The Consumption Value of College*

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Abstract

This paper uses the Euler Equation and novel data from Berea College students on their consumption expenditures during and after college, desired borrowing amounts, beliefs about post-college earnings, and elicited risk-aversion and time preference parameters to determine their consumption value of college attendance. Our preferred estimates suggest that the average annual consumption value of college is about $14,000 with some heterogeneity across students. Accounting for these benefits raises the average expected return to college by nearly 20% and substantially lowers the estimated willingness-to-pay for higher student loan limits.

Keywords: college, consumption value, psychic value, returns to college, borrowing constraints, expectations

JEL: D1, D8, I2

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1 Introduction

A growing number of studies estimate that factors beyond traditionally measured costs (tuition and foregone earnings) and earnings benefits of education play an important role in college attendance and field-of-study decisions. These factors are often referred to as "psychic", "utility", or "consumption" costs/benefits of schooling, yet there is little, if any, direct evidence on their nature or values. Instead, their values are typically inferred from schooling choices that deviate from what is expected based on measured costs and financial returns (e.g., someone who attends college despite negative predicted net returns is estimated to have a positive "psychic/utility/consumption" value of college). Commonly observed differences in behavior among individuals with the same measured costs and returns are further taken to imply considerable heterogeneity in these factors.[1]

By measuring the amenities provided by institutions, Jacob, McCall, and Stange (2018) provide some of the most direct evidence suggesting a sizable consumption value of college attendance. They show that, on average, colleges spend about half as much on amenities as on academics and that these amenities influence students' decisions about which college to attend. The goal of Jacob, McCall, and Stange (2018) is to provide marginal valuations of spending on amenities, not to provide a measure of the total consumption value of college. However, their paper highlights two key challenges in attempting to identify the consumption value based on direct measures of specific activities, perks, or benefits valued by students: (i) disentangling consumption from human capital benefits can be difficult because, as they note, amenities may influence choices, in part, by improving the earnings prospects of students,[2] and (ii) capturing all consumption benefits can be difficult both because many recognized amenities may be difficult to measure and because consumption benefits may arise in ways that are hard to recognize or describe.

This paper takes a very different approach and represents the first attempt to quantify all consumption benefits of college that are directly substitutable with other goods, services, and activities that students would otherwise purchase. For example, students have easy

[1] Lazear (1977) provides an early analysis of the consumption vs. investment value of education. See, e.g., Keane and Wolpin (1997, 2001), Cunha, Heckman, and Navarro (2005), Heckman, Lochner, and Todd (2006), Abbott et al. (2019), and Guo and Leung (2020) for estimates of the importance of "psychic/utility/consumption" factors in explaining schooling attendance decisions. See, e.g., Arcidiacono (2004), Rask (2010), Zafar (2013), Gemici and Wiswall (2014), and Wiswall and Zafar (2015) for evidence on the importance of tastes in college major decisions.

[2] Several expenditure categories in their amenity measure could improve post-schooling earnings, including spending on student activities, student organizations, student health services, cultural events, etc.

access to athletic and entertainment facilities on campus. Many participate in formal clubs, organizations, or sports teams. Students also have many other free or inexpensive leisure and entertainment opportunities available to them that are often unavailable to non-students. A quintessential example involves playing frisbee with friends on the campus quad. Students may benefit greatly from such opportunities, allowing them to achieve high levels of effective consumption with much lower levels of personal spending. We refer to the "consumption value" of college as the difference between effective consumption and measured consumption expenditures.

It is important to quantify these consumption benefits of college for at least two reasons. First, a large consumption value of college would lead to low levels of observed consumption expenditures during school, which could easily be misinterpreted as evidence of binding credit constraints.[3] In this case, policymakers might overstate the amounts students need to borrow in order to smooth (effective) consumption during and after college. Second, the "consumption value" of college may be an important factor determining the total return to college, so that a failure to incorporate it could lead to an under-valuation of post-secondary education. This is highlighted by the recent pandemic, during which the movement to distance/online learning appears to have made college less attractive for many (potential) students (e.g., Aucejo, French, and Zafar, 2023).[4]

We develop an innovative approach to estimating the consumption value of college that exploits the canonical Euler Equation (EE) for intertemporal consumption allocations. The EE is commonly used to estimate preference parameters related to discounting, risk aversion, and intertemporal substitution (for consumption and labor supply), as well as the importance of borrowing constraints, risk-sharing, and self-insurance (e.g., Hansen and Singleton, 1982; MaCurdy, 1983; Zeldes, 1989; Meghir and Weber, 1996; Blundell, Pistaferri, and Preston, 2008).[5]

In the absence of borrowing constraints, the EE makes clear that students should equate

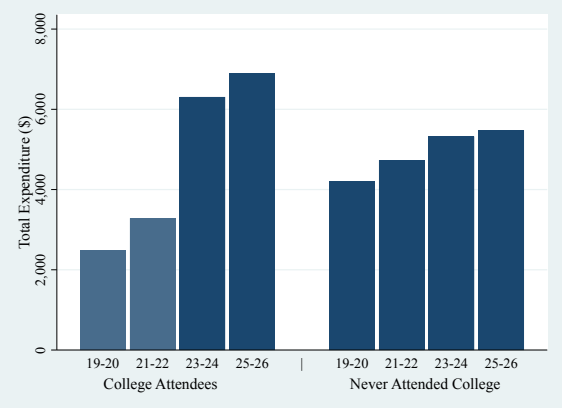
[3]Many studies exploit measures of assets during and/or after school to identify borrowing limits and the role of borrowing constraints (e.g., Keane and Wolpin, 2001; Johnson, 2013; Hai and Heckman, 2017). This implicitly assumes that consumption expenditures reflect total effective consumption, thereby ignoring the "consumption" benefits of college we study.

[4]Note, however, that shifts in demand for college related to the unexpected shift to distance learning would not necessarily identify the consumption value of college, because distance learning also has direct effects on educational (academic) quality.

[5]Blundell and Preston (1998) further exploit the EE to identify transitory vs. permanent earnings innovations. For additional applications and details, see surveys by Browning, Hansen, and Heckman (1999), Browning and Crossley (2001), Attanasio and Weber (2010), and Meghir and Pistaferri (2011).

the marginal utility of consumption during college with the (discounted) expected marginal utility of consumption after school (Becker, 1964). Thus, a comparison of observed consumption expenditures during college to the amount that students (expect to) spend on consumption after college should be informative about the consumption value of college. Figure 1 shows that quarterly consumption expenditures in the Consumer Expenditure Survey (CES) nearly double for 23–24 year-old individuals who previously attended college relative to 21–22 year-old currently enrolled students. Consumption growth is much more modest both during and after college. It is also also much more modest (over those same ages) for those who never attend college. Data from the Berea Panel Study (BPS), discussed in detail below, allows us to follow individual students over their college careers and a few years after. Figure 2 shows the evolution of average annual consumption spending (including dormitory costs for food and housing during college) during and after college. As with the CES data, total expenditures grow very little during their college years or after they leave college, while they nearly double when they transition out of college.

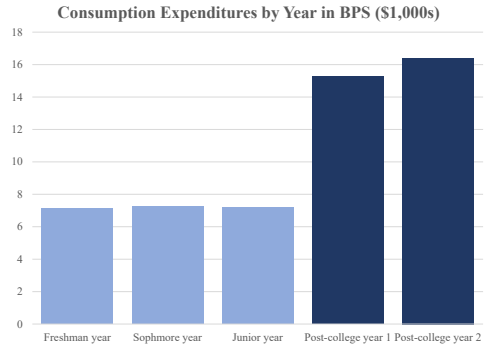
Figure 1: Quarterly Consumption Expenditures by Age and College Attendance in CES



Notes: Left panel reports average quarterly consumption expenditures (in year 2001 $) for 19–20 and 21–22 year-olds who are currently attending college and for 23–24 and 25–26 year-olds who previously attended college but are no longer enrolled. Right panel reports quarterly expenditures by age for respondents that never attended college. Sample restricted to single-person consumer units in 2000–2015, trimming top and bottom 3% of observations.

If individuals desire smooth consumption profiles, the particularly large jump in consumption spending upon leaving college suggests a sizable consumption value of college. Two important challenges to this interpretation arise due to credit/insurance market frictions. First, limited borrowing opportunities during school could lead to a jump in consumption spending after college when individuals begin to receive higher earnings. Second, when

Figure 2: Annual Consumption Expenditures During and After College in BPS



Notes: Reported annual consumption expenditures (in year 2001 $). Amounts during college include Berea College's per-student dormitory food and housing costs.

students face uninsurable post-college earnings risk, a jump in consumption spending after college could also reflect the resolution of that risk and a reduction in precautionary savings motives.

We address both of these concerns using rich data from the BPS, which follows students from Berea College in central Kentucky. While Berea College is unique in one important respect discussed below, it is otherwise quite typical of hundreds of small, high-quality liberal arts institutions scattered throughout the U.S. We address the first concern using a BPS survey question that identifies whether students are currently borrowing constrained, and if so, how much they would choose to borrow if the constraint were eliminated. This not only allows us to identify who is unconstrained, but it also allows us to identify desired consumption expenditures (during college) for everyone in our sample, regardless of whether they are borrowing constrained. We take two broad approaches to the second challenge, which requires determining the expected marginal utility of post-college consumption for each student. We begin by assuming that students have rational expectations (RE) about their future consumption allocations. This allows us to obtain the expected marginal utility by integrating over realized post-college consumption distributions. With this, we estimate the mean consumption value of college conditional on observed student characteristics. While the RE assumption is quite common and convenient, a growing literature casts doubt on it for many college students (e.g., Crossley et al., 2024; Tincani, Kosse, and Miglino, 2025). We, therefore, develop and focus on a second approach that exploits BPS survey questions

designed to elicit students' beliefs about their post-college earnings possibilities. Combining these student-specific beliefs with an estimated post-college consumption function (over post-college earnings, debt, and student characteristics), we estimate the full distribution of college consumption values, allowing for unobserved heterogeneity.

The rich set of information collected in the BPS enables us to consider the relevance of other economic forces that might explain sharp increases in consumption upon college graduation. First, debt-averse students may not wish to borrow despite low levels of in-school consumption. Taking advantage of survey information that identifies students who might be debt-averse, we show that results are not sensitive to whether these students are included in estimation. Second, the end of college is a natural time to purchase expensive durable goods like cars or furniture, producing a jump in consumption expenditures. We show that Berea graduates did not spend a substantial amount on durable goods immediately after graduation, so taking this into account has little effect on our main conclusions. Third, one might be concerned that students have low out-of-pocket expenditures, because the requirement to live in a dorm and utilize a campus food plan imposes a limit on housing and food consumption. This concern is unlikely to be empirically important in our context, because the value of room and board at Berea is similar to spending on housing for representative college students not living in student housing (as reported in the Consumer Expenditure Survey, CES). Additionally, we obtain similar results when excluding housing expenditures from both in-school and post-school consumption measures. Fourth, Aguiar and Hurst (2005, 2007) show that, by devoting more time to home production and shopping, older individuals are able to maintain high levels of effective consumption despite reduced expenditures. Since the combined amount of time Berea students spend studying and working is similar to the amount of time spent working after school (Stinebrickner and Stinebrickner, 2003, 2008a; Stinebrickner, Stinebrickner, and Sullivan, 2019), a similar phenomenon is unlikely to explain sizable changes in consumption upon graduation for our sample. Finally, one might worry that there are fewer consumption opportunities in the city of Berea than in locations where graduates move after college, which could lead to lower "market-constrained" consumption expenditures while in school. We show, however, that Berea's population density is similar to that of the cities its students live in two years after graduation, suggesting that local

offerings are unlikely to improve after college.[6]

Our empirical results suggest that Berea students receive considerable consumption value from college. Using students' subjective beliefs about post-college earnings, our preferred estimates indicate that the average annual consumption value of college is about $14,000, a figure robust to many alternative assumptions.[7] These sizable benefits are consistent with other survey responses in which the vast majority of Berea freshman indicate that they enjoy college more than they think they would enjoy not being in college. Incorporating these additional consumption benefits of college increases average rates of return to college by almost 20% and substantially reduces the measured value of increasing student loan limits. Despite the fact that we examine students attending the same institution, we document heterogeneity in the consumption value across students, some of which is explained by differences in gender, family income, and high school grades.

The rest of this paper proceeds as follows. In Section 2, we discuss key conceptual issues and corresponding data requirements for quantifying the consumption value of college. Data from the BPS are discussed in Section 3. Estimates obtained under the assumption of RE are reported in Section 4, while our preferred estimates using subjective beliefs about post-college earnings are discussed in Section 5. The latter section also explores the robustness of our results to several alternative assumptions and data treatments. In Section 6, we study several additional issues, including heterogeneity in college consumption values across students from different backgrounds and the implications of a sizable consumption value for estimated returns to college and for evaluating the benefits from increasing student borrowing opportunities. We also explore whether college students receive discounted prices on consumption goods/services along with "free" benefits. Section 7 concludes with a summary of key results and broader lessons from our approach and empirical findings.

[6]Indeed, the presence of Berea College and its many students likely means that Berea offers more goods and services valued by students compared to similarly sized areas without a post-secondary institution. The fact that roughly 80% of students report in the BPS that they enjoy their life in school more than if they were not enrolled further suggests that low levels of in-school consumption are not driven by a lack of opportunities. We explore differential prices for goods/services during and after school in Section 6.4.

[7]Because students substantially overestimate future earnings, estimates obtained under the assumption of RE are notably lower, though still considerable.

2 Measuring the Consumption Value of College

Our general approach to measuring the consumption value of college is based on the canonical EE equating the marginal utility of consumption during college with the discounted expected marginal utility of consumption after leaving school, accounting for potential borrowing constraints.

Specifically, we consider the EE linking consumption during year $t = 1, ..., G$ of college to the first year after graduation, where G reflects the final year of school. Letting $U(C; \rho)$ (with $U'(\cdot; \rho) > 0$, $U''(\cdot; \rho) < 0$, and ρ a measure of risk-aversion) reflect utility from "effective consumption" C, $\beta > 0$ the rate of time preference, and $r > 0$ the market interest rate, the EE for student i can be written as

$$U'(C_{i,t}; \rho_i) = [\beta(1 + r)]^{G+1-t} E_t[U'(C_{i,G+1}; \rho_i)|\mathcal{I}_{i,t}] + \lambda_{i,t}, \tag{1}$$

where $E_t[\cdot|\mathcal{I}_{i,t}]$ reflects expectations conditional on information known at date t (including student-specific preferences for risk, ρ_i) and $\lambda_{i,t} \geq 0$ is the Lagrange multiplier on borrowing constraints (where $\lambda_{i,t} > 0$ if and only if students are borrowing constrained). We defer a discussion of durable goods, debt-aversion, and other potential challenges until Section 2.3.

While enrolled in college, we assume that "effective consumption" $C_{i,t}$ reflects the sum of out-of-pocket consumption expenditures $C^{ex}_{i,t}$ and any additional "consumption value of college", $\mathcal{V}_{i,t}$:

$$C_{i,t} = C^{ex}_{i,t} + \mathcal{V}_{i,t} \quad \text{for all } t = 1, ..., G. \tag{2}$$

This assumes that the consumption value $\mathcal{V}_{i,t}$ enters in a "lump sum" fashion, capturing all benefits that are direct substitutes for purchased consumption goods and services. For example, access to on-campus entertainment opportunities can reduce a student's willingness to pay for movie and concert tickets. School sports and club activities can also substitute for a wide range of recreational expenditures. Transportation is typically free on college campuses and heavily subsidized (or unneeded) otherwise. In general, these and other "psychic benefits" of college are reflected in $\mathcal{V}_{i,t}$ to the extent that they reduce the demand for purchased goods and services.[8] We include the value of room and board in $C^{ex}_{i,t}$ so it is not part of $\mathcal{V}_{i,t}$. In Section 6.4, we examine whether college also provides goods and services at a discounted price.

[8]Our estimates of $\mathcal{V}_{i,t}$ do not capture benefits that are fully separable from other consumption goods/services. For example, individuals may feel pride in attending college, which may have little effect on their demand for traditional consumption goods/services.

Once individuals leave school, we assume that effective consumption is fully reflected in expenditures (i.e., $C_t = C_t^{ex}$ for all $t \geq G + 1$); however, our estimates represent a lower bound on the consumption value if, after leaving school, individuals benefit from free non-market amenities provided by, for example, municipalities or their employers.[9] We explicitly address the possibility that individuals who live with family after leaving school may benefit from significant in-kind transfers.

Our EE-based approach for estimating $\mathcal{V}_{i,t}$ presents several measurement challenges. Using the BPS, we show that each can be overcome with rich panel data. First, while consumption data is rarely collected for individuals during and after college, the BPS contains measures of consumption expenditures in each college and post-college year. Second, the reality that students' risk-preferences may affect desired consumption profiles highlights the benefits of previously validated BPS survey questions that elicit student-level risk-aversion, ρ_i. Third, it is difficult to know when a student is borrowing constrained or how severe any constraints may be. Previous studies attempt to identify constrained individuals based on observable characteristics like wealth (e.g., Zeldes, 1989; Blundell, Pistaferri, and Preston, 2008). In contrast, we take a direct approach by utilizing a novel BPS survey question that asks students whether they would like to borrow more than they are currently able to *and*, if so, what additional amount they would like to borrow. Fourth, surveys of students do not generally elicit beliefs about future *consumption*, which are needed for determining the expected marginal utility of consumption. We take two alternative approaches to address this challenge: (i) we make the standard assumption that students have RE, using post-college consumption distributions conditional on student characteristics to determine expected marginal utilities of consumption; (ii) we develop a novel approach that combines elicited student-specific subjective beliefs about future *earnings* with an estimated post-college consumption function (over earnings, debt, and other student characteristics) to determine expected marginal utilities of consumption.

Our more-traditional approach based on RE does not require measures of student beliefs, making it feasible in more data environments. However, it assumes that students are accurately informed about all of their post-college earnings possibilities. Because several

[9]For example, individuals may have access to public parks or events organized by local municipalities; employers may also provide valuable amenities that substitute for goods and services individuals might otherwise purchase. In both cases, reported post-college consumption expenditures would understate effective post-college consumption, in which case our approach would provide a lower bound for the consumption value of college.

recent studies have cast doubt on the validity of this assumption (Crossley et al., 2024; d'Haultfoeuille, Gaillac, and Maurel, 2021), we view our novel approach that leverages student-specific measures of beliefs about post-school earnings as our preferred specification. Another important advantage of using student-specific measures of beliefs is that it enables us to estimate the full distribution of consumption values, accounting for both unobserved heterogeneity and measurement error in consumption, when students are observed at least twice during college. Relying on RE limits the extent of heterogeneity that can be estimated.

In both cases, we assume that $\beta(1+r)$ and the function $U(\cdot;\rho_i)$ are known (the latter with risk-aversion parameter ρ_i determined from our data); although, we explore alternative values of $\beta(1+r)$ and ρ_i in Section 5.1.

2.1 Estimation under Rational Expectations

Studies that exploit the EE in estimation typically assume RE, often relying on a moment-based approach (see, e.g., Zeldes, 1989). We begin with this approach, then proceed to develop a new, intuitive approach that requires a slightly stronger assumption on what the econometrician observes but serves as a bridge to our more general approach using data on subjective expectations about post-college earnings (developed in Section 2.2).

2.1.1 A General Method of Moments (GMM) Approach

Based on equation (1), it is useful to define the following EE prediction "error" for students:

$$\xi_{i,t} \equiv [\beta(1+r)]^{G+1-t} U'(C_{i,G+1};\rho_i) - U'(C_{i,t}^{ex} + \mathcal{V}_{i,t};\rho_i) + \lambda_{i,t}, \tag{3}$$

where $Z_{i,t}$ reflects any observed student characteristics known (to both the student and the econometrician) at time t. Assuming that $\mathcal{V}_{i,t} = \mathcal{V}_t(Z_{i,t}^{\mathcal{V}})$, where $Z_{i,t}^{\mathcal{V}} \subseteq Z_{i,t}$ reflects observed determinants of the consumption value of college, we can form the following moments:

$$E\left[\xi_{i,t}\middle|Z_{i,t}\right] = 0 \quad \text{or} \quad E\left[\xi_{i,t} Z_{i,t}\right] = 0. \tag{4}$$

Even when data on consumption expenditures during and after college are available, a key challenge in estimating $\mathcal{V}_t(Z_{i,t}^{\mathcal{V}})$ based on these moments arises due to the (typically) unobserved nature of borrowing constraints: $\lambda_{i,t}$ is generally unknown to the econometrician. As note earlier, it is common for researchers to define unconstrained individuals based on

observable characteristics like wealth. If unconstrained students can be identified, GMM based on equation (4), setting $\lambda_{i,t} = 0$, can be used to estimate $\mathcal{V}_t(Z^{\mathcal{V}}_{i,t})$. Of course, it may be impossible to identify $\mathcal{V}_t(Z^{\mathcal{V}}_{i,t})$ for some $Z^{\mathcal{V}}_{i,t}$ values/types if there are no unconstrained students with those characteristics.

More generally, if some students (mistakenly included in estimation) are borrowing constrained, this strategy would tend to over-estimate $\mathcal{V}_{i,t}$. This can be seen by re-arranging equation (1):

$$\begin{aligned} \mathcal{V}_{i,t} &= U'^{-1}\left([\beta(1+r)]^{G+1-t}E[U'(C_{i,G+1};\rho_i)|\mathcal{I}_{i,t}] + \lambda_{i,t};\rho_i\right) - C^{ex}_{i,t} \\ &\leq U'^{-1}\left([\beta(1+r)]^{G+1-t}E[U'(C_{i,G+1};\rho_i)|\mathcal{I}_{i,t}];\rho_i\right) - C^{ex}_{i,t}, \end{aligned} \tag{5}$$

where the inequality follows from $U'(\cdot) > 0$, $U''(\cdot) < 0$, and $\lambda_{i,t} > 0$ for constrained students.[10] When some students are borrowing constrained, it is impossible to distinguish between binding constraints and a positive consumption value of college using only information on preferences and consumption.[11]

We avoid this problem altogether by exploiting a novel BPS survey question that directly asks if students would like to borrow more than they are able to (i.e., whether they are borrowing constrained). As noted above, one could use the sample of students who would not like to borrow more to estimate $\mathcal{V}_t(Z^{\mathcal{V}}_{i,t})$ based on the moments in equation (4), setting $\lambda_{i,t} = 0$.

The BPS further asks students who would like to borrow more during college (i.e., constrained students) how much more they would like to borrow at a reasonable interest rate. Let this desired additional borrowing amount be $d_{i,t} \geq 0$, setting $d_{i,t} = 0$ for (unconstrained) students answering that they would not like to borrow more. With this additional information, it is natural to assume that $\lambda_{i,t} = \lambda_t(d_{i,t}, Z^d_{i,t})$, where $Z^d_{i,t} \subseteq Z_{i,t}$ reflects characteristics that determine the distortionary impacts of borrowing constraints and $\lambda_t(\cdot)$ should be increasing in $d_{i,t}$ (zero when $d_{i,t} = 0$). With data on consumption expenditures during and after college, student characteristics, and desired additional borrowing, GMM can be directly applied to the moments in equation (4), supplemented with additional moments related to $(d_{i,t}, Z^d_{i,t})$, to estimate both $\mathcal{V}_t(Z^{\mathcal{V}}_{i,t})$ and $\lambda_t(d_{i,t}, Z^d_{i,t})$ using the full sample of students.[12]

[10] $U'^{-1}(C;\rho)$ reflects the inverse function for $U'(C;\rho)$ with respect to C.

[11] A similar problem arises if individuals are debt-averse, in which case the EE need not hold with equality even for individuals who do not wish to borrow. Our survey identifies these students, but it does not ask how much they would like to borrow if they were not debt-averse. We discuss this and a few other challenges (e.g., expenditures on durable goods) below.

[12] We discuss moments related to $(d_{i,t}, Z^d_{i,t})$ in Section 4 where we also specify the function $\lambda_t(\cdot)$.

2.1.2 A Direct Approach

We next discuss an intuitive direct approach for estimating the consumption value of college using the sample of unconstrained students only. Unlike the GMM approach of Section 2.1.1, this simpler approach requires that $Z_{i,t}$ contain *all relevant information* affecting the marginal utility of post-college consumption. It serves as a bridge to our more general approach using data on subjective beliefs about post-college earnings (discussed in Section 2.2).

If $Z_{i,t}$ contains all information in $\mathcal{I}_{i,t}$ relevant to consumption behavior, then we can replace $E[U'(C_{i,G+1};\rho_i)|\mathcal{I}_{i,t}]$ with $E[U'(C_{i,G+1};\rho_i)|Z_{i,t}]$ in equation (5). Re-arranging this and setting $\lambda_{i,t}=0$ yields the following student-specific "estimate" of $\mathcal{V}_{i,t}$ for unconstrained students:

$$\tilde{\mathcal{V}}_{i,t} \equiv U'^{-1}\left([\beta(1+r)]^{G+1-t}E[U'(C_{i,G+1};\rho_i)|Z_{i,t}];\rho_i\right) - C^{ex}_{i,t}, \quad \text{for } d_{i,t}=0. \tag{6}$$

Notice that $\tilde{\mathcal{V}}_{i,t}$ is mechanically decreasing in observed consumption expenditures during college, $C^{ex}_{i,t}$, and in the expected marginal utility of post-college consumption, $E[U'(C_{i,G+1};\rho_i)|Z_{i,t}]$. Our data contain direct measures of the former, while the latter must be estimated in a preliminary step. The RE assumption implies that $E[U'(C_{i,G+1};\rho_i)|Z_{i,t}]$ can be estimated using data on post-college consumption expenditures and student characteristics.[13]

2.1.3 Measurement Error in Consumption

Measurement error in consumption, both during and after school, will bias student-specific estimates, $\tilde{\mathcal{V}}_{i,t}$, from equation (6), as well as GMM estimates of $\mathcal{V}_t(Z^{\mathcal{V}}_{i,t})$ from Section 2.1.1. In discussing these biases, we assume that measurement error in consumption is additively separable and independent of true values of consumption, actual and desired student debt, and student characteristics $Z_{i,t}$.

Beginning with $\tilde{\mathcal{V}}_{i,t}$, assume that $Z_{i,t}$ contains all relevant information for the marginal utility of post-college consumption, abstracting from any bias caused by imperfectly observing a student's information set. Measurement error in consumption implies that $\tilde{\mathcal{V}}_{i,t}$ will not provide accurate measures of student-specific consumption values or their distribution, $F_{\mathcal{V}_t}(\cdot)$. However, it is noteworthy that $E[\mathcal{V}_{i,t}|Z^{\mathcal{V}}_{i,t}]$ can be consistently estimated via regression of $\tilde{\mathcal{V}}_{i,t}$ on $Z^{\mathcal{V}}_{i,t}$ (or from desired (sub)sample averages of $\tilde{\mathcal{V}}_{i,t}$) if consumption is only noisily measured during college. Any measurement error in $C^{ex}_{i,t}$ can be simply averaged away due

[13] For example, $E[U'(C_{i,G+1};\rho_i)|Z_{i,t}]$ can be estimated from a regression of $U'(C_{i,G+1};\rho_i)$ on $Z_{i,t}$ or from conditional averages if $Z_{i,t}$ are categorical variables.

to the additive separability. Unfortunately, measurement error in post-college consumption is more problematic when $U'(\cdot)$ is nonlinear. Jensen's Inequality implies that the sign of bias for $E[U'(C_{i,G+1};\rho_i)|Z_{i,t}]$ is the same as that of $U'''(\cdot;\rho)$.[14] Thus, measurement error in post-college consumption produces biased estimates for $E[\mathcal{V}_{i,t}|Z^{\mathcal{V}}_{i,t}]$ with the bias having the opposite sign of $U'''(\cdot;\rho)$.

GMM estimates of $\mathcal{V}_t(Z^{\mathcal{V}}_{i,t})$ from Section 2.1.1 suffer from the same bias associated with measurement error in post-college consumption; however, they also suffer from an offsetting bias due to measurement error in consumption during college, which also enters equation (3) nonlinearly. In general, the total bias cannot be signed; however, when $U'''(\cdot) > 0$, GMM estimates of $\mathcal{V}_t(Z^{\mathcal{V}}_{i,t})$ are likely to be larger than estimates of $E[\mathcal{V}_{i,t}|Z^{\mathcal{V}}_{i,t}]$ obtained from $\tilde{\mathcal{V}}_{i,t}$.

2.2 Using Subjective Beliefs about Post-College Earnings

Rational Expectations (RE) assumptions have played an important role in the economics literature. However, because these assumptions tend to be somewhat arbitrary and are largely made for reasons of convenience, a recent literature has stressed the potential benefits of viewing beliefs as data that can be elicited directly using carefully worded survey questions. This literature, which has often focused on issues related to education, has frequently found that RE assumptions are inconsistent with elicited beliefs, and, in some cases, has shown that elicited beliefs do a better job satisfying basic implications of theory or predicting outcomes of interest (Stinebrickner and Stinebrickner, 2014; Tincani, Kosse, and Miglino, 2025; de Bresser, 2024).

Using data on year-t (in-school) student-specific subjective beliefs about post-college earnings distributions, i.e., $F_{i,t}(W_{G+j})$ for $j \geq 1$, we relax the RE assumption and modify the intuitive approach above to estimate rich student-level heterogeneity in $\mathcal{V}_{i,t}$. This approach has two main advantages over the approaches based on RE in Section 2.1. First, it addresses well-documented misperceptions in students' beliefs about their future earnings. In particular, when students are, on average, overly optimistic about their future earnings prospects, estimates of average consumption values based on the RE assumption will tend

[14] To see this, suppose that observed consumption is measured with iid error $\eta_{i,t}$ each period with $\eta_{i,t} \perp\!\!\!\perp (C_{i,G+1}, Z_{i,t})$. Based on a third-order Taylor Approximation to $U(\cdot)$, the average marginal utility of observed post-college consumption for students of type Z is

$$\frac{1}{N_Z}\sum_{Z_i=Z} U'(C_{i,G+1}+\eta_{i,G+1}) \xrightarrow{p} E[U'(C_{i,G+1})|Z] + \frac{1}{2}E[U'''(C_{i,G+1})|Z]E[\eta^2_{i,G+1}|Z].$$

to be biased downward. Second, with data on consumption and beliefs from two (or more) periods of college, it is possible to nonparametrically identify the full distribution of the permanent component of college consumption values while allowing for unobserved heterogeneity and measurement error in consumption.

We now discuss a three-step approach using subjective expectations data.

Step 1: Estimating the post-college consumption function. To determine the expected marginal utility of post-college consumption using subjective beliefs about post-college earnings, it is first necessary to identify the post-college consumption function. We assume that post-college consumption, $C_{i,G+1} = \tilde{C}(D_{i,G+1}, W_{i,G+1}, Z_i^C)$, is a function of observed post-college debt $D_{i,G+1}$, earnings $W_{i,G+1}$, and student characteristics $Z_i^C \subseteq Z_{i,t}$ (including ρ_i). Assuming the consumption function $\tilde{C}(\cdot)$ is well-specified, it can be consistently estimated using survey data on $C_{i,G+1}$, $D_{i,G+1}$, $W_{i,G+1}$, and Z_i^C.[15] Fortunately, classical measurement error in post-college consumption does not bias estimates of $\tilde{C}(\cdot)$.

While we prefer this estimation approach for determining $\tilde{C}(\cdot)$, one could alternatively use a model-based approach, obtaining the consumption function as the solution to a standard lifecycle consumption allocation problem under uncertainty. We briefly discuss and explore this alternative in Section 5.1.

Step 2: Calculating $\tilde{\mathcal{V}}_{i,t}$. Assuming that the accumulation of student debt, $D_{i,G+1}$, is fully anticipated in period t, we need only integrate over the student-specific (subjective) distribution of post-college earnings possibilities, $F_{i,t}(W_{G+1})$, to obtain the expected post-college marginal utility of consumption for each student:[16]

$$E_{i,t}[U'(C_{i,G+1}; \rho_i)] = \int U' \left(\tilde{C}(D_{i,G+1}, W_{i,G+1}, Z_i^C); \rho_i \right) dF_{i,t}(W_{G+1}), \tag{7}$$

where $\tilde{C}(\cdot)$ comes from Step 1, and we use the more compact notation $E_{i,t}[U'(C_{i,G+1}; \rho_i)] \equiv E[U'(C_{i,G+1}; \rho_i)|\mathcal{I}_{i,t}]$. Unlike with RE, heterogeneity in beliefs about post-college earnings

[15] Our approach requires that additional unobserved factors do not affect post-college consumption. In theory, the consumption function depends on credit market frictions and beliefs about subsequent post-college earnings (conditional on $D_{i,G+1}$ and $W_{i,G+1}$). As discussed further in Section 5, we find in practice that factors other than income have little impact on contemporaneous consumption in our sample.

[16] Anticipated D_{G+1} is consistent with students reporting that over 80% of end-of-college debt (in our sample) was borrowed to cover college-related expenditures, which are likely anticipated early in college. Empirically, we observe modest differences in student debt and estimate little effect of student debt on post-college consumption, so failing to account for uncertainty about D_{G+1} should have negligible effects on the expected marginal utility of consumption.

across students can lead to differences in expected marginal utilities, even when conditioning on student debt and observed student characteristics.[17]

The expected marginal utility from equation (7) can be substituted into equation (6) for unconstrained students to obtain the following:

$$\tilde{\mathcal{V}}_{i,t} = U'^{-1}\left([\beta(1+r)]^{G+1-t}E_{i,t}\left[U'\left(\tilde{C}(D_{i,G+1}, W_{i,G+1}, Z_i^C); \rho_i\right)\right]\right) - C_{i,t}^{ex}, \quad \text{for } d_{i,t} = 0. \tag{8}$$

We can also exploit our measure of the amount constrained students would like to borrow, $d_{i,t}$, to identify their consumption value of college.[18] Given the modest values for $d_{i,t}$ in our sample, we assume that students' post-school earnings would be unaffected by borrowing this additional amount. As such, additional (hypothetical) debt, $d_{i,t}$, should affect future consumption in the same way as does existing debt. This implies a minor modification to equation (8):

$$\begin{aligned}\tilde{\mathcal{V}}_{i,t} \;=\; & U'^{-1}\left([\beta(1+r)]^{G+1-t}E_{i,t}\left[U'\left(\tilde{C}(D_{i,G+1} + (1+r)^{G+1-t}d_{i,t}, W_{i,G+1}, Z_i^C); \rho_i\right)\right]\right) \\ & - C_{i,t}^{ex} - d_{i,t},\end{aligned} \tag{9}$$

which reduces to equation (8) for unconstrained students (i.e., $d_{i,t} = 0$).

Step 3: Estimating $E[\mathcal{V}_{i,t}|Z_{i,t}^{\mathcal{V}}]$ and $F_{\mathcal{V}}(\cdot)$. Since idiosyncratic measurement error in post-college consumption does not affect the consistency of estimates of $\tilde{C}(\cdot)$, it does not affect $\tilde{\mathcal{V}}_{i,t}$ estimates. However, as with the RE case, measurement error in consumption expenditures during school, $C_{i,t}^{ex}$, cannot be separately identified from idiosyncratic variation in $\mathcal{V}_{i,t}$ with a single in-school period of data. Measurement error would lead to over-dispersion in the distribution of estimated $\tilde{\mathcal{V}}_{i,t}$ relative to the distribution of true consumption values $\mathcal{V}_{i,t}$, $F_{\mathcal{V}_t}(\cdot)$. As long as measurement error in $C_{i,t}^{ex}$ is mean independent of $Z_{i,t}^{\mathcal{V}}$, we can consistently estimate average consumption values conditional on these characteristics, $E[\mathcal{V}_{i,t}|Z_{i,t}^{\mathcal{V}}] = E[\tilde{\mathcal{V}}_{i,t}|Z_{i,t}^{\mathcal{V}}]$, via regression (or using desired (sub)sample averages).

If $\mathcal{V}_{i,t} = \mathcal{V}_i + \nu_{i,t}$ is composed of a permanent component, $\mathcal{V}_i$ and a purely transitory component, $\nu_{i,t}$, then two periods of in-school data are sufficient for nonparametric identification of the distribution of the permanent component, $F_{\mathcal{V}}(\cdot)$.[19] Below, we test whether

[17] Additionally, when using direct measures of beliefs to determine expected marginal utilities, there is no need to worry about identifying the full set of characteristics that determine beliefs as was necessary in Section 2.1.2.

[18] Recall that $d_{i,t} > 0$ for those that are constrained, while $d_{i,t} = 0$ for those that are not.

[19] To see this, notice that consumption value estimates can be written as $\tilde{\mathcal{V}}_{i,t} = \mathcal{V}_i + \nu_{i,t} + \eta_{i,t}$, where $\eta_{i,t}$ reflects measurement error in observed college consumption, $C_{i,t}^{ex}$. With $\mathcal{V}_i \perp\!\!\!\perp (\nu_{i,t}, \eta_{i,t})$ and both $\nu_{i,t}$ and $\eta_{i,t}$ serially independent, then we can apply Kotlarski's Lemma to identify $F_{\mathcal{V}}(\cdot)$.

average consumption values are the same across the first two years of college. Since we cannot reject that $E[\tilde{\mathcal{V}}_{i,1}] = E[\tilde{\mathcal{V}}_{i,2}]$, we assume that $\mathcal{V}_{i,t}$ contains both permanent and transitory components in estimating the distribution of consumption values, $F_{\mathcal{V}}(\cdot)$.[20]

2.3 Potential Challenges with our EE-based Approaches

Our discussion, thus far, has described efforts to address two particularly salient challenges inherent in the EE-based approach: identifying constrained individuals and characterizing the full distribution describing beliefs about future consumption.

Throughout the remainder of the paper, we describe and examine a variety of other potential challenges described in the introduction:

1. Debt-aversion could create a jump in consumption after school.
2. Consumption of durable goods can complicate the structure of the EE.
3. The EE focuses on aggregate consumption, implicitly assuming that individual consumption goods (e.g., housing, food, and other goods) are perfect substitutes.
4. The EE above abstracts from issues related to home production and time-use.
5. School location might create differences in consumption opportunities between the in-school and post-college periods.

Section 3.1 appeals to a combination of institutional details and additional data to show that Challenges 4 and 5 are unlikely to be empirically important in our context. Section 5.1 shows that our baseline estimates of the college consumption value are largely unchanged when considering model specifications that explicitly account for the first three concerns.

3 Berea College, Data, and Descriptive Statistics

3.1 Berea College and the Berea Panel Study (BPS)

Our empirical analysis is based on the BPS conducted by Todd and Ralph Stinebrickner. It is a longitudinal survey that follows two cohorts of students at Berea College from the time

[20] With data on 2 years of in-college consumption and beliefs, it is possible to identify a homogeneous growth rate in the permanent component of $\mathcal{V}_{i,t}$ (e.g., $\mathcal{V}_{i,1} = \mathcal{V}_i + \nu_{i,1}$ and $\mathcal{V}_{i,2} = \Gamma\mathcal{V}_i + \nu_{i,2}$) or a constant level shift (e.g., $\mathcal{V}_{i,1} = \mathcal{V}_i + \nu_{i,1}$ and $\mathcal{V}_{i,2} = \gamma + \mathcal{V}_i + \nu_{i,2}$). With at least 3 years of in-school data, we could allow for more general time-variation in the permanent component of $\mathcal{V}_{i,t}$ across individuals. See, e.g., Hu and Schennach (2008) for the required conditions.

they entered college, in 2000 and 2001, until 2014. Students were surveyed multiple times each year while in college, with the baseline survey taking place immediately after students arrived for their freshman year. Post-college surveys were conducted annually.

Berea College is a four-year liberal arts school located in central Kentucky. As discussed previously (Stinebrickner and Stinebrickner, 2003), the school focuses on providing educational opportunities to students from relatively low-income backgrounds. As part of this focus, Berea offers full-tuition scholarships to all students. Additionally, all students work in on-campus jobs. Related to Challenge 4 in Section 2.3, the total amount of time spent working and studying during school is very similar to the amount of time spent working in the post-college period.[21] This suggests that students do not have significantly different amounts of time for consumption during the in-school and post-college periods.

Berea offers a standard liberal arts curriculum, and its students are similar in academic quality to students at nearby University of Kentucky (Stinebrickner and Stinebrickner, 2008b). Additionally, Berea's campus is similar to that of other quality liberal arts colleges. Consistent with recent trends (Jacob, McCall, and Stange, 2018), Berea constructed a 10.5 million dollar recreational/wellness center, built a new dorm, and entirely re-vamped its dining facilities within the last two decades. Based on the IPEDS data used by Jacob, McCall, and Stange (2018), Berea College's per student expenditures on student amenities in 2004 were at roughly the 65th percentile among U.S. private bachelor's degree-granting institutions. Aside from fully subsidized tuition, Berea is similar to most other small, private liberal arts institutions in the U.S.

With a population of approximately 10,000, the city of Berea has a similar population density to the places its students move to after leaving. Using post-college address data, we find that Berea's population is at the 40th percentile based on zip code of residence 2 years after graduation. Relevant for Challenge 5 in Section 2.3, this suggests that the availability of various consumption goods and local amenities, aside from additional offerings associated with living in a "college town", is likely to be quite similar to that faced by students after they graduate.

[21] The BPS collected information about time use during both the in-school and post-college periods. In the first year of college, students on average spent about 21 hours per week studying outside of the classroom. They are also required to work for 10 hours per week. A typical student spends 12 hours in class per week. Adding all these up, we find that students spend roughly 43 hours working and studying while in college. This is similar to the average amount of time spent working (about 41 hours per week) for our sample.

3.2 Overview of BPS Surveys and Key Variables

We begin our data description with a brief overview of the BPS surveys used to create key variables for our analysis. The next subsection provides greater details on these variables and the main samples we use. Because a question critical to determining the extent of borrowing constraints was not available in early years for the 2000 cohort, our analysis focuses only on the cohort of students who matriculated in 2001. We also focus mainly on determining the consumption value associated with the first year of college, allowing us to identify consumption values for all attendees. Considering later years of school necessarily limits the sample to those who have remained in college. With that in mind, we also report select results below based on the second year of college.

Baseline (College Entry) Survey. The baseline survey was completed by 375 (out of 434) students immediately after they entered Berea College in 2001. It elicited beliefs about each student's own (subjective) distribution of post-college earnings and administered a battery of questions designed to identify person-specific measures of risk aversion, ρ. Administrative data on standard background information (e.g., gender, race, high school grades, family income) were also merged with survey records for each student.

Second Semester Survey. The second survey we use was administered at the beginning of the second semester. Roughly 9% of Berea freshman had dropped out by the time of this survey, which collected information from 327 respondents about their consumption expenditures during the first year of college (used to determine C_1^{ex}) and information about desired borrowing used to determine d and whether students are debt-averse.

End-of-College Survey. Students were surveyed at the end of their college careers. With a cumulative drop out rate of nearly 50%, these surveys collected information about end-of-college savings, college loans, credit debt, and other loans from 195 students. These responses are combined to create our measure of end-of-college debt, D_{G+1}.

Post-College Survey. The last major survey we use was administered to 247 students during the first year after graduation (2006 for most students).[22] It collected information on post-college consumption, C_{G+1}, and earnings, W_{G+1}. The sample size for the post-college

[22] A small fraction of students spent five years in college, so their first post-college year was 2007.

survey is somewhat larger than the sample size for the end-of-college survey, in part, because participation on the baseline survey was a necessary condition for subsequent in-school survey participation, but not for post-college survey participation.

3.3 First-Year Measures of Consumption, Desired Borrowing, and Beliefs

The BPS baseline survey asks students to report the value of all expenditures (other than room and board charges and spending on textbooks) during the first year of college, which we denote C_1^{oth}. The value of room and board for the academic year at Berea is \$4,760 (in 2001 dollars), which is quite similar to that of comparable four-year colleges in the Appalachian region of Kentucky.[23] We further assume that the quality of food and housing that students receive in-kind from parents during the three-month summer break is similar to the quality of accommodations received at Berea during the school year. We, therefore, inflate Berea's room and board costs by the factor 12/9 to obtain a total annual value for food and housing of $C^{fh} = \$6{,}350$.[24] Based on the CES, we find that this amount is similar to the housing and food expenditures for a representative sample of college students who do not live on campus.[25] Related to Challenge 5 in Section 2.3, this suggests that constraints on housing and food associated with living on campus are unlikely to account for empirically important jumps in consumption expenditures when students leave college. Total expenditures during the first year of college are $C_1^{ex} = C_1^{oth} + C^{fh}$.

Crucial for identification of $\mathcal{V}_t$, the BPS contains a unique question that characterizes students' preferred additional borrowing — and, therefore, the presence of borrowing constraints — while in school:

- Suppose that someone offered to loan you money this year so that you could increase the amount of money that you would have for spending money during this year. Suppose

[23]Based on figures from the US News & World Report Best Colleges listing (www.usnews.com/best-colleges), average room and board charges amount to \$5,800 for the following set of institutions: Berea College, Alice Lloyd College, Eastern Kentucky University, Morehead State University, Union College, University of Pikeville, and University of the Cumberlands. This average is based on amounts for academic years 2017-18 or 2018-19, adjusted for inflation to 2001 dollars using the CPI.

[24]This amount is quite similar to average per-person expenditures on food and housing for households with a 22–29 year old college graduate living (in the South) with his/her parents. See Appendix A.2.

[25]Based on the 2000-2008 CES, 19–22 year-olds enrolled in college and not living in student housing spent \$2,032 (in 2001 \$) per quarter on food and housing. This includes the following expenditure categories: food at home, away from home (excluding school), and at school; owned dwellings; rent; housing at school; utilities; and household operations. Sample restricted to single person consumer units.

that the loan is made at a fair interest rate and that you would not have to begin repaying the loan until after you leave Berea.

Q.1. Would you accept the loan? **YES** **NO**

- **Q.1.A. If you answered YES,**

  You would like to borrow money to increase your spending at Berea during this year. Remember, you will have to pay back the loan and any interest after leaving Berea. How much money would you choose to borrow this year in order to increase your spending money this year? $_____

We set $d_t = 0$ for students who would not accept a loan and set d_t to the desired amount reported in Q.1.A for those who would.[26] In considering the quality of survey responses to this question, it is noteworthy that students are being asked to consider choices — whether and how much to borrow — that should be quite salient to them.[27] Indeed, as discussed later in this section, roughly four-fifths of Berea students borrow during school, with these students accumulating an average of over $5,500 in debt during their college careers.

A separate battery of questions elicits students' beliefs about the distribution of future period t earnings, $F_1^{W_t}$, asked during the first year of college. Students were asked about three specific future periods (1, 6, and 16 years after graduation), which we use to determine belief distributions about earnings over students' future post-college careers. Given the importance of beliefs about the possibility of low earnings realizations (for the expected marginal utility of post-college consumption), it is noteworthy that the preamble to these questions explicitly asked respondents to take into account "...the possibility that [they would] work part-time, the possibility that [they would] not be working at all, and the possibility that [they would] attend graduate school."

Students were asked to report the minimum ($\underline{W}_{1,t}$) and three quartiles ($Q_{1,t}^k$, for $k = 1, 2, 3$) of their belief distributions. Assuming that $F_1^{W_t}$ is a shifted log-normal distribution,

[26] Given that, on average, students believe the probability of graduating is greater than 80%, we assume that leaving Berea is equivalent to spending $G = 4$ years in college.

[27] In their study of the importance of credit constraints, Stinebrickner and Stinebrickner (2008b) show that this question is predictive of college dropout, even when conditioning on observed characteristics like race and high school grades. Crossley and Low (2014) exhibit the usefulness of a similar survey question that was administered to characterize whether young workers would like to borrow.

i.e., $\log(W_t - \underline{W}_{1,t}) \sim N(\mu_{1,t}, \sigma^2_{1,t})$, we identify individual-specific distribution parameters:

$$\mu_{1,t} = \log\left(Q^2_{1,t} - \underline{W}_{1,t}\right) \quad \text{and} \quad \sigma_{1,t} = \log\left(\left[\frac{Q^3_{1,t} - \underline{W}_{1,t}}{Q^1_{1,t} - \underline{W}_{1,t}}\right]\right) / \left[\Phi(0.75) - \Phi(0.25)\right], \tag{10}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function (CDF). After dropping 26 students who reported invalid (i.e., non-response, non-increasing quartile values) or extreme (expected maximum earnings over \$1 million) responses, we are left with 349 students with measured belief distributions given by $(\underline{W}_{1,t}, \mu_{1,t}, \sigma_{1,t})$.

Overall, there are 300 students for whom we have valid measures of consumption expenditures C_1^{ex}, desired borrowing d_1, and subjective beliefs about post-college earnings $F_1^{W_t}$. We estimate $\mathcal{V}_1$ for these students.

Table 1 summarizes our measures of college consumption, desired borrowing, and beliefs about post-college earnings elicited during the first year of college for our main in-school sample.[28] On average, students at Berea College spend only \$970/year on consumption goods and services, in addition to Berea's room and board charges and textbook purchases. More than two-thirds report that they would not like to borrow more ($d_1 = 0$), while the rest report average desired additional borrowing, d_1, of \$890. Combining these figures with C^{fh}, average preferred annual consumption expenditure during college ($C_1^{ex} + d_1$) is $\$7,500$. The median of individual-specific subjective earnings distributions for the first year out of school ($Q^2_{1,G+1}$) has a sample average of \$43,820, while the reported minimum value ($\underline{W}_{1,G+1}$) has a sample average of \$28,830. On average, students expect to earn much more after school than they spend when in school; however, there is considerable heterogeneity in beliefs about post-college earnings, especially in comparison with the variation in college consumption expenditures.

3.4 Post-College Debt, Consumption, and Earnings

The BPS also collects information on actual earnings, W_{G+1}, and consumption, C_{G+1}, during the first year after college. Unlike the in-school surveys, which only asked about total consumption expenditures, the post-college survey asked students to report expenditures on 10 distinct categories of goods/services, which we combine to create our measure of total post-college consumption C_{G+1}. (See Appendix Table A-2 for the distribution of expenditures within each category.)

[28] All dollar amounts in the paper are reported in year 2001 dollars based on the CPI.

Table 1: First-Year Consumption, Desired Borrowing, and Beliefs in BPS

	C_1^{oth}	d_1	d_1 (if > 0)	$Q^2_{1,G+1}$ (Median)	$\underline{W}_{1,G+1}$ (Min)
Mean	0.97	0.18	0.89	43.82	28.83
Std. Dev.	1.47	0.56	0.97	24.50	16.05
1^{st} Quartile	0.40	0.00	0.30	30.00	20.00
Median	0.60	0.00	0.50	40.00	28.00
3^{rd} Quartile	1.00	0.00	1.00	51.75	35.00
Sample Size	300	300	60	300	300

Notes: All values in thousands of year 2001 U.S. dollars. C_1^{oth} represents reported annual consumption expenditures (excluding room, board, and textbooks) during the first year of college. d_1 represents the amount of additional loan a student is willing to take in the hypothetical borrowing scenario during the first year of college. $Q^2_{1,G+1}$ and $\underline{W}_{1,G+1}$ are the median and minimum of reported subjective earnings distributions during the first year of college, respectively.

A potentially important practical concern is that reported post-college consumption expenditures may understate effective post-college consumption if individuals receive transfers in-kind from parents or other family members. This concern is particularly relevant for food and housing consumption for those who live with family after graduation (Kaplan, 2012). To address this concern, we turn to the CES from 2003–2007, using it to estimate average annual food and housing expenditures for 22–29 year-old college graduates living with their parents (in the South) as a function of own and parental earnings (see Appendix A.2). We then use these estimates to impute post-college food and housing spending for Berea graduates who are living with their parents at $t = G + 1$ and report less spending (than the CES value) on these categories. This adjusted measure of food and housing expenditures is used in the construction of our baseline measure of total post-college consumption, C_{G+1}.[29]

Student debt at the end of college, D_{G+1}, is obtained for 195 sample respondents. Among these students, 81% reported positive end-of-college debt, where net savings implies $D_{G+1} < 0$. The average accumulated debt was \$5,640 with a standard deviation of \$6,660 and an interquartile range of \$7,750. Our baseline analysis imputes missing values of post-college debt using observed demographic characteristics as predictors.[30]

Since the post-college consumption function $\tilde{C}(\cdot)$ depends on C_{G+1} and W_{G+1}, we use a

[29]About one-third of students in our sample were living with their parents at $t = G + 1$. Nearly all of these students (53/56) reported post-college food and housing consumption expenditures less than their predicted amounts based on estimates from the CES, which averaged \$7,220. In Section 5.1, we consider a more conservative alternative that does not adjust reported post-college consumption in this way.

[30]The predictors include gender, race, high school GPA, and family income in the first year of college.

Table 2: Post-College Debt, Consumption, and Earnings in BPS

	D_{G+1}	C_{G+1}	W_{G+1}
Mean	5.87	14.41	20.11
Std. Dev.	5.83	9.87	10.53
1^{st} Quartile	2.52	9.66	12.95
Median	4.89	12.68	18.68
3^{st} Quartile	8.04	17.45	26.12
Sample Size	151	151	151

Notes: All values in thousands of year 2001 U.S. dollars. D_{G+1} reflects end-of-college total debt. C_{G+1} and W_{G+1} are realized annual consumption and earnings in the first year after college, respectively.

sample that differs from our main in-school sample when estimating this function. This sample is limited to graduates of Berea who reported positive post-college consumption, C_{G+1}, and earnings, W_{G+1}. Dropping those few recent graduates with children yields a sample of 194 graduates. Further excluding married respondents yields our main post-college sample of 151 unmarried, childless Berea graduates (with positive earnings and consumption). These additional family composition restrictions are imposed to avoid taking a stand on family consumption allocation decisions, since our main goal in estimating $\tilde{C}(\cdot,\cdot)$ is to determine how much students expect to consume (themselves) after college. However, we explore the robustness of our results to the inclusion of married graduates under an equal allocation rule.

Table 2 describes our data on post-college debt, consumption, and realized earnings for our main post-college sample. The average post-college debt for this sample is \$5,870 (about \$230 more than average post-college debt for the full sample of 195 respondents who reported D_{G+1}).[31] During the first year after college, average consumption spending for these individuals was \$14,410 while actual earnings averaged \$20,110.

The much higher average post-college expenditures relative to (desired) spending during college (\$14,410 vs. \$7,560) is a strong indication that college provides considerable consumption benefits.[32] Yet, this simple comparison neglects important concerns. On the one hand, uncertainty about post-school earnings could explain some of the rise in consumption.

[31] We impute D_{G+1} for 33 (out of the 151) graduates in the main post-college sample who responded to the post-college survey but not the end-of-college survey.

[32] This large difference in consumption during and after college also exists when considering the 124 students in both the main in-school and post-college samples, which yields averages for $C_1^{ex} + d$ and C_{G+1} of \$7,350 and \$14,190, respectively.

On the other hand, actual post-college earnings are substantially less than what students anticipated during their first year of college, consistent with the broader literature using expectations data.[33] This optimism suggests that a simple comparison of consumption during and after school may lead to an under-statement of the true consumption value of college. Fortunately, our approach explicitly accounts for both of these factors in estimating $\mathcal{V}_t$.

3.5 Risk-Aversion

We assume standard CRRA preferences, $U(C;\rho) = \frac{C^{1-\rho}}{1-\rho}$, throughout our analysis and use an approach based on Barsky et al. (1997) to estimate students' degree of risk aversion, ρ_i. Specifically, we determine ρ_i from a survey question that asks each person to compare the option of a risk-free wage with three options that all have a 50% chance of paying twice the risk-free wage and a 50% chance of paying either (1) one-half the risk-free wage, (2) two-thirds the risk-free wage, or (3) four-fifths the risk-free wage. For each person, the comparisons reveal whether ρ falls in $(0,1]$, $(1,2]$, $(2,3.76]$, or $(3.76,\infty)$.[34] For simplicity, our main analysis assigns values of 1, 1.5, 2.88, and 3.76 to these four categories, respectively; although, Section 5.1 shows that our results are robust to other reasonable assumptions.

Since the scenarios underlying these preference-eliciting questions were explicitly designed to mimic the type of lifecycle consumption/savings problem we consider, the implied ρ_i values are well-suited for our use.

4 Estimated Consumption Value of College under Rational Expectations

As noted above, we focus on the consumption value associated with the first year of college, which allows us to consider $\mathcal{V}_{i,t}$ for all students choosing to enroll in Berea College. Since our GMM approach requires data on both in-school and post-college consumption to compute

[33] Most directly related, Stinebrickner and Stinebrickner (2012) find that entering Berea students over-estimated their future grade performance. Based on a national sample of Americans, Dominitz (1998) shows that although elicited earnings beliefs are predictive of earnings one year later, they are also consistently biased upwards. Hastings et al. (2016) document that, on average, Chilean college applicants substantially over-estimated the earnings of college graduates, while Delavande and Zafar (2019) document a similar pattern among Pakistani post-secondary students. In the BPS, the evolution of expectations suggests that initial optimism fades as students progress through college, systematically revising their beliefs about post-college earnings downward. By the end of college, the sample average of Q^2_{G+1} falls to roughly \$27,000, much closer to, though still higher than, average actual post-college earnings.

[34] Among the 365 students who answered this risk preference question, 16% fall in $(0,1]$, 24% fall in $(1,2]$, 27% fall in $(2,3.76]$, and 33% fall in $(3.76,\infty)$.

the EE "error," we restrict our attention to students who appear in both the 300-student in-school sample and the 151-student post-college sample. This restriction results in a sample of 124 students. We consider the full sample of students (regardless of whether they are borrowing constrained), assuming that $\lambda_1(d_{i,1}, Z^d_{i,1}) = d_{i,1}\tilde{\lambda}_d + \mathbb{1}(d_{i,1} > 0)Z^d_{i,1}\tilde{\lambda}_Z$, where indicators for gender and race are included in the $Z^d_{i,1}$ characteristics. In terms of information structure, we let the information set variable $Z_{i,1}$ include gender, race, and risk-preference ρ_i.

Table 3 reports estimates of the average consumption value of college for the full sample, as well as separately for different subsamples. We begin by discussing our GMM estimates of $\mathcal{V}_1(Z^{\mathcal{V}}_1) = Z^{\mathcal{V}}_1\gamma_1$, allowing for variation by gender and race.[35] These estimates suggest that the average consumption value of the first year of college at Berea is about \$5,200. Female students appear to benefit more than male students, while differences by race are comparatively modest and statistically insignificant.[36] We observe little difference in the average consumption value of college for those who are borrowing constrained vs. those who are not, reflecting the fact that those reporting that they would like to borrow more do not desire much additional borrowing and, otherwise, have similar debt and consumption patterns to their unconstrained counterparts. This result is also consistent with our finding that none of the $(\tilde{\lambda}_d, \tilde{\lambda}_Z)$ parameter estimates is significant at a 5% level. See Appendix Table B-1 for the full set of estimation results.

Estimates in the final column of Table 3 are based on (sub)sample averages of $\tilde{\mathcal{V}}_{i,1}$ using our direct approach.[37] Compared to the GMM estimates, these indicate a slightly lower average consumption value (\$4,300) for the full sample. These estimates also indicate a higher consumption value for female students; although, the gap is only about \$500 and not statistically significant. By contrast, the gap between black and non-black students is slightly higher, though insignificant, at nearly \$1,000. Estimated differences in the consumption value between constrained and unconstrained students are modest and insignificant. Altogether, the patterns are quite similar across estimation approaches, although lower consumption values with the direct approach are consistent with measurement error in consumption, as discussed in Section 2.1.3.

[35] To identify γ_1, $\tilde{\lambda}_d$, and $\tilde{\lambda}_Z$, we use the following moments in estimation: $E(\xi_{i,1}Z_{i,1}) = 0$, $E(\xi_{i,1}d_{i,1}) = 0$, and $E(\xi_{i,1}\mathbb{1}(d_{i,1} > 0)Z_{i,1}) = 0$.

[36] Throughout the paper, we use a 5% significance level in reporting whether an estimate is statistically significant.

[37] Since we cannot reject $\tilde{\lambda}_d = \tilde{\lambda}_Z = 0$, we set $\lambda_1(d_{i,1}, Z^d_{i,1}) = 0$ in the calculation.

Table 3: Consumption Value Estimates (in $1,000s) under Rational Expectations

Sample	Num. Obs.	GMM Approach $\mathcal{V}_1(Z_1^{\mathcal{V}})$	Direct Approach $E(\mathcal{V}_{i,1}\|Z_{i,1}^{\mathcal{V}})$
All	124	5.18	4.30
		(0.84)	(2.38)
Male	35	2.57	3.89
		(1.06)	(2.24)
Female	89	6.20	4.46
		(1.08)	(2.59)
Black	24	4.78	5.06
		(1.47)	(2.77)
Non-Black	100	5.27	4.11
		(0.99)	(2.34)
Constrained	19	4.86	3.67
		(0.81)	(2.41)
Unconstrained	105	5.24	4.41
		(0.86)	(2.38)

Notes: Results are based on a balanced sample of students who appear in both the in-school and post-college samples. Characteristics affecting $\lambda_{i,1}(\cdot)$, $Z_{i,1}^d$, include gender and race. In estimating $\tilde{\mathcal{V}}_{i,1}$ and $E(\mathcal{V}_{i,1}|Z_{i,1}^{\mathcal{V}})$ for the Direct Approach, variables describing the information set, $Z_{i,1}$ include gender, race, and risk preference ρ_i. Bootstrapped standard errors are in parentheses.

Despite very low out-of-pocket expenditures, these results indicate that most students at Berea enjoy substantial consumption benefits while enrolled in school. This is generally confirmed by responses to an independent BPS survey question administered during the first year of college, which reveals that 80% of all students think that being in school is more enjoyable than being out of school.

5 Estimated Consumption Value of College using Subjective Expectations

In this section, we use data on subjective beliefs about post-college earnings and our three-step approach (see Section 2.2) to estimate mean consumption values, $E(\mathcal{V}_1|Z_i^{\mathcal{V}})$. We also discuss identification and estimation of the full distribution of the permanent component of consumption values, including any unobserved heterogeneity.

Step 1: Estimating the Post-College Consumption Function

We begin by estimating the post-college consumption function, $\tilde{C}(D_{G+1}, W_{G+1}, Z_i^C)$, needed for $E[U'(C_{i,G+1};\rho_i)|\mathcal{I}_{i,t}]$ in equation (7). In principle, one could non-parametrically estimate $\tilde{C}(D_{G+1}, W_{G+1}, Z_i^C)$ with cross-sectional data on post-college consumption, debt, earnings, and characteristics Z_i^C. Given our small sample sizes, we pursue a parametric approach. We include gender and race indicators, as well as risk-aversion, ρ_i, in the set of characteristics Z_i^C, allowing these to affect the level of consumption conditional on earnings and debt. Our baseline specification assumes that consumption is a linear function of earnings, where the intercept and slope (with respect to earnings) are allowed to differ for those with debt above and below the median.[38] These estimates are reported in Table 4, along with results for several other specifications.

Focusing on our baseline estimates of $\tilde{C}(\cdot)$ in column (1) of Table 4, we see that, conditional on debt and earnings, post-college consumption is about \$2,800 higher for men than women and about \$600 lower for blacks than non-blacks; however, neither of these estimates is statistically significant. Risk-aversion has negligible (and insignificant) effects. As one would expect, consumption is significantly increasing in earnings, with low-debt students

[38] After some exploration, we determined that debt levels have very modest effects on post-college consumption and that, conditional on debt and Z_i^C, consumption is approximately linear in earnings. Appendix Figure D-1 shows predicted consumption (residualized on Z_i^C) as a nonparametric function of (residualized) earnings for students with different debt levels.

consuming about 44 cents out of every dollar of additional income. Coefficient estimates on the indicator for high-debt levels and its interaction with earnings are both imprecise and statistically insignificant; however, the point estimates suggest that consumption is lower for high-debt students who earn more than $21,450 after college.

Table 4 also reports estimates for consumption functions based on different assumptions about the role of student debt. In all cases, we find that income has strong positive effects on consumption, while debt has (comparatively) small and statistically insignificant effects. As discussed below, the differences across specifications generate only modest differences in estimated consumption values, $E(\mathcal{V}_{i,1}|Z^{\mathcal{V}}_{i,1})$.

Table 4: Estimated Post-College Consumption Function (in $1,000s)

	(1)	(2)	(3)	(4)
Constant	4.253	7.034	2.463	7.072
	(3.399)	(2.884)	(3.694)	(2.896)
Male	2.773	2.791	2.674	2.526
	(1.684)	(1.692)	(1.714)	(1.701)
Black	-0.567	-1.118	-0.126	-0.565
	(1.988)	(1.964)	(2.013)	(2.009)
ρ	0.137	0.193	0.118	0.153
	(0.782)	(0.785)	(0.783)	(0.787)
Debt > Median	5.167			
	(3.385)			
Debt in middle tercile			6.440	
			(4.188)	
Debt in upper tercile			7.403	
			(3.976)	
Earning	0.438	0.331	0.546	0.367
	(0.106)	(0.080)	(0.126)	(0.088)
Earning × (Debt > Median)	-0.241	-0.041		
	(0.148)	(0.069)		
Earning × (Debt in middle tercile)			-0.347	-0.095
			(0.181)	(0.083)
Earning × (Debt in upper tercile)			-0.355	-0.062
			(0.179)	(0.086)

Notes: Each column reflects a separate regression with the consumption expenditure (in $1,000s) in the first year after graduation as the dependent variable. Earnings and debt (in $1000s) are also from the first year after graduation. Standard errors are in parentheses. Debt levels at 33rd, 50th, and 67th percentiles are $3,310, $4,890, and $6,820, respectively. Sample size is 151.

Step 2: Calculating $\tilde{\mathcal{V}}_{i,t}$

Substituting CRRA preferences into equation (9), we now calculate student-specific estimates, $\tilde{\mathcal{V}}_{i,t}$ for each student using the consumption function estimated in Step 1:

$$\begin{aligned}\tilde{\mathcal{V}}_{i,t} &= \left([\beta(1+r)]^{G+1-t} E_{i,t}\left[\tilde{C}\left(D_{i,G+1} + (1+r)^{G+1-t} d_{i,t}, W_{i,G+1}, Z_i^C\right)^{-\rho_i}\right]\right)^{-1/\rho_i} \\ &\quad - C_{i,t}^{ex} - d_{i,t}. \end{aligned} \tag{11}$$

As discussed in Section 2.2, expectations are taken with respect to each student's own subjective beliefs about post-college earnings, $F_{i,t}^{W_{G+1}}$.

Conditional on student characteristics, $Z_{i,t}^{\mathcal{V}}$, variation in $\tilde{\mathcal{V}}_{i,t}$ comes from differences in risk-aversion, ρ_i, in-school beliefs $F_{i,t}^{W_{G+1}}(\cdot)$, preferred consumption in college $C_{i,t}^{ex} + d_{i,t}$, and preferred student debt $D_{i,G+1} + (1+r)^G d_{i,t}$, as well as any measurement error in consumption expenditures during college. Because of measurement error, these estimates will generally be more disbursed than the distribution of true consumption values, $F_{\mathcal{V}_t}$. Figure 3 reports the distributions of $\tilde{\mathcal{V}}_{i,t}$ for the first two years of college.[39]

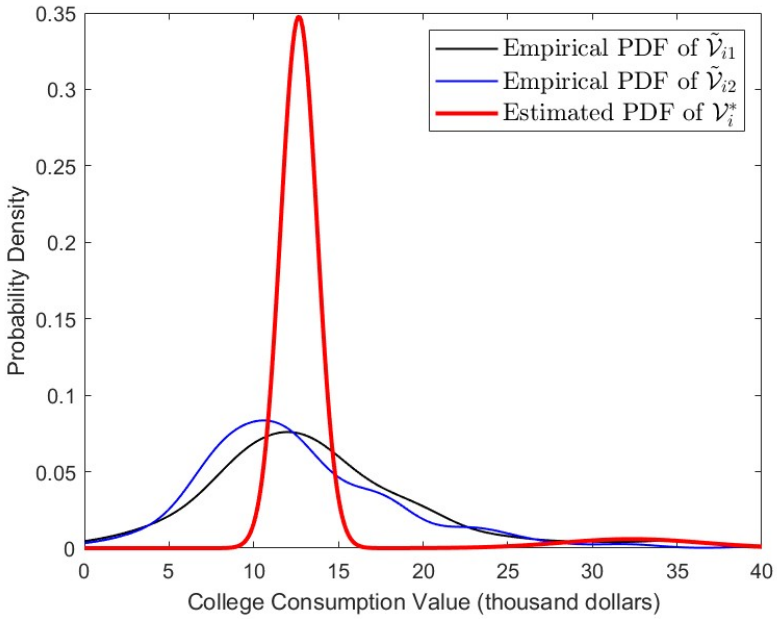
Step 3: Estimating $E[\mathcal{V}_{i,t}|Z_{i,t}^{\mathcal{V}}]$ and the distribution $F_{\mathcal{V}}(\cdot)$

We can consistently estimate mean consumption values (unconditional or conditional on any population subgroup defined by $Z_{i,t}^{\mathcal{V}}$). Table 5 shows that the average consumption value (for the first year of college) across all Berea students is about \$14,300. This is roughly \$9,000 higher than estimated values based on the RE assumption reported in Table 3. Measurement error in consumption during college may explain some of the difference. As noted in Section 2.1.3, estimates of mean consumption values based on the Direct Approach under RE are biased downward when $U'''(\cdot) > 0$, as is the case for CRRA preferences. A more important factor, however, is the overly optimistic beliefs held by students entering college, who expect to earn much more than they ultimately do. A larger consumption value of college is needed to reconcile such low consumption during college given much higher expected future earnings and consumption.

Looking at other rows in Table 5, we see that male students, on average, benefit from a \$3,700 (30%) greater consumption value during their first year of college than do female

[39] We find a correlation between $\tilde{\mathcal{V}}_1$ and $\tilde{\mathcal{V}}_2$ of 0.31. See Appendix E for details on $\tilde{\mathcal{V}}_2$ estimates using data from the second year of college.

Figure 3: Estimated Distribution of $\tilde{\mathcal{V}}_{1,i}$, $\tilde{\mathcal{V}}_{2,i}$, and $\mathcal{V}_i$



Notes: Kernel density estimated distributions for $\tilde{\mathcal{V}}_{i,1}$ and $\tilde{\mathcal{V}}_{i,2}$. Estimated distribution for $\mathcal{V}_i$ based on $\tilde{\mathcal{V}}_{i,t} = \mathcal{V}_i + \tilde{\nu}_{i,t}$ where $\mathcal{V}_i$ is a mixture of two Normal distributions and $\tilde{\nu}_{i,t} \sim N(0, \sigma^2_{\nu,t})$ for $t = 1, 2$.

students, this gap reversed from that under RE.[40] While the gender gap is statistically insignificant, a higher consumption value of college for men would be consistent with the fact that male students at Berea devote less time to studying than their female counterparts (Stinebrickner and Stinebrickner, 2012). The estimates also suggest that black students benefit from a $1,200 (about 8%) higher consumption value than non-black students; although, this gap is also insignificant. Finally, we estimate little difference in the consumption value of college for constrained vs. unconstrained students. This is consistent with our finding of insignificant Lagrange multipliers on the borrowing constraint under RE (Section 4).

Finally, we use estimates of $\tilde{\mathcal{V}}_{i,1}$ and $\tilde{\mathcal{V}}_{i,2}$ to estimate the distribution of the permanent component of consumption values, $\mathcal{V}_i$, assuming that $\tilde{\mathcal{V}}_{i,t} = \mathcal{V}_i + \tilde{\nu}_{i,t}$ where $\tilde{\nu}_{i,t} \sim N(0, \sigma^2_{\nu,t})$, for $t = 1, 2$, reflects a combination of year-to-year fluctuations in $\mathcal{V}_{i,t}$ and measurement error in college consumption expenditures. The distribution for $\mathcal{V}_i$ is assumed to be a mixture of two Normal distributions. Figure 3 shows the estimated distribution for $\mathcal{V}_i$, along with nonparametrically estimated distributions for $\tilde{\mathcal{V}}_{i,1}$ and $\tilde{\mathcal{V}}_{i,2}$. The results suggest considerable

[40] Mechanically, the larger estimated increase in mean consumption values among men is (relative to women) due to their greater over-optimism about future earnings.

Table 5: Consumption Value Estimates (in $1,000s) Using Subjective Expectations

Sample	Num. Obs.	$E(\mathcal{V}_{i,1}\|Z^{\mathcal{V}}_{i,1})$
All	300	14.27
		(1.86)
Male	131	16.34
		(2.74)
Female	169	12.66
		(1.44)
Black	49	15.26
		(2.09)
Non-Black	251	14.07
		(2.00)
Constrained	60	13.57
		(1.65)
Unconstrained	240	14.44
		(2.03)

Notes: Results are based on the main in-school sample with 300 observations. The consumption function is based on estimates reported in column (1) of Table 4. Bootstrapped standard errors are in parentheses.

measurement error in consumption or idiosyncratic year-to-year variation in the consumption value of college with most of the distribution for $\mathcal{V}_i$ between $10,000 and $16,000.[41]

The estimated variation in $\mathcal{V}_i$ (across and within demographic groups) suggests that even students who choose to attend the same institution — and therefore, enjoy similar campus and local opportunities — appear to place different values on those opportunities (or avail themselves of different opportunities).

5.1 Robustness

While our baseline analysis addresses important concerns about borrowing constraints, it abstracts from several other factors that may distort intertemporal consumption allocations. We explore three of those factors in this subsection, along with other measurement issues related to preferences, beliefs, and consumption. Estimated mean consumption values, $E(\mathcal{V}_{i,t}|Z^{\mathcal{V}}_{i,1})$, for these specifications are reported in Table 6, while associated estimates for the consumption functions, $\tilde{C}(\cdot)$, are reported in Appendix Table D-2.

[41] The estimated distribution is identified from the balanced sample of 188 students for whom both $\tilde{\mathcal{V}}_{i,1}$ and $\tilde{\mathcal{V}}_{i,2}$ are obtained.

5.1.1 Main Challenges with EE Approach

We begin by considering three potential challenges to our EE-based approach described in Section 2.3: (1) debt-aversion could create a jump in consumption after school; (2) consumption of durable goods can complicate the structure of the EE; and (3) the EE focuses on aggregate consumption, implicitly assuming that individual consumption goods (e.g., housing, food, and other goods) are perfect substitutes.

Debt-aversion. Thus far, we have treated all borrowers as unconstrained (with $d_1 = 0$) if they answered 'no' to the BPS question asking if students would accept a loan at reasonable interest rates. An important concern is that some of these students may have answered this way, because they are reluctant to borrow even though they are not fully consumption-smoothing. That is, they may be debt-averse. In this case, the EE would not be satisfied with equality as our approach assumes.[42]

To address this concern, we use a follow-up BPS question that asks why students do not want to borrow more (if they would not accept an additional loan). We identify students as "debt-averse" if any of their responses indicate that they would reject a loan for a reason other than consumption smoothing (see Appendix A.1 for details). Dropping these students from our sample, we re-estimate $\tilde{\mathcal{V}}_{i,1}$ for all non-debt-averse students, reporting mean consumption values for this population in Panel A of Table 6. Even though this drops 120 students otherwise defined as "unconstrained", it has negligible effects on our estimates of $E(\mathcal{V}_1|Z_1^{\mathcal{V}})$ for all subsamples. Given the similarity of results when dropping these students and the very low levels of desired borrowing even among those reporting that they are constrained, we continue to include these potentially debt-averse students in our remaining analysis.

Durable goods. Another concern is that our measure of C_{G+1} may contain expenditures on durable goods such as cars, which could potentially lead to artificially high levels of measured consumption after school. Put another way, the price paid for durable goods may cover utility flows for multiple years. This would also mean that, within a particular consumption category that contains durable goods, such expenditures should tend not to appear repeatedly over a short time horizon. For example, a student who buys a car (or expensive television) at $t = G + 1$ is likely to benefit from that car (or television) for several years and

[42] In this case, our estimates would provide an upper-bound for the consumption value.

Table 6: $E(\mathcal{V}_{i,1}|Z^{\mathcal{V}}_{i,1})$ (in \$1,000s) under Alternative Assumptions

	All	Male	Female	Black	Non-Black	Const.	Unconst.
A) Exclude Debt-Averse Students							
$E(\mathcal{V}_{i,1}\|Z^{\mathcal{V}}_{i,1})$	14.04	16.09	12.12	14.80	13.88	13.57	14.27
Sample size	180	87	93	31	149	60	120
B) Other Robustness for $E(\mathcal{V}_{i,1}\|Z^{\mathcal{V}}_{i,1})$							
1. Conservative adjustment for durable goods	12.35	14.27	10.87	12.18	12.39	11.30	12.60
2. Exclude housing consumption ($\mathcal{V}^o_1$)	12.58	14.86	10.82	13.42	12.42	11.74	12.79
3. $\beta = 1/1.05$ and $r = 0.08$	12.99	14.92	11.50	14.00	12.80	12.28	13.17
4. $max\{\rho\} = 5$	14.05	16.11	12.46	14.93	13.88	13.38	14.22
5. $\rho = 2$	14.35	16.36	12.78	15.43	14.13	13.56	14.54
6. Alternative interpretation of income beliefs	13.11	15.10	11.56	14.19	12.90	12.80	13.18
7. Conservative extrapolation for C_{G+1}	12.20	13.65	11.08	12.78	12.09	11.30	12.43
8. Include married individuals	12.22	13.39	11.32	13.95	11.89	11.54	12.40
9. Ignoring post-college transfers (living at home)	13.47	15.79	11.68	14.09	13.35	13.19	13.54
10. Model-based approach for $C(\cdot)$	22.62	24.72	20.98	26.66	21.83	24.04	22.26
Sample size	300	131	169	49	251	60	240

Notes: Results in Panel A are based on 180 students who either accepted an additional loan or said they did not want an additional loan for reasons unrelated to debt-aversion. Results in Panel B are based on the main in-school sample with 300 observations.

is, therefore, unlikely to buy another car (or television) over the next few years. This suggests that the lesser of a student's reported expenditures on a particular category of goods containing durables in $t = G + 1$ and the student's reported expenditures on that category in $t = G + 2$ should represent a conservative measure of non-durable expenditures for that category in $t = G + 1$. We, therefore, take advantage of measured consumption expenditures for 10 categories of goods and services. Among these categories, two plausibly include spending on durable goods: "Car and other travel expenses including gas, car payments, and car insurance" and "Music, computer equipment, TV and stereo equipment, and other electronic equipment". Based on this, we construct an alternative measure of C_{G+1} where, separately for each of these two categories, students' reported consumption expenditures at time $t = G+1$ for the category are replaced by the lesser of the amount reported in $t = G+1$ and $t = G + 2$. The sample average of this alternative measure is roughly \$1,000 lower than that of our baseline measure. We then estimate $\tilde{C}(\cdot)$ using these measures of C_{G+1}. As shown in Panel B (specification 1) of Table 6, this conservative alternative yields a mean consumption value of college that is about \$2,000 (15%) lower than our baseline estimates, with similar declines for all student subgroups.

Housing. Our baseline specification assumes that housing is perfectly substitutable with other consumption goods and services. Here, we consider an alternative specification in which utility is separable in housing, C^h, and all other consumption, C^o:

$$\tilde{U}(C^o, C^h; \rho) = U^o(C^o; \rho) + U^h(C^h),$$

where $U^o(C^o; \rho) = \frac{(C^o)^{1-\rho}}{1-\rho}$. In the post-college period, C_t^h and C_t^o are assumed to equal the expenditures on housing and other consumption goods, respectively. During college, we assume that students receive free consumption benefits from college, so $C_1^o = C_1^{o,ex} + \mathcal{V}_1^o$ and $C_1^h = C_1^{h,ex} + \mathcal{V}_1^h$, where $\mathcal{V}_1^o$ and $\mathcal{V}_1^h$ reflect the consumption benefits of college that are substitutable with non-housing ($C_1^{o,ex}$) and housing-related ($C_1^{h,ex}$) purchases, respectively.

In the first year of college, most Berea students lived in the dorm, hence C_1^h was, to a large extent, exogenously set by the college. This has two important implications. First, we cannot apply the Euler equation approach to identify $\mathcal{V}_1^h$, because students were unable to smooth their housing consumption. Second, survey-reported in-college expenditures and the desired additional loan d_1 all go towards non-housing consumption goods. Hence, we can modify equation (11) as follows to estimate the non-housing consumption value, $\mathcal{V}_1^o$, from

$$\tilde{\mathcal{V}}_1^o = \left([\beta(1+r)]^G E\left[\tilde{C}^o \left(D_{G+1} + (1+r)^G d_1, W_{G+1}, Z^C \right)^{-\rho} \right] \right)^{-1/\rho} - C_1^{o,ex} - d_1,$$

where $C_1^{o,ex}$ reflects self-reported in-college expenditures plus the annual value of food provided as part of Berea's room and board.[43] Due to separability, estimation of $\tilde{\mathcal{V}}_1^o$ requires no assumptions on $U^h(\cdot)$ or C_{G+1}^h.

We estimate the non-housing post-college consumption function $\tilde{C}^o(D_{G+1}, W_{G+1}, Z^C)$ using data on D_{G+1}, W_{G+1}, Z^C, and non-housing post-college consumption C_{G+1}^o.[44] The mean non-housing consumption value $E(\mathcal{V}_1^o)$, reported in Panel B (specification 2) of Table 6, is about \$1,700 less than our baseline estimate of the mean overall consumption value, $E(\mathcal{V}_1)$.

5.1.2 Additional Robustness Analysis

Next, we explore the robustness of our results to different assumptions about preferences and to alternative methods for characterizing both subjective beliefs about post-college earnings

[43] Recall that the annual value for food and housing, C^{fh}, is \$6,350. Using reported post-college consumption data (accounting for in-kind transfers for graduates living with their parents), we find that the ratio of average food expenditure to average food and housing expenditures is roughly 0.254. Letting $C^f = \$6,350 \times 0.254 = \$1,610$, we define $C_1^{o,ex} = C_1^{oth} + C^f$, where C_1^{oth} is defined earlier in Section 3.3 as total reported expenditures on all items except Berea-provided room and board (and textbooks).

[44] We use the same specification for $\tilde{C}^o(\cdot)$ as we use for our baseline $\tilde{C}(\cdot)$, including race, gender, and risk-aversion parameter ρ_i in Z^C.

and the post-college consumption function.

Alternative assumptions about preferences and interest rates. It is clear from equation (11) that estimated consumption values are decreasing in $\beta(1+r)$, which we assume equals 1, implying that students want to equate expected marginal utilities of consumption over time. Intuitively, the more students discount the future (i.e., lower β) or the lower they earn on savings (i.e., lower r), the higher should be desired in-school consumption relative to post-school consumption. For any observed consumption expenditure amounts and beliefs about post-school earnings, a higher consumption value of college is needed to equate marginal expected utility over time.

Recognizing that college students may believe borrowing costs are high, we explore the sensitivity of our consumption value estimates to assuming $\beta(1+r) = 1.026$, consistent with a standard discount rate of $\beta = 1/1.05$ and a high interest rate of $r = 0.08$. As shown in Panel B (specification 3) of Table 6, even this high interest rate only reduces the mean consumption value of college by about \$1,300 relative to the baseline case.

We also examine the sensitivity of our results to alternative assumptions about risk-aversion, ρ_i. We begin by considering our baseline assumption that $\rho = 3.76$ for those students whose self-reported risk preference places their value of ρ in the range of $(3.76, \infty)$, instead assuming a value of $\rho = 5$ for these students. Given the inherent challenges in eliciting preferences for individuals, we also calculate $E(\mathcal{V}_1|Z_1^{\mathcal{V}})$ using "standard" assumptions for risk-aversion, setting $\rho = 2$ for all students (Browning, Hansen, and Heckman, 1999). In both cases, the resulting estimates for average consumption values are nearly identical to those of our baseline case (see Panel B, specifications 4 and 5, of Table 6).

Altogether, these results suggest that reasonable alternative assumptions about preferences and interest rates all yield an average consumption value of college that ranges between \$13,000 and \$14,400.

Alternative interpretation of reported subjective earnings distributions. A key feature of the BPS is the elicitation of distributions describing beliefs about future earnings. Due to diminishing marginal utility, consumption decisions tend to be sensitive to the left tail of subjective (future) earnings distributions, since individuals want to avoid even the smallest possibility of near-zero consumption. This makes it particularly important to elicit beliefs about worst-case scenarios for future earnings. Fortunately, as discussed in Section 3.3, the

preamble to belief-elicitation questions instructed survey respondents to consider the most salient reason that low earnings could arise — that they might not be working in the future.

Nonetheless, to explore the consumption value under a more conservative assumption about how students respond to survey questions about their beliefs, we re-estimate consumption values assuming that reported student beliefs reflect the distribution of earnings conditional on working (i.e., despite the instructions, students ignore the possibility of not working). This robustness check takes advantage of a first-year BPS survey question that elicits each student's perceived probability of not working in different post-college years t, P_t^U. These perceived probabilities are quite low for Berea students. On average, P_t^U is 0.09 in the first post-college year ($t = G + 1$), dropping to about 0.06 both five ($t = G + 6$) and fifteen ($t = G + 16$) years later.

Since unemployment spells typically last only a few months, we assume that P_t^U reflects the fraction of year t that a student expects to be non-employed. In this case, a student's unconditional subjective earnings distribution can be obtained by multiplying each realization of the reported subjective earnings distribution by $(1 - P_t^U)$.[45] As reported in Panel B (specification 6) of Table 6, this conservative approach yields an estimate of $E(\mathcal{V}_1)$ of \$13,110, only about \$1,200 less than the baseline estimate.

Alternative estimates of the post-college consumption function. We next consider several alternative robustness checks related to estimation of the post-college consumption function.[46]

One practical concern in estimating $\tilde{C}(D_{G+1}, W_{G+1}, Z^C)$ is that students' expectations about post-college earnings often exceed their actual post-college earnings. The empirical support of post-college earnings does not cover roughly 30% of the upper end of the support for students' subjective earnings distributions, requiring extrapolation of the post-college consumption function at these earnings realizations. To examine the sensitivity of our results to this extrapolation, we calculate $\tilde{\mathcal{V}}_{i,1}$ assuming that consumption remains constant above the highest observed post-college earnings level in our sample, i.e., $\tilde{C}(D_{G+1}, W_{G+1}, Z^C) =$

[45] This approach abstracts from any unemployment insurance individuals may expect to receive. In estimating $\tilde{C}(\cdot)$, it also implicitly assumes that individuals working at the time of the survey did not experience any periods of unemployment over the year. Both of these assumptions imply that we obtain conservative estimates of $E(\mathcal{V}_1)$. For an even more conservative approach, Appendix D.2 considers the case in which P_t^U reflects the probability that a student is unemployed for the entire year t. This suggests an average consumption value of \$11,900, about 17% lower than the baseline average.

[46] See Appendix Table D-2 for estimated consumption functions $\tilde{C}(\cdot)$ and sample sizes for all specifications.

$\tilde{C}(D_{G+1}, \max\{W_{G+1}\}, Z^C)$ for all $W \geq \max\{W_{G+1}\}$. This assumption yields lower bound estimates of $E(V_1|Z^{\mathcal{V}})$ if $\tilde{C}(D_{G+1}, W_{G+1}, Z^C)$ is non-decreasing in W_{G+1}. As shown in Panel B (specification 7) of Table 6, the mean consumption value estimated under this assumption is about \$2,000 (15%) lower than the baseline estimate.

A second challenge in estimation of the post-college consumption function arises because some students are married at $t = G + 1$ while our Euler equation characterizes the trade-off faced by single individuals. Our baseline approach addresses this by limiting the analysis to unmarried students. Here, we instead include married graduates in the estimation of $\tilde{C}(\cdot)$, assuming that their individual earnings and consumption are one-half their family earnings and consumption, respectively. As shown in Panel B (specification 8) of Table 6, this reduces the estimated mean consumption value of college by about \$2,000 (15%) relative to our baseline estimate.

Next, we note that our baseline estimates use data from the CES to impute food and housing consumption for graduates living with their parents who report low expenditures on these items. For these individuals, post-college consumption expenditures (especially on food and housing) are likely to understate C_{G+1} due to in-kind parental transfers. Here, we explore the implications of this adjustment by re-estimating the post-college consumption function using all reported consumption amounts, ignoring any potential unpaid benefits associated with living with parents. As shown in Panel B (specification 9) of Table 6, this reduces the estimated mean consumption value of college by only \$800 relative to the baseline estimate.

A model-based approach for the post-college consumption function. Finally, we consider a model-based approach for determining the post-college consumption function $\tilde{C}(\cdot)$, assuming that this reflects the solution to a relatively standard lifecycle consumption allocation problem from period $t = G + 1$ to retirement. In particular, we assume that students continue to face uncertainty and borrowing constraints after college; although, we allow them to roll over their initial post-college debt.[47] In this case, $\tilde{C}(\cdot)$ depends on beliefs about the lifecycle earnings process. Appendix C discusses in detail the model and

[47] One could allow students to additionally borrow up to a fixed amount after college, broadly consistent with the model settings in, e.g., Johnson (2013) and Abbott et al. (2019). This would likely result in students wanting higher consumption during and immediately after college, implying an even higher college consumption value.

its parameterization. As shown in Panel B (specification 10) of Table 6, this yields larger consumption values than our baseline estimates. Given the many additional assumptions and data demands required of this approach, we prefer our main, data-driven approach.

6 Heterogeneity, Returns to College, Borrowing Limits, and Price Discounts

In this section, we examine several important issues related to the consumption value of college. First, we further study the extent to which average college consumption values vary across students with different backgrounds. Second, we show that the consumption value of college is an important component of the total expected return to college for Berea students. Third, we show that accounting for the consumption value of college dramatically reduces the estimated marginal value of relaxing student borrowing limits relative to an approach that ignores any consumption benefits. Fourth, we consider the possibility that college students may receive discounted pricing on many goods and services, estimating this price discount as well as a lump-sum consumption value associated with college.

6.1 More on Heterogeneity in Consumption Values

While students at Berea are much more homogeneous than the population of American youth at large (especially in terms of family income), it is still interesting to explore the extent to which consumption during college varies across students from different backgrounds. While we have already considered differences by gender and race, we now additionally consider differences by final high school grade point average (GPA) and total family income (reported during the first year of college). Table 7 reports the estimated effects of these student characteristics on various measures of consumption (including $\mathcal{V}_1$) using standard linear regressions.

As shown in the first and second rows of Table 7, there is surprisingly little systematic variation in observed expenditures C_1^{ex}, or desired expenditures, $C_1^{ex} + d_1$, during college. This is not the case when we incorporate the consumption value of college. In row three, we see that men experience a significantly greater consumption value (as noted earlier), as do students with a higher high school grade point average (GPA) and lower family income. Not surprisingly, these differences carry over to the total value of all consumption, $C_1^{ex} + d_1 + \mathcal{V}_1$, as reported in the final row. By contrast, differences by race are relatively modest and

statistically insignificant. As noted earlier, the higher consumption value of college for men is consistent with the fact that male students at Berea devote less time to studying than their female counterparts (Stinebrickner and Stinebrickner, 2012).

Table 7: Heterogeneity in Different Consumption Measures (in $1,000s)

	C_1^{ex}	$C_1^{ex} + d_1$	$\mathcal{V}_1$	$C_1^{ex} + d_1 + \mathcal{V}_1$
Constant	7.703	8.614	6.799	15.413
	(0.720)	(0.791)	(3.433)	(3.418)
Male	-0.163	-0.137	4.055	3.918
	(0.180)	(0.198)	(0.857)	(0.853)
Black	-0.412	-0.225	1.306	1.081
	(0.245)	(0.269)	(1.166)	(1.161)
HS GPA	-0.051	-0.275	2.097	1.822
	(0.196)	(0.216)	(0.935)	(0.931)
Family Income	-0.003	-0.004	-0.064	-0.067
	(0.005)	(0.005)	(0.023)	(0.023)
R^2	0.013	0.008	0.103	0.100

Notes: Each column reports a separate regression with the reported consumption value as the dependent variable. Family income measured in $1,000s. Standard errors are in parentheses. Sample size is 300.

6.2 Consumption Value and the Expected Return to College

One concrete way to view the quantitative importance of the consumption value $\mathcal{V}_1$ is to consider its effect on the return to college. To do this, we use students' subjective beliefs about future earnings in both college and non-college scenarios elicited in the baseline BPS survey at the beginning of college. We consider the 283 students (out of 300) from our main in-school sample who have valid responses to these questions.

The average expected lifetime earnings of the college and non-college options (evaluated at age 18) are $825,000 and $542,000, respectively. Ignoring the college consumption value (as is typical of the literature), these figures imply a monetary return to college of 52.1 percent. Taking into account four years of the average consumption value of college ($14,070 per year for this sample of 283 students) raises the total return to college by 18.6% (9.7 percentage points).[48] We note that these numbers likely understate the full importance of

[48]These calculations are based on baseline estimates, $\tilde{\mathcal{V}}_{i,1}$, and assume a 5% interest rate in discounting lifetime earnings through age 65 and the consumption value flows from college.

the consumption value, since the marginal utility of consumption during college generally exceeds the discounted expected marginal utility after graduation for constrained students. This understatement is likely to be quite modest, however, given that only 30% of Berea students wanted to borrow more and the amounts they wanted to borrower were small.

6.3 Value of Relaxing the College Borrowing Constraint

Borrowing constraints limit the ability of individuals to smooth consumption over time, reducing the value of attending college. While most of the literature focuses on the impacts of credit market distortions on college-going decisions (Lochner and Monge-Naranjo, 2012), the inability to smooth consumption can also reduce the lifetime utility of students who choose to attend college.

To better understand the costs of borrowing limits, note that the Lagrange multiplier in equation (1), $\lambda_1 \geq 0$, equals the marginal lifetime utility value of increasing the cumulative college borrowing limit. Dividing $\lambda_1 = U'(C_1) - [\beta(1+r)]^G E_1 [U'(C_{G+1})]$ by the marginal utility of consumption, $U'(C_1)$, yields a student's willingness-to-pay for the opportunity to borrow one additional dollar as a college freshman, WTP. This WTP is strictly positive (but less than one) for students that are borrowing constrained and zero for those that are unconstrained. See Appendix F for details.

Because $U'(C_1^{ex}) > U'(C_1^{ex} + \mathcal{V}_1)$ (assuming $\mathcal{V}_1 > 0$), ignoring the consumption value of college leads to an overstatement of the willingness-to-pay for additional borrowing. Table 8 shows just how much, reporting this willingness-to-pay based only on observed consumption expenditures (i.e., assuming $\mathcal{V}_1 = 0$), WTP^{ex}, and when incorporating estimated consumption values for each student, $WTP^{\mathcal{V}}$, based on our baseline estimates of $\mathcal{V}_1$ from Section 5. Ignoring the consumption value of college, we would conclude that students are, on average, willing to pay considerable amounts to borrow more — as much as 86 cents per additional dollar. Perhaps more surprising, we see similarly high WTP^{ex} for students regardless of whether they report that would like to borrow more (i.e., constrained vs. unconstrained).

Accounting for $\mathcal{V}_1$, students are willing to pay much less to increase their borrowing limit: those who are unconstrained would not be willing to give up any money to borrow more, while those who report that they are constrained would be willing to pay 12 cents to borrow an additional dollar. The final column shows that accounting for the consumption value of college reduces the estimated amount constrained students would be willing to pay by 88%.

Table 8: Average Willingness-to-Pay for One Additional Dollar of Borrowing

	Ignores $\mathcal{V}_1$ (WTP^{ex})	Accounts for $\mathcal{V}_1$ ($WTP^{\mathcal{V}}$)	$WTP^{\mathcal{V}}/WTP^{ex}$
Full Sample	0.857	0.021	0.025
Borrowing Constrained	0.859	0.105	0.123
Unconstrained	0.856	0	0

Notes: Willingness-to-pay reflects the amount of money a college freshman would be willing to pay to be able to borrow an additional dollar. Sample averages are reported (in 2001 dollars) based on the main in-school sample (300 students) and baseline assumptions used in Table 5.

These results highlight the importance of accounting for the consumption benefits of college when considering policies aimed at alleviating borrowing constraints.

6.4 Lump-Sum Consumption Value and Price Discounts

Our focus on the lump-sum consumption value of college specified in equation (2) is natural since many benefits associated with college (e.g. recreational facilities or friends living in close proximity) are effectively free for students. At the same time, students may receive discounted prices on many other goods and services (e.g. student discounts at nearby establishments).

Assuming any price discounts during college apply to all expenditures besides room and board at Berea, the mapping from consumption expenditures to effective consumption becomes

$$C_{i,1} = \frac{C_{i,1}^{oth}}{\pi_1} + C^{fh} + \mathcal{V}_{i,1},$$

where $\pi_1 > 0$ is the price of purchased goods in college (relative to the price of goods purchased after college, normalized to one). Then, the modified EE can be written as

$$\underbrace{\left([\beta(1+r)]^G E\left[\tilde{C}_{i,G+1}^{-\rho_i}\right]\right)^{-1/\rho_i}}_{\Omega_i} = \pi_1^{\frac{1}{\rho_i}-1}\left(C_{i,1}^{oth} + d_{i,1}\right) + \pi_1^{\frac{1}{\rho_i}}\left(C^{fh} + \mathcal{V}_{i,1}\right).$$

Note that we have already computed Ω_i for each student in Section 5. We assume π_1 is common across students and $\mathcal{V}_{i,1} = Z_{i,1}^{\mathcal{V}}\delta_1 + \nu_{i,1}$, where unobserved component $\nu_{i,1}$ is mean-zero and independent of other observed characteristics. The values of π_1 and δ_1 can be estimated by exploiting cross-sectional variation in $(C_{i,1}^{oth} + d_{i,1})$, ρ_i, and $Z_{i,1}^{\mathcal{V}}$. Specifically, the following regression can be estimated via non-linear least squares:

$$\Omega_i = \pi_1^{\frac{1}{\rho_i}-1}(C_{i,1}^{oth} + d_{i,1}) + \pi_1^{\frac{1}{\rho_i}}\left(C^{fh} + Z_{i,1}^{\mathcal{V}}\delta_1\right) + \omega_i \tag{12}$$

where $\omega_i \equiv \pi_1^{\frac{1}{\rho_i}} \nu_{i,1}$.

Letting $Z_{i,1}^{\mathcal{V}}$ include gender and race, we obtain an estimate for π_1 of 1.06 with a standard error of 0.076. Hence, we cannot reject the null that Berea students purchase goods at prices similar to what they pay after graduation. This result provides support for our baseline specification assuming a lump sum consumption value of college. Given how close π_1 is to 1, it is not surprising that equation (12) yields an estimate for $E(\mathcal{V}_1)$ of \$13,730, only \$540 less than our baseline estimate that abstracts from price discounts (see Table 5).

7 Conclusions

The well-known but rarely studied "consumption" benefits of college — from access to sports and recreation facilities to dorm and campus activities to frisbee on the quad — have never been more in the spotlight than during the recent pandemic. This paper provides the first available estimates of the total value of all benefits associated with college attendance that are substitutable for other purchased goods and services – the consumption value of college.

Unfortunately, these benefits are not easily quantified. For example, it is tempting to think that the consumption value might be estimated from changes in prices charged by post-secondary institutions (and/or in enrollment rates) associated with moves to online instruction during the pandemic. However, such an approach faces the fundamental challenge that remote learning also likely impacts academic quality and content. The hedonic willingness-to-pay approach taken by Jacob, McCall, and Stange (2018) provides useful estimates of the marginal valuation of quantifiable amenities, but this general approach also suffers from the challenge of separating consumption from educational benefits for certain amenities. It is equally difficult to measure (or even comprehensively list) all potential benefits accruing to students. More importantly, it is unclear how to go from estimated marginal valuations of college amenities to a measure of the total valuation of consumption benefits associated with college.[49] In light of these challenges, our analysis offers a promising methodological contribution that exploits the well-understood EE to identify the total consumption value of college. While we rely on survey data not typically collected and study

[49]Through a series of hypothetical scenarios, Aucejo, French, and Zafar (2023) target their willingness-to-pay analysis to specific amenities of interest (e.g., in-person vs. online courses, the value of all vs. no campus/life activities). While this approach addresses common concerns about unobserved heterogeneity in tastes that can confound standard hedonic estimates, it shares other features of the hedonic approach mentioned here.

a single institution, there is nothing to preclude the handful of survey questions critical for our approach from being added to general longitudinal surveys in the future. Our empirical findings suggest that this would likely be both valuable and could open up several new lines of research.

Our results indicate that the students we study, on average, receive about $14,000 in consumption benefits from each year of college attendance. Factoring in four years of these benefits raises the total anticipated return to college by nearly 20%, on average. We also document a moderate degree of heterogeneity in these benefits across students, which suggests that they likely play a role in determining who attends college in addition to overall attendance rates. Accounting for these benefits (or at least recognizing their existence) is, therefore, critical for higher education policy. Most notably, many students may not need financial aid to cover much more than their tuition, room, and board costs to attain high levels of effective consumption during college. Our results, therefore, have important implications for empirical studies of credit constraints, since low levels of consumption expenditures during college do not necessarily imply binding constraints. We find that accounting for the consumption value of college greatly reduces the estimated marginal value of expanding student borrowing opportunities for those who choose to enroll.

While caution is appropriate when studying a single school, for reasons described in Section 3.1, it is likely that the college experience at Berea is similar to that at many other institutions, especially smaller liberal arts colleges spread throughout the U.S. Of course, the consumption value associated with attendance at large public universities or institutions in major American cities may differ non-trivially. Wealthy students attending elite private institutions may also enjoy different experiences while in college. In terms of future work, it would be informative to determine whether consumption values differ systematically across schools (and a broader distribution of students) in easily observed ways. This may be of great interest to policymakers, who are likely to be more interested in subsidizing the investment component of higher education rather than its consumption benefits.

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Online Appendix

A Data Issues

A.1 Survey Question on Debt-Aversion

To address concerns about debt-aversion, we use a follow-up BPS question that asks why students do not want to borrow more. If students report in Q1 (see Section 3.3 for details) that they would not accept an additional loan, the survey asks the following:

- **Q.1.B. If you answered NO,** please check any that apply. Why would you not accept the loan? Please check any of the following that apply.

    1. I am happy with the amount I am currently spending and would not choose to increase spending now because I would have less to spend later when I had to repay the loan and interest._____
    2. Even though I would prefer to spend more now and less later, I would not feel comfortable accepting a loan._____
    3. Other (please explain)_____

We identify students as "debt-averse" if any of their responses indicate that they would reject a loan for a reason other than consumption smoothing (e.g., answer '2' or similar written 'other' responses).

A.2 Estimating Average Housing and Groceries Consumption for Graduates living with Parents

Many Berea graduates that live at home with their parents report very low expenditures on food and housing, likely reflecting sizable in-kind transfers from their parents. To better account for these in-kind transfers, we use data on total household expenditures for similar families, adjusting for family size, to impute food and housing amounts when reported values in the BPS are low.

This analysis first uses the Consumer Expenditure Survey (CES) from 2003–2007 to estimate the average food and housing consumption for college graduates living with their parents. We restrict this analysis to CES respondents with at least one child in the household who (i) is aged 22–29 years old, (ii) is not currently enrolled in school, and (iii) has a college

degree. For each household, we use information on (i) household expenditures on various categories of consumption goods, (ii) number of household members, (iii) total household income, (iv) salary of each household member, and (v) location of the household.

For each of the 244 22–29 year-old household members in this sample, we first measure total household food and housing consumption using reported expenditures on food, rent (or equivalent rent for home-owners), and other home services. We then divide this household-level consumption by the number of members in the household to obtain individual-level measures of food and housing consumption. We also obtain a measure of parental income by subtracting total salaries earned by young members in the household from total household income.

Next, we regress individual food and housing consumption on parental income, the youth's own salary, and a location dummy that takes the value of 1 if the household is in the South Census Region (excluding Washington DC) or a neighboring state of Kentucky.[50] We use these regression coefficients to obtain predicted post-college food and housing consumption values for Berea graduates living with their parents (at $t = G+1$) using annual parental income reported during college and W_{G+1}, letting the location dummy take the value of 1. The average of this CES-based measure for the 151 students in our post-college sample is \$7,220, which is about \$900 more than the total annual value for food and housing during college, $C^{fh} = \$6,350$.

Finally, our baseline analysis only imputes total food and housing expenditures using this CES-based amount for Berea graduates living with their parents if their total post-college consumption on food and housing (as reported in the BPS survey) is lower. Based on this criteria, we impute food and housing expenditures for 53 of the 56 graduates who are living with their parents in year $t = G + 1$.

A.3 Descriptive Statistics for Second-Year Data

Table A-1 reports descriptive statistics for second-year in-school consumption expenditures, desired additional borrowing, and beliefs about post-college earnings.

[50] Besides Kentucky, this location dummy covers the following states: Delaware, Florida, Georgia, Maryland, North Carolina, South Carolina, Virginia, West Virginia, Alabama, Mississippi, Tennessee, Arkansas, Louisiana, Oklahoma, Texas, Indiana, Ohio, and Illinois.

Table A-1: Second-Year Consumption, Desired Borrowing, and Beliefs in BPS

	C_2^{oth}	d_2	d_2 (if > 0)	$Q^2_{2,G+1}$ (Median)	$\underline{W}_{2,G+1}$ (Min)
Mean	0.82	0.23	1.17	41.72	28.26
Std. Dev.	1.02	0.63	0.99	26.97	22.95
Median	0.49	0.00	0.99	34.97	24.63
Interquart. Range	0.69	0.00	1.13	23.64	11.82
Sample Size	210	210	41	210	210

Notes: All values in thousands of year 2001 U.S. dollars. C_2^{oth} represents reported annual consumption expenditures (excluding room, board, and textbooks) during the second year of college. d_2 represents the amount of additional loan a student is willing to take in the hypothetical borrowing scenario during the second year of college. $Q^2_{2,G+1}$ and $\underline{W}_{2,G+1}$ are the median and minimum of reported subjective earnings distributions during the second year of college, respectively.

A.4 Descriptive Statistics for Post-College Consumption by Category

Table A-2 reports descriptive statistics for post-college consumption expenditures by category.

A.5 Descriptive Statistics for Student Characteristics

Table A-3 describes student characteristics for our main in-school and post-college samples. Table A-4 reports these statistics for a smaller in-school sample that excludes those who are considered "debt-averse" based on their answers to question Q.1.B of the BPS and a broader post-college sample that includes married individuals.

Table A-2: Descriptive Statistics for Post-college Consumption by Category

	Mean	Standard Deviation	Median	Interquartile Range
Rent (inc. Utilities)	3.11	2.92	3.18	5.05
Groceries	1.18	0.95	1.06	1.06
Rent (inc. Utilities) + Groceries	4.29	3.42	4.34	5.29
Adjusted Food and Housing	6.32	2.57	6.79	2.18
Telephone	0.64	0.43	0.58	0.41
Car and Travel	2.86	3.35	2.11	2.65
Recreation and Entertainment	1.12	1.60	0.53	0.74
Clothing and Other Personal	0.72	0.79	0.53	0.84
Music, Computers, TV, and Other Electronics	0.27	1.17	0.00	0.16
Medical and Dental, Other than Insurance	0.30	1.06	0.00	0.16
Health Insurance	0.82	6.98	0.00	0.31
Total Other Spending	1.36	4.16	0.00	1.05

Notes: Consumption measures based on main post-college sample of 151 students. All categories based on direct survey responses, except for 'Adjusted Food and Housing', which adjusts 'Rent (inc. Utilities) + Groceries' for graduates living with parents who report lower amounts than imputed from Consumer Expenditure Survey (see Appendix A.2). All values in thousands of year 2001 U.S. dollars.

Table A-3: Descriptive Statistics for Student Characteristics

	Male	Black	High School GPA	Family Income
A) Main In-school Sample (300 students)				
Mean	0.44	0.16	3.39	25.40
Std. Dev.	0.50	0.37	0.47	17.78
Median	0.00	0.00	3.50	25.53
Interquart. Range	1.00	0.00	0.71	28.63
B) Main Post-college Sample (151 students)				
Mean	0.19	0.30	3.49	27.75
Std. Dev.	0.40	0.46	0.45	18.37
Median	0.00	0.00	3.62	28.64
Interquart. Range	0.00	1.00	0.68	27.02

Notes: Family income in thousands of year 2001 U.S. dollars.

Table A-4: Descriptive Statistics for Student Characteristics (Alternative Samples)

	Male	Black	High School GPA	Family Income
A) Smaller In-School Sample Excluding Debt-Averse (180 students)				
Mean	0.48	0.17	3.40	26.10
Std. Dev.	0.50	0.38	0.50	19.30
Median	0.00	0.00	3.50	26.80
Interquart. Range	1.00	0.00	0.70	32.30
B) Expanded Post-College Sample Including Married (194 students)				
Mean	0.15	0.31	3.50	27.78
Std. Dev.	0.36	0.47	0.43	17.68
Median	0.00	0.00	3.60	28.89
Interquart. Range	0.00	1.00	0.68	26.00

Notes: Compared to the main in-school sample, the smaller in-school sample excludes those who would reject an additional loan due to debt-aversion. Compared to the main post-college sample, the expanded post-college sample also includes those who were married. Family income in thousands of year 2001 U.S. dollars.

B Estimated Euler Equation Parameters under Rational Expectations

Table B-1 reports coefficient estimates for GMM estimation under rational expectations.

Table B-1: Estimated Euler Equation Parameters under Rational Expectations

	$\mathcal{V}_1(Z^{\mathcal{V}}_{i,1})$	$\lambda_1(d_{i,1}, Z^{d}_{i,1})$
Constant	6.29	-0.0038
	(1.09)	(0.0026)
Male	-3.63	0.0098
	(1.24)	(0.0062)
Black	-0.45	0.0002
	(1.27)	(0.0032)
Additional Loan		-0.0015
		(0.0016)

Notes: This table reports the estimated coefficients in the Euler Equation under Rational Expectations. Column 1 reports estimated coefficients for the consumption value. Column 2 reports estimated coefficients for the Lagrange multiplier function. Both consumption value and additional loan amounts are measured in $1,000s. Sample size is 124. Standard errors are in parentheses.

C Model-Based Approach

This appendix considers a Model-Based (MB) Approach for determining the post-college consumption function, assuming that this reflects the solution to a standard lifecycle consumption allocation problem (with uncertainty and borrowing constraints) from period $t = G + 1$ to retirement.

C.1 Lifecycle Framework for Post-College Consumption

In solving the lifecycle problem and mapping ages to t, we assume that individuals enter college at age 18 (so $t = 1$ at age 18) and work until they retire in year $T = 47$ (i.e., age 65).[51] Taking initial post-college debt and earnings (D_{G+1}, W_{G+1}) as given and assuming

[51] In practice, very few students were over age 19 when they entered Berea. We implicitly assume that all students will work 47 years after graduating regardless of when they entered college.

that all debts must be repaid eventually ($\bar{D}_{T+1} = 0$), individuals

$$\max_{C_{G+1},...,C_T} E\left[\sum_{t=G+1}^{T} \beta^{t-G-1} U(C_t)|D_{G+1}, W_{G+1}\right] \quad \text{subject to}$$
$$D_{t+1} = (D_t + C_t - \psi(W_t))(1+r) \leq \bar{D}_{t+1} \quad \text{for } t = G+1, ..., T, \tag{13}$$

where $\psi(\cdot)$ represents after-tax earnings based on federal and Kentucky tax code in 2001. Of interest in our analysis is the optimal consumption function in the first year after college, $\tilde{C}_i(D_{G+1}, W_{G+1})$, which varies across students conditional on post-college debt and earnings due to heterogeneity in beliefs. This consumption function is used in equation (11) — along with in-school consumption C_1^{ex}, desired borrowing $d_{i,1}$, risk-aversion ρ_i, and beliefs $F_{i,1}^{W_{G+1}}$ — to determine $\tilde{\mathcal{V}}_{i,1}$ for each student.

Two key challenges arise here. First, one must specify post-college borrowing limits in a practical way. To that end, we assume that students can roll over their initial post-college debt, but cannot take on additional debt after college:[52]

$$\bar{D}_{i,t+1} = (1+r)^{t-(G+1)} \max\{0, D_{i,G+1}\}, \text{ for } t < T \text{ and } \bar{D}_{i,T+1} = 0. \tag{14}$$

This specification guarantees that students can afford positive consumption in all periods regardless of earnings realizations.

Second, the post-college consumption function depends on beliefs about the lifecycle earnings process. In determining $\tilde{\mathcal{V}}_{i,1}$ in equation (11), beliefs are based on information available as of the first year of college, so the relevant post-college consumption function for that equation depends on $\{F_{i,1}^{W_t}\}_{t=G+2}^{T}$.

C.2 Parameterization and Results

In solving the lifecycle problem defined in equation (13), we parametrize all model primitives. Starting from the preference parameters, we assume individual-specific risk-aversion, ρ_i, as described in Section 3.5. The time discount rate β is assumed to be 0.95 for all individuals.

Moving next to the constraints, we need to specify the interest rate r, tax schedule $\psi(\cdot)$, and the income beliefs. First, we continue to assume that the interest rate $r = 0.05$. Second, the tax schedule is constructed using 2001 federal and Kentucky state tax schedules for single individuals without children. An individual with before-tax earnings w needs to pay

[52] If a student can take on additional debt after college, they would likely desire to consume more during college, implying a higher level of college consumption value.

Table C-1: Federal and Kentucky Income Tax Brackets in 2001

Federal Taxes		Kentucky Taxes	
Tax Rate	Taxable Earnings	Tax Rate	Taxable Earnings
15%	($0, $27,050]	2%	($0, $3,000]
27.5%	($27,050, $65,550]	3%	($3,000, $4,000]
30.5%	($65,550, $136,750]	4%	($4,000, $7,000]
35.5%	($136,750, $297,350]	5%	($7,000, $8,000]
39.1%	($297,350, ∞]	6%	($8,000, ∞]

Source: Internal Revenue Service and Kentucky Department of Revenue.

FICA, $FICA(w)$, federal tax, $FT(w)$, and state tax, $ST(w)$, and receives state income credit $SIC(w)$. Formally, after-tax earnings $\psi(w)$ is given by:

$$\psi(w) = w - FICA(w) - FT(w) - ST(w) + SIC(w),$$

where $FICA(w) = 0.062 \cdot \min\{w, \$80400\}$ and other taxes/credits are determined as follows. To compute federal and state taxes, we first subtract deductions and exemptions from w to obtain taxable earnings. The federal standard deduction and exemption are $4,550 and $2,900 in 2001. The state standard deduction for Kentucky is $1,700. We then apply the income tax brackets shown in Table C-1 to taxable earnings to compute $FT(w)$ and $ST(w)$. The state income credit for Kentucky is $20.

With respect to the income beliefs, we also continue to assume that subjective earnings distributions are described by a shifted log-normal distribution with dynamics determined by an autoregressive process. Beliefs for college freshman are characterized as follows: $\log(W_t - \underline{W}_{1,t}) = \mu_{1,t} + \sigma_{1,t}\epsilon_t$, where $\epsilon_{G+1} \sim N(0,1)$, $\epsilon_t = \Gamma\epsilon_{t-1} + \eta_t$ for $t = G+2, ..., T$, and $\eta_t \sim N(0, 1-\Gamma^2)$ for all t.

Since the BPS did not elicit beliefs about earnings autocorrelations, we assume that subjective beliefs about Γ match the estimated autocorrelation in realized earnings for the post-college period. Using the autocovariance structure for annual earnings from the unbalanced panel of 10 post-graduation years in the BPS, we estimate $\Gamma = 0.62$ via Minimum Distance estimation.[53] The remaining parameters of the belief distribution for college freshman $\{\underline{W}_{1,t}, \mu_{1,t}, \sigma_{1,t}\}_{t=G+1}^{T}$ are obtained from elicited beliefs about post-college earnings for years $G+1$, $G+6$, and $G+16$ (i.e., ages 23, 28, and 38), as described earlier in Section 3.3. We follow Stinebrickner and Stinebrickner (2014) in assuming that $\underline{W}_{1,t}$, $\mu_{1,t}$, and $\sigma_{1,t}$ grow

[53] Details available upon request.

linearly between the observed ages and remain constant after age 38 until retirement.

Having parameterized the model, for each student, we numerically solve for the post-college consumption function and calculate $\mathcal{V}_1$. As reported in Table 6, the estimated mean consumption value from this model-based approach is \$22,600, nearly 60% higher than our baseline estimate (reported in Table 5).

D Additional Robustness Results

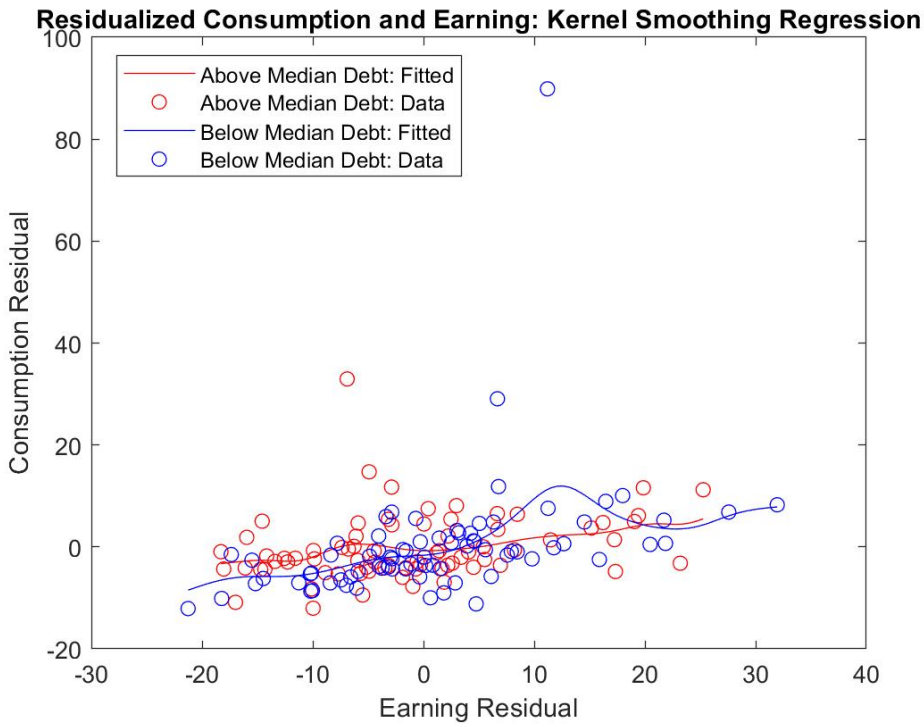
D.1 Additional Post-College Consumption Functions

Figure D-1 shows the estimated relationship between post-college consumption and post-college earnings (both residualized) for students with high and low post-college debt levels. Consumption and earnings residuals are obtained from regressions on baseline Z^C: race, gender, and risk-aversion, ρ_i. Figure D-2 shows the same relationship after first excluding observations with consumption, earnings, or debt that are 3 or more standard deviations away from their respective means.

Table D-1 reports estimates for $E[\mathcal{V}_1(Z_1^{\mathcal{V}})]$ based on the subjective expectations approach using alternative estimates for the consumption function. See Table 4 for the estimated consumption functions.

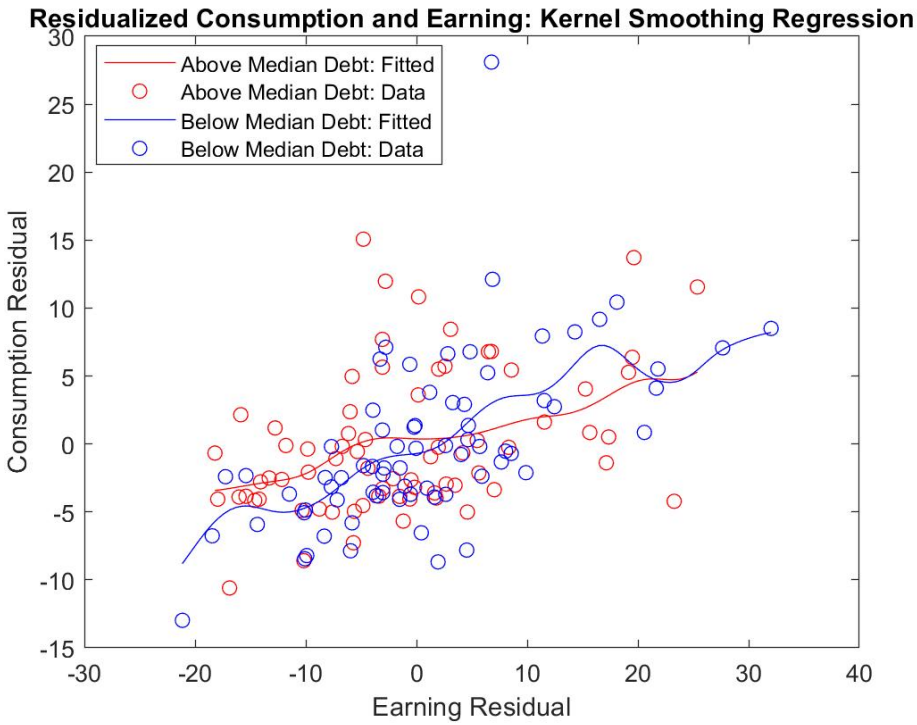
Table D-2 reports estimates for alternative specifications for the consumption function related to our robustness analysis reported in Table 6 and discussed in Section 5.1. In general, the estimates are quite similar across specifications, especially with respect to the role of earnings and debt.

Figure D-1: Residualized Consumption and Earning



Notes: Function is estimated using Normal kernel smoothing regression. Plotted without data trimming.

Figure D-2: Residualized Consumption and Earning (Outliers Trimmed)



Notes: Function is estimated using Normal kernel smoothing regression. Plotted after trimming outliers (i.e., excludes observations with consumption, earnings, or debt 3 standard deviations away from their respective means).

Table D-1: Consumption Value Estimates (in $1,000s) Using Subjective Expectations - Alternative Specifications

	All	Male	Female	Black	Non-Black	Constrained	Unconstrained
Spec. 1	14.27	16.34	12.66	15.26	14.07	13.57	14.44
	(1.86)	(2.74)	(1.44)	(2.09)	(2.00)	(1.65)	(2.03)
Spec. 2	14.71	17.30	12.70	15.67	14.52	14.94	14.65
	(1.92)	(2.90)	(1.37)	(2.12)	(2.06)	(1.84)	(2.04)
Spec. 3	14.20	16.38	12.51	15.02	14.04	13.26	14.43
	(2.04)	(3.06)	(1.52)	(2.09)	(2.16)	(1.76)	(2.25)
Spec. 4	14.80	17.45	12.75	15.85	14.59	15.09	14.73
	(2.03)	(3.07)	(1.45)	(2.15)	(2.14)	(1.86)	(2.19)
Sample Size	300	131	169	49	251	60	240

Notes: Results are based on the main in-school sample with 300 observations. Control variables Z_i^C in the post-college consumption function include gender, race, and risk preference ρ. Estimated consumption functions associated with these specifications are reported in Table 4. Bootstrapped standard errors are in parenthesis.
Spec. 1: Two debt groups (below and above median $4,890); both intercept and slope depend on debt group.
Spec. 2: Two debt groups (below and above median - $4,890); slope depends on debt group.
Spec. 3: Three debt groups (below 33^{th} percentile - $3,310, between 33^{th} percentile and 67^{th} percentile - $6,820, above 67^{th} percentile); both intercept and slope depend on debt group.
Spec. 4: Three debt groups (below 33^{th} percentile - $3,310, between 33^{th} percentile and 67^{th} percentile - $6,820, above 67^{th} percentile); slope depends on debt group.

Table D-2: Alternative Estimated Post-College Consumption Function (in $1,000s)

	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.862	0.665	5.201	4.636	5.431	1.975
	(3.294)	(3.361)	(3.112)	(2.591)	(2.828)	(3.247)
Male	2.842	3.555	2.697	2.752	1.154	2.563
	(1.632)	(1.665)	(1.687)	(1.674)	(1.422)	(1.608)
Black	-1.583	-0.313	-0.548	-0.561	0.576	-1.544
	(1.926)	(1.965)	(1.987)	(1.981)	(1.871)	(1.899)
ρ	0.033	0.180	-0.174		-0.028	0.163
	(0.757)	(0.773)	(0.528)		(0.660)	(0.747)
Debt > Median	4.727	5.021	5.227	5.195	4.309	3.859
	(3.279)	(3.347)	(3.381)	(3.369)	(2.979)	(3.233)
Earning	0.391	0.364	0.434	0.437	0.367	0.466
	(0.103)	(0.105)	(0.106)	(0.105)	(0.090)	(0.101)
Earning × (Debt > Median)	-0.234	-0.237	-0.243	-0.242	-0.193	-0.187
	(0.143)	(0.146)	(0.147)	(0.147)	(0.129)	(0.141)
Median Debt Level	4.887	4.887	4.887	4.887	4.987	4.887
Sample Size	151	151	151	151	194	151

Notes: Each column reflects an alternative specification of the post-college consumption function (associated with robustness estimates in Table 6) with consumption expenditure (in $1,000s) in the first year after graduation as the dependent variable. Earnings and debt (in $1000s) are also from the first year after graduation. Column (1): conservative adjustment for durable goods; column (2): exclude housing consumption ($\mathcal{V}_1^o$); column (3): $max(\rho) = 5$; column (4): $\rho = 2$; column (5): include married individuals; and column (6): ignoring post-college transfers (living at home). Standard errors are in parentheses.

D.2 Alternative Assumptions about Expected Unemployment Spells

Section 5.1 considers the possibility that students report beliefs about the distribution of post-college earnings conditional on working (rather than unconditionally as the survey asks). In doing so, we take advantage of students' perceived probability of not working in future periods, P_t^U. In Section 5.1, we assume P_t^U reflects the fraction of a year students expect to be unemployed. Here, we consider a more extreme case, assuming that P_t^U represents the probability that a student is unemployed for the entire year t.

For clarity of exposition, we denote survey-reported (conditional) beliefs about earnings in year t as $\underline{F}_1^{W_t}$, which may now differ from their unconditional subjective beliefs $F_1^{W_t}$.[54] Letting $\tilde{\tilde{C}}_e(D_{G+1}, W_{G+1}, Z^C)$ denote the consumption function conditional on employment, $e \in \{0, 1\}$, we modify equation (11) to explicitly account for the two employment possibilities:

$$\tilde{\mathcal{V}}_t = \left([\beta(1+r)]^G E_t \left[\tilde{\tilde{C}}_e \left(D_{G+1} + (1+r)^G d_t, W_{G+1}, Z^C \right)^{-\rho} \right] \right)^{-1/\rho} - C_t^{ex} - d_t, \tag{15}$$

where the expectation is now taken over beliefs about both employment and earnings conditional on employment. Because earnings are always zero in the unemployed state, we can write the expression for the expected marginal utility of post-college consumption as follows:

$$\begin{aligned} & E_t \left[\tilde{\tilde{C}}_e \left(D_{G+1} + (1+r)^G d, W_{G+1}, Z^C \right)^{-\rho} \right] \\ = \; & (1 - P_{G+1}^U) \int \tilde{\tilde{C}}_1 \left(D_{G+1} + (1+r)^G d_t, w, Z^C \right)^{-\rho} d\underline{F}_t^{W_{G+1}}(w) \\ & + P_{G+1}^U \tilde{\tilde{C}}_0 \left(D_{G+1} + (1+r)^G d_t, 0, Z^C \right)^{-\rho}. \end{aligned} \tag{16}$$

Since our estimated baseline consumption function is based on individuals with positive earnings, $\tilde{\tilde{C}}_1 \left(D_{G+1}, W_{G+1}, Z^C \right)$ directly corresponds to the post-college consumption function $\tilde{C}(D_{G+1}, W_{G+1}, Z^C)$ estimated in Section 5. We assume $\tilde{\tilde{C}}_0 \left(D_{G+1}, 0, Z^C \right) = e^{Z^C \alpha_0 + \alpha_1 D_{G+1}}$ (ensuring that consumption is strictly positive) and estimate (α_0, α_1) via nonlinear least squares using the 24 students who reported that they were unemployed in $t = G + 1$. The estimates indicate that post-college consumption is decreasing in accumulated debt and that the implied post-college consumption for an unemployed graduate with average observed characteristics and \$3,640 in debt (the sample average for unemployed graduates) is roughly equal to that of an average working graduate with the same debt who earns \$13,180.[55]

[54] This distinction was not needed for our baseline analysis, since that assumes that students follow the survey instructions and report unconditional distributions.

[55] Estimated α_1 is -0.066 (t-statistic of 2.58).

Combining the estimated consumption functions $\tilde{\tilde{C}}_1\left(D_{G+1}, W_{G+1}, Z^C\right)$ and $\tilde{\tilde{C}}_0\left(D_{G+1}, 0, Z^C\right)$, perceived unemployment probability P^U_{G+1}, and subjective beliefs about earnings conditional on working $\underline{F}_1^{W_t}$, we quantify the mean consumption value of college, $E(\mathcal{V}_1)$, using equations (15) and (16). This yields an average consumption value of \$11,900, about 17% lower than the baseline average.

E Estimation Using Second-Year Data

In the baseline, we quantify the consumption value of college using consumption expenditures in the first year of college and the expected marginal utility of consumption during the first year after college. Since all the relevant in-school survey questions were collected annually during college, we can conduct the same analysis using data from later college years; although, we lose any college dropouts along the way. To examine the robustness of our results to the choice of in-school year, we re-do our analysis using second-year college data.

In the second year of college, 210 students gave valid responses to earnings expectations questions, the consumption expenditure question, and the hypothetical borrowing question. They form our main second-year sample. See Appendix A.3 for details on the sample.

Based on this second-year sample, estimates of $E(\mathcal{V}_1)$ are only slightly smaller than their counterparts in the baseline analysis using data from students' first year at Berea.

To further explore the relationship between first- and second-year estimates at an individual level, we restrict our attention to the 188 students who are in both the main in-school (first-year) sample (300 students) and the second-year sample (210 students). For these students, we obtain $E(\mathcal{V}_1) = \$14,140$ and $E(\mathcal{V}_2) = \$13,470$. The correlation between the first- and second-year estimates, $Corr(\tilde{\mathcal{V}}_1, \tilde{\mathcal{V}}_2) = 0.31$. Applying the Two-Sample Kolmogorov-Smirnov tests, we cannot reject the null that the first- and second-year estimated $\tilde{\mathcal{V}}_t$ distributions are the same (based on a 5% significance level).

F Marginal Value of Increasing the Student Borrowing Limit

To see why the Lagrange multiplier in equation (1) reflects the marginal lifetime value of an increasing in the student borrowing limit, let $V_{G+1}(W_{G+1}, D_{G+1})$ reflect the value function associated with an individual's post-college lifetime utility maximization problem

as of $t = G + 1$, where $\partial V_{G+1}(W_{G+1}, D_{G+1})/\partial D_{G+1} = -U'(C_{G+1})$. See equation (13) in Appendix C.1 for an example. The student's utility maximization problem at $t = 1$ can then be written as follows:

$$V_1(W_1; \bar{D}_{G+1}) = \max_{C_1,\ldots,C_G,D_{G+1}} E_1 \left[\sum_{t=1}^{G} \beta^{t-1} U(C_t) + \beta^G V_{G+1}(W_{G+1}, D_{G+1}) \right]$$

$$\text{s.t.} \quad \sum_{t=1}^{G} \frac{C_t}{(1+r)^{t-1}} \leq \sum_{t=1}^{G} \frac{W_t}{(1+r)^{t-1}} + \frac{D_{G+1}}{(1+r)^G}, \tag{17}$$

$$D_{G+1} \leq \bar{D}_{G+1}, \tag{18}$$

where W_t reflects income in year t (including any initial wealth in W_1) and $\bar{D}_{G+1}$ is the maximum debt that can be accumulated during school.

Letting $\phi \geq 0$ and $\tilde{\lambda}_1 \geq 0$ reflect the Lagrange multipliers on equations (17) and (18), respectively, the first order conditions for C_1 and D_{G+1} are:

$$C_1: \quad U'(C_1) = \phi \tag{19}$$

$$D_{G+1}: \quad \beta^G E_1 \left[\frac{\partial V_{G+1}(W_{G+1}, D_{G+1})}{\partial D_{G+1}} \right] + (1+r)^{-G} \phi = \lambda_{G+1}. \tag{20}$$

Combining these equations and substituting in $U'(C_{G+1}) = -\partial V_{G+1}(W_{G+1}, D_{G+1})/\partial D_{G+1}$ yields the following consumption Euler Equation:

$$U'(C_1) = [\beta(1+r)]^G E_1 \left[U'(C_{G+1}) \right] + \tilde{\lambda}_1, \tag{21}$$

which is equivalent to equation (1) for $\tilde{\lambda}_1 = (1+r)^{-G} \lambda_1$.

To determine the willingness-to-pay for an increase in the student borrowing limit, notice that the Envelope Conditions for the $t = 1$ maximization problem above imply:

$$\frac{\partial V_1}{\partial W_1} = \phi = U'(C_1),$$

$$\frac{\partial V_1}{\partial \bar{D}_{G+1}} = \tilde{\lambda}_1 = \frac{U'(C_1) - [\beta(1+r)]^G E_1[U'(C_{G+1})]}{(1+r)^G},$$

where the second equality in each case follows from equations (19) and (21), respectively. Hence, the amount of W_1 that a person is willing to give up to obtain one dollar increase in debt limit $\bar{D}_{G+1}$ is $\frac{\partial V_1/\partial \bar{D}_{G+1}}{\partial V_1/\partial W_1} = \frac{U'(C_1) - [\beta(1+r)]^G E_1 U'(C_{G+1})}{U'(C_1)(1+r)^G}$.

Because one dollar increase in $\bar{D}_{G+1}$ corresponds to $(1+r)^{-G}$ dollar increase in current borrowing, the amount of income or wealth, W_1, that a student is willing to give up to increase borrowing during the first year of college by one dollar is $(1+r)^G \frac{\partial V_1/\partial \bar{D}_{G+1}}{\partial V_1/\partial W_1} = \frac{U'(C_1) - [\beta(1+r)]^G E_1[U'(C_{G+1})]}{U'(C_1)}$.