NBER WORKING PAPER SERIES

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Working Paper 26335
http://www.nber.org/papers/w26335

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
October 2019

We thank Tom Crossley for valuable suggestions/comments and Kevin Stange for providing data from Jacob et al. (2018) on amenity measures for US colleges. The project was made possible by generous funding from The Mellon Foundation, The Spencer Foundation, The National Science Foundation, and The Social Sciences and Humanities Research Council. Lochner acknowledges generous support from Social Sciences and Humanities Research Council of Canada for this research. Lochner has no other relevant or material financial interests that relate to the research described in this paper. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 26335
October 2019
JEL No. I20,I21,I23,I26,I28

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. Estimates suggest an average annual consumption value of college as high as $11,600, with considerable heterogeneity across students. Incorporating these benefits raises the average expected return to college by as much as 14%.

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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, these factors are generally unobserved with their values typically inferred from choices that deviate from what is expected based on measured costs and 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, et al. (2018) provide some of the most direct evidence suggesting a non-trivial 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. However, as they note, these amenities may influence choices, in part, by improving the earnings prospects of students.[2] Additionally, they may not capture all of the consumption-related benefits associated with attending college.

This paper represents the first attempt to quantify the full consumption benefits of college that are directly substitutable with other goods, services, and activities that students would otherwise purchase. For example, students have easy access to athletic and entertainment facilities on campus. They may also have many free or inexpensive leisure and entertainment opportunities available to them that are unavailable (or much less attractive) to non-students. Students may benefit greatly from these opportunities, allowing them to achieve high levels of effective consumption with much lower levels of actual expenditures. 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, the "consumption value" of college may be an important factor determining

[1]Lazear (1977) provides an early analysis of the consumption vs. investment value of education. See, e.g., Keane and Wolpin (1997), Cunha, et al. (2005), Heckman, et al. (2006), and Abbott, et al. (forthcoming) 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.

the total return to college; a failure to incorporate it could lead to an under-valuation of post-secondary education. Second, 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.

We take an innovative approach made possible by unique data from the Berea Panel Study (BPS), which follows students from Berea College, a four-year liberal arts college in central Kentucky. We exploit BPS data to identify individual-specific consumption values of college based on the Euler equation for consumption during and after college. Under perfect credit markets, a comparison of observed consumption expenditures during college to the amount that students (expect to) spend on consumption after college would be directly informative about the consumption value of college. Intuitively, if individuals desire smooth consumption profiles, a large jump in consumption expenditures upon leaving college indicates a sizable consumption value of college.

Two important challenges arise due to credit market frictions. First, limited borrowing opportunities during school could lead to a jump in consumption spending after college. We address this concern using a BPS survey question that identifies whether individuals are currently credit constrained, and if so, how much they would choose to borrow if the constraint were eliminated. This allows us to identify desired consumption expenditures (during college) for everyone in our sample, regardless of whether they are borrowing constrained.

Second, when 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. To address this concern, it is necessary to characterize the full distribution of beliefs about post-college consumption. We take two different approaches for calculating this distribution. Both approaches take advantage of survey questions in the BPS that elicit beliefs during college about the distribution of future earnings, but they differ in the way that the distribution of post-college consumption beliefs are determined.

The BPS data also enable us to consider other factors that could lead to a jump in consumption upon college graduation. First, debt-averse students may not wish to borrow more despite low levels of in-school consumption. We sidestep this concern by

[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). This implicitly assumes that consumption expenditures reflect total effective consumption, thereby ignoring the "consumption" benefits of college we study.

focusing on the majority of students that show no indication of debt-aversion when asked why they would not prefer to borrow more. Second, Aguiar and Hurst (2005, 2007) show that older individuals can maintain high levels of effective consumption despite reduced expenditure levels by devoting more time to home production and shopping. The notion that students may have more time available for 'home production' during school is unlikely to explain important changes in consumption upon graduation for our sample, since the combined amount of time Berea students spent studying and working is similar to the amount of time spent working after school (Stinebrickner and Stinebrickner 2003, 2008a; Stinebrickner et al. 2019). Third, one might worry that there are fewer consumption opportunities in Berea than wherever graduates move after college; however, this seems unlikely since Berea's population density is similar to that of the places its students lived two years after graduation.[4] Fourth, graduating students may purchase a new car or other durables, leading to artificially high levels of measured consumption after school. As discussed below, we conclude that this is not an important factor by examining consumption patterns in the first two years after college. Fifth, desired consumption levels might jump for students that get married and/or have children. Our main analysis focuses on the 75% of students who remain single and childless during and immediately after college; however, results for the full sample that account for change in marital status are quite similar.

Overall, our results suggest that a substantial consumption value of college exists among Berea students, with the average annual value ranging from \$9,900 to \$11,600, depending on the approach used to estimate beliefs about the distribution of post-school consumption. These sizeable benefits are consistent with other survey responses in which roughly 80% 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 12-14%. We also document considerable heterogeneity in the consumption value across students.

2 Measuring the Consumption Value of College

Our approach to measuring the consumption value of college is based on the Euler equation that equates the marginal utility of consumption during the first year of college with the discounted expected marginal utility of consumption during the first year after leaving school G years later. Letting $U(C_t)$ (with $U'(\cdot) > 0$, $U''(\cdot) < 0$) reflect utility

[4] The fact that roughly 80% of students report 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 consumption opportunities. We explore differential prices for goods/services during and after school in Section 4.5.

from "effective consumption" C_t each period, $\beta > 0$ the rate of time preference, and $r > 0$ the market interest rate, the relevant Euler equation (in the absence of borrowing constraints) is

$$U'(C_1) = [\beta(1+r)]^G E[U'(C_{G+1})], \tag{1}$$

where $t = 1$ reflects the first year of college.

While enrolled in college, we assume that "effective consumption" C_t reflects the sum of consumption expenditures C_t^{ex} and any additional "consumption value of college", $\mathcal{V}$:

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

This assumes that the consumption value $\mathcal{V}$ enters in a "lump sum" fashion (e.g. free access to athletic facilities, leisure, and entertainment opportunities). In Section 4.5, we examine whether college also provides goods/services at a discounted price. Once individuals leave school, we assume that effective consumption is fully reflected in expenditures (i.e., $C_t = C_t^{ex}$ for all $t \geq G+1$).[5]

A natural approach for estimating $\mathcal{V}$ exploits the Euler equation (1), which implies

$$\mathcal{V} = U'^{-1}\left([\beta(1+r)]^G E[U'(C_{G+1})]\right) - C_1^{ex}. \tag{3}$$

This approach presents two distinct challenges. The first challenge is one of data availability: equation (3) requires information about preferences (β and $U(\cdot)$), consumption expenditures during college (C_1^{ex}), and the distribution describing beliefs (at the beginning of college) about post-college consumption. We address this challenge through a combination of rich data and economic modeling.

The second challenge is conceptual: Equations (1) and (3) only hold in the absence of binding borrowing constraints. When some students are borrowing constrained, as suggested by much of the literature (Lochner and Monge-Naranjo, 2012), it is impossible to distinguish between binding constraints and a positive consumption value of college using only information on preferences and consumption behavior. We address this critical problem using a novel survey question that identifies whether students are borrowing constrained during college *and* the amount that constrained students would like to borrow if they could.[6]

Let $\hat{\delta} \geq 0$ reflect the amount of additional resources a student would like to borrow during college, to be repaid after leaving college. Notice $\hat{\delta} > 0$ for those that are constrained, while $\hat{\delta} = 0$ for those that are not. Letting $\hat{C}_{G+1}$ reflect "optimal" post-college

[5]Below, we address the possibility that youth may live with family after leaving school, in which case reported consumption expenditures may understate actual consumption.

[6]The introduction discusses other factors related to the Euler equation and our approach (e.g., debt aversion, home production, durable goods, etc.)

consumption in the hypothetical borrowing scenario, equation (3) can be modified to account for constrained students wishing to borrow $\hat{\delta}$:

$$\mathcal{V} = U'^{-1}\left([\beta(1+r)]^G E[U'(\hat{C}_{G+1})]\right) - C_1^{ex} - \hat{\delta}. \tag{4}$$

When students are unconstrained, $\hat{\delta} = 0$ and $\hat{C}_{G+1} = C_{G+1}$, so equation (4) reduces to equation (3).

Our data contain measures of C_1^{ex} and $\hat{\delta}$. We assume r is known and that preferences have the standard CRRA form,

$$U(C) = \frac{C^{1-\rho}}{1-\rho}.$$

A battery of survey questions about risk and intertemporal tradeoffs are used to obtain estimates of relative risk aversion ρ and time preference β for each respondent.

Finally, we need to determine the expected marginal utility of post-college consumption $E[U'(\hat{C}_{G+1})]$, which requires knowledge of the distribution describing beliefs about $\hat{C}_{G+1}$. Although the BPS does not directly elicit this distribution, it does contain measures of student debt and beliefs about post-college earnings that enable us to characterize the distribution and $E[U'(\hat{C}_{G+1})]$.[7] With this in mind, write post-college consumption, $C_{G+1} = \tilde{C}(D_{G+1}, W_{G+1})$, as a function of observed post-college debt D_{G+1} and earnings W_{G+1}.[8] Given the modest values for $\hat{\delta}$ in our sample, we assume that students' post-school earnings would be unaffected by borrowing this additional amount. As such, additional (hypothetical) debt $\hat{\delta}$ should affect future consumption in the same way as does existing debt. Given CRRA preferences, this implies that

$$\mathcal{V} = \left([\beta(1+r)]^G E\left[\tilde{C}\left(D_{G+1} + (1+r)^G\hat{\delta}, W_{G+1}\right)^{-\rho}\right]\right)^{-1/\rho} - C_1^{ex} - \hat{\delta}. \tag{5}$$

Assuming that D_{G+1} is fully anticipated when students enter college, expectations need only be taken over post-college earnings possibilities.[9] We use our subjective belief measures, elicited during students' first year of college, for this expectation.

We adopt two different approaches to identify the distribution describing beliefs about post-college consumption and, therefore, $\mathcal{V}$. First, we take a data-driven approach under the assumption that all students have the same post-college consumption function

[7] If unconstrained students all faced the same distribution of post-college consumption and held rational expectations about future consumption, then we could estimate $E[U'(\hat{C}_{G+1})]$ for those students using their observed post-college consumption. As shown below, first-year students are considerably optimistic about their future earnings, raising serious concerns about this approach.

[8] This consumption function may also (implicitly) depend on credit market frictions, preferences, and beliefs about future earnings (conditional on D_{G+1} and W_{G+1}), all of which could vary across individuals.

[9] Known D_{G+1} is consistent with the fact that over 80% of end-of-college debt comes from college loans, which are likely anticipated early in college.

$\tilde{C}(\cdot,\cdot)$.[10] For this approach, we flexibly estimate $\tilde{C}(D_{G+1}, W_{G+1})$ using survey data on C_{G+1}, D_{G+1}, and W_{G+1}. Second, we take a model-based approach in which the consumption function is obtained as the solution to a standard lifecycle consumption allocation problem under uncertainty and limited borrowing opportunities.[11] Sections 4.1 and 4.2 describe these approaches.

3 Data and Descriptive Statistics

3.1 Berea College and the Berea Panel Study (BPS)

Conducted by Todd Stinebrickner and Ralph Stinebrickner, the BPS is a longitudinal survey that followed two cohorts of students at Berea College from the time they entered college, in 2000 and 2001, until 2014.

Berea is a liberal arts college in central Kentucky that focuses on providing educational opportunities to students from relatively low-income backgrounds, offering full-tuition scholarships to all students. Despite these unique features, Berea offers a standard liberal arts curriculum, and its students are similar in academic quality to those at nearby University of Kentucky (Stinebrickner and Stinebrickner, 2008b). Furthermore, the Berea campus is similar to that of other quality liberal arts colleges. For example, consistent with recent trends, Berea constructed a 10.5 million dollar recreational/wellness center and entirely revamped its dining facilities within the last two decades. 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.[12] With a population of approximately 10,000, the city of Berea has a similar population density as the places students live two years after graduation (specifically, 40th percentile based on zip code).

3.2 Borrowing, Consumption, and Earnings

Figure 1 shows the question used to characterize a student's preferred additional borrowing level $\hat{\delta}$. We set $\hat{\delta} = 0$ for students who would not accept a loan and set $\hat{\delta}$ to the desired amount reported in Q.1.A for those who would.[13]

Also important for our analysis are BPS questions eliciting students' beliefs about the distribution of future period t earnings, F_t^W, asked during the first year of college. (These

[10] This would be the case if individuals faced identical credit markets and were homogeneous in their preferences and beliefs about future earnings conditional on period $G+1$ earnings and debt. This approach also assumes that individuals know this post-college consumption function when they attend college.

[11] See Browning and Crossley (2001) for a survey on lifecycle models of consumption allocation.

[12] Student amenities as defined in Jacob, et al. (2018).

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

Figure 1: Hypothetical Borrowing Question

- 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 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? $__________

  - **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)______________________________

beliefs were asked about three specific future periods: the first year after graduation, age 28, and age 38.) Specifically, students were asked to report the minimum ($\underline{W}_t$) and three quartiles (Q_t^k, for $k = 1, 2, 3$) of these belief distributions. Assuming that F_t^W is a shifted log-normal distribution, i.e., $\log(W_t - \underline{W}_t) \sim N(\mu_t, \sigma_t^2)$, we identify individual-specific

$$\mu_t = \log\left(Q_t^2 - \underline{W}_t\right) \qquad \text{and} \qquad \sigma_t = \log\left(\left[\frac{Q_t^3 - \underline{W}_t}{Q_t^1 - \underline{W}_t}\right]\right) / \left[\Phi(0.75) - \Phi(0.25)\right], \tag{6}$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function (cdf).

The BPS also elicits student expenditures during the first year of college, excluding room and board charges and textbooks, which we denote C_1^{oth}.[14] The value of room and

[14] This is obtained from a question designed to elicit all expenditures by the student and family on the student's consumption with an explicit follow-up question on parental contributions.

board for the academic year at Berea is \$4,760 (in 2001 dollars).[15] 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 $C^{fh} = \$6{,}350$. Total expenditures during the first year of college are $C_1^{ex} = C_1^{oth} + C^{fh}$.

Our analysis is based on students from the 2001 cohort who answered question Q.1, as well as questions eliciting beliefs about future earnings (F_t^W) and about their consumption expenditures during college (C_1^{oth}). Because the Euler equation underlying our approach abstracts from debt-aversion, our main sample (177 students) drops all students who indicate that they would reject the loan for a reason other than consumption smoothing (answer 1 in Q.1.B). Conclusions about $\mathcal{V}$ are very similar when including these students (Appendix C).

The BPS also collects information on consumption C_{G+1} and earnings W_{G+1} during the first year after college. One concern is that reported post-college consumption expenditures understate actual post-college consumption when individuals receive transfers in-kind from parents or other family members, especially for those who live with family after graduation (Kaplan, 2012). To address this, we assume that the "actual" amount of post-college consumption C_{G+1} is the greater of reported consumption expenditures and the relevant poverty level, \$8,590.[16]

Another concern is that students may spend a lot on durable goods (e.g. a new car) during their first year out of college. In Appendix C, we identify two expenditure categories that may contain durable goods purchases and compare expenditures within these categories over the first two years after college. These patterns suggest very modest spending on durables and an effort to remove them has little impact on our estimates of $\mathcal{V}$. Our main analysis includes all expenditures.

Table 1 summarizes BPS data on college consumption, desired borrowing, and beliefs about post-college earnings elicited during the first year of college.[17] On average, students at Berea College spend only \$910/year on consumption, excluding room and board charges and textbooks. Based on Question Q.1, two-thirds report that they would not like to borrow more ($\hat{\delta} = 0$), while the rest report average desired borrowing $\hat{\delta}$ of \$890.

[15] This is similar to that of other comparable four-year colleges in the Appalachian region of Kentucky (\$5,800).

[16] 47 students in our sample report post-college consumption expenditures less than the poverty level. In Appendix C, we consider an alternative in which a student's "actual" annual post-college consumption from housing and groceries is no less than the annual cost of food and housing during college. This yields a slightly larger $\mathcal{V}$.

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

Table 1: Descriptive Statistics in BPS

	C_1^{oth}	$\hat{\delta}$	$\hat{\delta}$ (if > 0)	Q^2_{G+1} (Median)	$\underline{W}_{G+1}$ (Min)	C_{G+1}	W_{G+1}
Mean	0.91	0.30	0.89	43.62	28.89	13.30	21.54
Std. Dev.	0.88	0.70	0.97	23.15	15.25	9.04	10.50
Median	0.60	0.00	0.50	40.00	30.00	10.48	20.27
Interquart. Range	0.60	0.30	0.70	20.00	16.00	6.13	13.36
Sample Size	177	177	60	177	177	151	151

Note: All values in thousands of year 2001 U.S. dollars.

Combining these figures with C^{fh}, average preferred annual consumption expenditure during college ($C_1^{ex} + \hat{\delta}$) is $\$7,560$. The median of individual-specific subjective earnings distributions for the first year out of school (Q^2_{G+1}) has a sample average of \$43,620, while the reported minimum value ($\underline{W}_{G+1}$) has a sample average of \$28,890. There is considerable sample variation in both.

Table 1 also describes our data on post-college consumption and realized earnings. To avoid issues with intra-family consumption allocations, we limit our analysis of C_{G+1} and W_{G+1} to the 151 BPS respondents who were single and childless at the time of their post-college survey.[18] During the first year after college, average consumption expenditure for these individuals was \$13,300 while actual earnings averaged \$21,540. The latter is substantially less than what they had anticipated during their first year of college. This optimism among new students is consistent with other recent evidence from studies using expectations data.[19] The evolution of expectations in the BPS suggests that this initial optimism fades as students progress through college and systematically revise 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. The fact that post-college consumption and earnings (both anticipated and realized) are all substantially greater than preferred consumption during school strongly indicates a non-trivial consumption value of college.

Finally, the BPS contains information about student debt at the end of college, D_{G+1}, for 195 sample respondents.[20] Among these students, average accumulated debt was \$6,120 with a standard deviation of \$7,240. We impute missing values of post-college

[18] These measures are not available for everyone in our main sample but are available for others who are not. Below, we discuss additional sampling frames when using these measures.

[19] Stinebrickner and Stinebrickner (2012) find that students at Berea also overestimated their grade performance at the time of college entrance. Combining survey and administrative data from Chile, Hastings et al. (2016) document that, on average, college applicants substantially overestimate earnings of college graduates.

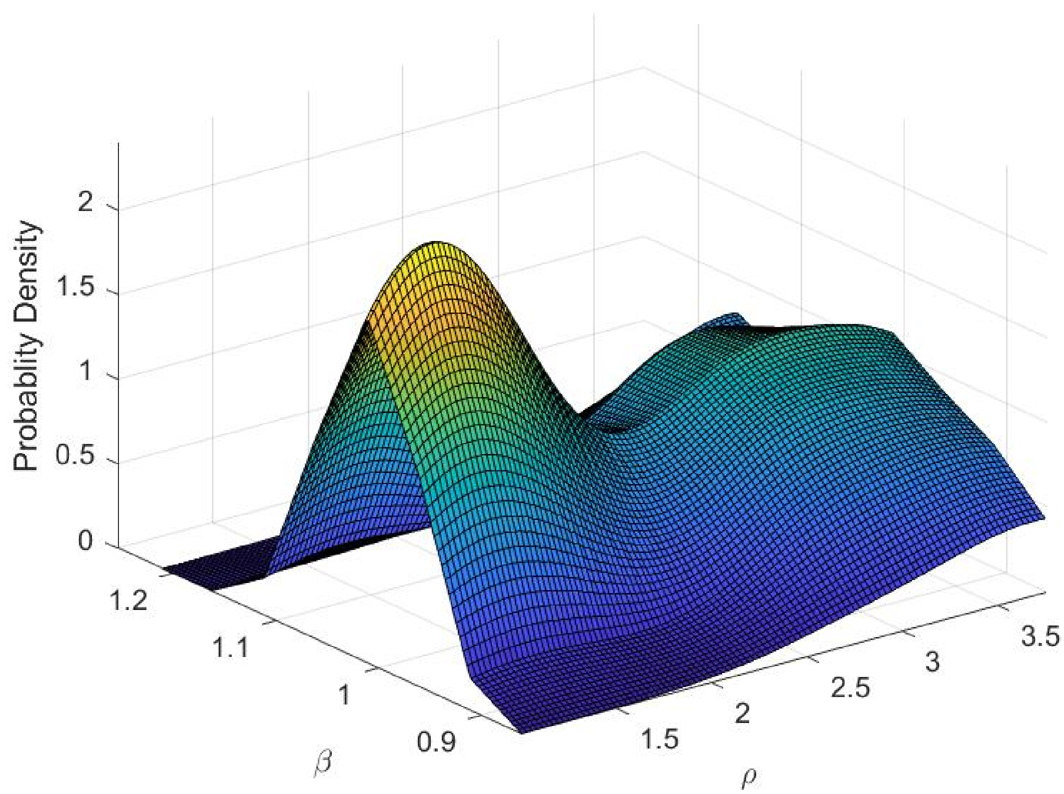
[20] Some of these students are not in our main sample, because they did not answer questions about earnings expectations during their freshman year.

debt with this sample average.[21]

3.3 Risk Aversion and Time Preference

We utilize an approach based on Barsky et al. (1997) to estimate students' rate of time preference, β, and degree of risk aversion, ρ. This approach exploits survey questions asking students about preferred consumption growth (determining β) and to rank job offers differing in expected income and risk (determining ρ). The estimated sample averages for β and ρ are 1.02 and 2.54, respectively. Figure 2 depicts the (kernel density-smoothed) joint distribution for β and ρ, revealing considerable variation in ρ but little heterogeneity in β. See Appendix A for details. Our main analysis uses these elicited values in calculating $\mathcal{V}$; however, Appendix C shows that results are similar for other reasonable parameterizations (e.g. $\beta = 0.95$, $\rho = 2$).

Figure 2: Joint Distribution of ρ and β



[21]We impute D_{G+1} for 65 students in our main sample.

4 Results

This section provides estimated distributions of $\mathcal{V}$ based on equation (5), assuming the interest rate is $r = 5\%$. We use two distinct approaches to obtain the post-college consumption function.

4.1 Data-Driven Approach

Our first approach relies on the assumption that all students have the same post-college consumption function $\tilde{C}(D_{G+1}, W_{G+1})$. In principle, one could non-parametrically estimate this function with cross-sectional data on C_{G+1}, D_{G+1}, and W_{G+1}. Due to our relatively small sample size, we estimate a second order polynomial in D_{G+1} and W_{G+1} under the constraints that C_{G+1} is decreasing in D_{G+1} and increasing in W_{G+1} at all data points.[22] The average derivatives of the estimated $\tilde{C}(\cdot,\cdot)$ with respect to W_{G+1} and D_{G+1} are 0.283 and -0.078, respectively.

The assumption that all students have the same consumption function is consistent with homogeneity in preferences and beliefs about lifecycle earnings, interest rates, and borrowing opportunities conditional on student debt and earnings during the first year following college. Hence, we set β and ρ to their respective sample averages. In applying equation (5), individual heterogeneity in computed values of $\mathcal{V}$ comes only from differences in beliefs F^W_{G+1}, preferred consumption in college $C_1^{ex} + \hat{\delta}$, and preferred student debt $D_{G+1} + (1+r)^G\hat{\delta}$.

The "+" curve in Figure 3 shows the cdf for $\mathcal{V}$ estimated using this Data-Driven (DD) Approach. The average consumption value across the students in our sample is \$11,570. Dispersion of $\mathcal{V}$ is moderate with an interquartile range of \$7,070 (\$6,320 to \$13,390).[23]

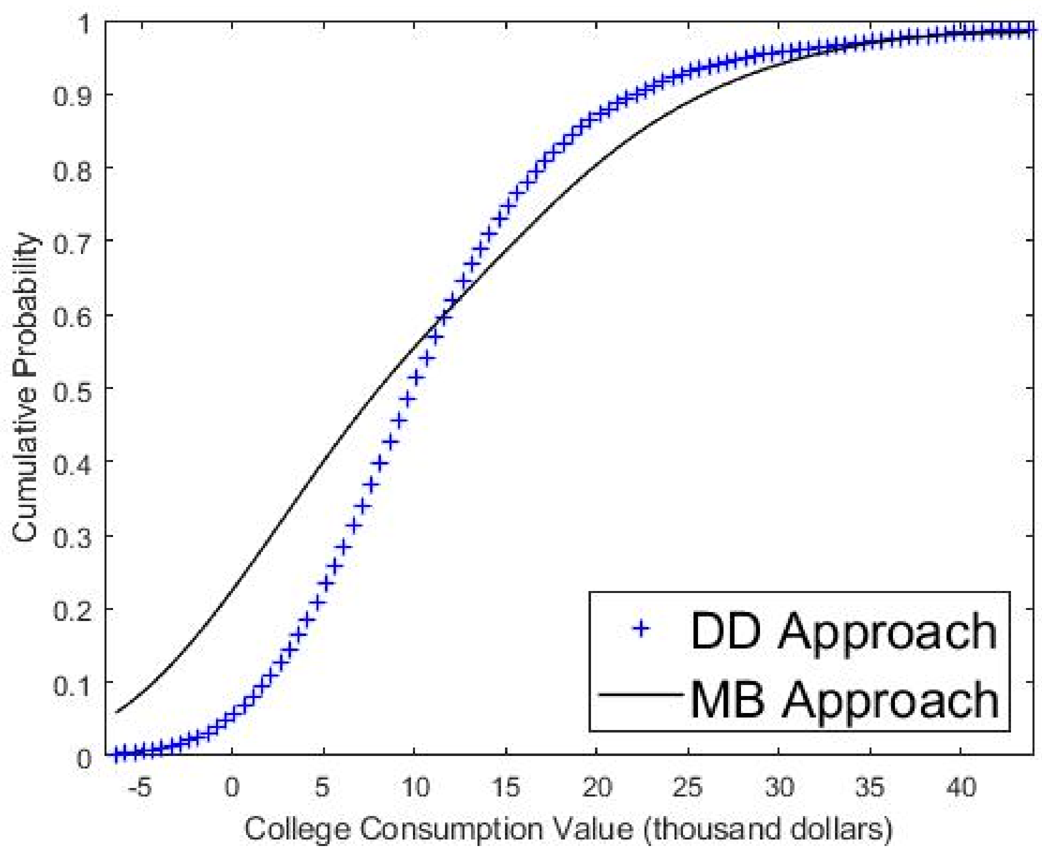
4.2 Model-Based Approach

Our Model-Based (MB) Approach assumes that each student has her own post-college consumption function determined as the solution to a standard lifecycle consumption allocation problem (with uncertainty and borrowing constraints) from period $G+1$ to

[22] Estimation of the post-college consumption function is based on 151 respondents with data on W_{G+1} and C_{G+1} who were single and childless at the time of the survey (D_{G+1} is imputed for 33 observations using the sample average debt level). We then calculate the expected marginal utility of post-college consumption in equation (5) using the estimated consumption function, preferred post-college debt, and the distribution of beliefs about post-college earnings (integrating over F^W_{G+1}) to calculate $\mathcal{V}$ for all 177 students in our main sample. Appendix C explores including those who are married when estimating the consumption function, assuming that individual earnings and consumption are each half of family earnings and consumption. This produces very similar estimated distributions of $\mathcal{V}$.

[23] Appendix C discusses the fact that the empirical support for post-college earnings does not cover the top end of the support for students' subjective earnings beliefs. Conservative assumptions used to extrapolate consumption at these high earnings levels produce similar average $\mathcal{V}$.

Figure 3: CDF of the Sample Distribution of $\mathcal{V}$



retirement, $T = 65$:

$$\max_{C_{G+1},\ldots,C_T} E\left[\sum_{t=G+1}^{T} \beta^{t-G-1} U(C_t) | D_{G+1}, W_{G+1}\right] \quad \text{subject to}$$

$$D_{t+1} = (D_t + C_t - \psi(W_t))(1+r) \leq \bar{D}_{t+1} \quad \text{for } t = G+1, \ldots, T, \tag{7}$$

taking initial post-college debt and earnings (D_{G+1}, W_{G+1}) as given and assuming all debts must be repaid eventually $\bar{D}_{T+1} = 0$. The function $\psi(\cdot)$ determines after-tax earnings based on federal and Kentucky tax code in 2001 (see Appendix D). This maximization problem requires information on preferences (ρ, β), as well as the perceived earnings process and borrowing limits for all post-college periods. We use elicited individual-specific preferences as discussed in Section 3.3.

We assume that earnings follow a shifted log-normal distribution with dynamics determined by an autoregressive process: $\log(W_t - \underline{W}_t) = \mu_t + \sigma_t \epsilon_t$, where $\epsilon_{G+1} \sim N(0,1)$, $\epsilon_t = \lambda \epsilon_{t-1} + \eta_t$ for $t = G+2, \ldots, T$, and $\eta_t \sim N(0, 1-\lambda^2)$ for all t. Section 3.2 describes how we obtain parameters $(\underline{W}_t, \mu_t, \sigma_t)$ for the post-college year $G+1$, age 28, and age 38 from students' responses to the income beliefs question using equation (6). Following Stinebrickner and Stinebrickner (2014), we assume that $\underline{W}_t$, μ_t, and σ_t grow linearly between the observed ages and remain constant after age 38 (until retirement at age 65).

The only remaining parameter to be determined is the degree of autocorrelation in earnings shocks, λ. Using the autocovariance structure for annual earnings from the unbalanced panel of about 10 years post-graduation in the BPS, we estimate $\lambda = 0.62$ via Minimum Distance estimation (see Appendix B). We assume that subjective beliefs about λ match the "actual" autocorrelation in realized earnings for the post-college period; however, results are similar for other values of λ (Appendix C).

Finally, we assume that students cannot take on any new debt after college; however, they can continue to roll over some of their student debt. Specifically, we assume that they must repay at least their minimum (perceived) earnings each year, imposing the following borrowing limit:[24]

$$\bar{D}_{t+1} = \max\left\{0, (1+r)^{t-(G+1)} D_{G+1} - \sum_{t'=G+1}^{t} (1+r)^{t+1-t'} \psi(\underline{W}_{t'})\right\}. \tag{8}$$

Only 9% of students in our sample ever face non-zero borrowing limits. This only arises during the first several years after college, and the limits are quite modest.

With parameters for the earnings process estimated and borrowing limits specified, we numerically solve for the post-college consumption function and calculate $\mathcal{V}$ for each student. The solid line in Figure 3 shows the cdf for $\mathcal{V}$ computed using this MB Approach. The average consumption value is \$9,900, similar to that obtained using the DD Approach; however, the interquartile range is notably larger here, \$16,130 (\$960 to \$17,090). This greater heterogeneity in $\mathcal{V}$ is partly explained by the incorporation of heterogeneity in ρ and β. It is also consistent with the fact that students with low expectations about earnings immediately after school also tend to have low expectations about subsequent earnings. This implies less consumption conditional on post-college debt and earnings due to precautionary motives, which is not captured by a homogeneous consumption function that only depends on (D_{G+1}, W_{G+1}).

4.3 Variation in Consumption Values

Our two approaches yield considerable heterogeneity in college consumption values. We briefly explore the predictability of this heterogeneity by regressing $\mathcal{V}^{\mathcal{DD}}$ ($\mathcal{V}$ from DD approach), $\mathcal{V}^{\mathcal{MB}}$ ($\mathcal{V}$ from MB approach), C_1^{ex}, $C_1^{ex} + \hat{\delta}$, $C_1^{ex} + \hat{\delta} + \mathcal{V}^{\mathcal{DD}}$, and $C_1^{ex} + \hat{\delta} + \mathcal{V}^{\mathcal{MB}}$ on gender, race, final high school grade point average (GPA), and total family income (in the first year of college).[25]

[24]This constraint is very tight, yielding conservative estimates for $\mathcal{V}$, but it ensures that borrowers can always cover their required payments. Assuming students face (more relaxed) Aiyagari (1994) 'natural' borrowing limits (i.e. borrowing can never exceed the perceived minimum discounted present value of future income) implies much larger consumption values of college. See Appendix C.

[25]Similar regressions for time and risk preferences (β and ρ) reveal that little of the variation in these preferences can be explained by these characteristics.

As shown in the first row of Table 2, the only statistically significant predictor of C_1^{ex} is race. Black students spent roughly \$400 less per year during college. However, the second row of Table 2 shows that black Berea students did not have statistically lower total desired consumption ($C_1^{ex} + \hat{\delta}$) than non-black students, suggesting that black students may be more credit constrained.

Turning to results for the consumption value of college, we again find some differences by race. The consumption value of college is estimated to be about \$4,000 higher for black students than non-black students, which could explain why Stinebrickner and Stinebrickner (2014) find that black Berea students are more likely to remain in college conditional on grade performance. Finally, the DD Approach suggests that the consumption value of college is \$3,200 higher for males than females. Altogether, the characteristics we consider explain less than 5% of the variation in all of the consumption measures reported in Table 2.

Table 2: Regression Results: Consumption Value (in \$1,000s)

Dependent Variable	Constant	Male	Black	HS GPA	Family Income
C_1^{ex}	7.850	-0.041	-0.437	-0.116	-0.004
	(0.529)	(0.138)	(0.188)	(0.143)	(0.004)
$C_1^{ex} + \hat{\delta}$	9.360	-0.026	-0.137	-0.483	-0.005
	(0.617)	(0.309)	(0.837)	(0.048)	(0.004)
$\mathcal{V}^{\mathcal{DD}}$	2.733	3.219	3.802	1.782	0.022
	(5.662)	(1.480)	(2.015)	(1.534)	(0.038)
$\mathcal{V}^{\mathcal{MB}}$	4.134	2.071	4.193	1.074	0.015
	(7.104)	(1.857)	(2.528)	(1.925)	(0.048)
$C_1^{ex} + \hat{\delta} + \mathcal{V}^{\mathcal{DD}}$	12.093	3.194	3.665	1.299	0.017
	(5.627)	(1.471)	(2.002)	(1.525)	(0.038)
$C_1^{ex} + \hat{\delta} + \mathcal{V}^{\mathcal{MB}}$	13.494	2.045	4.057	0.591	0.011
	(7.073)	(1.849)	(2.517)	(1.916)	(0.047)

Notes: Each row reflects 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 177.

4.4 Consumption Value and the Expected Return to College

One concrete way to view the quantitative importance of the consumption value $\mathcal{V}$ is to consider its effect on the return to college. To do this, we take advantage of BPS survey questions eliciting students' subjective beliefs about future income in both college and non-college scenarios for the 170 students (out of 177) with valid responses to these questions.

The average expected lifetime income of the college and non-college options (evaluated at age 18) are \$852,000 and \$544,000, respectively. Ignoring the college consumption value (as is typical of the literature), these figures imply a monetary return to college of 56.6 percent. Taking into account four years of the average consumption value of college raises the total return to college by 13.8% (7.8 percentage points) based on the DD Approach and 12.0% (6.8 percentage points) based on the MB Approach.[26] Indeed, these numbers likely understate the full importance of 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 one-third of Berea students wanted to borrow more and the amounts they wanted to borrower were small.

4.5 Lump-Sum Consumption Value and Price Discounts

Our focus on the lump-sum consumption value 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. 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 food and housing, the mapping from consumption expenditures to effective consumption becomes

$$C_1 = \frac{C_1^{oth}}{\pi} + C^{fh} + \mathcal{V}, \tag{9}$$

where $\pi > 0$ is the price of purchased goods in college (relative to the price of goods purchased after college, normalized to one). In Appendix E, we show how π and $\mathcal{V}$ can be identified from the (appropriate) Euler equation (using the MB Approach) when these two parameters are homogeneous across students.

We obtain an estimate for π of 0.69, suggesting that Berea students receive a discount of about 30% on the goods they purchase. The estimated $\mathcal{V}$ is \$12,810, which is about \$2,900 higher than the average value obtained from the MB Approach of Section 4.2 that abstracts from price discounts. The total consumption value of college is given by $C_1 - C_1^{ex} = \frac{1-\pi}{\pi} C_1^{oth} + \mathcal{V}$. Using average C_1^{ex} and estimated $(\pi, \mathcal{V})$, students receive an average annual total consumption value from college of \$13,220. Because spending during college is so low, the price discount channel accounts for less than 5% of this value.

[26]These calculations assume a 5% interest rate in discounting lifetime earnings and the consumption value flows from college.

5 Conclusions

Our results indicate that the students we study, on average, receive $10,000+ in consumption benefits from each year of college attendance. Factoring in four years of these benefits raises the total anticipated return to college by as much as 14%, on average. We also document considerable heterogeneity in these benefits across students, which suggests that the consumption value of college is likely a major factor 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 also have important implications for empirical studies of credit constraints, since low levels of consumption expenditures during college do not necessarily imply binding constraints.

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. In terms of future work, it would be informative to know whether consumption values differ systematically across schools in easily observed ways (e.g. by school size or type, city size, local weather). 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. From a methodological standpoint, there is nothing to preclude the survey questions needed for our approach from being added to general longitudinal surveys in the future.

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Appendices

A Risk Aversion and Time Preference: Details

This appendix describes our method for estimating a student's degree of risk aversion ρ and time preference β. The method we use is a slightly modified version of that proposed in Barsky, et al. (1997).

We determine ρ 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 $(-\infty, 1)$, $(1, 2)$, $(2, 3.76)$, or $(3.76, \infty)$. For simplicity, our main analysis assigns values of 1, 1.5, 2.88, and 3.76 to these four categories, respectively. (Appendix C explores the robustness of our results to assigning $\rho = 5$ for the highest category.)

The estimation of time preference relies on a survey question about a student's preferred growth rate for consumption. Combined with knowledge of ρ, their choice identifies their discount rate β. Specifically, students are asked to choose from different lifecycle consumption profiles that vary in initial consumption and its growth rate g_C such that they all yield the same (undiscounted) sum of total consumption. Assuming individuals choose the consumption profile to solve the following maximization problem:

$$\max_{c_t} \sum_t \beta^t \frac{c_t^{1-\rho}}{1-\rho} \qquad \text{subject to} \qquad \sum_t c_t = C,$$

yields the Euler equation $\beta^{t+1} c_{t+1}^{-\rho} = \beta^t c_t^{-\rho}$, which directly identifies $\beta = \left(\frac{c_{t+1}}{c_t}\right)^{\rho} = g_C^{\rho}$. The BPS asks students to decide between six potential growth rates: 0.96, 0.98, 1.02, 1.04, and 1.06.

The estimated joint distribution for ρ and β in Figure 2 is based on a kernel density estimator with a normal kernel function and optimal bandwidth. There is considerable variation in ρ with an interquartile range of 1.5 to 3.76. By comparison, there is little heterogeneity in β, with an interquartile range of 0.98 to 1.06.[27]

B Estimating the Autocorrelation in Log Wage Shocks

In this appendix, we estimate the autocorrelation parameter for wage shocks, λ, using data on the students' realized annual earnings in the post-college periods.

[27] For the 15% of students who did not answer questions related to ρ and/or β, we impute this missing information using the sample average values for ρ and/or β.

Since realized cross-sectional earnings distributions differ markedly from anticipated distributions, it is necessary to determine $(\mu_t, \sigma_t, \underline{W}_t)$ for actual earnings. Given a limited number of observations per student, we assume that σ_t and $\underline{W}_t$ do not vary across individuals in our estimation of λ. Since we always observe some respondents with zero earnings in our sample, we set $\underline{W}_t = 0$ for this analysis. Allowing for observable and unobservable heterogeneity in mean log earnings, we assume that $\mu_{it} = \mathbf{x}_i'\phi + \alpha_i + g_t$ for individual i in year t. Observed characteristics are reflected in the vector $\mathbf{x}_i$, which includes gender, race, high school GPA, and ACT scores. Unobserved individual differences are captured by $\alpha_i \perp\!\!\!\perp \mathbf{x}_i$, while year dummies g_t capture both time and age/experience effects. These assumptions yield the following log wage equation:

$$\log(W_{it}) = \mathbf{x}_i'\phi + g_t + \alpha_i + \sigma_t\epsilon_{it} \qquad\qquad \forall i \text{ and } \forall t \geq G+1,$$

where ϵ_{it} has zero mean, unit variance, and is uncorrelated with $(\mathbf{x}_i, g_t, \alpha_i)$.

To estimate λ (as well as $\sigma_\alpha^2 \equiv Var(\alpha_i)$ and all σ_t), we first regress $\log(W_{it})$ on $\mathbf{x}_i$ and g_t to obtain residuals: $y_{it} \equiv \alpha_i + \sigma_t\epsilon_{it}$. Next, we use the Minimum Distance (MD) estimator that minimizes the distance between empirical and theoretical second moments for y_{it}, where the covariance between y_{it} and y_{it+k} is

$$cov(y_{i,t}, y_{it+k}) = \sigma_\alpha^2 + \sigma_t\sigma_{t+k}\lambda^k.$$

Collect all parameters to be estimated in $\theta \equiv (\lambda, \sigma_\alpha^2, \sigma_5^2, ..., \sigma_{12}^2)$. Denote the theoretical co-variance matrix implied by θ as $M(\theta)$, and define $\mathbf{m} \equiv vech(M)$, the stacked vector of unique moments in $M(\theta)$. Given that our panel consists of 8 periods, we have 10 parameters and 36 unique moments.

In order to handle missing observations (for some person-years), we adopt the notation used in Blundell, et al. (2008). Denote

$$\mathbf{y_i} = \left\{ \begin{array}{c} y_{i,5} \\ y_{i,6} \\ ... \\ y_{i,12} \end{array} \right\} \qquad \text{and} \qquad \mathbf{d_i} = \left\{ \begin{array}{c} d_{i,5} \\ d_{i,6} \\ ... \\ d_{i,12} \end{array} \right\},$$

where $y_{it} = d_{it} = 0$ if student i is not observed in period t and $d_{it} = 1$ if student i is observed in period t. Then, sample moments $\hat{\mathbf{m}}$ satisfy

$$\hat{\mathbf{m}} = vech\left\{ \left(\sum_{i=1}^{N} \mathbf{y_i}\mathbf{y_i}' \right) \oslash \left(\sum_{i=1}^{N} \mathbf{d_i}\mathbf{d_i}' \right) \right\},$$

where $\oslash$ is element-wise division.

The MD estimator $\hat{\theta}$ is defined as follows:

$$\hat{\theta} = \min_{\theta} \; (\hat{\mathbf{m}} - \mathbf{m}(\theta))'\Omega(\hat{\mathbf{m}} - \mathbf{m}(\theta)),$$

where Ω is the weighting matrix. We use the identity matrix instead of the estimated 'optimal' weighting matrix, since the latter tends to create significant small sample bias (Altonji and Segal, 1996). We estimate $\lambda = 0.6165$.

C Robustness

Table 3: Distribution for $\mathcal{V}$ (in \$1,000s) under Alternative Assumptions

	Mean	25th Perc.	Median	75th Perc.
A) Expanded Sample (300 obs.)				
DD Approach	11.88	6.35	9.37	13.66
MB Approach	10.07	1.06	7.29	16.55
B) Alternative Values for ρ and/or β (177 obs.)				
$\rho = 5$ for the $(3.76, \infty)$ Group (DD Approach)	11.53	6.39	9.57	13.41
$\rho = 5$ for the $(3.76, \infty)$ Group (MB Approach)	9.93	0.95	7.38	17.09
$\beta = 0.95$ and $\rho = 2$ (DD Approach)	14.43	8.14	12.27	16.44
$\beta = 0.95$ and $\rho = 2$ (MB Approach)	15.70	6.34	15.24	22.21
C) Alternative Value for r and λ (177 obs.)				
$r = 8\%$ (DD Approach)	10.74	5.71	8.94	12.52
$r = 8\%$ (MB Approach)	8.20	-0.37	5.85	15.25
$\lambda = 0.9$ (MB Approach)	9.65	0.80	6.87	16.93
D) Alternative Post-College Consumption Function Estimates (177 obs.)				
Conservative Extrapolation Assumption	8.93	6.23	9.13	12.19
Including Married Individuals	10.76	5.82	8.42	12.38
Excluding Individuals w/o D_{G+1} Data	11.61	6.23	9.65	13.55
Alternative Min. Consumption Adjustment	9.59	7.80	9.83	11.95
Conservative Measure of Durable Goods	10.53	5.38	8.45	11.98
E) Alternative Borrowing Limit for MB Approach (177 obs.)				
Aiyagari Borrowing Limit	19.02	4.20	12.05	26.57

Recall that our main estimates of $\mathcal{V}$ reported in the paper average \$11,570 and \$9,900 for the DD and MB Approaches, respectively. Table 3 reports the distribution for estimated $\mathcal{V}$ under a variety of alternative assumptions. All of these results suggest substantial and heterogeneous consumption values of college.

Panel A of Table 3 shows that expanding our sample to include all students who answered survey question Q.1 (including those who would reject an additional loan due to reasons other than consumption smoothing) yields average consumption values $\mathcal{V}$ of \$11,880 for the data-driven approach and \$10,070 for the model-based approach.

As discussed in Appendix A, our main analysis assigns $\rho = 3.76$ for students whose self-reported risk preference places their value of ρ in the range of $(3.76, \infty)$. This could lead to over-estimates of $\mathcal{V}$ for these students. To examine the sensitivity of our results to this assumption, we consider an alternative in which we assign $\rho = 5$ for these students. The first two rows of Panel B in Table 3 show that the sample distributions for $\mathcal{V}$ estimated under this alternative are very similar to their baseline counterparts reported in Sections 4.1 and 4.2.

Our estimates of β are higher than values typically assumed in the consumption literature. For example, the average β exceeds 1, which implies that the average student prefers positive consumption growth over the lifecycle. Given the inherent challenges in eliciting time and risk preferences for individuals, we also calculate $\mathcal{V}$ using "standard" assumptions for these parameters, setting $\beta = 0.95$ and $\rho = 2$ for all students. The last two rows of Panel B show that using these "standard" values produces estimates of $\mathcal{V}$ that are, on average, \$3,000-6,000 higher than our baseline estimates.

Our conclusions about $\mathcal{V}$ also depend on student perceptions about interest rate r and autocorrelation parameter λ. Our main analysis assigns $r = 5\%$ for all students. Taking into account the possibility that college students believe borrowing is more costly, we consider an alternative imposing $r = 8\%$. As shown in the first two rows of Panel C, the sample averages for $\mathcal{V}$ estimated under this alternative are slightly lower (\$830 for the DD Approach and \$1,700 for the MB Approach) than their baseline counterparts reported in Sections 4.1 and 4.2.

Our main analysis using the MB Approach assumes that students' perceived value of λ is equal to 0.62, as estimated from realized earnings reported in the post-college portion of the BPS. This value is somewhat smaller than what researchers typically find using national datasets like the PSID. The third row of Panel C shows that setting λ to 0.9, a more "standard" value in the literature, produces a slightly lower $\mathcal{V}$ than its counterpart reported in Section 4.2.

The DD Approach estimates the post-college consumption function $\tilde{C}(D_{G+1}, W_{G+1})$ using data on C_{G+1}, D_{G+1}, and W_{G+1}. One practical concern 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 high end of the support of students' subjective earnings distribution, requiring extrapolation of the post-college consumption function at these earnings realizations. To examine the sensitivity of our results to this extrapolation, we calculate $\mathcal{V}$ assuming that $\tilde{C}(D, W) = \tilde{C}(D, \max\{W_{G+1}\})$ for all $W \geq \max\{W_{G+1}\}$. This assumption yields the most conservative estimates of $\mathcal{V}$ under the assumption that $\tilde{C}(D_{G+1}, W_{G+1})$ is increasing in W_{G+1}. As shown in the first row of Panel D, the average consumption value computed under this conservative assumption is \$8,930, roughly \$2,600 lower than the average value of $\mathcal{V}$ reported in Section 4.1.

Additional challenges arise in estimation of $\tilde{C}(D_{G+1}, W_{G+1})$ for the DD Approach, because (1) some students are married at $t = G+1$ while our key Euler equation characterizes the trade-off faced by single individuals; (2) among the 151 unmarried students who reported W_{G+1} and C_{G+1}, only 118 also reported D_{G+1}; and (3) post-college consumption expenditures may understate C_{G+1} due to in-kind parental transfers after college. In the paper, we address these issues by (1) only including unmarried students in our sample, (2) imputing the missing values of D_{G+1} using the sample average of D_{G+1}, and (3) assuming C_{G+1} is the greater of reported consumption expenditures and the relevant poverty level, \$8,590. Here, we explore a few alternative approaches.

The second row of Panel D shows the distribution of $\mathcal{V}$ calculated using the DD Approach when we include married students in estimation of $\tilde{C}(\cdot, \cdot)$, assuming that their individual earnings and consumption are half of their family earnings and consumption, respectively. In this case, we have 194 observations for estimation of $\tilde{C}(\cdot, \cdot)$. Average derivatives of $\tilde{C}(\cdot, \cdot)$ with respect to W_{G+1} and D_{G+1} are 0.250 and -0.084, respectively. The average value of $\mathcal{V}$ is \$10,760, and the interquartile range of $\mathcal{V}$ is \$6,560.

The third row of Panel D shows the distribution of $\mathcal{V}$ calculated using the DD Approach when we exclude the students who did not report D_{G+1} from our sample when estimating $\tilde{C}(\cdot, \cdot)$. In this case, we have 118 observations for estimation of $\tilde{C}(\cdot, \cdot)$. Average derivatives of $\tilde{C}(\cdot, \cdot)$ with respect to W_{G+1} and D_{G+1} are 0.302 and -0.079, respectively. The average value of $\mathcal{V}$ is \$11,610, and the interquartile range of $\mathcal{V}$ is \$7,320.

Next, instead of assuming that students' "actual" consumption cannot fall below the poverty line, we consider an alternative in which a student's "actual" post-college consumption from housing and groceries is no less than the cost of food and housing while in college. Average derivatives of $\tilde{C}(D_{G+1}, W_{G+1})$ with respect to W_{G+1} and D_{G+1} are 0.292 and -0.092, respectively. Recall that, since we only restrict the derivative with respect to W_{G+1} to be positive within the empirical support of W_{G+1} and D_{G+1} when estimating $\tilde{C}(D_{G+1}, W_{G+1})$, the estimated function can be decreasing in W_{G+1} for realizations of W_{G+1} that are much larger than the maximum value of observed W_{G+1}, $\max\{W_{G+1}\}$. We find this is the case under this alternative. To deal with this issue, we also assume that $\tilde{C}(D, W) = \tilde{C}(D, \max\{W_{G+1}\})$ for all $W \geq \max\{W_{G+1}\}$. As shown in the fourth row of Panel D, the average value of $\mathcal{V}$ is \$9,590.

Another concern about our measure of C_{G+1} is that it might contain expenditures on durable goods such as cars, which could potentially lead to artificially high levels of measured consumption after school. To address this concern, we take advantage of the fact that our measure of C_{G+1} is obtained by summing over students' reported consumption expenditures on 10 categories of consumption goods. Among the categories listed, 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". The inclusion of durable goods may inflate our measure of C_{G+1} if the price paid covers utility flows beyond that year. This also means that such expenditures should not appear repeatedly within a short time horizon. For example, a student who buys a car at $t = G + 1$ is likely to benefit from that car for several years and is, therefore, unlikely to buy another car over the next few years. This suggests that the lesser of a student's reported expenditures (within each of these two categories) in 2006 ($t = G + 1$) and 2007 ($t = G + 2$) should represent a conservative measure of their non-durable expenditures in $t = G + 1$. Based on this, we create an alternative measure of C_{G+1} by replacing students' reported consumption expenditures on these two categories with this conservative measure. The sample average of this alternative measure is roughly \$710 lower than the sample average of our baseline measure. We then estimate $\tilde{C}(\cdot, \cdot)$ using these alternative measures of C_{G+1} and estimate $\mathcal{V}$ using the DD Approach. Average derivatives of $\tilde{C}(D_{G+1}, W_{G+1})$ with respect to W_{G+1} and D_{G+1} are 0.238 and -0.069, respectively. As shown in the last row of Panel D, the average value of $\mathcal{V}$ is \$10,530, and the interquartile range of $\mathcal{V}$ is \$6,600.

The MB Approach requires a specification for borrowing limits faced by students. Here, we consider the natural borrowing limit of Aiyagari (1994) based on the perceived lower bound on earnings reported by students:

$$\bar{D}_{t+1} = \sum_{t'=t+1}^{T} (\frac{1}{1+r})^{t'-t} \psi(\underline{W_{t'}}).$$

Panel E shows that Aiyagari-type borrowing constraints imply a much higher average $\mathcal{V}$ (\$19,020) than the much more restricted borrowing environment assumed in the paper. This is because the Aiyagari-type constraint is fairly loose for most of the students in our sample – even the most constrained student is allowed to borrow up to around \$16,400 during the first year after college. Due to the greater access to credit, youth behave roughly as if they are unconstrained. There is little incentive for precautionary savings, resulting in higher levels of consumption immediately after college.

D After-tax Earnings

After-tax earnings are computed using federal and state tax schedules for Kentucky circa 2001 for single individuals without children. An individual with before-tax earnings w needs to pay 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 4 to taxable earnings to compute $FT(w)$ and $ST(w)$. The state income credit for Kentucky is \$20.

Table 4: Federal and Kentucky Income Tax Brackets in 2001

Federal		Kentucky	
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.

E Estimation of π and $\mathcal{V}$

When college enrollment not only provides some consumption benefits for free but also reduces the price for all purchased goods/services (not including food and housing provided by the college), the modified Euler equation analogous to equation (4) is

$$\underbrace{\left([\beta(1+r)]^G E\left[\hat{C}_{G+1}^{-\rho}\right]\right)^{-1/\rho}}_{\Omega} = \pi^{\frac{1}{\rho}-1}\left(C_1^{oth} + \hat{\delta}\right) + \pi^{\frac{1}{\rho}}\left(C^{fh} + \mathcal{V}\right),$$

where $\pi > 0$ reflects the price of goods purchased in college relative to the price of goods purchased after college (normalized to one). Note that we already compute Ω for each student using the DD and MB Approaches. If π and $\mathcal{V}$ are common across students, their values can be estimated by exploiting cross-sectional variation in $(C_1^{oth} + \hat{\delta})$ (and ρ). Specifically, allowing for individual-specific values for $(C_1^{oth} + \hat{\delta})$, ρ and Ω (calculated from the MB Approach), we use non-linear least squares to estimate π and $\mathcal{V}$.[28]

[28] Letting i subscripts denote values for student i, the following regression can be estimated via non-linear least squares:

$$\Omega_i = \pi^{\frac{1}{\rho_i}-1}(C_{1,i}^{oth} + \hat{\delta}_i) + \pi^{\frac{1}{\rho_i}}\left(C^{fh} + \mathcal{V}\right) + \nu_i,$$

where $\nu_i \perp\!\!\!\perp (C_{1,i}^{oth} + \hat{\delta}_i, \rho_i)$ reflects measurement error in Ω_i. For homogeneous ρ, a standard linear regression of Ω_i on $(C_{1,i}^{oth} + \hat{\delta}_i)$ yields estimates of $\pi^{\frac{1}{\rho}-1}$ and $\pi^{\frac{1}{\rho}}\mathcal{V}$ from which estimates of $(\pi, \mathcal{V})$ can be obtained. Unfortunately, we do not have sufficient variation in desired consumption alone to obtain precise estimates in this case.

We obtain an estimate for π of 0.69 with a standard error of 0.15, suggesting that Berea students receive a discount of about 30% on the goods they purchase. The estimated $\mathcal{V}$ is \$12,810 with a standard error \$1,910.