine how sensitive the results in Lovenheim (2011) are to the inclusion of student ability measures as well as to the use of another sample. Third, our use of the NLSY97 allows us to dig more deeply into the ways in which housing wealth influences postsecondary choices and student outcomes. We estimate the effect of home price variation on student application decisions, the delay between high school and college, BA receipt and student labor supply while enrolled in college. These outcomes provide a more complete picture of how wealth in general and housing wealth in particular affect students' paths through the postsecondary system.

Finally, the majority of previous work examining college choices and family resources estimates conditional income gradients (e.g., Kinsler and Pavan, 2010). Instead, we use quasi-experimental variation in home prices generated by the most recent housing boom to identify the effect of household wealth on college choice. Our approach allows one to assess the validity of the assumption made in the income gradient literature that income is conditionally exogenous. Furthermore, how housing wealth variation influences the intensive margin of college choice is of high policy interest in its own right given the evidence suggesting large labor market and educational returns to attending different types of colleges combined with the large fluctuations in home prices in the United States over the past decade. The decision of where to go to college may be at least as important for future labor market outcomes as is the decision of whether to attend college,⁴ so identifying how family resources in general and housing wealth in particular affect college choices on the intensive margin is of central importance.

We quantify the effect of individual-level home price growth that is driven by MSA-level home price changes on college choice using restricted-use NLSY97 data that provide detailed information on post-secondary institutions attended and the Metropolitan Statistical Area (MSA) in which the student's family lived in 1997 as well as AFQT scores and student demographic characteristics. We estimate multinomial logit models among homeowners of the likelihood of attending a flagship state university, a private university or a community college, with non-flagship public four-year schools as the omitted category, as a function of home price growth in

⁴For example, both Hoekstra (2009) and Brewer, Eide and Ehrenberg (1999) find earnings returns from attending more elite public universities on the order of 25%. Kane and Rouse (1995) also show substantial earnings penalties of attending a community college relative to a four-year school.

the four years prior to a student turning 18. We also control for a detailed set of student background characteristics that include AFQT scores and state fixed effects. Our empirical strategy is to compare the college choices of students within states or cities who come of college age in different years and thus who experience housing price increases of varying magnitudes when they are in high school. The main identifying assumptions are that housing price changes at the state or MSA level as well as initial home price and homeownership status are conditionally exogenous. We present detailed evidence that our results are robust to these assumptions.

We find that home price variation affects college quality. A \$10,000 increase in home prices in the four years prior to turning 18 increases the relative probability of attending a public flagship by 0.0019 percentage points, or 2.0 percent, and decreases the probability of attending a community college by 0.0059 percentage points, or 1.6 percent. We split our sample into three income groups and find that the effect of short-run housing wealth changes on enrollment decisions is largest for students from lower and middle-class households earning less than \$75,000 per year. Similar to Lovenheim (2011), we also find that home price changes affect the extensive margin of college enrollment, and we show these results are robust to including controls for pre-collegiate academic ability.

The changes in college sector choices we find suggest that students are reacting to home price changes by altering application and enrollment decisions. Using application data, we show that home price changes lead to increases in the total number of applications and to applications to both flagship and non-flagship four-year schools. However, conditional on applying, there is no strong relationship between home price changes and admission, which suggests that the college sector effects we estimate are coming from changes in student behavior, not from changes in institutional admissions decisions.

The effect of home price changes on selection across sectors leads to increases in observable institutional quality and resources for affected students. These effects also are largest for families with household income below \$75,000 per year. Finally, we present evidence that short-run housing price growth in the time period prior to children being of college age is positively associated with the likelihood of obtaining a BA for the lowest-income households in our sample, increasing BA attainment rates by 1.8% for each \$10,000 increase in home prices

during high school. We also find student labor supply is negatively affected by home family price growth, which together with the school quality effect likely drives the BA result.

The sum total of the evidence presented in this paper indicates that the quality of colleges students attend is affected by short-run variation in families' housing wealth. This finding has important implications given the collapse of the housing market in many areas and the severe reduction in home price growth in others. To the extent decisions about where to attend influence the likelihood of graduation, which both we and previous literature present evidence they do, the burst of the housing bubble could have long-run consequences for the national stock of college-educated labor.

2 Data

2.1 NLSY97 Data

The data we use for this analysis come from the restricted-access National Longitudinal Survey of Youth 1997 (NLSY97), which is a nationally-representative survey of children age 12 through 18 in 1997. Respondents are interviewed initially in 1997 and then yearly thereafter until 2008, which is the most recent follow-up available.

The NLSY97 data contain detailed family background and student demographic information, including parental education levels, family income in 1997, and home value. For mother's and father's education, we include dummy variables indicating highest level of schooling completed: no high school diploma, high school diploma (or GED), some college, and BA or more. One of the major advantages of the NLSY97 is that respondents were given the Armed Forces Qualifying Test (AFQT) in 1997, which is a comprehensive test of cognitive skills. Together with controls for parental education and income, these test scores allow us to control for the ability level of students, which is correlated with college choices and potentially with housing price growth.

The NLSY97 data include a significant amount of item non-response. For example, 10.8% of the sample do not have a valid father's education level, approximately 16.6% of the sample is missing family income information and 23% of respondents do not have valid AFQT scores. Many previous analyses drop respondents without valid income and AFQT scores (e.g., Belley

and Lochner, 2007; Cameron and Taber, 2004; Carneiro and Heckman, 2002). However, if such information is not missing at random conditional on the observables in the model, dropping these observations can bias the estimates. Thus, we use the multiple imputation by chained equation (MICE) method developed by Van Buuren, Boshuizen, and Knook (1999).⁵ The credibility of multiple imputation with the NLSY97 is enhanced by the large volume of observable characteristics with which to impute missing values. In addition to all of the covariates used in our empirical analysis, we use MSA-level means of all covariates, college type attended, high school GPA, the PIAT math exam scores and household income when students are 17. Another value of multiple imputation is that no respondents are dropped due to item non-response, which yields a larger sample size for our analysis. Estimates that drop those with missing income and AFQT scores are similar and are available upon request.

We further limit our sample to those who are under 18 in 1997 and who attend college within two years of high school graduation.⁶ In the NLSY97, 8.7% of respondents who attend college do so more than 2 years post-high school graduation. The reason we condition on attending college within two years of high school graduation is so we can more directly link home price changes while respondents are in high school to their subsequent college choices. Given the small number of students who delay attendance beyond two years, this restriction has little effect on our results and conclusions. Finally, throughout most of this analysis, we restrict our data to include only the 78.5% of our sample who are homeowners in 1997. We include this restriction because homeowners and renters are likely to have different responses to home price increases, with renters becoming worse off when local home prices rise. Our estimates are virtually identical when we include renters, which is supported by the evidence we present below that renters do not alter their college choices in response to home price changes.

2.2 Measuring Housing Prices

The main variable of interest in this analysis is the four-year home price change of students' families prior to the student turning 18. We focus on this variable rather than on home price

⁵We use the STATA module "ICE" (Royston, 2004) to implement the MICE procedure. MICE is an iterative imputation method, whereby missing values of all variables are first randomly filled in using the posterior distribution. Then, a cycle of regressions is estimated using each variable with missing responses as a dependent variable and replacing the previously missing information with the predicted values. A cycle of ten was used for each imputation, and the imputation was done five separate times, with the reported results representing averages over the results estimated on each imputed data set.

⁶Less than half a percent of the sample is 18 in 1997, so this restriction has negligible consequences for our results.

levels because the price of a home can bear little relationship to the amount of equity a family has in a home.⁷ Since all home price changes are capitalized into equity, and because we lack direct home equity measures, we examine the four-year change in home prices during the high school years.

In the NLSY97, housing information only is collected in 1997. We take the self-reported 1997 home prices reported by the parents and calculate predicted home values in each calendar year using the MSA-level Conventional Mortgage Housing Price Index (CMHPI). The CMHPI is a home price index created from all mortgages securitized by Fannie-Mae and Freddie-Mac for repeat-sale, single family homes. It is a widely used home price index in the housing literature and provides a consistent measure of the MSA-average home price change in each year. Since migration tends to occur across cities with similar home price growth rates (Sinai and Souleles, 2009), the 1997 MSA-level home price growth is likely to be an accurate measure of the actual city-level home price growth experienced by each household. The home price of homeowner i in MSA m in year t is calculated as:

$$\hat{P}_{imt} = P_{im1997} * \frac{CMHPI_{imt}}{CMHPI_{m1997}}. \quad (1)$$

Note that this method does not allow any within-MSA variation in home price growth rates in a given year. Instead, all growth rate variation is coming from differential home price changes across MSAs and within MSAs over time. We calculate the four-year change in home price for each homeowner in 1997 as $\hat{P}_{imt} - \hat{P}_{imt-4}$. Because our home price change measure requires information about aggregate MSA-level home prices, we additionally limit the sample to respondents who live in an identified MSA. Our final analysis sample contains 2,801 students.⁸

⁷Both Lovenheim (2011) and Lovenheim and Mumford (forthcoming) find little behavioral response to home price levels but show that families respond to variation in home price changes. This finding is consistent with the importance of measuring housing wealth, not simply housing prices.

⁸An alternative method of measuring home price changes would be to use the within-MSA percentage change in home prices only. Measuring home price growth in this way leads to similar results (see Appendix Table A-1), but we favor the measure given by equation (1) because it relates postsecondary decisions to financial gains rather than to percentage gains in home prices. Using dollar values also is more common in the literature on home prices and education decisions (e.g., Lovenheim, 2011; Dynarski, 2003), so this measure of housing wealth change allows our estimates to be more directly comparable to those in existing studies.

2.3 Institutional-level Data and Student Outcomes

We categorize students into four mutually exclusive sectors of higher education: non-flagship public four-year schools, flagship public universities, private four-year institutions and community colleges. Each student’s assignment is not a function of her state of residence in 1997, as we do not distinguish between out-of-state and in-state attendees. However, we also investigate whether housing wealth changes affect the likelihood of out-of-state college attendance.⁹ Assignment to institution type is based on the UNITID code of the first postsecondary institution at which a student enrolled after high school. Only college attendees therefore are included in our main sample. This restriction could bias our estimates, as college enrollment is responsive to housing wealth changes (Lovenheim, 2011). We show evidence below that including non-attendees has little effect on our estimates, so we exclude non-attenders from our main analysis in order to have a consistent sample for the multinomial logit analysis and for the analysis that uses observed college quality measures (for which there is no information among non-attendees).¹⁰

For each initial institution attended by a respondent, we merge in a set of mean institutional quality characteristics using Integrated Postsecondary Education Data System (IPEDS) data from 1997 through 2003, corresponding to the years in which respondents turn 18 in our sample. We construct averages over time of all measures within institutions in order to guard against the possibility that institutional quality responds to home price variation. While there is no evidence in the data that this is so, we also present estimates using lagged quality measures that demonstrate any such relationship is not driving our results.

The quality measures we use are 25th and 75th percentile of institutional SAT scores,¹¹ faculty-student ratios, total expenditures per student, instructional expenditures per student,

⁹Previous work has demonstrated that there are capacity constraints at flagship institutions – when demand increases, students flow into less selective universities and community colleges (Bound and Turner, 2007). To the extent that home price increases generate demand increases, total enrollment at less selective schools should increase by more than at flagship universities. However, the composition of flagship students may change to favor those with more recent housing wealth growth. Such capacity constraints should mute somewhat any effect of home price growth on flagship enrollment, because these schools are less likely to increase total enrollment slots when demand increases. We find effects on the flagship margin despite such capacity constraints.

¹⁰In three states, there is not a designated flagship university. In California, the University of California system is considered a flagship system, but we assign University of California at Berkeley and University of California at Los Angeles as the two flagship universities in the state. In Texas, there are two flagship universities – University of Texas at Austin and Texas A&M – College Station. Finally, in New York, we assign the statutory colleges of Cornell University as the flagships as well as State University of New York at Binghamton, the latter because it has the highest average SAT score and graduation rate of all the SUNY schools.

¹¹For those schools only supplying ACT scores, ACT scores were converted to SAT equivalents using the top-value of the SAT interval in the concordance tables developed by the ACT.

institutional graduation rate, and posted tuition and fees.¹² We use multiple measures of collegiate resources and quality because no one variable constitutes an accurate proxy for quality (Black and Smith, 2006). Table 1 presents means of these measures by our four higher education sectors, which are undergraduate-enrollment weighted averages across all higher education institutions in the IPEDS surveys. Focusing on the first two columns, there is a clear quality difference between flagship public schools and non-flagship public four-year schools. The flagship institutions have higher SAT scores, with a 71 point difference in the 75th percentile. Faculty-student ratios are 54% higher in the flagship public schools, and both total and instructional expenditures per student are substantially larger as well. These large resource and quality differences across schools, even within the public four-year sector, are consistent with the high returns to attending a flagship public university found in previous studies (Hoekstra, 2009; Brewer, Eide and Ehrenberg, 1999) and reinforce the importance of understanding how students select across different types of institutions.

Critically, the flagship public institutions also are more expensive to attend, with an in-state tuition difference of \$1,210 per year and an out-of-state tuition difference of \$4,104 per year. Although this calculation omits financial aid, these means suggest students must pay more to access the higher quality and resources available at the state's flagship university.

There also are substantive differences across public and private schools as well as between two- and four-year schools that are evident in Table 1. Due to sample size limitations, we do not split the private sector by selectivity. For the direct resource measures, the four-year private schools on average are very similar to the public schools. However, they are significantly more expensive. The two-year sector is characterized by much lower resources per student but also by a lower cost of attendance than the four-year sector. Focusing on the public sector, moving from a community college to a non-flagship institution to a flagship university, which describes the relevant choice set for most students, entails significant increases in per-student resources and institutional quality while raising attendance costs through higher tuition.

¹²Henceforth, "tuition" refers to tuition and fees.

2.4 Descriptive Statistics

Descriptive statistics of the analysis variables for the full analysis sample and by income group are presented in Table 2. Low income are households with family income under \$75,000, middle income are households with total real income between \$75,000 and \$125,000 and high income households are those with real income above \$125,000.¹³ Although the low-income group extends high up into the income distribution, it outlines the group of middle-class students whose families likely qualify for little aid and thus for whom differences in college costs probably are the most relevant.

The mean four-year home price change among homeowners in the sample is \$53,310, with a standard deviation larger than the mean. These tabulations underscore the large variation in home prices that occurred over this time period. While these increases were largest for the highest income households, both lower and middle income homeowners experienced large relative home price increases of about \$33,890 and \$49,890, respectively.

Table 2 also shows the distribution of attendance patterns across the four sectors of higher education we examine. Within the four-year sector, public non-flagship schools enroll the largest proportion of students, followed by the private sector and then the flagship publics. For example, while 33.0% of attendees enroll in a non-flagship public school, only 9.4% enroll in a flagship. The largest single sector is comprised of community colleges, at 37.8%. Enrollment trends across the income distribution largely conform to expectations, with community college enrollment declining with family income and flagship enrollment rising. For the lowest income sample, flagship enrollment is 4.7%, while for the highest income sample it is 18.7%, a fourfold increase across groups. The income differences in college selection patterns lead to significant disparities in institutional quality and resource measures, which also are shown in Table 2. Some of these differences likely are due to the positive correlations among family income, AFQT scores, parental education and admission to higher-quality schools, but they are at least suggestive of a role for family resources in affecting where students enroll in college.

¹³All financial variables in this analysis are inflated to real \$2007 using the CPI-U.

3 Empirical Methodology

A straightforward human capital model predicts that students will enroll in the school that maximizes their net rate of return. With perfect access to credit, changes in family resources should not affect this decision – students are able to borrow at their internal rate of return to the investment. However, because one cannot collateralize human capital, it may not be possible to borrow at one’s rate of return, which creates the possibility for a binding credit constraint to affect college choice. Changes to parental resources through changes in home values thus could impact the types of schools students choose to attend. If there is consumption value to schooling, and in particular to college quality, then home price changes also can influence college enrollment through an income effect, regardless of whether there are liquidity constraints. The goal of this analysis is to identify the causal effect of short-run home price changes on students’ college enrollment decisions. This is an important policy parameter independent of whether it is driven by liquidity constraints or an income effect, especially given recent large fluctuations in the housing market.

The time period of our analysis, which uses home price variation over the period 1993 (four years prior to the 17-year-old cohort turning 18) to 2003 (when the 12-year-old cohort turns 18), is particularly appropriate to identify the effect of housing wealth on the college choices of students because it coincides with a large increase in home prices in many areas. Between 1993 and 2003, the CMHPI increased by 121% nationally and did so unevenly across cities. Furthermore, housing wealth also became much more liquid over this time period. This increased liquidity has been well documented by researchers and in the popular press; towards the turn of the millennium, it became much easier for families to extract the wealth from their homes using cash out refinances, home equity loans, and home equity lines of credit. Home equity extractions as a percent of per-capita income rose from 2.16 in 1990 to 11.67 in 2004, an increase of over 439 percent (Greenspan and Kennedy, 2005). Thus, if enrollment decisions are sensitive to housing wealth fluctuations, it should be most apparent in the time period we are studying.

In order to test whether home price changes in the four years prior to a child becoming of college age affects her decision of where to enroll, we estimate multinomial logit models of the

following form:

$$P(j_{imsc}^* = j_{imsc}) = \beta_0 + \beta_1 \Delta P_{imc}^h + \gamma X_i + \alpha Z_{sc} + \delta W_{mc} + \theta_s + \psi_c + \epsilon_{imsc}, \quad (2)$$

where i indexes family, m indexes MSA, s indexes state and c indexes cohort. The cohort of each respondent is defined by age in 1997. The variable ΔP_i^h is the four-year real home price change in the time period prior to the respondent turning 18. The vector X is comprised of the set of individual and family background characteristics listed in Table 2, W is a vector of MSA-by-cohort macroeconomic variables, and Z is a vector of state higher education provision measures that are presented in Table 2 as well. Equation (2) also contains state fixed effects (θ) and cohort fixed effects (ψ). Note that because cohorts are defined as of 1997, one can interpret the cohort fixed effects as year fixed effects that describe national economic and higher education conditions when respondents first become eligible for college enrollment. The state fixed effects control for the fact that student selection into different types of postsecondary schools is systematically different across states in a way that may be correlated with short-run home price changes. Ideally, we would control for MSA fixed effects, but with only 2,801 observations, we were not able to achieve convergence in the multinomial logit model with these fixed effects. We show below using direct resource and quality measures that using state instead of MSA fixed effects *reduces* the estimated effect of housing price changes.¹⁴ This finding suggests that using state fixed effects rather than MSA fixed effects actually understates the true relationship between home price changes and college quality selection.

Equation (2) is estimated using the four school type categories discussed in Section 2.3. For all estimates, the non-flagship public sector is the omitted category. The parameter of interest in this analysis is the marginal effect of a \$10,000 change in home values over the four years before a child turns 18 on the likelihood she enrolls in a given type of university. This marginal effect is a function of the β_1 estimate for each outcome.¹⁵ In order to claim that β_1 identifies a causal relationship between housing wealth changes and college choice, the housing

¹⁴The use of MSA fixed effects and MSA-level home price indices requires that the NLSY97 is representative within each MSA. While this is a difficult assumption to test, the primary sampling unit used by the BLS for the survey is the MSA. This sampling frame is suggestive that the data are representative of the population in each, once sampling weights have been applied.

¹⁵The formula for the marginal effect of a change in variable x_k on the probability of a given outcome being chosen (i.e., $p(j^* = j|X)$) is $P_j(\beta_{jk} - \frac{1}{J} \sum_{j=1}^J \beta_{jk})$, where P_j is the predicted probability of outcome j occurring. So, the sign of the marginal effect is a function not only of the parameter value for that specific option but also of the average of all parameter values for that variable.

price changes at the MSA level must be conditionally uncorrelated with unobserved factors that affect college choice.

Arguing that home price changes at the MSA-level are exogenous is complicated by the fact that there still is little understanding of why home prices increased dramatically in some areas at specific times. Housing price dynamics are a function of supply and demand forces, most of which are unobserved in this study.¹⁶ We argue that the main source of home price variation is coming from average price growth differences within MSAs over time, which combined with the structure of our data and the extensive set of student-level background controls creates plausibly exogenous housing wealth variation to the household.

Home price variation in our model comes from three sources: 1) 1997 home price levels, 2) cross-sectional differences across cities within states in average home prices and 3) changes in average 4-year home price growth within cities over time. Of these three sources, the third is the most promising because it is based solely on differences over time within cities in the size of average home price changes. For example, between 1993 and 2003 home prices in New York City increased by 90% but only increased by 20% in Rochester and by 19% in Syracuse. Furthermore, the timing of steep home price increases varied across cities. Miami home prices increased by 14% between 1993 and 1996, by 17% between 1996 and 2000 and by 45% between 2000 and 2003. In San Francisco, however, home prices remained flat between 1993 and 1996, rose by 67% between 1996 and 2000 and increased by 23% between 2000 and 2003. Figure 1 shows the extent of such variation in our data. The figure presents percentage home price changes by MSA from 1994-1998 (the pre-housing boom period) versus from 1999-2003 (the housing boom period in our data). The 45 degree line also is shown – points above the line have higher home price growth in the later period than in the earlier period, and vice versa. Figure 1 demonstrates that there is a large amount of cross-sectional and within-city over time variation in home price growth rates. While the majority of cities experienced large home price growth in the 1999-2003 period, the magnitude of this growth is quite varied and is unrelated to growth in the earlier period. Furthermore, there is a non-trivial number of MSAs that had

¹⁶As of yet, there is no consensus in the literature regarding why the housing boom varied across cities and over time. Gyourko, Mayer and Sinai (2006) and Glaeser, Gyourko and Saks (2005) suggest that local supply constraints are an important cause of these differences. To the extent that these housing supply constraints are responsible for the temporal and geographic variation in the housing boom, it indicates home price changes are exogenous because such MSA-level constraints are unlikely to be directly related to individual collegiate selection.

higher home price growth in the 1990s than in the early 2000s (such as San Francisco). It is these differential rates of home price changes within MSAs over time as well as across MSAs in each year that our identification strategy seeks to exploit.

Using only within-city variation in home price changes over time, β_1 would be identified solely off of the fact that in our data different age cohorts within each city come of college age at different times and thus are exposed to different home price changes. Controlling for the city in which one lives and the timing of coming of college age, any endogenous selection must be based on families with higher unobserved preferences for or access to higher quality schools sorting into MSAs pre-1997 that will have the highest housing price growth when their children are in high school. Recall that because we are able to control for strong measures of student academic ability, such as AFQT scores and parental education, any such selection would have to be residual to these controls.

The variation due to the first two sources of home price variation could be more problematic. In particular, 1997 home price levels could be proxying for an unobserved component of ability or for permanent income. However, in Section 4.5 and in Appendix Table A-1, we present evidence that neither source of variation appears to be driving the results.

The structure of the data also allows us to guard against the main threats to identification from potential endogeneity of home price changes. First, because each respondent's location is fixed as of 1997, no endogenous moving occurs in our sample. Combined with the location fixed effects, this restriction allows us to control for any fixed differences across households in college choice and home price changes that are a function of household location. Second, because homeownership status is fixed throughout our sample, families cannot endogenously switch in and out of home ownership based on local market forces that may be related to college choice. However, it is possible that fixed homeownership status is endogenous. Home ownership rates for our sample are very high, at 79%. The proportion of the sample potentially affected by endogenous home ownership thus is small. Furthermore, for homeowner endogeneity to be driving our results it would have to be the case that families with higher unobserved likelihood of attending a higher quality school are more likely to own a home in 1997 in the MSAs in which home prices will rise more when their kids are in high school.

The richness of our data combined with the source of housing price variation makes it unlikely that our results are plagued by selection of students with higher unobserved ability into areas that have higher home price growth when they are in high school. However, any factor affecting both home price growth and expected returns to different college types could bias our estimates. For example, high-skilled labor demand shocks could both increase home prices and increase the returns to college quality. The existence of such shocks is unlikely since there was a negative relationship between MSA-level home price changes and real income per capita during the housing boom (Mian and Sufi, 2010). However, in order to address this potential source of bias, we control for real income per capita and the unemployment rate at the MSA-by-cohort level. We also control for the state-by-cohort mean of average college graduate wages relative to both high school wages and associate’s degree wages, calculated from CPS Outgoing Rotation Group data.¹⁷ These wage ratios control for the possibility of high-skilled labor demand shocks that likely impact individuals’ college enrollment decisions and could be correlated with home price growth. We only control for these shocks at the state-level, which is problematic if the relevant variation is within-state. However, high-skilled labor demand is not highly localized within states (Bound, Groen, Kezdi and Turner, 2004). Insofar as local demand shock affects all students in the state roughly equally, within-state changes will not bias our estimates. Finally, we control for the number of schools of each type within each MSA because the presence of universities may drive housing price growth, and students who live closer to universities are more likely to attend college (Card, 1995).

Because higher education sector is an incomplete measure of college quality, we also estimate OLS models that examine the relationship between housing wealth and the direct resource and school quality measures students experience at their first postsecondary school:

$$Y_{imsc} = \beta_0 + \beta_1 \Delta P_{imc}^h + \gamma X_i + \alpha Z_{sc} + \delta W_{mc} + \theta_m + \psi_c + \epsilon_{imsc}, \quad (3)$$

where θ_m are MSA fixed effects and all other variables are as previously defined. This model

¹⁷We construct the ratio of hourly wages of 25-55 year olds with a bachelor’s degree (BA) to the hourly wages of 25-55 year olds with an associate’s degree (AA) in the state. We construct a similar wage ratio for those with a BA compared to those whose highest level of educational attainment is a high school diploma. We also control for real need-based aid per student provided by the state, calculated from National Association of State Student Aid Providers (NASSGAP) surveys. All state and MSA variables are measured as of when each respondent is 18 years old. These variables all vary at the state or MSA by cohort level, where each cohort is defined by respondent age in 1997.

identifies β_1 using only within MSA-level variation in home price growth rates over time, leveraging the fact that different age cohorts in 1997 experienced different short-run home price changes before they turn 18 due to the differential timing and strength of the housing boom across cities. This model is identified by comparing college choices within cities among students who were different ages in 1997 and thus who experienced different home price variation when they were 14 through 18 years old. The identifying assumptions underlying identification of β_1 in equation (3) are similar to those in equation (2), but we have removed the variation across MSAs within states. Now, any selection on unobservables would have to be occurring by families with children of different ages who have unobserved characteristics that make them more likely to go to a higher quality university selecting into MSAs prior to 1997 that will have higher home price growth rates during the child’s high school years. While it is not possible to test for such selection with our data, given the richness of the characteristics we observe about students we believe such selection is unlikely.

4 Results

4.1 Multinomial Logit Estimates

Marginal effects at the mean of all variables from multinomial logit estimates of equation (2) are shown in Table 3. All marginal effects are relative to non-flagship public four-year institutions, and all standard errors are clustered at the MSA-level to reflect the within-MSA correlation of home price changes. The estimates shown in Table 3 are from one regression.

The table shows a strong relationship between home price changes in the four years before a respondent turns 18 and her decision to attend a more prestigious college or university. A \$10,000 increase in home prices increases the likelihood that a student attends a public flagship university by 0.0019 percentage points and reduces the likelihood a student attends a community college by 0.0059 percentage points, although the latter coefficient is only statistically significant at the 10% level. Relative to the baseline enrollment rates in Table 2, these estimates translate into enrollment increases of 2.0% ($= \frac{0.0019}{0.094} * 100$) in flagship public and decreases of 1.6% ($= \frac{-0.0059}{0.378} * 100$) in community colleges from each \$10,000 increase in home prices.

Given the substantial variation in home prices over the past decade, these marginal effects

imply large changes in college selection. The average homeowner in our sample experienced a four-year home price increase of \$53,310, which leads to a 10.7% increase in the probability of attending a state flagship university and a decrease in the likelihood of attending a community college of 8.5%. These average effects mask a significant change across cohorts: the average four-year home price increase was \$72,621 for the sample of 12-year-olds in 1997. For this cohort, home price changes increased attendance at flagship universities by 14.5% and decreased community college attendance by 11.6%. The marginal effects for housing price growth in Table 3 therefore lead to sizeable shifts in the types and quality of schools students attend within the public sector, which has important implications given the recent large declines in home prices in many areas of the country.

We find no effect of home price changes on selection into private universities. This result most likely is due to the fact that private universities are more likely to “tax” home equity for the purposes of financial aid and that they are considerably more expensive than public universities.¹⁸ Most students need to access additional aid to finance private university attendance, even when their parent’s home gains in value. Table 3 thus indicates that housing wealth changes affect sorting within the public sectors of higher education, not across the public and private sectors. This finding reinforces the importance of examining how family resources affect college selection within the public sector, which previous work largely has ignored.

In our characterization of school sectors, we did not distinguish between in-state and out-of-state enrollment. Some students may decide to attend a public or private university outside their home state, which could increase institutional quality and/or match quality but would entail higher attendance costs. Using a dummy variable for out-of-state attendance as the dependent variable in equation (2), we estimate that a \$10,000 increase in home prices while in high school increases the likelihood of leaving one’s home state for college by 0.0035 percentage points, or 2.0%. This result provides further evidence that housing wealth increases lead to the purchase of more expensive higher education.

The average effects in Table 3 may mask heterogeneity across the income distribution in the response of college choice to family resources, particularly if credit constraints play a role in

¹⁸In 1992, the federal government exempted home equity from federal financial aid calculations. See Dynarski (2003) for more details on this change. Institutions still can include family housing wealth as a part of institutional support, and although systematic data on which institutions engage in this practice are unavailable, conversations with financial aid officers at various universities suggest private universities are more likely to account for home equity when calculating institutional aid.

driving these results. A potential problem with examining heterogeneity by household income is that the MSA average home price changes we use may not equal the home price changes experienced by different income groups within MSA. However, using the Panel Study of Income Dynamics (PSID), we found little evidence that households with different income levels experienced different home price growth rates within MSAs.¹⁹

To examine differences in the effect of home prices by family income, we estimate a modified version of equation (2) in which we interact home price changes with income group indicators: less than \$75,000 (low income), \$75,000 to \$125,000 (middle income) and greater than \$125,000 (high income). Table 4 shows these estimates, which come from one multinomial logit regression. The results indicate that most of the estimated effect of home price changes in Table 3 is coming from lower-income households. The probability a student attends a public flagship increases by 0.0039 percentage points, or 8.3%, for every \$10,000 four-year home price increase for families with income under \$75,000. Families earning between \$75,000 and \$125,000 also are more likely to send their child to a flagship university, although the marginal effect is smaller at 0.0032 percentage points, or 3.9%. We find a small and statistically insignificant effect of home price growth on flagship attendance among families with incomes over \$125,000, and the low and high income estimates are statistically distinguishable from each other at approximately the 3% level. It is only among lower-income families that community college attendance is influenced by home price changes. The estimated marginal effect is large, however, suggesting a \$10,000 increase in four-year home price growth leads to a 0.0180 percentage point, or 3.8%, decline in community college enrollment. This estimate is statistically distinguishable from the other two income groups at the 1% level. Even for the private sector, the marginal effect is consistent with a positive impact of home prices on private school enrollment, but it is imprecisely estimated.

Multiplying these marginal effects by the average four-year home price change for the lower-income sample of \$33,890 (see Table 2) yields an average relative increase in the likelihood of flagship enrollment of 28.1% and an average relative decrease in the likelihood of community college enrollment of 12.9%. Among twelve-year-olds in 1997, the average home price increase

¹⁹In particular, we used the 2001, 2003 and 2005 samples and focused on households with children age 18 or 19. We regressed the four-year percentage home price change on income group dummies and MSA fixed effects, using the same income groups as in the analysis below. The coefficient on the middle-income dummy variable is -0.051(0.049) and is -0.071(0.055) for the highest-income dummy. Thus, the lower-income groups experienced slightly larger percentage changes in home prices within MSA, but the differences are small and are not statistically different from zero.

was \$44,622, which leads to a 37.0% increase in flagship enrollment and a 17.0% decrease in community college enrollment relative to non-flagship public enrollment. Table 4 demonstrates that the housing boom caused significant changes among lower and middle income families in the sectors in which their children enrolled in college.

4.2 Extensive Margin Estimates

Using the PSID, Lovenheim (2011) shows that the type of housing wealth variation we use in this analysis affects the extensive margin of college enrollment. In particular, he finds a \$10,000 increase in housing wealth increases the likelihood of college enrollment by 0.0071 percentage points. In Table 5, we conduct a similar analysis using the NLSY97 data. In order to explore the importance of controlling for student academic ability, which is not available in the PSID, we estimate the model both with and without AFQT scores. In column (i), we find each \$10,000 in housing wealth leads to a 0.0092 percentage point increase in college enrollment. This estimate is very similar to Lovenheim (2011).²⁰ In the next column, we control for AFQT scores and the estimate drops to 0.0072. This result is suggestive of a small upward bias from excluding pre-collegiate ability measures, but the bias is small and column (ii) still points to a positive and statistically significant effect of home price changes on college enrollment.

In columns (iii) and (iv), we allow the estimates to vary by household income. Similar to Table 4, we find the lower-income sample to be most responsive to home price changes. A \$10,000 increase in home prices is associated with a 0.015 percentage point higher likelihood of attending college, which is statistically different from the highest income group estimate at the 1% level in both columns. The estimates change little when AFQT scores are included. However, these results are smaller than in Lovenheim (2011), who finds a marginal effect of 0.0567 for each \$10,000 change in home equity. These differences could be due to differences in when income is measured with respect to when students turn 18, differences in the timing of the sample, differences in the samples themselves, or differences in how housing wealth is measured. Despite the fact that the estimates are somewhat smaller for the lower income sample in Table 5, they still point to a rather large and statistically significant effect of home price changes on

²⁰Note that Lovenheim (2011) estimates instrumental variables models in which four-year home equity changes are used to instrument for contemporaneous home equity. We cannot use this method with the NLSY97 data because we do not have information on home equity changes. He also includes renters in his baseline model.

college enrollment that is robust to controlling for AFQT scores. This finding suggests that while the primary determinant of college attendance may well be student ability (see Carneiro and Heckman (2002) for a discussion), conditional upon that ability there still is a role for short run changes in household resources to affect college attendance.

4.3 Effects on Applications and Admissions

That housing wealth impacts whether and where students attend college is suggestive that it may impact application behavior. In Table 6, we examine the effects of housing wealth on applications and admissions in order to shed light on some of the mechanisms by which housing wealth influences college choices.²¹ In Panel A, we estimate poisson regressions of the number of applications at four-year institutions by sector, where the control variables are the same as those in equation (2) in addition to MSA fixed effects.²² Each column is a separate regression, and we find that each \$10,000 increase in home prices leads to a 1% increase in applications. The effects are larger for non-flagship and flagship applications, at 2.7 and 3.3% respectively. Consistent with our findings above, home price changes are uncorrelated with private school applications. The final column in Table 6 shows logit estimates of the effect of home price changes on the likelihood of applying to a two-year school. Even though two-year attendance falls with home price increases, the likelihood of applying to one does not. Thus, students whose families experience home price increases while in high school submit more applications overall and submit more in particular to public four-year schools, including flagships.

In Panel B, we show the relationship between admissions and home price changes. These estimates include the change in applications shown in Panel A, and they are very similar to those estimates. This similarity suggests the admissions effect is being driven by the applications, not by the relative likelihood of being admitted conditional on applying. Panel C shows these conditional likelihoods, and while the estimates for flagships and non-flagships are positive, they are much smaller than the estimates in Panel A. This is particularly true for the flagship

²¹We examine the number of applications in order to see whether the choice set of students expands when parental resources increase. Such an expansion would come about if students believe that they will be better able to afford enrollment at a higher quality school, which induces them to apply.

²²Applications only are available for the sample of respondents who were 12-14 years old. We cannot exclude renters from the application regressions because the sample size is too small to achieve convergence. We include renters, assigning them zeros for home price growth, and include a dummy variable for home ownership status. Given that all of our previous estimates are robust to including renters in this manner, including renters is unlikely to impact these estimates.

estimates, which indicate that family resource changes while in high school affect applications to more elite public institutions that students are qualified to attend. An actual or perceived lack of resources appears to dissuade at least some students from applying to, and thus attending, flagship state universities. We argue below in Section 4.5 that this result is not being driven by changes in investments during high school or in high school quality. Rather, the evidence points to family resources when students are in high school directly affecting application and attendance decisions of students in a manner that affects higher education quality.

4.4 Direct Resource and Quality Effects

Because college sector is an imperfect proxy for college resources and because students may be changing their selection behavior within our four sectors when home prices change, we examine the effect of housing price changes on direct quality and resource measures in Table 7. In the table, each cell for the full sample results comes from a separate regression of equation (3), and for the results by income, each row comes from a separate regression.

The estimates suggest that students attend higher quality and resource institutions when their parents' home value increases over the previous four years. For example, a \$10,000 increase in four-year home prices increases the 75th percentile SAT scores of the attending university by 0.80 points, the student-faculty ratio by 0.0003, expenditures per student by \$289.92, instructional expenditures per student by \$63.56, and the six-year BA graduation rate of the university by 0.001. Although many of these marginal effects are modest, each of these measures is at best a partial proxy for the underlying quality of the institution. Furthermore, when multiplied by the average changes in home prices shown in Table 2, these marginal effects translate into sizeable institutional quality changes experienced by students, which are driven by changing enrollment decisions. Table 7 also shows that home price changes have at most a small effect on posted tuition.²³ Given that most students are likely to receive federal, state and institutional aid, however, posted tuition may be a poor measure of the amount actually paid by families.

The remaining columns in Table 7 present estimates that vary by income group. As with the multinomial logit results, the effects are largest for the lowest income group. All estimates

²³We define tuition as posted in-state tuition if a student attends in the state in which she lived in 1997 and as out-of-state tuition if the student attends in a different state.

except for tuition are positive and are statistically significantly different from zero at the 5 or 10% level. Although students from both lower and middle income families attend institutions with higher SAT scores and with higher graduation rates when home prices increase, there is no significant effect among families with income over \$125,000 per year. The multinomial logit estimates are suggestive that at least some of these results are being driven by the higher likelihood of both lower and middle income families to send their children to flagship public schools that have higher resources when they experience housing price increases.

4.5 Robustness Checks

Interpreting the estimates in Tables 3-7 as causal relies on several assumptions about the exogeneity of home price changes that were discussed in Section 3. In this section, we show a series of robustness checks in order to assess the sensitivity of our results to many of these assumptions. In column (i) of Table 8, we show estimates from equations (2) and (3) using only renters.²⁴ We assign each renter the 4-year percentage change in the CMHPI for his MSA. These regressions are informative because they check whether unobserved factors at the MSA level, such as high-skilled labor demand, are affecting both home prices and college selection for all residents. Furthermore, these estimates show whether it is appropriate to restrict our main analysis to home owners. Table 8 presents evidence that renters do not alter their school choices in response to MSA-level home price changes. In neither panel is any estimate statistically different from zero at conventional levels, and the estimates are universally small in magnitude.

The estimates for renters suggest that our results are not being driven by home price changes influencing K-12 education quality, as such quality changes would be experienced by both renters and home owners. In order to explore this issue further, we examine whether four-year home price changes while in high school impact the likelihood of attending a private school, the size of one's high school, teacher-student ratios, high school GPA, the number of AP tests taken and hours worked while in high school. We also investigated the impact of housing price changes on the likelihood of high school completion in the full sample. In no case is there a statistically or economically significant relationship between home price changes and these variables, which suggests our estimates are not being driven by differential investment in human capital while

²⁴Descriptive statistics by home owner status in 1997 are presented in Appendix Table A-2.

in high school. All results are available upon request.

In column (ii) of Table 8, we control for 1997 home prices. These estimates distinguish between the effects of owning an expensive home and the effect of being exposed to home price changes based on one's location and age. The results in both columns are qualitatively and quantitatively similar to those in Tables 3 and 7. Overall, the estimates indicate that MSA-level home price changes are the main driver of our results, which supports many of our identification assumptions because this source is the most likely to be exogenous.²⁵

Throughout much of this analysis, we have excluded non-attenders from the sample in order to make the multinomial logit and the school resource samples the same. However, as shown in Table 5 and in Lovenheim (2011), the extensive margin also is affected by home price changes. In column (iii), Panel A of Table 8, we include non-attendance as its own category in our multinomial logit model. The marginal effects are very similar to those in Table 3, which suggests the exclusion of this group is not driving our results and conclusions.

Furthermore, our categorization of college sectors may be problematic because some non-flagship state universities are of higher quality than some flagship universities in other states. In order to assess the sensitivity of our estimates to the way in which we categorize schools, column (iv) of Table 8 shows estimates that use the top 50 public universities according to the 2005 U.S. News and World Report ranking instead of the state flagship. While the result for top-50 attendance is less precisely estimated, primarily because we are identifying this effect off of fewer states and MSAs due to school location differences, the estimates are qualitatively and quantitatively the same as our baseline estimates.

One important distinction between the multinomial logit and direct resource estimates is that the latter include MSA fixed effects and the former include state fixed effects. Estimating equation (3) using state fixed effects provides a check on the use of state fixed effects in equation (2); if the estimates are much larger, it will suggest our multinomial logit results are overstated. In column (iii) of Panel B, we show such estimates, and the results are inconsistent with the existence of across-MSA selection within states biasing upward our multinomial logit effects. The results are extremely similar to, if mostly smaller in absolute value than, the

²⁵We also have controlled for four-year home price growth when students are between 21 and 24, and we find that this home price growth measure has no effect on college choice when four-year home price growth during high school also is included in the regression.

estimates in Table 7, with the notable exception of tuition. While this is not a perfect test for MSA-level selection in our multinomial logit models, the strong correlation between sector and our resources/quality measures (see Table 1) makes it unlikely that state fixed effects would understate direct quality effects while overstating cross-sector selection.

Our direct resource measures are averages over 1997-2003. Despite the use of such averages, if housing price increases cause an increase in these measures, it could cause a mechanical relationship between quality/resources and home price changes that is not reflective of changes in student enrollment decisions.²⁶ In column (iv) of Panel B, we use average quality measures from 1992-1994. Note that SAT and graduation rate data were not collected in these years. However, for the data that overlap, the estimates are very similar to those from Table 7. This similarity is unsurprising given the high correlation between the lagged and contemporaneous measures (between 0.8 and 0.97 depending on the variable).

Tables A-3 and A-4 of the Appendix present additional robustness checks. In Table A-3, we show there is at most a weak relationship between housing price changes and institutional resources. Table A-4 presents evidence that state-level home prices growth did not lead to increases in financial aid. These results, together with the estimates from Table 8, suggest we induce little bias by using contemporaneous college quality measures.

4.6 College Outcomes

The results thus far indicate that students who experience increases in their parents' home price in the four years prior to turning 18 attend higher resource and higher quality postsecondary institutions. Do these collegiate resource changes, combined with the increased access to family financial resources brought about by home price increases, affect students' postsecondary outcomes? In Table 9, we present estimates of the effect of home price changes in the four years prior to a child turning 18 on three college outcomes: time between college and high school, BA completion and weekly hours worked during college. These estimates present new evidence on the effect of family resources on collegiate outcomes, using wealth variation generated by the housing boom rather than conditional income gradients. Note that because we only observe

²⁶From a budgeting perspective, this story is unlikely because property taxes are not used to fund four-year schools and only are used to fund two-year schools in certain states.

BA receipt as of 2008, our estimates may reflect both “on time” graduation as well as whether students eventually obtain a four-year degree.²⁷ We show estimates for the full sample in Panel A and by income groups in Panel B that include state fixed effects in the odd columns and MSA fixed effects in the even columns.

The estimates in the first two columns show little evidence that housing price increases affect the length of time between high school and college for either the full sample or across income groups. In Panel B, a \$10,000 home price increase among the lowest income families increases the likelihood of obtaining a BA by between 0.004 and 0.006 percentage points. Table 2 shows the baseline graduation rate for the lower-income sample is 31.2%, which implies that the probability of graduating increases by 1.8% for every \$10,000 increase in home prices, using the estimates with MSA fixed effects. Multiplying by the average change in home prices among these households leads to a change in BA receipt of 6.2%. This represents a large change in the BA completion rate of lower-income families over this time period, and we find no effect of housing wealth on BA completion rates for middle and high income families. Importantly, these estimates are suggestive of potential reductions in the BA attainment rate among lower-income families due to the housing market bust that began in 2006.

As student labor supply has grown markedly in recent years (Scott-Clayton, forthcoming; Bound, Lovenheim and Turner, forthcoming; Babcock and Marks, 2011) and has been linked to reduced academic success (Stinebrickner and Stinebrickner, 2003; Kalenkoski and Pabilonia, 2010), we next examine the effect of home price changes on student working behavior. As shown in the final two columns of Table 9, while there is little evidence of an overall effect, for low income students, a \$10,000 home price increase while a student is in high school reduces average weekly hours worked by between -0.21 and -0.31 hours. The median lower-income student works 15.9 hours per week in the sample, so these marginal effects are modest relative to the baseline. However, they do indicate that increased family resources cause a reduction in student labor supply for lower-income students, which together with the school quality effects documented above, lead to higher BA attainment rates for this group.

²⁷When we restrict the sample to students who are over 13 in 1997, our results are qualitatively and quantitatively similar, which suggests we are not simply identifying an “on-time” graduation effect.

5 Conclusion

With growing evidence of the high labor market and educational attainment returns to college quality, determining how students make college choices and, in particular, whether low family resources deter students from attending higher quality institutions is of preeminent importance. This paper uses quasi-experimental evidence from the housing boom to examine whether families that experienced increases in their home's value in the time period prior to their children becoming of college-age due to the fact that they live in a high home price growth city make systematically different decisions about where to send their children to college. Employing restricted-use data from the National Longitudinal Survey of Youth 1997 (NLSY97), we find a \$10,000 increase in a family's housing wealth in the four years prior to a student becoming of college-age increases the likelihood he attends a flagship public university relative to a non-flagship public university by 2.0% and decreases the relative probability of attending a community college by 1.6%. There is no effect of home price growth on selection into private universities, however. By splitting our sample into different income groups, we show these effects are driven by relatively low-income families. Similar to Lovenheim (2011), we also show that housing prices affect the extensive margin of college enrollment and present evidence that housing wealth impacts the number and quality of the schools to which students apply. Finally, we demonstrate a link between housing price growth and direct resource/quality measures and show that lower-income students living in homes that appreciate in value while they are in high school are more likely to graduate from college.

These results have particular importance for current policy as housing prices have fallen about 35% in the United States since their peak in 2006. These declines have been even more dramatic in certain metro areas in which the housing bubble was most severe. Our estimates are suggestive that these home price declines will have an effect on the quality and sector of postsecondary schools students attend and that the attendance decisions of lower-income students will be most affected. To the extent that these changes in attendance decisions translate into declines in graduation and labor market outcomes, the housing bust may have long-run effects on the supply of high-skilled labor and on income inequality. Future research examining policies that may insulate lower-income families from housing price volatility in the

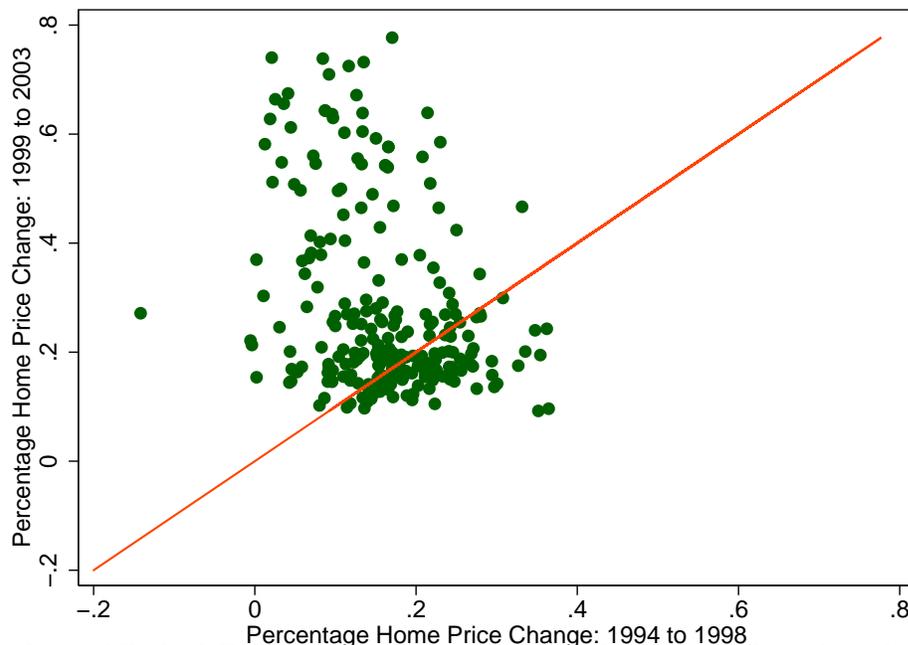
college attendance decision is warranted.

References

- [1] Andrews, Rodney, Jing Li and Michael Lovenheim, 2011. “Quantile Treatment Effects of College Quality on Earnings: Evidence from Administrative Data in Texas.” Mimeo.
- [2] Avery, Christopher and Caroline M. Hoxby, 2004. “Do and Should Financial Aid Packages Affect Students’ College Choices?” In Caroline M. Hoxby (Ed.) *College Choices: The Economics of Where to Go, When to Go, and How to Pay for It*. Chicago: University of Chicago Press.
- [3] Babcock, Phillip S. and Mindy Marks, 2011. “The Falling Time Cost of College: Evidence from Half a Century of Time Use Data.” *Review of Economics and Statistics* 93(2).
- [4] Belley, Philippe and Lance Lochner, 2007. “The Changing Role of Family Income and Ability in Determining Educational Achievement.” *Journal of Human Capital* 1(1): 37–89.
- [5] Black, Dan A. and Jeffrey A. Smith, 2004. “How Robust is the Evidence on the Effects of College Quality? Evidence from Matching.” *Journal of Econometrics* 121(1-2): 99–124.
- [6] Black, Dan A. and Jeffrey A. Smith, 2006. “Estimating the Returns to College Quality with Multiple Proxies for Quality.” *Journal of Labor Economics* 24(3): 701–728.
- [7] Bound, John, Jeffrey Groen, G. Gábor Kézdi and Sarah Turner, 2004. “Trade in University Training: Cross-state Variation in the Production and Stock of College-educated Labor.” *Journal of Econometrics* 121(1-2): 143-173.
- [8] Bound, John, Michael F. Lovenheim and Sarah Turner, 2010. “Why Have College Completion Rates Declined? An Analysis of Changing Student Preparation and Collegiate Resources.” *American Economic Journal: Applied Economics* 2(3): 1-31.
- [9] Bound, John, Michael F. Lovenheim and Sarah Turner, Forthcoming. “Increasing Time to Baccalaureate Degree in the United States.” *Education Finance and Policy*.
- [10] Bound, John, and Sarah Turner, 2007. “Cohort Crowding: How Resources Affect Collegiate Attainment.” *Journal of Public Economics* 91: 877–899.
- [11] Bowen, William, Martin Kurzweil, and Eugene Tobin, 2005. *Equity and Excellence in American Higher Education*. Charlottesville: University of Virginia Press, 2005.
- [12] Brewer, Dominik, Eric Eide and Ronald Ehrenberg, 1999. “Does it Pay to Attend an Elite Private College? Cross-Cohort Evidence on the Effects of College Type on Earnings.” *Journal of Human Resources* 34(1): 104-123.
- [13] Card, David, 1995. “Using Geographic Variation in College Proximity to Estimate the Return to Schooling,” in *Aspects of Labour Market Behaviour: Essays in Honour of John Vanderkamp*, ed. by Louis N. Christofides, E. Kenneth Grant, and Robert Swidinsky. Toronto: University of Toronto Press, 201-222.
- [14] Cameron, Stephen V. and Christopher Taber, 2004. “Estimation of Educational Borrowing Constraints Using Returns to Schooling” *Journal of Political Economy* 112(1): 132–182.
- [15] Carneiro, Pedro and James J. Heckman, 2002. “The Evidence on Credit Constraints in Post-Secondary Schooling.” *The Economic Journal* 112(482): 705–734.
- [16] Dale, Stacey Berg and Alan B. Krueger, 2002. “Estimating the Payoff to Attending A More Selective College: An Application of Selection on Observables and Unobservables.” *Quarterly Journal of Economics* 117(4): 1491-1527.
- [17] Dynarski, Susan, 2003. “Loans, Liquidity and Schooling Decisions.” Mimeo.
- [18] Glaeser, Edward L., Joseph Gyourko and Raven E. Saks, 2005. “Why Have Housing Prices Gone Up?” NBER Working Paper No. 11129.
- [19] Greenspan, Alan and James Kennedy, 2005. “Estimates of Home Mortgage Originations, Repayments and Debt on One-to-Four Family-Residences.” Federal Reserve Board Working Paper, Finance and Economics Discussion Series.
- [20] Gyourko, Joseph, Christopher Mayer and Todd Sinai, 2006. “Superstar Cities.” Mimeo.
- [21] Hoekstra, Mark, 2009. “The Effect of Attending the State Flagship University on Earnings: A Discontinuity-Based Approach.” *Review of Economics and Statistics* 91(4): 717–724.
- [22] Hoxby, Caroline M., 2009. “The Changing Selectivity of American Colleges.” *Journal of Economic Perspectives* 23(4): 95–118.
- [23] Kalenkoski, Charlene Marie and Sabrina Wulff Pabilonia, 2010. “Parental Transfers, Student Achievement, and the Labor Supply of College Students.” *Journal of Population Economics* 23(2): 469-496.
- [24] Kane, Thomas J. and Cecilia Elena Rouse, 1995. “Labor-Market Returns to Two- and Four-Year Colleges.” *American Economic Review* 85(3): 600-614.
- [25] Kinsler, Joshua and Ronni Pavan, 2010. “Family Income and Higher Education Choices: The Importance of Accounting for College Quality.” *Journal of Human Capital* 5(4): 453-477.

- [26] Kurleander, Michal and Bridget Terry Long, 2009. "Do Community Colleges Provide a Viable Pathway to a Baccalaureate Degree?" *Education Evaluation and Policy Analysis* 31(1): 30-53.
- [27] Light, Audrey and Wayne Strayer, 2000. "Determinants of College Completion: School Quality or Student Ability?" *Journal of Human Resources* 35(2): 299-332.
- [28] Long, Bridget Terry, 2004. "How Have College Decisions Changed Over Time? An Application of the Conditional Logistic Choice Model." *Journal of Econometrics* 121(1-2): 271-296.
- [29] Lovenheim, Michael F., 2011. "The Effect of Liquid Housing Wealth on College Enrollment." *Journal of Labor Economics* 29(4): 741-771.
- [30] Lovenheim, Michael F. and Kevin Mumford, Forthcoming. "Do Family Wealth Shocks Affect Fertility Choices? Evidence from the Housing Market Boom and Bust." *Review of Economics and Statistics*.
- [31] Lovenheim, Michael F. and C. Lockwood Reynolds, 2011. "Changes in Postsecondary Choices by Ability and Income: Evidence from the National Longitudinal Surveys of Youth." *Journal of Human Capital*. forthcoming.
- [32] Mian, Atif and Amir Sufi. 2009. "The Consequences of Mortgage Credit Expansion: Evidence from the U.S. Mortgage Default Crisis." *Quarterly Journal of Economics* 121(4): 1449-1496.
- [33] Pallais, Amanda and Sarah E. Turner, 2006. "Opportunities for Low Income Students at Top Colleges and Universities: Policy Initiatives and the Distribution of Students." *National Tax Journal* 59(2): 357-386.
- [34] Pallais, Amanda and Sarah E. Turner, 2007. "Access to Elites" in *Economic Inequality and Higher Education, Access, Persistence, and Success*, Dickert-Conlin, Stacey and Ross Rubenstein (Eds.): 128-156. New York: Russell Sage Foundation.
- [35] Reynolds, C. Lockwood, Forthcoming. "Where to Attend? Estimating the Effects of Beginning College at a Two-year Institution." *Economics of Education Review*.
- [36] Rouse, Cecilia E., 1995. "Democratization or Diversion? The Effect of Community Colleges on Educational Attainment." *Journal of Business and Economic Statistics* 13(2): 217-224.
- [37] Royston, Patrick. 2004. "Multiple Imputation of Missing Values." *Stata Journal* 4(3): 227-241.
- [38] Scott-Clayton, Judith, Forthcoming. "What Explains Increasing Labor Supply Among U.S. Undergraduates, 1970-2003?" *National Tax Journal*.
- [39] Sinai, Todd and Nicholas S. Souleles, 2009. "Can Owning a Home Hedge the Risk of Moving?" Mimeo.
- [40] Stinebrickner, Ralph and Todd R. Stinebrickner, 2003. "Working During School and Academic Performance." *Journal of Labor Economics* 21(2): 473-491.
- [41] Van Buuren, Stef, Hendriek C. Boshuizen, and Dick L. Knook. 1999. "Multiple Imputation of Missing Blood Pressure Covariates in Survival Analysis." *Statistics in Medicine* 18(6): 681-694.

Figure 1: MSA-Level Home Price Index Changes, 1994-1998 vs. 1999-2003



Source: MSA-level CMHPI percent differences as described in the text. The 45 degree line also is shown. The 4-year changes in the figure correspond to the home price growth experienced by the 17-year old and the 12-year old cohorts in the NLSY97. Each point represents a separate MSA in the data.

Table 1: Means of College Resource and Quality Measures by Higher Education Sector

	Non-flagship Public	Flagship Public	Private Four-year	Two Year
25 th Percentile Math SAT	455.31	525.14	494.66	
75 th Percentile Math SAT	569.52	640.72	607.52	
Faculty-Student Ratio	0.041	0.063	0.045	0.020
Expenditures Per Student	18337	41350	25482	7698
Instructional Expenditures Per Student	5649	10188	8434	2796
Graduation Rate	0.461	0.674	0.560	
In-state Tuition	4536	5746	18161	2805
Out-of-state Tuition	12072	16176	18170	6017

¹ Source: 1997-2003 IPEDS data as described in the text. All monetary figures are in real \$2007 and are weighted by total undergraduate enrollment. All per-student means are per total enrollment. Graduation rates are for BA degrees within six years of initial enrollment.

² SAT scores and graduation rates are reported for a small percentage of two-year schools. Because of the open-admission mandate of community colleges and the fact that many students do not intend to obtain a BA, we do not report means for SAT scores and graduation rates for this sector.

Table 2: Means and Standard Deviations of Analysis Variables Among Homeowners

Variable	Full Sample		Low Income		Middle Income		High Income	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
4 Year Home Price Change (\$10,000)	5.331	6.034	3.389	3.922	4.989	4.895	8.891	8.315
Real Family Income (\$10,000)	10.110	6.958	5.023	2.114	9.706	1.357	19.034	7.001
AFQT Score	63.86	25.43	57.57	26.46	65.12	24.19	72.27	22.65
Father HS Dropout	0.085	0.279	0.148	0.355	0.058	0.233	0.023	0.150
Father HS Diploma	0.314	0.464	0.415	0.493	0.316	0.465	0.147	0.354
Father Some College	0.227	0.419	0.222	0.416	0.274	0.446	0.165	0.371
Father BA+	0.374	0.484	0.216	0.411	0.352	0.478	0.666	0.472
Mother HS Dropout	0.069	0.253	0.122	0.327	0.043	0.203	0.020	0.138
Mother HS Diploma	0.307	0.462	0.400	0.490	0.299	0.458	0.167	0.373
Mother Some College	0.282	0.450	0.269	0.444	0.330	0.470	0.232	0.422
Mother BA+	0.342	0.474	0.209	0.406	0.328	0.470	0.582	0.493
Female	0.526	0.499	0.544	0.498	0.511	0.500	0.522	0.500
White	0.736	0.441	0.640	0.480	0.773	0.419	0.838	0.369
Black	0.097	0.296	0.151	0.358	0.077	0.267	0.039	0.194
Hispanic	0.099	0.299	0.145	0.352	0.084	0.278	0.047	0.212
Other Race	0.068	0.251	0.064	0.245	0.066	0.248	0.076	0.265
Age 12	0.135	0.342	0.151	0.358	0.126	0.332	0.124	0.329
Age 13	0.193	0.395	0.189	0.391	0.206	0.404	0.179	0.384
Age 14	0.200	0.400	0.183	0.387	0.215	0.411	0.206	0.404
Age 15	0.194	0.396	0.196	0.397	0.187	0.390	0.203	0.402
Age 16	0.202	0.401	0.201	0.401	0.192	0.394	0.215	0.411
Age 17	0.076	0.264	0.078	0.269	0.074	0.262	0.073	0.260
Non-Flagship Public	0.330	0.471	0.303	0.460	0.363	0.481	0.327	0.469
Flagship Public	0.094	0.291	0.047	0.212	0.082	0.274	0.187	0.390
Private 4-Year	0.198	0.399	0.173	0.378	0.188	0.391	0.254	0.436
Community College	0.378	0.485	0.477	0.500	0.368	0.482	0.232	0.422
Unemployment Rate	4.354	1.495	4.432	1.532	4.370	1.510	4.203	1.397
Real Per Capita Income (\$1,000)	32.05	5.90	31.88	5.99	31.88	5.85	32.57	5.79
2-Year Schools Per 18-24 Year Old	0.038	0.018	0.040	0.020	0.037	0.017	0.038	0.017
4-Year Schools Per 18-24 Year Old	0.071	0.043	0.068	0.040	0.073	0.042	0.074	0.048
Real Need-based Aid Per Student	0.463	0.438	0.436	0.431	0.493	0.459	0.463	0.416
BA-AA Wage Ratio	1.407	0.087	1.407	0.089	1.410	0.084	1.404	0.089
BA-HS Wage Ratio	1.845	0.127	1.836	0.128	1.848	0.121	1.854	0.133
25 th Percentile Math SAT	484.56	67.67	463.07	64.84	479.57	59.89	513.43	69.34
75 th Percentile Math SAT	595.99	63.61	575.63	63.80	591.78	55.10	622.75	63.82
Faculty-Student Ratio	0.038	0.024	0.033	0.020	0.037	0.022	0.047	0.029
Expenditures Per Student	16217	18453	12337	12775	14685	15212	24015	26103
Instructional Expend. Per Student	5925	5341	4884	3875	5484	4156	8253	7711
Graduation Rate	0.564	0.177	0.509	0.174	0.552	0.165	0.639	0.166
In-state Tuition	7085	7501	5899	6422	6974	7053	9194	9155
Out-of-state Tuition	11791	6858	10106	6101	11691	6378	14698	7709
Time Between HS and College	0.187	0.403	0.238	0.458	0.188	0.406	0.101	0.263
BA	0.416	0.493	0.312	0.463	0.418	0.493	0.584	0.493
Observations	2801		1242		967		592	

¹ All estimates include sample weights and are for the sample who attend college within two years of high school graduation and whose parents own a home in 1997.

² Low-income families are those with total income under \$75,000, medium income families are those with total income between \$75,000 and \$125,000, and high-income families are those with total income over \$125,000.

Table 3: Marginal Effects from Multinomial Logit Estimates of the Effect of Housing Price Changes on the Likelihood of Attending a Given Type of College Relative to a Non-flagship Public School

Independent Variable	Flagship Public	4 Year Private	Community College
4 Year Home Price Change (\$10,000)	0.0019** (0.0009)	-0.0007 (0.0018)	-0.0059* (0.0031)
Real Family Income (\$10,000)	0.0021** (0.0006)	0.0024 (0.0015)	-0.0074** (0.0023)
AFQT Score	0.0016** (0.0002)	0.0024** (0.0004)	-0.0080** (0.0004)
Father HS Diploma	-0.0006 (0.0159)	0.0021 (0.0345)	0.0073 (0.0412)
Father Some College	-0.0122 (0.0196)	0.0347 (0.0385)	-0.0474 (0.0466)
Father BA+	0.0159 (0.0160)	0.1225** (0.0378)	-0.1115** (0.0466)
Mother HS Diploma	0.0033 (0.0186)	-0.0963* (0.0506)	0.0372 (0.0412)
Mother Some College	0.0148 (0.0185)	-0.0739 (0.0467)	0.0220 (0.0421)
Mother BA+	0.0209 (0.0187)	-0.0634 (0.0484)	-0.0730* (0.0431)
Female	0.0073 (0.0059)	0.0332** (0.0168)	-0.0425* (0.0260)
Black	0.0010 (0.0146)	0.0479** (0.0241)	-0.2542** (0.0358)
Hispanic	-0.0161 (0.0161)	-0.0175 (0.0312)	-0.0458 (0.0373)
Other Race	0.0358** (0.0137)	-0.0616* (0.0343)	-0.0774 (0.0610)
MSA Unemployment Rate	0.0043 (0.0034)	-0.0300** (0.0122)	-0.0053 (0.0106)
MSA Real Per Capita Income	0.0007 (0.0007)	-0.0018 (0.0021)	-0.0038 (0.0026)
Public 2 Year Schools Per 18-24 Yr. Old	1.2260 (0.9551)	0.4393 (3.1572)	-2.4975 (4.0443)
Public 4 Year Schools Per 18-24 Yr. Old	0.1970 (0.1270)	0.5100** (0.2312)	-0.3641 (0.5339)
Real State Aid Per 18-24 Yr. Old	-0.0485 (0.0631)	0.0980 (0.1425)	-0.0263 (0.2619)
BA/AA Wage Ratio	0.0046 (0.0663)	-0.0200 (0.1701)	-0.2796 (0.2412)
BA/HS Wage Ratio	0.0814 (0.0766)	-0.0197 (0.2116)	0.0665 (0.2778)
# of Flagships in MSA	0.0110 (0.0144)	-0.0456 (0.0278)	0.0762* (0.0429)
# of Community Colleges in MSA	-0.0009 (0.0009)	0.0040** (0.0016)	0.0035* (0.0020)
# of Public 4 Years in MSA	-0.0013 (0.0043)	-0.0219** (0.0090)	0.0031 (0.0109)
# of Private 4 Years in MSA	0.0014** (0.0006)	0.0006 (0.0012)	-0.0061** (0.0016)

¹ All estimates include state fixed effects and age in 1997 fixed effects and are weighed by sampling weights. All results in the table come from one multinomial logit model and include homeowners only.

² Housing price changes are real housing price changes over the 4 years prior to students turning 18 predicted by the conventional mortgage housing price index.

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 4: Marginal Effects from Multinomial Logit Estimates of the Effect of Housing Price Changes on the Likelihood of Attending a Given Type of College Relative to a Non-flagship Public School, by Family Income

Independent Variable	Flagship Public	4 Year Private	Community College
4 Year Home Price Change (\$10,000)* I(Low Income)	0.0039** (0.0010)	0.0013 (0.0033)	-0.0180** (0.0062)
4 Year Home Price Change (\$10,000)* I(Middle Income)	0.0032** (0.0011)	-0.0017 (0.0032)	-0.0027 (0.0044)
4 Year Home Price Change (\$10,000)* I(High Income)	0.0012 (0.0009)	-0.0015 (0.0023)	0.0006 (0.0029)
AFQT Score	0.0016** (0.0002)	0.0024** (0.0004)	-0.0080** (0.0004)
Real Family Income (\$10,000)	0.0006 (0.0009)	0.0034 (0.0022)	-0.0045 (0.0036)
I(Middle Income)	0.0295 (0.0343)	0.0124 (0.0584)	0.0749 (0.0899)
I(High Income)	0.0558** (0.0166)	0.2707** (0.0926)	0.3229** (0.1616)
P-value(Low Income=Middle Income)	0.567	0.415	0.009
P-value(Low Income=High Income)	0.031	0.460	0.003

¹ All estimates include state and age in 1997 fixed effects as well as controls for mother's and father's education, gender, race, MSA-level unemployment and real income per capita, state-level public and private institutions per college age population, per-student state need-based aid, the ratio of BA to associates degree wages, the ratio of BA to high school wages and the number of each type of college in each MSA. All estimates also are weighted by NLSY97 sampling weights and include only homeowners. All results in the table come from one multinomial logit estimation.

² Housing price changes are real housing price changes over the 4 years prior to students turning 18 predicted by the conventional mortgage housing price index.

³ Low-income families are those with total income under \$75,000, medium income families are those with total income between \$75,000 and \$125,000, and high-income families are those with total income over \$125,000.

⁴ Standard errors clustered at the MSA-level are in parentheses: ** indicates significance at the 5% level and * indicates significance at the 10% level.

Table 5: Marginal Effects from Logit Estimates of the Effect of Housing Price Changes on the Likelihood of Attending Any College

Independent Variable	No AFQT (i)	AFQT (ii)	No AFQT (iii)	AFQT (iv)
4 Year Home Price Change (\$10,000)	0.0092** (0.0030)	0.0072** (0.0031)	.	.
4 Year Home Price Change (\$10,000)* I(Low Income)	.	.	0.0153** (0.0058)	0.0104** (0.0053)
4 Year Home Price Change (\$10,000)* I(Middle Income)	.	.	0.0085** (0.0035)	0.0069** (0.0033)
4 Year Home Price Change (\$10,000)* I(High Income)	.	.	0.0012 (0.0047)	0.0011 (0.0049)
AFQT Score	.	0.0053** (0.0003)	.	0.0049** (0.0004)
Real Family Income (\$10,000)	0.0071** (0.0017)	0.0052** (0.0015)	0.0047 (0.0035)	0.0026 (0.0029)
I(Middle Income)	.	.	0.1143** (0.0564)	0.0842 (0.0574)
I(High Income)	.	.	-0.0161 (0.0994)	0.0668 (0.0738)
P-value(Low Income=Middle Income)	.	.	0.209	0.458
P-value(Low Income=High Income)	.	.	0.006	0.012

¹ All estimates include MSA and age in 1997 fixed effects as well as controls for mother's and father's education, gender, race, MSA-level unemployment and real income per capita, state-level public and private institutions per college age population, per-student state need-based aid, the ratio of BA to associates degree wages, the ratio of BA to high school wages and the number of each type of college in each MSA. All estimates also are weighted by NLSY97 sampling weights and include only homeowners. Each row in the table comes from a separate logit model.

² Housing price changes are real housing price changes over the 4 years prior to students turning 18 predicted by the conventional mortgage housing price index.

³ Low-income families are those with total income under \$75,000, medium income families are those with total income between \$75,000 and \$125,000, and high-income families are those with total income over \$125,000.

⁴ 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: The Effect of Housing Price Changes on Application Decisions and Admission Probabilities

	Panel A: Number of Applications				
	Total	Flagship	Non-Flagship	4 Year Private	Apply To 2 Year?
4 Year Home Price Change (\$10,000)	0.010** (0.005)	0.033** (0.008)	0.027* (0.014)	-0.002 (0.011)	0.004 (0.016)
AFQT Score	0.006** (0.001)	0.013** (0.002)	0.010** (0.002)	0.015** (0.003)	-0.032** (0.002)
Real Family Income (\$10,000)	-0.0001 (0.004)	-0.001 (0.007)	-0.007 (0.008)	0.001 (0.009)	-0.025** (0.012)
	Panel B: Number of Admissions				
	Total	Flagship	Non-Flagship	4 Year Private	
4 Year Home Price Change (\$10,000)	0.012** (0.005)	0.037** (0.008)	0.027 (0.016)	-0.008 (0.014)	
AFQT Score	0.007** (0.001)	0.013** (0.002)	0.012** (0.002)	0.017** (0.003)	
Real Family Income (\$10,000)	-0.003 (0.004)	-0.005 (0.009)	-0.009 (0.009)	0.0003 (0.009)	
	Panel C: Number of Admissions, Conditional on Applying				
	Total	Flagship	Non-Flagship	4 Year Private	
4 Year Home Price Change (\$10,000)	0.012** (0.005)	0.009 (0.011)	0.018* (0.010)	-0.015 (0.017)	
AFQT Score	0.007** (0.001)	0.002 (0.002)	-0.00003 (0.002)	0.005** (0.002)	
Real Family Income (\$10,000)	-0.003 (0.004)	-0.005 (0.102)	-0.006 (0.007)	0.009 (0.006)	

¹ All estimates include MSA and age in 1997 fixed effects as well as controls for mother's and father's education, gender, race, home ownership status in 1997, MSA-level unemployment and real income per capita, state-level public and private institutions per college age population, per-student state need-based aid, the ratio of BA to associates degree wages, the ratio of BA to high school wages and the number of each type of college in each MSA. All estimates also are weighted by NLSY97 sampling weights. Each column in each panel comes from a separate regression. Estimates in the first four columns come from poisson models, while estimates in the fifth column of Panel A come are coefficient estimates from a logit model.

² Housing price changes are real housing price changes over the 4 years prior to students turning 18 predicted by the conventional mortgage housing price index.

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 7: OLS Estimates of the Effect of Housing Price Changes on College Resources

Dependent Variable	Independent Variable: Home Price Change (\$10,000)			
	Full Sample	Low Income	Middle Income	High Income
25 th Percentile Math SAT	0.796* (0.417)	1.299** (0.577)	1.297** (0.588)	0.549 (0.464)
75 th Percentile Math SAT	0.573* (0.311)	0.902* (0.542)	0.814* (0.503)	0.426 (0.467)
Faculty-Student Ratio	0.0003** (0.0001)	0.0004** (0.0002)	0.0002 (0.0002)	0.0002 (0.0002)
Expenditures Per Student	289.915** (217.118)	427.974** (181.085)	173.842 (128.781)	273.834 (149.890)
Instructional Expenditures Per Student	63.597** (22.875)	118.608** (40.821)	35.170 (28.171)	55.832 (39.610)
Graduation Rate	0.0014* (0.0008)	0.0016** (0.0007)	0.0022* (0.0012)	0.0011 (0.0011)
Tuition	23.932 (43.622)	25.853 (56.573)	-4.023 (50.441)	27.664 (60.811)

¹ All estimates include MSA and age in 1997 fixed effects as well as controls for AFQT score, parental income, mother's and father's education, gender, race, MSA-level unemployment and income per capita, state-level public and private institutions per college age population, per-student state need-based aid, the ratio of BA to high school wages and the number of each type of college in each MSA. All estimates also are weighted by NLSY97 sampling weights and include homeowners only. Each cell in the first column comes from a separate regression, while each row in the subsequent columns represents a separate regression.

² Housing price changes are real housing price changes over the 4 years prior to students turning 18 predicted by the conventional mortgage housing price index.

³ Low-income families are those with total income under \$75,000, medium income families are those with total income between \$75,000 and \$125,000, and high-income families are those with total income over \$125,000.

⁴ Standard errors clustered at the MSA-level are in parentheses: ** indicates significance at the 5% level and * indicates significance at the 10% level.

Table 8: Robustness Checks

Panel A: Multinomial Logit Estimates				
School Type	Renters Only (i)	Controlling for 1997 Home Price (ii)	Including Non Attenders (iii)	Using Top 50 Public (iv)
Flagship/Top 50 Public	$2.52e^{-9}$ ($3.90e^{-9}$)	0.0023** (0.0011)	0.0014** (0.0005)	0.0024* (0.0014)
4 Year Private	0.0002 (0.0002)	-0.0014 (0.0028)	0.0012 (0.0016)	0.0001 (0.0018)
Community College	-0.0025 (0.0021)	-0.0069** (0.0028)	-0.0060* (0.0035)	-0.0054* (0.0030)
No College Attendance			-0.0095** (0.0033)	

Panel B: School Resource Estimates				
Dependent Variable	Renters Only (i)	Controlling for 1997 Home Price (ii)	State Fixed Effects (iii)	1992-1994 Average Quality Measures (iv)
25 th Percentile Math SAT	0.476 (0.448)	0.778** (0.363)	0.729** (0.338)	
75 th Percentile Math SAT	0.796 (0.482)	0.676** (0.320)	0.523* (0.316)	
Faculty-Student Ratio	0.0003 (0.0002)	0.0003** (0.0001)	0.0003** (0.0001)	0.0002* (0.0001)
Expenditures Per Student	63.487 (53.404)	235.958** (80.308)	295.864** (98.210)	224.699** (74.304)
Instructional Expenditures Per Student	14.059 (15.257)	53.992** (17.731)	63.598** (22.875)	82.371** (25.503)
Graduation Rate	0.0007 (0.0013)	0.0011 (0.0009)	0.0005 (0.0015)	
Tuition	-14.369 (30.553)	80.922** (30.565)	78.436** (36.818)	16.379 (35.371)

¹ All estimates in Panel A include state fixed effects and all estimates in Panel B except those in column (iii) contain MSA fixed effects. All estimates include age in 1997 fixed effects as well as controls for all covariates used throughout the analysis and are weighed by sampling weights. Estimates in columns (ii)-(iv) include only homeowners

² Housing price changes are real housing price changes over the 4 years prior to students turning 18 predicted by the conventional mortgage housing price index. In column (i), the main independent variable is the four-year percent change in home prices at the MSA-level, and the sample is restricted to renters in 1997.

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 9: The Effect of Housing Wealth on Collegiate Outcomes and Student Labor Supply

Panel A: Average Effects						
	Time Between HS and College		BA		Weekly Hours Worked	
	4 Year Home Price Change (\$10,000)	0.0008 (0.0034)	0.0027 (0.0032)	0.0008 (0.0022)	0.0036 (0.0035)	-0.0690 (0.0803)
Real Family Income	-0.0085** (0.0021)	-0.0062** (0.0022)	0.0076** (0.0020)	0.0070** (0.0021)	-0.1535** (0.0450)	-0.1746** (0.0504)
AFQT Score	-0.0038** (0.0007)	-0.0041** (0.0007)	0.0053** (0.0004)	0.0057** (0.0005)	-0.0792** (0.0132)	-0.0751** (0.0143)
MSA Fixed Effects?	No	Yes	No	Yes	No	Yes
Panel B: Effects by Family Income						
	Time Between HS and College		BA		Weekly Hours Worked	
	4 Year Home Price Change* I(Low Income)	-0.0034 (0.0026)	-0.0022 (0.0028)	0.0039** (0.0019)	0.0057** (0.0022)	-0.3059** (0.0929)
4 Year Home Price Change* I(Middle Income)	0.0027 (0.0033)	0.0033 (0.0028)	0.0017 (0.0019)	0.0044** (0.0022)	-0.0158 (0.1009)	-0.0329 (0.1226)
4 Year Home Price Change* I(High Income)	-0.0035** (0.0012)	-0.0016 (0.0018)	-0.0015 (0.0014)	0.0005 (0.0021)	-0.0251 (0.1007)	-0.0164 (0.1407)
AFQT Score	-0.0016** (0.0004)	-0.0014** (0.0004)	0.0044** (0.0002)	0.0046** (0.0002)	-0.0789** (0.0132)	-0.0748** (0.0142)
Real Family Income	-0.0011 (0.0014)	-0.0007 (0.0015)	0.0038** (0.0016)	0.0030* (0.0018)	-0.1033 (0.0674)	-0.1495** (0.0723)
I(Middle Income)	-0.0188 (0.0554)	0.0384* (0.0537)	0.0576 (0.0470)	0.0707 (0.0617)	0.6088 (2.1485)	2.4569 (2.3290)
I(High Income)	-0.0106 (0.1767)	0.0170 (0.1734)	-0.0320 (0.0859)	0.0550 (0.0935)	-2.1475 (4.4655)	-1.3234 (4.5007)
P-value(Low Income=Middle Income)	0.063	0.068	0.288	0.593	0.009	0.120
P-value(Low Income=High Income)	0.979	0.846	0.006	0.030	0.006	0.090
MSA Fixed Effects?	No	Yes	No	Yes	No	Yes

¹ All estimates include state and age in 1997 fixed effects as well as controls for mother's and father's education, parental income, gender, race, MSA-level unemployment and income per capita, state-level public and private institutions per college age population, per-student state need-based aid, the ratio of BA to associates degree wages and the ratio of BA to high school wages. All estimates include only homeowners and are weighted by NLSY97 sampling weights. The time between college and high school and the weekly hours worked estimates are from OLS models, while the BA completion estimates are marginal effects from logit models calculated at the mean of all variables.

² Housing price changes are real housing price changes over the 4 years prior to students turning 18 predicted by the conventional mortgage housing price index.

³ Low-income families are those with total income under \$75,000, medium income families are those with total income between \$75,000 and \$125,000, and high-income families are those with total income over \$125,000.

⁴ Weekly hours worked is calculated by dividing total yearly hours worked in the first year of college enrollment by 52, including respondents who work zero hours in the year.

⁵ 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: Marginal Effects from Multinomial Logit Estimates of the Effect of Housing Price Changes on the Likelihood of Attending a Given Type of College Relative to a Non-flagship Public School, using Four-Year Percentage Change in MSA-level Home Prices Calculated from the CMHPI

Panel A: Average Effects Among Homeowners			
Independent Variable	Flagship Public	4 Year Private	Community College
4 Year Percentage Home Price Change	0.0013** (0.0003)	0.0006 (0.0008)	-0.0012* (0.0007)
Panel B: Effects by Income Group Among Homeowners			
Independent Variable	Flagship Public	4 Year Private	Community College
4 Year Percentage Home Price Change* I(Low Income)	0.0016** (0.0006)	0.0024** (0.0011)	-0.0039** (0.0017)
4 Year Percentage Home Price Change* I(Middle Income)	0.0011** (0.0004)	0.0002 (0.0011)	-0.0004 (0.0013)
4 Year Percentage Home Price Change* I(High Income)	0.0001 (0.0004)	-0.0006 (0.0010)	0.0006 (0.0015)

¹ All estimates include state and age in 1997 fixed effects as well as controls for mother's and father's education, gender, race, MSA-level unemployment and real income per capita, state-level public and private institutions per college age population, per-student state need-based aid, the ratio of BA to associates degree wages, the ratio of BA to high school wages and the number of each type of college in each MSA. All estimates also are weighted by NLSY97 sampling weights and include only homeowners. All results in the table come from one multinomial logit estimation.

² Housing price changes are the percentage change in the CMHPI within each MSA over the four years prior to the student turning 18.

³ Low-income families are those with total income under \$75,000, medium income families are those with total income between \$75,000 and \$125,000, and high-income families are those with total income over \$125,000.

⁴ 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-2: Means and Standard Deviations of Analysis Variables

Variable	Homeowners		Renters	
	Mean	S.D.	Mean	S.D.
4 Year CMHPI Change (%)	26.422	14.766	28.216	15.780
Real Family Income (\$10,000)	10.110	6.958	4.752	4.534
AFQT Score	63.86	25.43	51.69	26.86
Father HS Dropout	0.085	0.279	0.231	0.422
Father HS Diploma	0.314	0.464	0.408	0.491
Father Some College	0.227	0.419	0.165	0.371
Father BA+	0.374	0.484	0.196	0.397
Mother HS Dropout	0.069	0.253	0.218	0.413
Mother HS Diploma	0.307	0.462	0.320	0.466
Mother Some College	0.282	0.450	0.289	0.454
Mother BA+	0.342	0.474	0.173	0.378
Female	0.526	0.499	0.567	0.496
White	0.736	0.441	0.454	0.498
Black	0.097	0.296	0.258	0.438
Hispanic	0.099	0.299	0.211	0.408
Other Race	0.068	0.251	0.077	0.266
Age 12	0.135	0.342	0.136	0.343
Age 13	0.193	0.395	0.198	0.398
Age 14	0.200	0.400	0.205	0.404
Age 15	0.194	0.396	0.204	0.403
Age 16	0.202	0.401	0.206	0.404
Age 17	0.076	0.264	0.050	0.219
Non-Flagship Public	0.330	0.471	0.258	0.438
Flagship Public	0.094	0.291	0.041	0.199
Private 4-Year	0.198	0.399	0.131	0.337
Community College	0.378	0.485	0.570	0.495
Unemployment Rate	4.354	1.495	4.603	1.595
Real Per Capita Income (\$1,000)	32.05	5.90	31.46	5.32
2-Year Schools Per 18-24 Year Old	0.038	0.018	0.037	0.016
4-Year Schools Per 18-24 Year Old	0.071	0.043	0.066	0.037
Real Need-based Aid Per Student	0.463	0.438	0.453	0.457
BA-AA Wage Ratio	1.407	0.087	1.406	0.090
BA-HS Wage Ratio	1.845	0.127	1.859	0.138
25 th Percentile Math SAT	484.56	67.67	464.80	65.17
75 th Percentile Math SAT	595.99	63.61	577.94	64.65
Faculty-Student Ratio	0.038	0.024	0.030	0.020
Expenditures Per Student	16217	18453	11662	13977
Instructional Expend. Per Student	5925	5341	4429	3666
Graduation Rate	0.564	0.177	0.502	0.171
In-state Tuition	7085	7501	5327	6074
Out-of-state Tuition	11791	6858	9420	5828
Time Between HS and College	0.187	0.403	0.311	0.509
BA	0.416	0.493	0.234	0.403
Observations	2801		908	

All estimates include sample weights and are for the sample who attend college within two years of high school graduation and whose parents own a home in 1997. The 4-year CMHPI change is the percent change in the MSA home price index over the four years prior to the respondent turning 18.

Table A-3: Effect of Statewide Housing Price Changes on College Resources Across Institutions Types

Sector	Independent Variable: Ln(Home Price Index)					
	Total Expend.	Inst. Expend.	Faculty/ Total	Faculty/ First-year	Faculty	In-state Tuition
Flagship	0.122** (0.061)	0.106 (0.088)	-0.008 (0.109)	-0.006 (0.132)	-0.015 (0.119)	-0.167* (0.091)
Other public four-year	0.032 (0.097)	0.144 (0.094)	-0.066 (0.090)	-0.234** (0.109)	0.024 (0.132)	-0.117 (0.115)
Two-year	0.115 (0.130)	0.187* (0.095)	0.169** (0.057)	-0.113 (0.131)	0.127* (0.071)	0.128 (0.172)

¹ All dependent variables are logged. All estimates include state unemployment rates, real state per capita income, institution fixed effects and year fixed effects. Each cell in the table represents a separate regression.

² All monetary variables are in 2007 dollars.

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

Table A-4: Effect of Log Statewide Housing Price Index on Financial Aid Offerings by Institution Types

	Any Aid	Federal Grants	State Grants	Institutional Grants	Loans
Dependent variable: natural log of proportion of entering cohort receiving aid					
Flagship	-0.085 (0.080)	-0.226 (0.212)	-1.198** (0.539)	-0.210 (0.189)	-0.251** (0.118)
Other public four-year	-0.143** (0.057)	-0.285** (0.084)	0.164 (0.187)	-0.281 (0.196)	-0.511** (0.135)
Two-year	0.047 (0.075)	-0.098 (0.092)	-0.126 (0.183)	0.294** (0.124)	-0.302** (0.090)
Dependent variable: natural log of real average aid given					
Flagship		0.037 (0.144)	-0.366 (0.245)	-0.210 (0.189)	0.048 (0.168)
Other public four-year		-0.265* (0.054)	-0.281 (0.164)	-0.007 (0.196)	-0.216** (0.108)
Two-year		-0.082** (0.037)	0.155 (0.218)	0.294** (0.124)	-0.133** (0.039)

¹ Each cell represents a separate regression, and all dependent variables are logged. All estimates include state unemployment rates, real state per capita income, institution fixed effects and year fixed effects. Standard errors are clustered at the state level.

² All monetary variables are in 2007 dollars.

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