The Relationship between Location Choice and Earnings Inequality*

Peter McHenry [†]

Version: December, 2011

Abstract

This paper provides new empirical evidence about how workers' locations affect inequality in earnings and costs of living. I find that young college graduates grow up and choose to live in locations that have smaller effects on their own wages and higher costs of living, relative to locations of their less-educated peers. Consequently, young college graduates' migration behavior actually *decreases* earnings inequality, at least in the short-run. In addition, college graduate movers choose destinations with higher average wages (for all workers) and tend to be more responsive to local labor demand shocks. I infer from these observations that college graduates choose to live in more economically productive labor markets than do workers with less education. I argue that young college graduates accept relatively low wages and high costs of living in exchange for local learning opportunities in large, dense cities.

Keywords: Earnings inequality, Migration, Regional labor markets

JEL codes: J31, R23, J61

*For helpful comments, I thank William Evans, Daifeng He, Melissa McInerney, Masaki Nakabayashi, Florian Ploeckl, two anonymous referees, and seminar participants at the 2011 meetings of the Southern Economic Association. I am grateful to the College of William and Mary for a Faculty Summer Research Grant, which partially supported this research.

†Department of Economics, College of William and Mary, P.O. Box 8795, Williamsburg, VA 23187; pmchenry@wm.edu; http://wmpeople.wm.edu/site/page/pmchenry.

1 Introduction

Similar workers in different locations often earn different wages. So, part of measured earnings inequality is due to location-specific wage determinants, like the presence of a natural port or agglomeration economies. Higher wages in a particular location may improve the welfare of its workers if local costs of living (e.g., land prices) do not fully compensate (say, if workers have limited mobility). A major focus of economic research has been to understand the causes and consequences of a rapid rise in U.S. earnings inequality from the 1970s to the present. Relatively few authors explicitly study how location affects earnings inequality (those few include Moretti (2010) and Black, et al. (2009)).[1]

At the same time, locations are–perhaps increasingly–important for labor productivity. The most talented college graduates appear increasingly to flock to high-growth cities. Berry and Glaeser (2005) show that cities with higher initial proportions of college-educated residents experience more growth in the proportion of college-educated residents between 1970 and 2000. Moreover, a city's share of college graduates appears to be linked with its growth and productivity. Glaeser and Saiz (2003) show that cities with more college graduates tend to grow faster throughout the 20th century, and they argue that local skills enable cities to adapt to changing economic environments. Indeed, *The Wall Street Journal* reported recently that the highest-educated American cities gained the most college graduates between 2000 and 2010, noting the specific link between location and widening gaps in earnings: "regions with the most skilled and highly paid workers continue to widen their advantages over less well-endowed locales" (Dougherty and Barry, Sept. 2011).

More- and less-educated people make different migration choices, and moving costs

[1] Moretti (2010) uses Census data to show that college graduates increasingly reside in locations with higher housing costs than less-educated respondents. He demonstrates that controls for local housing costs attenuate the increase in earnings inequality between 1980 and 2000. Black, et al. (2009) use U.S. Census data to estimate returns to schooling in specifications with fixed effects for respondents' locations. They note that the measure of earnings inequality with fixed effects increased less between 1980 and 1990 than the alternative (and more common) measure that does not control for location differences in wages. They also note that the fixed-effects specification is only consistent given a particular form of individual preferences (homotheticity), although they provide evidence against this assumption.

may impede the free flow of labor toward relatively productive places. People with more education tend to migrate with more frequency (Greenwood 1997). Basker (2003) finds that movers with more education are more likely to have a job lined up in their destinations, and less-educated movers are more likely to search for work after arriving at their destinations. Topel (1986) and Bound and Holzer (2000) demonstrate that aggregate shocks to local areas tend to reduce wages of less-mobile residents, in particular those with relatively low education, implying that they may be less able to respond to local economic conditions through migration. Wozniak (2010) shows that workers with some college education are more likely to live in states with better labor market conditions than workers with less education. Part of the return to schooling may be the ability to choose a better destination. This would exacerbate earnings inequality to the extent that locations offer different wage opportunities. It would also exacerbate consumption inequality if local prices do not fully compensate for local wages (say, if labor is not fully mobile).

This paper provides new empirical evidence about how workers' locations affect earnings inequality, which I measure using the log earnings gap between college graduates and high school graduates (the "college wage premium"). I analyze migration behavior in two longitudinal data sets housed at the U.S. Department of Education: the National Longitudinal Study of the High School Class of 1972 (NLS-72) and the National Education Longitudinal Study of 1988 (NELS:88). Both data sets include random samples of seniors in U.S. high schools and follow the respondents with questionnaires into their mid-20s. The NLS-72 cohort members were high school seniors in 1972, and the NELS:88 cohort were seniors in 1992. These data sets imply nationwide trends in early adulthood behavior from the 1970s through the 1990s, ideal for a study of determinants of the rise in U.S. earnings inequality. In particular, I investigate differences over time in migration behavior (location choice) of college graduates (the highly-educated group) and high school graduates (who did not attend college).

In order to understand how location choice affects the earnings distribution, it is informative to compare childhood and adult locations (as in McHenry 2011). Workers did not actively choose their childhood locations, but they did–for the most part[2]–choose adult locations, at least partially based on labor market opportunities. It is much different for highly-educated people to concentrate in high-earnings locations because of their parents' choices than because of their own choices. So, I describe both locations where people grew up[3], and conditional on where they grew up, locations where people chose to live in their 20s. The degree of earnings inequality explained by childhood location is another piece of evidence about intergenerational earnings mobility (see Solon 1999). In addition, if some workers attain much higher wages by exploiting migration opportunities better than others, then a promising strategy to attenuate earnings inequality is to encourage strategic migration behavior among those with relatively low earnings where they live. In addition to wages, workers that tend to cluster in highly-productive local economies may enjoy higher employment rates and wage growth through more productive job matching.

Since I compare labor-market-related decisions of people in the 1970s and 1990s, I focus only on white men. Female labor force participation increased dramatically over this period (Fullerton 1999), and major labor market trends also differed across races (Fairlie and Sundstrom 1999). Inclusion of women and non-white men would introduce those trends and potentially complicate the analysis of changes in migration behavior and earnings inequality over time. However, the main results I emphasize below are similar in specifications that include women and respondents in all racial and ethnic groups.

In my empirical work, I control for respondents' origins when describing destination choices. People with more and less education are not randomly allocated to their origin locations, so differences in their destinations might reflect both their origins and benefits they perceive in different destinations. College graduates may choose high-wage locations on average because they tend to grow up near high-wage locations (e.g., large cities), rather than particular differential benefits they enjoy in such destinations. So, I

[2]The large literature on spousal ties in migration decisions following Mincer (1978) provides one reason to suspect migration decisions are not always individually earnings-maximizing. Nevertheless, I expect adult location decisions to be much closer linked to individual earnings opportunities and preferences than childhood locations are.

[3]In the empirics, this is the location where the survey respondent attended 12th grade.

compare location choices of people with more and less schooling, conditional on origin.

I find that college graduate movers choose destinations that increase their wages *less* than destinations chosen by movers with less education. That is, destination average wage residuals earned by college graduates tend to be *lower* in college graduates' destinations than are high school graduate wage residuals in high school graduates' destinations. These differences occur both in the 1970s cohort and the 1990s cohort, with no discernible trend. So, early-career college graduates appear *not* to choose locations where workers similar to themselves earn relatively high wages, and migration of the relatively young people I observe does not directly exacerbate measured earnings inequality.

In addition, college graduates choose destinations with relatively high costs of living.[4] Since college graduates choose locations where their wages are relatively low and their costs of living are relatively high, the migration behavior I observe works against inequality in nominal wages and purchasing power (nominal wages adjusted for local costs of living).

However, I also find that college graduates tend to live in areas with relatively high *average* wages (over all education groups). College graduates live where college graduate wages are relatively low but wages of workers with less education are relatively high. Appealing to an economic model with many locations and mobile workers and firms, I infer that locations combining high average wages and high costs of living are those with relatively productive labor. Otherwise, firms would not be willing to pay the high wages necessary to compensate workers for high costs of living. The implication is that young college graduates choose more productive locations than movers with less education.

To expand upon these results, I also describe the relationship between local labor de-

[4] While earnings inequality has increased dramatically, Moretti (2010) demonstrates that differences in local costs of living tend to dampen that dispersion. He shows in U.S. Census data that college graduates choose to live in cities with higher costs of living than do high school graduates, and at least 22 percent of the growth in the nominal college premium from 1980 to 2000 is accounted for by costs of living. My findings about costs of living are distinct from Moretti's (2010) in three main ways: 1) I distinguish workers' origins from their adulthood migration choices, 2) I specifically measure location-specific influences on workers' earnings, and 3) my location definition is the commuting zone (CZ), rather than the metropolitan statistical area (MSA).

mand conditions and migration behavior of NELS:88 respondents around 2000. College graduates tend to move to places with larger positive labor demand shocks than destinations of high school graduates. So, college graduates' migration behavior appears to be more responsive to local labor demand conditions than people with lower education (consistent with recent results in Wozniak 2010). Together with the relatively low destination wage impact among of college graduate movers, this result is consistent with college graduate labor being more elastically supplied to locations.

My findings imply that college graduates on average do not parlay their higher education into better migration decisions in terms of finding locations where higher real earnings (and more consumption) are available, relative to workers with less education. As a result, early-career migration decisions did not exacerbate earnings or consumption inequality in the 1970s and 1990s. However, it is possible that college graduates still gain in other ways from their relative concentration in more-productive locations. For example, they may be more likely to be promoted throughout their careers, or they may be less prone to the negative consequences for employment of living in a declining area. Peri (2002) shows that young college-educated workers cluster in large cities early in their careers and move to less dense places as they age. Glaeser and Maré (2001) find evidence of wage growth effects that are larger in cities than rural areas. They argue that this indicates learning and increased productivity from the dense population and activities in cities. College graduates may choose relatively dense productive cities early in their careers in order to develop their own skills. It would be worth a short-term pay cut in order to invest in skills that induce wage growth later on.

The NELS:88 panel stops before respondents are old enough to exhibit much wage growth. However, I do find some suggestive evidence that NLS-72 college graduates who choose lower-wage and higher-cost destinations tend to experience more wage growth until they are 30 years old (the end of the panel). This is consistent with highly-educated young workers paying in the short-run for the opportunity to develop their skills in productive labor markets. Large and dense local labor markets are likely to offer the most beneficial learning opportunities, and I also find that college graduate movers are more likely to choose larger cities than less-educated movers.

2 A model of workers' location decisions, wages, and costs of living

Moretti (2011) provides a simple and insightful economic model that describes workers and firms choosing locations in a setting where local prices vary. It is in the spirit of Roback (1982) but allows for imperfect mobility among heterogeneous workers. There are two types of workers, high-skilled (H) and low-skilled (L). They all work and earn wages w_{jc} for skills $j = H, L$ and city c. They pay housing costs r_c that vary with their city and enjoy a city- and skill-specific amenity A_{jc}. The model also allows for individuals to have idiosyncratic tastes for living in a particular city, which induces imperfect mobility.

Let the utility of individual i with skill level j living in city c be:

$$U_{jic} = w_{jc} - r_c + A_{jc} + e_{jic}.$$

Utility equals a person's wage (w_{jc}) net of local costs (r_c) plus the local amenity (A_{jc}) and idiosyncratic taste for the location (e_{jic}). Suppose for simplicity that there are only two cities: a and b. The idiosyncratic utility cost to individuals living in city b (relative to city a) is distributed uniform:

$$\begin{aligned} e_{Hia} - e_{Hib} &\sim U[-s_H, s_H] \\ e_{Lia} - e_{Lib} &\sim U[-s_L, s_L]. \end{aligned}$$

If $s_L > s_H$, then low-skilled workers are less likely to move (their elasticity of labor supply with respect to local wages is relatively low). Skilled and unskilled workers are employed at separate Cobb-Douglas firms with the following production functions:

$$\ln y_{jc} = X_{jc} + hN_{jc} + (1-h)K_{jc}$$

where X is a productive amenity, N is population, and K is capital. Inverse housing supply in city c has the form: $r_c = z + k_c N_c$, where N_c is the total population in c.

Each worker chooses to live in the city that maximizes his or her utility. They tend to move toward cities with high wages, low rents, and high amenities, although in equilibrium, wages adjust down and rents adjust up to compensate for population in-flows. Firms maximize profits and tend to locate where productivity X is high, although high wages and rents discourage local entry. An equilibrium occurs when workers and firms would not be better off by changing their behavior, conditional on prices in the economy. Note that since mobility is imperfect, otherwise-identical workers in different locations may attain different utility levels.

Moretti (2011) demonstrates that a more-productive (higher X) city has higher nominal wages, since local productive traits augment the marginal product of local workers.[5] A more-productive city also tends to have higher rents (housing prices), since firms want to produce there and thereby bid up land prices. A more-amenable location tends to have higher rents from workers flowing in. However, such a city does not have lower nominal wages, since fully-mobile capital flows there, augments the productivity of workers, and offsets the labor-supply-induced downward pressure on wages. In addition, high- and low-skilled workers in the model have potentially different rates of mobility (influenced by the parameters s_H and s_L). If one group (e.g., the less educated) is relatively immobile, then wages tend to vary more across locations for that group.

Below, I provide evidence that young college graduates tend to originate from and

[5] The comparative static result that Moretti (2011) works through explicitly in the model with heterogeneous labor is the effect of an increase in local productivity of high-skilled workers only: their nominal wages increase, but low-skilled wages do not increase. A more general increase in local productivity X (affecting both high- and low-skilled workers' marginal products), would increase both of their nominal wages (as in the simpler model with homogeneous labor).

to choose locations in which all workers earn relatively high wages and housing costs are also relatively high. I appeal to the equilibrium model and interpret such location decisions as implying that young college graduates choose locations with relatively high productive attributes (higher X), although I do not identify specific attributes that are more and less important (e.g., the presence of a port or agglomeration economies). This is similar to the interpretation in Chen and Rosenthal (2008) that cities with a high sum of wages and housing prices (adjusted for differences in worker and housing characteristics) feature attractive "business environments."

I also find that local wages of college graduates themselves are not relatively high where young college graduates choose to live. This is consistent with high overall (average) wages in such locations in the model, since local returns to schooling in the model can differ across locations. For example, $w_{Ha}/w_{La} > w_{Hb}/w_{Lb}$ is consistent with college graduates gaining relatively little in terms of wages from locating in city b (w_{Hb} similar to w_{Ha}) even if that city has higher average wages (brought up by high wages among low-skilled workers: w_{Lb} significantly larger than w_{La}).

3 Data description

I use several data sets to analyze the relationship between location choice and the college wage premium. To construct location-specific characteristics that describe local wages and costs of living, I use data from the 1980 and 2000 U.S. decennial Censuses (using IPUMS: Ruggles, et al. (2010)). To study changes over time in early labor market geographic mobility, I use two longitudinal data sets: the National Longitudinal Study of the High School Class of 1972 and the National Education Longitudinal Study of 1988.

3.1 Location definition: Commuting zones

An important research decision concerns which location definition to use. In this study, I use the commuting zone (CZ). Each CZ approximates a local labor market, which I consider to be the smallest geographic space where most residents work and most workers reside. Tolbert and Sizer (1996) describe the identification of CZs using journey-to-work data from the 1990 Census.[6] Each CZ is a collection of counties (or a single county) with strong commuting links among them. The CZ definition has the added feature of encompassing both rural and urban areas.[7] There are 741 CZs in the U.S. 604 of them are entirely contained by a single state, 129 of them by two states, and 8 of them by three states (e.g., Washington, D.C.). CZ populations in 2000 range from 1,193 (Murdo, SD) to 16,393,360 (Los Angeles, CA). 258 CZs contain a metropolitan statistical area.

In metropolitan areas, CZs and MSAs overlap significantly. The main advantage of using commuting zones is their tailored measurement of rural areas. The two most common practices (at least among economists) when measuring location-specific variables are 1) include only MSAs (drop rural areas), or 2) calculate statistics for each MSA and the non-MSA space in each state. Rural areas are too important to drop in studies like mine, and pooling non-MSA sections of entire states is costly, since rural areas within a state can vary dramatically. Consider Colorado, whose rural areas include both the mountain country featuring tourist towns like Breckenridge but also the much less snow-filled San Luis Valley in the south central part of the state. A measure of average monthly housing costs in the group of counties including Breckenridge is \$1,150 but only \$540 in the San Luis Valley (American Community Surveys, 2005-09: from Ruggles, et al. 2010).

People in this paper's framework choose destinations that have particular characteristics: wages and costs of living. I use U.S. Census data (the 1980 and 2000 5 percent samples) to calculate CZ-specific measures of these characteristics. The smallest identifiable area in the Census is the "county group" in 1980 and the public use microdata area (PUMA) in 2000. Both are Census-defined places with population no less than 100,000. This definition does not allow perfect matching of boundaries for all CZs. The method used to convert PUMA averages to CZ averages involves assigning PUMA characteristics

[6]The definitions of commuting zones come from work at the U.S. Department of Agriculture.

[7]This is the same location definition used in Autor and Dorn (2008) to study the interactions of different types of workers within labor markets.

to a CZ based on the population weight of the PUMA in the CZ. I use the same method for 1980 county groups and 2000 PUMAs. The Data Appendix describes the sample sizes attained when using Census data to describe CZ locations.

3.2 Location-specific wage and cost-of-living measures

In my empirical work, I focus on differential behavior and outcomes between college graduates and high school graduates (who did not attend college). Much of the literature on rising earnings inequality focuses on the "college wage premium"–the regression-adjusted difference in mean log earnings between college graduates and high school graduates.[8] Moreover, college and high school graduates make significantly different migration decisions, and they are simple to compare in the data.

My motivation for investigating the role of location choice in earnings inequality is the fact that firms pay similar-looking workers more in some locations than others. For example, firms in large cities offer higher wages and salaries than firms in smaller rural labor markets, a phenomenon labeled the "urban wage premium" and the focus of a large research literature.[9] It is very likely that locations paying relatively high wages to observationally similar workers have higher labor productivity than locations that pay less: otherwise, firms would move operations to areas with lower labor costs. In equilibrium, the higher wages in more productive places could be sustained if they are off-set by higher costs of living or if workers have limited geographic mobility. In the model of Section 2, higher wages follow the presence of a productive local attribute illustrated with X_{jc}, and the degree to which wages increase with productivity depends at least partially

[8]See Moretti (2010) for an example. Goldin and Katz (2008) document the relationship between the college wage premium and other measures of earnings inequality, such as the ratio of 90th percentile to 10th percentile earnings. Trends in inequality series are not always the same, but many measures of earnings inequality increased overall from the 1960s to the early 2000s. Lemieux (2006a) argues that the rising return to postsecondary education was a particularly important element of inequality trends in the U.S. The increase in earnings inequality in the U.S. over this time period is the subject of much research, mostly investigating potential causes behind the trends (e.g., skill-biased technological change, changes in minimum wage laws and union activity, increasing international trade). Katz and Autor (1999) provide a survey. More recent contributions include Lemieux (2006b) and Autor, Katz, and Kearney (2007).

[9]See Glaeser and Maré (2001), Yankow (2006), Wheeler (2006), and Gould (2007) for analyses of the forces behind the urban wage premium.

on workers' mobility influenced by the parameters s_L and s_H.

Below, I investigate whether young workers appear to sort differentially into locations featuring higher and lower wages. To start, I calculate location-specific wage measures. I estimate Equation (1) with nation-wide U.S. Census samples (separately for 1980 and 2000):

$$w_{ij} = x_i\beta + e_{ij}, \tag{1}$$

where w_{ij} is the natural logarithm of person i's average weekly labor earnings observed in location j. The vector x_i includes indicators for education categories (high school drop-out, some post-secondary education but no degree, and college graduate), and an indicator for each year of potential work experience from 0 to 39.[10]

I collect the wage residual for each worker in Equation 1, and then take the average of workers' residuals in a given location j. This is a measure of local average log wages conditional on education and potential experience, that is, by how much more or less firms in each location pay observationally similar workers.[11]

Although the wage residual measure does not perfectly capture local labor productivity, I interpret it as being related to local characteristics that increase overall labor productivity. These could be favorable physical features like a port or human capital externalities, for example. A very likely reason for wages–conditional on worker characteristics–to differ across locations is that different features of the locations induce a variety of local labor productivity levels. In Section 4.4, I investigate the potential for unobserved worker

[10]The regression sample includes non-Hispanic white men ages 18 to 64 who were not in group quarters. I do not include data for women and non-white and Hispanic workers, since those groups experienced significant labor market trends that are probably unrelated to location choices (the main findings in the paper are not sensitive to this exclusion). I include only those with unallocated work hours, work weeks, and labor earnings data. I replace top-coded earnings data with 1.5 times the top-code level ($75,000 in 1980 and $175,000 in 2000). I include only those who worked at least 40 weeks and at least 35 hours per week usually. The weekly wage variable is the annual wage and salary income divided by weeks worked. I weight the regression by the person sample weight (PERWT).

[11]As described above, the Census data do not identify CZ of residence (or workplace) for workers, so I approximate CZ averages using county group averages. In practice, I calculate average wage residuals for each county group or PUMA. I then take a population-weighted average of PUMA averages that make up each CZ and call that the CZ average wage residual measure.

characteristics to offer an alternative explanation for the variation in local wage residuals.

There is no comprehensive set of cost-of-living indices that are consistent over time, specific to locations in the U.S., cover the whole country, and include multiple types of local prices (housing and other prices).[12] However, U.S. Census data include housing prices that cover the entire country and are consistent over time. I therefore use local housing prices to proxy local costs of living. Housing accounts for a large share of household expenditures and is clearly the most important location-specific price category.

The method I use to construct location-specific housing price indices follows Moretti (2010). I use household-level data from the 1980 and 2000 U.S. Censuses (Ruggles, et al. 2010). I select only households in 2- or 3-bedroom housing units (not in group quarters). For the results reported here, I select only renters and use the variable "monthly gross rent" as the baseline housing price measure (using only values that were not allocated).[13] This rental variable includes utility costs. For top-coded values, I impute 1.3 times the top-code ($999 in 1980 and $9,999 in 2000).

I calculate the average 2- or 3-bedroom unit's monthly rent for each county group (or PUMA) identified in each Census year, weighting by the Census household weights. Using the same procedure described above for Census average wage residuals, I estimate Commuting Zone average rental costs as population-weighted averages of county group housing costs. I then convert these CZ-average housing rental prices to CZ-specific housing cost indices. Local costs of living are a weighted average of prices of local goods and traded goods that have a single price across all locations. To weight local prices in overall costs of living, I adopt the housing share in expenditures used to calculate the CPI-U. These are the "relative importance" of housing expenditures in the CPI-U closest to the

[12] Moretti (2010) provides a helpful discussion of availability of local price data. The Bureau of Labor Statistics publishes local price indices including non-housing goods, but they do not allow comparisons across cities and only include a limited number of large cities. The ACCRA Cost of Living Index includes non-housing consumption goods prices for a large sample of cities over time, but the sample sizes are somewhat small.

[13] I also estimated specifications using a housing cost index from owners' self-reported house values. The results are very similar, since location-specific rental and housing prices move very closely together, as expected.

dates of my data (U.S. Department of Labor). Using this method, about 60 percent of costs of living are common across locations, but about 40 percent vary across households in different locations.

Table 1 describes the relationship between average wage residuals and other CZ characteristics. There is a strong positive correlation between CZ population and average wage residuals in both 1980 and 2000 (columns (1) and (2), respectively). CZs are grouped into six categories: small town, small urban, large urban, small metro, medium metro, and major metro, from smallest to largest. The first three contain no metropolitan statistical areas (MSAs), while the last three are categorized by the size of their largest MSA.[14] The increase in average wage residuals between medium metropolitan areas and large metropolitan areas is particularly large. Of course, Table 1 does not demonstrate that larger population causes higher wages or that higher wages cause larger population, but on average, workers can expect to earn higher wages in larger CZs. Conditional on population category, the western region has the highest wage residuals. CZs that border an ocean also have higher wage residuals.

The variation in costs of living across CZs (columns (3) and (4)) mimics the variation in average wage residuals. Larger populations tend to have higher costs of living, and there is a sharp increase in costs from the second-largest-population category to the largest (major metro areas). The cost-of-living gradient in population category is very similar to the analogous gradient in wage residuals. Western and coastal CZs have the highest costs of living, conditional on population category. These relationships exist in both 1980 and 2000 data.

[14] More specifically, the categories describe the largest population center in each CZ. Small towns have fewer than 5,000 residents, small urban centers have between 5,000 and 20,000, and larger urban centers have at least 20,000 but no MSAs in the CZ. The remaining three categories are CZs with at least one MSA in their territory. They are classified according to the size of the largest MSA, where small metro centers have fewer than 250,000 residents, medium metro centers have between 250,000 and 1 million, and major metro centers have more than 1 million. These population figures refer to 1990. The categorization is from Tolbert and Sizer (1996).

3.3 Individual longitudinal data: NLS-72 and NELS:88

To investigate location choices over time, I use the National Longitudinal Survey of the High School Class of 1972 (NLS-72) and the National Education Longitudinal Study of 1988 (NELS:88). From both, I take a representative sample of high school seniors in the United States: in 1972 from NLS-72 and 1992 from NELS:88.[15] Both surveys were administered by the U.S. Department of Education.

Both surveys allow identification of respondent residence locations (though access is restricted by the Department of Education). I focus in particular in both surveys on the respondent's commuting zone (CZ) as a high school senior and again at age 26 (the age of final follow-up in NELS:88). The NLS-72 data file includes county of the respondent's high school and zip code of residence at the fourth follow-up survey (fielded from October 1979 to May 1980). For the NELS:88 sample, I infer zip code of a student's school from provided data on detailed Census characteristics of the school's zip code, and the NELS:88 restricted data file includes the respondent's residence zip code for the fourth (final) follow-up survey (fielded in early 2000). I assign each county or zip code location to its associated CZ.[16]

Other information I use from the longitudinal data sets includes sex, race, ethnicity, highest level of completed schooling, employment status (e.g., full-time or part-time), and earnings. The earnings variable is the sum of all labor earnings in a year and is only counted for full-time workers who have completed their formal schooling.[17] Throughout, I use sample weights that make the NLS-72 and NELS:88 longitudinal samples representative of 12th grade students in U.S. schools in 1972 and 1992, respectively.

[15] NELS:88 started with a random sample of 8th graders, but it is possible to drop respondents who did not become high school seniors in 1992 and use an appropriate weighting scheme to analyze a representative sample of high school seniors (Curtin et al. 2002). I do so in the interest of comparability with the NLS-72.

[16] I was able to match all NLS-72 respondents to a high school CZ and more than 98 percent of them to a fourth follow-up CZ. The corresponding match rates for the NELS:88 were 97 percent and 99 percent. Unmatched respondents tend to be somewhat more educated but otherwise similar to others. Tables 11 through 13 show differences between respondents with and without usable location information. I drop from the analysis respondents without location information.

[17] I assume a respondent has finished formal schooling if he or she does not return to formal schooling during the sample period.

Tables 2 and 3 show summary statistics for the samples I use from the NLS-72 and NELS:88, respectively. NLS-72 provides a sample of approximately 5,440 and NELS:88 provides a sample of approximately 3,380 respondents with non-missing location information in 12th grade and the fourth follow-up surveys.[18] Both tables show that migration out of one's 12th grade origin CZ is common and becoming more common over time. In the NELS:88 sample, about 38 percent of respondents lived at age 26 in a CZ other than their 12th grade CZ.

Migration behavior varies substantially across education levels. Tables 2 and 3 both imply that college graduation is much more common among movers than stayers. Research consistently shows such a positive correlation between education and migration frequency (for example, Malamud and Wozniak (2009) argue that college graduation causes more frequent migration). In addition, migration rates increased similarly for higher and lower education groups in this sample of non-Hispanic white men. The migration rate of college graduates increased from 39.4 to 55.3 percent, while the migration rate among high school graduates increased from 13.9 to 20.4 percent between the 1970s cohort (NLS-72) and the 1990s cohort (NELS:88).

4 Empirical findings about local wages and costs of living by education level

4.1 Differences in location effects on wages by education level

I use data on individual geographic mobility behavior from the 1970s (NLS-72) and 1990s (NELS:88), along with CZ average wage residuals, to understand the effect of location choices on differences in earnings across education levels. I describe locations at two points in the life cycle: 1) locations in high school (presumably chosen by one's parents), and 2) destinations of young adult movers away from their high school locations. I show

[18] Following requirements for the use of restricted-access data, I round all unweighted sample sizes describing these data to the nearest ten. I follow this procedure throughout this paper.

below that similar patterns arise at both points: relative to less-educated peers, college graduates tend to live in areas where they can expect relatively low wages and high costs of living. However, average wages (in all education groups) are relatively high where college graduates disproportionately live.

Table 4 displays new findings about the relationship between educational attainment and geographic location. Each column presents results from a regression in which the observations correspond to respondents to either NLS-72 or NELS:88. The dependent variable is the average wage residual in the respondent's CZ of residence *among workers with his own education level* (college graduate, some college, only high school, less than high school): in columns (1) and (2), this refers to the CZ where the respondent attended high school (12th grade). For example, a college graduate respondent from Nashville, TN has as the dependent variable the average wage residual among college graduate workers in the Nashville CZ (from the 1980 Census in column (1) and the 2000 Census in column (2)). This is a proxy for the expected effect of a respondent's location on his wage (that would enter a calculation of earnings inequality).

The reason the dependent variables are conditional on education group is that high local average wages (over all education groups) do not necessarily apply equally to each group of workers.[19] Black, Kolesnikova, and Taylor (2009) provide evidence that returns to schooling vary across cities and are lowest in the cities with the highest costs of living. This implies that wages do not always increase in equal proportions for each education group as overall costs of living (and wages) rise. Indeed, the results in Black, Kolesnikova, and Taylor (2009) imply that college graduates' wages rise more slowly from low- to high-cost-of-living cities, relative to wages for other education groups. The model in Section 2 allows for such differential location-specific returns to schooling (e.g., $w_{Ha}/w_{La} < w_{Hb}/w_{Lb}$).

Specifications in columns (1) and (2) of Table 4 include all respondents and regress own-education average wage residuals in their high school (origin) CZ on indicators for

[19] I am grateful to an anonymous referee for making this point.

the respondent's eventual level of completed schooling. In the 1970s and 1990s, high school seniors who would eventually finish college lived in relatively low-wage CZs based on this measure. College graduates tend to benefit less–in terms of expected local earnings–from their parents' location decisions than high school graduates do. In this way, initial location tends to increase intergenerational earnings mobility.[20]

Columns (3) and (4) of Table 4 include only movers and describe differences in education-level-specific average wage residuals of movers' destinations. The motivation behind these regression specifications is to assess how people with the same geographic origin (high school CZ) but with different characteristics make different location decisions. The specifications in these columns include fixed effects for high school CZ and include only respondents who moved away from their high school CZ. Conditioning on high school location controls for any origin characteristic that might affect future location decisions. Examples are proximity to a large city, local institutions that make out-migration more and less attractive, and local labor market conditions like unemployment and job growth.

Conditional on their origins, young college graduate movers choose destinations where they might expect low wages, relative to expectations of less-educated movers. While college graduates increasingly cluster in cities with high pre-existing college shares, such clustering *does not* appear to exacerbate increasing earnings inequality, as least not directly. Based on location-specific wage residuals, college graduates do not originate in or move toward locations where they would expect wage advantages over high school graduates (beyond the nationwide college wage premium).

Below, I investigate differences in costs of living where different education groups live. Young college graduates tend to live where costs of living are high, which further erodes their consumption possibilities. I then describe evidence about benefits that young college

[20]Coefficients on Ed $<$ HS are positive in columns (1) and (2), implying that high school dropouts in the samples originated in locations with larger effects on their wages than high school graduates. This is also consistent with origin locations dampening earnings inequality. However, I do not emphasize the differences between high school dropouts and high school graduates in these samples: since the sample frame begins with high school seniors, students who drop out before 12th grade are excluded. The result is that the sample does not represent high school dropouts overall. Also, the subsamples of high school dropouts are rather small, and coefficient estimates related to them are generally imprecise.

graduates' location choices yield, for which they trade off relatively low wages and high costs of living.

4.2 Differences in local costs of living by education level

The previous section demonstrated that differential origin locations and subsequent migration choices differ across education groups in terms of local wages. A fuller picture of location differences includes costs of living, since they adjust in equilibrium to determine differences in consumption possibilities of residents. Consider the economic model of multiple locations described in Section 2. The relatively high level of economic activity in a very productive location should induce relatively high local prices, as firms and workers bid up the price of local goods (e.g., land). This tends to offset the workers' utility gain from higher wages there. How much local prices adjust to local productivity differences depends on the elasticities of labor supply to a location and of local goods (e.g., housing supply). Hence, it is an empirical question.

In this section, I focus on differences between college and high school graduates in their local costs of living. Table 5 adds controls for local costs of living to specifications from Table 4. Again, the dependent variable is the average wage residual among workers with the same education level as the respondent where he lives. Columns (1) and (2) describe high school locations, and columns (3) and (4) describe destinations of movers (with fixed effects for high school CZ). Coefficients in the rows labeled "Log rent index" imply that higher costs of living are partially compensated by wages (the coefficients are positive and less than one).[21] Furthermore the gap between college and high school graduates here is larger than in Table 4 specifications that do not control for costs of living. This implies that college graduates grow up in and move toward relatively high-cost locations. These differences are particularly high among the 1990s NELS:88 cohort.

To the extent that college graduates choose locations with high costs of living, they fur-

[21]One reason full compensation is not necessary to retain workers is that workers in high-price locations tend to substitute consumption of traded goods for local goods, thereby mitigating the consumption reduction of high local costs. DuMond, Hirsch, and Macpherson (1999) discuss such an effect.

ther reduce the consumption or utility impact of their differential location-specific nominal wages. I find that this is the case: young college graduates choose locations with higher costs of living. An implication of this is that levels and increases in earnings inequality in the U.S. are larger than levels and increases in cost-of-living-adjusted earnings. This finding, complementing similar recent evidence in Moretti (2010), implies that U.S. earnings inequality–though large in magnitude–is higher than inequality in purchasing power.

4.3 Differences in local average wages by education level

To provide a fuller picture of differences in location choices, I also describe the average wages of workers where NLS-72 and NELS:88 respondents live. This is a measure of overall employment costs that local firms face. The dependent variable in each column of Table 6 is the average wage residual (in all education categories) in the respondent's CZ of residence. Otherwise, the specifications are the same as those in corresponding columns of Table 4.

In both cohorts, people who eventually attain more education tend to attend high school in higher-wage locations (columns (1) and (2)). In addition, the difference between origin location wage residuals for college graduates and high school graduates increases markedly between the 1970s cohort and 1990s cohort. Relative to their peers who did not attend college, high school seniors in 1992 who graduated from college lived in CZs where similar workers earned about 0.05 log points more on average.

Columns (3) and (4) of Table 6 focus on location choices made by the respondents themselves. The specifications include fixed effects for high school CZ and include only movers. Conditional on where they attended high school, college graduates in the 1990s tend to move toward higher-wage locations than their less-educated peers. The difference in destination choice average log wage residuals between college and high school graduates is not significant in the 1970s but grows to 0.0438 log points in the 1990s. The first thing to note is that–to the extent high overall wages signal higher local productivity–

college graduates choose more-productive labor markets. It was not clear ex ante that this would be the case, since college graduates may simply earn more in all locations and not be over-represented in highly-productive locations. This finding complements others in the literature. Moretti (2010) shows that college graduates tend to live in areas with higher costs of living, which may be related to local productivity but also to amenability and local housing supply. Berry and Glaeser (2005) show that college graduates tend to cluster in cities with relatively high initial education levels and relatively high college wage premia. Neither study estimates migration behavior directly, but both assess location in cross-sections from the U.S. Census.

I interpret the findings of Tables 4 through 6 to imply that young college graduates choose more productive labor markets than their high-school graduate peers. College graduates are increasingly clustering, by origin and choice, in local labor markets featuring both relatively high overall wages and relatively high costs of housing. Firms would not be willing to pay relatively high wages and land costs in these cities unless they also feature relatively productive amenities. These could be human capital externalities, physical attributes like a port, access to markets, or spillovers from other industries. My findings complement Chen and Rosenthal (2008), who show that young college graduates in the U.S. Census choose to live in areas with relatively high regression-adjusted wages and housing costs. They also appeal to an equilibrium model to describe such places as having favorable environments for business.

4.4 The effect of geographical sorting on unobservables

The previous sections demonstrated that college graduates tend to live in CZs where average workers earn relatively high wages. I argue that this relationship implies college graduates choose locations based on local characteristics in a way that is systematically different from other education groups: the higher average wages (along with higher costs of living) in college graduates' destinations are due to higher average labor productivity. For my purposes, a potentially confounding reason for a local labor market to have high wages is differential selection of workers with high unobserved skills to some locations more than others. My framework implies that a location's average wage residual gives a proxy for how much the wage would increase for a randomly-selected worker locating there. If my productivity measure is just capturing the local stock of unobserved skills, then it will not necessarily influence the earnings of a worker moving to that location.

While I cannot completely rule out an influence of differential selection, I can provide some evidence that it is not likely to drive the results. When calculating the location-average wage residual, I control flexibly for important wage determinants including education and potential experience. A selection story would then need to rely on other wage determinants. Of course, there remains the possibility that other labor market skills are left in the residual and not measured in the Census data. So, I use the more detailed individual characteristics in the NLS-72 and NELS:88 longitudinal data sets to explore the potential for unobserved skills to explain the location average wage residuals.

In Table 7, each column includes regression coefficients from a specification following Equation (1), but this time estimated using the longitudinal samples of early labor force participants (NLS-72 and NELS:88) rather than Census respondents. The dependent variable is the natural logarithm of annual earnings when respondents are around 25 years old. I include only those respondents working full-time who have completed their formal schooling.

The coefficients on the "College grad" variable of Table 7 indicate a large college premium in all specifications, and a much larger college premium among the later cohort. The relatively young samples from the NLS-72 and NELS:88 display college wage premia that are smaller than analogous college wage premia for the entire population: the college premium takes time to expand fully, but it is quite high even among young labor market participants. Columns (2) and (6) include as an additional regressor the average wage residual for the respondent's CZ of residence from Census data (described above). As expected, local average wage residuals calculated in the Census predict higher individual earnings in the NLS-72 and NELS:88.

Columns (3) and (7) test the extent to which some proxies for labor market skills unobserved in the Census can explain the relatively high wages in some CZs (that is, locational selection on unobserved skills). The first skill proxy is a transformed value from a test given to student respondents. I regressed reading and math scores on earnings later in life and from the regression coefficients created an index of predicted earnings given a student's test scores. Parent education is the maximum years of schooling between the respondent's mother and father, and family income is measured while the respondent is in secondary school. As expected, test scores and family income have positive partial correlations with earnings (conditional on these, the parent education relationship is not clearly positive and might be negative). Importantly, the relationship between the residence CZ average wage residual and respondent wages remains strong after controlling for several proxies for skills unobserved in the Census.

Previous literature also supports the claim that some local labor markets exhibit higher wages for workers than others, for reasons other than differential sorting on unobserved worker traits. Moretti (2010) argues that wage differences across locations are driven by differences in labor demand conditions. As evidence, he shows that MSAs experiencing relatively large increases in their college graduate populations from 1980 to 2000 also experienced relatively large increases in their college wage premia. Higher local labor demand can explain higher local wages for a given resident without regard to his observed or unobserved characteristics. In his model (from which the model in Section 2 is drawn), a relatively high local productivity term X_{jc} justifies relatively high wages for a worker with skill level j, and this wage might be higher than an identical worker earns elsewhere if costs of living (r_c) offset the inter-location utility difference or mobility is costly ($s_j > 0$). Otherwise, identical workers would migrate toward the location with higher wages and erase the inter-location wage difference.

I argue that my findings imply that young college graduates tend to locate in more productive local labor markets than young high school graduates. Part of this locational difference comes from differences in NLS-72 and NELS:88 respondents' locations when they were in high school (columns (1) and (2) in Table 6). Since high school students do not in general choose their locations, they are probably not likely to be driven by labor market sorting.[22]

When NLS-72 and NELS:88 respondents choose their own locations as adults, I also observe college graduates choosing destinations with higher wage residuals than respondents with less education. This is *not* because some local labor markets offer high wages to college graduates–with relatively high unobserved skills as well–but not to other workers. Columns (4) and (8) of Table 7 show regression specifications that allow the relationship between the CZ average wage residual and individual workers' earnings to vary by education level. In both NLS-72 and NELS:88 samples, the effect is positive for all education categories. Indeed, higher-wage-residual locations offer an even larger wage increase to high school graduates than college graduates in the NLS-72 sample. So in comparison to college graduates, high school graduates appear to have at least as much to gain by moving to productive CZs. Furthermore, I demonstrated above that college graduate movers *do not* choose locations where just college graduates earn relatively high wages: indeed, education-specific wage residuals at destination are relatively low among college graduate movers. Instead, college graduate movers disproportionately choose locations where *all* workers earn relatively high wages, and this kind of relationship does not follow from selection on unobserved skills.

5 Local labor demand and wage growth by education level

The previous sections imply that young college graduates tend to live in higher-cost locations with smaller expected effects on their wages, relative to people with less education. To investigate what makes such areas relatively attractive to college graduates, I describe in this section the relationship between local labor demand conditions and loca-

[22] To the extent that parents pass their unobserved abilities to their children, there may be a link between unobserved abilities of high schoolers and average workers in their locations. However, I expect this connection to be somewhat weak, since it would rely on both an intergenerational correlation in skills (which is imperfect) and location sorting of parents (which is not clearly strong).

tion choices. I find that people with more schooling tend to choose locations with more positive labor demand conditions (fleeing locations with fewer available jobs and flocking to locations with growing employment opportunities). I view this as additional evidence that young college graduates are attracted to local economies where labor inputs are relatively productive.

The findings in this section complement those in Wozniak (2010). She demonstrates that young college graduates tend to choose states with more robust labor demand conditions than less-educated peers. Major differences between her study and my analysis below include the model, data set, and location definition. Wozniak (2010) estimates a conditional logit model with U.S. Census respondents choosing states with more and less robust labor demand growth. I estimate OLS regressions describing CZ labor demand conditions in destinations chosen by NELS:88 respondents.

To approximate local labor demand shocks, I predict for each CZ the employment growth it would experience from 1998 to 2000 if each *local* industry's employment grew at that industry's *national* growth rate. This variation in employment growth is plausibly uncorrelated with location-specific factors that might confound estimates of the relationship between employment growth and location choices, such as location-specific regulatory changes. The employment growth measure also identifies economic factors behind growth, as opposed to changes in location preferences or local amenities like climate characteristics. The motivation for the measure comes from Bartik (1991), who cites an earlier use in Bradbury, Downs, and Small (1982).

In particular, I take 1998 and 2000 employment counts by industry in each county in the U.S. from the County Business Patterns (CBP) data from the Census Bureau. I aggregate employment by industry (at the 3-digit NAICS code level) to the CZ level and the national level. Let $LD_{c,1998-2000}$ be the proxy for labor demand changes in CZ c between 1998 and 2000. Let $-c$ denote values in all CZs except c, and let j index industries. Then,

$$LD_{c,1998-2000} = 100 \times \sum_j \frac{E_{j,-c,2000} - E_{j,-c,1998}}{E_{j,-c,1998}} \times \frac{E_{j,c,1998}}{E_{c,1998}}. \tag{2}$$

The first term in the sum is industry j's employment growth in the nation excluding CZ c. The second term multiplies this by the pre-existing (1998) industry j employment share in CZ c ($E_{j,c,1998}$ is the number of workers in CZ c and industry j, and $E_{c,1998}$ is the total number of workers in CZ c, all industries). CZs dominated in 1998 with industries that grew everywhere else are predicted to grow overall; CZs whose major industries declined everywhere else are predicted to decline. The factor of 100 allows interpretation in terms of percentage points of growth.

An important point made in Wozniak (2010) is that robust demand for one education group may exist where relatively few employment opportunities are available for other education groups. To account for this possibility, I also calculate education-specific measures of local labor demand changes. The idea is to weight each local industry according to its share of workers in a given education category. For example, the college-graduate-specific labor demand proxy is high for CZs with large shares of employment in Funds, Trusts, and Other Financial Vehicles–an industry with a high share of college graduates–when that industry grows nationwide. On the other hand, the less-than-high-school-specific labor demand proxy is high for CZs with large shares of employment in Crop Production–an industry with a high share of high school dropouts–when that industry grows nationwide. The labor demand conditions proxy for education level e in CZ c is:[23]

[23] Wozniak (2010), whose location definition is the state, uses state-specific education shares in each industry as weights. I do not have data describing education attainment within industries at the CZ level, so I use a coarser measure: education shares in industries at the national level. The ideal is to have E_{jce}/E_{ce}, the share of industry j among education level e workers in CZ c. But I don't have E_{jce}. I assume the likelihood of an industry j worker having education e is the same across CZs: $\Pr(e|j,c) = \Pr(e|j)$ for each c. Now, $E_{jce} = E_{jc} * \Pr(e|j,c) = E_{jc} * \Pr(e|j) = E_{jc} * E_{je}/E_j$. Substitute this into the expression I want:

$$\begin{aligned} E_{jce}/E_{ce} &= (E_{jc}/E_{ce}) * (E_{je}/E_j) \\ &= ((E_{jc}/E_c)/(E_{ce}/E_c)) * (E_{je}/E_j) \\ &= ((E_{jc}/E_c) * (E_{je}/E_j)/(E_{ce}/E_c)) \end{aligned}$$

So, the industry-weight to use for each CZ is just a function of: share of industry j in CZ c (E_{jc}/E_c), share of education e in industry j (national) (E_{je}/E_j), and share of education e in CZ c (E_{ce}/E_c)). I use 2000 Census data describing workers aged 24 to 64 to calculate the share of workers in each industry who have a given education level (college graduate, some college, high school graduate, less than high school).

$$LD_{c,e,1998-2000} = 100 \times \sum_{j} \frac{E_{j,-c,2000} - E_{j,-c,1998}}{E_{j,-c,1998}} \times \frac{E_{j,c,1998}}{E_{c,1998}} \times \frac{E_{j,e,1998}}{E_{j,1998}} \times \left(\frac{E_{c,e,1998}}{E_{c,1998}}\right)^{-1}. \quad (3)$$

The education-specific local labor demand proxy in Equation (3) is analogous to Equation (2) but weights each local industry according to its workers' education levels.

I use the NELS:88 sample to assess how young adults with different education levels respond to local labor demand conditions.[24] I regress the labor demand conditions ($LD_{c,1998-2000}$ or $LD_{c,e,1998-2000}$) where respondents live in 2000 (at age 26) on their education levels. All specifications include fixed effects for origin CZ to identify variation in respondents' own choices separately from their parents' choices. Table 8 shows the results. Overall, respondents with more education choose to live where labor demand shifts are predicted to be more positive. Columns (1) and (2) display results when the dependent variable measures overall labor demand ($LD_{c,1998-2000}$). Whether the sample includes residences of all respondents (movers and stayers) or only destinations of movers, college graduates live in the CZs with the largest increases in labor demand.

The education gradient is even steeper when I use the education-specific labor demand proxy ($LD_{c,e,1998-2000}$) as the dependent variable. Columns (3) and (4) assign to each respondent his destination's labor demand proxy in his own education level. The results imply that college graduates' location decisions are more responsive to local demand for college graduates, than are high school graduates' location decisions to local demand for high school graduates. I interpret this as being consistent with the claim that college graduates seek out relatively productive local economies.

Even though – as I demonstrated in previous sections – college graduates do not appear as sensitive to local earnings and disposable income (accounting for costs of living), they are the most sensitive group to overall local employment growth. It appears that college graduates find something in such relatively robust labor markets that makes the

[24]The CBP data I use do not include early enough years to describe location decisions of NLS-72 respondents.

sacrifice of purchasing power worthwhile. One possibility is that short-term disposable income is relatively low, but anticipated wage growth makes up for the cost. Below, I present suggestive evidence that young college graduates in the NLS-72 sample did experience such a trade-off.

The NELS:88 sample stops when respondents are about 26 years old, so I do not have enough earnings observations for college graduates to infer much about wage growth. However, the NLS-72 sample features a final interview when respondents are about 30 years old. Typical college graduates will have had as much as 8 years of work experience, so I use these data to measure wage growth.

I calculate the year-to-year growth in annual earnings of NLS-72 college graduates after graduation. Each worker's average of annual growth rates (among those with at least four years of full-time earnings) is the dependent variable. I regress this on the average wage residual among college graduates and the rental price index where the respondent lived in the fourth follow-up survey (age 26). The sample includes only college graduates.

Table 9 displays results from specifications with and without fixed effects for origin (high school CZ). Both specifications imply more wage growth among residents in CZs with lower average wage residuals and higher costs of living, although statistical significance is very weak, and I interpret the coefficients as only suggestive. The relationships are consistent with higher wage growth being a payoff for college graduates who live in locations that offer them relatively low disposable income in the short-run. The wage growth may be the result of particularly productive learning opportunities available in such cities. Indeed, college graduates in the NLS-72 and NELS:88 live on average in larger cities than their less educated peers.[25] This finding is consistent with the arguments in Glaeser and Maré (2001) and Peri (2002) that dense urban areas are particularly valuable to young workers for the learning opportunities they offer, as such skill acquisi-

[25]In specifications analogous to those in Table 4 columns (3) and (4) but with the logarithm of the destination CZ's population as the dependent variable, the coefficient on "College grad" is 0.24 for the NLS-72 sample and 0.611 for the NELS:88 sample. That is, college graduate movers, conditional on origins, choose larger destinations than high school graduate movers. College graduates also originate in larger CZs than less-educated respondents.

tion should be capitalized into wages over time.

6 Conclusion

This paper provides new empirical evidence about how workers' locations affect earnings gaps in the United States. I argue that young college graduates increasingly locate in local labor markets that are more productive than those chosen by their less-educated peers. However, this does not widen the income gap between college and high school graduates (the college wage premium), at least not directly. Young college graduates originate in and move toward locations where education-specific measures of wages (proxies for relative wages they will earn in their locations) are relatively low. However, these locations feature high average wages and high costs of living.

The equilibrium framework implies that firms would not do business in locations with high land costs and high wages unless productivity there is relatively high. So, I interpret young college graduates' choices of such locations as evidence that they value high local productivity more than people with less education. I provide further evidence that college graduates choose locations with relatively robust employment growth, and also that college graduates who choose low-wage and high-cost-of-living locations experience relatively high wage growth (though these latter estimates are imprecise).

One implication is that nominal earnings inequality measures (not accounting for local costs of living) are higher than inequality in purchasing power (which depend on costs of living), since the most-educated respondents (with the highest earnings on average) live in locations with the highest costs of living. This complements similar findings in Moretti (2010). While Moretti's findings are based on repeated cross-sections, I use panel data to demonstrate that both origin locations and migration behavior contribute to this finding.

It would be helpful for future research to determine the longer-term ramifications of differential migration behavior of the relatively young adults in my samples. I suggest here that some workers trade-off relatively low local wages and high local prices for more wage growth. But my NLS-72 sample stops when respondents are 30 years old, and the NELS:88 does not even get that far. More later-career wage growth may imply that young college graduates' choices of productive locations does increase earnings inequality, as the skills they learn in productive cities yield higher earnings over time.

College graduates may gain in additional ways from their relative concentration in more-productive locations. More-productive locations may feature more job offers, which could help reduce unemployment spells and increase lifetime work experience and human capital developed on the job. A similar benefit would accrue if more-productive locations are less susceptible to economic downturns.

If such labor market benefits to migration accrue more to college graduates than less-educated workers (in particular, if market frictions inhibit beneficial migration), then public policies that encourage migration among the less-educated may improve overall welfare. An example is the relocation assistance feature of the U.S. Trade Adjustment Assistance program, which reimburses moving expenses and provides a modest lump-sum payment to workers who acquire a job that requires a long-distance move.

References

[1] Autor, David H. and David Dorn (2008) "Inequality and Specialization: The Growth of Low-Skill Service Jobs in the United States" MIT Working Paper.

[2] Autor, David H., Lawrence F. Katz, and Melissa S. Kearney (2008) "Trends in U.S. Wage Inequality: Revising and Revisionists" *Review of Economics and Statistics* 90(2) 300-323.

[3] Bartik, Timothy J. (1991) *Who Benefits from State and Local Economic Development Policies?* (Kalamazoo, MI: W. E. Upjohn Institute for Employment Research).

[4] Berry, Christopher and Edward L. Glaeser (2005) "The Divergence of Human Capital Levels across Cities" *Regional Science* 84(3) 407-444.

[5] Black, Dan, Natalia Kolesnikova, and Lowell Taylor (2009) "Earnings Functions When Wages and Prices Vary by Location" *Journal of Labor Economics* 27(1) 21-47.

[6] Bound, John and Harry J. Holzer (2000) "Demand Shifts, Population Adjustments, and Labor Market Outcomes during the 1980s" *Journal of Labor Economics* 18(1) 20-54.

[7] Bradbury, Katherine, Anthony Downs, and Kenneth Small (1982) *Urban Decline and the Future of American Cities* (Washington, D.C.: The Brookings Institution).

[8] Chen, Yong and Stuart S. Rosenthal (2008) "Local Amenities and Life-Cycle Migration: Do People Move for Jobs or Fun?" *Journal of Urban Economics* 64, 519-537.

[9] Curtin, Thomas R., Steven J. Ingels, Shiying Wu, and Ruth Heuer (2002) *National Education Longitudinal Study of 1988: Base-Year to Fourth Follow-up Data File User's Manual* (NCES 2002-323). Washington, DC: U.S. Department of Education, National Center for Education Statistics.

[10] Dougherty, Conor and Rob Barry (2011) "Select Cities See Brain Gain: Metro Areas With High Education and Income Levels Widen Lead, Census Finds" *The Wall Street Journal* Sept. 22, A3.

[11] DuMond, J. Michael, Barry T. Hirsch, and David A. Macpherson (1999) "Wage Differentials across Labor Markets and Workers: Does Cost of Living Matter?" *Economic Inquiry* 37(4) 577-598.

[12] Fairlie, Robert W. and William A. Sundstrom (1999) "The Emergence, Persistence, and Recent Widening of the Racial Unemployment Gap" *Industrial and Labor Relations Review* 52(2) 252-270.

[13] Fullerton, Jr., Howard N. (1999) "Labor force participation: 75 years of change, 195098 and 19982025" *Monthly Labor Review* 122(12) 3-12.

[14] Glaeser, Edward L. and David C. Maré (2001) "Cities and Skills" *Journal of Labor Economics* 19(2) 316-342.

[15] Glaeser, Edward L. and Albert Saiz (2003) "The Rise of the Skilled City" NBER Working Paper 10191.

[16] Goldin, Claudia and Lawrence F. Katz (2008) *The Race between Education and Technology* (Cambridge: Harvard UP).

[17] Gould, Eric D. (2007) "Cities, Workers, and Wages: A Structural Analysis of the Urban Wage Premium" *Review of Economic Studies* 74, 477-506.

[18] Greenwood, Michael J. (1997) "Internal Migration in Developed Countries" Chapter 12 in M.R. Rosenzweig and O. Stark, eds. *Handbook of Population and Family Economics* (Elsevier Science) 648-720.

[19] Katz, Lawrence F. and David H. Autor (1999) "Changes in the Wage Structure and Earnings Inequality" Chapter 26 in Orley Ashenfelter and David Card, eds. *Handbook of Labor Economics*, Volume 3A (Amsterdam: Elsevier) 1463-1555.

[20] Lemieux, Thomas (2006a) "Postsecondary Education and Increased Wage Inequality" *American Economic Review* 96(2) 195-199.

[21] Lemieux, Thomas (2006b) "Increased Residual Wage Inequality: Composition Effects, Noisy Data, or Rising Demand for Skill?" *American Economic Review* 96(3) 461-498.

[22] Malamud, Ofer and Abigail Wozniak (2009) "The Impact of College Education on Geographic Mobility: Identifying Education Using Multiple Components of Vietnam Draft Risk" mimeo.

[23] McHenry, Peter (2011) "The Geographic Distribution of Human Capital: Measurement of Contributing Mechanisms" College of William and Mary.

[24] Mincer, Jacob (1978) "Family Migration Decisions" *Journal of Political Economy* 86(5) 749-773.

[25] Moretti, Enrico (2010) “Real Wage Inequality” UC Berkeley working paper.

[26] Moretti, Enrico (2011) “Local Labor Markets” Chapter 14 in Orley Ashenfelter and David Card, eds. *Handbook of Labor Economics, Vol 4B* (Elsevier) 1237-1313.

[27] Peri, Giovanni (2002) “Young Workers, Learning, and Agglomerations” *Journal of Urban Economics* 52, 582-607.

[28] Roback, Jennifer (1982) “Wages, Rents, and the Quality of Life” *Journal of Political Economy* 90(6) 1257-1278.

[29] Ruggles, Steven, J. Trent Alexander, Katie Genadek, Ronald Goeken, Matthew B. Schroeder, and Matthew Sobek. *Integrated Public Use Microdata Series: Version 5.0* [Machine-readable database]. Minneapolis: University of Minnesota, 2010.

[30] Solon, Gary (1999) “Intergenerational Mobility in the Labor Market” Chapter 29 in Orley Ashenfelter and David Card, eds. *Handbook of Labor Economics*, Volume 3A (Amsterdam: Elsevier) 1761-1800.

[31] Tolbert, Charles M. and Molly Sizer (1996) “U.S. Commuting Zones and Labor Market Areas. A 1990 Update.” Economic Research Service Staff Paper No. 9614.

[32] Topel, Robert H. (1986) “Local Labor Markets” *The Journal of Political Economy* 94(3) Part 2: Hoover Institution Labor Conference. S111-S143.

[33] U.S. Department of Education, National Center for Education Statistics, National Education Longitudinal Study of 1988 (NELS:88/94 and NELS:88/2000). Restricted use files.

[34] U.S. Department of Education, National Center for Education Statistics, National Longitudinal Study of the High School Class of 1972 (NLS-72).

[35] U.S. Department of Labor, Bureau of Labor Statistics, *CPI Detailed Reports*, various years, Table 1: Consumer Price Index for All Urban Consumers: U.S. city average, by expenditure category and commodity and service group.

[36] Wheeler, Christopher H. (2006) "Cities and the Growth of Wages among Young Workers: Evidence from the NLSY" *Journal of Urban Economics* 60, 162-184.

[37] Wozniak, Abigail (2010) "Are College Graduates More Responsive to Distant Labor Market Opportunities?" *Journal of Human Resources* 45(4): 944970.

[38] Yankow, Jeffrey J. (2006) "Why Do Cities Pay More? An Empirical Examination of Some Competing Theories of the Urban Wage Premium" *Journal of Urban Economics* 60, 139-161.

7 Figures and Tables

Table 1: Commuting Zone Wages, Costs of Living, and Other Characteristics

	(1)	(2)	(3)	(4)
Dependent Var.:	Average Wage Residual		Log(Rent Index)	
VARIABLES	1980	2000	1980	2000
Small Urban (non-MSA)	.00691	.0324***	-.00402	.00908
	(.0108)	(.00859)	(.00811)	(.00729)
Large Urban (non-MSA)	.0256**	.0441***	.035***	.0448***
	(.0129)	(.0102)	(.00964)	(.00866)
Small Metro	.056***	.0778***	.0927***	.0874***
	(.0127)	(.01)	(.00947)	(.00852)
Medium Metro	.0725***	.12***	.146***	.139***
	(.0139)	(.011)	(.0104)	(.00938)
Large Metro	.131***	.219***	.201***	.229***
	(.0172)	(.0136)	(.0128)	(.0116)
South	-.105***	-.0172**	-.172***	-.106***
	(.0101)	(.00798)	(.00754)	(.00678)
Midwest	-.0495***	-.0239***	-.0979***	-.0638***
	(.0104)	(.00822)	(.00776)	(.00698)
Northeast	-.126***	-.0217	-.0874***	-.0448***
	(.0175)	(.0139)	(.0131)	(.0118)
Ocean coast	.0718***	.0641***	.109***	.1***
	(.0119)	(.00946)	(.00893)	(.00803)
Constant	-.067***	-.195***	.0349***	-.00831
	(.0107)	(.00846)	(.00799)	(.00718)
Observations	741	741	741	741
R-squared	0.274	0.416	0.666	0.649

***p<0.01 **p<0.05 *p<0.1. Observations are CZs in either 1980 or 2000. Dependent variable is either average log wage residuals or log housing cost index, calculated using U.S. Census samples. Small town (non-MSA) is the omitted size category. West is the omitted region.

Table 2: Characteristics of NLS-72 Respondents, by Move Status

	(1)	(2)	(3)	(4)	(5)	(6)
	All		Movers		Stayers	
	[$N \approx$ 5440]		[$N \approx$ 1480]		[$N \approx$ 3960]	
			[$Rate =$ .265]		[$Rate =$ .735]	
Variable	Mean	SE	Mean	SE	Mean	SE
HS Dropout	.004	.001	.002	.001	.004	.001
HS Grad	.166	.006	.086	.008	.196	.007
Some PSE	.525	.007	.466	.014	.547	.009
College Grad	.305	.007	.446	.014	.253	.008

Sample sizes rounded to the nearest 10 due to confidentiality restrictions. Move status is determined by residence in a commuting zone (CZ) at age 26 that is different from the CZ of the last high school attended. HS, PSE, and SE refer to high school, post-secondary education, and standard error, respectively.

Table 3: Characteristics of NELS:88 Respondents, by Move Status

	(1)	(2)	(3)	(4)	(5)	(6)
	All		Movers		Stayers	
	[$N \approx$ 3380]		[$N \approx$ 1330]		[$N \approx$ 2050]	
			[$Rate =$ .38]		[$Rate =$ .62]	
Variable	Mean	SE	Mean	SE	Mean	SE
HS Dropout	.005	.002	.003	.002	.007	.003
HS Grad	.176	.009	.094	.011	.226	.013
Some PSE	.465	.013	.391	.019	.511	.017
College Grad	.348	.011	.507	.019	.251	.013

Sample sizes rounded to the nearest 10 due to confidentiality restrictions. Move status is determined by residence in a commuting zone (CZ) at age 26 that is different from the CZ of the last high school attended. HS, PSE, and SE refer to high school, post-secondary education, and standard error, respectively.

Table 4: Average Wage Residuals in Respondents' Origins and Destinations by Education Category (Wage Residuals in Own Education Category)

	(1)	(2)	(3)	(4)
Dependent Var.:	Origin CZ Own Educ. Lev. Wage Residual		Destination CZ Own Educ. Lev. Wage Residual	
	Full sample		Movers only	
VARIABLES	NLS-72	NELS:88	NLS-72	NELS:88
College grad	-.0314***	-.0491***	-.0461***	-.0458***
	(.00924)	(.0157)	(.0128)	(.0169)
Some PSE	.000681	.00582	-.0173	-.0155
	(.00626)	(.00799)	(.0129)	(.016)
Ed< HS	.0631**	.0149	-.115	.0117
	(.0257)	(.0188)	(.0797)	(.073)
Constant	-.0194**	-.0416***	-.042***	.0882***
	(.00836)	(.00995)	(.0127)	(.0169)
Observations	5440	3380	1480	1330
R-squared	0.023	0.043	0.273	0.334
Origin CZ Fixed Effects?	NO	NO	YES	YES

***p<0.01 **p<0.05 *p<0.1. OLS regressions. Dependent variable is CZ average log wage residual in the respondent's own education category. Columns (1) and (2) describe origin CZ wages. Columns (3) and (4) describe destination CZ wages and include fixed effects for origin CZ. Origin is CZ of high school attended as a senior. Destination is CZ of residence at fourth follow-up (age 26). Sample weights used. Standard errors clustered at base year CZ level.

Table 5: Average Wage Residuals in Respondents' Origins and Destinations by Education Category (Wage Residuals in Own Education Category), Controlling for Local Housing Costs

	(1)	(2)	(3)	(4)
Dependent Var.:	Origin CZ Own Educ. Lev. Wage Residual		Destination CZ Own Educ. Lev. Wage Residual	
	Full sample		Movers only	
VARIABLES	NLS-72	NELS:88	NLS-72	NELS:88
College grad	-.0528***	-.102***	-.0584***	-.0851***
	(.00711)	(.00689)	(.0118)	(.0126)
Some PSE	-.0191***	-.0241***	-.0283**	-.0281**
	(.00479)	(.00532)	(.0113)	(.0113)
Ed< HS	.051***	.0348**	-.0605	.01
	(.0186)	(.0147)	(.0612)	(.0336)
Log rent index in Origin CZ	.512***	.767***		
	(.0418)	(.0368)		
Log rent index in Destination CZ			.574***	.756***
			(.028)	(.0292)
Constant	-.0624***	-.0933***	.0733***	-.0625***
	(.00702)	(.00598)	(.0117)	(.0129)
Observations	5440	3380	1480	1330
R-squared	0.427	0.737	0.593	0.769
Origin CZ Fixed Effects?	NO	NO	YES	YES

***p<0.01 **p<0.05 *p<0.1. OLS regressions. Dependent variable is CZ average log wage residual in the respondent's own education category. Columns (1) and (2) describe origin CZ wages. Columns (3) and (4) describe destination CZ wages and include fixed effects for origin CZ. Origin is CZ of high school attended as a senior. Destination is CZ of residence at fourth follow-up (age 26). Sample weights used. Standard errors clustered at base year CZ level.

Table 6: Average Wage Residuals in Respondents' Origins and Destinations by Education Category (Average Wage Residuals over All Education Categories)

	(1)	(2)	(3)	(4)
Dependent Var.:	Origin CZ Average Wage Residual		Destination CZ Average Wage Residual	
	Full sample		Movers only	
VARIABLES	NLS-72	NELS:88	NLS-72	NELS:88
College grad	.0236***	.0496***	.00878	.0438**
	(.00557)	(.0128)	(.0121)	(.0172)
Some PSE	.0163***	.0283***	.00901	.00671
	(.00522)	(.00714)	(.0128)	(.0171)
Ed< HS	.0295	-.0115	-.109*	.0033
	(.0183)	(.0151)	(.0639)	(.0649)
Constant	-.0287***	-.0696***	-.0716***	.0547***
	(.0085)	(.00981)	(.0124)	(.0172)
Observations	5440	3380	1480	1330
R-squared	0.006	0.025	0.293	0.354
Origin CZ Fixed Effects?	NO	NO	YES	YES

***p<0.01 **p<0.05 *p<0.1. OLS regressions. Dependent variable is CZ average log wage residual (for workers in all education categories). Columns (1) and (2) describe origin CZ wages. Columns (3) and (4) describe destination CZ wages and include fixed effects for origin CZ. Origin is CZ of high school attended as a senior. Destination is CZ of residence at fourth follow-up (age 26). Sample weights used. Standard errors clustered at base year CZ level.

Table 7: Determinants of Log Annual Earnings

VARIABLES	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	NLS-72 (1979 earnings)				NELS:88 (1999 earnings)			
College grad	.171***	.161***	.125***	.153***	.388***	.353***	.261***	.377***
	(.0266)	(.0265)	(.0268)	(.0269)	(.0516)	(.0489)	(.0484)	(.052)
Some PSE	.0842***	.074***	.0587***	.0683***	.239***	.229***	.189***	.261***
	(.0213)	(.0206)	(.0205)	(.0216)	(.0399)	(.0388)	(.0415)	(.0429)
Ed< HS	-.0155	-.0259	-.03	-.0397	.068	.0599	.0676	.0447
	(.141)	(.143)	(.143)	(.131)	(.0946)	(.0897)	(.0886)	(.108)
Yrs Experience	.0429***	.0444***	.0459***	.0445***	.0375***	.0422***	.0412***	.0414***
	(.00442)	(.00426)	(.00434)	(.00424)	(.0109)	(.011)	(.00964)	(.0108)
CZ avg. wage resid.		.782***	.722***	1.01***		.85***	.762***	.52***
		(.0764)	(.0806)	(.176)		(.122)	(.131)	(.195)
Test Index × 100			.00567**				.0168***	
			(.00236)				(.00321)	
Parent ed			-.00494*				-.0106	
			(.00298)				(.00777)	
Log Family inc			.0765***				.0785***	
			(.0143)				(.0209)	
College				-.46**				.387
× CZ avg. wage resid.				(.203)				(.312)
Some PSE				-.191				.495
× CZ avg. wage resid.				(.195)				(.318)
Ed< HS				-.806				-.315
× CZ avg. wage resid.				(1.33)				(.686)
Constant	9.4***	9.42***	8.6***	9.42***	10***	10.1***	-7.43**	10.1***
	(.0316)	(.0302)	(.138)	(.0304)	(.0629)	(.0635)	(3.19)	(.0635)
Observations	4010	4010	4010	4010	2020	2020	2020	2020
R-squared	0.025	0.064	0.075	0.065	0.056	0.094	0.130	0.096

***p<0.01 **p<0.05 *p<0.1. Dependent variable is individual's log annual earnings (1979 for NLS-72, 1999 for NELS:88). Full-time workers only. Sample weights used. Standard errors clustered at residence CZ level. The test score index is a prediction of adult earnings conditional on a student's math and reading test scores. Family income is a measure from when respondent was in secondary school. Parent education is the higher of mother's and father's years of schooling. Specifications with test scores, family incomes, and parent education also include indicators for missing values, which were replaced by predictions based on other respondent characteristics.

Table 8: Destinations' Predicted Local Labor Demand between 1998 and 2000 by Education Level, NELS:88

	(1)	(2)	(3)	(4)
Dependent Var.:	Overall Predicted Labor Demand		Education-Specific Predicted Labor Demand	
VARIABLES	Full sample	Movers only	Full sample	Movers only
College grad	.265***	.25	.746***	.658***
	(.0676)	(.224)	(.0662)	(.201)
Some PSE	.0355	-.11	.177***	.000365
	(.0567)	(.218)	(.0577)	(.2)
Ed< HS	-.185	-.582	-.237	-.596
	(.14)	(.509)	(.2)	(.513)
Constant	-.893***	1.01***	-1.15***	1.65***
	(.0676)	(.224)	(.0662)	(.201)
Observations	3380	1330	3380	1330
R-squared	0.589	0.351	0.618	0.385

***p<0.01 **p<0.05 *p<0.1. Dependent variable is a prediction of the change in labor demand from 1998 to 2000 using 1998 local industry shares and national industry-level employment changes. All specifications also include fixed effects for origin, which is CZ of high school attended as a senior. Destination is CZ of residence at fourth follow-up (age 26). Sample weights used. Standard errors clustered at base year CZ level.

Table 9: Average Annual Wage Growth of College Graduates in NLS-72

	(1)	(2)
VARIABLES	No Fixed Effects	Fixed effects for HS CZ
Average wage residual	-.0331	-.0998
of college graduates in destination CZ	(.0456)	(.0894)
Log rent index	.0787**	.0739
in destination CZ	(.0392)	(.0962)
Constant	.0627***	-.00921
	(.00769)	(.00859)
Observations	1070	1070
R-squared	0.004	0.186

***p<0.01 **p<0.05 *p<0.1. Data from NLS-72, college graduates only. Dependent variable is average annual growth in earnings. Origin is CZ of high school attended as a senior. Sample weights used. Standard errors clustered at base year CZ level.

8 Data appendix

8.1 Sample sizes for measuring commuting zone (CZ) characteristics

The location-specific wage and cost-of-living measures I use are averages from Census samples and contain sampling error. It is important not to rely on very small samples, but some CZs are small areas with small total populations from which to draw samples. Table 10 describes sample sizes from the Census for CZs where at least one NLS-72 or NELS:88 respondent lives. The different sample sizes reflect different target populations: e.g., average wage residuals cover all full-time white male workers ages 24 to 64, average wage residuals for BA holders covers the subset of college graduates, and average housing rents cover households who live in 2- to 3-bedroom dwellings but do not own them.

Since CZ averages are themselves weighted averages of county group (in 1980) or PUMA (in 2000) averages, there is not a single sample size to attribute to each CZ. For example, suppose 10 percent of a CZ's population comes from PUMA A and 90 percent comes from PUMA B. The sample size from PUMA A is 1000, and the sample size from PUMA B is 100. What is the sample size to attribute to the CZ? It could be the sum of samples contributing to the average (1100), or a weighted average of them (say, $0.1 \times 1000 + 0.9 \times 100 = 190$). Instead, I derive the sampling error of the CZ (weighted) average and call the CZ's "sample size" that part of the sampling error expression that is analogous to the sample size in the sampling error of a simple average (that is, n in $\sigma/\sqrt{n}$).

Let CZs be indexed by j, PUMAs be indexed by p, and people be indexed by i. x is the variable of interest (for calculating averages). n denotes a sample size. w_{pj} is the share of CZ j population that is in PUMA p. The CZ j average of x is calculated as:

$$\sum_p w_{pj} \left(n_p^{-1} \sum_i x_{ip} \right) \tag{4}$$

Assume that $Var(x_{ip}) = \sigma^2 \; \forall i, p$. The standard error of the CZ mean estimate is:

$$\begin{aligned} SE(\widehat{\bar{x}}_j) &= \sqrt{Var\left(\sum_p w_{pj}\left(n_p^{-1}\sum_i x_{ip}\right)\right)} \\ &= \sqrt{\sum_p w_{pj}^2 n_p^{-2} \sum_i Var(x_{ip})} \\ &= \sigma \sqrt{\sum_p w_{pj}^2 n_p^{-1}} \end{aligned} \tag{5}$$

The standard error of a simple mean estimate is the true σ multiplied by $\sqrt{n_j^{-1}}$. In the CZ context, the analogous relationship is the true σ multiplied by $\sqrt{\sum_p w_{pj}^2 n_p^{-1}}$. So, the intuition we have for sample size n_j in the simple case should apply correspondingly to the following expression:

$$\left(\sum_p w_{pj}^2 n_p^{-1}\right)^{-1}. \tag{6}$$

This is the sample size measure that I calculate for each CZ to describe the "sample size" used in calculating means, and to gauge how much confidence to have in them.

The smallest sample ever used to calculate a location characteristic is approximately 10 (as part of a confidentiality agreement, I round to the nearest 10 to obscure the CZs where NELS:88 and NLS-72 respondents live). This is a very small sample, but it only occurs once for one measure. Even the very smallest CZs in the sample have hundreds of data points contributing to housing cost measures. Overall, I interpret Table 10 to imply that almost all of the CZs in my sample have precise measures of location characteristics.

Table 10: Census Sample Sizes for CZ Characteristics at Age 26

	(1) Mean	(2) StDev	(3) Min	(4) Max
Avg. Ln(wage) Resid	8440	10150	220	49140
Avg. Ln(wage) Resid LTHS	830	1150	10	4550
Avg. Ln(wage) Resid HS	2820	3170	50	14590
Avg. Ln(wage) Resid Some PSE	1880	2500	40	14270
Avg. Ln(wage) Resid BA	2400	3110	50	14980
Avg. Rent	6730	9380	210	44670

Summary statistics on the sample of respondents (NLS-72 and NELS:88). Statistics rounded to the nearest 10 due to confidentiality restrictions. LTHS, HS, PSE, BA refer to less than high school, high school, post-secondary education, and bachelor's degree, respectively.

8.2 Identifying locations in NLS-72 and NELS:88

I was not always able to identify residence Commuting Zones (CZs) for all respondents to the NLS-72 and NELS:88. Tables 11 to 13 compare characteristics of respondents for which I do and do not have CZ identified. I was able to identify origin locations for all NLS-72 respondents, so there is no table comparing NLS-72 respondents with identified and not-identified origins. I drop respondents with missing CZ from the analysis.

Table 11: Characteristics of NELS:88 Respondents, by High School Location Data Status

	(1)	(2)	(3)	(4)
	CZ identified [$N \approx 3410$]		CZ not identified [$N \approx 110$]	
Variable	Mean	SE	Mean	SE
HS Dropout	.005	.002	.008	.008
College Grad	.351	.011	.36	.064
Test Index	10.027	.001	10.024	.003
Parents Ed	14.411	.056	14.508	.197
Parents Income	50766	865	59562	6174
Married by Age 26	.418	.012	.296	.062
Any Kids by Age 26	.242	.011	.145	.04

CZ means Commuting Zone, a location definition. The test score index is a prediction of adult earnings conditional on a student's math and reading test scores. Family income is a measure from when respondent was in secondary school. Parent education is the higher of mother's and father's years of schooling.

Table 12: Characteristics of NLS-72 Respondents, by Fourth Follow-up Location Data Status

	(1)	(2)	(3)	(4)
	CZ identified [$N \approx 5440$]		CZ not identified [$N \approx 80$]	
Variable	Mean	SE	Mean	SE
HS Dropout	.004	.001	0	0
College Grad	.305	.007	.344	.06
Test Index	.316	0	.321	.004
Parents Ed	13.134	.033	13.507	.292
Parents Income	11739	73	11583	643
Married by Age 26	.58	.007	.596	.062
Any Kids by Age 26	.312	.007	.326	.061

CZ means Commuting Zone, a location definition. The test score index is a prediction of adult earnings conditional on a student's math and reading test scores. Family income is a measure from when respondent was in secondary school. Parent education is the higher of mother's and father's years of schooling.

Table 13: Characteristics of NELS:88 Respondents, by Final Follow-up Location Data Status

	(1)	(2)	(3)	(4)
	CZ identified $[N \approx 3490]$		CZ not identified $[N \approx 30]$	
Variable	Mean	SE	Mean	SE
HS Dropout	.006	.002	0	0
College Grad	.348	.011	.598	.119
Test Index	10.027	.001	10.047	.015
Parents Ed	14.411	.055	14.669	.403
Parents Income	50868	854	64758	13581
Married by Age 26	.414	.012	.424	.12
Any Kids by Age 26	.238	.011	.305	.117

CZ means Commuting Zone, a location definition. The test score index is a prediction of adult earnings conditional on a student's math and reading test scores. Family income is a measure from when respondent was in secondary school. Parent education is the higher of mother's and father's years of schooling.