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BOOMERANG COLLEGE KIDS: UNEMPLOYMENT, JOB MISMATCH AND CORESIDENCE

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ABSTRACT

Labor market outcomes for young college graduates have deteriorated substantially in the last twenty five years, and more of them are residing with their parents. The unemployment rate at 23-27 year old for the 1996 college graduation cohort was 9%, whereas it rose to 12% for the 2013 graduation cohort. While only 25% of the 1996 cohort lived with their parents, 31% for the 2013 cohort chose this option. Our hypothesis is that the declining availability of 'matched jobs' that require a college degree is a key factor behind these developments. Using a structurally estimated model of child-parent decisions, in which coresidence improves college graduates' quality of job matches, we find that lower matched job arrival rates explain two thirds of the rise in unemployment and coresidence between the 2013 and 1996 graduation cohorts. Rising wage dispersion is also important for the increase in unemployment, while declining parental income, rising student loan balances and higher rental costs only play a marginal role.

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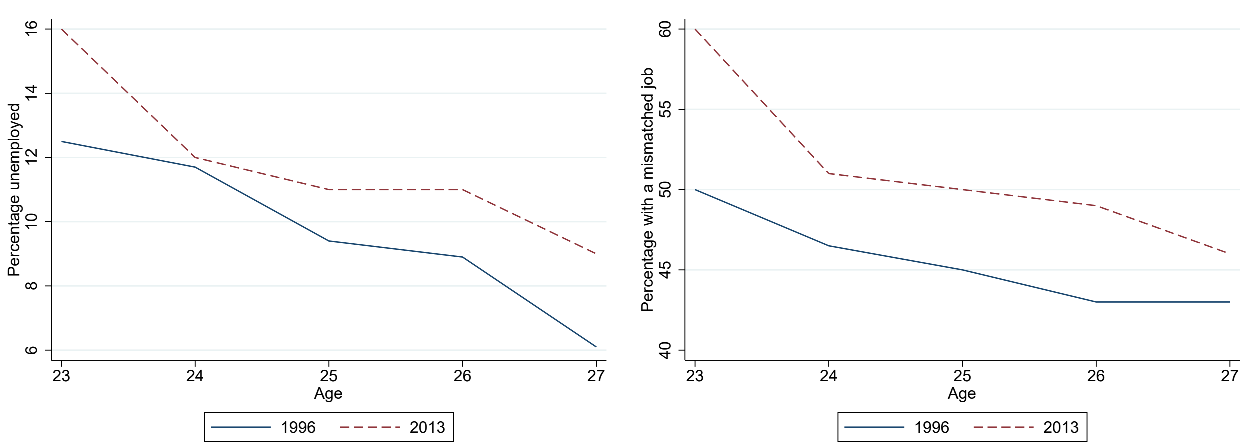
1 Introduction

Millennial college graduates have faced challenging labor market conditions at the start of their careers. This can be clearly seen in panel a) of Figure 1, which compares the unemployment rate at age 23 to 27 years old for the 1996 and 2013 college graduation cohorts in the Panel of Survey of Income and Program Participation (SIPP). The average unemployment rate for this age group in the 1996 cohort is 9% whereas it rises to 12% for the 2013 cohort. Additionally, an increasing fraction of employed college graduates experience 'job mismatch,' which we define as being employed in a position that does not require a college degree.[1] This can be seen in panel b) of Figure 1. The right panel shows that the job mismatch rate for the 2013 graduation cohort at age 23 to 27 years is around 52% on average, which is 7% higher than for the 1996 graduation cohort at the same age. Moreover, college graduates in mismatched jobs earn substantially less than their counterparts in matched jobs. As shown in Table 1, based on SIPP data, total monthly earnings at a matched job are 12% higher than at mismatched jobs for the 1996 graduation cohort and 34% higher for the 2013 graduation cohort. Additionally, earnings in mismatched jobs declined by 8% for the 2013 cohort compared to the 1996 cohort.

Figure 1: Labor Market Outcomes for Young College Graduates

(a) Unemployment rate (b) Job mismatch rate



Unemployment rate and job mismatch rate for college graduates age 23-27 not enrolled in school. College graduates hold bachelor's degree. Sources: Survey of Income and Program Participation (1996 and 2014) and Department of Labor, O*NET Education, Experience, Training.

[1] See Section 2 for a detailed definition of job mismatch.

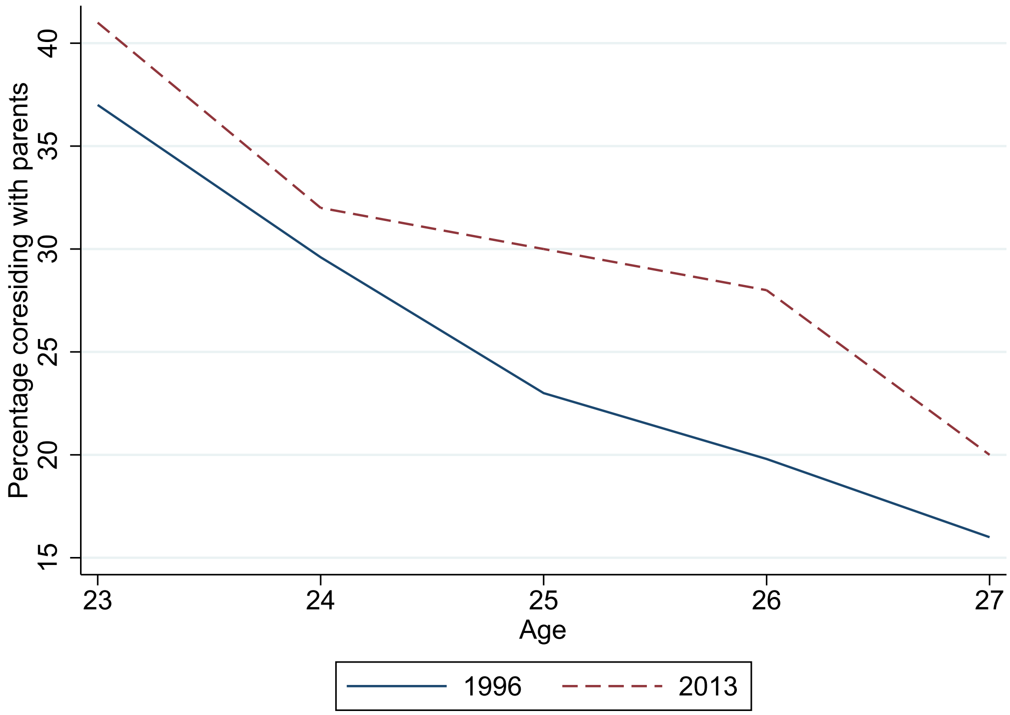
College graduates have also been faced with increasing student debt burdens in addition to adverse labor market conditions. The fraction of college graduates with student loans and the average student loan balances have been increasing since the early 1990s, almost doubling since then (see Figure A.1). Specifically, for the 2013 graduation cohort, Table 1 shows that the fraction with student loans is 41%, compared to 18% for the 1996 graduation cohort. Conditional on having student debt, average balances were $25,091 for the 2013 graduation cohort, an increase of $5,000 relative to the 1996 graduation cohort. The increase in both fraction and amount of student loans resulted from the rise in college tuition and other costs (Lucca et al., 2018).

Many young college graduates have chosen to live in their parents' home. Figure 2 shows that on average 31% of the 2013 college graduation cohort reside with their parents at age 23 to 27 years old, compared to only 25% for the 1996 graduation cohort. The coresidence rate declines with age, as do the unemployment rate and the job mismatch rate, shown in Figure 1, suggesting that as labor market outcomes improve, young college graduates are more likely to live independently. While we focus on the 2013 graduation cohort in comparison to the 1996 cohort, the differences in outcomes for these two cohorts reflect systematic trends that can be documented since at least the early 1990s. Figures A.2 and A.3 in Appendix A show the evolution of the job mismatch rate and the coresidence rate for young college graduates between 1990 and 2018, indicating a common countercyclical pattern for both variables. Our choice of the 1996 and 2013 graduation cohort is mainly driven by data availability and limitations.[2]

In this paper, we examine the joint determinants of coresidence and labor market outcomes for young college graduates. Our hypothesis is that the decline in availability of matched jobs plays a key role in the rise of unemployment and coresidence for recent graduation cohorts. Coresidence allows young adults to smooth their consumption in response to adverse labor market shocks. More importantly, it increases their outside options on the labor market, thereby raising their reservation wage and allowing them the opportunity to wait for a matched job, leading to better outcomes than other college graduates competing

[2]The 2013 cohort is the most recent cohort for which panel data is available from the SIPP data, while the 1996 cohort is the earliest panel for which we have the same complete information with 2013 cohorts.

Figure 2: Youth Coresidence Rate



Coresidence rate for college graduates age 23-27 not enrolled in school. College graduates hold bachelor's degree. Coresidence rate is defined as the average share of college graduates that live together with either of their parents in the survey month. Sources: Survey of Income and Program Participation (1996 and 2014).

for the same vacancies without this option. This initial advantage will likely compound over the life cycle, as a better job match at the beginning of one's career is associated with higher earning growth (Barnichon and Zylberberg, 2019). Coresidence can therefore play an important role in mitigating the adverse impact of worsening labor market conditions for college graduates at the start of their career.

We first explore the empirical link between labor market outcomes and coresidence empirically. We find that in the short run young college graduates who are employed are less likely to coreside with their parents then those who are unemployed, and that those who work at a matched job are less likely to coreside than those working at a mismatched jobs, suggesting that labor market performance is inversely related with coresidence in the short run. We also show that, in the long run, coresidence mitigates the adverse impact of unemployment and employment at a mismatched job for future earnings. We find that college graduates who at age 23 are either unemployed or working at a mismatched job have monthly earnings that are 17% lower than those working at a matched job by age 27. But while for those who did not coreside or move back with their parents at the time of the unemployment or mismatched job spell earnings at age 27 were 26% lower, there was no earning impact for those who did coreside or move back with their parents. This suggests a strong positive effect of coresidence on future earnings for young college graduates experiencing adverse labor market conditions.

To quantify the effect of coresidence we develop a structural model of child-parent decisions where labor market outcomes and coresidence are jointly endogenous. The model also allows for additional economic factors, such as higher student loan balances, greater wage dispersion, variation in family background, and increased rental costs. We estimate the model using the 2014 Survey of Income and Program Participation (SIPP) data to account for the differences in living arrangements, unemployment and earnings between the 1996 and 2013 college graduation cohorts.

The model centers around a dynamic game between parents and college children, in which coresidence status and labor market outcomes for the children are jointly determined as a function of earnings, assets, family characteristics and preferences. We find that coresidence at the early career stage has important quantitative implications for college graduates' life time earnings. By deciding to reside with their parents, college graduates can wait for a matched job, rather than accept a mismatched job. If the rate of arrival of matched jobs declines, more college graduates will choose to reside with their parents.

Using the estimated structural model, we decompose the impact of changes in the matched job arrival rate, earnings dispersion, student debt burden, parental income and rental costs. Our counterfactual analysis suggests that these factors can jointly explain all of the difference in unemployment rates, 54% of the difference in matched job rates and 68% of the difference in coresidence rates between the 1996 and 2013 college graduation cohorts. We also perform counterfactuals to assess the strength of each of the channels in our model in isolation. We find that the decline in the matched job arrival rate and rise in earnings dispersion have the largest effect on changes in unemployment. The rise in earnings dispersion also has a large impact on coresidence, jointly with the rise in student debt burdens and rising rental costs. We also find that changes in preferences over marriage and household formation are important in shaping the evolution of coresidence behavior between the two graduation cohorts.

Our paper is related to the literature that studies the determinants of coresidence, focusing on the effect of labor market shocks on coresidence outcomes (Rosenzweig and Wolpin, 1993, 1994; Wiemers, 2014; Bitler and Hoynes, 2015; Matsudaira, 2016). This research shows that young workers experiencing negative employment and earnings shocks are more likely to move back with their parents. In addition, Bleemer et al. (2014) and Dettling and Hsu (2018) show that student debt is a big contributing factor to the increase in coresidence for the young in the United States. Moreover, a growing literature using European data (Manacorda and Moretti, 2006; Giuliano et al., 2004), Asian data (Sakudo, 2007), and American data (Kaplan, 2012) finds that preferences play an important role in determining coresidence behaviors. Marriage formation (White, 1994; Sakudo, 2007; Yu and Kuo, 2016), housing costs (Ermisch, 1999; Guo et al., 2019; Rosenzweig and Zhang, 2019) and public benefits (Hoerger et al., 1996; Hu, 2001) also affect young people's living arrangement with parents.

Our paper is also related to the literature studying the effect of coresidence on economic outcomes. Rosenzweig and Wolpin (1993) find that both shared residence and financial transfers help sons smooth consumption. Moreover, they also find that an increase in welfare benefits affects the provision of parental support in terms of transfers and coresidence (Rosenzweig and Wolpin, 1994). Krolikowski et al. (2020) extend the idea of coresidence by studying the effect of living in the same neighborhood as parents on earnings. They find that young people who live close to their parents experience stronger earnings recoveries after a job displacement than those who live farther away.

Our paper contributes to these literatures by quantifying the dynamic impact of coresidence on college graduates' ability to find a matched job and to their life cycle earning potential. We also quantify the role of student debt and labor market conditions, such as the availability of matched jobs and earnings dispersion for college graduates, on coresidence patterns. Finally, we examine the effect of family background and housing costs in the joint determination of labor market outcomes and coresidence patterns for young college graduates.

Our theoretical model builds on Kaplan (2012), who examines the role of coresidence as an insurance channel against labor market risk for high school graduates. We instead focus on college graduates, since they have experienced a marked increase in coresidence in the last twenty years, whereas coresidence rates have remained stable for high school graduates. This can be seen in Figure A.4, which plots the coresidence rate for the 2013 and 1996 college graduation cohorts and for young adults in the same age range without a college degree. Our focus is on the impact of declining job match rates and other factors such increased student debt burdens on coresidence for college graduates.

The paper is structured as follows. In Section 2, we present descriptive evidence on coresidence and job mismatch for college graduates. Section 3 presents our structural model. The identification and estimation of the model are described in Section 4. We conduct a series of counterfactual analysis in Section 5. Section 6 concludes.

2 Data and Empirical Evidence

2.1 SIPP Data

Our data is drawn from the 2014 and 2018 Panel of Survey of Income and Program Participation (SIPP). The 2014 Panel has 4 waves, covering from January 2013 to December 2016. The 2018 Panel has one wave, covering the entire year 2017. Each wave in both panels used the previous 12-months as the reference period and tracks each individual of the sampled households for the entire time span. The survey contains extensive information on individuals' labor market behavior and educational outcomes, together with detailed information about family and community background. The SIPP (2014 and 2018) also provides detailed individual and household assets and debt information.[3] For comparison purposes, we also use the 1996 SIPP, covering from April 1996 to March 2000. We use 2014 and 2018 SIPP for estimating the baseline model and we use 1996 SIPP data for conducting the counterfactual experiments.

The SIPP is ideal to study the dynamics of parent-college graduates living arrangements as it has detailed information on monthly coresidence, student debt, and labor market out-

[3]We include SIPP 2018 for the purpose of increasing our sample size. While we use both 2014 and 2018 SIPP panels, we sometimes refer to both as the "2014 SIPP panel" for expositional ease moving forward.

comes, along with the large representative sample size. At each interview, the survey asked respondents to list the father/mother household number if they are living together with them. It also asks whether the children move in/out of the parental house and the number of family members in the household within that month. From these questions, it is possible for us to construct a monthly panel of parental coresidence for each respondent. Furthermore, the data also contains information on labor market outcomes and debt at the times that coresidence transitions take place.

2.1.1 Sample

Our analysis focuses on college graduates who obtained their bachelor's degrees in 2011-2013. The graduates in those years are in the cohort born between 1990-1993 and face similar economic conditions at graduation, and we refer to them as the 2013 graduation cohort. For the 1996 SIPP, we focus on individuals who graduate in 1994-1996, born in 1972-1976, who we refer to as the 1996 graduation cohort. For both cohorts, we exclude individuals who pursue a postgraduate degree.[4] Excluding those attending graduate school allows us to focus on the interaction between residential status and labor market outcomes. Additionally, graduate training may be a function of labor market conditions at graduation and will also affect labor market outcomes.[5] However, there does not seem to evidence of any link between coresidence rates and demand for post-graduate education. Moreover, attending post-graduate program may impose location constraints that prevent coresidence. The final 2013 graduation cohort sample consists of 2,169 college graduates with 28,339 year-month-youth observations. The detailed steps of sample selection for 2014 SIPP are described in Table A.1.

2.1.2 Descriptive Statistics

We find that among college graduates in the 2013 graduation cohort, 31% reside with their parents at age 23 to 27 years old. The average duration of time spent coresiding with their

[4]In the 2014 SIPP sample, about 9% of the college graduates pursue a postgraduate degree.

[5]As documented in Table A.1, the fraction of college graduates attending graduate school is 3.8% for the 1996 graduation cohort and 11.5% for the 2013 graduation cohort, reflecting the growth in individuals obtaining post-graduate degrees (Brown, 2005; Zhou and Gao, 2021)

parents is 5 months. Additionally, approximately 6% of individuals who coresided with their parents once experienced another spell of coresidence lasting at least one month after initially moving away. By contrast, 25% of the 1996 college graduation cohort live with their parents at age 23 to 27 years old. The average duration of time co-residing with their parents is 7 months and 4.5% of the cohort live with their parents for at least one month after initially moving away. Additionally, the fraction of people living with parents who never moved out for the 2013 cohort was 19% and 14% for the 1996 cohort.

To measure the job mismatch rate, we use the data from the U.S. Department of Labor Occupational Information Network (O*NET). We use the following question from the O*NET Education and Training Questionnaire to determine whether an occupation requires a college degree: "If someone were being hired to perform this job, indicate the level of education that would be required." We consider a college education to be a requirement for a given occupation if at least 50 percent of the respondents working in that occupation indicated that a bachelor's degree is necessary to perform the job. We then merged these data on the educational requirements for each occupation with data from Survey of Income and Program Participation (SIPP) on individual workers and their occupations. A college graduate is employed in a a mismatched job if they are working in an occupation that does not require a bachelor's degree.

The 2014 SIPP data contains detailed information on each category of assets and debt. Financial assets include savings accounts, checking accounts, stocks, mutual funds, and bonds.[6] Debt includes student loans, credit card loans, and loans on stocks/funds. We present assets and debt statistics for the 1996 and 2013 college cohort in Panel A of Table 1. For both cohorts of college graduates, student debt is the major component of their debt and net assets. The share with student debt increased from 18% for the 1996 cohort to 41% for the 2013 cohort. For those who have student loans, the average amount increase by 25% from the 1996 cohort to the 2013 cohort. As the 2013 cohort has more student debt, their net assets, which is defined as the total assets minus total debt, are much lower than that for the 1996 cohort.[7]

[6]We do not consider mortgages as the share of college graduates with a mortgage is less than 10% in earlier ages.

[7]Table A.2 in Appendix A presents the summary statistics by gender. The variation over time in the

Table 1: Assets and Earnings: 1996 VS 2013 College Graduate Cohorts

	1996		2013	
Assets and debt	share	amounts (>0)	share	amounts (>0)
Total assets	40%	$4,845	60%	$4,415
Total debt:	34%	$10,502	52%	$22,110
Student loans	18%	$20,594	41%	$25,091
Other debt	20%	$2,847	27%	$4,561
Net assets (total assets-total debt):	-$1,647		-$7,299	
Parental transfers	$6,336		$6,058	
Coresidence				
Percent residing with parents	25%		31%	
Labor Market				
Unemployment rate	9%		12%	
Percent in matched jobs	55%		48%	
Monthly earnings, matched jobs	$3,459		$3,837	
Monthly earnings, mismatched jobs	$3,090		$2,854	

Note: Values are for 23 to 27 year old college graduates in the 1996 and 2013 graduation cohorts. Total assets include savings accounts, checking accounts, stocks, mutual funds, and bonds. Total debts include student loans and other debts, where other debts include credit card loans and debt on stocks or bonds. Net assets are defined as total assets minus total debts. Parental transfers are the amount of dollars transferred from parent during the survey year. Individual monthly earnings are conditional on employment and include wages and salary, non-farm self-employment income, and farm self-employment income. All values reported are in real terms, CPI adjusted to 2014 dollar units. The coresidence rate is defined as the average share of college graduates that live with either of their parents in the surveyed month. We use the occupation information from U.S. Department of Labor Occupational Information Network (O*NET) and link it to SIPP. An occupation is defined as a matched/mismatched job for a college graduate if more/less than 50% of the employees in that occupation do not have a college degree.
Sources: Survey of Income and Program Participation (1996, 2014, 2018). Health and Retirement Study (1996, 2014, 2016, 2018).

2.2 HRS Data

Since there is no parental transfer or completed parental income information included in the SIPP,[8] we turn to the Health and Retirement Study (HRS) to obtain information on college graduates' parental background. The Health and Retirement Study (HRS) is a nationally representative longitudinal study of the economic, health, family status, as well as public and private support systems of older adults conducted every two years. The survey has detailed information about older citizens' income and their children's education level, which allows us to estimate the parental income for college graduates in our analysis. The data also records the level of monetary transfers from parents to their adult children in each calendar year. According to HRS (2014-2018), the average annual transfer from parents to college graduates is $6,058. We will use the parental transfer data from HRS to proxy the transfer in our sample.

2.3 Labor Market Outcomes And Coresidence

We now examine the relation between coresidence and labor market outcomes. We first estimate the impact of labor market performance on coresidence in the short run. Moreover, we examine the relation between coresidence and subsequent labor market performance over a longer horizon. In both cases, we proxy labor market performance with employment, having a matched job and earnings.

The hypothesis is that in the short run, coresidence may be used as a form of insurance against the risk of unemployment or low earnings due to the inability to find a matched job, so that coresidence is inversely correlated with contemporaneous labor market performance. In the long run, however, having a coresidence option may increase the value of unemployment and allow college graduates to wait until they find a matched job. Therefore, we expect a

variables we consider is similar for both men and women. The fraction in matched jobs is higher for women, at 55% than for men at 52% for the 1996 graduation cohort, though the gender difference is reversed for the 2013 graduation cohort. For both graduation cohorts, the unemployment rate is 3 percentage points higher for women compared to men. The coresidence rate for women is 4 percentage points lower for women compared to men in the 1996 graduation cohort, but only 1 percentage points lower for the 2013 cohort. In both cohorts women have higher student loan balances and lower earnings both in matched and mismatched jobs.

[8] As with other household surveys, SIPP only reports parental income information if the parents and youths are living in the same household.

positive relation between coresidence and future earnings.

Short Run Table 2 shows the logit estimation results for the relation between coresidence and selected contemporaneous labor market outcomes using the SIPP 2014 data. In particular, we consider a dummy variable for whether an individual was employed in a given month, a dummy variable for whether they were employed in a mismatched job, and log monthly earnings. For the models with mismatch and log earnings as the independent variable, the sample is restricted to those employed. All specifications include a set of fixed and time-varying control variables including age, age square, age cubic, race, metro area, marital status, gender fixed effect, and year fixed effect. We also control for lagged coresidence dummy to capture the mechanical effect of previous coresidence behavior.

Table 2: Labor Market Performance and Coresidence

	(1)	(2)	(3)	(4)	(5)	(6)
	Logit Coresidence			Fixed effect logit Coresidence		
Employed	-0.101			-0.357		
	(0.295)			(0.594)		
Mismatch		0.673**			1.070	
		(0.316)			(0.717)	
Log earnings			-0.460***			-1.010***
			(0.128)			(0.274)
Includes fixed effects				Yes	Yes	Yes
Observations	25,962	17,418	17,418	2,925	2,177	2,177
Individuals	2,008	1,632	1,632	221	199	199

Note: All estimates include controls for age, age square, age cubic, race, metro dummy, marital status, lag of coresidence, and gender fixed effect as well as year fixed effect. Standard errors are in parentheses, clustered by individuals. Parameters are multiplicative effects of probability of working, or marginal change in earnings, on probability of living with parents. The sample is college graduates in the 2013 graduation cohort, who are 23-27 years old between 2013-2017. Coresidence is a dummy variable that equals one if the college graduate lives with either one of his/her parents or both during the reference month. Employed is a dummy variable that equals one if the college graduate reported working during the reference month. Earnings are measured by the total person's earned income for the reference month, which includes wages and salary, nonfarm self-employment income, and farm self-employment income. Log earnings are the logarithm of earnings. The first three columns do not control for individual fixed effects and the last three columns control for individual fixed effects. *** p<0.01, ** p<0.05, *p <0.1.
Sources: Survey of Income and Program Participation (2014, 2018).

Columns (1)-(3) show the regression results without control for individual fixed effects. Column (1) shows that employed individuals are less likely to be living with their parents than those who are not employed. The point estimate for the Logit model is -0.1, which converts to a small average marginal effect of employment on coresidence at -0.001. Among employed individuals, those who work in a mismatched job are more likely to live with their parents. The Logit point estimate at 0.67 is statistically significant at the 5% level, converting to an average marginal effect of 0.03, which implies that mismatched college graduates are 3% more likely to live with their parents on average. Moreover, individuals with higher earnings are also less likely to live at home. The point estimate implies that a 10% increase in earnings will decrease the probability of coresidence by 2%. To control for unobserved heterogeneity that may be correlated with labor market outcomes, columns (4)-(6) report results from an individual fixed-effects (conditional) Logit model. The main results are consistent with the baseline specification but with a much larger average marginal effect. For instance, the point estimate in column (5) implies that college graduates with mismatched jobs are 5% more likely to live with their parents.

Long Run The evidence from the previous section suggests that improved labor market performance is inversely related to coresidence over the short run. We now provide evidence that coresidence is also important for long-term labor market outcomes. Particularly, we show that unemployment and job mismatch have persistent negative effects on earnings for college graduates. However, these negative effects are mitigated by having a coresidence option after a spell of unemployment or job mismatch. To illustrate this, we consider the effect of two labor market outcomes after graduation, being unemployed or being employed in a mismatched job, on future earnings. For most of the college graduates in our sample, we can observe earnings up to age 27. Therefore, we regress log earnings at age 27 on an indicator variable for unemployment or mismatched employment at age 23, which is the initial period we can observe them.[9]

The results are displayed in Table 3. Column (1) of Table 3 shows that unemployment

[9]The interpretation of the coefficients on the indicator variable requires a transformation given that the dependent variable is log-transformed. It is the percent change, $100*(e^{\beta}-1)$, in earnings at age 27 associated with being mismatched or unemployed at age 23.

or job mismatch at age 23 can have a significant negative impact on future earnings. College graduates who are unemployed or employed in a mismatched job at age 23 have earnings at age 27 that are on average 17% lower than those who did not. In columns (2)-(3), we divide the sample by coresidence status. Column (2) considers those who do not coreside with their parents, whose earnings at age 27 are 26% lower, whereas, column (3) considers those who were coresiding with their parents when unemployed or working in a mismatched job, for whom the effect on earnings is much smaller. In columns (4) and (5), we further divide the sample of college graduates who were not coresiding if unemployed or working in a mismatched job, into those who moved back with their parents after this spell, and those who did not, respectively. Column (4) considers the effect on earnings at age 27 for the first group, which is very small and not statistically different from zero. Column (5) considers the effect on earnings at age 27 for the second group. Unemployment or employment at a mismatched job at age 23 is associated with a 26% reduction in earnings at age 27 for this group. Taken together, these results suggest that coresidence strongly reduces the negative impact on earnings of early career unemployment or job mismatch.

Table 3: Long Run Impact of Job Mismatch and Coresidence

Dependent Variable	Log earnings at age 27				
	Full sample (1)	No cores (2)	Cores (3)	Later cores (4)	Never cores (5)
Mismatch or unemployed	-0.189*** (0.0375)	-0.308*** (0.0461)	0.007 (0.0623)	0.001 (0.000)	-0.309*** (0.0466)
Observations	1,524	936	588	36	900

Note: The sample is college graduates in the 2013 graduation cohort, who are 27 years old during the last month of the survey. Earnings are conditional on employment. Sample for each column is as follows:
(1) Full sample described above; (2) Those not coresiding at the time of mismatch or unemployment during the first month observed as 23 years old; (3) Those coresiding at the time of mismatch or unemployment during the first month observed as 23 years old; (4) Those not coresiding and who moved in with parents after mismatch or unemployment during the first month observed as 23 years old; (5) Those not coresiding and who did not move in with parents after mismatch or unemployment during the first month observed as 23 years old. *** p<0.01, ** p<0.05, *p <0.1.
Sources: Survey of Income and Program Participation (2014, 2018).

3 Quantitative Analysis

We now examine the joint determination of labor market outcomes and coresidence for young college graduates through the lens of a dynamic structural model. The model examines the causal relation between family background, student debt and other factors and coresidence and labor market outcomes, and helps to model the long run implications of the rise in coresidence for college graduates. We also use the model to examine a number of counterfactuals to quantify the impact of these factors.

The model, which builds on Kaplan (2012), while parsimonious, is rich enough to enable estimation of the key parameters governing asset accumulation, coresidence, and labor market status for young college graduates. The economy is populated by families consisting of a parent/child pair, where children are assumed to be young college graduates. Parents have exogenous labor income and assets, while children face a frictional labor market. They can be unemployed or employed at a matched or mismatched job. A matched job, is interpreted as corresponding to one that requires a college degree. Earnings at matched jobs are higher and grow over time. The arrival rate for matched jobs is higher than for a mismatched job, so there is option value to waiting for a matched job. Parents can provide their children support via monetary transfers or coresidence. Children and parents engage in negotiations to determine whether the child will coreside with their parent or live independently. Parents care about their children's welfare via a warm glow motive. Both parents and children prefer to live independently.

3.1 Environment

The economy is populated by families who live for $t = 0, 1, ...T$ periods, where the unit of time is a month. A family consists of a college graduate and his/her parents. Families are indexed by i, an adult parent is indexed by p, and a college child is indexed by c. In any given period t, the child can be in either one of two residence statuses $r_{it} \in \{0, 1\}$. If $r_{it} = 0$, the child lives with his/her parents; otherwise if $r_{it} = 1$, the child lives independently.

3.1.1 Children's Preferences

The child's utility is defined over consumption, work, and living arrangement, with period utility additively separable across these three states. Children obtain utility from two types of consumption goods: c^y is the private good, consumed exclusively by them; G is the total public good inside the family, consisting of the youth's own purchase of the good, g^y, as well as a public good provided by the parent, g^p. The public good provided by parents is only available inside the parental home and the youth can only gain access to it if he lives with the parent, with:

$$G_{it} = g^y_{it} + (1 - r_{it})g^p_{it}$$

Let U^y_{it} denote the period utility for a child in family i in time t:

$$U^y_{it} = \frac{[c^{y(1-\phi)}_{it} G^{\phi}_{it}]^{(1-\gamma)}}{1-\gamma} - h_{it}v + r_{it}z_{it} \tag{1}$$

where h_{it} denotes work status, *employed/working* if $h = 1$, or *unemployed/not working*, if $h = 0$.[10] The disutility of working is fixed at v.

Utility over the two types of consumption goods takes a Cobb-Douglas specification, with the parameter ϕ indexing the weight of the public good in total consumption. For $\phi = 1$, only public goods are consumed and there are full economies of scale, while for $\phi = 0$, all consumption is private. The preference for living away from home is captured by the shock z_{it}, which follows an AR(1) process, with $z_{it} = E[z_t] + \rho_z z_{i,t-1} + \varepsilon_{it}$ where $\varepsilon_t \sim N(0, \sigma^2_z)$. The mean preference for living away from home, $E[z_t] = \alpha_z + \gamma_z t$, is allowed to increase linearly with age. The parameter γ_z tends to be positive, which captures the fact that more children will live away from home as they get older. The autocorrelation coefficient ρ_z and the variance σ^2_z do not depend on age. The preference shocks capture the effect of non-economic heterogeneity, such as taste for independence, on college graduates' coresidence behavior.

[10]Since we do not model labor force participation, the category unemployed/not working covers both individuals who are out of the labor force and those who are looking for a job. The unemployment rate measure in the model does not correspond to the official measure conditional on labor force participation, but corresponds to the fraction not working. The fraction out of the labor force is stable across cohorts, at 8% for the 2013 graduation cohort and 7% for the 1996 graduation cohort.

A child's lifetime utility is given by:

$$V_0^y = E_0 \sum_{t=0}^{T} \beta^t U_{it}^y + \beta^{T+1} V_{T+1}^y \tag{2}$$

where V_{T+1}^y is a terminal value function.

3.1.2 Parents' Preferences

Parents derive utility from their own private consumption, c^p, and public consumption in the family, g^p:

$$U_{it}^p = \frac{[c_{it}^{p(1-\phi)} g_{it}^{p\phi}]^{(1-\gamma)}}{1-\gamma} \tag{3}$$

Parents are altruistic towards their children, so the parents' overall value is given by their value from consumption and the children's value weighted by altruism factor η.

$$V_0^p = \tilde{V_0^p} + \eta V_0^y = E_0 \sum_{t=0}^{T} \beta^t U_{it}^p + \beta^{T+1} V_{T+1}^p + \eta V_0^y \tag{4}$$

We assume that parents do not derive utility from the public good purchased by the children living at home, so that the intergenerational link between parent and child operates only through the parents' altruism. Because parents are altruistic towards their children, they have an incentive to provide income transfers to their children, enabling them to have more resources and to live on their own. In addition, parents do not have a direct preference for coresidence but they have an indirect preference over the residential state because they care about their children's welfare. Since $\eta < 1$, parents have a weaker preference for their children's independence than their children's.

3.1.3 Budget Constraints

In each period, children can be employed or unemployed. Let w_{it} be the monthly earnings, which is a stochastic process depending on their type of job. The labor income will be taxed according to the tax function τ.[11] If the child is not employed, they will receive an

[11] The tax function is constructed based on the US tax system in 2014. See Appendix C for more details.

unemployment benefit, b.

Children use their income to purchase consumption, c^y_{it} and g^y_{it}. In addition, they accumulate net savings, denoted with a_{it+1}, with a gross rate of return R.[12] Children start their life in the model with an exogenously assigned level of net savings drawn from the net asset distribution from SIPP data, which mainly reflects variation in student loan balances. Children cannot borrow during the course of their lives, so if they start with negative net savings, their level of debt can only fall over the course of their life. Children can also receive a transfer T_{it} from their parents. For children who do not coreside, there is a per period fixed cost of housing, χ. If the children were coresiding last period and move out this period, they will incur a one period moving cost, κ. The moving cost includes time and monetary costs. We assume there are no costs associated with moving back to their parents' home. Therefore, a college graduate's budget constraint is given by:

$$c^y_{it} + g^y_{it} + a_{i,t+1} + r_{it}[\chi + (1 - r_{it})\kappa] \leq (1 - \tau)w_{it}h_{it} + b(1 - h_{it}) + Ra_{it} + T_{it} \tag{5}$$

Parents' income I^p_i, is exogenously given and differs across families. Parents can use their income for private good purchases, c^p_{it}, public good purchases, g^p_{it}, housing cost χ, and making transfers to their children, T_{it}. Hence the parents budget constraint is given by:

$$c^p_{it} + g^p_{it} + T_{it} + \chi \leq (1 - \tau)I^p_i \tag{6}$$

3.1.4 Key Assumptions

The model makes three key assumptions about access to asset markets and transfers between parents and children. First, parents cannot save or borrow. This is mainly a simplifying assumption to reduce the computational burden associated with solving the model, stemming from imperfect altruism for the parents and the lack of commitment in the relation between children and parents.[13] The key implication of this assumption is that it forces the parents to face a trade-off between making a transfer to children and their own consumption. If we allow

[12] Since for young college graduates in the data most of their net savings correspond to student loan balances, we use the federal student loan interest rate for R, which annualized was 4.66% in 2014.

[13] See Barczyk and Kredler (2014a,b) for a full discussion of the issues.

parents to hold assets, they could smooth their consumption over time through assets. By ruling out parental savings, we limit the extent to which parents can use a financial transfer to offset the effect of labor market shocks to the youth. This makes coresidence a more attractive way of intergenerational resource sharing. Second, we assume that children cannot borrow, though they may start their lives with negative net assets, reflecting outstanding student loans. This assumption reflects limited access to consumer credit, other than educational loans, for young borrowers (Cooper et al., 2019).

Finally, we assume that children don't make transfers to parents or pay housing costs and services when living at home. This assumption is based on empirical evidence. The SIPP data provide information about who pays the household rent and how much they paid. It shows that when college graduates live with their parents, only 0.5% of them contribute to part of the rent cost. The low contribution is because most of the parents (85%) own their homes rather than rent their homes. Even for the rest who rent the house, children rarely share rent costs when living with parents. To check whether children contribute to public good consumption, we turn to the National Survey of Families and Households (NSFH), which contains information about cost-sharing within families. We focus on the most recent wave of NSFH which is the 2001-2002 wave. Focusing on the subset of youth with a college degree and aged 21-28, we found that 18% of the sample contributes something to the household and the average contribution is \$212. Therefore, about 80% of youth doesn't make contributions to households, and among those who made contributions, the amount is very small.

3.2 Labor market

Young college graduates can be unemployed (U), working in a matched job (MA), or working in a mismatched job (MI). A matched job is interpreted as corresponding to one in which a college degree is required, while a mismatched job is one in which a college degree is not required. Mismatched jobs pay lower earnings and can also be performed by those with only a high school education. There is no on-the-job search. Each period an unemployed individual receives one job offer of type $j \in \{MA, MI\}$ with probability λ^j, which he/she can accept or reject. The earnings offer distribution is job type specific and follows a lognormal distribution:

$$w^j \sim N(\mu_0^j, \sigma_0^j)$$

Since the mean earnings of matched jobs is higher than that of mismatched jobs, waiting for a matched job is beneficial. In addition, the job, regardless of the type, is exogenously destroyed with probability δ in each period.

Decisions Let V^U, V^{MA}, and V^{MI} denote the value of being unemployed, working in a matched job, and working in a mismatched job. The values depend on the youth's state variables (Ω) which include earnings offer (w), preference for coresidence (z), assets (a), and parents' transfer (T). The value of being unemployed is:

$$V^U(\Omega) = u(b)+\beta E\{max\{\lambda^{MA}\int_0^\infty V^{MA}(\Omega')dF_{MA}(w')+\lambda^{MI}\int_0^\infty V^{MI}(\Omega')dF_{MI}(w'),\ V_U(\Omega')\}\}$$

where b is unemployment benefits, λ^{MA} and λ^{MI} are arrival rates of matched and mismatched jobs. The terms F_{MA} and F_{MI} are the earnings distributions for matched and mismatched jobs. The expectation E is taken over the next period distribution of the coresidence preference shock (z').

The values of working in a matched or mismatched job are:

$$V^{MA}(\Omega) = u(w^{MA}) + \beta E\{max\{(1-\delta)\int_0^\infty V^{MA}(\Omega')dF_{MA}(w') + \delta V^U(\Omega'),\ V^U(\Omega')\}\}$$

$$V^{MI}(\Omega) = u(w^{MI}) + \beta E\{max\{(1-\delta)\int_0^\infty V^{MI}(\Omega')dF_{MI}(w') + \delta V^U(\Omega'),\ V^U(\Omega')\}\}$$

A youth who receives an earnings offer of job type j will accept it if his/her value of accepting the offer is larger than the value of being unemployed and keeping search.

Given that the state variables (w, z, a, T) change over time, a youth working in a mismatched job or a low earning matched job may quit their jobs, become unemployed and search for a new job in the following circumstances: 1) he/she becomes less averse to moving back home; 2) he/she pays off student loans; 3) his/her parents provide more transfers; 4) he/she experiences negative shocks to current earnings. In particular, a youth will reject or quit working in a matched (or mismatched) job if $V^U(\Omega) > V^{MA}(\Omega)$ (or $V^U(\Omega) > V^{MI}(\Omega)$).

Earnings Process After an initial earnings draw, the earnings process for individual i working in job type j at time t evolves as:

$$logw_{ijt} = \theta_t + log\ job_{ijt}$$

Where θ_t is the experience effect that is common for everyone regardless of job types. The term $log\ job_{ijt}$ is the job type-dependent component.
For a matched job ($j = MA$), this is given by:

$$log\ job_{i,MA,t} = \mu_d + log\ job_{i,MA,t-1} + \varepsilon_{i,MA,t}$$

where the term μ_d is estimated to be positive, reflecting on the earnings growth for matched jobs. The term $\varepsilon_{i,MA,t} \sim N(0, \sigma^2_{MA})$ is i.i.d and captures job-type specific shocks to current earnings.
For a mismatched job ($j = MI$), the earnings process evolves according to:

$$log\ job_{i,MI,t} = log\ job_{i,MI,t-1} + \varepsilon_{i,MI,t}$$

The difference between a matched and mismatched job is that: 1) the initial earnings offer distribution of a matched job is different than that for a mismatched job, with matched jobs having a higher mean of initial earnings offers; 2) a matched job features trend growth (μ_d) in addition to growth related to the accumulation of on the job experience by the individual worker, while the earnings growth for a mismatched job only only reflects individual experience effect. The trend growth in matched job earnings is assumed to reflect economy wide skill biased technological change.

In this environment, the ability to coreside with their parents for young college graduates may have long-run effects on labor market outcomes. Specifically, there is an option value of waiting for a matched job offer, so those who can wait longer for jobs are more likely to obtain a matched job offer. Children with higher value of unemployment will be more likely to reject a mismatch job offer and wait for the arrival of a matched job. The ability to coreside with their parents or higher parental transfers increase the value of unemployment for youth.

3.3 Initial Conditions and Terminal Values

Closing the model requires specifying a set of initial and terminal conditions. The initial age $t = 0$ corresponds to 21-22. Initial assets a_0 are drawn from the empirical distribution of net worth at age 21-22 in SIPP data, corresponding to Jan 2013. Additionally, we assume that an exogenous fraction of agents at $t = 0$ is living at home, corresponding to the empirical value in Jan 2013. Similarly, an exogenous fraction of these individuals are assumed to be employed at $t = 0$, to match the corresponding empirical value in Jan 2013. The initial fraction employed in matched and mismatched jobs is also taken directly from the data. Their earnings are given by the empirical distribution of monthly earnings for that age group conditional on type of job.

Following Kaplan (2012), we set the terminal age to 30 years old, which corresponds to $T = 90$ given that the model is monthly. At the terminal period, all interaction between parents and children ceases. There is no coresidence happening and children have to move out of their parents' home. Additionally, parents stop making financial transfers. Children's labor supply becomes inelastic and there is no uncertainty about future earnings, corresponding to the assumptions we make for parents. The above assumptions and specifications allow us to obtain closed-form solutions for the terminal value functions.

3.4 Feasible Allocations and Markov-Perfect Equilibrium

Given housing costs (χ) and interest rates (R), an allocation is a mapping of labor market outcomes and preference shocks $\{w^t, j^t, z^t\}$, initial conditions $\{a_0, w_0, h_0, j_0, r_0\}$, and parental income $\{I^p\}$ into values for $\{r_t, h_t, c_t^p, c_t^y, g_t^p, g_t^y, T_t, a_{t+1}\}$. An allocation is feasible if it satisfies both the parental and the children's budget constraint (5) and (6), and the non negativity constraints for transfers, net assets, and consumption.

We specify the order in which children and parents make decisions to guarantee the uniqueness of the equilibrium household allocation. This sequence can be interpreted as a subgame perfect equilibrium of a sequential game played by the children and their parents, in which at every stage, the players take into account the optimal response of the other players in the subsequent stages. The sequence of choices is as follows. In stage 1, given the state variables, children make their residence decisions. In stage 2, parents will take the children's residence choice as given and make their transfer and consumption decisions. In the third stage, children will make their work, assets, and consumption decisions given the choices made by their parents in the previous stage. The timing of actions is summarized in Table 4.

Table 4: Stages of the game

Stage	State variables	Choice	By whom
1	$(a_t, r_{t-1}, w_t, j_t, z_t)$	r_t	Children
2	$(a_t, r_{t-1}, r_t, w_t, j_t, z_t)$	$T_t,\ g_t^p,\ c_t^p$	Parents
3	$(a_t, r_{t-1}, r_t, w_t, j_t, z_t, T_t, g_t^p)$	$h_t,\ a_{t+1}, c_t^y, g_t^y$	Children

Based on these timing assumptions, an equilibrium allocation is a feasible allocation such that: (1) given the prices $\{\chi, R\}$, labor market shocks $\{w_t, j_t\}$, preference shocks, z_t, college graduates choose their living arrangement r_t to maximize their lifetime utility; (2) given children's optimal residence decisions and their states, parents choose $\{T_t, c_t^p, g_t^p\}$ to maximize their lifetime utility; (3) given parents' transfer and public good consumption $\{T_t, g_t^p\}$, children choose asset holdings, employment and consumption $\{a_{t+1}, h_t, c_t^y, g_t^y\}$ to maximize their lifetime utility.

3.5 Factors Affecting Coresidence

There are four state variables that affect living arrangements in equilibrium. The first is earnings, which are determined by employment status and job quality. The second is net assets. The third is the realized value of the preference for living independently, and the last is parental income. Children are more likely to live independently if their labor earnings, net assets, or value of independence are high. However, the effect of parental income on living away is ambiguous. On the one hand, if parents are wealthy, they can provide higher transfers to the children, which makes living independently an attractive option. On the other hand, wealthy parents are more likely to provide higher levels of household public good consumption, which increases the value of coresidence for the children.

4 Estimation

Our strategy for determining parameter values for the model is to identify a small set of parameters that can be obtained from independent evidence, which we refer to as calibrated parameters, and to rely on structural estimation for most of the key parameters. We adopt a Simulated Method of Moments (SMM) approach, based on simulating the theoretical moments and minimizing the difference between simulated moments and data moments, weighted by the variance-covariance matrix of the data moments.

4.1 Externally Calibrated Parameters

The value and reference of the externally estimated parameters are reported in Table 5. Parents and children are assumed to have a coefficient of relative risk aversion parameter of $\gamma = 1.5$. The discount factor is $\beta = 0.96$ annualized with a corresponding monthly value of $\beta = 0.996$. Since for most young college graduates, net assets are negative and are comprised mainly of education loans, we set the interest rate equal to the Stafford loan interest rate, which is 4.66% annualized, or 0.4% monthly. We derive the unemployment benefit as the mean of unemployment benefits for unemployed youth sample from SIPP data, which is approximately \$600 per unemployment month for college graduates. The parental income distribution is estimated from the HRS data. It is discretized into a four-point grid, reflecting average parental income in each quartile of the distribution. The share of public goods consumption in utility ϕ is set to be 0.3 following Kaplan (2012). We obtain the monthly housing cost χ from the median gross rent between 2013 and 2017 drawn from US Census, which is \$1,062. The fixed cost of moving κ is set equal to half month housing cost, which is \$500.[14]

[14]See Appendix B.5 for more details.

Table 5: Externally Calibrated Parameters

Parameter	Description	Value	Reference
γ	Risk aversion	1.5	Attanasio et al. (2008)
β	Monthly discount factor	0.996	Prescott (1986)
R	Monthly interest rate	1.004	Student debt interest rate (2014)
b	Unemployment benefits	$600	SIPP (2014)
I^p	Parental income dist.	[3566,5562,7449,9749]	HRS (2014-2018)
ϕ	Share of public goods	0.3	Kaplan (2012)
χ	Housing cost	$1,062	US Census (2013-2017)
κ	Moving out cost	$500	See Appendix B.5

4.2 Internally Estimated Parameters

The approach to estimating the remaining parameters is simulated method of moments (SMM). We choose a set of moments related to labor market outcomes, coresidence, net assets, and parental transfers over the age range from 23-27 to identify all the parameters. The full set of moments is shown in Table A.3. The estimated parameters include labor market parameters $(\delta, \lambda^{MA}, \lambda^{MI}, \mu_0^{MA}, \mu_0^{MI}, \sigma_0^{MA}, \sigma_0^{MI}, \sigma_{MA}, \sigma_{MI}, \mu_\theta, \mu_d)$; parameters governing the coresidence preference shock $(\alpha_z, \gamma_z, \sigma_z^2, \rho_z)$, altruism η, and disutility of working ν. Since the number of moments is larger than the number of parameters, our model is over-identified.

Although all of the moments are used to estimate all of the parameters, there are certain moments that are especially important to identify certain parameters. We provide a heuristic argument for how each of the parameters can be identified from a subset of the moments and give the intuition for identification.

For the labor market parameters, a typical identification challenge arises as a result of the fact that rejected job offers are not observed. Therefore, the labor market parameters are estimated within the model. The job destruction rate δ is identified from the probability of being unemployed, conditional on working in the previous month. We assume the job destruction rate is the same for a matched job and mismatched job. Moreover, the identification for parameters relevant to matched vs mismatched jobs is quite intuitive as we have the corresponding data analog. The arrival rate of matched jobs λ^{MA} is identified from the probability of working in a matched job, conditional on not working in the previous month and the proportion of college graduates with a matched job. The arrival rate of mismatched jobs λ^{MI} is identified from the probability of working in a mismatched job, conditional on not working in the previous month. The mean and standard deviation of the initial earnings distribution of matched jobs $(\mu_0^{MA}, \sigma_0^{MA})$ are identified from the mean and standard deviation of the log entry earnings of matched job. Similarly, the mean and standard deviation of the initial earnings distribution of mismatched jobs $(\mu_0^{MI}, \sigma_0^{MI})$ are identified from the mean and standard deviation of the log entry earnings of mismatched job. The experience effect μ_θ is identified from the mean growth of mismatched job earnings, as the only source of growth for a mismatched job is experience effect. Conditional on the experience effect, the matched job growth μ_d is pinned down by the mean growth of matched job earnings, as a matched job has earning growth in addition to the experience effect. The standard deviation of matched (mismatched) job earning shocks, σ_{MA} (σ_{MI}) is identified from the standard deviation of matched (mismatched) job earnings conditional on working for more than two consecutive periods. Conditional on the values for labor market parameters, the disutility of working ν is pinned down by the average unemployment rate.

For the parameters governing coresidence, the average proportion of college graduates living independently and the increase by age contributes to pin down the intercept and slope in the mean utility of living independently (α_z, γ_z). The average difference in earnings between children living independently and children coresiding helps determine the variance of preference shocks σ_z^2, which measures the cross-sectional heterogeneity in the taste for living independently. To shed light on identification, suppose that there was no preference heterogeneity among children $\sigma_z^2 = 0$, we would expect to see that all coresidence dynamics are driven by economic factors like earnings, assets, and housing costs. This would imply that children living away from home have far higher earnings than children living at home. As σ_z^2 increases, the amount of non-labor market heterogeneity increases. The heterogeneity reduces the variation of earnings across children who live independently and those who coreside. Based on the variation in observed earnings by residence status, heterogeneity in the value of independence is necessary to match the data.

The within-person time-series variation in parental coresidence pins down the persistence of the preference parameter ρ_z. In particular, we use the monthly autocorrelation of coresidence, the fraction of youth who ever move back with their parents, and the mean duration of the coresidence period. It is important to have the last moment to establish the role of preference shocks in the coresidence decision, otherwise the duration of coresidence would be determined only from the duration of labor market shocks, such as spells of unemployment or employment at a mismatched job. Finally, parental altruism is identified by the average transfer from parents to children in a given year, as the optimal transfer decision is directly affected by the weight that parents put on the utility of children.

The estimated parameters are displayed in Table 6. To illustrate the quantitative role of the sign and magnitude of the parameters governing coresidence, note that the linear growth rate of preference γ_z captures the growing taste for independence as children get older. The point estimate for γ_z is positive, which suggests that the taste for independence grows with age. The autocorrelation ρ_z is estimated to be 0.85, implying high persistence in the preference for coresidence despite the large cross-sectional heterogeneity in this shock $\sigma_z^2 = 6.25$.

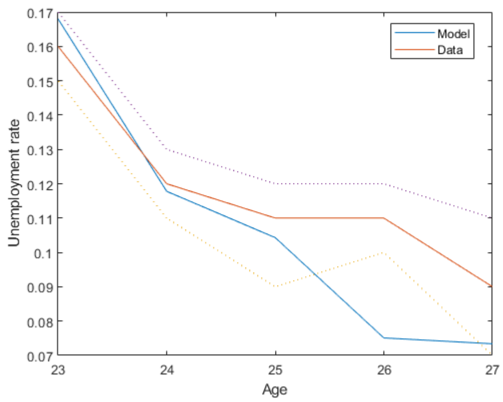
4.3 Model Fit

The fit of the model for selected labor market moments is displayed in Figure 3. The unemployment rate is shown in panel (a). The blue line is the average unemployment rate for age 23-27 simulated from the model, while the red line corresponds to the same statistic calculated from SIPP data in years 2013-2017. The fraction of college graduates with a matched job for the same age group is displayed in panel (b). We can see that our model matches the trend and level of unemployment and job match rate for the cohort closely. Panels (c) and (d) display the comparison of data and model for matched and mismatched job earnings. We can see that the model can replicate the data very well.

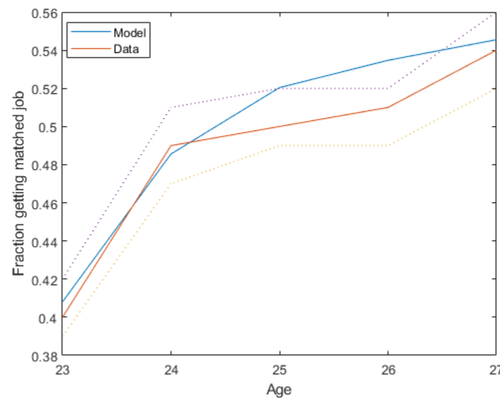
The fit for coresidence moments is displayed in Figure 4, showing a close match with the SIPP data. The fraction of college graduates living independently is shown in panel (a). Our model can match the level and variation with age of this statistic very well. The fraction of children ever coresiding with their parents is shown in panel (b). The data indicate that children's coresidence rates decline with age from 5% at age 23 to around 2% at age 27. This trend is mostly captured by the model though it over predicts the fraction coresiding at each

Figure 3: Model Fit

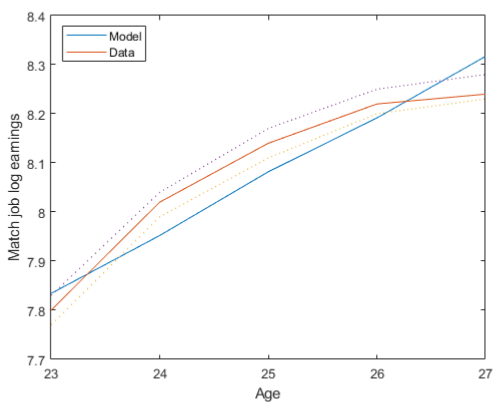
(a) Unemployment rate



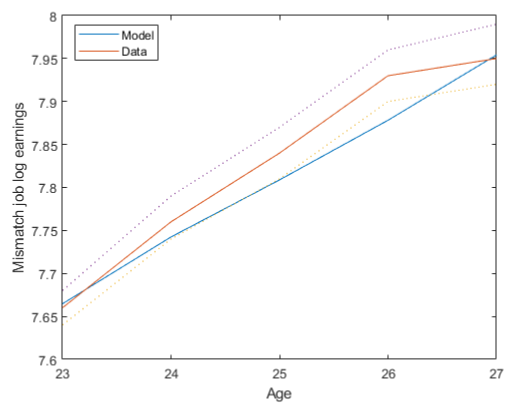
(b) Fraction with matched jobs



(c) Log earnings at matched jobs



(d) Log earnings at mismatched jobs



Note: Model fit for labor market moments. Solid red lines correspond to the data; solid blue line correspond to the model; dotted lines are 95% confidence interval for data. Variables are (a) unemployment rate; (b) fraction working in a matched job (c) matched job log earnings; (d) mismatched job log earnings.

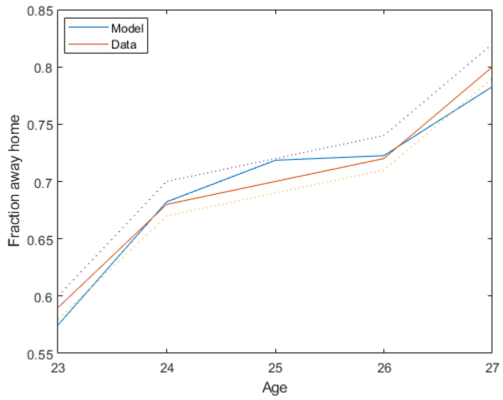
Table 6: Parameter Estimates

Parameter	Description	Estimate	Standard error
Labor Market			
δ	Job destruction rate	0.03	0.01
λ^{MA}	Match job arrival rate	0.53	0.13
λ^{MI}	Mismatch job arrival rate	0.44	0.09
μ_0^{MA}	Mean matched job log earnings offer	7.52	2.1
μ_0^{MI}	Mean mismatched job log earnings offer	7.35	2.1
σ_0^{MA}	SD matched job log earnings offer	0.51	0.22
σ_0^{MI}	SD mismatched job log earnings offer	0.51	0.24
σ_{MA}	SD of matched job earnings shocks	0.04	0.01
σ_{MI}	SD of mismatched job earnings shocks	0.06	0.01
μ_θ	Growth log experience effect	0.074	0.02
μ_d	Matched job earning growth	0.042	0.01
Preference			
α_z	Intercept mean value of living away	0.72	0.31
γ_z	Age slope mean value of living away	0.07	0.02
σ_z^2	variance of value of living away	6.25	0.22
ρ_z	Autocorrelation of value of living away	0.85	0.22
η	Altruism factor	0.04	0.02
ν	Disutility of working	2.9	0.57

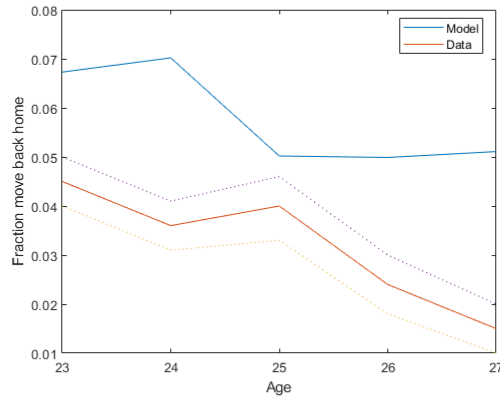
age. Panel (c) shows the mean duration of coresidence spells, which is decreasing from 5 months to 2 months. The earnings difference between children living independently and those coresiding is displayed in panel (d). Children living independently have approximately 15% higher earnings than those coresiding, and this difference decreases and then increases over age. The positive earning difference indicates that those living independently are positively selected relative to those who coreside with their parents. Our model predicts a positive earning difference and matches the data in trend and level. Transfers from parents are shown in panel (e). Parents transfer less as their children grow older. In our model, parents' transfer has the same trend but it decreases at a slower speed than the data. Finally, figure 4F shows that children save to pay back their debt as they are aging, with net worth rising by 5,000 dollars between age 23 and 27.

Figure 4: Model Fit

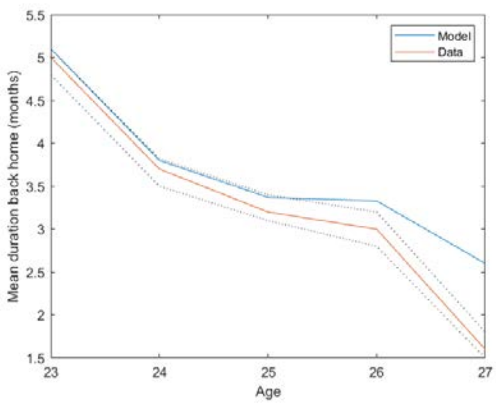
(a) Fraction living independently



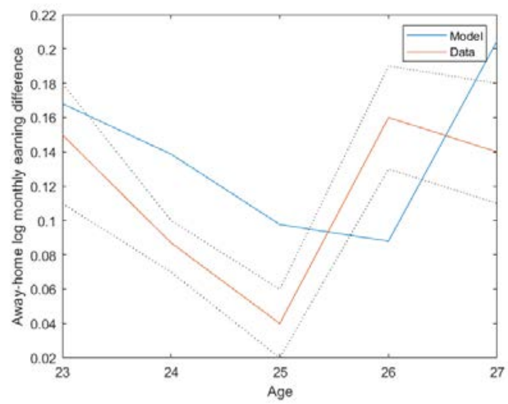
(b) Fraction moving back with parents



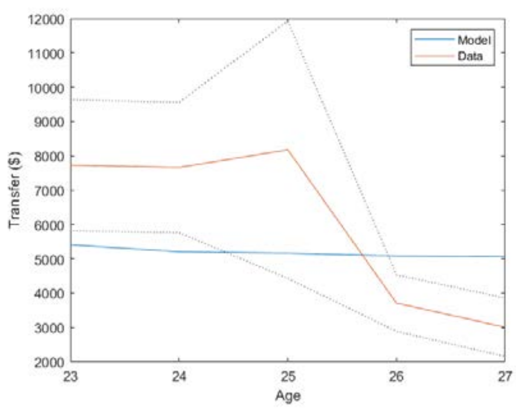
(c) Mean duration back home



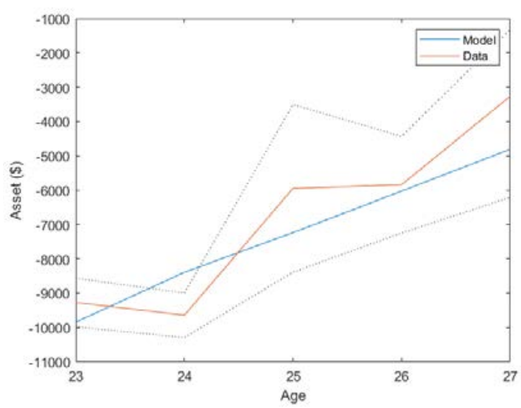
(d) Independent/coresiding earnings difference



(e) Parental transfers



(f) Net assets



Note: Model fit for coresidence moments. Solid red lines correspond to the data; solid blue line correspond to the model; dotted lines are 95% confidence interval for data. Variables are (a) fraction living away; (b) fraction ever move back; (c) mean duration back home; (d) away home log earning difference; (e) average transfer; (f) average stock of net assets (total assets-total debt).

4.4 Model Validation

There are several salient moments that are not targeted in the estimation that we examine to validate the model and assess its mechanisms. These include the fraction of college graduates with a matched job by residence status and mean net assets by residence status. The comparison between data and model is shown in Table 7. The model predicts that college graduates coresiding with their parents are less likely to have a matched job. College graduates with higher debt are more likely to live with parents. The model replicates the trend in the data very well.

Table 7: Model validation

	Model	Data	95% CI
Fraction with matched job			
Independent	0.53	0.52	(0.51, 0.53)
Coresiding	0.49	0.45	(0.44, 0.46)
Net assets			
Independent	-6,449	-6,227	(-7,363, -5,090)
Coresiding	-7,506	-9,621	(-10,175, -9,067)

5 Understanding Changes in Coresidence Over Time

Given the model and the parameter estimates, we can explore which factors led to the joint changes in college graduates' labor market outcomes and coresidence patterns for the 1996 and 2013 graduation cohorts. The goal of this section is to quantify the role of each of the main channels individually and the combined effects of all channels.

5.1 Matched Job Arrival Rate

In the model, obtaining a matched job is important for college graduates' welfare because a matched job has a much higher earnings. The labor market environment determines the fraction of college graduates obtaining a matched job. For the 1996 graduation cohort, the fraction in a matched job is 55% while only 48% for the 2013 cohort. This difference is driven by variation in the arrival rates for matched and mismatched jobs for the two cohorts. To simulate this change, we set the matched job arrival rate so that the fraction of college graduates in a matched job is the same as in the data for the 1996 graduation cohort. In the estimated model, the job arrival rate for a matched job is 0.53 and a mismatched job is 0.44 in 2014. The corresponding values for the 1996 graduation cohort are 0.55 and 0.42, respectively. This experiment allows us to examine how the change in the matched job arrival rate accounts for the change in outcomes across the two cohorts.

The result of this counterfactual experiment is shown in column (2) of Table 8. Because the matched job arrival rate is higher, the unemployment rate drops by 1 percentage points or 9%, which helps close the unemployment data gap by 36%.

5.2 Earnings Dispersion

Earnings dispersion has risen systematically for workers with a college degree (Autor et al., 2005) since 1990, with the increase more pronounced for more experienced and educated workers. Consistent with this evidence, we find that the earnings dispersion for college graduates rise for the 2013 graduation cohort, compared to the 1996 cohort. The standard deviation of monthly earnings is $2,577 for college graduates with a mismatched job and $3,126 with a matched job in the 2013 graduation cohort. The corresponding inflation adjusted values for the 1996 graduation cohort are $1,948 for those with a mismatched job and $2,153 for those with a matched job, which implies an increase of 32% and 45% for mismatched and matched jobs across cohorts, respectively.

To assess the role of rising earnings dispersion, we set the standard deviation of log earnings offer for matched and mismatched jobs to their values for the 1996 cohort. The result is shown in column (3) of Table 8. The unemployment rate decreases from 11% to 9% in the counterfactual, as the probability of a low earnings offer declines in both match and mismatched jobs. The decrease in earnings dispersion contributes to closing the unemployment gap between the two cohorts by 72%. Moreover, the fraction of college graduates co-residing drops from 31% to 29%, which helps to close the gap between the two cohorts by 33%.

5.3 Student Loan Distribution

As our model predicts, the level of net assets significantly affects coresidence and labor market outcomes of college graduates. Since the major component of net assets is student debt, we consider the change in student loans for college graduates between 1996 and 2013 and how this change affects their outcomes. The fraction of college graduates with student debt and the average amount of debt rises sharply after 2000. This is mostly due to the rise in tuition and fees associated with attending college, as argued by (Lucca et al., 2018). For the 2013 graduation cohort, the fraction of college graduates with student loans is 41%. Conditional on having student loans, the average amount of student debt is $25,901 in 2014 USD. The corresponding values are much lower for the 1996 graduation cohort. The fraction of college graduates with student loans is 18% and the average amount for those who have student debt is $20,594 in 2014 USD. As a result of the difference in student debt balances, average net assets (total assets-total debt) for the 2013 graduation cohort are much lower (-$7,299 in 2014 USD), compared to the 1996 graduation cohort (-$1,647 in 2014 USD), as previously shown in Table 1.

When we change the initial net assets distribution (at age 21-22 and model period $t = 0$) of college graduates from the 2013 values to inflation adjusted 1996 values, the counterfactual outcome is shown in column (4) of Table 8. With lower student debt or higher net assets, the share of college graduates co-residing drops by 1 percentage point or 3%. Given the coresidence rate gap between the two college cohorts is 6%, the higher net assets contribute to closing the gap by 16%. Due to the change in the initial distribution of net assets, the asset gap between the two cohorts is also closed.

5.4 Parental Income

Parental income is one of the major channels that affect coresidence behavior and labor market outcomes. The major change in parental income of college graduates from 1996 to 2013 is that more college graduates have lower parental income in 2013 graduation cohort. The distribution of parental income for the 2013 graduation cohort is estimated from HRS (2014-2018) as equal probability multinomial distribution over the support [3,066 5,562 7,449

9,749] in 2014 USD. To be consistent, the parental income distribution in 1996 is also estimated to be a four-point distribution with equal probability. After adjusting for inflation, the support for the distribution of parental income in 1996 is [3,628 5,658 7,566 10,343] is 2014 USD. Thus, the parental income of college graduates in 1996 is 5.3% higher than in 2013 on average. As a result of higher parental income for 1996 cohort, data shows that parental transfers for the 1996 cohort are also 5% higher than that for the 2013 cohort.

We change parental income from the 2013 to the 1996 distribution and display the corresponding counterfactual outcomes in column (5) of Table 8. With higher parental income, the average transfers rise by 1%, which closes the transfer gap between the two cohorts by 20%. We do not detect any significant impact of parental income change on other outcomes.

5.5 Rent

Another important change across the 1996 to 2013 college graduation cohorts is rental costs. According to the Consumer Expenditure Survey, the average rent, the main housing cost for college graduates, increased 20% in real terms from 1996 to 2014. To quantify the role of this change, we decrease rent to the 1996 inflation adjusted value.

The result is shown in the last column of Table 8. Intuitively, with a lower housing cost, more college graduates are co-residing, with a drop in the corresponding fraction from 31% to 29%, closing the gap between the two graduation cohorts in this outcome by 33%. At the same time, fewer college graduates are unemployed and parental transfers are correspondingly lower. Setting rental cost to its 1996 value closes the gap in unemployment rates across the 2013 and 1996 graduation cohorts by 72%.

5.6 Combined Effects

In this section, we examine the combined effects of all the channels explored individually above. The combined channels may have a different impact than each individual channel because of offsetting interactions. The results from this combined counterfactual are shown in Table 9. From the table, we can see that the fraction unemployed decreases by 25% from the 2013 to 1996 graduation cohort in the data, and the combined channels predicted a 27%

Table 8: Counterfactual experiments

	(1) Data	(2) MA arrival rate	(3) Earnings dispersion	(4) Asset dist	(5) Parents' income	(6) Rent
Fraction Unemployed						
2013	0.12	0.11	0.11	0.11	0.11	0.11
1996	0.09	0.10	0.09	0.11	0.11	0.09
% change	25%	9%	18%	0	0	18%
Fraction with matched job						
2013	0.48	0.50	0.50	0.50	0.50	0.50
1996	0.55	0.55	0.49	0.50	0.50	0.49
% change	15%	10%	-2%	0	0	-2%
Fraction coresiding						
2013	0.31	0.31	0.31	0.31	0.31	0.31
1996	0.25	0.31	0.29	0.30	0.31	0.29
% change	19%	0	6%	3%	0	6%
Net assets						
2013	-7,299	-7,259	-7,259	-7,259	-7,259	-7,259
1996	-1,647	-7,264	-7,225	-41	-7,323	-7,354
% change	77%	0	0	99%	0	0
Parental transfers						
2013	6,058	5,187	5,187	5,187	5,187	5,187
1996	6,336	5,195	5,076	5,139	5,224	5,053
% change	5%	0	-2%	0	1%	-2%

Note: This table presents counterfactual experiments when considering each of the economic factors: matched job arrival rate, mean and standard deviation of earnings for matched and mismatched jobs, initial student loans, parental income, and housing cost (rent). Column (1) shows the data moments and percent change between 2013 and 1996 college graduation cohorts. Columns (2)-(6) show the model simulation by turning each of the economic factors from the 2013 scenario into the 1996 scenario. For each of the moment we considered, the row "2013" represents the data or model simulation for 2013 college graduation cohorts. The row "1996" represents the data or model simulation by changing each of the factors from 2013 into the 1996 scenario. The row "% change" represents the gap in percentage between 2013 and 1996 college cohorts.

decrease, which accounts for almost all of such change. The fraction with a matched job increases by 15% from the 2013 to 1996 cohort in the data and the combined channels account for 54% of this variation. The fraction co-residing is 19% lower in 1996 and the channels in the model account jointly for 68% of the overall change. Net asset accumulation over the course of their life span is 77% higher for the 1996 graduation cohort and our channels can account for more than that change. Finally, parental transfers do not experience large variation over the period and our joint channels also predict no significant change of parental transfers for the two cohorts.

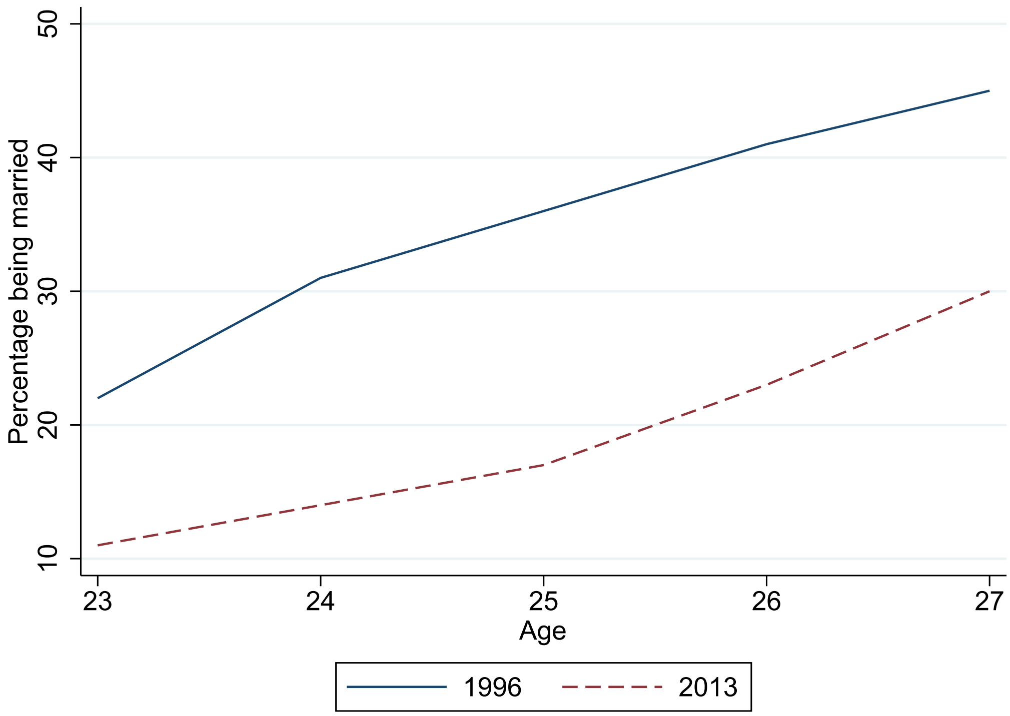
Table 9: Combined counterfactuals

	Data % change	Counterfactuals 1-5	Closing the gap by
Fraction unemployed	25%	27%	108%
Fraction with matched job	15%	8%	54%
Fraction coresiding	19%	13%	68%
Net Assets	77%	95%	123%
Parental transfer	5%	-3%	-160%

5.7 Taste for Independence

Our model implies that coresidence is driven by economic factors, such as net assets, job offer arrival rates, earnings, parental income, as well as a preference for independence, captured by the preference shock z. The estimated model implies that 63% of the residence behavior is driven by economic factors, while the rest 37% is due to the taste for independence. This preference shock, however, not only captures the strength of preferences for independence, but also additional economic factors that are not included in our model. A key factor driving a preference for independence is the wish to marry or live with a romantic companion (White, 1994; Sakudo, 2007; Yu and Kuo, 2016), and variation in preferences over marriage may also be driving changes in coresidence rates across the 1996 and 2013 cohorts of college graduates. Figure 5 compares marriage rates for these two groups, and clearly shows lower marriage rates for the 2013 graduation cohort compared to the 1996 cohort. The average marriage rate for the college graduates in the 1996 graduation cohorts is 35% at age 23-27, while it is only 19% for the 2013 cohort. Changes in attitudes towards marriage across these two cohorts in our model are captured in the preference for independence shock.

Figure 5: College Graduates Marriage Rate



Note: Young college graduates are those aged 23 to 27 with a bachelor's degree or higher. All figures exclude those currently enrolled in school. Sources: Survey of Income and Program Participation, 1996 and 2014 panels.

Other underlying cultural factors influencing the taste for independence also may be changing over time. For example, (DePaulo, 2016) shows that parents of millennials have changed their parenting style and values have changed making it more acceptable for parents to support adult children directly and reducing the stigma associated with coresidence.

We also examine the characteristics of parents for the two cohorts, other than economic factors such as income, to identify other factors that may contribute to the change in coresidence rates. For instance, if the parents of 2013 graduation cohorts are more likely to live in densely populated urban or suburban areas, where there may be a higher concentration of matched jobs, that would provide a greater benefit from coresidence for the 2013 graduation cohort. However, we do not find substantial differences in the fraction of parents living in metropolitan areas for 1996 and 2013 graduation cohorts.

To interpret the strength of the taste for independence in the model and therefore its role in explaining changes in coresidence rates across the 1996 and 2013 college graduation cohorts, we assess the economic role of the taste for independence by calculating its monetary value. To do so, we construct a counterfactual in which we first adjust the parameters that govern preferences for independence, the mean value of the taste for living independently and the slope of its relation to age (α_z, γ_z), to a value that imply our estimated model can match the coresidence pattern for the 1996 cohort. Then, we compute the compensating variation in net assets that would make a 24 year old college graduate indifferent between the original taste for coresidence and the adjusted taste for coresidence. We calculate it separately for those with a matched job and with a mismatched job. We find that the net asset transfer that compensates for the change in preference for coresidence for college graduates with a matched job is $\$2,900$ and it is $\$3,500$ for those with a mismatched job. These transfers are roughly the monthly labor earnings of graduates with a mismatched jobs, implying that from an economic standpoint the change in preferences for independence across cohorts is quite modest.

6 Conclusion

This paper examines the joint determinants of coresidence and labor market outcomes. We quantify the effect of economic factors, such as family background, outstanding student loan balances, job mismatch rate, earnings dispersion, and rental costs, in accounting for the differences in living arrangements, employment and earnings between the 1996 and 2013 college graduation cohorts, using a dynamic structural model estimated using 2014 SIPP panel data. The model revolves around a dynamic game between parents and their college graduate children in which coresidence status and labor market outcomes for the children are jointly determined as a function of earnings, assets, and other family characteristics, as well as preferences. We find that coresidence at the early career stage has important quantitative implications for college graduates in terms of life time earnings. Using the estimated structural model, we decompose the impact on changes in parental income, student debt, matched job arrival rate, earnings dispersion, and rental costs. Our counterfactual analysis suggests that these factors can jointly explain 54% of the difference in matched job rates and 63% of the difference in coresidence rates between the 1996 and 2013 college graduation cohorts. We also find that changes in preferences over marriage are significant in shaping the evolution of coresidence behavior between the two graduation cohorts.

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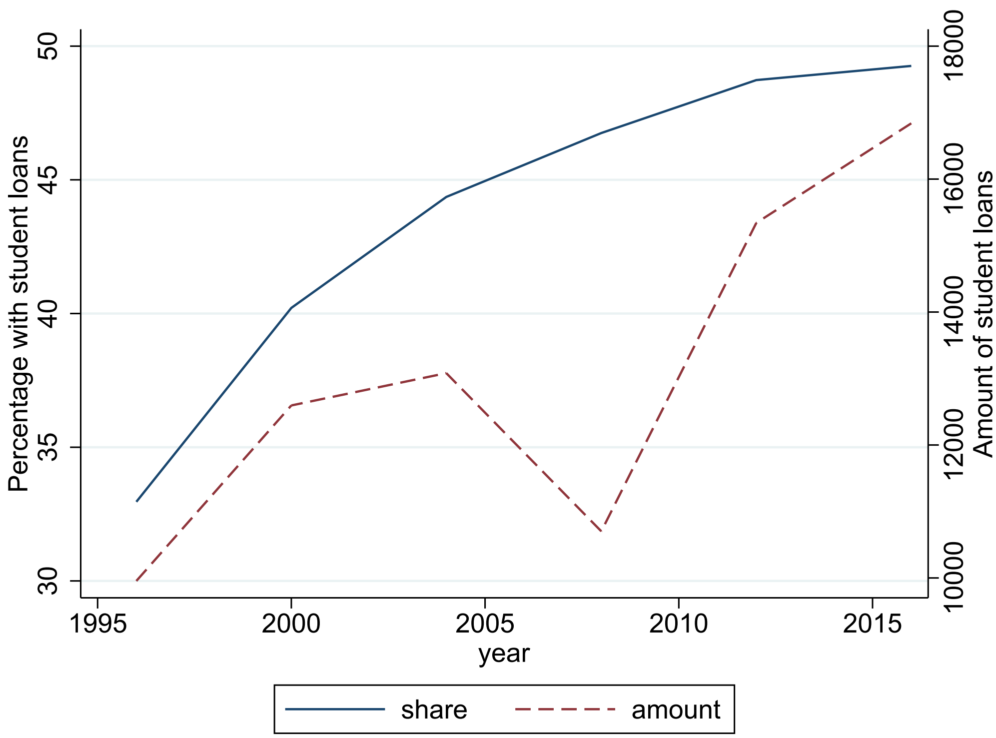
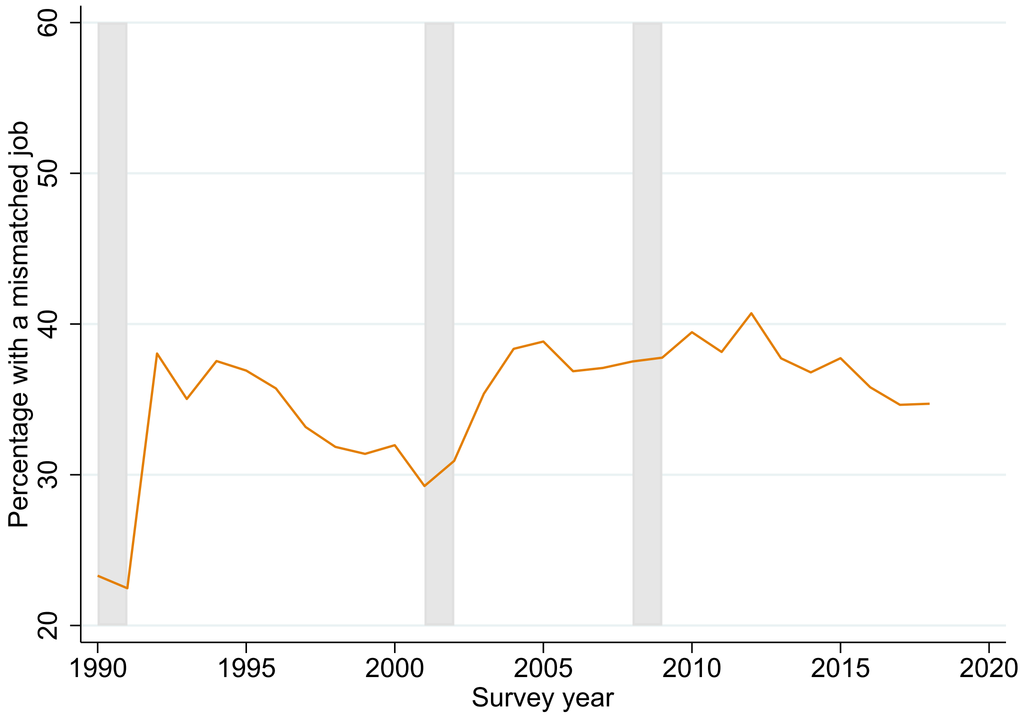
A Figures and Tables

Figure A.1: College Graduates Student Debt



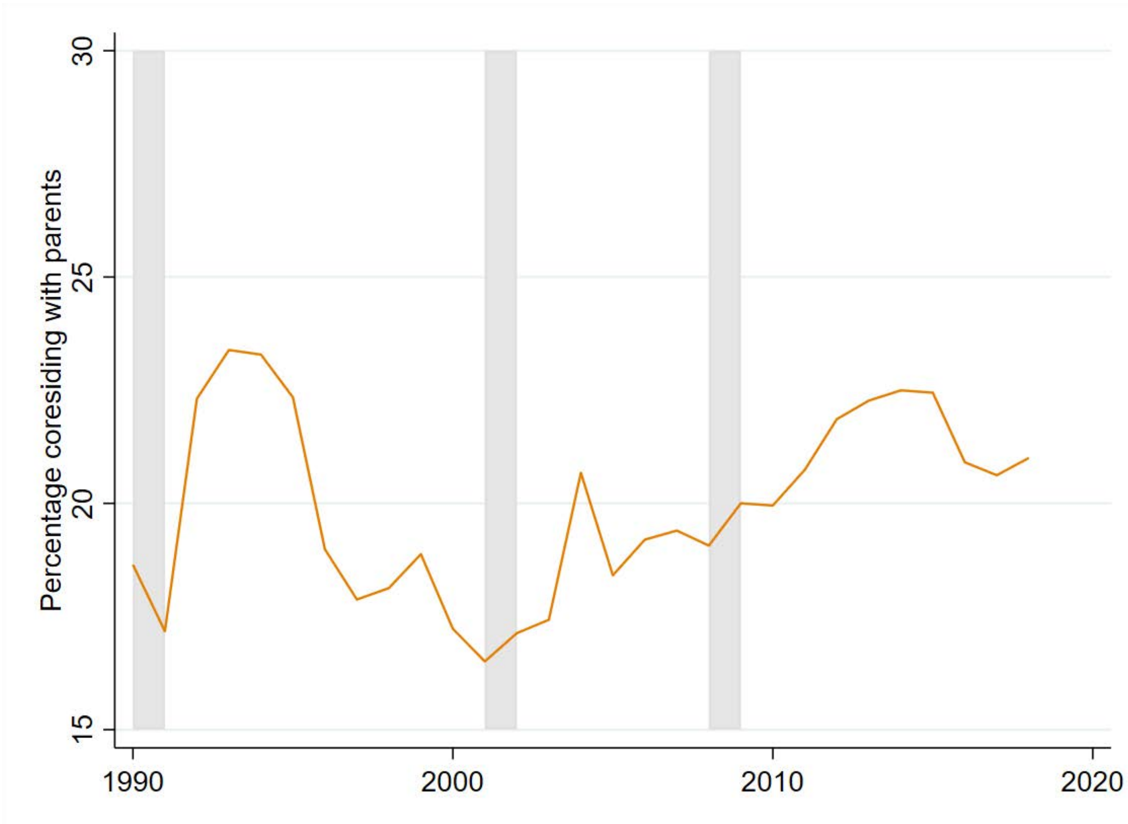
The “share" is the percentage of undergraduates with education loans, both subsidized and unsubsidized from the Stafford program. The ’amount’ is the average balance on student loans conditional on having a positive balance. Sources: U.S. Department of Education, National Center for Education Statistics, and 1993, 1996, 2000, 2004, 2008, 2012 National Postsecondary Student Aid Studies.

Figure A.2: College Graduates with Mismatched Jobs



Young college graduates are those aged 21 to 28 with a bachelor's degree or higher. All figures exclude those currently enrolled in school. Shaded areas indicate periods designated recessions by the National Bureau of Economic Research. Job mismatch is defined as the share of college graduates with a mismatched job. We use the occupation information from U.S. Department of Labor Occupational Information Network (O*NET) and link it to CPS. An occupation is defined as a mismatch for a college graduate if more than 50% of the employees in that occupation do not have a college degree. Sources: U.S. Bureau of Labor Statistics, Current Population Survey, March Supplement.

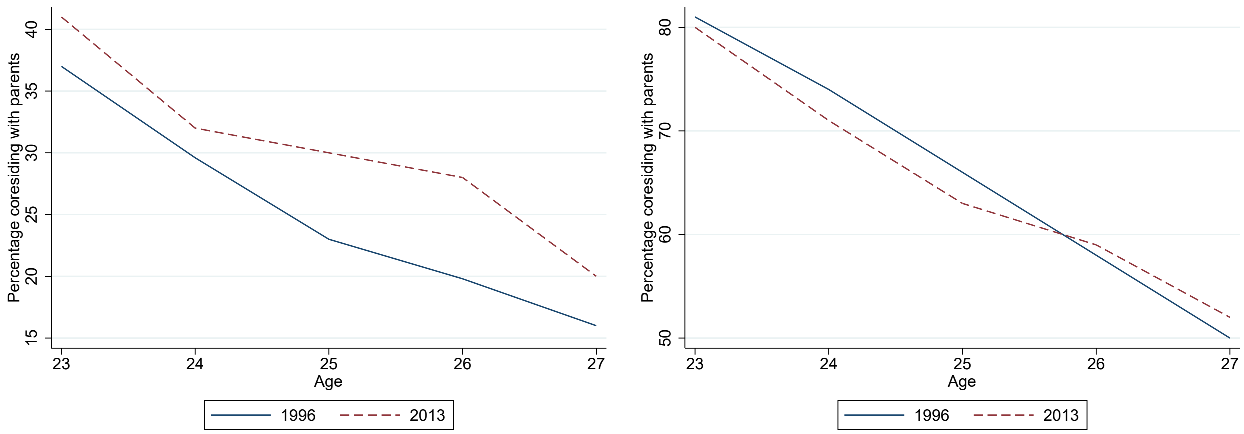
Figure A.3: Coresidence Rate for College Graduates



Young college graduates are those aged 21 to 28 with a bachelor's degree or higher. Coresidence is defined as the share of college graduates living together with either of the parent in the surveyed month. All figures exclude those currently enrolled in school. Shaded areas indicate periods designated recessions by the National Bureau of Economic Research. Sources: U.S. Bureau of Labor Statistics, Current Population Survey, March Supplement.

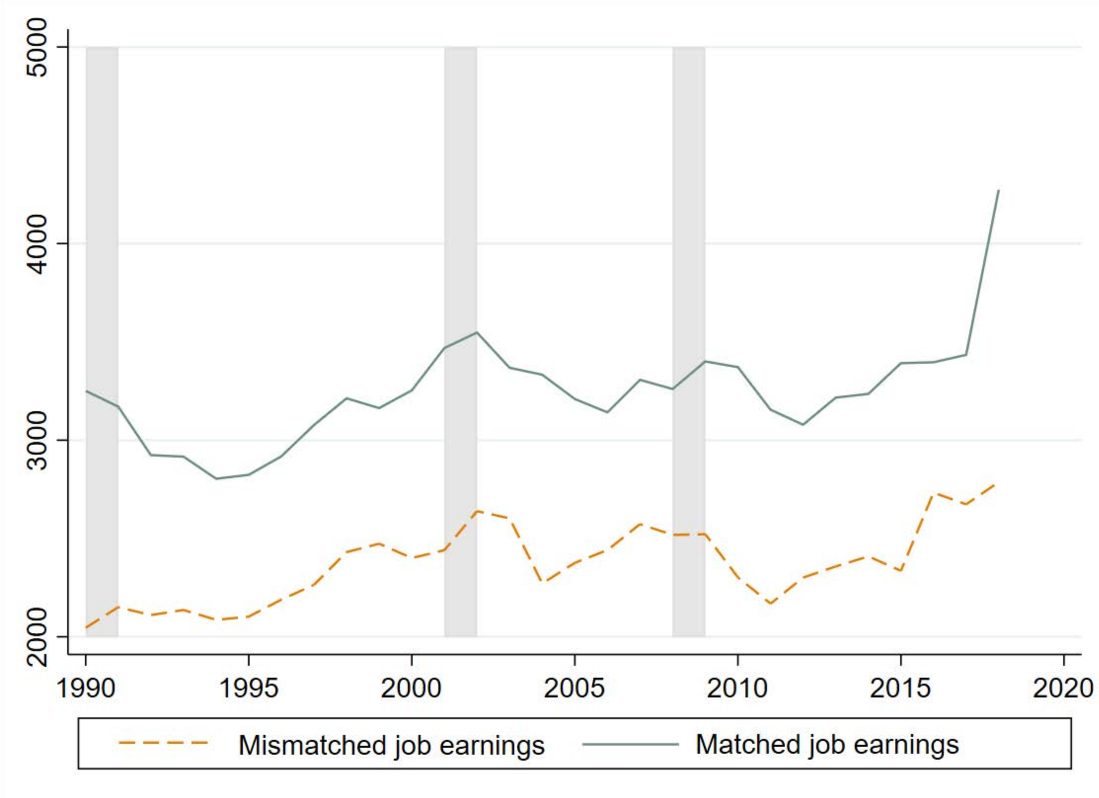
Figure A.4: Coresidence Rates by Education

(a) College (b) Non college



Young college graduates are those aged 23 to 27 with a bachelor's degree. Young non-college graduates are those aged 18 to 22 without a bachelor's degree. Coresidence is defined as the share of college graduate living together with either of the parent in the surveyed month. All figures exclude those currently enrolled in school. Sources: Survey of Income and Program Participation (1996 and 2014) and Department of Labor, O*NET Education, Experience, Training.

Figure A.5: College Graduates Monthly Earnings by Job Type



Young college graduates are those aged 21 to 28 with a bachelor's degree or higher. All figures exclude those currently enrolled in school. Job mismatch rate is defined as the share of college graduates with a mismatched job. We use the occupation information from U.S. Department of Labor Occupational Information Network (O*NET) and link it to CPS. An occupation is defined as a mismatch for a college graduate if more than 50% of the employees in that occupation do not have a college degree. Earnings is the average monthly wage. Shaded areas indicate periods designated recessions by the National Bureau of Economic Research. Sources: U.S. Bureau of Labor Statistics, Current Population Survey, March Supplement; U.S. Department of Labor, O*NET.

Table A.1: Sample selection

	N. of observations	N. of individuals
SIPP 2014 and 2018 sample	2,923,967	144,342
keep youth born between 1990-1993	150,722	8,355
keep sample with a bachelor degree	32,217	2,452
keep sample not enrolled in graduate school	28,339	2,169
SIPP 1996 sample	3,897,177	115,996
keep youth born between 1972-1976	284,184	10,411
keep sample with a bachelor degree	38,338	1,677
keep sample not enrolled in graduate school	35,475	1,613

Table A.2: Assets and Earnings: 1996 VS 2013 College Graduate Cohorts by Gender

	1996		2013	
Panel A: Male				
Assets and debt	share	amounts (>0)	share	amounts (>0)
Total assets	42%	$6,153	59%	$3,966
Total debt:	33%	$12,403	50%	$22,605
Student loans	19%	$19,693	40%	$26,003
Other debt	19%	$3,489	25%	$3,026
Net assets (total assets-total debt):	-$1,349		-$-7,258	
Coresidence				
Percent residing with parents	27%		31%	
Labor Market				
Unemployment rate	8%		11%	
Percent in matched jobs	52%		49%	
Monthly earnings, matched jobs	$3,753		$4,051	
Monthly earnings, mismatched jobs	$3,156		$2,998	
Panel B: Female				
Assets and debt	share	amounts (>0)	share	amounts (>0)
Total assets	38%	$3,826	61%	$4,612
Total debt:	35%	$ 9,289	53%	$21,721
Student loans	18%	$21,313	42%	$23,409
Other debt	22%	$2,485	30%	$5,615
Net assets (total assets-total debt):	-$-1,853		-$7,334	
Coresidence				
Percent residing with parents	23%		30%	
Labor Market				
Unemployment rate	11%		13%	
Percent in matched jobs	55%		47%	
Monthly earnings, matched jobs	$3,262		$3,651	
Monthly earnings, mismatched jobs	$3,036		$2,740	

Note: For data source and variable definitions please refer to notes in Table 1. Parental transfers are not reported since HRS data do not distinguish transfers to adult children by gender. 46% of individuals in the 2013 graduation cohort are males compared to 42% in the 1996 graduation cohort.

Table A.3: Moments

Moments	Data Value
Labor Market:	
Prob unemployed conditional on working in last period	0.04
Prob working in MA job conditional on unemployment in last period	0.52
Prob working in MI job conditional on unemployment in last period	0.43
Fraction of getting matched job	0.48
Mean MI log entry earnings	7.4
Variance MI log entry earnings	0.52
Variance MI log earnings conditional on working in consecutive periods	0.05
Growth mean MI log earnings	0.068
Mean MA log entry earnings	7.56
Variance MA log entry earnings	0.5
Variance MA log earnings conditional on working in consecutive periods	0.045
Growth mean MA log earnings	0.078
Average unemployment rate	0.12
Coresidence:	
Fraction living away	0.69
Growth fraction living away	0.05
Fraction ever move back	0.06
Autocorrelation of living away	0.87
Mean back home duration	4
Away home log earning difference	0.14
Assets and Transfers:	
Mean transfer	$6,058
Mean net assets	-$7,299

B Variables and Model Choices

In this section, we discuss the construction of the main variables and several model choices.

B.1 Coresidence Variables

Information about living arrangements in SIPP can be attained in the following ways. Parents and the child are supposed to live together if the child's relation to the reference person (household head) is "son" or "daughter" and there exists father's person number (EPNDAD) and/or mother's person (EPNMOM) number. If the parents don't live in the household, the father's person number and the mother's person number will be 9999. This information is recorded in the core microdata file for all months and all waves. We use this information to construct coresidence with parents variables.

B.2 Labor Market Variables

The SIPP Panel data includes detailed information about an individual's monthly labor market outcomes, i.e. employment status, wage and salary, and occupation for each job. Most of the employed college graduates (90%) have only one job. If the individual reports more than one job, we take the first one as his main job. We classified the college graduates' job as matched or mismatched job based on the occupation they work in. An individual is considered unemployed if they are not working or not participating in the labor force (not employed, out of the labor force/not searching. For unemployed individuals, the data set also includes the information on whether the person claims unemployment benefits and the amount of unemployment benefits.

Matched vs Mismatched Job To determine whether college graduates get a mismatched job, we use the data from the U.S. Department of Labor Occupational Information Network (O*NET). O*NET has detailed descriptions of the work by job seekers, workforce development and HR professionals, students, researchers. It describes the features and characteristics of each occupation. We use the following question from the O*NET Education and Training Questionnaire to determine whether an occupation requires a college degree: "If someone were being hired to perform this job, indicate the level of education that would be required." We consider a college education to be a requirement for a given occupation if at least 50 percent of the respondents working in that occupation indicated that a bachelor's degree is necessary to perform the job. We then merged these data on the educational requirements for each occupation with the SIPP data.

Unemployment benefits The unemployment benefits are calculated based on the SIPP data for college graduates. The 2014 SIPP Panel surveys the amount of unemployment benefits for unemployed college graduates. The average amount of unemployment benefits for unemployed college graduates is around $600 per month during the years 2013 and 2017. The calculation of this number includes zeros because there are observations that receive no unemployment benefits when not working. This could be because unemployment benefits are time-limited. If we restrict the sample to nonzero unemployment benefits, the average unemployment benefits are $1,160 per month.

B.3 Parental Income and Transfers Variables

As the problem with most household survey data, we can only observe the characteristics of the parents if the parents live in the same household with the children at some time in the sample period. If the children always live independently in our sample period, we won't be able to know their parents' information. Due to this data limitation, we turn to the Health and Retirement Study (HRS) 1996-2000 and 2014-2018 Panel data to obtain parental income and transfer data. The University of Michigan Health and Retirement Study (HRS) is a longitudinal panel study that surveys a representative sample of approximately 20,000 elder people in America. The data set tracks the same sample every two years. It contains detailed information on an individual's income and and the value of any transfers to their children. We apply the same sample restriction criteria with the SIPP data to the HRS data. We restrict the sample to individuals whose children are college graduates, aged 23-27 years old. Parents of these college graduates are around 47-60 years old in the sample, and most of them are still working. We get the parental income data from Section J EMPLOYMENT of HRS. It contains wage, salary, and self-employed income. We estimated the parental income as a four-point uniform distribution. Since in the data, parental income doesn't change much during 2014-2018, we take parental income as constant in the model. The transfer from parents to children is from Section E FAMILY STRUCTURE (CHILDREN) AND TRANSFERS (To Child) of HRS data. The survey question is stated as follows:

"About how much did that amount to for [that child/ [her /his /your] deceased child/, [her /his /your] deceased child/ each child/ each grandchild/ each child and grandchild/ [WHICH CHILDREN GAVE LGST AMT - SPECIFY]/[WHICH CHILD GIVEN LARGEST AMT - SPECIFY]/[WHICH CHILDREN GAVE SAME AMOUNT- [[since [Previous Wave Month], [PREV WAVE IW YEAR OF FAMILY R]/since [PREV WAVE IW YEAR OF FAMILY R]/in the last two years]])?"

Since the transfer data is surveyed for the past two years, we take the average to make it corresponds to per year. In other words, we only have annual transfer data.

B.4 Share of public consumption in utility ϕ

The share of public consumption, ϕ, is from Kaplan (2012). Kaplan (2012) calibrates this parameter from household-equivalence scales, where he considers three scales: the OECD (Organization for Economic Cooperation and Development) equivalence scale, the OECD modified scale, and the square-root scale. For each equivalence scale, he computes the percentage increase in income needed by a household to keep welfare constant when moving from a household with two adults to a household with three adults. These three scales give values of 41%, 33%, and 22%, respectively. Kaplan (2012) applies a static version of his model to map these values into the parameter ϕ, which implies values for ϕ ranging from 0.2 to 0.42. We took the average of this range, which is 0.3. We also experimented with other numbers like 0.25 or 0.35 and found the results to be robust to changes in the equivalence scale.

B.5 Moving cost κ

We calculate this number based on the following information.

a) The average moving cost, including the cost of hiring professionals for local and distance moves, is obtained from: https://www.moving.com/movers/moving-cost-calculator.asp. The average cost of a local move is $1,250. The average cost of a long distance move is $4,890 (distance of 1,000 miles or more). These estimates are based on a 2-3 bedrooms move of approximately 7,500 pounds." The estimates for 1 bedroom move is estimated to be about half of that price, which is \$650 for local and \$2400 for long distance.

b) We also refer to U-haul website to calculate the moving cost for a 1 2 bedroom. It ranges from \$150 to \$300 for a 200-500 miles move and \$1,000 for more than 1,000 miles move.

C Tax function

We use a tax function that includes three types of tax: payroll, federal and state. There are two parts in payroll. First, social security tax of 6.2% of annual income up to $102,000. Second, a medicare levy of 1.5% of annual income with no limit. In terms of federal income tax, we calculate net income by gross income less a standard deduction of $6,200 and a personal exemption of $3,950. We then use the progressive tax rates for a single with no dependents for 2014 on the basis of the net income. We assume that state income taxes are 2.5% of gross income minus a deduction for federal taxes plus another $2,500. All calculation are based on annual income, by multiplying the monthly income by 12 and dividing the resulting tax by 12. The above calculation is based on Internal Revenue Service, IRS Revenue Procedure 2013-35, in Internal Revenue Bulletin 2013-47, Nov.18, 2013, http://www.irs.gov/pub/irs-drop/rp-13-35.pdf.

D Numerical Methods

The model is solved by backward induction from the terminal value functions that are described in the main text. The asset choice is discretized into a 16 points exponentially spaced grids between the natural borrowing limit and the maximum asset. Similarly, the number of grid points for earnings offer is 10 and the number of grid for public consumption is 7. The distribution of the preference shocks, z_{it} is discretized into a 10 point stationary Markov chain using the Tauchen method with parameters ρ_z and σ_z^2. Value functions and decisions are calculated based on the grids mentioned above. Values between grid points are calculated based on linear interpolation. Discrete choices, like coresidence and labor supply decisions, are solved by interpolating the choice specific value function at the relevant stage of the game.

The estimation method is the Method of Simulated Moments (MSM), as proposed by McFadden (1989) and Pakes and Pollard (1989). The method involves finding the parameter vector Θ that minimizes the distance between the actual data and data simulated from our model. Let d_r denote a statistic from the actual data, and let $d_r^s(\Theta)$ be the corresponding statistic calculated in the simulated data, and assume we fit the model to $r = 1, 2, ..., R$ statistics. We then construct moments of the form:

$$m_r^s(\Theta) = [d_r - d_r^s(\Theta)] \quad for \quad r = [1, 2, ..., R]$$

The vector of simulated moments is given by $g'(\Theta) = [m_1^s(s), ..., m_R^s(s)]$. We minimize the objective function $G(\Theta) = g'(\Theta)Wg(\Theta)$, where the weighting matrix W is a diagonal matrix consisting of the inverse of the estimated variance of each moment (from a first step). We minimize $G(\Theta)$ with respect to Θ using the Simplex algorithm. We conduct our computation using the H2P Cluster from Center for Research Computing, University of Pittsburgh.

To calculate standard errors, we follow Eckstein and Lifshitz (2011) to construct the asymptomatic standard error. To compute the numerical standard errors, we must first compute the numerical derivative of the objective function with respect to each of the parameters, Θ_p, use the five-point stencil formula with a long baseline:

$$f_{\Theta_p} = \frac{-f(\Theta_p + 2\epsilon_p) + f(\Theta_p + \epsilon_p) - 8f(\Theta_p - 8\epsilon_p) + f(\Theta_p - 2\epsilon_p)}{12\epsilon_p}$$

where f is a vector of the squared moments divided by their weights: $[d_r - d_r^s(\Theta)]^2/W_r$ and ϵ_p is equal to $0.01\Theta_p$. Given the numerical derivatives, we compute the covariance matrix using the outer product approximation to the Hessian.