The Impact of Pell Grant Aid on Academic Outcomes and Degree Mismatch*

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January 23, 2024

Abstract

The Pell Grant, the largest student aid program in the United States, is dispersed in cash grants to eligible students. The EFC, a non-linear formula, is the federal government's measure of financial need and is used to determine Pell Grant eligibility and grant amount. As part of the formula, students whose family's adjusted gross annual income falls below a specific cut-off automatically receive the maximum Pell Award. The partial expiration of the College Cost Reduction and Access Act (CCRAA) in 2012 reduced this cut-off from $31,000 to $23,000. We use this change in the eligibility criteria to ask if Pell Grant generosity impacts academic outcomes and choice of major. We use the Fixed Effects - Instrumental Variable approach coupled with student-level administrative data from the University of New Mexico (UNM) to estimate the effect of the eligibility change on retention, credit hours attempted, and degree choice. We find first-order effects on Pell Grant generosity and second-order effects on retention, credit hours attempted, and degree choice, with Latino and Indigenous students demonstrating the largest magnitudes.

Keywords: Transfer Payments, Education, Welfare
JEL Codes: H5, I2, I3

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1 Introduction

The Pell Grant is the largest United States aid program for low-income students. The assistance is dispersed through cash grants to eligible students at the start of the academic semester. The maximum Pell Award has increased in generosity from $1,400 in 1975 to $5,550 in 2013. Despite an increase in the nominal amount, the Pell Award has undergone a 4 percent decline in real terms (Turner, 2017). More importantly, due to rising education costs, the award has gone from covering 67% to only 27% of the average cost of attendance from 1975 to 2018 [Citation]. This sizable decline in cost coverage of the Pell Grant Award and the continued increase in the cost of attendance led House and Senate democrats to attempt legislation such as the FAFSA Simplification Act in 2020[1] and the Pell Grant Preservation and Expansion Act in 2021[2], and were successful in passing the former. The FAFSA Simplification Act of 2020, which becomes active in the academic year 2023/2024, will result in an additional 610,000 students becoming Pell Grant eligible and nearly 1.5 million more students receiving the maximum Pell Award under the revamped and simplified Free Application for Federal Student Aid (FAFSA)[3]. During the intervening period of legislative inaction, the federal government has been using its executive leeway to increase the maximum award from year to year, with the last two years (2021/2022 and 2022/2023) experiencing a combined $900 (13.9 percent) increase in the maximum award [Citation]. In the academic year 2023/2024, a sizable $2,175 (33.5%) increase in the maximum award (to $8,670) will coincide with the FAFSA Simplification Act's increase in Pell Grant eligibility[4]. As a result, Pell Grant Program expenditures will increase from $26.7 billion in 2022 to $38.8 billion in 2023, a massive $12 billion increase in government spending[5]. This increase in spending undoubtedly has an opportunity cost; thus, estimating the impact of Pell Grant eligibility

[1]https://crsreports.congress.gov/product/pdf/R/R46909. Accessed 12/13/2023

[2]https://www.congress.gov/bill/117th-congress/house-bill/3946. Accessed 11/13/2023

[3]https://www.ed.gov/news/press-releases/us-department-education-releases-new-data-highlighting-how-simplified-streamlined-and-redesigned-better-fafsa%C2%AE-form-will-help-deliver-maximum-pell-grants-15-million-more-students. Accessed 12/13/2023

[4]https://www2.ed.gov/about/overview/budget/budget23/justifications/o-sfa.pdf. Accessed 12/13/2023

[5]https://www2.ed.gov/about/overview/budget/budget23/justifications/o-sfa.pdf. Accessed 12/13/2023

changes on academic outcomes and its interaction with other institutional programs, such as Direct Student Loans, has become a pressing concern.

How does Pell Grant eligibility impact degree completion and students' degree choice? This paper investigates the causal relationship between Pell Grant generosity and students' academic outcomes. A decrease in Pell Grant generosity, which results in students reallocating hours from education activities to labor, would support the existence of income and substitution effects from education-specific cash grants. Student cash transfers have increased graduation in specific contexts (Denning, 2017; Denning, Marx, and Turner, 2019; Marx and Turner, 2019; Murphy and Wyness, 2023) in the U.S. and U.K. Cash transfers result in postsecondary schools retaining marginal dropouts for longer tenures or until graduation (Denning, Marx, and Turner, 2019; Eng & Matsudaira, 2021; Marx & Turner, 2019; Murphy & Wyness, 2023). Denning (2017) has demonstrated an income or substitution effect (or both) in such an instance, with discrete Pell Grant amount increases associated with student labor supply declines. However, what remains to be studied is the effect of cash transfers on intra-marginal students, students who would have graduated irrespective of cash transfers. This group, encompassing most postsecondary students, will also experience income and substitution effects. For intra-marginal students', the income and substitution effects can only affect the intensive margin. The intra-marginal student will reallocate hours from education to labor supply and will either (a) enroll in fewer credit hours per semester, in which case the student will graduate later, and we will see an increase in the average time-to-degree, or (b) enroll in lower-difficulty coursework and degree major (with lower expected income on average), in which case the results will show students changing majors and experiencing a poorer student-degree match.

We build on past research that investigates enrollment and educational effects of the Pell Grant program. Most early research found negligible enrollment effects associated with the Pell Grant (Hansen 1983; Kane 1995; Turner 2017; Marx and Turner 2018; Denning 2019; Denning, Marx, and Turner 2019; Carruthers and Welch 2020). More recently, Denning,

Marx, and Turner (2019) and Eng and Matsudaira (2021) found effects on graduation rates and time to degree, with the former finding sizable magnitudes and the latter significantly smaller.

Denning, Marx, and Turner (2019) studied 4-year colleges in Texas using the AZ-EFC eligibility threshold in a fuzzy Regression Discontinuity Design (RDD). AZ-EFC eligibility for first-year students increases graduation, earnings, and tax payments. Thus, increased Pell assistance pays for itself via increased tax payments due to higher earnings. Eng and Matsudaira (2021) replicate the quasi-experimental setting of the AZ-EFC eligibility cut-off on a broader swath of higher education institutes. They find a small increase in degree completion, with the effect not robust to differing sample years and specifications. They highlight the importance of context and speculate that the interaction between the federally provisioned Pell Grant and state or institutional student aid programs may explain the difference between their findings and those of Denning, Marx, and Turner (2019) and other state-specific studies.

Marx and Turner (2019) and Denning (2019) are other studies that find an impact of Pell assistance on academic outcomes. Marx and Turner (2019) use the EFC eligibility threshold in a Randomized Control Trial (RCT) to estimate the effect of Pell Grants and student loans on attainment. They found that a $1000 increase in the Pell Grant is associated with an 11-21 percent increase in credits attempted, credits obtained, and college GPA. Students classified as financially independent receive considerably more assistance than financial dependents. Students' status as independent (or dependent) is determined on the 1st of January of each year. If a student is 24 years or older at the beginning of the calendar year, they are considered financially independent. Denning (2019) uses this age cut-off in a Donut RDD framework and finds financial independence associated with increased credit hour enrollment and reduced time-to-degree. Notably, Denning (2019) identifies an employment response as the mechanism. Financial independence is associated with a $579 decline in earnings for working students, constituting 55 percent of the increase in grants from financial independence.

Lastly, Murphy and Wyness (2023) estimate the impact of institutional aid in the United Kingdom using differences in student aid schedules across nine universities. They find that an increase in institutional financial aid for first-year students increases the probability of first-year completion, improves test scores, and increases the chances of graduating with a "good" degree (a first-class or second-class Upper Division grade).

This paper is the first to study changes in AZ-EFC eligibility as a policy lever to increase college affordability and access to higher education. Along with the federal Pell Grant, state and institutional student aid programs also determine assistance amounts using the EFC formula and, thus, expansion of the AZ-EFC eligibility threshold increases total student assistance over any increase in Pell Grant assistance, and the reverse is true in the case of a contraction. Using a novel identification approach, we use the longitudinal aspect of our data to account for unobserved heterogeneity, which addresses concerns about unobserved confounders over a pooled cross-section approach. Addressing these concerns is important because policy changes or thresholds associated with the Pell Grant are only partially binding, which leads to the possibility of an unobserved factor (confounder) correlated with Pell Grant recipiency and changes in assistance amounts, as well as students' academic outcomes. Lastly, we evaluate how changes in Pell Grant eligibility interact with other major federal programs, such as Direct Student Loans. We use causal mediator analysis to decompose the average treatment effect (ATE) into the average indirect treatment effect (AITE), which is the effect via a change in Direct Student Loans, and the average direct treatment effect (ADTE), which is the isolated effect of the variation in Pell Grant.

The remainder of this paper is organized as follows. Section 2 explains the context in which AZ-EFC eligibility threshold changes happened and lays out our conceptual framework. Section 3 details our data sources and characteristics, followed by an explanation of our analysis samples. Section 4 details our empirical methodology and explains the identification. Section 7 presents our primary specifications, mediator, and heterogeneity analysis results, and section 8 concludes with a discussion of our findings, limitations, and suggestions for

future research.

2 The Pell Grant Program

The Pell Grant was part of the Higher Education Act of 1965, signed into law by Lyndon B. Johnson to bolster higher education resources. The Pell Grant is a subsidy to aid students from low-income households to afford college, which, unlike student loans, does not have to be repaid. Pell Grant eligibility, for our sample years, depends on two factors: (i) the annual maximum award (set by the federal government) and (ii) the expected family contribution (EFC). The EFC is the federal government's measure of financial need and determines Pell Grant eligibility and amount. It is a non-linear formula calculated using the Free Application for Free Student Aid (FAFSA) information. This information includes family income, the value of assets, and welfare recipiency status. Only those who receive an EFC score of zero qualify for the maximum grant award. One way in which students automatically qualify for the maximum award is if their family's adjusted gross annual income (AGI) falls below a specific threshold. This income cut-off is the automatic zero EFC (AZ-EFC) eligibility threshold. The FAFSA Simplification Act, which becomes effective in the academic year 2023/2024, abolishes the AZ-EFC eligibility threshold, as it replaces the EFC formula with a more simplified student need measure, the Student Aid Index (SAI). It also establishes an AGI cut-off of $60,000, which ensures automatic eligibility for the maximum award without any score conversion. Thus, in reality, the AGI threshold for automatic maximum Pell Award eligibility has increased to $60,000, more than doubling the previous year's threshold of $27,000, while also discarding the now expired "AZ-EFC eligibility threshold" nomenclature. This increase will result in 1.5 million more students receiving the maximum Pell Award [6].

[6]https://www.ed.gov/news/press-releases/us-department-education-releases-new-data-highlighting-how-simplified-streamlined-and-redesigned-better-fafsa%C2%AE-form-will-help-deliver-maximum-pell-grants-15-million-more-students. Accessed 12/13/2023

3 The College Cost Reduction and Access Act

The U.S. legislature enacted the College Cost Reduction and Access Act of 2007 (CCRAA) in response to the increasing cost of higher education and the decline in the Pell Grant's cost of attendance coverage. Alongside several other components, it increased the AZ-EFC eligibility threshold from $20,000 in 2008 to $30,000 in 2009. The CCRAA also increased the maximum Pell Grant award from $4,310 to $5,400 by 2012. Some components of the CCRAA, including the increase in the AZ-EFC eligibility threshold, were stipulated to be reversed in 2012, notwithstanding a legislative extension. Congress was unable to agree on an extension, and in 2012, the AZ-EFC eligibility threshold declined from $31,000 to $23,000.

The CCRAA created sizable changes in the AZ-EFC eligibility threshold, with an initial expansion in 2009 and a subsequent decline in 2012. These created exogenous variations in Pell Grant generosity; students whose family income fell between $20,000 and $30,000 qualified for the maximum Pell Award after the initial expansion and experienced a discrete increase in their Pell Grant award. In 2012, when the threshold declined, students whose family income fell between $31,000 and $23,000 no longer qualified for the maximum Pell Award and experienced a discrete decline in their Pell Grant award.

The initial expansion coincided with the Great Recession and the American Recovery and Reinvestment Act of 2009 (ARRA). The stimulus component of the ARRA was responsible for substantial federal and state education outlays, including a sizable increase in Pell Grant funding. The ARRA supplemented the annual discretionary appropriation of $17.3 billion for Pell assistance in F.Y. 2009 with a further $15.6 billion in discretionary spending. Thus, the total discretionary appropriation for the Pell Grant Program in F.Y. 2009 was $32.9 billion, a massive 131.6% increase over its F.Y. 2008 level of $14.2 billion. Due to the economic turmoil of the Great Recession and the substantial federal and state stimulus spending on education in 2009, we can not accurately estimate the effect of the AZ-EFC eligibility expansion (2009) on academic outcomes. An empirical methodology using the 2009 AZ-EFC eligibility expansion for causal identification would lack internal validity. As a result, we use

the 2012 contraction in the AZ-EFC eligibility threshold as our source of exogenous variation in Pell Grant generosity.

We analyze the intensive margin, encompassing retention, academic performance, and graduation. Inclusion in our sample is conditional on initial enrollment at UNM. We do not examine the extensive margin (admission enrollment) because of selection bias issues. Given that we use a postsecondary dataset, inclusion in admission enrollment analysis is conditional on a student application, i.e., inclusion in the institutional dataset is conditional on interaction with the institution, which is rarely random. This is a common issue encountered in administrative datasets. As students self-select into the applicant pool, the applicant pool is not a representative sample of the high school graduate population. Using terminology from the Pearl (2009) framework, inclusion in our sample is conditional on a collider variable, which fails the back-door criterion. As demonstrated by Cunningham (2021), the ensuing bias may be sizable enough to switch the sign of our coefficients.

4 Data, Sample, and Descriptive Statistics

We use University of New Mexico (UNM) administrative data with detailed student information by semester from admission until graduation. We use admission and enrollment data from the Institute of Design and Innovation (IDI) at UNM, encompassing the academic years 2006-2018. The administrative data contains information on student demographics, year of application, high school GPA, ACT scores, student's degree major, semester enrollment, and high school information – at the city-only level – for New Mexico residents. Notably, the data also includes detailed financial aid and student loan information. The longitudinal student data tracks all students every semester they attend UNM, which includes semester-specific financial aid and student loan information. Our data set encompasses cohorts admitted as freshmen in 2007-2018. The freshmen class of the 2018/2019 academic year is our last cohort, and we only observe them for their two freshman semesters.

We obtained information on the AZ-EFC eligibility threshold from each year's Federal Student Aid public release of the EFC formula. Federal Student Aid is an office of the U.S. Department of Education.

For the marginal student, the outcome of interest is graduation, a dichotomous variable for degree completion. For the intra-marginal student, we are interested in the impact on time-to-degree and degree match. Time to degree is a count variable for the number of semesters enrolled before graduation. For degree major mismatch, we create a continuous measure using standardized examinations (ACT and SAT) by following Maragkou's (2020) approach. The measure has two components: individual ability distribution – the student's position in the ACT (or SAT) distribution - and a distribution of degree quality, the median ACT (or SAT) score of a degree. We construct the index by subtracting the ACT point score of the student from the median ACT point score of students who majored (and graduated) in the student's degree of choice. This measure can identify high and low levels of degree undermatch and overmatch, with a negative value implying that the student is under-matched, which means the student placed lower on the degree quality distribution relative to the individual ability distribution. In the instance of a positive value, the student placed higher on the degree quality distribution than the individual ability distribution.

The average Pell Award for the 2010 and 2011 freshmen students is \$1711.13 and \$1787.97, respectively. XX and XX percent of freshmen students received the Pell Grant in the fall years 2010 and 2011. Non-federal sources of student financial aid and federal student loans are possible confounders and necessitate inclusion in our model. We include state and institutional financial aid offers in our model to account for changes in non-Pell assistance. Some need-based state and institutional financial aid programs also use the EFC formula (and, thus, the AZ-EFC eligibility threshold) to determine student aid amounts (Denning, Marx, and Turner, 2019). Moreover, state and institutional student aid may also experience upward pressure as states may reallocate funding in response to decreases in federal student assistance, and institutions may extract less consumer surplus (which they do so via differ-

ential pricing) from students in fear of negatively impacting enrollment (Singell and Stone, 2007). XX and XX percent of freshmen students received financial aid from the University of New Mexico in 2010 and 2011, averaging $1196.89 and 1142.63$, respectively. The financial aid from New Mexico state was mainly in the form of the New Mexico Lottery Scholarship, which pays for the tuition of all New Mexico residents conditional on full-time enrollment and maintaining a minimum 2.5 GPA. State financial aid was 3014.65 and 3188.78 for 2010 and 2011 freshmen students.

UNM has a diverse study body; 50% of 2010 freshmen students were Latino, representing the largest group. Non-Hispanic White students accounted for 37%, and Indigenous students 5%. The remaining 8% consisted of Asian, Pacific Islander, and Black students. International students are excluded from our analysis.

5 Empirical Specification

We use equations (1) and (2) in Two-stage Least Squares (2SLS) estimation coupled with Student-level fixed effects (FE) to analyze the impact of changes in the AZ-EFC eligibility threshold on degree completion and degree choice.

$$\hat{Pell}_{ist} = \beta_0 + \beta_1 T_{st} + \delta \mathbf{X}_i + \epsilon_i \tag{1}$$

$$E_{ist} = \beta_0 + \beta_1 \hat{Pell}_{ist} + \delta \mathbf{X}_i + \epsilon_i \tag{2}$$

$\hat{Pell}_{ist}$ is the predicted value of exogenous changes in the Pell Grant award for student i between period t and t + 1, obtained from estimating the first stage (1). The AZ-EFC eligibility threshold is the instrument variable excluded from our second stage (2). It is determined exogenously and given by T_{st}. $\mathbf{\Delta X}_i$ is a vector of student-level time-varying covariates, encompassing other types of student aid and federal student loans. E_{ist} is our academic outcome of interest. The individual fixed effects - 2SLS is a *with-in* student esti-

mator. We first estimate a student-level dichotomous variable for retention as our outcome to establish a relationship between changes in Pell Grant generosity and the marginal student. Second, we estimate our model with credit hours attempted and student degree match as outcomes to identify the effect of a decrease (or increase) in Pell Grant generosity on the intra-marginal student.

Our hypothesis is given by:

$$H_0 : \beta_1 = 0$$

$$H_A : \beta_1 \neq 0$$

where H_0 is the null hypothesis, i.e., the effect is statistically indistinguishable from zero, and H_A is the alternative hypothesis.

6 Identification

The critical assumption to identify causal variation in our model is that students or their families cannot manipulate their AGI in response to changes in the AZ-EFC eligibility threshold. Any manipulation is unlikely because over half of all students eligible for the Pell Grant have previously undergone FAFSA audits (Denning, Marx, and Turner 2019). Second, the AZ-EFC eligibility threshold and its role are not well known; the complicated setup and inaccessibility of the EFC are the main reasons the system has been reworked and simplified in the FAFSA Simplification Act. Lastly, we only analyze the intensive margin of college attendance. The FAFSA is submitted every academic year. Post-freshmen submissions usually entail mechanically pulling past information, with limited effort spent on understanding the EFC formula and changes.

In our empirical approach given by equations (1) and (2), our sample is an individual-level panel, where we observe each student at t and t+1 (two periods). Our sample encompasses fall years 2010, 2011, and 2012; thus, the two-period student observations (t and t+1) are

the fall academic year combinations of 2010-2011 and 2011-2012. The individual fixed effects estimator accounts for unobserved heterogeneity across students and reduces the likelihood of unaccounted-for confounders. We identify exogenous changes in Pell Award generosity by using changes in the AZ-EFC eligibility threshold. The fall academic year combinations of 2010-2011 and 2011-2012 experience changes in the AZ-EFC eligibility threshold of +$1,000 ($30,000 to $31,000) and -$8,000 ($31,000 to $23,000). This variation in the AZ-EFC eligibility threshold is our model's source of exogenous variation in Pell Award generosity. The first stage identifies the exogenous variation in the Pell Award by using the AZ-EFC eligibility threshold as the instrument variable excluded from the second stage. $\Delta \hat{P}ell_{ist}$. The predicted value of the exogenous variation in the Pell Award is substituted in the second stage to identify the impact of exogenous Pell Award change on retention, attempted credit hours, and degree match. The individual fixed effects estimator provides the with-in-individual effect of the exogenous change in the Pell Award between period t and t+1.

7 Results and Discussion

We begin by estimating models for retention and credit hours attempted, which are the extensive and intensive enrollment margins (conditional on college attendance) in Table 1. The degree match model is in Table 2. The tables have two panels labeled "First-Stage" and "Second-Stage." The First-Stage panel displays estimates for the first stage of the 2SLS, which models the effect of AZ-EFC eligibility change on Pell Grant assistance. The Second-Stage Panel displays the coefficients for the 2SLS second stage, which models the effect of exogenous Pell Award change on academic outcomes. Each Panel has four sets of model estimates for enrollment years t and t+1, i.e., 1-2, 2-3, 3-4, and 4-5. Sample inclusion is conditional on enrollment in period t.

7.1 Results

Equation (1) is the first stage of the 2SLS model. It represents the first-order relationship between the AZ-EFC eligibility threshold and the Pell Grant. It is vital to establish this first-order relationship before studying the second-order effects on academic outcomes. The first stage estimates, in Table 3, represent the exogenous variation in the Pell Award resulting from the shifts in the AZ-EFC eligibility threshold. Students enrolled in their first year of postsecondary school show a $247 decline in their Pell Award associated with a $10,000 decrease in the AZ-EFC eligibility threshold in their second year. Second-year students show a $195 decline in their third year associated with a $10,000 decline in the AZ-EFC eligibility threshold, and third-year students show a $103 decline in their fourth year associated with a $10,000 decline in the AZ-EFC eligibility threshold. The coefficient for fourth-year students as they progress to their fifth year is economically and statistically insignificant.

Equation (2), the second stage, estimates the impact of the Pell Award decline on enrollment margins. The retention and credit hours attempted model estimates are in Table 3. For first-year students, a $100 decline in their second-year Pell Award results in a 0.062 percentage point decline in second-year retention. For second-year students, a $100 decline in their third-year Pell Award results in a 0.037 percentage point decline in third-year retention, and for third-year students, a $100 decline in their fourth-year Pell Award results in a 0.038 percentage point decline in fourth-year retention. The coefficient for fourth-year students as they progress to their fifth year is statistically insignificant.

On the intensive margin, for first-year students, a $100 decline in second-year Pell Award results in 1.03 fewer credit hours attempted in the second year. For second-year students, a $100 decline in their third-year Pell Award results in 0.53 fewer credit hours attempted, and for third-year students, a $100 decline in their fourth-year Pell Award results in 0.030 fewer credit hours attempted. The coefficient for fourth-year students as they progress to their fifth year is statistically indistinguishable from zero.

The change in the Pell Award associated with changes in AZ-EFC eligibility is larger and

more statistically significant the earlier students are in their postsecondary tenure. Years 1 - 2 students demonstrate the largest first-order and second-order effects. The effect consistently decreases in magnitude for the student year transitions that come after. Students in transition 1 - 2, 2 - 3, and 3 - 4 demonstrate effects statistically significant at the 0.1 percent level on retention and credit hours attempted. The final progression from the fourth to the fifth year demonstrates statistically insignificant coefficients for retention and credit hours attempted.

The estimates for the degree match outcome are presented in Table 4. A $100 decline in the Pell Award in the second year is not associated with an effect statistically distinguishable from zero. For third-year students, a $100 decline is associated with placing 0.065 standard deviations higher on the matching index. The effect reverses for fourth-year students, for whom a $100 decline is associated with scoring 0.038 standard deviations lower on the matching index. In the fifth year, the first and second stages effects are statistically indistinguishable from zero. The relationship between the Pell Grant generosity and degree match is inconsistent across students' undergraduate tenure.

7.2 Treatment Heterogeneity

New Mexico is a minority-majority state, with the highest proportion of Latino ancestry among the fifty states, with Latinos accounting for 47.7% of the state population in 2020. These include the Hispanos of New Mexico, also known as Neomexicanos, and more recent immigrants from Latin America. New Mexico also has a sizable Indigenous population, accounting for 10.0% of the state population in 2020. Our dataset gives a rare opportunity to study the grant responsiveness of historically marginalized groups, especially given the demographic change in the K-12 and postsecondary population ages in the U.S. The Pell Grant can be a remedy for wealth inequities perpetuated by the lack of college affordability and, in doing so, can serve a long-term equity function. We estimate the FE-IV model for White, Hispanic, and Native American students independently. The FD-IV first-stage estimates in Table 5 show that $10,000 decline in the AZ-EFC eligibility threshold in their second year

will result in a $186 decline in the Pell Award for White students, a $275 decline for Hispanic students, and a $638 decline for Indigenous students. The declines in the Pell Award for third and fourth years mirror the above pattern of Indigenous students experiencing the largest decline, Latino students the second largest, and White students the smallest.

These findings reflect the lower average household income and wealth among minorities compared to White households in the U.S., with New Mexico representative of the United States. As a result, Latinos and Native American households are more affected by the decline in the AZ-EFC eligibility Threshold. White students demonstrate a 0.08 percentage point decline in retention in the second year for a $100 decline in the Pell Award. The second-stage estimates for retention also demonstrate a statistically significant negative impact on Latinos and Indigenous students. Second-year retention shows a 0.058 and 0.027 percentage point decline in retention for Latino and Indigenous Students, associated with a $100 decline in the Pell Award. For students entering their third year, a $100 decline in the Pell Award results in statistically significant delines of 0.039, 0.037, and 0.024 percentage points for White, Latino, and Indigenous students, respectively. The effects for students entering their fourth year are statistically indistinguishable from zero.

7.3 Limitations

A limitation of this study is that only two cohorts are suitable for inclusion in the DiD analysis: freshmen cohorts 2010 and 2011. The 2009 freshmen cohort experienced a substantial influx of student funding as part of the ARRA stimulus package, both by direct assistance - via increases in Pell Award and other student financial aid - and indirect assistance - via more significant federal and state funding for educational institutes. Thus, the 2009 cohort may differ along unobserved characteristics, which may be possible confounders, and their existence would make the 2009 freshmen cohort an inappropriate control group.

Due to the continuous nature of the treatment variable, it is impossible to estimate a plausible event study, which demonstrates the lack of violation of the parallel trends as-

sumption. Despite this, the TWFE approach saturates the model with every combination of interaction between treatment, cohort, and time variables, which addresses possible treatment heterogeneity and, to some extent, forces pre-treatment parallel trends for treatment and control groups.

Given the uniqueness of UNM and New Mexico, there are concerns about generalizing these findings. New Mexico is a majority-minority state with sizable Hispanic and Native American populations, and UNM is a Hispanic-serving flagship university. Moreover, New Mexico is the third poorest state in the U.S., with the two poorer states (Mississippi and Louisiana) having very different demographic composition.

The rapidly rising cost of higher education means that the net price of a college degree is at a very different region on the demand curve. The implication is that the contemporary net price elasticity of enrollment is very different from 2012, and students will react differently to changes in the net price compared to 2012. This limits the extrapolation of our findings to contemporary settings, if not their generalizability.

8 Summary and Concluding Remarks

This study, taken in the context of the national conversation on college affordability and a substantial federal push to increase Pell Grant eligibility and cost coverage, demonstrates the efficacy of education-specific cash grants to needy students. We find that an increase in Pell Grant generosity results in increased retention and credit hours attempted, and the reverse is true of a decline. As greater educational attainment is associated with higher expected income, increasing Pell Grant generosity results in higher earnings for recipients, and higher earnings will result in greater tax collection. Denning, Marx, and Turner (2019) demonstrated that the increase in Pell assistance that results from falling just below the AZ-EFC eligibility cut-off is recouped in ten years from the additional payments that result from higher earnings. The increase in Pell Grant generosity will pay for itself over time.

This raises the possibility of the federal government recouping the cost of increasing Pell Grant generosity. Denning, Marx, and Turner (2019) found that the discrete increase in Pell Grant associated with falling just below the AZ-EFC eligibility threshold versus just above is paid back to the state in 10 years by the increase in tax collection associated with the higher earnings of recipients.

The impact on degree match is more mixed, with students initially experiencing a negative relationship between Pell generosity and degree match, which later in their degree switches to a positive relationship — making the eventual impact on the future earnings of recipients uncertain.

The means-tested nature of the Pell Grant program and the use of family income as a determinant in aid amount calculation result in the Pell Grant program serving a valuable equity function in the higher education ecosystem. The decline in the AZ-EFC eligibility threshold resulted in students of color experiencing the largest declines in Pell generosity, considerably larger than their White counterparts. We find that a $10,000 decline in the AZ-EFC eligibility threshold in students' second year will result in a $275 decline in the Pell Award for Latino students and a massive $638 decline in the Pell Award for Indigenous students. White students experience a smaller but non-trivial decline of $186 in the Pell Award.

The FAFSA Simplification Act raises the AGI threshold for automatic maximum award eligibility from $27000 to $60,000, and given our findings that greater Pell Grant generosity is associated with improved academic performance and future earning prospects, the expansion of the AGI threshold will significantly benefit students. Moreover, since minority households nationally have lower household income and wealth than their White counterparts (similar to New Mexico), students of color will experience greater increases in Pell generosity, which may, in turn, spur social mobility.

Despite these positives, the FAFSA Simplification Act's expansion of the AGI threshold is considerably larger than any previous attempt, with 1.5 million additional students becoming

eligible for the maximum Pell Award. The substantial increase in government expenditure that will result raises the possibility of diminishing returns to Pell Grant assistance as less needy students become eligible for aid. Thus, future research must study changes to the Pell Grant Program's Marginal Value of Public Funds (MVPF) that results from the FAFSA Simplification Act and compare the MVPF across public assistance programs to gauge the opportunity cost of the massive increase in government spending.

REFERENCES

Carruthers, C. K., & Welch, J. G. (2020). Not whether, but where? Pell grants and college choices. Journal of Public Economics, 172, 1–19.

Cunningham, C. (2021). Causal inference: The mixtape. Yale university press.

Denning, J. T. (2017). College on the cheap: Consequences of community college tuition reductions. American Economic Journal: Economic Policy, 9(2), 155–188.

Denning, J. T. (2019). Born under a lucky star: Financial aid, college completion, labor supply, and credit constraints. Journal of Human Resources, 54(3), 760–784.

Denning, J. T., Marx, B. M., & Turner, Lesly. J. (2019). ProPelled: The effects of grants on graduation, earnings, and welfare. American Economic Journal: Applied Economics, 11(3), 193–224.

Denning, J. T., & Turley, P. (2017). Was that SMART? Institutional Financial Incentives and Field of Study. Journal of Human Resources, 52(1), 152–186.

Eng, A., & Matsudaira, J. (2021). Pell grants and student success: Evidence from the universe of federal aid recipients. Journal of Labor Economics, 39(S2), S413– S454.

Hansen, W. L. (1983). Impact of student financial aid on access. Proceedings of the Academy of Political Science, 35(2), 84–96.

Kane, T. (1995). Rising public college tuition and college entry: How well do public subsidies promote access to college? National Bureau of Economic Research.

Maragkou, K. (2020). Socio-economic inequality and academic match among post-compulsory education participants. Economics of Education Review, 79, 102060.

Marx, B. M., & Turner, Lesly. J. (2019). Attainment Effects of Student Loans and Pell Grants. AEA Papers and Proceedings, 109, 223–226.

Murphy, R., & Wyness, G. (2023). Testing means-tested aid. Journal of Labor Economics, 41(3), 687–727.

Pearl, J. (2009). Causality (2nd ed.). Cambridge University Press.

Singell Jr, L. D., & Stone, J. A. (2007). For whom the Pell tolls: The response of university tuition to federal grants-in-aid. Economics of Education Review, 26(3), 285–295.

Wooldridge, J. M. (2021). Two-way fixed effects, the two-way mundlak regression, and difference-in-differences estimators. SSRN 3906345

Table 1: Data Description for Selected Variables

Variable Name	**Description**
Enrollment	Dummy variable for enrollment in the academic year
Credit hour attempted	Count variable for the number of credit hours attempted in the academic year
Degree Match	Student-level measure of major over or under-match (Median ACT score for major - Students ACT score)
Pell Award	Pell Grant assistance amount received
Institutional Financial Aid	Student financial aid amount received from the University of New Mexico
State Financial Aid	Student financial aid amount received from the state of New Mexico
Direct Subsidized Loans	Federally subsidized student loan amount borrowed
Direct Unsubsidized Loans	Federal (unsubsidized) student loan amount borrowed

Notes: This table describes retention and degree match outcomes and financial aid covariates included in our model specifications.

Table 2: First Year Student Descriptive Statistics for 2010 and 2011 Freshmen Cohorts

Variable Name	**Cohort 2010**	**Cohort 2011**
White	0.37	0.33
	(0.48)	(0.47)
Latino	0.50	0.53
	(0.50)	(0.50)
Indigenous	0.05	(0.05)
	(0.21)	(0.22)
Pell Award	1711.13	1787.97
	(2434.54)	(2439.11)
Institutional Financial Aid	1196.89	1142.63
	(2179.09)	(2761.03)
State Financial Aid	3014.65	3188.78
	(2530.32)	(2674.35)
Direct Subsidized Loans	624.31	1092.81
	(1294.41)	(1580.15)
Direct Unsubsidized Loans	712.44	(1854.72)
	(1612.27)	(2367.57)
Full-Time Tuition and Fees	5505.6	5809.2
	(0)	(0)
N	3,049	2,866

Notes: Column 1 displays mean and standard deviations for selected variables for the 2010 freshmen cohort for their freshmen year. Column 2 displays the mean and standard deviation for selected variables for the 2011 freshmen cohort for their freshmen year. Standard deviations are in parenthesis

Table 3: Two-Stage Least Squares Results for Impact of AZ-EFC Eligibility Threshold Shift on Retention and Credit Hours Attempted

Variable	First-Stage	Second-Stage	
	AZ-EFC	**Retention**	**Credit Hours**
Year 1 - 2			
AZ-EFC	247.36		
(×10000)	(45.67)		
Pell Grant		0.062	1.03
(×100)		(0.01)	(0.18)
N	11,830	11,830	11,830
Year 2 - 3			
AZ-EFC	194.69		
(×10000)	(32.93)		
Pell Grant		0.037	0.53
(×100)		(0.007)	(0.10)
N	11,902	11,902	11,902
Year 3 - 4			
AZ-EFC	103.21		
(×10000)	(30.12)		
Pell Grant		0.038	0.30
(×100)		(0.012)	(0.12)
N	11,242	11,242	11,242
Year 4 - 5			
AZ-EFC	14.46		
(×10000)	(35.94)		
Pell Grant		−0.063	−2.73
(×100)		(0.18)	(7.03)
N	9,432	9,432	9,432

Notes: Panel 1 displays first-stage estimates for AZ-EFC eligibility threshold changes on Pell Award, scaled per additional $1,000 change in the AZ-EFC eligibility threshold. Panel 2 displays second-stage estimates for Pell Award changes on retention, scaled per additional $100 in baseline grant aid. The sample consists of students who graduated from a high school in New Mexico and enrolled full-time at the University of New Mexico in the following academic year. Robust standard errors, clustered by individual, are in parentheses

Table 4: Two-Stage Least Squares Results for Impact of AZ-EFC Eligibility Threshold Shift on Degree Match

Variable	**Degree Match**	
	First-Stage	**Second-Stage**
Year 1 - 2		
AZ-EFC	241.50	
(×10000)	(47.02)	
Pell Grant		0.8
(×100)		(1.43)
N	11,266	11,266
Year 2 - 3		
AZ-EFC	210.40	
(×10000)	(33.95)	
Pell Grant		−0.065
(×100)		(0.016)
N	11,250	11,250
Year 3 - 4		
AZ-EFC	120.65	
(×10000)	(30.60)	
Pell Grant		0.038
(×100)		(0.019)
N	10,570	10,570
Year 4 - 5		
AZ-EFC	10.83	
(×10000)	(37.49)	
Pell Grant		−4.01
(×100)		(13.87)
N	8,874	8,874

Notes: Panel 1 displays first-stage estimates for AZ-EFC eligibility threshold changes on Pell Award, scaled per additional $1,000 change in the AZ-EFC eligibility threshold. Panel 2 displays second-stage estimates for Pell Award changes on degree Match, scaled per additional $100 in baseline grant aid. The sample consists of students who graduated from a high school in New Mexico and enrolled full-time at the University of New Mexico in the following academic year. Robust standard errors, clustered by individual, are in parentheses

Table 5: Two-Stage Least Squares and Individual Fixed Effects Estimates for Impact of AZ-EFC Eligibility Threshold Shift on Retention for White, Latino & Indigenous Students for the Freshmen-Sophmore Transition

Variable	**Pell Grant (First-Stage)**			**Retention (Second-Stage)**		
	White	**Latino**	**Indigenous**	**White**	**Latino**	**Indigenous**
Year 1 - 2						
AZ-EFC	186.45	274.73	637.99			
(×1000)	(69.76)	(66.28)	(209.58)			
Pell Grant				0.08	0.058	0.027
(×100)				(0.029)	(0.013)	(0.0098)
N	4,094	6,052	574	4,094	6,052	574
Year 2 - 3						
AZ-EFC	166.49	196.37	513.83			
(×1000)	(47.30)	(49.05)	(189.91)			
Pell Grant				0.039	0.037	0.024
(×100)				(0.012)	(0.0099)	(0.0093)
N	4,412	5,672	590	4,412	5,672	590
Year 3 - 4						
AZ-EFC	68.50	133.23	−5.32			
(×10000)	(43.54)	(46.73)	(132.04)			
Pell Grant				0.038	0.034	−0.46
(×100)				(0.027)	(0.013)	(11.46)
N	4,464	4,920	636	4,464	4,920	636

Notes: Panel 1 displays first-stage estimates for AZ-EFC eligibility threshold changes on Pell Award for White, Latino, and Indigenous students, scaled per additional $1,000 change in the AZ-EFC eligibility threshold. Panel 2 displays second-stage estimates for Pell Award changes on retention for White, Latino, and Indigenous students, scaled per additional $100 in baseline grant aid. The sample consists of students who graduated from a high school in New Mexico and enrolled full-time at the University of New Mexico in the following academic year. Robust standard errors, clustered by individual, are in parentheses