College Financial Aid Application Frictions*

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Abstract

We document that 11 percent of recent US high school graduates did not apply for federal student aid due to difficulty in applying, mistaken beliefs, or lack of awareness. Not applying due to such application frictions negatively predicts college enrollment after controlling for other attributes. We represent application frictions as heterogeneous filing costs in a general equilibrium life cycle model of college enrollment. We find that eliminating these frictions generates modest gains on average because less than half of those affected would ultimately utilize aid. However, welfare gains are large for the affected few with high skill and poor parents.

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1 Introduction

The federal student aid program of the United States finances Pell grants and Stafford loans to make college more affordable.[1] This aid can only be accessed after filing the Free Application for Federal Student Aid (FAFSA). However, application frictions may prevent some individuals from filing a FAFSA and accessing the aid they are eligible for, thereby making college enrollment prohibitively expensive for them. In particular, young people may face difficulties in applying for federal financial aid, misunderstand their eligibility for it, or be unaware of the program's existence. These issues may arise due to complexities in the filing process, information frictions, and behavioral biases.

To partially address aid application frictions, policy makers have recently attempted to simplify the FAFSA filing process through the 2020 *FAFSA Simplification Act*, as described in more detail in the Congressional Research Service report Collins and Dortch (2022).[2] However, implementation of the *FAFSA Simplification Act* has been characterized by rollout delays, difficulty with the new forms, and generally exacerbated confusion (Government Accountability Office, 2024b,a). Even when such reforms are succesfully put into place, their potential benefits depend on the overall extent of aid application frictions and their costs.

We make two main contributions. First, we document the extent of FAFSA nonfiling due to aid application frictions in the distribution of high school graduates using nationally representative survey data collected prior to the *FAFSA Simplification Act*. Second, we build a life cycle model that embeds aid application frictions as heterogeneous filing costs and calibrate it to our survey data. We then use the model to quantify the benefits from eliminating application frictions (and thus the cost of their presence) by setting the filing costs to zero.

Our main finding from eliminating application frictions in the model is that, while 11 percent of high school graduates cite application frictions as a reason for not filing a FAFSA, fewer than half of these nonfilers due to frictions would use federal aid after filing costs are set to zero. This is because many nonfilers due to frictions would file a FAFSA if filing were costless, anticipating that they may ultimately enroll in a BA even though this enrollment outcome is rare. Consequently, eliminating frictions generates modest gains for the average nonfiler due to frictions, amounting to 0.62 percent of lifetime consumption in partial equilibrium and 0.79 percent in general equilibrium. However, there is a high likelihood of transitioning from nonenrollment to enrollment for the few

[1] Pell grants and Stafford loans are the largest federal grant and student loan programs, respectively. Stafford loans may be subsidized or unsubsidized. Subsidized loans do not accrue interest while the loan recipient is enrolled in college.

[2] Prior to this legislation, Dynarski and Scott-Clayton (2006, 2008) illustrated unnecessary complexities in the FAFSA form by showing that most of the variation in disbursed aid can be accounted for by a few of the more than 70 data items used in the aid formula.

nonfilers due to frictions with high skill and poor parents. Hence, the benefits to this group amount to more than 5 percent of lifetime consumption in both partial and general equilibrium.

Our main empirical results are established using the High School Longitudinal Study of 2009 (HSLS:09), a nationally representative panel survey of 9th graders from the National Center of Education Statistics, a subsidiary of the United States Department of Education. In a data collection wave administered the summer after high school completion for most sample members, respondents who report not filing a FAFSA are asked to agree or disagree with a list of seven possible reasons for not filing. We group these reasons into two categories based on whether they are related to frictions. Reasons for not filing a FAFSA related to frictions are because the forms were too much work, because they did not know how, because they did not know they could, and because they thought they were ineligible for aid (despite the fact that unsubsidized loans do not restrict eligibility). Reasons not related to frictions are being able to afford college without financial aid, not wanting to go into debt, and not intending to enroll in postsecondary education. Because respondents can agree with more than one reason for not filing, we identify those who cite frictions as a reason for not filing (and possibly other reasons) and those who cite frictions as the only reason for not filing.

We find that 11 percent of high school graduates did not file a FAFSA due to frictions (and possibly other reasons), while 4 percent did not file a FAFSA due to only frictions. We also document the following patterns. First, in the cross-section broken down by four-year bachelor's degree (BA) enrollment outcome, nonfiling due to frictions is more common among nonenrollees. This pattern by enrollment outcome is observed among all high school graduates and within each skill tercile, where skill is measured using high school grade point average. In the cross-section broken down by skill and parental income, nonfiling due to frictions is more common among those with low skill or high parental income. Second, a battery of probit regressions demonstrates that not applying for federal aid due to frictions is associated with a lower likelihood of enrolling in a BA both immediately and three years after high school graduation, even when we control for other attributes such as student skill, parental income, and not filing for aid due to lack of intent to continue into postsecondary education. Third, our financial aid imputation suggests that many high school graduates who do not file due to aid application frictions would be eligible for substantial amounts of Pell grants were they to enroll in a BA.[3]

To quantify the costs of financial aid application frictions, we include these frictions as heterogeneous filing costs in an equilibrium life cycle model of college enrollment. These filing costs,

[3] Regarding the other components of federal aid, all applicants enrolled in a BA will be eligible for unsubsidized loans. Therefore, unsubsidized loans are left unclaimed simply by not applying. We do not provide an imputed estimate for subsidized loans because the amount one is eligible for is somewhat idiosyncratic to each institution, as discussed in more detail in Section 2.

incorporated as a utility penalty, parsimoniously capture difficulty in applying, mistaken beliefs about eligibility, and lack of awareness about the program. The benefit of filing a FAFSA is access to federal aid, specifically Pell grants and subsidized and unsubsidized Stafford loans.

In addition to having different filing costs, high school graduates also differ in skill, initial assets, and eligibility for need-based aid. Importantly, at the time of making the FAFSA filing decision, high school graduates face uncertainty about whether they would ultimately enroll in college. Hence, it can be beneficial for them to file and gain access to federal aid for the states of the world in which they would enroll, although these states can be rare. Apart from incorporating a FAFSA filing decision with heterogeneous filing costs, another novel feature of our model is that it approximates the way in which family attributes map into eligibility for need-based financial aid (that is, Pell grants and subsidized loans) via the Expected Family Contribution (EFC) formula.

We assume that the filing costs are drawn from a skill-specific log-normal distribution. For each skill type, the mean and the variance of the distribution are disciplined using the shares of high school graduates who cite application frictions as a reason and as the only reason for not filing a FAFSA. In the model, we identify these shares using partial-equilibrium counterfactual exercises in which filing is made costless or other factors of the environment related to college enrollment are changed and then the FAFSA filing decision is re-examined. These counterfactual exercises are constructed to mimic the HSLS:09 survey questions about the reasons for not filing a FAFSA.

Before using the calibrated model to quantify the cost of aid application frictions, we show that it successfully accounts for the empirical patterns we document which are discussed above. We also demonstrate that the model produces an enrollment elasticity which is close to the data in a quasi-natural experiment in which we compare the enrollment rate response to a tuition subsidy with its empirical counterpart.

In our main experiment, we quantify the cost of aid application frictions by analyzing the benefits of setting the filing costs to zero. Specifically, we use the model to quantify the increase in enrollment, the increase in access to aid among status quo enrollees, the welfare benefits for nonfilers due to application frictions as well as other subgroups of high school graduates, and the macroeconomic gains. Our counterfactuals measure only the benefit of a successful reform in the sense that we assume eliminating financial aid application frictions incurs no direct cost to implement. Additionally, we do not allow for a rise in college costs as demand for college rises.[4]

While a large share of high school graduates (11 percent) cite application frictions as a reason for not filing, what matters for the impact of removing these frictions is the proportion of nonfilers

[4]If either an implementation cost is incorporated or tuition does rise with demand, then the benefits of eliminating financial aid application frictions will be even smaller than indicated by our baseline results.

due to frictions who will respond by transitioning into enrollment in a BA with access to financial aid. This type of transition can happen because nonenrollees who do not file a FAFSA switch to filing and enrolling, or because enrollees switch to filing.[5] To examine this further, we separate the 11 percent of high school graduates who are FAFSA nonfilers due to frictions in the baseline economy into three mutually exclusive categories: 0.8 percent of high school graduates would switch to filing and enrolling, 3.3 percent would switch to filing although they were enrolling in the first place, and the remaining 7 percent or so would still not enroll although they switch to filing. Therefore, only 37 percent of nonfilers due to frictions (the roughly 4.1 percent of all high school graduates who fall into the first two categories) are under-utilizing aid in the baseline equilibrium.[6]

The uncertainty about college enrollment when making the FAFSA filing decision is a key model ingredient for the result of modest (as opposed to high) under-utilization among nonfilers due to frictions. Due to this feature, among the many nonfilers due to frictions who are low- and medium-skill high school graduates, the primary reason to switch to filing once frictions are eliminated is that access to aid may facilitate BA enrollment if they have favorable realizations of the state space at the point of the BA enrollment decision. However, such favorable realizations are rare. Therefore, more than half of the nonfilers due to frictions will remain nonenrolled after application frictions are eliminated.

Of course, the desirability of reducing frictions in the federal student aid application process depends ultimately on the welfare costs of those frictions. Our structural model is suited to quantifying these welfare costs, as it offers a laboratory that accounts for the rates of nonfiling due to frictions both in the aggregate and in the cross-section along the margins of skill, enrollment outcome, and parental income, while also taking into account skill-specific lifetime returns to bachelor's degree attainment. Accordingly, to quantify these welfare costs we compute and examine the welfare gains that arise after eliminating aid application frictions. For the average member of the 11 percent of high school graduates who are nonfilers due to frictions, the gains amount to 0.62 percent of lifetime consumption in partial equilibrium. In general equilibrium, these gains increase to 0.79 percent. Breakdowns by skill and parental income reveal that the few nonfilers due to frictions who have high skill and poor parents experience larger welfare gains amounting to more than 5 percent of lifetime consumption in both partial and general equilibrium.

A useful benchmark for evaluating the magnitude of the gains from eliminating frictions is the

[5]Our model does not feature a margin in which nonfilers due to frictions transition to a college of higher quality. This is because we assume one type of college with skill-specific returns. The quantitative literature on the college market is relatively nascent. For pioneering work, see Chade, Lewis, and Smith (2014), Fu (2014), Gordon and Hedlund (2022), and Marto and Wittman (2024).

[6]The gains to the remaining 89 percent of high school graduates who are *not* identified as nonfilers due to frictions are second order.

value of the federal student aid program as it stands in the baseline equilibrium. This value amounts to 2.13 and 5.68 percent of lifetime consumption for the average high school graduate in partial and general equilibrium, respectively. Hence, the welfare gains from eliminating frictions for the average nonfiler due to frictions are comparatively modest.

Our structural work contributes to the macroeconomic literature on postsecondary education that analyzes the college enrollment decision. Examples include Caucutt and Kumar (2003), Andolfatto and Gervais (2006), Ionescu (2009), Lochner and Monge-Naranjo (2011), Chatterjee and Ionescu (2012), Krueger and Ludwig (2016), Ionescu and Simpson (2016), Abbott, Gallipoli, Meghir, and Violante (2019), Caucutt and Lochner (2020), Matsuda (2020, 2022), Colas, Findeisen, and Sachs (2021), Kim and Kim (2023), Luo and Mongey (2024), Krueger, Ludwig, and Popova (2024), Hendricks, Koreshkova, and Leukhina (2024), Moschini, Raveendranathan, and Xu (2025), and Vardishvili (2025). These papers examine various aspects of postsecondary education, such as the substitutability between financial aid and family transfers or between federal and private student loans, dropout risk, and intergenerational effects. We contribute to this literature by incorporating a FAFSA filing decision with heterogeneous filing costs into a life cycle model of college enrollment, which we calibrate to target the rates of directly reported reasons for not filing a FAFSA and then use to quantify the costs of the application frictions.

Our empirical work contributes to growing evidence that federal aid application frictions suppress college enrollment. Previous studies usually infer the presence of frictions by documenting changes in FAFSA filing and college enrollment outcomes after some form of treatment related to the FAFSA filing decision. For example, Bettinger, Long, Oreopoulos, and Sanbonmatsu (2012) and Deneault (2023), which study regional interventions, find increased college enrollment from an intervention that provided personal assistance for filing a FAFSA and a policy that mandated FAFSA filing for high school graduation, respectively. While these two studies find positive effects, the form of the intervention used to infer the presence of frictions also matters. This is demonstrated by the evidence from information interventions being more mixed (e.g., Castleman and Page (2016), Page, Castleman, and Meyer (2020), Bird, Castleman, Denning, Goodman, Lamberton, and Rosinger (2023)). Relative to all of these studies, Dynarski, Libassi, Michelmore, and Owen (2021) find a large response in enrollment after an intervention that offered an early tuition guarantee to high-achieving low-income students conditional on applying to and being accepted at a flagship state university. We contribute to this literature by analyzing the extent of FAFSA nonfiling due to application frictions in the distribution of high school graduates using directly reported reasons for nonfiling collected from survey respondents. We also show that nonfiling due to frictions predicts a lower likelihood of enrolling in a four-year BA even after controlling for other characteristics, and that many nonfilers due to frictions do not claim substantial amounts of Pell grants that they could be eligible for.

This paper proceeds as follows. Section 2 overviews the federal student aid system in the United States. Section 3 explains our main empirical results, and Section 4 presents our structural model. Section 5 parameterizes the model and presents the main model validation exercises. Section 6 quantifies the cost of aid application frictions by computing the benefits from eliminating FAFSA filing costs in the calibrated model. Section 7 concludes.

2 Federal Student Aid in the United States

Federal student aid in the United States is a system of public financial support for those pursuing education after high school. In the period covered by our empirical analysis (the mid-2010s), filing the FAFSA is necessary in order to qualify for federal aid (National Association of Student Financial Aid Administrators, 2014). Filers usually complete the FAFSA in the spring of their final year of high school, and re-submit it before each academic year of postsecondary enrollment thereafter.[7] The FAFSA records information on parental income, wealth, tax liability, employment status, and number of dependents enrolled in college.[8] A formula then assigns the family an Expected Family Contribution (EFC), which is the amount that the family is deemed able to contribute towards the Cost of Attendance (COA). The difference between the COA and the EFC is "unmet need," the upper bound for total need-based financial aid. During the process of establishing postsecondary enrollment, institutions that accept a FAFSA-filing applicant offer them a financial aid package; the applicant then decides which program (if any) to enroll in.[9]

Financial aid packages are generated by the institution's financial aid administrator (FAA). Before proceeding, FAAs can invoke "professional judgment" to adjust FAFSA inputs if special circumstances for the FAFSA filer are documented, and then use the resulting EFC based on the adjusted inputs as they build the aid package. FAAs at any accredited institution may include Pell grants (the largest federal grant program) and Stafford loans (the largest federal loan program) in the aid package offered to FAFSA filers who meet each aid program's eligibility criteria. Stafford loans may be unsubsidized (for which interest accrues on the loan balance during college) or subsidized

[7] FAFSA filings determine aid from federal-, state-, and institution-level sources (non-federal sources may use additional information). Federal aid is distributed over several rounds during the academic year; FAFSA filings or updates within the academic year are reflected in the next round of aid.

[8] Here, we describe dependent FAFSA filers (the vast majority of first-year filers).

[9] Only accredited postsecondary institutions are eligible to distribute federal student aid (Hegji, 2024). Table A10 of Appendix A.1.6 reports the distribution of aggregate federal student aid received by the HSLS:09 cohort in the 2013-2014 academic year, both across and within postsecondary program types. Most federal student aid is spent on BA enrollees, and each of the three sources of federal aid (Pell grants, subsidized Stafford loans, and unsubsidized Stafford loans) contribute a substantial amount to spending on that group. This partially motivates our focus on BA programs and all three sources of federal aid. The HSLS:09 is described further in Section 3.

(for which interest does not accrue). Eligibility for subsidized Stafford loans and Pell grants is need-based, while eligibility for unsubsidized Stafford loans is universal. Specifically, the Pell grant amount offered to a student is determined by the difference between an upper bound and their EFC; the upper bound is the minimum of the maximum Pell grant amount and the COA. Subsidized Stafford loans are offered up to an annual borrowing limit, equal to the minimum of an annual limit and unmet need net of Pell grants; total Stafford loans (subsidized plus unsubsidized) are also subject to an annual limit. The FAA is expected to include any Pell grants the filer is eligible for in the aid package before turning to other sources of aid, such as Stafford loans.

3 Data

Our main data source is the High School Longitudinal Study of 2009, a nationally representative panel survey of 2009 9th graders in the United States (National Center for Education Statistics, U.S. Department of Education, 2020). The survey's four main waves collected information on all sample members regardless of postsecondary education (PSE) outcome, which allows us to observe respondents who did not continue their education after high school. Each wave (with its academic timing for most sample members) is referred to as follows: the Base-year (2009, 9th grade), First follow-up (2012, 11th grade), 2013 Update (the summer after high school graduation), and Second follow-up (2016, three years after high school graduation). These waves are supplemented by the Postsecondary Transcripts and Student Records or PETS-SR wave, collected from institutional sources up to the 2015-2016 academic year for postsecondary enrollees. Financial aid records reported in the PETS-SR wave are pulled from the National Student Loan Database for the sample with a student record collection. In the Base-year and First follow-up survey waves, both the sample member and their parent are interviewed with distinct questionnaires. The 2013 Update is an abbreviated survey questionnaire completed by the sample member or their parent (in the latter case, survey questions are reframed to be about the respondent's child). Only the sample member is interviewed in the Second follow-up.

For our main analyses we use a cleaned sample of high school graduates for whom we observe valid values for our variables of interest. Our measure of youth skill in the HSLS:09 is honors-weighted high school grade point average (GPA).[10] In Appendix A.1.1, we provide details of our sample cleaning procedure. In addition, in Appendix A.1.1 we describe how we assign observations to PSE outcomes in the academic year after high school completion (2013-2014) by capitalizing on the various sources of information available in the HSLS:09, and validate our estimated enrollment rate by comparing it with a national-level statistic from the U.S. Department of Education in Table

[10] Honors-weighting raises the total GPA of the individual if the difficulty of the course is higher (e.g., honors or college level). See the HSLS:09 2013 Update's Student file codebook and User Manual Appendix.

A1. In Table A2 of that appendix we compare our cleaned HSLS:09 sample of 7,143 observations with the raw data.

In Section 3.1, we define federal financial aid application frictions in the context of our survey data. In Section 3.2, we quantify the extent of FAFSA nonfiling due to these frictions in the distribution of high school graduates and the extent to which nonfiling due to these frictions is correlated with a lower likelihood of BA enrollment after controlling for other observables. Lastly, in Section 3.3, we discuss the extent to which those who do not file a FAFSA due to application frictions may forgo federal financial aid, particularly Pell grants.

3.1 Defining federal financial aid application frictions

To define and measure federal financial aid application frictions, we turn to the 2013 Update questionnaire. Regardless of postsecondary enrollment outcome, the 2013 Update asks the sample member (or their parent) whether or not they completed the FAFSA for themselves (or on behalf of the sample member) by the time of the interview. There are four possible replies: "Yes," "No," "Don't know what a FAFSA is," and "Not sure." If the answer to the FAFSA completion question is "No," then the questionnaire asks "Why not?" and provides a list of seven possible reasons for not submitting the form. The survey asks the respondent to agree or disagree with each possible reason; respondents may agree with more than one reason or with none of them.

We group the seven possible reasons for not filing a FAFSA into two categories, based on whether or not they are related to aid application frictions. For each category, we create a corresponding indicator equal to one if the respondent says that a FAFSA nonfiling reason assigned to that category applied to them, and equal to zero otherwise. If a respondent does not assent to any of these reasons driving their nonfiling decision, we refer to them as nonfilers due to "no reason given."

Reasons for FAFSA nonfiling related to frictions are "because the forms were too time-consuming or too much work," "because they did not know how," "because they did not know they could," and "because they thought they were ineligible or unqualified." Believing oneself ineligible is classified as a reason related to application frictions because it indicates mistaken beliefs about federal aid eligibility, as all applicants are eligible for unsubsidized loans. Broadly, the four reasons reflect nonfiling due to complexities in the filing process, information frictions, or behavioral biases.[11] Reasons unrelated to frictions are "because they can afford college without financial aid," "because

[11] We interpret "Don't know what a FAFSA is" as synonymous with "Not sure" instead of interpreting it as reflecting a friction because (1) it is possible that the FAFSA form was filled out without the recollection of the respondent and, (2) even if they are in fact nonfilers, respondents who select this answer are not asked about their nonfiling reasons so we cannot tell whether the nonfiling was also due to reasons related to frictions. Our interpretation yields a lower-bound value for the percentage not filing for aid due to frictions.

they did not want to go into debt," and "because the teen does not plan to continue their education."

3.2 Quantifying the extent and role of frictions

How common is it to not apply for federal financial aid due to frictions in the financial aid application process? In Table 1, we report the rates of FAFSA filing and nonfiling before college as well as the reasons for not filing in units of percentages, organized into three panels. Specifically, Panel A reports the frequency of FAFSA filing statuses, while Panel B reports the frequencies of FAFSA nonfiling due to frictions and nonfiling due to reasons unrelated to frictions (these groups are not mutually exclusive). In Panel C, FAFSA nonfilers are broken down into four mutually exclusive groups of nonfiling reasons: only frictions, only not frictions, both, or no reason given. The statistics are provided for all high school graduates and by BA enrollment outcome in the 2013-2014 academic year.[12]

Among all high school graduates in the first column of Table 1, Panel A indicates that many do not file a FAFSA (21 percent). Panel B indicates that many high school graduates do not file a FAFSA and cite application frictions as a reason (11 percent).[13] A potential concern with the rate of nonfiling due to frictions reported in Panel B is that these nonfilers may also cite other reasons for not filing. This concern is addressed in Panel C, which indicates that a smaller but qualitatively significant share (4 percent) of high school graduates do not file a FAFSA and cite only application frictions as a reason.

The breakdown by enrollment outcomes in the last two columns of Table 1 reveals that nonenrollees in comparison to enrollees are more likely to not file, not file due to application frictions, and not file due to only application frictions. We also note that those who did not enroll in a BA in the fall of 2013 might not have enrolled in any PSE or have enrolled in a sub-baccalaureate program (e.g., certificate or two-year program). Table A3 of Appendix A.1.2 shows that, in comparison to sub-baccalaureate enrollees, those who did not enroll in any PSE are more likely to not file, not file due to frictions, and not file due to only frictions.

Having documented the extent of application frictions in the aggregate and in the cross-section by BA enrollment outcome, we next examine the cross-section by skill and parental income. We

[12]In Table 1, the sample count for BA enrollees is higher than the sample count for nonenrollees despite the BA enrollment rate being less than 50 percent in Table A2 of Appendix A.1.3. This difference is due to the use of survey weights.

[13] In the 2013-2014 academic year there were 3,168,450 public high school graduates in the United States (National Center for Education Statistics, U.S. Department of Education, 2025). This means that 11 percent of high school graduates corresponds to approximately 350,000 individuals who are nonfilers due to frictions. This figure is a lower bound because the total number of graduates we use to compute it does not include high school graduates from private institutions. In Table A4 of Appendix A.1.3, we provide summary statistics comparing the characteristics of nonfilers due to frictions with those of their peers.

Table 1: FAFSA filing status and nonfiler reasons

			Enrolled in BA	
Category	**Variable**	**All**	**No**	**Yes**
Panel A: FAFSA filing rates	Nonfilers	20.70	29.20	9.33
	Filers	69.51	55.75	87.90
	Uncertain	9.80	15.05	2.78
	Total	100	100	100
Panel B: FAFSA nonfiler reasons (not mutually exclusive)	Frictions	10.92	13.95	6.86
	Not frictions	12.90	16.83	7.64
Panel C: FAFSA nonfiler reasons (mutually exclusive)	Only frictions	4.23	6.28	1.50
	Only not frictions	6.21	9.16	2.28
	Both	6.68	7.67	5.36
	No reason given	3.56	6.09	0.19
	Nonfilers	20.70	29.20	9.33
	Observations	7,143	3,382	3,761

Notes: The table reports FAFSA filing status frequencies and reasons for not filing a FAFSA, for all high school graduates and broken down by 2013 BA enrollment outcome. Sample counts are for each column's total sample. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

focus on these variables because they are first order for the BA enrollment decision.

Table 2 reports the rates of FAFSA nonfiling due to frictions and possibly other reasons (Panel A) and FAFSA nonfiling due to only frictions (Panel B), broken down by skill tercile and by skill tercile and enrollment outcome. Among all high school graduates in Panel A, nonfiling due to frictions is highest for those in the lowest skill tercile (14 percent) and positive but less common for those in the top skill tercile (8 percent). Panel B shows that even when we focus on nonfilers due to only frictions, the frequencies are still quantitatively significant in each skill tercile, and the skill gradient is maintained. Both panels also show that in each skill tercile, BA nonenrollees are more likely to cite application frictions for not filing than are enrollees.

Of course, respondent skill measured in high school is positively correlated with parental income. At the same time, FAFSA nonfiling due to frictions may be due to higher parental income and a sense among high school graduates that this makes FAFSA filing not worthwhile. Table 3 shows that the negative relationship between FAFSA nonfiling due to frictions and skill survives after controlling for parental income, by reporting the rate of nonfiling due to frictions by skill tercile and parental income tercile. For each parental income tercile, the rate of nonfiling due to frictions is decreasing in skill. Additionally, within each skill bin, nonfiling due to frictions is most common within the highest parental income tercile.

Does FAFSA nonfiling due to frictions predict BA enrollment, controlling for other attributes (e.g., skill, parental income, parental education, or intent to attend college)? To answer this question, Table 4 begins by reporting the average marginal effects (AMEs) for four probit models which all

Table 2: FAFSA nonfilers due to frictions by skill tercile and overall

Category	Skill	All	Enrolled in BA: No	Enrolled in BA: Yes
Panel A: FAFSA nonfiler due to frictions	1	14.31	15.29	6.74
	2	10.22	12.69	6.79
	3	8.22	12.15	6.92
	Total	10.92	13.95	6.86
Panel B: FAFSA nonfiler due to only frictions	1	6.12	6.56	2.76
	2	4.29	6.17	1.67
	3	2.30	5.58	1.21
	Total	4.23	6.28	1.50
	Observations	7,143	3,382	3,761

Notes: The table reports frequencies of FAFSA nonfiling due to frictions (and possibly other reasons) in Panel A and only frictions in Panel B, broken down by skill tercile, for all high school graduates and broken down by 2013 BA enrollment outcome. Sample counts are for each column's total sample. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

Table 3: FAFSA nonfiling due to frictions by parental income tercile and skill tercile

Parental income	Skill: 1	Skill: 2	Skill: 3
1	9.75	8.98	5.76
2	17.32	7.12	4.16
3	21.17	15.17	11.57
Total	14.31	10.22	8.22
Observations	1,855	2,304	2,984

Notes: The table reports the rates of nonfiling due to frictions by skill and parental income terciles. Weights: Second follow-up student longitudinal weights. Source: HSLS:09.

include flags for FAFSA nonfiling reasons as well as a set of demographic controls, specifically indicators for being in the low or medium skill tercile, logged parental income, an indicator for whether at least one parent has a BA or higher, and indicators for being female, nonwhite, Hispanic, or being from a family with a household size greater than four. Table 4 reports selected AMEs; the full set of AMEs and regression coefficients for all exercises in Table 4 are presented in Tables A5 and A6 of Appendix A.1.6, respectively.

In models (1) and (2) of Table 4, the dependent variable is an indicator for BA enrollment in the 2013-2014 academic year. Model (1) includes an indicator for not filing a FAFSA due to frictions (and possibly other reasons). Nonfiling due to frictions is associated with being 16.2 percentage points less likely to enroll in a BA. Because citing reasons related to frictions may be correlated in the population with citing other reasons, including not wanting to enroll in any postsecondary education, model (2) includes a flag for citing *only* reasons related to frictions, and adds a flag for

Table 4: Average marginal effects of FAFSA nonfiling due to frictions

	BA enrollment by:				**Fall 2013 BA outcome**		
	Fall 2013		**Spring 2016**		**Applied**	**Accepted**	**Enrolled**
Control variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Flag: nonfiler frictions	-0.162		-0.142				
	(0.0181)		(0.0217)				
Flag: nonfiler frictions only		-0.207		-0.165	-0.175	-0.045	-0.227
		(0.0327)		(0.0333)	(0.0384)	(0.0435)	(0.0891)
Flag: nonfiler no PSE		-0.408		-0.392			
		(0.0180)		(0.0534)			
Flag: low skill	-0.513	-0.494	-0.538	-0.518	-0.489	-0.198	-0.268
	(0.0215)	(0.0217)	(0.0208)	(0.0211)	(0.0218)	(0.0297)	(0.0364)
Flag: medium skill	-0.253	-0.242	-0.263	-0.254	-0.231	-0.062	-0.091
	(0.0219)	(0.0219)	(0.0212)	(0.0197)	(0.0181)	(0.0158)	(0.0212)
Log parental income	0.097	0.088	0.104	0.097	0.063	0.025	0.066
	(0.0111)	(0.0098)	(0.0117)	(0.0119)	(0.0125)	(0.0084)	(0.0133)
Flag: At least 1 parent BA+	0.143	0.136	0.148	0.141	0.115	0.042	0.102
	(0.0207)	(0.0198)	(0.0221)	(0.0217)	(0.0200)	(0.0136)	(0.0257)
Additional demographic flags	Y	Y	Y	Y	Y	Y	Y
Observations	7,143	7,143	7,143	7,143	7,143	4,970	4,692
pseudo- R^2	0.30	0.31	0.32	0.33	0.24	0.23	0.11

Notes: The table reports selected AMEs from probit regressions of various outcomes on flags for FAFSA nonfiling due to frictions or only frictions and a set of additional controls for skill tercile, logged parental income, and an indicator having at least one parent with a BA or higher. Controls included in all regressions but not reported here are indicators for the sample member being female, nonwhite, Hispanic, or having a household size greater than four. In models (2) and (6) we also control for being a nonfiler due to not intending to enroll in any postsecondary education. The dependent variable for models (1), (2), and (7) is an indicator for enrolling in a BA in the fall of 2013; for models (3) and (4), the dependent variable is an indicator for enrolling in a BA by the spring of 2016; for model (5), the dependent variable is an indicator for applying to at least one BA program; and, for model (6), the dependent variable is an indicator for being accepted to at least one BA program. The estimation sample for models (1) through (5) is all high school graduates; for model (6), the sample is high school graduates who applied to at least one BA program; for model (7), the sample is high school students who were accepted to at least one BA program. Bootstrapped standard errors are in parentheses. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

not intending to enroll in any PSE. Being a FAFSA nonfiler due to only frictions is associated with a 20.7 percentage point drop in the likelihood of enrolling in a BA. Not applying for aid due to not intending to enroll in any PSE is associated with a 40.8 percentage point drop in the likelihood of enrolling in a BA; this sizable AME is intuitively appealing and lends credibility to the survey responses for questions related to FAFSA nonfiling reasons.

In models (3) and (4), the dependent variable is redefined as an indicator that takes a value of one if the sample member enrolled in a BA at some point by the spring of 2016, and zero otherwise, and exercises of models (1) and (2) are repeated. In the data, the BA enrollment outcome by 2016 is constructed in a similar fashion to the 2013-2014 academic year BA enrollment outcome but using information available for later years. Conceptually, enrollment in a BA by 2016 incorporates potential learning about financial aid eligibility or using strategies other than financial aid to finance later enrollment in a BA program (such as saving or attending a two-year program before transferring to a BA). The AMEs of interest for (3) and (4) are only slightly smaller in magnitude compared to their counterparts in models (1) and (2), at 14.2 and 16.5 percentage points, respectively.

Does being a FAFSA nonfiler due to frictions predict BA enrollment because it is associated with a lower likelihood of applying to college, being accepted conditional on applying, or enrolling conditional on being accepted? To answer this question, in models (5), (6), and (7), we examine the AME of not filing a FAFSA due to only frictions for three outcomes: applying to at least one BA program, being accepted to at least one BA program conditional on applying, and enrolling in a BA program conditional on being accepted. To construct indicators for these outcomes, we use the 2013 Update to identify survey respondents who say that they applied to at least one BA program and those who say that they were accepted to at least one BA program, supplemented with information on BA enrollment outcomes in the 2013-2014 academic year.

In model (5), we regress an indicator that takes a value of one if the respondent applied to at least one BA, and zero otherwise, on an indicator for being a FAFSA nonfiler due to only frictions as well as the demographic controls included in models (1) through (4). On average, being a nonfiler due to only frictions is associated with a 17.5 percentage point lower likelihood of applying to at least one BA program.[14] This AME is statistically significant at the 1 percent level. In model (6), we regress an indicator for being accepted to at least one BA program on the same set of controls, for the sample of those who applied to at least one BA. Being a FAFSA nonfiler due to only frictions is associated with a statistically insignificant and small change in the likelihood of being accepted to a BA conditional on applying. Finally, in model (7), we regress an indicator that takes a value of one if the respondent enrolls in a BA program, and zero otherwise, on the same set of controls, for the sample accepted to at least one BA program. Being a FAFSA nonfiler due to only financial aid application frictions is associated with a 22.7 percentage point drop in the probability of BA enrollment among those accepted to a BA program. This AME is statistically significant at the 5 percent level.

3.3 Estimating counterfactual financial aid outcomes

How much financial aid would nonfilers due to frictions receive, were they to apply for aid and enroll full time in a BA? Anyone who files a FAFSA and enrolls at least part-time is eligible for unsubsidized Stafford loans, so all nonfilers leave the option for this form of aid on the table. As for need-based aid, we impute a dollar amount of Pell grant eligibility for all high school graduates regardless of FAFSA filing status. Given the financial aid system outlined in Section 2, Pell grant awards are relatively deterministic compared to subsidized Stafford loans. Examining Pell grant

[14]Table A7 of Appendix A.1.4 reports that only 20 percent of nonenrollees who are nonfilers due to frictions report applying to at least one BA.

aid left on the table is also useful for our purposes because grant aid unambiguously lowers the financial cost of college.

Specifically, our imputation assigns an EFC to each observation by drawing on descriptions of the 2013-2014 FAFSA form available in the EFC formula guide for the 2013-2014 academic year, prepared by the Federal Student Aid Office, U.S. Department of Education (2014). We use the Pell grant payment schedules indicated in the Dear Colleague Letter from Federal Student Aid, U.S. Department of Education (2013) to map from the estimated EFC to an imputed dollar amount of Pell grants that the sample member would be eligible for were they to enroll full time in a BA program with an average COA. The discussion surrounding Table A8 of Appendix A.1.5 provides further details of our imputation procedure. Table A9 of the same appendix reports the distribution of differences between the imputed and realized Pell grants among 2013-2014 BA enrollees who file a FAFSA. The differences are centered around zero, establishing credibility for our imputation.

Table 5 reports our findings on counterfactual Pell grant aid for nonfilers due to frictions (Panel A) and nonfilers due to only frictions (Panel B). The first column of Panel A shows that about 4 percent of high school graduates are FAFSA nonfilers due to frictions (and possibly other reasons) who are eligible for Pell grants. Dividing this number by the 11 percent of high school graduates who are nonfilers due to frictions from Table 1 reveals that more than 30 percent of nonfilers due to frictions are eligible for Pell grants. Conditional on being eligible, the average Pell grant amount these nonfilers leave on the table is sizable, amounting to \$4,816 on average, which is close to the maximum Pell amount of \$5,645 for the 2013-2014 academic year. The last two columns of Panel A show that being a nonfiler due to frictions who is eligible for a Pell grant is much more common among BA nonenrollees (6.50 percent) than among BA enrollees (0.63 percent). In Panel B, even after restricting attention to nonfilers due to only frictions, the frequency of Pell grant eligibility is quantitatively significant, especially for BA nonenrollees. The magnitudes of Pell grant dollars left on the table by eligible nonfilers due to only frictions are very similar to the analogous statistics in Panel A (3.34 percent).

To summarize, we have used a nationally representative survey to show that many high school graduates cite application frictions as a reason for not filing a FAFSA. The extent to which these reasons are cited is heterogeneous by BA enrollment outcome, skill, and parental income. Furthermore, nonfiling due to frictions predicts a lower likelihood of BA enrollment after controlling for other observables and implies significant amounts of aid left on the table. Motivated by our empirical findings, we build a life cycle model of college enrollment with a FAFSA filing decision and heterogeneous filing costs in order to quantify the costs of federal financial aid application frictions.

Table 5: Counterfactual Pell grant aid among FAFSA nonfilers due to frictions

Category	Statistic	All	Enrolled in BA No	Enrolled in BA Yes
Panel A: Nonfiler due to frictions and Pell>0	Percentage of high school graduates	3.99	6.50	0.63
	Pell $ | Pell>0	4,816	4,823	4,720
Panel B: Nonfiler due to only frictions and Pell>0	Percentage of high school graduates	2.06	3.34	0.36
	Pell $ | Pell>0	4,928	4,978	4,307
	Observations	7,143	3,382	3,761

Notes: The table reports statistics related to counterfactual Pell grant aid for FAFSA nonfilers due to frictions, both overall and broken down by 2013 BA enrollment outcome. Panel A reports the share of high school graduates who are nonfilers due to frictions (and possibly other reasons) and who are eligible for Pell grant aid, and the dollar amount of Pell grant aid conditional on being eligible for this group. Panel B reports the same statistics for nonfilers due to only frictions. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

4 Model

We build a general equilibrium overlapping generations model in which high school graduates differ in initial assets, skill, labor market productivity, FAFSA filing costs, and eligibility for need-based aid. College financial aid application frictions are introduced into the model as heterogeneous FAFSA filing costs. A high school graduate must file a FAFSA in order to access federal aid, which consists of Pell grants and student loans (both subsidized and unsubsidized). Furthermore, we include as a counterpart to the key determinant of need-based federal student aid a model equivalent for the EFC formula. This formula determines the amount of Pell grants and subsidized federal student loans that a potential enrollee is eligible for.

Consistent with our empirical analysis of federal student aid application frictions, in our model we do not distinguish between frictions that arise due to filing difficulties, mistaken beliefs about eligibility for aid, or lack of awareness about the aid program. The FAFSA filing cost in the model parsimoniously captures all of these frictions. Note that mistaken beliefs and lack of awareness are similar to high enough difficulty in filing in that all of them result in nonfiling and, consequently, lack of access to federal aid.

The model economy contains heterogeneous consumers, a government, and a final goods firm. In what follows, Section 4.1 presents consumer preferences and an overview of the life cycle phases. Sections 4.2 and 4.3 discuss the goverment's and firm's problems, respectively. To illustrate how financial aid application frictions affect FAFSA filing and college enrollment decisions, Section 4.4 presents the set of consumer value functions during the FAFSA-and-college phase. The value functions for the subsequent phases, additional functional forms, equilibrium definition, and computational algorithm are provided in Appendix B.

4.1 Consumer preferences and life cycle overview

In addition to the FAFSA filing cost, a utility cost given by ξ_f, the consumer's flow utility is determined by the utility function, $U(c, x, j, d_e, d_D)$, in which the inputs are household consumption, c, hours worked, x, adult age and college year for the first four years, j, indicator for enrollment in college, d_e, and indicator for federal student loan delinquency, d_D. The utility function is given by

$$U(c, x, j, d_e, d_D) = \frac{\left[\left(\frac{c}{\zeta_j}\right)^{\upsilon}\left(1 - x - d_e\lambda\right)^{1-\upsilon}\right]^{1-\sigma}}{1-\sigma} + d_e CV - d_D \xi_D, \tag{1}$$

where ζ_j is an adult equivalence parameter to reflect the presence of children, the 1 in the numerator is time endowment (normalized), λ is college effort cost, υ is consumption share, σ determines the relative risk aversion, CV is a utility shifter for the consumption value of college, and ξ_D is a stigma cost associated with student loan delinquency.

The remainder of this section provides an overview of the consumer life cycle phases. Time is discrete and runs forever; each period lasts one year. Consumers start making decisions when they turn 18 at model age $j = 1$. Adults survive each period with probability ψ_j and live for a maximum of J periods. An illustration of the life cycle phases is provided in Figure 1.

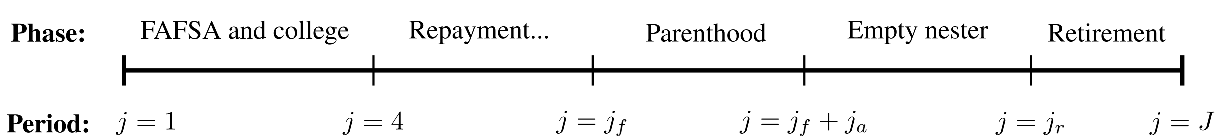


Figure 1: Phases of the consumer's life cycle

Notes: The figure illustrates the phases of the consumer's life cycle. Note that repayment begins for all consumers with student debt immediately after the college phase is completed. The end of repayment depends on consumer repayment decisions; this dependency is indicated in the figure with an ellipsis in the repayment phase label. The length of each phase in the figure does not reflect its relative length after parameterization.

FAFSA-and-college phase At the start of adulthood, a high school graduate makes two sequential decisions: first, whether or not to file the FAFSA, and second, whether or not to enroll in college (if given the option to enroll).

When a high school graduate makes the FAFSA filing decision, they do not observe whether they will have the option to enroll in college and the stochastic component of their earnings productivity. Furthermore, there is potential uncertainty about the EFC, which is the key determinant of need-based aid. If parental income is below the automatic zero EFC income threshold, $y_{f=0}$, the 18-year-old will qualify for an EFC of zero and will be eligible for the maximum amount of need-based aid as long as they file a FAFSA. Otherwise, the EFC depends on parental income and a stochastic draw for whether or not the applicant qualifies for a professional judgment. This feature captures unmodeled special circumstances (e.g., recent unemployment of a family member, tuition expenses at an elementary or secondary school, and medical expenses not covered by insurance) in which the FAA may lower the income used to determine the EFC. Both lower parental income and qualification for professional judgment increase the amount of need-based aid an applicant is eligible for.[15] Figure 2 illustrates the timing of the FAFSA filing and college enrollment decisions for the case in which parental income is below the automatic zero EFC income threshold.

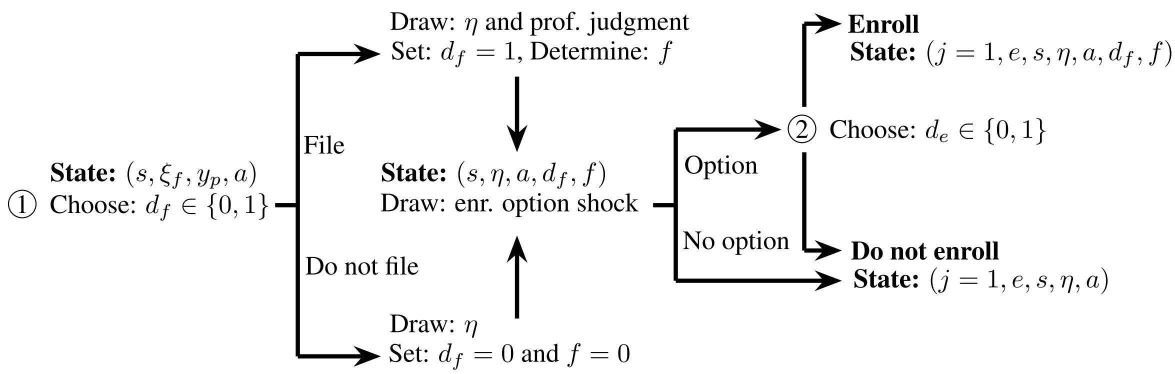


Figure 2: Timing of FAFSA filing and BA enrollment decisions within period $j = 1$

Notes: When an applicant does not qualify for an automatic zero EFC, the figure shows the timing of FAFSA filing and college enrollment decisions within period $j = 1$, moving from left to right. At ①, all consumers choose whether or not to file a FAFSA, d_f. At ②, consumers with the option to enroll decide whether or not to do so, d_e. The figure notes how the state space updates for each discrete choice: the realizations of η, f, and the option to enroll are known at ② but not at ①. Although not shown in the figure, when an applicant qualifies for an automatic zero EFC ($y_p \leq y_{f=0}$), for FAFSA filers there is no professional judgment and $f = 0$ to reflect the automatic zero EFC.

As noted in Figure 2, at the time of the FAFSA filing decision, high school graduates are indexed by skill, s, the FAFSA filing cost, ξ_f, parental income, y_p, and initial net assets, a. The skill endowment is drawn once from a probability distribution that depends on parental education. Skill indexes the college enrollment option shock, $q(s)$, which captures unmodeled reasons that lead a consumer to not go to college, such as personal preference and lack of acceptance by a college in which they would like to enroll. Skill also indexes the exogenous annual probability of being allowed to continue in college, $p(s)$, public grants other than Pell grants, $\theta^{other}(s)$, private grants, $\theta^{pr}(s)$, the deterministic life cycle component of earnings, $\epsilon_{j,e,s}$, Social Security transfers, $ss_{e,s}$ (defined in equation (23) in Appendix B.2), and the mean and variance of the log-normal distribu-

[15] Incorporating the professional judgment feature allows our model to account for the positive Pell grant uptake rates observed among students from families in the top income tercile, as demonstrated in Table D1 of Appendix D.1. In Appendix D.3, we consider a sensitivity analysis in which no one qualifies for a professional judgment. For more details about special circumstances and professional judgment, see Program Communications Division, Federal Student Aid (2013).

tion for the FAFSA filing cost, $\mu_{\xi_f}(s)$ and $\sigma^2_{\xi_f}(s)$. The FAFSA filing cost is a utility penalty drawn from a skill-specific log-normal distribution.[16] Parental income is determined based on the parent's income for the given year assuming full time work hours. Net assets at the start of adulthood are determined by a one-time inter vivos transfer from the high school graduate's parent, and are recorded with $a \geq 0$.

After the FAFSA filing decision is made, the earnings productivity shock and the college enrollment option shock are observed. Furthermore, the EFC is revealed to FAFSA filers who had not qualified for an automatic zero. Consumers with the option to enroll in college decide whether or not to enroll. At this stage, in addition to their skill and initial assets, a potential enrollee is indexed by an indicator for whether they had filed a FAFSA, d_f, their EFC, f, and the stochastic earnings productivity, η.[17]

In the joint distribution of idiosyncratic states at the start of adulthood, only the stochastic earnings productivity is exogenous in the sense that the distribution over earnings productivity is invariant across equilibria. The remaining idiosyncratic states (skill, filing cost, parental income, net assets, FAFSA filing status, and EFC) are endogenous in the sense that the distribution over these states among the population of 18-year-olds may change across equilibria.

While enrolled, college students incur a non-pecuniary effort cost in units of hours, λ, but also benefit from a non-pecuniary consumption value of college in units of utils, CV. Non-discretionary college expenses include only tuition and fees, κ. These expenses can be financed with federal student loans (the only form of debt in the model), where the stock of debt is recorded with $a < 0$, inter vivos transfers from parents, earnings from work while enrolled, Pell grants (described in Section 4.2), other public grants, and private grants. College graduation leads to a high level of completed education, $e = h$, while all other consumers (nonenrollees, enrollees, and dropouts) are considered to have a low level of completed education, $e = \ell$. Completed education indexes the wage rate, w_e, the deterministic component of life cycle earnings, $\epsilon_{j,e,s}$, the parameters for

[16] We assume that the filing cost distribution does not depend on parental education. However, a concern might be that children with parents who have a BA will be less affected by frictions because their parents are more likely to be informed about the FAFSA. We do not find stark evidence for such a pattern in the data, as shown in Table A12 of Appendix A.1.6. In fact, among high school graduates with medium and high skill, we observe that those with parents holding a BA are more likely to cite frictions as a reason for not filing a FAFSA than those with parents who do not hold a BA. In Appendix C.1, we show that the model rationalizes this pattern as being due to an income effect on the filing decision.

[17] As discussed in Section 2, in reality an individual can file a FAFSA even after college enrollment, which is not allowed in our model. We argue that our modeling choice is reasonable because, although filing late within a given academic year is an option in reality, it is a costly one as far as college enrollment is concerned. For example, when the FAA draws out a financial aid package, filing late could result in forgoing other aid. Furthermore, the college enrollee may face liquidity problems before the aid comes through. Consistent with the costs of filing late, we observe that nonfiling is highly persistent, both by BA enrollment status in the 2013-2014 academic year and among nonfilers due to frictions or nonfilers due to only frictions (Table A11 of Appendix of A.1.6).

the stochastic component of earnings, which is assumed to be AR(1) with persistence, ρ_e, and variance, σ_e^2, Social Security transfers, $ss_{e,s}$, and the probability for the child's skill endowment draw, $\pi_{s_c}(s_c|e)$.

Repayment phase Repayment of federal student loans begins after the college phase at age $j = 5$; subsidized federal loan balances have interest assessed starting at this age, whereas interest accrues on unsubsidized federal loan balances during college as well. During the repayment phase, consumers choose between making a full payment, $d_D = 0$, and delinquency, $d_D = 1$. A full payment implies that the consumer must make a payment of at least $\rho_R(j, a)$, whereas delinquency leads to a partial payment, $\rho_D(j, a, y)$, due to garnishment of disposable income above the amount $\bar{y}$ at the rate τ_g; additional costs of delinquency are a collection fee that is proportional to the missed payment, ϕ, and a utility cost, ξ_D. The payment functions are provided in Appendix B.2.

Parenthood and empty nester phase Upon paying off student loans, consumers solve a consumption-savings problem which at certain ages is affected by the presence of a child. Specifically, all consumers have a child at age j_f. At the beginning of age $j_f + j_a$, the family draws the child's skill endowment, s_c, and the child's FAFSA filing cost, ξ_f. The parent then makes an altruistic inter vivos asset transfer to their child.[18]

Retirement phase Consumers retire at age j_r and receive Social Security transfers until they die.

4.2 Government

Government spending is financed via income and consumption taxes. Expenditures for the government result from the provision of Pell grants for college education, as well the other public grants, the federal student loan program, Social Security, and exogenous government consumption set as a fraction g of gross domestic product (GDP).

Taxes Tax revenue is collected from a flat consumption tax, τ_c, and a progressive income tax and transfer function, $T(y)$, levied on pretax income, y. The income tax and transfer function follows the specification of Heathcote, Storesletten, and Violante (2017) and is given by

$$T(y) = y - \gamma y^{1-\tau_p}, \tag{2}$$

[18] We assume that parents do not decide college entry on behalf of their child. In our framework, the incentive for the parent to decide college entry on behalf of the child is limited because the only gains to the parent are altruistic. Furthermore, the ability for the parent to influence college entry is limited because the transfers are unconditional. To examine how financial aid application frictions would interact with parental decisions regarding college entry, one would need to modify the model framework so that the parent has a strong enough incentive and agency to decide college entry on behalf of their child (e.g., by incorporating non-altruistic paternalistic gains to the parent from the child attending college and college-conditional transfers). The quantitative impact of such modifications on our results are uncertain, and we leave this line of inquiry to future research.

where τ_p governs the tax progressivity and γ is used to balance the government budget constraint in every period, as shown in equation (25) in Appendix B.2.

The remainder of this section describes the determination of federal student aid. All of the objects related to federal student aid (that is, Pell grants, subsidized student loans, and EFC) are based on statutory formulas except for the features associated with professional judgment (equations (5) and (6)). For the professional judgment feature, in the data we do not observe either the EFC or the information seen by the FAA to adjust inputs into determining the EFC, nor do we see by how much they adjust inputs. Thus, for the equations related to professional judgment, the functional forms are assumed and are not based on statutory formulas.

Pell grants Pell grants provide an amount that is based on the EFC, f, and the cost of attendance, $\kappa + \bar{c}$, where κ denotes tuition and fees, and $\bar{c}$ denotes an amount for room and board. The amount for room and board only serves the purpose of determining the cost of attendance, which determines the extent of Pell grants and subsidized loans an applicant is eligible for, and is not a non-discretionary college expense as are tuition and fees. The Pell grant has a maximum value of θ^{Pell}_{max}, and is decreasing in the EFC, with a function given by

$$\theta^{Pell}(f) = \max[\min[\kappa + \bar{c} - f, \theta^{Pell}_{max} - f], 0]. \tag{3}$$

Federal student loans The federal student loan program is characterized by a cumulative student loan limit for subsidized and unsubsidized loans, $\bar{A}$, a cumulative student loan limit for subsidized loans, $\bar{A}_s$, and a student loan interest rate, $r_{SL} = r + \tau_{SL}$, where r is the risk-free interest rate on savings and τ_{SL} is an add-on set by the government. The four-year cumulative loan limits, $\bar{A}$ and $\bar{A}_s$, are scaled by $\frac{j}{4}$ so that these limits increase with each year of college.

The subsidized loan amount is determined by the year of college (which also indexes the consumer's age), j, EFC, the cumulative loan limit for subsidized loans, and cost of attendance. The subsidized loan function is given by

$$a_s(j, a', f) = -\mathbb{I}_{a'<0} \min[-a', \tfrac{j}{4}\bar{A}_s, j \max[\kappa + \bar{c} - f - \theta^{Pell}(f), 0]]. \tag{4}$$

This function stipulates the amount of federal loans taken out by the student that are treated as subsidized. The function implies that, subject to the year j loan limit $\frac{j}{4}A_s$, subsidized loans can be used to pay for at most the cost of attendance net of the EFC and the Pell grant.

Expected Family Contribution The EFC, f, is an input into the Pell grant and subsidized loan functions in equations (3) and (4) and is determined as follows. If the applicant has parental income below the automatic zero EFC income threshold, $y_{f=0}$, the EFC is set to zero. Otherwise, the applicant is subject to a professional judgment, which is stochastic and depends on parental income. Qualification for professional judgment along with parental income determines adjusted available income, which is used to calculate the EFC using a progressive step function.[19]

The probability an applicant qualifies for a professional judgment, $\pi_{d_{pj}}(y)$, is specified so that the probability of qualifying decreases with parental income. The functional form is given by

$$\pi_{pj}(y) = \exp(-\phi_{d_{pj}} y), \tag{5}$$

where ϕ_{pj} governs the rate at which the probability function is decreasing in y.

Adjusted available income is given by

$$y_{ad}(y, d_{pj}) = \begin{cases} \tau_{pj}[y - T(y)] - y_{PA} & \text{if } \; d_{pj} = 1 \\ y - T(y) - y_{PA} & \text{if } \; d_{pj} = 0, \end{cases} \tag{6}$$

where d_{pj} is an indicator variable with $d_{pj} = 1$ representing qualification for a professional judgment and $d_{pj} = 0$ representing nonqualification for a professional judgment, y_{PA} is the income protection allowance, and $\tau_{pj} \in [0, 1)$ is the factor by which the disposable parental income used to determine the EFC is scaled when the applicant qualifies for a professional judgment.

The progressive EFC step function is given by

$$G(y, d_{pj}) = \begin{cases} \max[\tau_{f,1} y_{ad}(y, d_{pj}), 0] & \text{if } \; y_{ad}(y, d_{pj}) \leq Y_{f,1} \\ \tau_{f,1} Y_{f,1} + \tau_{f,2}[y_{ad}(y, d_{pj}) - Y_{f,1}] & \text{if } \; Y_{f,1} < y_{ad}(y, d_{pj}) \leq Y_{f,2} \\ \ldots & \\ \tau_{f,1} Y_{f,1} + \ldots + \tau_{f,6}[y_{ad}(y, d_{pj}) - Y_{f,5}] & \text{if } \; Y_{f,5} < y_{ad}(y, d_{pj}), \end{cases} \tag{7}$$

where y is parental income, the set $\{Y_{f,i}\}_{i=1}^{5}$ determines the intervals of the step function, and $\tau_{f,1} < \tau_{f,2} < \ldots < \tau_{f,6}$ are the marginal rates within the intervals. The progressive EFC step function and the adjusted available income function jointly imply that among applicants who do not qualify for an automatic zero EFC, those with lower disposable parental income or qualification

[19] The abstraction from other inputs in the determination of EFC in our model is not a major concern because as argued by Dynarski and Scott-Clayton (2006, 2008), roughly 80 percent of the variation in EFC and disbursed aid can be accounted for by parental income and family information on parental marital status, family size, and number of family members in college. The variables related to family information are not inputs into the EFC formula in our model because there is no heterogeneity along these margins. In reality, marital status affects whose income is used for parental income; in our model, it is simply the income of the parent of the child. Family size and number of family members in college affect the income protection allowance, y_{PA}. Assumptions regarding these two variables are discussed when parameterizing the model in Section 5.1.1.

for professional judgment will be assigned a lower EFC.

To summarize, the determination of the EFC is such that applicants with low parental income are more likely to be assigned a lower EFC and, therefore, be eligible for more need-based aid.

4.3 Final goods firm

Output is produced by a final goods firm using a production function that combines aggregate capital, K, and aggregate labor, and is Cobb-Douglas with capital share α. Aggregate labor, in turn, is a constant elasticity of substitution aggregator of efficiency units of labor with low education, L_ℓ, and high education, L_h, with elasticity of substitution $1/(1-\iota)$ and share parameter ν. Specifically, the final goods production function is given by

$$Y = K^\alpha \left[Z \{ (\nu (L_\ell)^\iota + (1-\nu)(L_h)^\iota)^{1/\iota} \} \right]^{1-\alpha}, \tag{8}$$

where Z is aggregate labor productivity. The capital stock depreciates at rate δ.

4.4 Consumer value functions during the FAFSA-and-college phase

The lifetime expected value to an 18-year-old with type (s, ξ_f, y_p, a) at decision ① in Figure 2 is given by

$$W^0(s, \xi_f, y_p, a) = \mathbb{I}_{y_p \le y_{f=0}} W^{f=0}(s, \xi_f, y_p, a) + \mathbb{I}_{y_p > y_{f=0}} W^{f \neq 0}(s, \xi_f, y_p, a), \tag{9}$$

where $W^{f=0}(s, \xi_f, y_p, a)$ and $W^{f \neq 0}(s, \xi_f, y_p, a)$ represent the values when the 18-year-old can and cannot qualify for an automatic zero EFC conditional on filing a FAFSA, respectively. The value to an 18-year-old who can qualify for an automatic zero EFC is given by

$$\begin{aligned} W^{f=0}(s, \xi_f, y_p, a) = \max_{d_f \in \{0,1\}} & \; d_f \big[-\xi_f + q(s) \mathbb{E}_{\eta|\ell} W^{BA}(s, \eta, a, d_f, 0) \big] + \\ & (1-d_f) q(s) \mathbb{E}_{\eta|\ell} W^{BA}(s, \eta, a, d_f, 0) + (1-q(s)) V^{NC}(j, \ell, s, \eta, a), \end{aligned} \tag{10}$$

where $E_{\eta|\ell}$ is the expectation operator over the stochastic earnings productivity drawn from the low-education distribution, $W^{BA}(s, \eta, a, d_f, f)$ is the lifetime expected value to an 18-year-old with the option to enroll in college, and $V^{NC}(j, \ell, s, \eta, a)$ is the value of not going to college. In the case in which the potential enrollee does not file a FAFSA, $d_f = 0$, they will not be eligible for federal aid, and, as a result, the value of their EFC is irrelevant. Without loss of generality, in this case their EFC is set to 0. The value to an 18-year-old who cannot qualify for an automatic zero

EFC is given by

$$W^{f\neq 0}(s,\xi_f,y_p,a) = \max_{d_f\in\{0,1\}} d_f\big[-\xi_f + q(s)\mathbb{E}_{\eta|\ell}\mathbb{E}_{d_{pj}}W^{BA}(s,\eta,a,d_f,G(y_p,d_{pj}))\big]+ \\ (1-d_f)q(s)\mathbb{E}_{\eta|\ell}W^{BA}(s,\eta,a,d_f,0)+(1-q(s))V^{NC}(j,\ell,s,\eta,a), \tag{11}$$

where $\mathbb{E}_{d_{pj}}$ is the expectation operator over whether the FAFSA applicant qualifies for a professional judgment by the FAA, and $G(y_p, d_{pj})$ is the progressive step formula used to determine the EFC in equation (7) when the applicant does not qualify for an automatic zero EFC. These two objects distinguish $W^{f\neq 0}(s,\xi_f,y_p,a)$ from $W^{f=0}(s,\xi_f,y_p,a)$.

After the FAFSA filing decision, the lifetime expected value to an 18-year-old of type (s,η,a,d_f,f) with the option to enroll in college is given by

$$W^{BA}(s,\eta,a,d_f,f) = \max_{d_e\in\{0,1\}}(1-d_e)V^{NC}(j,\ell,s,\eta,a)+d_eV^{BA}(j,\ell,s,\eta,a,d_f,f), \tag{12}$$

where $V^{BA}(j,\ell,s,\eta,a,d_f,f)$ is the value of college.

The value of not going to college or dropping out for $j\in\{1,2,3\}$ is given by

$$\begin{aligned}
&V^{NC}(j,\ell,s,\eta,a) = \max_{c\geq 0,a',x\in X} U(c,x,j,d_e=0,d_D=0)+\beta\psi_j\mathbb{E}_{\eta'|\ell,\eta}V^{NC}(j+1,\ell,s,\eta',a')\\
&s.t. \qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad\qquad (13)\\
&(1+\tau_c)c+a' = y_{j,\ell,s,\eta,a,x}+a+Tr_j-T(y_{j,\ell,s,\eta,a,x})+\mathbb{I}_{a<0}r_{SL}a\\
&a'\geq \min[a,0]\\
&y_{j,e,s,\eta,a,x} = w_e\epsilon_{j,e,s}\eta x + r\left[a\mathbb{I}_{j>1}\mathbb{I}_{a>0}+Tr_j\right],
\end{aligned}$$

where a' is the stock of assets or federal student loans in the next period, β is the discount factor, $y_{j,e,s,\eta,a,x}$ summarizes pretax income, r is the risk-free savings rate, and Tr_j is accidental bequests of the deceased.[20] The value function at $j=4$ is a slightly modified version of equation (13) because mandatory payments on student loans begin at $j=5$. Hence, at $j=4$, the continuation value will be constructed using the value function for $j>4$ and $j\neq j_f+j_a$ in equation (15) of Appendix B.1.

[20]The indicator $\mathbb{I}_{j>1}\mathbb{I}_{a>0}$ implies that interest income on the inter vivos transfer accrues to the parents and not to the child who has age $j=1$.

The value of enrolling in college for the first three years, $j \in \{1, 2, 3\}$, is given by

$$
\begin{aligned}
& V^{BA}(j, \ell, s, \eta, a, d_f, f) = \max_{c \geq 0, a', x \in X} U(c, x, j, d_e = 1, d_D = 0) + \\
& \beta \psi_j \mathbb{E}_{\eta' | \ell, \eta} \big[p(s) \max[V^{BA}(j+1, \ell, s, \eta', a', d_f, f), V^{NC}(j+1, \ell, s, \eta', a')] + \\
& (1 - p(s)) V^{NC}(j+1, \ell, s, \eta', a') \big] \\
& s.t. \\
& (1 + \tau_c)c + a' + \kappa = y_{j,\ell,s,\eta,a,x} + a + Tr_j - T(y_{j,\ell,s,\eta,a,x}) + \theta^{other}(s) + \theta^{pr}(s) \\
& + d_f[\theta^{Pell}(f) + r_{SL}(\mathbb{I}_{a<0} a - a_s(j, a', f))] \\
& a' \geq -d_f \tfrac{j}{4} \bar{A} \\
& y_{j,e,s,\eta,a,x} = w_e \epsilon_{j,e,s} \eta x + r \left[a \mathbb{I}_{j>1} \mathbb{I}_{a>0} + Tr_j \right].
\end{aligned}
\tag{14}
$$

When the consumer did not file the FAFSA, so that $d_f = 0$, the constraints imply that the consumer does not have access to federal aid (that is, no Pell grants or student loans). The continuation value reflects that, apart from exogenously dropping out, consumers may also choose to drop out before the start of the next academic year if given the option to continue. The value function at $j = 4$ is a slightly modified version of equation (14): as long as the consumer is allowed to continue and graduate, the AR(1) draw in the next period will be made from the distribution for the high-education labor, there will be no endogenous dropout decision, and they will receive the high-education continuation value constructed using equation (15) of Appendix B.1.

5 Parameterization and Model Validation

Section 5.1 explains the model parameterization, and Section 5.2 validates the model's calibrated baseline equilibrium.

5.1 Parameterization

The externally estimated parameters are presented in Section 5.1.1, and the internally calibrated parameters are presented in Section 5.1.2. In several rows within the tables in this section, an external parameter or a target moment is normalized by GDP per capita for those 18 and over and is flagged accordingly. The value for GDP per capita for those 18 and over is computed by combining information on GDP from the Bureau of Economic Analysis (BEA) from BEA (2022, T1.1.5) with population levels from the US Census Bureau (Census Bureau of the United States, 2020) for 2013-2015.

5.1.1 Externally estimated parameters

Table 6 reports externally estimated parameters organized into Panels A through F based on topic. Panel A governs demographics and hours, which are set by assumption unless noted otherwise. The fertility age at which parenthood begins, j_f, is set to 13 so that consumers have a child when they turn 30; the age adulthood begins, j_a, is set to 18; j_r is chosen so that the retirement age is 65; and, finally, J sets maximum life span to 100 years. For ages $j < j_f + j_a$, survival probabilities ψ_j are set to one to rule out children without living parents; for ages $j \geq j_f + j_a$, we use estimates from the 2010 Social Security Administration Life Tables presented in Bell and Miller (2020). The probabilities over child skill conditional on parental education, $\pi_{s_c}(s_c|e)$, are based on the conditional distribution of child skill given parental education in the HSLS:09, drawn from Table A15 of Appendix A.1.6. The estimates reflect a positive correlation between child skill and parental education.[21] Full time work hours, ft, are set to 1/3, corresponding to a standard 40-hour workweek (8 hours per day, 5 days a week). The set of possible labor supply choices, X, consists of full time hours scaled by factors of 0, 0.75, 1.00, 1.25, and 1.50.

Panel B reports external parameters related to preferences and the goods production technology, which are set using estimates from the literature. The parameter that governs the relative risk aversion, σ, is set to $1/\upsilon + 1$ so that constant relative risk aversion is equal to 2 based on Chetty (2006). The adult equivalence scale, ζ, is set to 0.3 following the Organization for Economic Co-operation and Development (OECD) modified scale. The capital share, α, is set to 0.36 following Kydland and Prescott (1982). The depreciation rate of capital, δ, is set to 0.076, in line with Krueger and Ludwig (2016). Finally, the parameter that governs the elasticity of substitution between low- and high-education labor, ι, is set to 0.8. This estimate implies an elasticity of substitution of 5, the midpoint value within the range of 4 to 6 reported by Card and Lemieux (2001) after controlling for imperfect substitutability across age groups.

Panel C contains the parameters that determine the productivity components of earnings. The panel draws on our earnings process estimation using the Panel Study of Income Dynamics (PSID) and the 1997 National Longitudinal Survey of Youth (NLSY97), with estimation details and results provided in the discussion accompanying Table A19 of Appendix A.2.1. First is the deterministic component of the life cycle earnings process, $\epsilon_{j,e,s}$; second, the persistence of the AR(1) productivity shock, ρ_e; and, third, the variance of the AR(1) productivity shock, σ_e^2.

Panel D uses statutory values for Pell grant and federal student loan parameters, with two excep-

[21] Despite the baseline model incorporating this intergenerational persistence of skill, the baseline's intergenerational income elasticity estimate is low compared to its empirical counterpart. This indicates that the model has a higher intergenerational mobility than what is measured for the United States in recent years. See Appendix C.4 for more details.

Table 6: Externally estimated parameters

Parameter	Description	Data Target	Value
Panel A: Demographics and hours			
j_f	Fertility age	30 years	13
j_a	Age at adulthood	18 years	18
j_r	Retirement age	65 years	48
J	Maximum life span	100 years	83
ψ_j	Survival probability	2010 SSA Life Tables	-
$\pi_{s_c}(s_c\|e)$	Probability over child skill for $e = \ell$	HSLS:09	$(0.441, 0.343, 0.216)$
$\pi_{s_c}(s_c\|e)$	Probability over child skill for $e = h$		$(0.183, 0.320, 0.497)$
ft	Full time hours	8 hours per day	$1/3$
X	Labor supply choice set	Percent of full time hours	$(0, 0.75, 1, 1.25, 1.5)ft$
Panel B: Preferences and technology			
σ	Risk aversion parameter	Risk aversion = 2, Chetty (2006)	$\frac{1}{v} + 1$
ζ_j	Adult equivalence scale	OECD modified scale	$1 + 0.3\mathbb{I}_{j_f \leq j < j_f + j_a}$
α	Capital share	Kydland and Prescott (1982)	0.360
δ	Depreciation rate	Krueger and Ludwig (2016)	0.076
ι	Elasticity of substitution	Card and Lemieux (2001)	0.800
Panel C: Earnings productivity			
$\epsilon_{j,e,s}$	Deterministic life cycle component	PSID and NLSY97	Table A19, App. A.2.1
ρ_e	AR(1) persistence for $e = (\ell, h)$		$(0.855, 0.886)$
σ^2_e	AR(1) variance for $e = (\ell, h)$		$(0.081, 0.072)$
Panel D: Pell grants and federal student loans			
$\bar{c}$	College room and board, normalized	NCES	0.146
θ^{Pell}_{max}	Pell maximum, normalized	Statutory	0.081
$\bar{A}$	Subsidized and unsubsidized loan limit, normalized		0.377
$\bar{A}_s$	Subsidized loan limit, normalized		0.265
τ_{SL}	Interest rate add-on		0.021
T_{SL}	Maximum years to repay		10
τ_g	Federal SL garnishment rate		0.150
$\bar{y}$	Garnishment-exempt income, normalized		0.152
ϕ_D	Student loan collection fee	Luo and Mongey (2024)	0.185
Panel E: EFC			
$y_{f=0}$	Automatic zero EFC income threshold, normalized	Statutory	0.345
$Y_{f,i}$	EFC step formula intervals, normalized		(0.220,0.276,0.332,0.389,0.445)
$\tau_{f,i}$	EFC step formula marginal rates		(0.220,0.250,0.290,0.340,0.400,0.470)
y_{PA}	Income protection allowance, normalized		0.306
Panel F: Government consumption and tax policy			
g	Government consumption	BEA	0.147
τ_p	Income tax progressivity	CBO	0.177
τ_c	Consumption tax rate	OECD	0.044

tions. The first row pertains to both Pell grants and student loans, the second row to only Pell grants, and the remaining rows to only student loans. The college room and board amount, $\bar{c}$, is set to 0.146 using data from the National Center for Education Statistics (NCES) in NCES (2019). Note that the college room and board expenditure is an amount used only to determine the cost of attendance, which is then used to determine Pell grants and subsidized loans in equations (3) and (4). The maximum Pell amount, θ^{Pell}_{max}, is set to 0.081 based on Federal Student Aid, U.S. Department of Education (2013). The cumulative loan limit for any federal student loans, $\bar{A}$, is set to 0.377, while that for subsidized student loans, $\bar{A}_s$, is set to 0.265. Both values are determined using the limits for four years of college reported by the Congressional Research Service (CRS) in Smole (2019). The interest rate add-on, τ_{SL}, is set to 0.021 as reported by the Chief Operating Officer for Federal Student Aid (FSA) in Chief Operating Officer for FSA (2021). The repayment period for student loans, T_{SL}, is set to 10 years based on the standard repayment plan outlined in Smole (2019). The garnishment rate in the event of student loan delinquency, τ_g, is set following the rate established by the 2005 Deficit Reduction Act (109th Congress of the United States of

America, 2006). The income exempt from garnishment in delinquency, $\bar{y}$, is set to 0.152 based on our calculations using results from Yannelis (2020). The last parameter in this panel, the student loan collection fee, ϕ_D, is set to 0.185 following Luo and Mongey (2024).

Panel E reports external parameters related to the EFC, which are based on statutory values. These parameters are drawn from Tables A3 and A6 of the EFC formula guide for 2013-2014 prepared by the Federal Student Aid Office, U.S. Department of Education (2014). The income threshold below which applicants are assigned an automatic zero EFC, $y_{f=0}$, is set to 0.345. The parameters that determine the intervals and the marginal rates of the EFC step function, $\{Y_{f,i}\}_{i=1}^{5}$ and $\{\tau_{f,i}\}_{i=1}^{6}$, are reported in the next two rows of the panel. For the income protection allowance reported in the last row, y_{PA}, we use the allowance for a household with three members including the student and one student in college to set the parameter to 0.306.

Panel F reports external parameters related to government consumption and tax policy. Government consumption as a share of GDP, g, is set to 0.147 using estimates from BEA (2022, T1.1.5) and BEA (2022, T3.1). The income tax progressivity, τ_p, is set to 0.177 following our estimation results using data from the U.S. Congressional Budget Office (2018a,b) or CBO, with details of the estimation procedure provided in Appendix A.3 and point estimates reported in Table A24. Finally, the consumption tax rate, τ_c, is set to 0.044, estimated by applying the method of Mendoza, Razin, and Tesar (1994) to OECD data for the 2013-2015 period (OECD, 2024a,b,c). Details of the consumption tax rate estimation are provided in Appendix A.4, with point estimates reported in Table A26.

5.1.2 Internally calibrated parameters

Table 7 reports internally calibrated parameters organized into Panels A through E based on parameter type. Although parameters and moments are assigned a row using their most significant one-to-one relationship and are discussed accordingly, all parameters in the table are calibrated jointly, and each can affect multiple target moments. The primary data source for the calibration of target moments is the HSLS:09. Details can be found in Appendix A.1.

Panel A reports the parameters that determine the FAFSA filing costs. These costs are drawn from a skill-specific log-normal distribution, where $\log(\xi_f(s))$ follows a normal distribution with mean $\mu_{\xi_f}(s)$ and variance $\sigma^2_{\xi_f}(s)$. The mean and the variance are chosen to match skill-specific empirical estimates for the shares of high school graduates who are nonfilers due to frictions, as well as the shares of those who are nonfilers due to only frictions. These target moments are drawn from HSLS:09 estimates presented in Table 2 of Section 3.2.

To calibrate the distributions of FAFSA filing costs for each skill bin, we construct model moments

Table 7: Internally calibrated parameters

Parameter			Target moment		
Symbol	**Description**	**Value**	**Description**	**Data value**	**Model value**
Panel A: FAFSA filing costs					
$\mu_{\xi_f}(s)$	Mean log FAFSA filing cost	(-4.482,-3.716,-4.380)	Not file due to frictions: a reason	*(0.143,0.102,0.082)*	*(0.146,0.103,0.078)*
$\sigma^2_{\xi_f}(s)$	Variance log FAFSA filing cost	(3.792,5.571,9.278)	Not file due to frictions: only reason	*(0.061,0.043,0.023)*	*(0.062,0.041,0.020)*
Panel B: EFC and professional judgment					
τ_{pj}	Income adjustment | Professional judgment	0.406	Pell intensive margin, normalized | High income	*0.058*	*0.057*
ϕ_{pj}	Curvature of professional judgment likelihood	1.773	Pell extensive margin | High income	*0.062*	*0.062*
Panel C: College					
$q(s)$	Enrollment option shock	(0.508,0.804,0.858)	Enrollment fall 2013 | High income	*(0.212,0.609,0.834)*	*(0.212,0.609,0.834)*
$p(s)$	Continuation prob. average	(0.784,0.890,0.958)	Persist to Y3 | Enrolled Y1	*(0.544,0.769,0.912)*	*(0.546,0.769,0.912)*
CV	Consumption value	4.008	Enrolled fall 2013	*0.428*	*0.431*
λ	College effort cost	0.463	Ratio of Y3 average to full time hours	*0.351*	*0.351*
$\theta^{other}(s)$	Public grants net of Pell by s	(0.042,0.049,0.064)	Public grants net of Pell to tuition	*(0.201,0.232,0.305)*	*(0.201,0.232,0.305)*
$\theta^{pr}(s)$	Private grants by s	(0.028,0.030,0.033)	Private grants to tuition	*(0.132, 0.140, 0.158)*	*(0.132, 0.140, 0.158)*
κ	Annual tuition	0.211	Net tuition + fees, normalized	*0.097*	*0.097*
Panel D: Preferences and technology					
β_c	Parent altruism toward child	0.113	Average transfer, normalized	*0.579*	*0.579*
β	Discount factor	0.981	Capital-to-output ratio	*3.000*	*3.000*
υ	Consumption share utility	0.417	Average work hours = full time	*0.333*	*0.333*
Z	Aggregate labor productivity	1.535	GDP per capita 18+	*1.000*	*1.000*
ν	Low-education labor share	0.449	College wage premium | Middle skill	*1.422*	*1.421*
Panel E: Miscellaneous					
ξ_D	Federal delinquency cost	0.100	Federal delinquency rate	*0.088*	*0.087*
χ	SS replacement rate	0.194	SS expenditure, share of GDP	*0.048*	*0.048*

analogous to those using the HSLS:09 as follows. In the model's baseline equilibrium, we perform a "survey" to identify the relevant groups using counterfactual exercises. First, individuals who do not file a FAFSA in equilibrium but would choose to do so if filing were costless are identified as citing frictions as a reason for not filing.[22] Second, to identify nonfilers who cite only frictions, we perform two additional exercises to approximate alternative reasons for not filing cited in the data, such as not planning to continue higher education, being able to afford college without financial aid, and not wanting to go into debt. Specifically, in the two additional exercises, we identify (1) nonfilers who would file if the likelihood of their option to enroll in college, $q(s)$, were higher (specifically, set to one), and (2) nonfilers who would file if they had no initial net assets and a zero EFC—this latter exercise maximizes financial need and eligibility for need-based aid. Finally, combining all three exercises, we identify nonfilers as citing only frictions if they would file with

[22]That is, $d_f(s, \xi_f, y_p, a) = 0$, but $d_f(s, 0, y_p, a) = 1$ in the FAFSA filing problem of equations (10) and (11). Furthermore, all general equilibrium objects are held fixed in all the counterfactual exercises performed for the model survey. For the model survey, we also need to take a stance on tie breaking when an individual is indifferent between filing and not filing a FAFSA. Specifically, when we identify nonfilers due to frictions, we ask whether they would file if filing were costless. For this question, an individual with zero benefits to having access to federal aid would be indifferent between filing and not filing. In such instances, we break the tie in favor of not filing for two reasons. First, this tie-breaking rule leads to an outcome consistent with the data: not every nonfiler cites frictions as a reason for not filing (see Table 1, which shows that the share of high school graduates who are nonfilers due to only not frictions is positive). Second, the rule implies that the model's estimated shares of nonfilers due to frictions are not sensitive to setting the filing costs to an arbitrarily small enough number instead of exactly zero in the model survey question about whether the nonfiler would file if it were costless.

zero filing costs but would not even when $q(s) = 1$ or with zero assets and zero EFC.[23]

Heterogeneity in filing costs is key for the model to match both the shares of high school graduates who report not filing a FAFSA due to frictions and the shares of those who report not filing a FAFSA due to frictions as the only reason. To illustrate, Figure 3 plots these shares as a function of the filing cost for each skill endowment in our baseline calibration which features a positive variance. The figure shows that while frictions are cited as a reason for not filing even at relatively low filing costs (blue bars), these frictions are cited as the only reason only when filing costs are high (red bars). If instead there were no heterogeneity in filing costs (for example, if the mean is calibrated to match the share of nonfilers due to frictions as a reason while setting the variance to zero), the model would not generate any nonfilers due to only frictions.

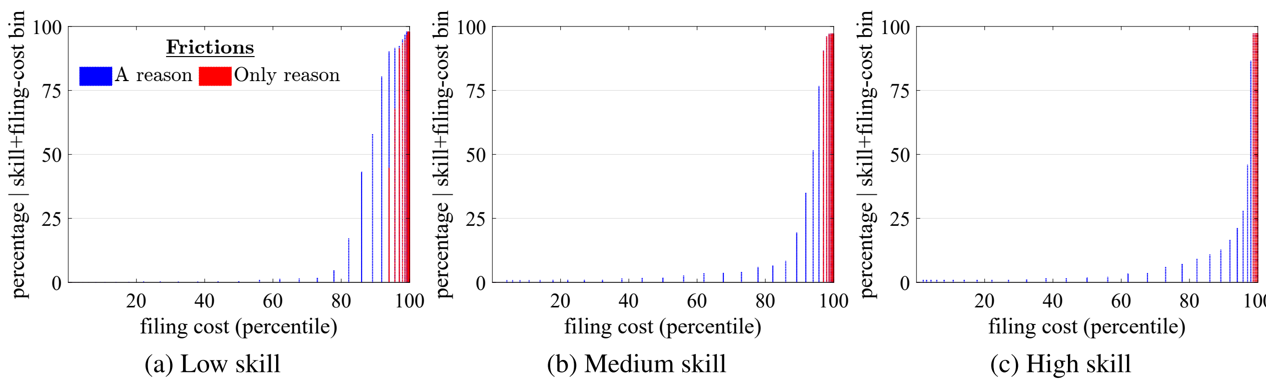


Figure 3: Not file FAFSA due to frictions by skill and filing cost

Notes: Figure 3 depicts the percentage of 18-year-olds who do not file a FAFSA due to frictions and due to only frictions, by skill and the filing cost percentile in the model.

Returning to Table 7, Panel B reports internally calibrated parameters related to the EFC and professional judgment for which the functional forms are assumed (as opposed to being based on statutory formulas). The parameter τ_{pj} scales down parental income for the EFC calculation conditional on qualification for professional judgment in equation (6). The parameter ϕ_{pj} governs the rate at which the likelihood of qualifying for professional judgment, $\pi_{pj}(y)$ given by equation (5), is decreasing in parental income. Recall that qualification for professional judgment increases the extent to which FAFSA applicants from high-income families qualify for need-based aid. As a result, these two parameters are chosen to match the uptake of Pell grants in the top income tercile in both the intensive and extensive margins. The target moments are estimated using the HSLS:09 and are drawn from Table A18 of Appendix A.1.6.

[23] Conceptually, we take a "partial derivative" view of the stated reason for nonfiling, in the sense that, if the reason were to be changed, then a respondent who stated that it determined their nonfiling decision would change their filing choice and apply for aid.

Panel C reports internally calibrated parameters related to college. All target moments in this panel except for the last are estimated from the HSLS:09 and are drawn from Tables A13, A14, A16, and A17 of Appendix A.1. The college enrollment option shock, $q(s)$, is chosen to match enrollment rates by skill for the top parental income tercile. Focusing on enrollment rates of young people from high-income families minimizes the role of financing constraints in the enrollment decision, so that the shock instead captures unmodeled reasons for nonenrollment such as personal preference and lower likelihood of acceptance into a college in which they would like to enroll. The skill-specific probabilities of being allowed to continue in college, $p(s)$, are chosen to match the rates of persistence to the end of the third academic year (Y3), given enrollment in a four-year BA program (Y1). The next parameter, the consumption value of college CV, is set to match the observed BA enrollment rate in the fall of 2013. The college effort cost, λ, is set to match the average weekly hours worked while in college as a fraction of 40 hours (full-time work) for third-year college students. The next two rows contain the vectors representing tuition and fees paid with grants and scholarships from public sources other than Pell grants, $\theta^{other}(s)$, and private sources, $\theta^{pr}(s)$, and are set to match the ratios of public grants net of Pell to tuition and private grants to tuition.

The last row of Panel C contains annual tuition, κ, which is calibrated to target the annual average net tuition and fees. The empirical moment is computed for bachelor's degree programs from 2013-2015 using data contained in a College Board report (Ma, Pender, and Libassi, 2020), supplemented with information from NCES (2019).

Panel D contains internal parameters related to preferences and technology. The degree of parental altruism, β_c, is set so that the model matches the average parent-to-child 6-year total transfers during the period from age 18 to 23 in the NLSY97, reported in Table A21 of Appendix A.2.3. The discount factor, β, is calibrated to target a capital-to-output ratio of three, consistent with Jones (2016). The consumption share in the utility function, υ, is calibrated so that the average working-age adult works full time, ft, as reported in Panel A of Table 6 in Section 5.1.1. The last two parameters of the panel are related to the production technology. Aggregate labor productivity, Z, is set so that GDP per capita for the population aged 18 and over is one in the model. The parameter that determines the labor share for low-education labor, ν, is set so that the college wage premium for the middle skill tercile matches that observed in the NLSY97, reported in Table A20 of Appendix A.2.2.

Panel E of Table 7 contains the remaining miscellaneous parameters. The stigma cost of being delinquent on student loans, ξ_D, is calibrated to the average cohort delinquency rate for the 2013-2015 period as reported in FSA (2021b) (e.g., a delay in payment of 270 days or more). The Social Security replacement rate, χ, targets the average ratio of total Social Security expenditure to GDP, estimated using 2013-2015 data from BEA (2022, T2.1) and BEA (2022, T1.1.5).

5.2 Model validation

In this section, we validate the model along three key dimensions: first, rates of FAFSA nonfiling due to frictions in the cross-section; second, enrollment elasticities; and, third, aid left on the table by nonfilers due to frictions. For the rates of nonfiling due to frictions in the cross-section, we analyze breakdowns by enrollment outcomes and skill and by skill and parental income. For the enrollment elasticities, we use both a cross-sectional analysis and a quasi-natural experiment. In the cross-section, we run a probit regression of BA enrollment on controls such as not filing due to frictions, skill, parental income, and parental education and estimate the average marginal effects. In the quasi-natural experiment, we assess how the college enrollment rate responds to changes in grant aid. For aid left on the table, we compute Pell grants left unclaimed by nonfilers due to frictions.

Appendix C supplements the validation exercises in the main text by examining the model's fit to the rates of nonfiling due to frictions by parental education and skill; to skill-specific college wage premiums; to the following variables broken down by parental income: college enrollment, college persistence, and key financing sources such as Pell grants, student loans, hours worked, and parental inter vivos transfers; and to intergenerational persistence of income.

5.2.1 Rates of FAFSA nonfiling due to frictions in the cross-section

Table 8 reports the share of high school graduates who do not file a FAFSA before college due to frictions by BA enrollment outcome in the data, the baseline model, and a model with an alternative timing described below. The statistics are reported both overall and for every skill tercile. Empirical moments are drawn from Table 2 in Section 3.2. The baseline model accounts for the empirical pattern that FAFSA nonfiling due to frictions is more common among nonenrollees than among enrollees, overall and in every skill tercile.

A key ingredient behind the fit of the baseline model in Table 8 is uncertainty about enrollment in college when making the FAFSA filing decision. Specifically, the high school graduate faces uncertainty about whether they would have the option to enroll in college, their EFC (if they do not qualify for an automatic zero EFC), and their AR(1) earnings productivity. To illustrate, suppose that we reduce the extent of enrollment uncertainty by changing the timing so that the AR(1) earnings productivity is observed when making the filing decision. The framework is kept the same in every other aspect, and the model with the alternative timing is recalibrated to match the same set of target moments as in the baseline model. Table 8 demonstrates that in contrast

Table 8: Nonfilers due to frictions by enrollment outcome in data and model

			Skill		
Enrolled in BA	**Category**	All	Low	Medium	High
No	Data	13.95	15.29	12.69	12.15
	Baseline model	13.69	15.99	11.19	10.05
	Alternative timing model	10.22	13.12	5.60	9.58
Yes	Data	6.86	6.74	6.79	6.92
	Baseline model	7.74	6.34	9.09	7.19
	Alternative timing model	9.62	13.25	12.04	7.34

Notes: The table reports the percentage of high school graduates who do not file a FAFSA due to frictions prior to college by enrollment outcome, both overall and by skill tercile, in the data, the baseline model, and a recalibrated alternative timing model (described in the main text). Data source: HSLS:09.

to the data, this model with alternative timing assumptions does not account for the pattern that nonenrollees are more likely to cite frictions as a reason for not filing than are enrollees in every skill tercile. This is because, with the alternative timing assumption, high school graduates can more accurately predict the expected benefits of FAFSA filing at the time of the filing decision. Therefore, more high school graduates who ultimately become nonenrollees are certain they will not enroll at the time of the FAFSA filing decision, and will therefore not cite application frictions as a reason for not filing.

Table 9 reports the share of high school graduates who do not file a FAFSA before college due to frictions, broken down by skill and parental income terciles in the data and in the baseline model. In both the data and the model, within every skill tercile high school graduates in the top parental income tercile are most likely to cite frictions as a reason for not filing a FAFSA. Two model features drive this pattern. First, high school graduates from high-income families qualify for less need-based aid, which reduces their incentive to file. Second, the filing cost—a utility penalty—has a larger impact on high school graduates from high-income families because they start with higher initial assets and, due to curvature in the utility function, have a lower marginal utility from access to aid than poorer high school graduates do.

Table 9: Nonfilers due to frictions by skill and parental income in data and model

	Data by skill			**Baseline model by skill**		
Parental income	**Low**	**Med**	**High**	**Low**	**Med**	**High**
1	9.75	8.98	5.76	10.39	6.09	2.93
2	17.32	7.12	4.16	15.77	9.43	4.72
3	21.17	15.17	11.57	18.72	15.23	13.90

Notes: The table reports the percentage of high school graduates who do not file a FAFSA due to frictions prior to college by skill tercile and parental income tercile, in the data and in the baseline model. Data source: HSLS:09.

5.2.2 Enrollment elasticities

Table 10 reports AMEs from a probit regression of BA enrollment on a flag for being a FAFSA nonfiler due to frictions and a set of demographic controls for skill, parental income, and parental education in the data and in the baseline model. The empirical AMEs are drawn from column (1) of Table 4 in Section 3.2. Being a FAFSA nonfiler due to frictions is associated with a 16 percentage point reduction in the likelihood of enrolling in a BA in the data versus a 13 percentage point reduction in the model. The other controls in the model also exhibit similar AMEs compared with their empirical counterparts.

Table 10: Probit regression of enrollment likelihood: Average marginal effects in data and model

Control variable	**Data**	**Baseline model**
Flag: Nonfiler due to frictions	-0.16	-0.13
Flag: Skill tercile 1	-0.51	-0.51
Flag: Skill tercile 2	-0.25	-0.22
Log parental income	0.10	0.08
Flag: At least one parent BA+	0.14	0.12

Notes: The table reports the AMEs for a probit regression of enrollment likelihood in the data and in the baseline model. The control variables are a flag on FAFSA nonfilers due to frictions, flag for skill tercile 1 (low skill), flag for skill tercile 2 (medium skill), logged parental income, and flag for at least one parent with a BA or higher. Controls included in the data regression but not reported here are indicators for the sample member being female, nonwhite, Hispanic, or having a household size greater than four. Data source: HSLS:09.

In addition to accounting for enrollment elasticities in the cross-section, the baseline model accounts for estimates of the responsiveness of the enrollment rate from quasi-natural experiments. Table 11 reports an enrollment rate response estimate from a quasi-natural experiment in which prospective students are given a $1,000 subsidy to attend college. The empirical estimate for the enrollment rate response, based on the preferred statistic of Deming and Dynarski (2009), is set to 4.00 percentage points. In the model, the analogous estimate is 4.23 percentage points, close to its empirical counterpart.

Table 11: Enrollment rate response to $1,000 subsidy in data and model

Quasi-natural experiment	**Data**	**Baseline model**
Enrollment change due to additional $1,000 tuition subsidy	4.00	4.23

Notes: The table reports estimates for the enrollment rate response given a subsidy of $1,000 in the data and in the baseline model. In the model, the enrollment rate response is computed in a partial equilibrium in which the distribution of 18-year-olds and general equilibrium prices, taxes, and transfers are held fixed at their initial steady state values. Data source: Deming and Dynarski (2009).

5.2.3 Aid left on the table by nonfilers due to frictions

Table 12 reports statistics related to Pell grants left on the table in both the data and the model. The empirical moments are drawn from Table 5 of Section 3.3. Specifically, Panel A of Table 12 reports the percentage of 18-year-olds who are nonfilers due to frictions and are eligible for Pell grants (extensive margin) and the average amount of Pell grants left unclaimed by FAFSA nonfilers due to frictions who are eligible for Pell grants (intensive margin); Panel B reports the analogous statistics for nonfilers due to only frictions. The statistics are reported for all high school graduates and by BA enrollment outcome. The baseline model does well in producing estimates close to those imputed in the data.[24]

Table 12: Counterfactual Pell grant aid among nonfilers due to frictions in data and model

	Data			Baseline model		
		Enrolled in BA			Enrolled in BA	
Variable	All	No	Yes	All	No	Yes
Panel A: Nonfiler due to frictions and Pell>0						
Percentage of high school graduates	3.99	6.50	0.63	4.61	7.55	0.73
Pell $ | Pell>0	4,816	4,823	4,720	3,672	3,691	3,417
Panel B: Nonfiler due to only frictions and Pell>0						
Percentage of high school graduates	2.06	3.34	0.36	2.35	3.84	0.38
Pell $ | Pell>0	4,928	4,978	4,307	3,790	3,797	3,703

Notes: The table reports statistics related to counterfactual Pell grant aid for high school graduates who do not file a FAFSA due to frictions, both overall and by enrollment outcome, in the data and in the baseline model. Panel A reports the percentage of high school graduates who are nonfilers due to frictions (and possibly other reasons) and who are eligible for Pell grant aid (extensive margin), and the dollar amount of Pell grant aid conditional on being eligible for this group (intensive margin). Panel B reports the same statistics for nonfilers due to only frictions. Data source: HSLS:09.

6 Main Experiment: Eliminating Aid Application Frictions

We use the calibrated model to quantify the cost of aid application frictions by computing the gains from eliminating them. Specifically, we set the FAFSA filing costs to zero and perform analyses in both partial and general equilibrium. Our analyses primarily focus on the impact of eliminating filing costs on high school graduates who cite frictions as a reason for not filing a FAFSA. The effects on the other high school graduates—filers and nonfilers who do not cite frictions as a reason

[24]Imputing subsidized student loans left on the table in the data is more complex because they also depend on the other components of aid chosen by the FAA, as discussed in more detail Section 2. Table D2 of Appendix D.2.1 reports the baseline model's predictions for subsidized student loans left on the table and compares them with the analogous model estimates for Pell grants. Unclaimed Pell grant amounts are lower than unclaimed subsidized loan amounts. This is because grants directly lower the cost of college while loans redistribute the costs into the future, so that those eligible for grants are more likely to incur the filing cost and file the FAFSA. All unsubsidized student loans are left on the table by those who do not file due to frictions in both the data and model.

for not filing—and the economy are second order.

In Section 6.1, we quantify the extent of under-utilization due to frictions in terms of reduced enrollment and reduced access to aid among status quo enrollees. Subsequently, in Sections 6.2 and 6.3, we quantify the welfare cost of aid application frictions in partial and general equilibrium, respectively. Finally, in Section 6.4, we argue that the model's estimates for reduced enrollment due to application frictions (a key margin underlying our main results) are commensurate with those from regional-based empirical studies.

6.1 Under-utilization

Although 11 percent of high school graduates do not file a FAFSA before college and cite frictions as a reason (see Table 1 for the data and Table 13 for the model baseline), the potential cost of this "under-filing" depends mainly on the extent of under-utilization of federal aid. Under-filing could lead to under-utilization of aid along two extensive margins. First, there are nonfilers in the status quo who do not enroll but would both file and enroll if filing were costless. Second, there are nonfilers in the status quo who do enroll but forgo access to aid. A third type of under-filing does not result in under-utilization: there are nonfiling nonenrollees in the status quo who would file a FAFSA if it were costless but still would not enroll. We refer to these three types of transitions as: (1) nonfiling nonenrollee to filing enrollee, (2) nonfiling enrollee to filing enrollee, and (3) nonfiling nonenrollee to filing nonenrollee.

To quantify the extent of under-utilization, in Table 13 we report statistics on the three types of transitions. Because these statistics are computed by eliminating application frictions in a partial equilibrium in which aggregate objects do not adjust, no one transitions from nonfiling enrollee to filing nonenrollee.

Table 13: Under-filing decomposition along utilization margins in the baseline

Utilization margin		**Skill**		
Units: percentage of 18-year-olds | All or Skill	All	Low	Med	High
(1) Nonfiling nonenrollee to filing enrollee (under-enrollment)	0.83	0.95	0.81	0.71
(2) Nonfiling enrollee to filing enrollee	3.34	0.89	3.98	5.57
(3) Nonfiling nonenrollee to filing nonenrollee	6.96	12.79	5.48	1.56
Total nonfilers due to frictions (under-filing)	11.13	14.64	10.27	7.84

Notes: The table reports a decomposition of under-filing along the three utilization margins described in Section 6.1. Within each utilization margin, the statistics are reported both overall and by skill type, as a percentage of 18-year-olds in the respective column's grouping.

When application frictions are eliminated, those who transition from nonfiling nonenrollee to filing enrollee account for 0.83 percent of high school graduates. This is the extent of "under-enrollment" due to application frictions. Analogously, those who transition from nonfiling enrollee to filing enrollee account for 3.34 percent of high school graduates. Together, these numbers imply that 4.17 percent of high school graduates, or only 37 percent of nonfilers due to frictions ($\approx (0.83 + 3.34)/11.13$), are potentially under-utilizing aid. The remaining 63 percent of nonfilers due to frictions (the 6.96 percent of high school graduates who transition from nonfiling nonenrollee to filing nonenrollee), will not utilize federal aid.

Why do we observe high school graduates who transition from nonfiling nonenrollee to filing nonenrollee? The reason is uncertainty at the time of the FAFSA filing decision. Specifically, in our model, when deciding whether to file the FAFSA high school graduates do not know whether they will have the option to enroll in college, their realization of the AR(1) earnings productivity, and potentially their EFC. Therefore, the filing decision is made by weighing the expected benefits of aid eligibility against the cost of filing. When filing is costless, high school graduates will file as long as the expected benefits are strictly positive, even though there exist states of the world in which they ultimately do not enroll and therefore do not utilize any aid.

After frictions are eliminated, the extent to which we observe transitions from nonfiling nonenrollee to filing nonenrollee depends on the nature and extent of uncertainty at the time of filing the FAFSA. Next, we elucidate how the three sources of uncertainty described in the previous paragraph contribute to the share of high school graduates who transition from nonfiling nonenrollee to filing nonenrollee observed in the baseline model.

In Table 14, we report the shares of high school graduates who transition from nonfiling nonenrollee to filing nonenrollee after eliminating frictions, in the baseline and in two counterfactual exercises. The goal of the counterfactual exercises is to quantify how modifying uncertainty from specific sources reduces the transitions from nonfiling nonenrollee to filing nonenrollee. Therefore, in the counterfactual in the second row, the likelihood of the option to enroll, $q(s)$, is set to one. The counterfactual in the third row builds on the second row by additionally setting $\pi_{pj}(y) = 1$, so that all high school graduates who do not qualify for an automatic zero EFC are guaranteed to qualify for a professional judgment. Qualification for professional judgment lowers the EFC and increases the need-based aid the applicant is eligible for, which increases the incentive to enroll.

Note that the stochastic process for earnings is not modified in both counterfactual exercises. Furthermore, both counterfactual exercises ensure that the set of nonfilers due to frictions remains unchanged across the baseline and the counterfactuals. This is achieved by holding fixed all elements of the model—including the FAFSA filing policy function, college entrance policy function, the initial distribution of 18-year-olds, and prices—at their baseline values. As a result, what differs is how the same set of nonfilers due to frictions are classified across the three utilization margins based on enrollment outcomes.

Table 14: Transitions from nonfiling nonenrollee to filing nonenrollee

Model	**Modification**				**Skill**		
Units: percentage of 18-year-olds | All or Skill	Enroll option	EFC	AR(1) earnings	All	Low	Med	High
Baseline	N	N	N	6.96	12.79	5.48	1.56
Baseline with $q(s) = 1$	Y	N	N	5.60	11.01	4.31	0.52
Baseline with $q(s) = 1$ and $\pi_{d_{pj}}(y) = 1$	Y	Y	N	4.72	9.33	3.80	0.18

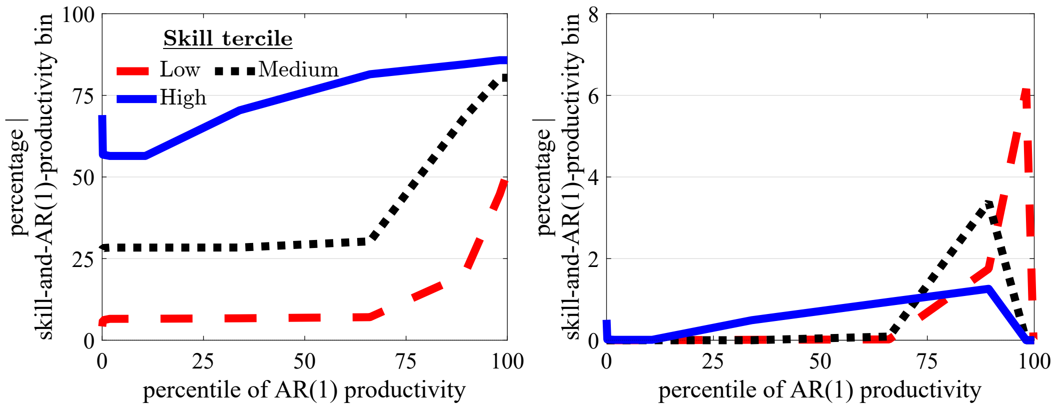
Notes: The table reports the share of high school graduates who transition from nonfiling nonenrollee to filing nonenrollee when application frictions are eliminated. The statistics are reported in the baseline (row 1) and in two counterfactual exercises (rows 2 and 3), both overall and by skill type. The counterfactuals are described in the main text.

The first two rows of Table 14 indicate that for the high-skill group, increasing the likelihood of the option to enroll reduces the share of high school graduates who transition from nonfiling nonenrollee to filing nonenrollee from 1.56 percent to 0.52 percent. When the likelihood of both the option to enroll and qualification for a professional judgment are increased in the last row, the share who transition from nonfiling nonenrollee to filing enrollee declines further, to 0.18 percent, bringing the share close to zero. In contrast, modifying these same sources of uncertainty has a much smaller impact for the low- and medium-skill groups: for example, even when the same two sources of uncertainty are changed, the third row indicates that the shares remain relatively close to the baseline estimates in the first row. Therefore, for high school graduates with high skill in the baseline model, the uncertainty about the option to enroll and the EFC play an important role in explaining the share who transition from nonfiling nonenrollee to filing nonenrollee. By contrast, the uncertainty about earnings is the primary driver of the same share in the low- and middle-skill groups.

Figure 4 illustrates the importance of earnings uncertainty to rationalize the elevated extent of nonfiling nonenrollee to filing nonenrollee transitions for those with low and medium skill. Panels (a) and (b) depict the percentage of high school graduates who enroll and under-enroll in the baseline equilibrium, respectively, by earnings productivity and skill type. As shown in Panel (a), for the bottom two skill types, the likelihood of enrolling is low and relatively flat at low to medium levels of productivity but rises sharply at higher levels.[25] As shown in Panel (b), under-enrollment is observed only at higher levels of earnings realizations. The figure suggests that, when filing is costless, low- and medium-skill high school graduates file a FAFSA in order to have the option to enroll with access to aid in the rare event they have a high enough productivity realization. Consequently, the many low- and medium-skill nonfiling nonenrollees who file a FAFSA when

[25]Higher earnings tend to increase the enrollment likelihood because they mitigate the role of financing constraints, and those with high income especially benefit from the consumption value of college because it is a positive utility shifter.

filing is costless will remain nonenrolled.



(a) Enrollment rate

(b) Under-enrollment rate

Figure 4: Enrollment and under-enrollment rates by AR(1) productivity and skill

Notes: The figure depicts bachelor's degree enrollment rates and under-enrollment rates by the AR(1) productivity component of earnings and skill tercile in the baseline calibration in Panels (a) and (b), respectively.

To summarize, although a quantitatively large share of high school graduates (11 percent) cite frictions as a reason for not filing a FAFSA, the resulting extent of aid under-utilization is relatively small, especially in terms of under-enrollment (0.83 percent of high school graduates). The fact that a large share of high school graduates are nonfilers due to frictions but a modest share switch to enrollment when frictions are eliminated is rationalized by the uncertainty at the time of the FAFSA filing decision.

6.2 Welfare changes in partial equilibrium

In this section, we report welfare changes from eliminating aid application frictions in partial equilibrium. We focus on welfare changes for the distribution of high school graduates in the baseline equilibrium. This choice is motivated by our goal of measuring the cost of aid application frictions for individuals in the baseline economy (analogous to the United States in the mid-2010s).[26] Welfare changes are measured in units of consumption-equivalent variation. Following Abbott, Gallipoli, Meghir, and Violante (2019) and Moschini, Raveendranathan, and Xu (2025), the equivalence units are measured relative to the expected value of not attending college in the initial stationary equilibrium because the value of not attending college does not include any fixed utility costs or benefits. Further details of the welfare calculations are provided in the discussion

[26] Appendix D.2.7 takes into account distributional changes when discussing the implications for the average 18-year-old.

surrounding equations (26) and (27) of Appendix B.4.[27]

Welfare changes by high school graduate group Table 15 reports the welfare gains from eliminating aid application frictions in partial equilibrium for the following groups of high school graduates: (1) those who do not file a FAFSA and cite frictions as a reason for not filing, (2) those who file a FAFSA, (3) those who do not file a FAFSA and do not cite frictions as a reason, and (4) those who do not file a FAFSA and cite frictions as the only reason. The first three groups are mutually exclusive and make up the entire set of high school graduates, while the fourth group is a subset of the first.

Table 15: Welfare changes in partial equilibrium by high school graduate group

High school graduate group	**Welfare change**
(1) Nonfiler due to frictions	0.62
(2) Filer	0.14
(3) Nonfiler due to only not frictions	0.02
(4) Nonfiler due to only frictions	0.87

Notes: The table reports welfare changes in percentage points of lifetime consumption from eliminating aid application frictions in partial equilibrium for the four high school graduate groups described in the text. The first three groups are mutually exclusive and make up the entire set of high school graduates while the fourth group is a subset of the first.

The table indicates that, among the four high school graduate groups, high school graduates who do not file due to frictions benefit the most, especially those who do not file due to only frictions. Specifically, the gains to the average nonfiler due to frictions are 0.62 percent of lifetime consumption, and when restricted to nonfiler due to only frictions the gains to the average increase to 0.87 percent. By comparison, the gains to filers and nonfilers due to only not frictions are much smaller, at 0.14 and 0.02 percent, respectively.

The ordering of welfare gains described in the previous paragraph is driven by selection along filing cost values. Compared to filers and nonfilers due to only not frictions, nonfilers due to frictions would benefit more from eliminating frictions because their filing costs are large enough that they would switch into filing if the cost were to be removed. This is particularly the case for the subset who cite frictions as the only reason for nonfiling: as shown in Figure 3 of Section 5.1.2, nonfiling due to only frictions only occurs at high filing cost levels. Analogously, the benefits to filers are smaller because their filing costs are small enough for this group to file in the baseline equilibrium

[27] In Table D4 of Appendix D.2.3, we report the welfare estimates when consumption-leisure equivalent variation instead of consumption-equivalent variation is used. We report the consumption-leisure estimates as well because our utility function includes leisure. Consumption-leisure equivalent variation measures the percent change in both lifetime consumption and leisure needed to make consumers indifferent across equilibria. In this alternative measure, because it requires adjustments in both consumption and leisure as opposed to only consumption, the magnitudes of the estimates are smaller. However, the qualitative takeaways do not change.

(the benefits to filers stem directly from no longer having to incur the filing cost). Nonfilers due to only not frictions are those who would not file even if the cost of filing were zero. Therefore, while they do not directly benefit from eliminating aid application frictions, they benefit slightly because their children benefit in expectation.

Welfare changes by skill and parental income Table 16 reports the welfare changes and associated statistics for nonfilers due to frictions by skill and parental income terciles. We focus on this group of high school graduates because these are the individuals most affected by application frictions in comparison to filers and nonfilers due to only not frictions. Table D6 of Appendix D.2.5 reports welfare changes for the other groups of high school graduates.

Table 16: Welfare changes and related statistics by skill and parental income terciles

High school graduate group: Nonfilers due to frictions		**Skill**		
Category	**Parental income**	Low	Med	High
Panel A: Welfare changes	1	0.20	1.33	5.60
Units: percentage points of lifetime consumption	2	0.13	0.76	3.24
	3	0.09	0.40	0.99
Panel B: Transition likelihood from	1	11.88	31.04	69.78
nonfiling nonenrollee/enrollee to filing enrollee	2	9.57	32.70	70.10
Units: percentage of nonfilers due to frictions	3	16.52	61.23	84.29
Panel C: Transition likelihood from	1	10.63	18.67	47.62
nonfiling nonenrollee to filing enrollee	2	6.88	12.06	17.44
Units: percentage of nonfilers due to frictions	3	3.12	1.20	0.80

Notes: The table reports, for high school graduates who are nonfilers due to frictions, welfare changes in partial equilibrium from eliminating aid application frictions and related statistics by skill and parental income terciles. Panel A reports the welfare changes. Panel B reports the transition likelihood from nonfiling nonenrollee/enrollee to filing enrollee for nonfilers due to frictions within each bin. Analogously, Panel C reports the transition likelihood from nonfiling nonenrollee to filing enrollee for nonfilers due to frictions within each bin.

The columns of Panel A of Table 16 indicate that the welfare gains are increasing in skill controlling for parental income. We observe these increasing patterns because the expected return to education is increasing in skill: specifically, the enrollment option likelihood, the graduation likelihood, and the college wage premium are increasing in skill.[28] As a result, when application frictions are eliminated, nonfilers due to frictions with higher skill benefit more because they are more likely to transition into being a filing enrollee and, conditional on such a transition, are likely to experience higher gains. The higher transition likelihood is demonstrated by the columns of Panel B of Table 16. The higher conditional gains by skill are reported in Table D3 of Appendix D.2.2.

[28]Specifically, Table 7 of Section 5.1.2 shows that the calibrated likelihood of the option to enroll is increasing in skill. When application frictions are eliminated, the graduation rates by skill for those who transition from nonfiling nonenrollment to filing enrollment are 29, 55, and 82 percent, respectively. Table C2 of Appendix C.2 shows that the college wage premium is increasing in skill in the baseline equilibrium.

The rows of Panel A of Table 16 indicate that the welfare gains are higher for nonfilers due to frictions with lower parental income controlling for skill. The reason for this pattern is that those with lower parental income benefit more from federal aid, especially from the need-based components (i.e., Pell grants and subsidized loans). As a result, nonfilers due to frictions with low parental income are more likely to transition from nonenrollment to enrollment, as demonstrated by the rows of Panel C of Table 16.

The patterns by skill and parental income discussed in the previous two paragraphs imply that, in the cross-sectional joint distribution of skill and parental income, the gains are largest for nonfilers due to frictions with high skill and low parental income (5.60 percent) and smallest for nonfilers due to frictions with low skill and high parental income (0.09 percent). Furthermore, the fact that those with low skill or high income make up a large proportion of nonfilers due to frictions contributes to the modest gains to the average nonfiler due to frictions.

Lastly, we argue that the gains from eliminating frictions for the average nonfiler due to frictions, amounting to 0.62 percent of lifetime consumption, are also modest in the context of postsecondary education policy. For example, the value to the average high school graduate of the federal student aid program (i.e., Pell grants and student loans) as it stands in the baseline equilibrium is significantly higher, at 2.13 percent in partial equilibrium and 5.68 percent in general equilibrium.[29]

6.3 Welfare changes in general equilibrium

In this section, we compare the welfare changes from eliminating aid application frictions in partial equilibrium to those in general equilibrium. We report the changes for education statistics, macroeconomic aggregates, and prices, taxes, and transfers across steady states in Table D5 of Appendix D.2.4.

Welfare changes are reported in Table 17. The population is restricted to high school graduates who do not file a FAFSA and cite frictions as a reason for not filing. The welfare changes are reported overall and by terciles of skill and parental income. We draw two key takeaways from Table 17, which we turn to next in the next paragraph. Table D6 of Appendix D.2.5 compares partial and general equilibrium welfare changes for the other groups of high school graduates. The two main takeaways do not change.

First, for the average nonfiler due to frictions, the general equilibrium gains of 0.79 percent are slightly higher than the partial equilibrium gains of 0.62 percent. These higher welfare gains in general equilibrium are driven by a rise in college enrollment and consequently the college education rate, which causes a rise in the low-education wage rate, a fall in the high-education

[29]The value is estimated by computing the welfare cost from eliminating federal aid in the baseline equilibrium.

wage rate, and a fall in the income tax rate. Overall, consumers benefit enough from the rise in the low-education wage rate and the fall in the income tax rate to offset the costs from a lower high-education wage rate.[30]

Second, the general-equilibrium rise in the low-education wage rate and the fall in the high-education wage rate lead to a redistributive effect across educational attainment categories. These changes manifest as a fall in the welfare gains of high school graduates with high skill and high parental income and a rise in the welfare gains of their peers with low skill and low parental income.[31]

Table 17: Welfare changes in partial and general equilibrium by skill and parental income terciles

		Partial equilibrium				**General equilibrium**			
			Skill				**Skill**		
High school graduate group	**Parental income**	All	Low	Med	High	All	Low	Med	High
Nonfiler due to frictions	All	0.62	0.13	0.74	2.30	0.79	0.35	0.90	2.29
Units: percentage points of	1	1.06	0.20	1.33	5.60	1.26	0.43	1.52	5.67
lifetime consumption	2	0.58	0.13	0.76	3.24	0.78	0.35	0.95	3.29
	3	0.38	0.09	0.40	0.99	0.51	0.30	0.51	0.94

Notes: The table reports welfare changes from eliminating aid application frictions, overall, by parental income, by skill, and by skill and parental income tercile, in partial and general equilibrium. The population is restricted to the high school graduate group of nonfilers due to frictions.

Lastly, we note that because eliminating aid application frictions removes a cost which is positive for all 18-year-olds, in our framework every high school graduate is strictly better off in partial equilibrium after aid application frictions are eliminated. However, in general equilibrium, the redistributive effect may make some worse off (as opposed to just dampening their welfare gains). Unlike our two key takeaways, this fact is not immediately evident in the welfare changes for a within-type average consumer reported in Table 17. To examine this further, in Table D7 of Appendix D.2.6 we show that while 9.70 percent of high school graduates are strictly worse off in general equilibrium, the average magnitude of the losses within this group is small at 0.03 percent of lifetime consumption. Those worse off tend to have high skill, high parental income, and a low filing cost. This population does not benefit very much from reducing filing costs but is hurt by the fall in the high-education wage rate.

[30]Imperfect substitutability between low- and high-education labor is key for the respective changes in the education-specific wage rates. Progressive income taxation is key for the fall in the income tax rate. To elaborate, the rise in the share of college graduates increases tax revenue because there are more high earners but also increases the level of government consumption because GDP increases. However, with progressive income taxation, tax revenue increases more than government consumption, which allows the government to reduce the tax rate.

[31]This is because high school graduates with low skill and low parental income are more likely to be low-education workers and their peers with high skill and high parental income are more likely to be high-education workers (as implied by the college enrollment and persistence rates that are increasing in both skill and parental income in Figures C1 and C2 of Appendix C.3).

6.4 Evidence for under-enrollment

Thus far, we have quantified the benefits from eliminating aid application frictions using our calibrated life cycle model. Our analysis has emphasized that the benefits are proportional to the extent of under-enrollment those frictions induce in the baseline equilibrium. Using our model parameterized to nationally representative data, in this section we argue that the model estimate for under-enrollment is commensurate with those from regional-based empirical studies of similar interventions.

In the first row of Table 18, the empirical estimate is based on Deneault (2023). The author examines a Louisiana state policy that mandated FAFSA completion for high school graduation and reports that the policy may have increased college enrollment in either two-year and four-year institutions by between 1 and 2 percentage points. Our model's estimate of 0.8 percentage points compares well with this range, especially given that our model incorporates only four-year college enrollment.

Table 18: Enrollment rate change post FAFSA reform/intervention in data and model

High school graduate group Units: percentage point change	**Data**	**Model**
All	1 to 2†	0.8
Low income	3.7 (2.7)††	1.2

Notes: The table reports estimates for changes in the enrollment rate post FAFSA reform/intervention in the data and model. The changes in enrollment rates are reported for all high school graduates and for low-income high school graduates. In the model, the change in the enrollment rate (under-enrollment) is for four-year colleges and is computed by eliminating aid application frictions in a partial equilibrium in which the distribution of 18-year-olds and general equilibrium prices, taxes, and transfers are held fixed at their initial steady state values.
† The estimate, reported by Deneault (2023), is from a Louisiana state policy that mandated FAFSA applications as a high school graduation requirement. The reported change is for both two-year and four-year college enrollment.
†† The estimate, reported by Bettinger, Long, Oreopoulos, and Sanbonmatsu (2012), is from an intervention that provided personal assistance with completing a FAFSA for low-income individuals (< \$45,000 in 2008) in Ohio and in Charlotte, North Carolina. The reported change is for four-year college enrollment. The standard error from the study is reported in parentheses.

In the second row of Table 18, the empirical estimate is based on Bettinger, Long, Oreopoulos, and Sanbonmatsu (2012). The authors analyze an intervention offering personal assistance with FAFSA completion to low-income individuals who were earning less than \$45,000 in 2008 in Ohio and in Charlotte, North Carolina. They estimate a 3.7 percentage point increase in four-year college enrollment following the intervention, with a standard error of 2.7 percentage points. Our model's estimate for the corresponding low-income group is 1.2 percentage points, falling within one standard error of the estimate in Bettinger, Long, Oreopoulos, and Sanbonmatsu (2012).

7 Conclusion

Using a public, nationally representative dataset covering high school students in the United States in the mid-2010s, we estimate that 11 percent of high school graduates did not apply for federal aid due to application frictions. These frictions reflect difficulty in completing the FAFSA form, mistaken beliefs about eligibility for aid, or lack of awareness about the aid program. We demonstrate that not applying for aid due to these frictions predicts a lower likelihood of enrolling in a bachelor's degree program after high school graduation in the short- and medium-run, even after controlling for other attributes such as skill, parental income, and nonfiling due to lack of intent to enroll in postsecondary education. In order to quantify the costs of aid application frictions, we incorporate them as heterogeneous filing costs in a life cycle model of college enrollment.

Our analysis using the calibrated life cycle model reveals that while many high school graduates are deterred from filing a FAFSA due to application frictions, fewer than half would actually use federal aid if those frictions were removed. The rationale for this modest under-utilization due to application frictions is that many nonfilers due to frictions would file a FAFSA if it were costless in the event that they may ultimately enroll in a BA, even though this enrollment outcome is rare. Because of the modest under-utilization, the welfare costs of application frictions for the average nonfiler due to frictions and the impact on the aggregate economy are also modest. However, for the few nonfilers due to frictions with high skill and low income, the welfare costs are large.

In the broader context of policies that address aid application frictions, our results suggest that the focus should be on targeted efforts rather than on large-scale reform. This is because in our experiment eliminating frictions is assumed to be costless to implement, and yet achieves only modest welfare gains for the average nonfiler due to frictions. At the same time, nonfilers due to frictions with high skill and low parental income benefit much more, and the net benefit of interventions targeted to that group would likely be positive even if intervention were costly.

Of course, in our study, we quantify the cost of financial aid application frictions in the period prior to the already-enacted *FAFSA Simplification Act*. While the *Simplification Act* attempted to reduce difficulties in FAFSA filing, it did not directly address mistaken beliefs about aid eligibility or lack of awareness about the program. As a result, financial aid application frictions are most likely still present, and we leave their analysis in the post-policy period to future research.

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Online Appendix for: “College Financial Aid Application Frictions”

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Contents

A Data Appendix

A.1 The HSLS:09

Our main data source is the High School Longitudinal Study of 2009 (HSLS:09). This survey was collected by the National Center for Education Statistics (NCES), a subsidiary of the U.S. Department of Education (National Center for Education Statistics, U.S. Department of Education, 2020). Unless specified otherwise, we use "skill" to refer to honors-weighted high school grade point average (GPA) of the sample member in the HSLS:09. We use honors weighted high school GPA as our measure of skill in the HSLS:09 because this survey does not contain a standardized measure like the 1997 National Longitudinal Survey of Youth's Armed Services Vocational Aptitude Battery (ASVAB) score.

A.1.1 Sample cleaning, postsecondary education outcomes, and summary statistics

Sample cleaning We begin by restricting attention to sample members who graduate from high school or earn a general education development certificate by the spring of 2013, and for whom we can construct a fall 2013 (i.e., 2013-2014 academic year) postsecondary enrollment outcome using the method described next. We also require that the sample member live with at least one parent, and that we observe parental education and nonimputed income, honors-weighted high school GPA, gender, whether or not the sample member is white, whether or not the sample member is Hispanic, household size, and whether or not the respondent reports submitting a Free Application for Federal Student Aid (FAFSA) in the 2013 Update survey wave. Finally, we require that, for those who report not filing a FAFSA, valid responses (yes or no) for each nonfiling reason are recorded.

We assign dollar values to the categorial income values reported in the HSLS:09 using the method described in Appendix A.5, converting them to 2012 US dollars (USD) using the Consumer Price Index or CPI (Bureau of Labor Statistics, U.S. Department of Labor, 2024).

Assigning postsecondary outcomes to high school graduates As part of our sample cleaning procedure, we assign postsecondary outcomes to the set of high school graduates and drop observations for whom this assignment is not possible or have inconsistent records. By postsecondary outcomes, we mean enrollment in a four-year bachelor's degree program, sub-baccalaureate programs such as a two-year or certificate, or nonenrollment in any postsecondary education.

To assign postsecondary outcomes to members of the cleaned sample in the fall of 2013 and the Second follow-up collected in 2016, we proceed as follows. First, we recognize that student records collected from postsecondary institutions are likely to be more reliable measures of postsecondary enrollment than survey responses. Because of this, we prioritize information on postsecondary outcomes collected from student records submitted by postsecondary institutions to the HSLS:09.

Specifically, we begin by identifying high school graduates who enroll in postsecondary education for the first time in the fall of 2013 (the 2013-2014 academic year). We flag this group by identifying those who have a nonmissing value for at least one of the variables X4PS1START, X5PFYEAR, or X5POSTHSAY. The variable X4PS1START records the month and year of enrollment at the first postsecondary institution, collected in the Second follow-up survey wave (the month of enrollment is suppressed in the public use data file). The variable X5PFYEAR records the first academic year of postsecondary enrollment as reported in the Student Records component of the Postsecondary Transcripts and Student Records (PETS-SR) data collection wave. The variable X5POSTHSAY reports the first known academic year of enrollment in postsecondary education as reported in the Postsecondary Transcript component of the PETS-SR wave. We require that these variables do not contradict each other if more than one of them is nonmissing. For the group of enrollees identified with this procedure, we use the variable X5PFYDEGREE (which records the degree program at the primary first-year institution the sample member enrolls in and is a variable from the Student Records component of the PETS-SR wave) to assign the individual to less than two-year program or an associate's degree/two-year program (that is, sub-baccalaureate), or to a bachelor's degree/four-year program. For observations that remain unassigned to a postsecondary outcome, we then use X4PS1DEGTYPE1 (which records the first degree or certificate pursued and is a variable from the Second follow-up survey wave) to allocate observations to the relevant element of the set of possible postsecondary outcomes. As we proceed, we use X5DUALFLG and X5HSCRDERN to rule out that postsecondary enrollment variables reflect postsecondary enrollment while also enrolled in high school.

Given our approach to measuring postsecondary enrollment in the 2013-2014 academic year, the last step is to clean the sample by removing observations with inconsistencies. We drop sample members who earned their high school credential before 2013, or who are recorded as receiving financial aid before the 2013-2014 academic year. Among those assigned to the "did not enroll" postsecondary outcome, we drop sample members with Second follow-up records that indicate enrollment in the fall of 2013 but have no record of what sort of degree they enrolled in. We discard nonenrollees whose record indicates postsecondary enrollment before 2013 but also have no record of dual enrollment. Finally, we drop sample members who have no postsecondary enrollment record after high school but whose student aid records indicate that they either attempted a positive number of academic credits or received federal student aid.

Table A1 compares the bachelor's degree (BA) enrollment rate of 42.8 percent computed in the

HSLS:09 cleaned sample with the national-level statistic for the 2013-2014 academic year reported by the NCES, which is 42.1 percent (National Center for Education Statistics, U.S. Department of Education, 2022). The NCES tabulations draw on the Current Population Survey for the 2013 year of interest. Our procedure yields a BA enrollment rate in the cleaned sample that aligns well with the national NCES tabulation value computed using a different data source. This lends support to the accuracy of our postsecondary enrollment outcome assignment procedure.

Table A1: Postsecondary education enrollment rates in the fall of 2013

	HSLS:09 cleaned sample	**NCES Table 302.10**
Enrollment in fall 2013	**HS graduates spring 2013**	**Recent high school completers**
Four-year bachelor's	42.79	42.1
Observations	7,143	

Notes: The table reports enrollment rates in four-year bachelor's degree programs for the cleaned HSLS:09 sample and for high school graduates aged 16-24 in the fall of the calendar year when they graduated from high school, set to the 2013 value in NCES Table 302.10. HSLS:09 weights: Second follow-up student longitudinal weights.

Summary statistics: raw versus cleaned samples We compare the cleaned sample, including postsecondary outcomes, with the raw data in Table A2. The cleaned sample has fewer observations, which partially affects sample composition compared to the raw sample. Panel A reports demographic attributes: the cleaned sample exhibits a slightly higher average high school GPA, average parental income, and parental education rate, but a similar share who are female, share with a two-parent family, and household size, compared to the raw sample. The cleaned sample also has a lower percentage who are nonwhite or Hispanic. Panel B reports rates of postsecondary enrollment outcomes in the fall of 2013 in the cleaned sample. About 43 percent of the cohort of high school graduates enroll in a four-year bachelor's degree, 27 percent enroll in a two-year or certificate program, and 30 percent do not enroll in any postsecondary education.

A.1.2 Breakdowns of FAFSA filing status and nonfiler reasons

Table A3 reports statistics on FAFSA filing status and nonfiling reasons overall among BA nonenrollees by their postsecondary education outcome (that is, no postsecondary education versus sub-baccalaureate) in the fall of 2013. In comparison to those who enroll in a sub-baccalaureate program, those who did not enroll in any postsecondary education (PSE) are more likely to be nonfilers, nonfilers due to frictions (and possibly other reasons), and nonfilers due to only frictions.

Table A2: Summary statistics

Category	Variable	Sample Raw	Sample Cleaned
Panel A: Demographic attributes	High school GPA	2.82	3.01
	Female	49.71	50.29
	Nonwhite	26.24	22.85
	Hispanic	21.95	19.42
	Parental income	76,106	83,340
	At least one parent BA+	36.48	41.82
	Two-parent family	69.83	73.74
	Household size	4.27	4.23
Panel B: Enrollment outcome in fall 2013	Not enrolled		29.94
	Two-year or certificate		27.27
	Four-year bachelor's		42.79
	Observations	13,283	7,143

Notes: The table reports means of variables for the raw and cleaned samples from the HSLS:09. Dollar values are in 2012 USD. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

A.1.3 Additional summary statistics

Table A4 reports summary statistics of the cleaned sample and broken down by whether or not the respondent is a FAFSA nonfiler due to frictions. The "Yes" column contains those who are nonfilers due to frictions, while the "No" column contains all high school graduates except nonfilers due to frictions. Panel A indicates that, compared to other sample members, FAFSA nonfilers due to frictions have slightly lower high school GPA and lower likelihoods of being nonwhite, and they are more likely to be Hispanic or female. Parental income among nonfilers due to frictions is higher than among other sample members, and the educational attainment of parents (as well as the rate of having a two-parent family) among nonfilers is slightly higher. Household size is similar across the two groups. Panel B reports that nonfilers due to frictions are much more likely to not attend any postsecondary education in the fall of 2013, while the rates of attending a sub-baccalaureate program (i.e., certificate or two-year programs) are similar across the two groups, and BA enrollment is much lower among FAFSA nonfilers due to frictions compared to their peers.

A.1.4 Predicting PSE outcomes with being a FAFSA nonfiler due to frictions

Tables A5 and A6 present the full regression AMEs and coefficients corresponding to the AMEs presented in Section 3.2. The main text reported AMEs for a selected set of controls that excluded flags for being female, nonwhite, Hispanic, and having a household size greater than four. Note that the cutoff for the household size flag is the average household size reported in Table A4 of Appendix A.1.3. See the main text for an extended explanation of the dependent variable and estimation sample for each regression exercise.

Table A3: BA nonenrollees FAFSA filing status and nonfiling reasons by PSE enrollment outcome

		PSE enrollment outcome	
Category	**Variable**	**None**	**Sub-BA**
Panel A: FAFSA filing rates	Nonfilers	42.06	15.08
	Filers	38.97	74.18
	Uncertain	18.97	10.74
	Total	100.00	100.00
Panel B: FAFSA nonfiler reasons (not mutually exclusive)	Frictions	17.34	10.23
	Not frictions	23.45	9.56
Panel C: FAFSA nonfiler reasons (mutually exclusive)	Only frictions	8.54	3.81
	Only not frictions	14.65	3.13
	Both	8.80	6.43
	No reason given	10.07	1.72
	Nonfilers	42.06	15.08
	Observations	1,740	1,642

Notes: The table reports summary statistics for those who do not enroll in a BA after high school broken down by specific outcome: not enrolling in any PSE ("None") and enrolling in a sub-baccalaureate program ("Sub-BA"). Weights: Second follow-up student longitudinal weights. Source: HSLS:09.

Table A4: Summary statistics breakdown

			Nonfiler due to frictions	
Category	**Variable**	**All**	**No**	**Yes**
Panel A: Demographic attributes	High school GPA	3.01	3.03	2.84
	Female	50.29	50.18	51.15
	Nonwhite	22.85	23.35	18.73
	Hispanic	19.42	18.66	25.57
	Parental income	83,340	79,960	110919
	At least one parent BA+	41.82	41.56	43.90
	Two-parent family	73.74	73.10	78.98
	Household size	4.23	4.23	4.22
Panel B: Enrollment outcome in fall 2013	Not enrolled	29.94	27.78	47.55
	Two-year or certificate	27.27	27.48	25.56
	Four-year Bachelor's	42.79	44.74	26.89
	Observations	7,143	6,294	849

Notes: The table reports summary statistics for the cleaned sample of all high school graduates and broken down by whether or not the respondent is a FAFSA nonfiler due to frictions. See main text for variable descriptions. The "Yes" column contains those who are nonfilers due to frictions, while the "No" column contains all high school graduates except nonfilers due to frictions. Dollar values are in 2012 USD. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

As evidenced by the results in models (5) and (7) of Table A5, being a nonfiler due to frictions is negatively associated with both applying to a BA and enrolling in a BA conditional on being accepted. Indeed, among the 14 percent of nonenrollees who are nonfilers due to frictions in Panel B of Table 1 of the main text, only 20 percent applied to at least one four-year BA program as shown in Table A7.

Table A5: The Average Marginal Effect of Aid Application Frictions on Outcomes

	BA enrollment by:				Fall 2013 BA outcome:		
	Fall 2013		Spring 2016		Applied	Accepted	Enrolled
Control variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Flag: nonfiler frictions	-0.162		-0.142				
	(0.0181)		(0.0217)				
Flag: nonfiler frictions only		-0.207		-0.165	-0.175	-0.045	-0.227
		(0.0327)		(0.0333)	(0.0384)	(0.0435)	(0.0891)
Flag: nonfiler no PSE		-0.408		-0.392			
		(0.0180)		(0.0534)			
Flag: low skill	-0.513	-0.494	-0.538	-0.518	-0.489	-0.198	-0.268
	(0.0215)	(0.0217)	(0.0208)	(0.0211)	(0.0218)	(0.0297)	(0.0364)
Flag: medium skill	-0.253	-0.242	-0.263	-0.254	-0.231	-0.062	-0.091
	(0.0219)	(0.0219)	(0.0212)	(0.0197)	(0.0181)	(0.0158)	(0.0212)
Log parental income	0.097	0.088	0.104	0.097	0.063	0.025	0.066
	(0.0111)	(0.0098)	(0.0117)	(0.0119)	(0.0125)	(0.0084)	(0.0133)
Flag: At least 1 parent BA+	0.143	0.136	0.148	0.141	0.115	0.042	0.102
	(0.0207)	(0.0198)	(0.0221)	(0.0217)	(0.0200)	(0.0136)	(0.0257)
Flag: Female	0.008	0.001	0.022	0.013	0.059	-0.026	-0.022
	(0.0165)	(0.0168)	(0.0164)	(0.0159)	(0.0202)	(0.0129)	(0.0204)
Flag: Nonwhite	0.089	0.082	0.079	0.071	0.075	-0.010	0.083
	(0.0235)	(0.0240)	(0.0226)	(0.0227)	(0.0267)	(0.0174)	(0.0276)
Flag: Hispanic	-0.040	-0.046	-0.029	-0.038	-0.065	-0.004	-0.007
	(0.0258)	(0.0257)	(0.0261)	(0.0257)	(0.0245)	(0.0209)	(0.0412)
Flag: HH size >4	0.002	0.004	0.001	0.001	-0.015	0.003	0.012
	(0.0174)	(0.0178)	(0.0170)	(0.0173)	(0.0177)	(0.0161)	(0.0219)
Sample	HS grads	HS grads	HS grads	HS grads	HS grads	Applied	Accepted
Observations	7,143	7,143	7,143	7,143	7,143	4,970	4,692
pseudo- R^2	0.30	0.31	0.32	0.33	0.24	0.23	0.11

Notes: The table reports AME results from probit regressions of various outcomes on flags for FAFSA nonfiling due to frictions and a set of additional controls. Details in text. Bootstrapped standard errors are in parentheses. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

A.1.5 Imputation of Pell grant eligibility: methodology and validation

Imputation methodology We use the HSLS:09 to impute the expected family contribution (EFC) and, mapping from the imputed EFC, a dollar amount of Pell grant financial aid to all high school graduates in our cleaned sample. Our main source of discipline on how the attributes of any high school graduate would map into their EFC is the *Expected Family Contribution (EFC) Formula Guide* published by the U.S. Department of Education for the 2013-2014 academic year (Federal Student Aid Office, U.S. Department of Education, 2014). In particular, we use Worksheet A for dependent students and the associated Tables A1-A7; whenever we cite Worksheet Table AX, where X is a number, we are referring to tables recorded in Worksheet A. We construct HSLS:09 survey analogs for the inputs into Worksheet A and then operate on them using the parameters provided in Worksheet Tables A1-A7 of the *Formula Guide*. We abstract from the FAFSA's expected student contribution for dependent students, so that the EFC is equal to the parents' contribution.

Table A8 summarizes the mapping from FAFSA formula inputs to observable counterparts that we use to impute financial aid eligibility. Appendix A.5 describes how we compute income and tax

Table A6: Coefficients of aid application frictions on outcomes

	BA enrollment by:				Fall 2013 BA outcome:		
	Fall 2013		Spring 2016		Applied	Accepted	Enrolled
Control variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Flag: nonfiler frictions	-0.622		-0.537				
	(0.0753)		(0.0856)				
Flag: nonfiler frictions only		-0.831		-0.637	-0.594	-0.328	-0.716
		(0.1463)		(0.1340)	(0.1290)	(0.2744)	(0.2532)
Flag: nonfiler no PSE		-2.323		-1.714			
		(0.2560)		(0.3500)			
Flag: low skill	-1.623	-1.600	-1.679	-1.651	-1.502	-1.435	-0.868
	(0.0732)	(0.0766)	(0.0730)	(0.0738)	(0.0731)	(0.1562)	(0.1077)
Flag: medium skill	-0.734	-0.729	-0.831	-0.828	-0.792	-0.771	-0.348
	(0.0649)	(0.0664)	(0.0668)	(0.0652)	(0.0645)	(0.1621)	(0.0794)
Log parental income	0.359	0.333	0.391	0.372	0.221	0.219	0.247
	(0.0437)	(0.0383)	(0.0482)	(0.0492)	(0.0445)	(0.0706)	(0.0522)
Flag: At least 1 parent BA+	0.491	0.479	0.517	0.504	0.386	0.373	0.370
	(0.0668)	(0.0652)	(0.0733)	(0.0739)	(0.0648)	(0.1190)	(0.0897)
Flag: Female	0.030	0.002	0.082	0.048	0.205	-0.224	-0.084
	(0.0610)	(0.0635)	(0.0616)	(0.0612)	(0.0697)	(0.1111)	(0.0772)
Flag: Nonwhite	0.333	0.313	0.301	0.279	0.267	-0.087	0.335
	(0.0899)	(0.0927)	(0.0897)	(0.0917)	(0.0977)	(0.1418)	(0.1235)
Flag: Hispanic	-0.148	-0.172	-0.109	-0.144	-0.223	-0.032	-0.025
	(0.0957)	(0.0977)	(0.0972)	(0.0971)	(0.0826)	(0.1762)	(0.1526)
Flag: HH size >4	0.008	0.014	0.004	0.005	-0.053	0.029	0.044
	(0.0644)	(0.0673)	(0.0640)	(0.0666)	(0.0616)	(0.1407)	(0.0829)
Constant	-3.637	-3.322	-3.666	-3.415	-1.551	-0.233	-1.942
	(0.4766)	(0.4254)	(0.5265)	(0.5384)	(0.5020)	(0.7855)	(0.5735)
Sample	HS grads	HS grads	HS grads	HS grads	HS grads	Applied	Accepted
Observations	7,143	7,143	7,143	7,143	7,143	4,970	4,692

Notes: The table reports probit coefficients for the AME results presented in the main text. Bootstrapped standard errors are in parentheses. Source: HSLS:09.

liability values from the Current Population Survey's Annual Socioeconomic Supplement, or CPS ASEC, and how we compute net worth values from the 2013 Survey of Consumer Finances Extract Public Data (SCF). We then impute these dollar values for income, tax liability, and net worth to discretized income bins (where recorded) in the HSLS:09 and keep the most recent value. This income value is also what we use to assign observations to parental income terciles in our analysis.

Beginning with Category I of Table A8, we measure family income in the HSLS:09 using non-imputed values for the categorical variables X1FAMINCOME and X2FAMINCOME, which record

Table A7: Share applied to at least 1 BA among nonenrollee nonfilers due to frictions

	Nonenrollee nonfilers due to frictions
Applied to 1+ BA	0.20
Observations	513

Notes: The table reports the share of 2013-2014 academic year nonenrollees who are also nonfilers due to frictions who applied to at least one BA. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

discretized family income reported in the Base-year and First follow-up of the survey, respectively. For each wave's income variable, we associate a value in 2012 dollars for income, federal tax liability, and net worth as described in Appendix A.5. In our imputation of dollar values, we keep the values associated with the most recent income observed because we want an approximation of the input into the FAFSA form, which is the taxable and untaxable income from the year prior to filing.

Moving to Category II of Table A8, we construct federal tax liability using the within-bin median for the most recent discretized income value, imputed from the CPS ASEC. We assign state and other tax allowance using the Worksheet Table A1 values for unobserved state of residence—because state of residence is unreported in the public HSLS:09—evaluated using observed family income constructed as explained in the previous paragraph. The Social Security tax allowance for each resident working parent is constructed using Worksheet Table A2 and observed income; the income protection allowance uses Worksheet Table A3 and the household size at the point of the Base-year and First follow-up reported in the HSLS:09 with variables X1HHNUMBER and X2HHNUMBER, respectively. The employment expense allowance is constructed with information on the number of resident working parents from the HSLS:09 and parameters reported in the FAFSA formula worksheet. Total allowances against income are then defined as the sum of all allowances in Category II.

Category III of Table A8, available income, is the difference between total income and total allowances against income.

Category IV of Table A8, parents' contribution from assets, sets the net worth to the value imputed using the SCF. The asset protection allowance is taken from Worksheet Table A5 evaluated using HSLS:09 information on the number of resident parents, established using the variables X1P2RELATION and X2P2RELATION, and the age of the oldest parent in the household, established using the variables P1YRBORN1, P2YRBORN1, P1YRBORN2, and P2YRBORN2. The parents' contribution from assets is the difference between net worth and the asset protection allowance, multiplied by the asset conversion rate of 0.12 taken from the *Formula Guide*.

Category V of Table A8, the adjusted available income (AAI) is the sum of the parents' available income and their contribution from assets if the family makes more than $50,000 (otherwise, the contribution from assets is not added because the family qualifies for the "simplified needs test"). Their contribution from AAI is defined using Worksheet Table A6, assuming that the family has only one child enrolled in college in the 2013-2014 academic year. The result is the total contribution from parents. When contributions from the student are set to zero, as we assume in our approximation, unless the family qualifies for the "automatic zero EFC" the parent contribution is also equal to the expected contribution from the family (that is, the EFC) so that our imputation result for the EFC in Category VI of Table A8 is equal to the parent contribution in line #28 of the worksheet. The family qualifies for the automatic zero EFC if the parents' total income is less than $24,000; in such a situation we set the imputed EFC equal to zero.

Table A8: EFC formula inputs and construction of empirical counterparts

FAFSA category	FAFSA line number and description	Construction	Data source	Note
I. Parents' income in 2012	7. Total Income	[1]	HSLS:09	If negative, set to 0.
II. Allowances against parents' income	8. U.S. Income tax paid if tax filers	[2]	HSLS:09, CPS ASEC	Assume everyone files taxes.
	9. State and other tax allowance	WT A1		WT A1 value for blank state.
	10. Parent 1 Social Security tax allowance	WT A2		WT A2 value at #7.
	11. Parent 2 Social Security tax allowance	WT A2		WT A2 value at #7.
	12. Income protection allowance	WT A3 [3]	HSLS:09	
	13. Employment expense allowance	[4a,4b]	HSLS:09	
	14. Total allowances	# 8 to # 13		
III. Available income	15. Available income (AI)	#7 to #14		May be negative.
IV. Parents' contribution from assets	20. Net worth	[5]	SCF	#s 16 to 19 are not imputed.
	21. Ed. saving and asset protection allowance	WT A5 [6]	HSLS:09	
	22-24. Contribution from assets	[7]		If negative, set to 0.
V. Parents' contribution	25. Adjusted Available Income (AAI)	#15 + #24		
	26. Total parents' contribution from AAI	WT A6		Evaluate WT A6 using AAI.
	27. Number dep. in college in 2013-2014	[8]	HSLS:09	Set to 1.
	28. Parents' contribution	$\frac{\#26}{\#27}$		If negative, set to 0.
VI. EFC		Equal to #28		Set contributions from student to 0.

[1] HSLS:09 variables: X1FAMINCOME and X2FAMINCOME

[2] Tax liability estimated by income bin using CPS ASEC and imputed using income from [1].

[3] HSLS:09 variables: X1HHNUMBER and X2HHNUMBER.

[4a] HSLS:09 variables: X1P2RELATION, X2P2RELATION, X2PAR1EMP, X2PAR2EMP.

[4b] FAFSA formula: $\min\{0.35y, 3900\}$ where y is lowest parent earned income.

[5] Source: see Appendix.

[6] HSLS:09 variables: P1YRBORN1,P2YRBORN1, P1YRBORN2, P2YRBORN2, X1P2RELATION, X2P2RELATION

[7] FAFSA formula: 12 percent of # 20 - # 21.

[8] HSLS:09 variables: P2INCLG2013,P2SIBSTARTCLG, and P2SIBCLGGRAD

Notes: The table summarizes our imputation of the EFC by mapping 2013 FAFSA formula inputs to their empirical counterparts. The first column reports the FAFSA formula category; the second column provides the FAFSA line number and short description. The third column explains how the empirical counterpart is constructed; for explanations that are longer, a table note number is provided in square brackets. The fourth column explains the data source for the empirical counterpart, and the fifth column provides additional notes. WT refers to Worksheet Table.

The cost of attendance (COA) affects eligibility for Pell grants only if the COA is less than the EFC. This is quite rare, especially for bachelor's degree programs such as those we consider in our Pell grant imputation exercise. Because of this, we abstract from the role of COA in determining Pell grant eligibility.

According to publications from the Federal Student Aid Office of the U.S. Department of Education and the National Association for Financial Aid Administrators, the Pell Grant is awarded first, and other sources of aid are awarded subsequently, when financial aid administrators (FAAs) generate aid package offers for an applicant to their school (Program Communications Division, Federal Student Aid, 2013; NASFAA Monograph, 8th Edition, 2023; Federal Student Aid, U.S. Department of Education, 2013). In our imputation, the amount of Pell grants that a high school graduate is eligible for is assigned using the discretized table which maps from the EFC value to a Pell award amount provided in Federal Student Aid, U.S. Department of Education (2013). The maximum Pell grant for the 2013-2014 academic year is \$5,645, and the minimum positive award amount is \$605.

Validating imputed Pell grant eligibility We validate the imputed Pell grant amount that individuals in the HSLS:09 are eligible for by comparing imputed with realized Pell grant amounts for 2013-2014 BA enrollees who apply for aid in the HSLS:09 in the 2013-2014 academic year. The realized aid values are pulled from student records submitted by postsecondary institutions to the HSLS:09 data collectors and are therefore likely to be accurate. Table A9 presents moments of the distribution of the individual-level value of Realized − Imputed Pell grants in the population of 2013-2014 BA enrollees who submitted a FAFSA. The distribution of differences is centered at zero.

Table A9: Imputed Pell grants compared to realized values

	Mean	**p10**	**p25**	**p50**	**p75**	**p90**
Difference: Realized - Imputed	228.5	-1,595	0	0	0	3,150
Observations	2,122					

Notes: The table compares realized and imputed values for Pell grants received by 2013 BA enrollees who filed a FAFSA. Values are current dollars. Sample: BA enrollees who submitted a FAFSA. Weights are PETS-SR student longitudinal weights. Source: HSLS:09.

A.1.6 Additional tabulations for model motivation, parameterization, and validation

Motivation: Financial aid accounting Table A10 reports the distribution of different categories of postsecondary financial aid across postsecondary education program types (Panel A) and within program types (Panel B). These distributions are computed using the HSLS:09 cleaned sample, and they are useful for motivating our choice of model ingredients. In Panel A, it is evident that most of each type of aid is spent on BA programs. This is the postsecondary education program that we model in our framework. In Panel B, within BA programs, the share of total financial aid dollars received by first-year enrollees in the 2013-2014 academic year is similarly sourced from the three programs that we incorporate in our model: Pell grants, subsidized Stafford loans, and unsubsidized Stafford loans.

Motivation: Persistence of FAFSA nonfiling rates among 2013-2014 academic year nonfilers Table A11 reports the percentage of FAFSA nonfilers in the 2013-2014 academic year (2013-2014 academic year) who have not filed a FAFSA by the 2014-2015 academic year (first row) and the 2015-2016 academic year (second row). Moving across columns from left to right, these nonfiling

Table A10: Distribution of realized aid in 2013-2014 academic year

		PSE type	
Conditional distribution of aid	**Type of aid**	**Sub-BA**	**BA**
Panel A: across PSE types	Pell grants	45.57	54.43
	Subsidized Stafford loans	18.71	81.29
	Unsubsidized Stafford loans	20.28	79.72
Panel B: within PSE types	Pell grants	60.20	30.49
	Subsidized Stafford loans	18.11	33.35
	Unsubsidized Stafford loans	21.69	36.16
	Observations	3,563	

Notes: The table reports distributions of financial aid by aid type both across postsecondary education (PSE) program types (Panel A) and within program types (Panel B). PSE types are either sub-baccalaureate (i.e., certificate and associate's degree programs) or bachelor's degree programs. Rows in Panel A sum to 100; columns in Panel B sum to 100. The number of observations refers to valid observations of financial aid outcomes for sub-BA or BA enrollees within our cleaned sample. Weights are PETS-SR student longitudinal weights. Source: HSLS:09.

rates are reported separately by 2013-2014 academic year BA enrollment outcome and for the sample of high school graduates who are nonfilers due to frictions and due to only frictions. The results indicate that FAFSA nonfiling is highly persistent. This is why in our model we assume that filing a FAFSA is a one-time decision before college.

Table A11: FAFSA nonfiling rates among 2013-2014 academic year nonfilers in later years

	BA enrollee		Nonfiler due to:	
Academic Year	**No**	**Yes**	**Frictions**	**Only frictions**
2014-2015	90.55	87.80	89.76	90.48
2015-2016	88.32	86.22	88.05	88.26
Observations	1,088	443	849	290

Notes: The table examines persistence in FAFSA nonfiling rates by reporting the percentage who are nonfilers by the 2014-2015 and 2015-2016 academic years among 2013-2014 academic year FAFSA nonfilers, broken down by 2013-2014 academic year BA enrollment outcome and nonfiling reason. Note that the 2013-2014 academic year BA nonenrollee group include those who enrolled in a sub-baccalaureate program in the 2013-2014 academic year. Weights are Second follow-up student longitudinal weights. Source: HSLS:09.

Motivation and Validation: Rates of FAFSA nonfiling due to frictions by skill tercile and parental education We report rates of FAFSA nonfiling due to frictions broken down by skill tercile and parental education in Table A12. Comparing across education categories, high school graduates from families with highly educated parents are more likely to be nonfilers due to frictions in the top two skill terciles, but this is not the case for the lowest skill tercile. The statistics in this table are used to motivate our model assumption that the FAFSA filing cost does not depend on parental education as discussed in footnote 16 of the main text and in the validation exercise in Table C1 of Appendix C.1.

Table A12: FAFSA nonfilers due to frictions by skill tercile and parental education

	At least one parent BA+	
Skill	**No**	**Yes**
1	14.55	13.52
2	8.22	13.22
3	6.01	9.56
Total	10.53	11.46
Observations	3,329	3,814

Notes: The table reports rates of FAFSA nonfiling due to frictions and possibly other reasons by skill tercile and parental education. Weights: Second follow-up student longitudinal weights. Source: HSLS:09.

Motivation and Parameterization: BA enrollment persistence by parental income tercile and skill tercile Table A13 reports persistence to the third year of enrollment for fall 2013 BA enrollees, broken down by parental income tercile and skill tercile. These statistics are used for the internal calibration in Table 7 of Section 5.1.2 and for the model validation exercise in Figure C2 of Appendix C.3.

Table A13: BA Persistence (Enr Y3 | Enr Y1) by parental income tercile and skill tercile

	Skill		
Parental income	1	2	3
1	42.31	78.42	82.15
2	53.39	74.47	87.01
3	65.61	77.90	95.62
Total	54.36	76.88	91.23

Notes: The table reports the percentage of each parental income tercile and skill tercile combination that persist to their third year of enrollment. Weights: Second follow-up student longitudinal weights. Source: HSLS:09.

Parameterization: Grant subsidy rates and skill distribution by parental education Table A14 reports, by skill tercile, grants received during the first year of enrollment as a share of tuition and fees. This subsidy rate is reported for private grants using shares from Krueger and Ludwig (2016), and for public grants net of Pell grants. These estimates are used for the internal calibration in Table 7 of Section 5.1.2.

Table A15 reports the conditional skill distribution of high school graduates, for low- and high-education parents. These estimates are used for the external calibration in Table 6 of Section 5.1.1.

Parameterization and validation: Postsecondary enrollment outcomes by skill and parental income Table A16 breaks down enrollment in a bachelor's degree program in the fall of 2013 by terciles of parental income and skill. Note that the sample size differs across skill bins in this table, because skill bins are assigned so that the weighted frequencies of the bins are equal (not the

Table A14: Grant subsidy rates by skill tercile

Skill	Private grants/TF	Public grants, net Pell/TF
1	0.132	0.201
2	0.140	0.232
3	0.158	0.305

Notes: The table reports subsidy rates for private grants and public grants net of Pell grants, as a fraction of tuition and fees, by skill tercile. Weights: PETS-SR longitudinal weights. Source: HSLS:09.

Table A15: High school graduates skill distribution by parental education

	At least one parent BA+	
Skill	**No**	**Yes**
1	44.01	18.46
2	34.33	31.93
3	21.65	49.61
Observations	3,329	3,814

Notes: The table reports the discretized skill distribution of high school graduates conditional on parent educational attainment. Weights: Second follow-up student longitudinal weights. Source: HSLS:09.

number of observations). The unconditional enrollment rate and the enrollment rates by skill for the highest parental income tercile are used for the internal calibration in Table 7 of Section 5. The breakdown by income and skill is used for the model validation exercise in Figure C1 of Appendix C.3.

Table A16: BA enrollment by skill tercile and parental income tercile

	Skill			
Parental income	1	2	3	Total
1	6.68	27.46	59.28	22.78
2	13.19	38.92	70.20	40.40
3	21.22	60.86	83.41	65.13
Total	11.47	41.83	75.05	42.79
Observations	1,855	2,304	2,984	7,143

Notes: The table reports the share of high school graduates who enroll in a bachelor's degree program in the fall of 2013, broken down by parental income tercile (rows) and skill tercile (columns). Weights: Second follow-up student longitudinal weights. Source: HSLS:09.

Parameterization and Validation: Labor supply of enrollees and financial aid receipt Table A17 reports statistics related to the labor supply of college enrollees, both overall and broken down by skill, using values in the third year of enrollment. The unconditional average of hours worked is used for the internal calibration in Table 7 of Section 5.1.2. The percentage working and the average hours conditional on working by income are used for the model validation exercise in Table C4 of Appendix C.3.

Table A17: Labor supply of college enrollees by parental income tercile

Parental income	**Hours>0**	**Average hours | hours>0**	**Average hours/40**
1	75.01	21.65	0.406
2	75.03	21.89	0.411
3	62.53	19.25	0.301
Total	68.26	20.54	0.351

Notes: The table reports statistics related to the labor supply of college students in their third year of enrollment, by parental income tercile and overall. Unconditional average hours include nonworking observations (zeros). Weights: Second follow-up longitudinal weights. Source: HSLS:09.

Table A18 contains the extensive and intensive margins for federal student aid receipt. Panel A reports the share receiving Pell grants, and the amount conditional on receipt, among fall 2013 BA enrollees for whom we have a student record with nonmissing information about student aid receipt (which includes those who receive no aid). These statistics are reported by parental income tercile and overall. Panel B reports the same statistics for Stafford loans (either subsidized or unsubsidized). The extensive and intensive margins of Pell uptake in the top income tercile are used for the internal calibration in Table 7 of Section 5.1.2. Furthermore, the uptake rates of both Pell grants and student loans are used for the model validation exercise in Table C3 of Appendix C.3.

Table A18: Financial aid among fall 2013 BA enrollees by parental income tercile

Category	**Parental income**	**Percent receiving**	**Average amount | receipt**
Panel A: Pell grants	1	80.16	4,777
	2	45.33	4,051
	3	6.20	4,019
	Total	32.44	4,365
Panel B: Stafford loans	1	67.98	3,735
	2	69.27	3,875
	3	47.44	2,598
	Total	58.41	3,229
Observations	2,642		

Notes: The table reports the extensive and intensive margins of Pell receipt (Panel A) and Stafford loans (Panel B) among fall 2013 BA enrollees, broken down by parental income tercile. Weights are Second follow-up longitudinal weights. Source: HSLS:09.

A.2 The PSID and NLSY97

Appendix A.2.1 explains how we use the Panel Study of Income Dynamics (PSID) and the 1997 National Longitudinal Survey of Youth (NLSY97) to estimate the deterministic and stochastic components of the life cycle earnings process and reports the results. Appendix A.2.2 reports the college wage premium by skill tercile in the NLSY97. Appendix A.2.3 reports moments related to inter vivos transfers computed in the NLSY97. Dollar values are in 2012 USD, converted using the CPI.

A.2.1 Life cycle earnings process functional forms and estimation results

In this section, we explain and report results for our estimation of the deterministic and stochastic components of the life cycle earnings process. Our estimation approach follows Moschini, Raveendranathan, and Xu (2025), which in turn builds on the method of Abbott, Gallipoli, Meghir, and Violante (2019). Methodologically, we differ to some extent from Moschini et al. (2025), for example by measuring skill with high school GPA rather than the ASVAB in the NLSY97. These changes slightly affect estimation sample counts.

The deterministic component $\epsilon_{j,e,s}$ depends on the consumer's age, j, their education, e, and their skill endowment, s:

$$\epsilon_{j,e,s} = \exp\left(\beta^A_{e,1} j + \beta^A_{e,2} j^2 + \beta^A_{e,3} j^3 + \beta^s_{e,s}\right).$$

The stochastic component is an AR(1) process where the persistence parameter ρ_e depends on the consumer's educational attainment, as does the variance σ^2_e of the Normal distribution from which the error term is drawn:

$$\eta' = \rho_e \eta + \nu_e, \quad \nu_e \sim \mathbb{N}\left(0, \sigma^2_e\right).$$

For each education group e, we use the PSID to estimate how logged real wages are related to a third-order polynomial of age within each education group. This identifies $\beta^A_{e,1}$, $\beta^A_{e,2}$, and $\beta^A_{e,3}$. The longer panel dimension of the PSID makes it better suited to this task than the NLSY97. We then clean logged hourly real wages in the NLSY97 of age effects with the PSID estimation results. We regress the resulting age-free log hourly real wages on indicators for skill terciles; the estimated coefficients on skill tercile indicators, $\beta^s_{e,s}$, are the factor loadings on skill s. The fact that high school GPA is observed in the NLSY97 but not in the PSID makes the NLSY97 suited to this task. The residuals from the NLSY97 regression are then used to jointly estimate ρ_e and σ^2_e. Education-specific point estimates are reported in Table A19: Panel A contains age profile estimates from the PSID, Panel B reports skill endowment tercile shifters estimated in the NLSY97, and Panel C reports estimates of the AR(1) process parameters.

A.2.2 College wage premium by skill tercile

Table A20 reports the college wage premium for those aged 25-39 in the NLSY97. The wage premium for the middle skill tercile is used for the internal calibration in Table 7 of Section 5.1.2. The wage premiums are also used for the model validation exercise in Table C2 of Appendix C.2.

Table A19: Earnings process estimation results

Category	Parameter	Estimation data	Educational attainment e	
			High school: $e = \ell$	Bachelor's: $e = h$
Panel A: Age third-order polynomial	$\beta^A_{e,1}$	PSID	0.0958	0.187
	$\beta^A_{e,2}$		-0.00151	-0.00328
	$\beta^A_{e,3}$		0.00000691	0.0000187
Panel B: Skill endowment tercile shifter	$\beta^s_{e,1}$	NLSY97	-0.0395	-0.201
	$\beta^s_{e,2}$		-0.0328	-0.122
Panel C: AR(1) persistence and variance	ρ_e	NLSY97 regression residuals	0.854621	0.886317
	σ^2_e		0.080784	0.071994

Table A20: Bachelor's degree wage premium by skill tercile: ratio of median wages

	High school		Bachelor's		
Skill	**Wage**	**Obs**	**Wage**	**Obs**	**Wage premium**
1	14.124	6,854	18.629	870	1.319
2	14.665	5,546	20.849	2,402	1.422
3	14.921	2,687	23.411	5,350	1.569

Notes: The table reports the median wage within each skill tercile by education attainment status for those not currently enrolled in postsecondary education and aged 25-39; the last column is the ratio of median wages in the two educational attainment categories, the college wage premium. Observation counts are at the individual-year level. Source: NLSY97.

A.2.3 Inter vivos transfers

To estimate average inter vivos transfers from parents to their college-aged children in the NLSY97, we use the earnings process estimation sample with four modifications involving requirements on sample member age, education status, independence status, and whether the observation has been assigned a family/parent income tercile. First, we allow individuals to be enrolled in an education program in a given year; second, we restrict attention to individuals classified as independent by the NLSY97 in a given year; third, we keep individuals between the ages of 18 and 23 during the years from 1997 to 2003; and, fourth, we require that we observe the family income tercile. This leaves 8,291 individual-year observations (3,063 individuals).

To account for an implicit transfer from parents to their children who live with them and do not pay rent, we flag those living with their parents and paying no monthly rent, then impute the average monthly rent using rent paid by sample members with the same family income tercile, college enrollment status, and observation year who are not living with their parents. Next, we transform monthly rent to yearly rent and add it to yearly net income received from parents (if both parents are present) or summing across both the mother and father (if both parents are not present). We also add any yearly allowances received. The resulting quantity is the yearly nominal transfers from parents to their child.

To compute the transfer ratio reported in the first row of Table A21, within each year we multiply the quantity by six and divide by nominal GDP per capita in that year (for those over 18) to estimate a unitless implied ratio of total transfers received to per capita income for each individual while they are young adults of college age. To compute GDP per capita for those 18 and over in these years, we use information on GDP from 1997-2003 from the Bureau of Economic Analysis (BEA) in BEA (2022, T1.1.5) and population levels from Census Bureau of the United States (2000, 2010). We then average this ratio across individuals and years to compute the transfer ratio while sample members are young adults of college age. The average real values of the components of transfers are also reported in the same table in units of 2012 USD, where dollars are converted using the CPI.

Table A21: Inter vivos transfers

Variable	**Mean**
Transfers ratio	0.579
Transfers	$6,281
Transfers not allowance	$721
Allowance	$188
Imputed rent	$6,227
Imputed rent to transfers ratio	0.856
Observations (individual-year)	8,291
Observations (individuals)	3,063

Notes: The table reports average transfers for the sample used to estimate inter vivos transfers. The transfers ratio is a six-year total, while dollar amounts of transfers and components are annual. Sample: independents between 18 and 23 observed during 1997-2003. Transfer dollar amounts are in 2012 USD. Data are at the individual-year level. Source: NLSY97.

In Table A22 we also report the transfer ratio broken down by parental income tercile. This breakdown is used for the model validation exercise in Table C5 of Appendix C.3.

Table A22: Inter vivos transfer ratio by parental income tercile

Parental income	**Transfer ratio**
1	0.544
2	0.545
3	0.638
Total	0.579
Observations (individual-year)	8,291
Observations (individuals)	3,063

Notes: The table reports average transfers for the sample used to estimate inter vivos transfers, by parental income tercile. Sample: independents between 18 and 23 observed during 1997-2003. Data are at the individual-year level. Source: NLSY97.

A.3 Income tax progressivity τ_p: CBO data and results

In order to estimate the progressivity of the income tax and transfer system, we use data underlying figures from the Congresional Budget Office (CBO) reports on the distribution of household income for 2014 and 2015 (U.S. Congressional Budget Office, 2018a,b), following the robustness exercise of Heathcote, Storesletten, and Violante (2017). Note that, although we parameterize to the period 2013-2015, in this estimation we omit 2013 because the CBO report for that year does not include the components necessary to implement the estimation procedure described next.

Qualitatively, the income tax progressivity parameter, τ_p, represents the progressivity of the federal tax system including not just federal tax liability but also transfers from Temporary Aid for Needy Families (TANF), Supplemental Nutrition Assistance Program (SNAP), and Supplemental Security Income (SSI). This is in contrast to the estimation in Appendix A.5, which only computes median federal tax liability within each income bracket for the purposes of imputing the EFC and Pell grant eligibility.

Table A23 reports the baseline federal tax rate, as well as the transfer rates from TANF, SNAP, and SSI shown in columns (1), (2), (3), and (4), respectively. We compute the empirical equivalent of the net tax rate for our model as the federal tax rate reported in column (1) minus the transfer rates from TANF, SNAP, and SSI and report this net tax rate in column (5). Average pretax income in column (6) is logged in column (7); logged after-tax income is reported in column (8), where after-tax income is computed by taking the log of the net tax rate in column (5) applied to the pretax income of column (6).

Table A23: CBO data by year

	Percentiles		**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Year	Min	Max	Fed. tax	TANF	SNAP	SSI	Net tax	Ave. Y	$\log(Y)$	$\log(Y_{AT})$
2014	99	100	33.6				33.6	1.774	0.249	0.071
	96	99	26.7				26.7	0.342	-0.466	-0.601
	91	95	23.4				23.4	0.207	-0.685	-0.801
	81	90	21.2				21.2	0.151	-0.820	-0.924
	60	80	17.8				17.8	0.105	-0.981	-1.066
	40	60	14.0				14.0	0.069	-1.163	-1.229
	20	40	9.1	1.6	1.6	1.1	4.8	0.042	-1.376	-1.397
	0	20	1.9	6.6	9.7	7.0	-21.4	0.019	-1.717	-1.632
2015	99	100	33.3				33.3	1.855	0.268	0.092
	96	99	26.7				26.7	0.356	-0.449	-0.583
	91	95	23.6				23.6	0.214	-0.670	-0.786
	81	90	21.3				21.3	0.157	-0.804	-0.908
	60	80	17.9				17.9	0.108	-0.967	-1.052
	40	60	14.0	0.5			13.5	0.071	-1.149	-1.212
	20	40	9.2	1.6	1.4	0.9	5.3	0.044	-1.357	-1.380
	0	20	1.5	6.5	9.0	6.7	-20.7	0.02	-1.699	-1.617

Notes: The table reports the components for the estimation of the income tax progressivity parameter τ_y. Data are from 2014 and 2015, and dollar values in column (6) are in millions of current USD. After-tax income is defined as $Y_{AT} \equiv \left(1 - \frac{\text{Net tax}}{100}\right) Y$, where the net tax rate is defined as $(5) \equiv (1) - (2) - (3) - (4)$.

We estimate the equation $\log(Y_{AT,i}) = \beta_1 \log(Y_i) + \beta_0$ where i corresponds to rows in Table A23, using population shares as weights. Table A24 reports the estimation results using CBO data presented in Table A23.

Table A24: Income tax progressivity estimation results by year and overall

Coefficient	2014	2015
β_1	0.822 (0.0314)	0.824 (0.0311)
β_0	-0.251 (0.0332)	-0.246 (0.0323)
Implied $\hat{\tau}_{p,t}$	0.178	0.176
Average 2014-2015 $\hat{\tau}_p$	0.177	

Notes: The table reports income tax progressivity parameter estimation results. Standard errors in parentheses.

A.4 Consumption tax τ_c: OECD data and results

In order to estimate the consumption tax rate, τ_c, we apply equation (5) from Mendoza, Razin, and Tesar (1994) to updated data corresponding to our parameterization time period. This equation is

$$\tau_{c,t} = 100 \times \frac{5110_t + 5121_t}{C_t + G_t - GW_t - 5110_t - 5121_t}.$$

Specifically, we use values for the United States from three data series (OECD, 2024c,b,a) to populate the 2013, 2014, and 2015 entries of Panels A, B, and C in Table A25.

Table A25: OECD data by year

Variable	Description	2013	2014	2015	Source
Panel A: Total tax revenue (all levels of government)					
5110	General taxes on goods and services	343,853	361,685	374,173	OECD (2024c)
5121	Excises	154,390	155,976	156,902	
Panel B: Final consumption expenditure					
C	Private	11,040,849	11,521,194	11,933,651	OECD (2024b)
G	Government	2,530,745	2,562,276	2,603,988	OECD (2024a)
Panel C: Compensation of employees by source					
GW	Paid by producers of gov't services	1,665,524	1,706,888	1,758,064	OECD (2024a)

Notes: The table reports OECD data used in the consumption tax rate estimation method of Mendoza, Razin, and Tesar (1994). Dollar values are in millions of current USD for that year, rounded to the nearest dollar.

Results are presented in Table A26. The average rate across the 2013-2015 time period is 0.044, which is the value we assign to τ_c.

Table A26: Consumption tax rate estimation results by year and overall

Variable	Description	2013	2014	2015
$\hat{\tau}_{c,t}$	Annual rate (share)	0.044	0.044	0.043
$\hat{\tau}_c$	Average rate 2013-2015 (share)	0.044		

A.5 Income, federal tax liability, and net worth: CPS ASEC and SCF data and results

Parental income, federal tax liability, and net worth are inputs into the synthetic FAFSA formula used to impute the EFC and Pell grant eligibility. Household income in the HSLS:09 is reported in both the Base-year and the First follow-up and records the previous year's income in current dollars (2008 for the Base-year, and 2011 for the First follow-up). The income is reported as a discretized variable where bin thresholds are in current dollars and are the same across the two waves. For each tax year (2008 and 2011), we use this discretized income to impute continuous values for income and federal tax liability from the CPS ASEC and for net worth from the SCF.

Specifically, we use 2009 and 2012 CPS ASEC data; these waves contain information on income earned and federal taxes on that income in the previous year (Flood et al., 2023). We assign individuals to tax units and then aggregate total individual income to the tax unit level. Federal tax liability is reported at the tax unit level by the CPS ASEC and is computed using TAXSIM (U.S. Department of Commerce, Economics and Statistics Administration, Bureau of the Census, 1993; O'Hara, 2006). We restrict attention to tax units where the head of household is aged between 35 and 70 in a given year, and they have at least one child living with them who is between 13 and 14 in 2009 or 16 and 17 in 2012. For each year of the CPS ASEC, we assign observations in that year to an income bin using thresholds in current dollars, where the bin cutoffs are drawn from the HSLS:09. Within each income bin, we then compute the median value of income and federal tax liability and convert to 2012 USD using the CPI. The results are reported in the first four columns of Table A27.

We use the 2013 SCF Summary Extract Public Data to compute the median net worth within each income bin (Board of Governors of the Federal Reserve System, 2013). We define net worth as the sum of the values of saving, checking, nonresidential real estate, trusts, money market deposit accounts, money market mutual funds, certificates of deposit, stocks, bonds, and net worth from farm or business sources. The last element of this sum, the net worth from farm or business sources, is first passed through the function provided in Table A4 from the EFC *Formula Guide* referenced in Appendix A.1.5 before we include it in the total. Because the Summary Extract Public Data is made available in real dollars for the most recent wave of the SCF, which was 2022 when we downloaded the data, we proceed by first selecting a tax year (2008 or 2011) and then convert the family-level income reported in the SCF to that tax years' dollars using the CPI. Based on this value, we assign each family to the income bin they would have been in in that tax year using current-dollar income bin cutoffs from the HSLS:09. After restricting attention to the sample of families with children living at home and household heads aged between 35 and 70, we compute the within-bin median of net worth for that sample. These within-bin median values, expressed in 2012 dollars, are reported in the last two columns of Table A27.

For the Base-year and First follow-up household income values in the HSLS:09, we impute the continuous dollar values for income, federal tax liability, and net worth. This yields one set of imputed dollar variables per discretized household income observation in the HSLS:09. We keep the values associated with the most recent observation of discretized household income as our dollar amounts for household income, federal tax liability, and net worth at the household level in the HSLS:09.

Table A27: Values of income level, federal tax liability, and net worth by discretized income bin

	CPS ASEC				SCF	
	Income		Tax liability		Net worth	
Income bin	2008	2011	2008	2011	2008	2011
1	9,093	8,590	0	0	50	50
2	26,665	25,547	0	0	399	350
3	47,996	45,459	568	315	1,997	1,997
4	69,274	66,329	2,514	2,397	6,291	5,692
5	89,642	85,814	4,382	4,582	9,487	9,487
6	110,462	105,764	6,855	6,906	15,379	13,282
7	131,864	126,571	10,523	9,743	45,810	48,135
8	154,134	148,174	13,941	12,279	53,927	51,940
9	175,026	167,808	18,731	16,485	78,466	55,225
10	195,559	187,339	15,729	18,625	159,436	112,747
11	217,222	207,419	23,758	24,916	74,899	80,890
12	237,512	228,722	11,662	24,845	141,808	74,899
13	419,805	315,814	40,471	40,484	628,346	628,346

Notes: The table reports median income, federal tax liability, and net worth by income bin from the 2009 and 2012 CPS ASEC and the 2013 SCF in 2012 USD rounded to the nearest dollar. Sources: 2009 and 2012 CPS ASEC and 2013 SCF.

B Model Appendix

B.1 Value functions after FAFSA and college phase

This section presents the value functions for the consumer life cyle phases after the FAFSA-and-college phase, which are Repayment, Parenthood, Empty nester, and Retirement (as depicted in Figure 1 of Section 4.1).

Consumers are required to begin student loan payments the year after college graduation age, regardless of whether or not they complete college. The idiosyncratic state of a consumer while $j > 4$ and $j \neq j_f + j_a$ is given by the tuple (j, e, s, η, a). The consumer's value function is given by

$$V(j, e, s, \eta, a) = \max_{d_D \in \{0,1\}} (1 - d_D) V^R(j, e, s, \eta, a) + d_D V^D(j, e, s, \eta, a), \tag{15}$$

where d_D denotes the student loan delinquency decision. The objects $V^R(\cdot)$ and $V^D(\cdot)$ denote the value of repayment and the value of delinquency, respectively. The value of repayment for $j > 4$ and $j \neq j_f + j_a$ is given by

$$V^R(j, e, s, \eta, a) = \max_{c \geq 0, a', x \in X} U(c, x, j, d_e = 0, d_D = 0) + \beta \psi_j \mathbb{E}_{\eta' | e, \eta} V(j + 1, e, s, \eta', a') \tag{16}$$
$$s.t.$$
$$(1 + \tau_c) c + a' = y_{j,e,s,\eta,a,x} + a + \mathbb{I}_{\{a<0\}} r_{SL} a + Tr_j - T(y_{j,e,s,\eta,a,x})$$
$$a' \geq \min[(1 + r_{SL}) a + \rho_R(j, a), 0]$$
$$y_{j,e,s,\eta,a,x} = w_e \epsilon_{j,e,s} \eta x \mathbb{I}_{j<j_r} + ss_{e,s} \mathbb{I}_{j \geq j_r} + r \left(a + Tr_j\right).$$

The constraint on a' is the loan repayment constraint, which requires that if the consumer has outstanding federal loans, then the consumer must repay at least $\rho_R(j, a)$ of the outstanding principal plus interest.

Alternatively, these consumers can choose delinquency. The value function for $j > 4$ and $j \neq j_f + j_a$ is given by

$$V^D(j, e, s, \eta, a) = \max_{c \geq 0, x \in X} U(c, x, j, d_e = 0, d_D = 1) + \beta \psi_j \mathbb{E}_{\eta' | e, \eta} V(j + 1, e, s, \eta', a') \tag{17}$$
$$s.t.$$
$$(1 + \tau_c) c = y_{j,e,s,\eta,a,x} + Tr_j - T(y_{j,e,s,\eta,a,x}) - \rho_D(j, a, y_{j,e,s,\eta,a,x})$$
$$a' = (1 + r_{SL}) a + \rho_D(j, a, y_{j,e,s,\eta,a,x}) - \phi_D[\rho_R(j, a) - \rho_D(j, a, y_{j,e,s,\eta,a,x})]$$
$$y_{j,e,s,\eta,a,x} = w_e \epsilon_{j,e,s} \eta x \mathbb{I}_{j<j_r} + ss_{e,s} \mathbb{I}_{j \geq j_r} + r \left(a + Tr_j\right).$$

In the case of delinquency, consumers do not make a consumption-savings decision. Instead, they have their wage garnished to make a partial payment of $\rho_D(j, a, y_{j,e,s,\eta,a,x})$. Therefore, they consume whatever remains from their disposable income, plus accidental bequests, after making the partial payment. The parameter ϕ_D is the fraction of the missed payment (the difference between full payment and partial payment) that is charged as a collection fee. The outstanding principal plus interest is then augmented by the missed payment plus the collection fee net of any partial payment. During delinquency the consumer also faces a stigma cost, which is represented in the utility function in equation (1) by ξ_D.

When $j = j_f + j_a$, in addition to the choices already described, the parent chooses an inter vivos transfer to make to their child, who will become an independent adult in that period. At the start of age $j_f + j_a$, the parent draws their child's skill type and the child's FAFSA filing cost, and then chooses whether or not to be delinquent on any student debt payments. The value function before the draw of child skill type and the FAFSA filing cost is given by

$$
\begin{aligned}
V(j,e,s,\eta,a) = &\sum_{s_c|e} \pi_{s_c}(s_c|e) \sum_{\xi_f} \pi_{\xi_f}(\xi_f|s_c) \, [\max_{d_D \in \{0,1\}} (1-d_D) V^R(j,e,s,\eta,a,s_c,\xi_f) \\
&+ d_D V^D(j,e,s,\eta,a,s_c,\xi_f)],
\end{aligned}
\tag{18}
$$

where $\pi_{s_c}(s_c|e)$ is the probability of a given child skill conditional on parental education, and $\pi_{\xi_f}(\xi_f|s_c)$ is the probability of a given FAFSA filing cost conditional on child skill. The value of repayment for $j = j_f + j_a$ is given by

$$
\begin{aligned}
&V^R(j,e,s,\eta,a,s_c,\xi_f) = \max_{c \geq 0, a', x \in X, a_c} U(c,x,j,d_e = 0, d_D = 0) + \\
&\beta \psi_j \mathbb{E}_{\eta'|e,\eta} V(j+1,e,s,\eta',a') + \beta_c W^0(s,\xi_f,y_p,a_c) \\
&s.t. \\
&(1+\tau_c)c + a' + a_c = y_{j,e,s,\eta,a,x} + a + r_{SL} a \mathbb{I}_{a<0} + Tr_j - T(y_{j,e,s,\eta,a,x}) \\
&a' \geq \min[(1+r_{SL})a + \rho_R(j,a), 0] \\
&a_c \geq 0 \\
&y_{j,e,s,\eta,a,x} = w_e \epsilon_{j,e,s} \eta x + r\,(a + Tr_j) \\
&y_p = y_{j,e,s,\eta,a,ft}\,,
\end{aligned}
\tag{19}
$$

where a_c is the inter vivos transfer to the child, $W^0(\cdot)$ is the child's value function, β_c disciplines the intensity of parental altruism toward the child, and y_p is income at full time work hours, $x = ft$. When computing the EFC, we use parental income assuming full time work hours to avoid moral hazard incentives with respect to hours worked; otherwise, the parent may have an incentive to work fewer hours to lower the EFC so that the child qualifies for more need-based aid.[1]

[1] In reality, this moral hazard incentive is most likely not big because the EFC is updated for every academic year of college. For tractability, in our model the EFC is determined in the first academic year after the FAFSA is filed and stays constant thereafter. Furthermore, Appendix D.1 shows that using full time work income allows the baseline model to account for uptake of Pell grants among first-year enrollees from the lowest parental income tercile. In Appendix D.3, we provide a sensitivity analysis in which realized income is used as the EFC input.

When $j = j_f + j_a$ and the consumer chooses delinquency, we assume for simplicity that those consumers cannot make an inter vivos transfer to their child. Therefore, the value function for delinquency is the same as in equation (17), with the difference that the parent has a term reflecting altruistic utility toward their child in their objective function.

B.2 Additional functional forms and equilibrium definition

This section presents functional forms not provided in Section 4 of the main text and the definition of equilibrium.

Full payment function. Federal student loan repayment leads to a full payment given by the function

$$\rho_R(j,a) = \begin{cases} -\left[\dfrac{r_{SL}}{1-(1+r_{SL})^{-(T_{SL}+5-j)}}\mathbb{I}_{j\in(4,T_{SL}+4]} + (1+r_{SL})\mathbb{I}_{j>T_{SL}+4}\right]a & \text{if } a<0 \\ 0 & \text{otherwise.} \end{cases} \tag{20}$$

If there is an outstanding balance and j is still within T_{SL} periods of the college phase, then the loan is amortized with an interest rate of r_{SL}; otherwise, the outstanding principal plus interest is due. If there is no outstanding loan balance, the payment amount is zero.

Partial payment function. Federal student loan delinquency leads to a partial payment given by the function

$$\rho_D(j,a,y) = \min[\tau_g \max[y - T(y) - \bar{y}, 0], \rho_R(j,a)]. \tag{21}$$

Notation to summarize the idiosyncratic state space. To present the function for Social Security transfers and then define the equilibrium, we must first discuss notation. Let $\vec{\omega}$ denote the idiosyncratic state of a consumer. This state depends on age and enrollment status in the following way:

$$\vec{\omega} = \begin{cases} (s,\xi_f,y_p,a) & \text{for 18-year-olds, before making the FAFSA filing decision} \\ (s,\eta,a,d_f,f) & \text{for potential enrollees, before making the college entrance decision} \\ (j,\ell,s,\eta,a,d_f,f) & \text{for consumers in college} \\ (j,e,s,\eta,a) & \text{for consumers not enrolled, dropouts, or graduates, if } j\neq j_f+j_a \\ (j,e,s,\eta,a,s_c,\xi_f) & \text{if } j=j_f+j_a. \end{cases} \tag{22}$$

Let $\Omega^0(\cdot)$, $\Omega^{BA}(\cdot)$, $\Omega^{NC}(\cdot)$, and $\Omega(\cdot)$ denote the distributions of 18-year-olds at the stage of making the FAFSA filing decision, college enrollees, non-college enrollees for $j \leq 4$, and consumers for

$j > 4$, respectively. Furthermore, let $d_{c,t}(\vec{\omega})$ denote the continue-or-drop-out decision that solves the discrete dropout problem in the continuation value of equation (14).

Social Security transfer function. Social Security transfers are set equal to a fraction χ of the average labor earnings for the 30 years before retirement (conditional on education and skill), plus the average unconditional labor earnings for the 30 years before retirement, divided by two. The transfer function is given by

$$\begin{aligned} ss_{e,s} =& \frac{\chi}{2}\left[\frac{\int w_e \eta \epsilon_{j,e,s} x(\vec{\omega})\Omega_t(\vec{\omega}|j_r - 30 \leq j < j_r, e, s)d\vec{\omega}}{\int \Omega_t(\vec{\omega}|j_r - 30 \leq j < j_r, e, s)d\vec{\omega}} + \right. \\ & \left. \frac{\int w_e \eta \epsilon_{j,e,s} x(\vec{\omega})\Omega_t(\vec{\omega}|j_r - 30 \leq j < j_r)d\vec{\omega}}{\int \Omega_t(\vec{\omega}|j_r - 30 \leq j < j_r)d\vec{\omega}}\right]. \end{aligned} \tag{23}$$

Although we compute the transition path in our analysis in Appendix D.2.7, thus far we have omitted time subscripts for ease of exposition. For the definition of equilibrium, we include a time subscript, t, to indicate which variables may change along a transition path.

Equilibrium definition. Given an initial level of capital stock K_0 and initial distributions $\{\Omega_0^0(\vec{\omega})$, $\Omega_0^{BA}(\vec{\omega})$, $\Omega_0^{NC}(\vec{\omega})$, $\Omega_0(\vec{\omega})\}$, a competitive equilibrium consists of sequences of household value functions $\{W_t^0(\vec{\omega})$, $W_t^{f=0}(\vec{\omega})$, $W_t^{f\neq 0}(\vec{\omega})$, $W_t^{BA}(\vec{\omega})$, $V_t^{BA}(\vec{\omega})$, $V_t^{NC}(\vec{\omega})$, $V_t(\vec{\omega})$, $V_t^R(\vec{\omega}), V_t^D(\vec{\omega})\}$, household FAFSA filing, college entrance, and continue-or-drop-out policy functions $\{d_{f,t}(\vec{\omega})$, $d_{e,t}(\vec{\omega})$, $d_{c,t}(\vec{\omega})\}$, household consumption, hours worked, and next period asset policy functions $\{c_t(\vec{\omega})$, $x_t(\vec{\omega})$, $a'_t(\vec{\omega})\}$, household delinquency policy functions $\{d_{D,t}(\vec{\omega})\}$, household inter vivos transfer policy function $\{a_{c,t}(\vec{\omega})\}$, production plans $\{Y_t, K_t, L_t, L_{\ell,t}, L_{h,t}\}$, tax policies $\{\gamma_t\}$, prices $\{r_t, w_{\ell,t}, w_{h,t}\}$, Social Security transfers $\{ss_{t,e,s}\}$, accidental bequests $\{Tr_{t,j}\}$, and distributions $\{\Omega_t^0(\vec{\omega})$, $\Omega_t^{BA}(\vec{\omega})$, $\Omega_t^{NC}(\vec{\omega})$, $\Omega_t(\vec{\omega})\}$ such that:

(i) Given prices, transfers, and policies, the value functions and household policy functions solve the consumer problems in equations (9)-(14) and (15)-(19);
(ii) The saving interest rate and wage rates satisfy firm first order conditions;
(iii) Social Security transfers satisfy equation (23);
(iv) Accidental bequests are transferred to households between ages 50 and 60 ($33 \leq j \leq 43$) after deducting expenditure on private education subsidies[2]

$$Tr_{t+1,j} = \frac{\int (1-\psi_j)a'_t(\vec{\omega})\Omega_t(\vec{\omega})d\vec{\omega} - \int \theta^{pr}(s)\Omega_{t+1}^{BA}(\vec{\omega})d\vec{\omega}}{\sum_{j=33}^{43} N_{t+1,j}}, \tag{24}$$

[2] In our baseline calibration and in all counterfactual exercises, accidental bequests are always positive because the assets of those who die exceed the expenditure on private subsidies to education costs. If they did not exceed private subsidies, then bequests would be negative, which is equivalent to a lump-sum tax.

where $N_{t,j}$ denotes the mass of population of age j at time t;
(v) Government budget constraint balances as follows, by adjusting γ in the income tax and transfer function $T(y_{t,j,e,s,\eta,a,x})$:

$$\int [\tau_c c_t(\vec{\omega}) + T(y_{t,j,e,s,\eta,a,x})]\Omega_t^{BA}(\vec{\omega})d\vec{\omega} + \int [\tau_c c_t(\vec{\omega}) + T(y_{t,j,e,s,\eta,a,x})]\Omega_t^{NC}(\vec{\omega})d\vec{\omega} + \int [\tau_c c_t(\vec{\omega}) + T(y_{t,j,e,s,\eta,a,x})]\Omega_t(\vec{\omega})d\vec{\omega} = G_t + E_t + D_t + SS_t, \tag{25}$$

where G_t, E_t, D_t, and SS_t are government consumption, total public education subsidy, federal student loan program expenditure, and Social Security expenditure, and are computed as follows:

$$\begin{aligned}
G_t =& gY_t \\
E_t =& \int [d_f(\vec{\omega})\theta^{Pell}(f) + \theta^{other}(s)]\Omega_t^{BA}(\vec{\omega})d\vec{\omega} \\
D_t =& \int d_f(\vec{\omega})[\min[a,0] - \min[a_t'(\vec{\omega}),0] + r_{SL}(\mathbb{I}_{a<0}a - a_s(j,a',f))]\Omega_t^{BA}(\vec{\omega})d\vec{\omega} + \\
& \int d_f(\vec{\omega})[\min[a,0] - \min[a_t'(\vec{\omega}),0] + r_{SL}\mathbb{I}_{a<0}a]\Omega_t^{NC}(\vec{\omega})d\vec{\omega} + \\
& \int \big[(1 - d_{D,t}(\vec{\omega}))[\min[a,0](1+r_{SL}) - \min[a_t'(\vec{\omega}),0]] + \\
& \quad d_{D,t}(\vec{\omega})[-\rho_D(j,a,y_{t,j,e,s,\eta,a,x}) + \phi\max[\rho_R(j,a) - \rho_D(j,a,y_{t,j,e,s,\eta,a,x}),0]]\big]\Omega_t(\vec{\omega})d\vec{\omega} \\
SS_t =& \int \mathbb{I}_{j\geq j_r} ss_{t,e,s}\Omega_t(\vec{\omega})d\vec{\omega}.
\end{aligned}$$

(vi) Labor, capital, and goods markets clear in every period t; and
(vii) $\left[\Omega_{t+1}^0, \Omega_{t+1}^{BA}, \Omega_{t+1}^{NC}, \Omega_{t+1}\right] = \Pi_t\Big(\Omega_t^0, \Omega_t^{BA}, \Omega_t^{NC}, \Omega_t\Big)$, where Π_t is the law of motion that is consistent with consumer household policy functions and the exogenous processes for population, labor productivities, skill, FAFSA filing costs, and the probabilities of being allowed to continue college.

Note that in the stationary equilibrium, the equilibrium joint distribution will be stationary, all aggregates, prices, taxes, and transfers will be constant, and all value functions and policy functions will be time invariant.

B.3 Computational algorithm

This section presents the computational algorithm to solve for the stationary equilibrium. The algorithm for the transition path is analogous except that the value functions, policy functions, prices, taxes, transfers, and distributions are indexed by a time subscript.

1. Guess interest rate, r_{guess}, wage rates, $w_{\ell,\text{guess}}$ and $w_{h,\text{guess}}$, the level parameter for the income tax rate, γ_{guess}, Social Security transfers, $ss_{e,s,\text{guess}}$, and accidental bequests, $Tr_{j,\text{guess}}$
2. Use backward induction to solve consumer problems during the empty nester and retirement phases from $j = j_f + j_a + 1, \ldots, J$ (equations (15)-(17))
3. Guess value function before college, $W^0_{\text{guess}}(s, \xi_f, y_p, a)$ (equation (9))
4. Use backward induction to solve consumer problem for FAFSA and college, parenthood, and loan repayment phases from $j = 1, \ldots, j_f + j_a$ (equations (9)-(19)). For $j = j_f + j_a$, use $W^0_{\text{guess}}(s, \xi_f, y_p, a)$ for the altruism term
5. Use new value before the FAFSA filing decision to update $W^0_{\text{guess}}(s, \xi_f, y_p, a)$; repeat 4.-5. until convergence
6. Guess initial distribution of 18-year-old consumers Ω^0_{guess}
7. Simulate and solve for distributions of $\{\Omega^{BA}, \Omega^{NC}, \Omega\}$ for $j = 2, \ldots, J$
8. Use distribution of Ω for $j = j_f + j_a$, exogenous processes for child skill, FAFSA filing costs, productivity, and qualification for professional judgment, and inter vivos transfers policy function to compute new estimates for distribution of initial 18-year-old consumers Ω^0_{update}
9. Update Ω^0_{guess} and repeat 7.-9. until convergence
10. Given the stationary distribution of Ω for $j = 1, \ldots, J$, solve for new guesses:
    - Compute interest and wage rates from the firm's first order conditions
    - Compute the level parameter for the income tax rate using the government budget constraint (equation (25))
    - Compute Social Security transfers and accidental bequests (equations (23) and (24))
11. Update guesses in 1., and repeat steps 2.-11. until convergence

B.4 Welfare computation

To measure welfare changes, we primarily use consumption equivalent variation. We measure equivalence units relative to the expected value of not attending college in the initial stationary equilibrium. We do this because the value of not attending college does not include any fixed utility costs or benefits. This approach is similar to that of Abbott, Gallipoli, Meghir, and Violante (2019) and Moschini, Raveendranathan, and Xu (2025).

For the average 18-year-old nonfiler due to frictions in the status quo, the welfare changes are computed in two steps. In the first step, the consumption equivalent variation in period t of the transition relative to the expected value of not attending college in the initial stationary equilibrium,

$g_{c,t}$, is computed using the following equation:

$$(1+g_{c,t})^{\upsilon(1-\sigma)}\int \mathbb{I}_{d_{f,\text{initial}}(s,\xi_f,y_p,a)=0}\mathbb{I}_{d_{f,\text{initial}}(s,0,y_p,a)=1}\mathbb{E}_{\eta|\ell}V^{NC}_{\text{initial}}(1,\ell,s,\eta,a)\Omega^0_{\text{initial}}(\vec{\omega})d\vec{\omega} =$$
$$\int \mathbb{I}_{d_{f,\text{initial}}(s,\xi_f,y_p,a)=0}\mathbb{I}_{d_{f,\text{initial}}(s,0,y_p,a)=1}W^0_t(s,\xi_f,y_p,a)\Omega^0_{\text{initial}}(\vec{\omega})d\vec{\omega}, \tag{26}$$

where "initial" refers to the initial stationary equilibrium, and the indicator functions $\mathbb{I}_{d_{f,\text{initial}}(s,\xi_f,y_p,a)=0}$ and $\mathbb{I}_{d_{f,\text{initial}}(s,0,y_p,a)=1}$ jointly identify nonfilers due to frictions in the status quo distribution $\Omega^0_{\text{initial}}$ on both the left- and right-hand sides of the equation. In the second step, to compute the resulting welfare changes from a transition in consumption equivalent units, $\Delta_{c,t}$, we report the difference between period t and the initial stationary equilibrium with the equation given by

$$\Delta_{c,t} = 100 \times (g_{c,t} - g_{c,\text{initial}}). \tag{27}$$

For the other groups of high school graduates (filers, nonfilers due to only not frictions, and nonfilers due to only frictions) and for the breakdowns by skill and parental income, the calculations are analogous, with modified requirements on the type space.

For the welfare decomposition analysis for nonfilers due to frictions based on utilization margin transitions provided in Table D3 of Appendix D.2.2, we use lifetime utilities instead of consumption-equivalent variation. Recall that the three utilization margins for nonfilers due to frictions (described in the first paragraph of Section 6.1) are: (1) nonfiling nonenrollee to filing enrollee, (2) nonfiling enrollee to filing enrollee, and (3) nonfiling nonenrollee to filing nonenrollee. Let $\Omega^1(\vec{\omega})$, $\Omega^2(\vec{\omega})$, and $\Omega^3(\vec{\omega})$ denote the distributions of nonfilers due to frictions who transition into the three utilization margins, respectively, where $\vec{\omega} = (s,\xi_f,y_p,a,\eta,d_f,f)$.[3]

Note that the lifetime utility to nonfilers due to frictions in the initial steady state can be decomposed as the sum of the conditional lifetime utilities based on the three utilization margins, as follows:

$$\int \mathbb{I}_{d_{f,\text{initial}}(s,\xi_f,y_p,a)=0}\mathbb{I}_{d_{f,\text{initial}}(s,0,y_p,a)=1}W^0_{\text{initial}}(s,\xi_f,y_p,a)\Omega^0_{\text{initial}}(\vec{\omega})d\vec{\omega} = \int V^{NC}_{\text{initial}}(1,\ell,s,\eta,a)\Omega^1(\vec{\omega})d\vec{\omega}$$
$$+\int V^{BA}_{\text{initial}}(1,\ell,s,\eta,a,0,f)\Omega^2(\vec{\omega})d\vec{\omega} + \int V^{NC}_{\text{initial}}(1,\ell,s,\eta,a)\Omega^3(\vec{\omega})d\vec{\omega}. \tag{28}$$

[3]The $\vec{\omega}$ specified here includes the union of the idiosyncratic states at the time of making the FAFSA filing decision and the enrollment decision (the first two rows of equation (22)). This is because these three distributions identify individuals based on both FAFSA filing and college enrollment outcomes.

And analogously the lifetime utility in the final steady state can be decomposed as follows:

$$\int \mathbb{I}_{d_{f,\text{final}}(s,\xi_f,y_p,a)=0}\mathbb{I}_{d_{f,\text{initial}}(s,0,y_p,a)=1}W^0_{\text{final}}(s,\xi_f,y_p,a)\Omega^0_{\text{initial}}(\vec{\omega})d\vec{\omega} = \int V^{BA}_{\text{final}}(1,\ell,s,\eta,a,1,f)\Omega^1(\vec{\omega})d\vec{\omega}$$
$$+ \int V^{BA}_{\text{final}}(1,\ell,s,\eta,a,1,f)\Omega^2(\vec{\omega})d\vec{\omega} + \int V^{NC}_{\text{final}}(1,\ell,s,\eta,a)\Omega^3(\vec{\omega})d\vec{\omega}. \tag{29}$$

In the initial steady state value in equation (28), in the first and third utilization margins, the individual realizes the value of not attending college; in the second utilization margin, the individual realizes the value of college without access to federal aid. In the final steady state value in equation (29), in the first two utilization margins, the individual realizes the value of college with access to federal aid, and in the third utilization margin, the individual realizes the value of not attending college as in the in the initial steady state value.

The extent of the gains from eliminating aid application frictions for nonfilers due to frictions depends on the masses of Ω^1, Ω^2, and Ω^3 and the conditional changes in lifetime utilities for each utilization margin. These conditional changes are reported in Table D3 of Appendix D.2.2. For example, the average gains conditional on a nonenrollee to filing enrollee transition (the first utilization margin), Δ_{u1}, is computed as follows

$$\Delta_{u1} = 100 \times \frac{\int \left[V^{BA}_{\text{final}}(1,\ell,s,\eta,a,1,f) - V^{NC}_{\text{initial}}(1,\ell,s,\eta,a)\right]\Omega^1(\vec{\omega})d\vec{\omega}}{\left|\int V^{NC}_{\text{initial}}(1,\ell,s,\eta,a)\Omega^1(\vec{\omega})d\vec{\omega}\right|}. \tag{30}$$

The average conditional gains for the remaining two utilization margins are computed analogously.

In Table D4 of Appendix D.2.3, we report welfare changes in consumption-leisure equivalence units because preferences in our model include leisure. In the first step, the consumption-leisure equivalent variation relative to the expected value of not attending college in the initial stationary equilibrium, $g_{cx,t}$, is measured using the following equation:

$$(1+g_{cx,t})^{1-\sigma}\int \mathbb{E}_{\eta|\ell}V^{NC}_{\text{initial}}(1,\ell,s,\eta,a)\Omega^0_{\text{initial}}(\vec{\omega})d\vec{\omega} = \int W^0_t(s,\xi_f,y_p,a)\Omega^0_{\text{initial}}(\vec{\omega})d\vec{\omega}. \tag{31}$$

The second step of computing the resulting welfare changes from a transition in consumption-leisure equivalent units, $\Delta_{cx,t}$, is analogous to that in equation (27).

In Figure D1 of Appendix D.2.7, we report welfare changes in consumption-equivalence units for the average 18-year-old in period t of the transition to the new stationary steady state. In this case, we take changes in the initial conditions of the 18-year-olds into account. In the first step, the consumption equivalent variation relative to the expected value of not attending college in the initial stationary equilibrium, $g_{c,t}$, is computed using the following equation:

$$(1+g_{c,t})^{\upsilon(1-\sigma)} \int \mathbb{E}_{\eta|\ell} V^{NC}_{\text{initial}}(1,\ell,s,\eta,a)\Omega^0_{\text{initial}}(\vec{\omega})d\vec{\omega} = \int W^0_t(s,\xi_f,y_p,a)\Omega^0_t(\vec{\omega})d\vec{\omega}. \tag{32}$$

When measuring welfare holding the distribution of 18-year-old consumers fixed to that from the initial stationary equilibrium, we use the distribution $\Omega^0_{\text{initial}}$ instead of Ω^0_{t} for the right-hand side of equation (32). The second step of computing the resulting welfare changes from a transition in consumption equivalent units is the same as in equation (27).

C Model Validation Appendix

This section supplements the model validation exercises from the main text by evaluating the model's fit along four additional dimensions: (1) rates of FAFSA nonfiling due to frictions broken down by parental education and skill, (2) skill-specific earnings returns to college, (3) college enrollment, persistence, and key sources of financing—specifically Pell grants, student loans, hours worked in college, and parental transfers—broken down by parental income tercile, and (4) intergenerational persistence of income.

C.1 Nonfilers due to frictions by parental education and skill

Table C1 reports the share of high school graduates who do not file a FAFSA before college due to frictions, broken down by parental education and skill. The model reproduces the empirical pattern that, within the top two skill terciles, high school graduates with at least one parent holding a BA are more likely to cite frictions as a reason for not filing a FAFSA in comparison to their peers who have no parent with a BA. This result in the model is driven by an income effect: parents with a BA tend to have higher income, and, as discussed in Section 5.2.1, high school graduates with higher parental income are more likely to not file a FAFSA due to frictions.[4]

C.2 Skill-specific earnings returns to college

Table C2 reports the college wage premium by skill tercile in the model and in the data. The college wage premium is computed as the median hourly earnings of individuals with a four-year college degree divided by the median hourly earnings of those without such a degree, for workers aged 25 to 39, within a given skill tercile. The age range is chosen to match the available NLSY97 sample

[4]In the model, high school graduates with low skill have a much higher rate of nonfiling due to frictions compared to the higher skill bins. As a result, in the low-skill bin, the rate of nonfiling due to frictions is high regardless of parental education. This pattern is also consistent with the data.

Table C1: Nonfilers due to frictions by parental education and skill in data and model

	Data by skill			**Model by skill**		
At least one parent BA+	Low	Med	High	Low	Med	High
No	14.55	8.22	6.01	14.68	9.05	4.40
Yes	13.52	13.22	9.56	14.40	13.29	11.30

Notes: The table reports the percentage of high school graduates who do not file a FAFSA due to frictions prior to college by parental education and skill tercile, in the data and model. Data source: HSLS:09.

used for empirical estimates, which are reported in Table A20 of Appendix A.2.2. The model captures the fact that the college wage premium increases with skill, although it underestimates the skill gradient.

Table C2: College wage premium by skill tercile in data and model

Skill	**Data**	**Model**
Low	1.319	1.401
Med	*1.422*	*1.421*
High	1.569	1.504

Notes: The table reports the college wage premium by skill tercile in the data and model. Data source: NLSY97. The middle row estimates are reported in italics because they are targeted in the calibration.

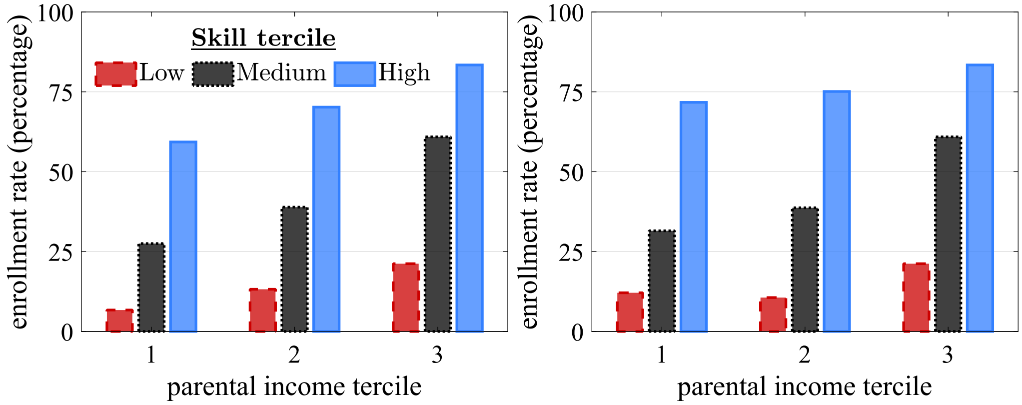
C.3 Parental income and college enrollment, persistence, and financing

Figure C1 depicts enrollment rates of high school graduates, broken down by skill and parental income terciles. Empirical values are drawn from Table A16 of Appendix A.1.6. Only enrollment rates by skill for the top parental income tercile are targeted in the model's calibration. The model generates a pattern that is largely similar to the data: enrollment rates are increasing in parental income within each skill tercile (and increasing in skill within each parental income tercile).[5]

Figure C2 depicts persistence rates of college enrollees to the end of their third academic year broken down by skill and parental income terciles. Empirical values are drawn from Table A13 of Appendix A.1.6. Again, the model generates a qualitatively similar pattern compared to that observed in the data: persistence rates are flat or somewhat increasing in parental income within each skill tercile and strongly increasing in skill within each parental income tercile.

Having shown that our model performs well on both enrollment and persistence rates by parental income, in what follows we compare the model to its empirical counterparts by parental income

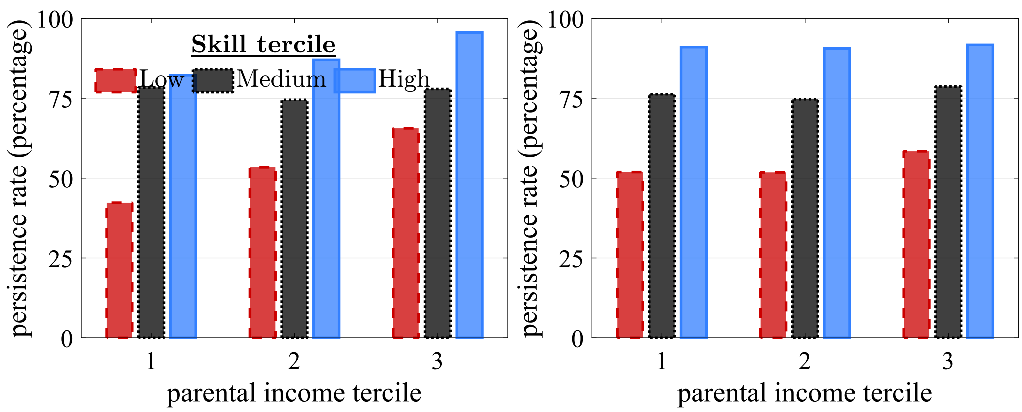
[5]While the model reproduces enrollment rates that are increasing in parental income for the medium- and high-skill terciles, for the low-skill tercile, the enrollment rate decreases slightly from the first to the second parental income tercile.



(a) Data (b) Model

Figure C1: BA enrollment rates by skill and parental income in data and model

Notes: The figure depicts bachelor's degree enrollment rates by skill and parental income terciles in the data and model. Data source: HSLS:09.



(a) Data (b) Model

Figure C2: BA persistence rates by skill and parental income in data and model

Notes: The figure depicts bachelor's degree persistence rates of enrollees to the end of the third academic year by skill and parental income terciles in the data and model. Data source: HSLS:09.

tercile for the key sources of college financing: Pell grants, student loans, hours worked in college, and parental transfers.

In Table C3, Panels A and B report Pell and student loan uptake rates by parental income, respectively. In both panels, both the extensive and intensive margins are reported: that is the percentage of first-year enrollees with Pell grants or student loans (extensive margin) and the average grant or student loan amount conditional on receipt (intensive margin). The empirical moments are drawn from Table A18 of Appendix A.1.6. In the extensive margin, Pell uptake decreases significantly with income in the data, and the model accounts for this pattern. In the intensive margin, Pell uptake does not change as drastically across income terciles in both the data and the model.[6] Student loan uptake in the data is higher in the bottom two income terciles than in the top income tercile in both the extensive and intensive margins, and the model qualitatively accounts for this pattern. The drop in the extensive margin by income is more substantial in the model than in the data.

Table C3: Pell grants and student loans by parental income tercile in data and model

Category	**Parental income**	**Margin**	**Statistic**	**Data**	**Model**
Panel A: Pell grants	1	Extensive	Share with grants	80.16	94.81
	2			45.33	51.52
	3			*6.20*	*6.19*
	1	Intensive	Avg. Pell | Pell grant > 0	\$4,777	\$4,547
	2			\$4,051	\$3,246
	3			*\$4,019*	*\$3,982*
Panel B: Student loans	1	Extensive	Share with student loans	67.98	69.56
	2			69.27	31.54
	3			47.44	3.50
	1	Intensive	Avg. student loan | Student loan > 0	\$3,735	\$4,923
	2			\$3,875	\$5,128
	3			\$2,598	\$4,313

Notes: The table reports Pell grant and student loan uptake, along the extensive margin (share with grants/student loans) and intensive margins (average dollar amount conditional on having a grant/student loan) for first-year enrollees, by parental income tercile in the data and model. In Panel A, the top income tercile estimates are in italics because they are targeted in the calibration. Data source: HSLS:09.

Table C4 reports the extensive and intensive margins of hours worked in college, that is, the share working and the average hours conditional on working. The empirical moments are drawn from Table A17 of Appendix A.1.6. The model qualitatively accounts for the decreasing extensive margin of hours worked in college by parental income, but the slope is steeper in the model than in the data. For those working, the average hours worked do not vary significantly by parental income in both data and model.

Table C5 reports average inter vivos transfers by parental income tercile in the data and the model. The empirical moments are drawn from Table A22 of Appendix A.2.3. The transfers are increasing in parental income, although the slope is relatively less steep in the data.

To summarize, the model fares well on enrollment and persistence rates by parental income tercile. While the model delivers qualitative success on key sources of college financing by parental income, the slopes are steeper in the model than in the data. We believe that this pattern is due to the model not accounting for the quantitative pattern of parental transfers observed in the data. For ex-

[6]The model overstates the extensive margin of Pell uptake in the low- and middle-income terciles. A sensitivity analysis without professional judgment in which the model is more conservative in regard to the extensive margin of Pell uptake is provided in Appendix D.3.

Table C4: Hours worked in college by parental income tercile in data and model

Parental income	**Margin**	**Statistic**	**Data**	**Model**
1	Extensive	Share working	75.01	85.24
2			75.03	51.77
3			62.53	20.95
1	Intensive	Average hours | Working	21.65	30.00
2			21.89	30.00
3			19.25	30.00

Notes: The table reports hours worked in college, along the extensive margin (share working) and intensive margin (average hours conditional on working) for third-year enrollees, by parental income tercile in the data and model. Data source: HSLS:09.

Table C5: Inter vivos transfers by parental income tercile in data and model

Parental income	**Data**	**Model**
1	0.544	0.094
2	0.545	0.355
3	0.638	1.288

Notes: The table reports average inter vivos transfers normalized by GDP per capita for those 18 and over received by high school graduates by parental income tercile in the data and model. Data source: NLSY97.

ample, if transfers by parental income tercile were flatter in the model, perhaps student loan uptake and hours worked in college by parental income would also be flatter. Quantitatively accounting for enrollment rates and the key sources of college financing by parental income is an interesting avenue for future research.[7]

C.4 Intergenerational persistence of income

Table C6 reports intergenerational income elasticity (IGE) estimates in the baseline model and three re-specifications of the baseline model. The IGE is a measure of persistence of income across generations with higher values indicating higher persistence, and therefore, lower intergenerational mobility. The IGE is computed to maintain comparability to the empirical estimate of Chetty, Hendren, Kline, and Saez (2014): for income, we use the average of 5-year income for parents from ages 43-47 and the average of 2-year income for children from ages 30-31. Furthermore, the IGE is computed by keeping track of the child's average income in the simulations. For the partial equilibrium estimates, we use baseline values for prices, tax rate, and transfers while the distribution

[7]Our speculation is that for such an exploration, the incorporation of the option to live with parents is key. In the data, imputed rent due to living with parents is the main component of transfers, accounting for roughly 85 percent of transfers (Table A21 of Appendix A.2.3). Therefore, in the data, we observe more parents providing positive transfers to their children than in the model.

of 18-year-olds is determined endogenously. The re-specified models are not re-calibrated.

In the baseline model, the child's skill realization is positively correlated with the level of parental education. The second row of the table reports the IGE when instead the child skill realization is assumed to be independent of parental education and drawn from a uniform distribution. This exercise suggests that the positive correlation between parental education and child skill does not contribute much to the persistence of income across generations in the baseline model.

The baseline model understates the IGE in comparison to the Chetty, Hendren, Kline, and Saez (2014) empirical estimate of 0.34. Our analysis reported in the remaining rows of the table suggests that generating an IGE that is more comparable to the data requires potential modifications to the modeling of earnings risk, measure of skill, and correlation of skill and earnings across generations. In the third row of the table, we consider an exercise in which there is perfectly positive correlation between child and parental skill and also between the child's initial AR(1) productivity draw and the parent's AR(1) productivity in the period at which the child leaves the household. The IGE increases slightly from 0.04 in the baseline to 0.16-0.17 in the re-specified model. In the fourth row of the table, we maintain the perfectly positive correlation between child and parental skill, but abstract from earnings risk by shutting down the AR(1) productivity process. The IGE further increases to 0.34-0.35.

Table C6: Intergenerational income elasticity

Model	**PE**	**GE**
(1) Baseline	0.04	0.04
(2) Uniform skill	0.02	0.02
(3) Uniform skill + Perfect correlation across generations for skill and AR(1) productivity	0.16	0.17
(4) Uniform skill + Perfect correlation across generations for skill + No AR(1) productivity	0.34	0.35

Notes: The table reports IGE estimates in the baseline model and three re-specifications of the baseline model in partial equilibrium (“PE") and general equilibrium (“GE").

D Results Appendix

D.1 Pell grant uptake and EFC ingredients

Table D1 reports the share of first-year enrollees with positive Pell grant uptake by income tercile in the data, the baseline model, and three alternative re-specifications of the model. The data moments are drawn from Table A18 of Appendix A.1.6. The Pell uptake rates in the alternative re-specifications highlight the role of two model ingredients.

The first ingredient is the professional judgment feature, in which a family may qualify for a lower

EFC with a probability that is decreasing in their income. Columns (3) and (5) show that, without the professional judgment feature, uptake of Pell is zero for the top income tercile; in the data, these uptake rates are positive. The second ingredient is the EFC income input in the baseline model being set to the full-time income of parents (instead of realized income). If we allow the EFC formula to use realized income instead of full-time income, columns (4) and (5) indicate that the Pell uptake rates in the bottom two income terciles rise and are further from their empirical counterparts compared to column (2).

Altogether, the exercises of the table show that the baseline model's professional judgment feature generates positive Pell uptake rates in the top tercile, while evaluating the EFC formula at full-time income prevents the model from further inflating uptake rates in the bottom two terciles.

Table D1: Extensive margin of Pell grant uptake by parental income tercile

	Data	**Baseline model**	**Re-specified model**		
Parental income	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
1	80.2	94.8	87.5	99.4	99.4
2	45.3	51.5	21.1	58.4	58.5
3	*6.2*	*6.2*	0	*6.5*	0
Professional judgment	_	Yes	No	Yes	No
Full-time income	_	Yes	Yes	No	No

Notes: Table D1 presents Pell uptake along the extensive margin for first-year enrollees, broken down by parental income tercile in the: (1) HSLS:09 data, (2) baseline model, (3) re-specification of the model in which there is no qualification for professional judgment, (4) re-specification of the model in which income from actual work hours (realized income) is used as the input for the EFC formula instead of income assuming full time work hours (full-time income), and (5) re-specification of the model in which there is no qualification for professional judgment and realized income is used as the input for the EFC formula instead of full-time income. All three re-specified models are re-calibrated. The top income tercile estimates in columns (1), (2), and (4) are in italics because they are targeted in the calibration of the respective models; in columns (3) and (5), Pell uptake in the top income tercile is not targeted because there is no qualification for professional judgment in these two re-specifications.

D.2 Additional results from baseline calibration

D.2.1 Aid left on the table by nonfilers due to frictions

Table D2 reports statistics related to subsidized student loans and Pell grants "left on the table" in the baseline calibration. Specifically, the statistics reflect the extensive margin (that is, the percentage of 18-year-olds who are nonfilers due to frictions and are eligible for subsidized loans/Pell grants) and the intensive margin (that is, the average amount of subsidized loans/Pell grants left unclaimed by FAFSA nonfilers due to frictions who are eligible for the aid). The table shows that the unclaimed subsidized loan amounts exceed those of grants, particularly in the extensive margin.

Table D2: Counterfactual subsidized student loans and Pell grants among nonfilers due to frictions

	Subsidized loans			Pell grants		
		Enrolled in BA			Enrolled in BA	
Variable	**All**	**No**	**Yes**	**All**	**No**	**Yes**
Panel A: Nonfiler due to frictions and Aid>0						
Percentage of high school graduates	7.75	11.79	2.42	4.61	7.55	0.73
Aid $ | Aid>0	4468	4,521	4,127	3,672	3,691	3,417
Panel A: Nonfiler due to only frictions and Aid>0						
Percentage of high school graduates	3.63	5.60	1.04	2.35	3.84	0.38
Aid $ | Aid>0	4523	4,550	4,333	3,790	3,797	3,703

Notes: The table reports statistics related to counterfactual subsidized student loan and Pell grant aid for high school graduates who do not file a FAFSA due to frictions, both overall and by enrollment outcome. Panel A reports the percentage of high school graduates who are nonfilers due to frictions (and possibly other reasons) and who are eligible for subsidized student loan or Pell grant aid (extensive margin), and the dollar amount of subsidized student loan or Pell grant aid conditional on being eligible for this group (intensive margin). Panel B reports the same statistics for nonfilers due to only frictions.

D.2.2 Ex-post lifetime utility changes by utilization margin transition

The gains to nonfilers due to frictions stem from transitions to enrollment with aid either from nonenrollment or from enrollment without aid. Therefore, the gains depend on the extent of these two transitions and the conditional changes in ex-post lifetime utilities at the enrollment stage from these two transitions. The average conditional changes in ex-post lifetime utilities from these two transitions as well as conditional on remaining nonenrolled are reported in Table D3. The details of the calculations are provided in equations (28) through (30) of Appendix B.4. For the welfare changes reported in this section, we use lifetime utility instead of consumption-equivalent variation because the former allows for a more direct decomposition exercise.

The results in the table lead to two takeaways. First, rows 1 and 2 indicate that the conditional gains from transitions to enrollment with aid (nonfiling nonenrollee to filing enrollee and nonfiling enrollee to filing enrollee) are increasing in skill. Second, the average conditional gains are largest when nonfilers due to frictions transition from nonfiling nonenrollee to filing enrollee both overall and within each skill type.

D.2.3 Welfare changes in consumption-leisure equivalence units

Table D4 reports welfare changes in consumption-leisure equivalence units for the same groups as Table 15 of the main text, which reported welfare changes in consumption-equivalence units. With this alternative measure, the magnitudes of the welfare changes are smaller because they imply adjustments in both consumption and leisure as opposed to only consumption. However, the qualitative takeaways discussed in the main text discussion surrounding Table 15 do not change.

Table D3: Changes in ex-post average lifetime utilities for nonfilers due to frictions

Utilization margin		**Skill**		
Units: percentage change in lifetime utility	All	Low	Med	High
(1) Nonfiling nonenrollee to filing enrollee (under-enrollment)	3.96	1.63	3.46	7.98
(2) Nonfiling enrollee to filing enrollee	1.27	0.68	1.33	1.35
(3) Nonfiling nonenrollee to filing nonenrollee	0.01	0.01	0.01	0.01

Notes: The table reports for nonfilers due to frictions changes in ex-post average lifetime utilities at the enrollment stage conditional on transitions to the three utilization margins described in Section 6.1. Within each utilization margin, the statistics are reported both overall and by skill type.

Table D4: Welfare changes in partial equilibrium

High school graduate group	**Welfare change**
(1) Nonfiler due to frictions	0.25
(2) Filer	0.05
(3) Nonfiler due to only not frictions	0.01
(4) Nonfiler due to only frictions	0.36

Notes: The table reports welfare changes in percentage points of lifetime consumption and leisure from eliminating aid application frictions in partial equilibrium for the four high school graduate groups described in the main text. The first three groups are mutually exclusive and make up the entire set of high school graduates while the fourth group is a subset of the first.

D.2.4 Aggregate changes across steady states

The effects of eliminating aid application frictions on the model's steady state equilibrium are summarized in Table D5, which reports changes in education and skill statistics (Panel A), macroeconomic aggregates (Panel B), and prices, the income tax rate, and transfers (Panel C), compared to the baseline equilibrium.

The first row of Panel A indicates that enrollment rates increase for each skill level. The next row of the panel indicates that the college graduation rate decreases; this happens because the skill composition of enrollees shifts toward the low- and medium-skill tercile. Nevertheless, on net in the new steady state the higher enrollment rate leads to more college graduates, as indicated by the third row of the panel. Through the effects of parental education on child skill endowments, the increase in the number of college graduates leads to a slightly larger share of young adults with high skill, as indicated by the last row of the panel.

Moving to Panel B, the increase in the mass of college graduates increases the total efficiency units of labor, which increases total labor earnings. Higher earnings, in turn, increase both savings and aggregate capital. This rise in factor inputs increases output and, consequently, consumption increases. The change in total hours worked is small in comparison to the changes in the other aggregates in the panel.

Table D5: Steady state changes after elimination of aid application frictions

Category	Variable	Changes from baseline equ.
Panel A: Education and skill statistics	College enrollment rate by skill s	(0.94,0.78,0.87)
Units: percentage point change	Graduation rate	-0.21
	Population share college graduates	0.58
	Share of 18-year-olds by skill s	(-0.15,-0.01,0.16)
Panel B: Macroeconomic aggregates	Low-education labor efficiency units	-0.85
Units: percentage change	High-education labor efficiency units	1.92
	Labor	0.29
	Capital	0.16
	Output	0.24
	Consumption	0.27
	Hours worked	0.01
Panel C: Prices, income tax rate, transfers	Risk-free savings interest rate	0.01
Units: percentage point/percentage change	Wage rate for low-education	0.19
	Wage rate for high-education	-0.36
	Income tax rate | Baseline mean income	-0.04
	Inter vivos transfers	-0.07
	Accidental bequests	0.33
	$\mathrm{ss}_{\ell,s}$ by skill s	(0.30,0.29,0.28)
	$\mathrm{ss}_{h,s}$ by skill s	(-0.04,-0.07,-0.09)

Notes: The table reports changes from a steady state comparison of the baseline economy with an economy in which aid application frictions are eliminated. Panels A, B, and C report changes in education and skill statistics, macroeconomic aggregates, and prices, income tax rate, and transfers, respectively. Statistics that vary over skill s are presented as a tuple in the order (s_1, s_2, s_3).

Panel C of Table D5 indicates that the risk-free savings rate barely changes: this is because the capital to labor ratio barely changes. The wage rate for those with low education increases, whereas the wage rate for those with high education decreases. This happens because of the fall and rise in the labor supply of each respective education group. The next row indicates that the income tax rate evaluated at the baseline equilibrium's average income decreases slightly. This happens because, with progressive income taxation, the increase in the share of college graduates who tend to have higher earnings leads to a larger rise in tax revenue than in government consumption, which allows the government to reduce the tax rate. Inter vivos transfers decrease because the high-education wage rate decreases. This mechanism is discussed in more detail in Appendix D.2.7. The changes in Social Security transfers reflect the signs of the changes in the wage rate for each education group.

D.2.5 Welfare changes in partial and general equilibrium

Table D6 compares the welfare gains from eliminating aid application frictions in partial equilibrium to those in general equilibrium for groups of high school graduates not provided in the main text. The two key takeaways discussed in the main text in Section 6.3 do not change. First, within each panel's group of high school graduates, the average gains are slightly higher in general equilibrium in comparison to their partial equilibrium counterparts. Second, in general equilibrium there is a redistributive effect, particularly from high school graduates with high skill and high parental income to their peers with low skill and low parental income.

Table D6: Additional welfare changes in partial and general equilibrium

		Partial equilibrium				General equilibrium			
			Skill				Skill		
Category	**Parental income**	All	Low	Med	High	All	Low	Med	High
Panel A: Filer	All	0.14	0.04	0.14	0.29	0.28	0.26	0.30	0.31
Units: percentage points of	1	0.14	0.04	0.15	0.31	0.31	0.26	0.33	0.37
lifetime consumption	2	0.13	0.04	0.13	0.29	0.28	0.26	0.30	0.31
	3	0.13	0.04	0.14	0.25	0.24	0.25	0.25	0.21
Panel B: Nonfiler due to	All	0.02	0.02	0.02	0.03	0.12	0.20	0.11	0.00
only not frictions	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Units: same as in Panel A	2	0.03	0.02	0.03	0.03	0.12	0.22	0.13	0.00
	3	0.02	0.02	0.02	0.03	0.12	0.20	0.11	0.00
Panel C: Nonfiler due to	All	0.87	0.14	1.02	4.23	1.06	0.36	1.20	4.28
only frictions	1	1.35	0.20	1.39	5.85	1.54	0.43	1.58	5.93
Units: same as in Panel A	2	0.68	0.13	0.85	3.81	0.88	0.35	1.03	3.89
	3	0.57	0.10	0.73	2.58	0.74	0.31	0.86	2.55

Notes: The table reports welfare changes from eliminating aid application frictions in percentage point lifetime consumption units, overall and by skill and parental income tercile, in partial and general equilibrium for additional groupings of consumers not provided in the main text. Each of the panels reportswelfare changes for the following groupings: (A) FAFSA filers, (B) FAFSA nonfilers due to only not frictions, and (C) FAFSA nonfilers due to only frictions. Welfare changes are computed for the distribution of 18-year-olds in the baseline equilibrium. Not applicable (“n/a") refers to cases in which there is no one in the corresponding cell.

D.2.6 Breakdowns of the worse-off and better-off in general equilibrium

Table D.2.6 shows that although some high school graduates—specifically those with high skill, high parental income, and low filing costs—are worse off from eliminating aid application frictions in general equilibrium, the magnitude of the welfare losses is small.

D.2.7 Welfare changes for the average 18-year-old

In the main text, we focused on welfare changes for the average consumer within various subgroups of high school graduates, averaging using the baseline equilibrium distribution of 18-year-olds within each subgroup. To supplement that analysis, in this appendix we instead compute welfare changes for the unconditional average high school graduate. Due to the intergenerational linkages present in our model, we highlight how the evolution of the initial characteristics affects welfare for the average high school graduate. This is done by averaging expected lifetime utility using the endogenous distribution of 18-year-olds in each period of the transition, which is further explained in the discussion of equation (32) in Appendix B.4.

Panel (a) of Figure D1 provides a welfare analysis of the gains for the average 18-year-old from

Table D7: Comparison of worse-off and better-off in general equilibrium

Variable	Units	All	Skill Low	Skill Med	Skill High
Panel A: Worse off					
Share	Percentage of 18-year-olds | All or Skill	9.70	0	0	32.25
Lifetime consumption change	Percentage points	-0.03	n/a	n/a	-0.03
Average parental income	Normalized by GDP per capita 18+	1.97	n/a	n/a	1.97
Average filing cost	Utils	.07	n/a	n/a	0.07
Panel B: Better off					
Share	Same as in Panel A	90.30	100	100	67.75
Lifetime consumption change		0.36	0.27	0.35	0.59
Average parental income		1.12	1.08	1.20	1.08
Average filing cost		0.33	0.06	0.29	0.86

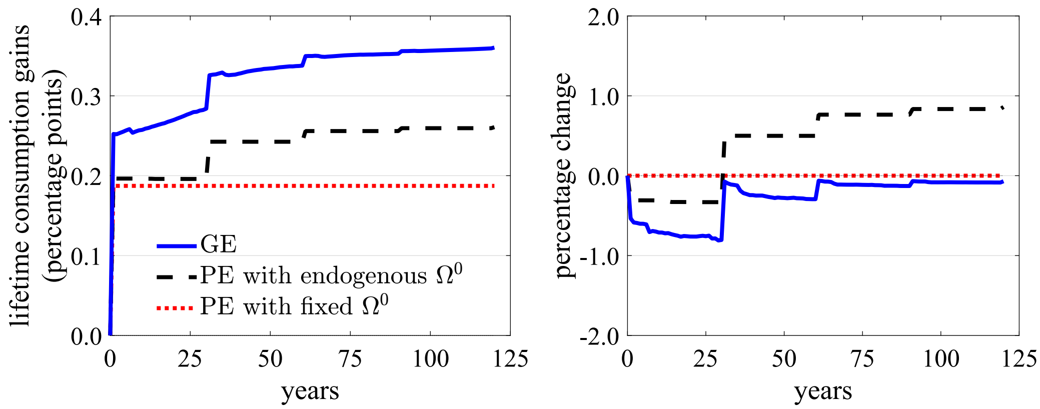
Notes: The table reports the percentage of 18-year-olds that are worse off and better off from eliminating aid application frictions in general equilibrium, the magnitude of the welfare changes, as well as the characteristics for those worse off and better off, both overall and by skill. No one is indifferent. Not applicable ("n/a") refers to cases in which there is no one in the corresponding cell.

eliminating aid application frictions. In the partial equilibrium without intergenerational and general equilibrium effects, the dotted red line of the figure (labeled "PE with fixed Ω^0") shows that the welfare gains are smallest. Once we allow for intergenerational effects, whereby the initial conditions of 18-year-olds change due to changes in inter vivos transfers, skill, and parental income (but do not incorporate price changes), the gains increase, as indicated by the dashed black line labeled "PE with endogenous Ω^0". Finally, once we take both distributional changes and general equilibrium effects into account, as indicated by the solid blue line labeled "GE", the welfare gains are largest. Overall, Panel (a) shows that welfare gains for the average 18-year-old increase relative to the partial equilibrium gains when we take into account both changes in initial characteristics due to intergenerational effects and general equilibrium effects.

Panel (b) of Figure D1, which depicts the evolution of the average inter vivos transfer in the three equilibrium cases analogous to those in Panel (a) of the same figure, provides intuition for why intergenerational effects increase the gains from eliminating aid application frictions. As Panel (b) indicates, new 18-year-olds benefit from inter vivos transfers that increase for future generations when the 18-year-old distribution is allowed to adjust.[8] The transfers increase for future generations because eliminating application frictions leads to more college enrollment and consequently more parents with a BA who tend to be income rich and transfer more to their children.

Although transfers increase across future generations when the 18-year-old distribution is allowed to adjust (dashed black line and solid blue line in Panel (b) of Figure D1), the overall increase is

[8]The changes in other aspects of the joint distribution such as skill and parental income (which matters for the EFC) are second order.



(a) Welfare

(b) Inter vivos transfer

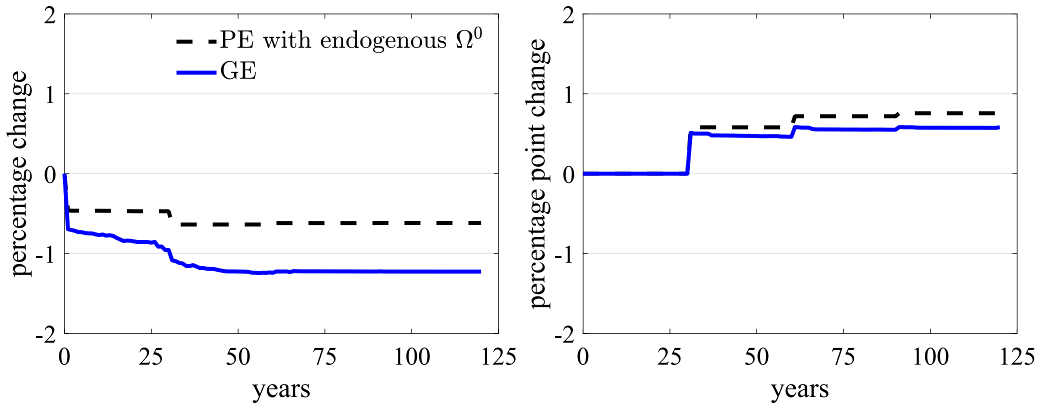
Figure D1: Average 18-year-old: welfare and transfers in partial and general equilibrium

Notes: The figure depicts changes in welfare and inter vivos transfers for the average 18-year-old in partial (PE) and general (GE) equilibrium from eliminating aid application frictions. Panel (a) depicts the welfare gains from eliminating aid application frictions in each period of the transition under the following cases separately: (1) a partial equilibrium in which the income tax rate, prices, bequests, Social Security transfers, and the 18-year-old distribution are fixed at their initial steady state values; (2) a partial equilibrium in which the income tax rate, prices, bequests, and Social Security transfers are fixed at their initial steady state values but the 18-year-old distribution is endogenous; and (3) general equilibrium. Analogously, Panel (b) depicts the evolution of the average inter vivos transfer.

mitigated in general equilibrium. This is because in general equilibrium, the high-education wage rate decreases, as shown in Table D5 of Appendix D.2.4. This general-equilibrium effect dampens the average transfers provided by parents with a BA and also the rise in the mass of parents with a BA. These offsetting effects that take place in general equilibrium are depicted in Figure D2.

D.3 Sensitivity analyses

In this section, we provide sensitivity analysis for our main experiment from Section 6 in which we compute the extent of under-utilization due to aid application frictions and the welfare gains from eliminating such frictions. The sensitivity analyses serve to highlight the importance of certain assumptions for our main results or to show that our main estimates for under-utilization and welfare gains are robust to alternative assumptions. In the discussion that follows, we explain the motivation for each sensitivity analysis and the details of the re-specified model. Each re-specification is re-calibrated to target the same set of moments as the baseline calibration to the extent possible given the re-specified model environment. For each sensitivity analysis, the extent of under-utilization along the three utilization margins (described in Section 6.1) and the welfare change from eliminating aid application frictions to the average nonfiler due to frictions are presented in Tables D9 and D8, respectively. The estimates from the baseline model are also included for comparison.



(a) Average inter vivos transfer | BA parent

(b) Mass of parents with a BA

Figure D2: Parents with BA: average transfer and mass in partial and general equilibrium

Notes: The figure depicts, for the population of parents with a BA at the age at which they can give an inter vivos transfer to their child, the average transfer and the mass of the parents in each period of the transition from eliminating aid application frictions in the following two cases: (1) a partial equilibrium (PE) in which the income tax rate, prices, bequests, and Social Security transfers are fixed at their initial steady state values but the 18-year-old distribution is endogenous; and (2) general equilibrium (GE).

In the baseline calibration, we assume that if consumers do not file a FAFSA, they forgo access to Pell grants and student loans but still have access to public grants other than Pell, $\theta^{other}(s)$, and private grants, $\theta^{pr}(s)$. In reality, however, in some instances a high school graduate who does not file a FAFSA also loses out on access to other forms of aid because the information from the FAFSA is used by the FAA to determine the entire financial package for the applicant, as discussed in Section 2. Therefore, the cost of nonfiling due to frictions might be higher than that estimated in the baseline. In the second row of Tables D8 and D9, we consider a sensitivity analysis in which a high school graduate who does not file a FAFSA loses access to Pell grants, student loans, and the other grants (the rows labeled "Forgo all aid if not file FAFSA"). This sensitivity exercise serves as an upper bound for our estimates. In this sensitivity analysis, under-enrollment is 1.42 percent of high school graduates and the welfare gains from eliminating aid application frictions amount to 1.18 and 1.39 percent of lifetime consumption in partial and general equilibrium, respectively. These are larger values than the under-enrollment estimate of 0.83 percent and the welfare gains of 0.62 and 0.79 percent in partial and general equilibrium, in the baseline model.

In the baseline model, the EFC was computed using income at full time work hours and included a shock for qualification for professional judgment. As Table D1 of Appendix D.1 indicates, these two features allow the model to better account for Pell uptake rates by income. In order to examine the consequences of not capturing these patterns for our main result, we consider two sensitivity analyses: (1) the input into the EFC is income from actual hours of work rather than

Table D8: Sensitivity: Under-filing decomposition along utilization margins

Model specification	Nonfiling nonenrollee to filing enrollee (1)	Nonfiling enrollee to filing enrollee (2)	Nonfiling nonenrollee to filing nonenrollee (3)	Total (4)
Baseline	0.83	3.34	6.96	11.13
Forgo all aid if not file FAFSA	1.42	1.62	7.35	10.39
Realized income for EFC	0.56	3.55	7.37	11.47
No professional judgment	0.70	3.40	6.80	10.91
Earnings skill measure: ASVAB	0.73	3.48	6.97	11.18

Notes: The table reports a decomposition of under-filing along the three utilization margins described in Section 6.1 in the baseline and in sensitivity analyses described in the main text. Within each utilization margin, the statistics are reported as a percentage of all 18-year-olds.

Table D9: Sensitivity: Welfare change for average nonfiler due to frictions

Model specification	Partial equilibrium	General equilibrium
Baseline	0.62	0.79
Forgo all aid if not file FAFSA	1.18	1.39
Realized income for EFC	0.47	0.63
No professional judgment	0.75	0.91
Earnings skill measure: ASVAB	0.92	1.08

Notes: The table reports welfare changes in percentage points of lifetime consumption from eliminating aid application frictions in partial and general equilibrium for the average FAFSA nonfiler due to frictions in the baseline and in sensitivity analyses described in the main text.

income assuming full time work hours ("Realized income for EFC" in the tables) and (2) there is no qualification for professional judgment ("No professional judgment" in the tables). When realized income is used to determine the EFC, the extent of under-utilization (the sum of columns (1) and (2) of Table D8) and the welfare gains (Table D9) are slightly smaller in comparison to the baseline. The reason is that when realized income is used to determine the EFC, parents with low income have an incentive to work fewer hours so that their family qualifies for a lower EFC and, consequently, higher need-based aid (for example, see Table D1 of Appendix D.1). This added incentive results in a compositional change featuring fewer nonfilers due to frictions with low income and more nonfilers due to frictions with high income in the "Realized income for EFC" model in comparison to the baseline. For example, in the baseline calibration, the rates of nonfiling due to frictions in each skill tercile of the lowest parental income tercile are 10.39, 6.09, 2.93 percent, whereas in the "Realized income for EFC" model the analogous estimates are smaller at 7.72, 4.26, 1.87 percent. When there is no qualification for a professional judgment, the resulting estimates are similar in magnitude to those from the baseline.

Lastly, our measure of skill in the HSLS:09 (the dataset we use to document aid application frictions) is honors-weighted high school GPA. In the HSLS:09, there is no counterpart to ASVAB, which is the more commonly used measure of skill in the NLSY97. For consistency, in the baseline calibration we used high school GPA as the measure of skill when we estimate the skill shifters of the earnings process using data from the NLSY97 (Appendix A.2). In the last rows of Tables D8 and D9, we consider a sensitivity analysis in which we estimate the skill shifters for the earnings process using ASVAB as a measure of skill ("Earnings skill measure: ASVAB"). The main takeaways that aid application frictions lead to modest under-utilization of aid and result in a modest welfare cost do not change.