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The Multiplier Effect of Education Expenditure*

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Abstract

This paper examines the short-run effects of federal education expenditures on local income. We exploit city-level variation in exposure to national changes in the $30-billion Federal Pell Grant Program, which is the largest program to help low-income students attend college in the U.S., to calculate fiscal multipliers of education expenditures. An increase in Pell grants by 1 percent of a city's income raises local income by 2.4 percent over the next two years. This multiplier effect is larger than estimates for military spending (1.5 on average). Multipliers are higher when grants are awarded to students at non-profit colleges, as for-profit colleges absorb most of the grant increases with raises in tuition. Multipliers are also higher during recessions than in expansions: Pell grants can be an effective tool for countercyclical policy that adds to already established benefits, such as, increasing the affordability of college and fostering long-run economic growth.

Keywords: Fiscal Expenditure, Pell Grants, Education Policy, Fiscal Multipliers.

JEL classification: H52, E62

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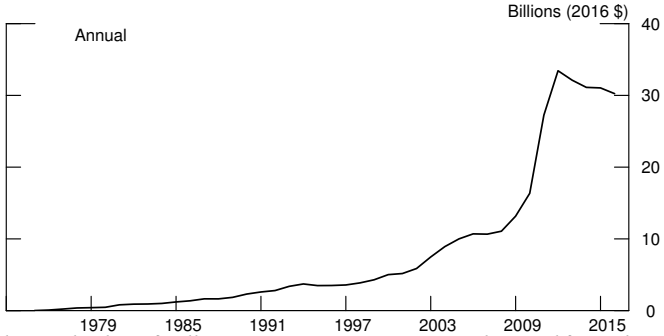
1. Introduction

Investments in education make up a significant part of government spending in advanced economies. In the United States, educational spending measured 6 percent of national income in 2019, which exceeds defense spending and spending on welfare programs. These investments are usually motivated by the well-documented effects that education has on well-being and economic growth in the long run (see, e.g., Barro, 1991, Benhabib and Spiegel, 1994, Bils and Klenow, 2000, and Manuelli and Seshadri, 2014). Like any other form of government spending, however, educational investments also have the potential to stimulate economic activity in the short run. Programs that reduce the cost of tuition or that involve direct transfers to students could, for example, increase purchasing power and therefore raise consumption and growth. Such programs could be used to stimulate economic activity during recessions and serve as a tool for macroeconomic stabilization. Empirical evidence on the short-run effects of educational investments on economic activity is needed to assess whether this is the case.

We quantify the effect of educational investments on economic growth in the short-run. Specifically, we measure the impact of the Federal Pell Grant Program on economic activity at the city (metropolitan statistical area–MSA) level. Pell grants are need-based grants to low-income undergraduate and select post-baccalaureate students, designed to enable them to access post-secondary education. It is the largest program to help low-income students attend college in the United States: total awards exceeded 30 billion U.S. Dollars in 2015 (Figure 1). We measure the effect of these grants on economic activity using city-level variation in the disbursements of Pell grants. In particular, we quantify the effect of a *relative* increase in Pell grant disbursements on the *relative* increase of a city's aggregate income. To assure a causal interpretation of our results, we instrument city-level changes with changes in the national-level generosity of the Pell Grant Program. This follows the approach by Nakamura and Steinsson (2014), who estimate the effect of defense spending on growth at the U.S. state level. It yields a causal interpretation as long as changes to the national-level generosity of the program do not depend on the relative economic growth of cities.

Figure 1. The Pell Grant Program: Expenditures and Recipients



Notes: The figure plots the total value of Pell grants in 2016 USD. Data is obtained from the Title IV Program Volume Reports by the Department of Education.

We find that Pell grants have a significantly positive effect on economic activity. Our main result is that the fiscal multiplier of Pell grants—the percentage increase in a city's relative income from a relative increase in Pell grants by one percent of initial income—is 2.4 on average. This means that a dollar spent on Pell grants creates more than twice as much relative economic activity. This coefficient is robust to the inclusion of city and time fixed effects, city-time trends, controls for spending by state governments and various other controls for economic performance of a city. We find that schools do not increase expenditures when the Pell grant program becomes more generous, which suggests that consumer spending rather than educational spending is the source of the short-run economic gains. When we compare the effect of Pell grants that are received by students at for-profit institutions to Pell grants for students at non-profit institutions, we find that multipliers are lower at for-profit colleges. This is potentially because for-profit schools respond to an increase in Pell grant generosity by proportionally raising tuition fees. It therefore appears that Pell grants are implicitly acting as subsidies for the for-profit university sector.[1] We also find that 2-year institutions have significantly larger multipliers that 4-year institutions. Multipliers at 4-year institutions are around 1.6, while at 2-year institutions are around 4. Thus, Pell grants have especially high multipliers if granted to students attending public community colleges. Finally, we assess whether the multiplier of Pell grants is higher during recessions, as has previously been found for military expenditure.[2] We find that the effect of Pell grants on income is larger in recessions than in expansions. While that effect is not statistically significant, the point estimate is large and suggests that Pell grants can serve as a macroeconomic stabilizer during recessions.

Our estimates of the multiplier of Pell grants add to a vast literature that uses geographic cross-sectional variation in fiscal spending to estimate its short-run economic effects. The use of geographic variation in spending became increasingly popular in the aftermath of the Great Recession. The advantage of using geographical cross-sectional data is that there is much greater variation in spending at the sub-national level, and more of this variation is plausibly exogenous than variation at the national level. Like other sub-national estimations of multipliers, our results do have a particular interpretation: they measure the effect of Pell grants in one city on that city's relative economic performance, rather than the effect of Pell grants on economic performance at the national level. This is because a city-level increase in Pell grants typically does not involve an increase in city-level fiscal deficits (and subsequent taxation), such that Pell grants do not crowd out private spending. Chodorow-Reich (2019), however, argues on theoretical grounds that the kind of geographical cross-sectional multiplier we estimate remains informative. It measures the national-level multiplier of fiscal spending when it is deficit financed and when monetary policy does not respond to the fiscal expansion, for example because interest rates are constrained by the effective lower bound. As these conditions often apply during recessions, our results give insight into the effectiveness of Pell grants as a tool to stimulate demand during downturns at the national level.

[1] Note that since 2010 the "Gainful Employment" regulation has limited the Pell grants at certain for-profit colleges (see Cellini et al., 2016). In general, Turner (2017) estimates that 11-20% of Pell grants passes through to schools.

[2] See, e.g., Nakamura and Steinsson (2014), Auerbach and Gorodnichenko (2012), and Berge et al. (2020).

The multiplier of 2.4 for Pell Grants is higher than most estimates based on cross-sectional geographical variation of other forms of government spending. Early examples include Nakamura and Steinsson (2014), who estimate the state-level response of output to defense spending and find an average multiplier of 1.5. Acconcia et al. (2014) estimate multipliers from reductions in spending due the expulsion of mafia-infiltrated city council members, and find a multiplier of 1.9. Cross-sectional estimates of the multiplier were also frequently used to assess the effect of the American Recovery and Reinvestment Act (ARRA) during the Global Financial Crisis (see, e.g., Chodorow-Reich et al. 2012, Chhabra et al. 2019, Conley and Dupor 2013, Dupor and Mehkari 2016, Feyrer and Sacerdote 2011). Chodorow-Reich (2019) summarizes the literature on cross-sectional multipliers on both ARRA-based and other studies and finds that the mean estimated multiplier is 2.1 and the median estimated multiplier is 1.9. This suggests that the multiplier for Pell grants is high compared to the multiplier of other forms of government spending, and is therefore an effective tool to stimulate short-run economic activity.

In addition to providing evidence on the magnitude of the fiscal multiplier, this paper contributes to the literature on the Pell Grant Program. Previous work has documented several other positive effects, in particular in relation to education outcomes. Bettinger (2004) shows that receiving a Pell grant reduces college drop-out behavior. Marx and Turner (2018) show that Pell grants substantially reduce borrowing as every additional dollar of Pell grants crowds out 1.80 dollars of potential borrowing, therefore reducing student debt. Pell grants also increase educational attainment, the probability of attending college, credit accumulation and has positive effects on students persistence and degree completion (Dynarski, 2003, Castleman and Long, 2016, and Fack and Grenet, 2015). Denning et al. (2019) shows that eligibility for an additional Pell grant significantly increases the likelihood of degree receipt and raises earnings four years after the receipt of the degree. As higher earnings increase tax payments, they estimate that the government expenditures are fully repaid within 10 years.

Dinerstein et al. (2014) look at the short-term economic benefits of Pell grants as part of various federal transfers to post-secondary education during the Global Financial Crisis. They find that counties which benefited from increases in the generosity of the Pell Grant Program did not have a significant increase in local income. They argue that one reason for this may be that students do not spend their grants in the immediate vicinity of their university. Our analysis differs from Dinerstein et al.'s because we estimate the Pell grant's multiplier from variation in Pell grants that is driven by changes to national generosity in the Pell Grant Program, interacted with city-level dummies to obtain variation by year. The latter enables us to control for state and time-fixed effects, such that our estimate of the multiplier is causal if national generosity is not driven by the relative performance of cities. We furthermore consider a sample from 1990 to 2015 rather than 2006-2009, and conduct our an analysis at the city (MSA) rather than the county level.

The remainder of this paper proceeds as follows. We begin by providing an overview of the Pell Grant Program in Section 2, in which we also explain our empirical approach. In Section 3 we discuss our main results while in Section 4 we discuss how multipliers vary over the business cycle and compare multipliers at different types of colleges. Section 5 concludes.

2. Empirical Approach

This section outlines the empirical strategy to estimate the short-term economic effects of Pell grants. We start with a brief summary of the Pell grant program and how grants are allocated to students in Section 2.1. Section 2.2 summarizes the dataset while the estimation equations are presented in Section 2.3.

2.1. Pell Grants: Background

The Federal Pell Grant Program was initiated in 1974 as the Basic Educational Opportunity Grant, to provide a need-based grant to enable low-income students to attend college. It was renamed the Pell Grant Program after Senator Claiborne Pell in 1980. The evolution of the program is plotted in Figure 2a. It started off as a program for 280 thousand students in 1974 with a total appropriation of 122 million dollars, which increased to over 9 million recipients and a 30 billion appropriation by 2015. The program's size depends on the size of the cohort receiving Pell grants and on the maximum grant amount determined by the law. The program expanded particularly rapidly from the early 2000s to 2010. Since 2000, the U.S. has witnessed a substantial increase in enrolment at post-secondary institutions and a marked increase in college tuition, both reflected in the non-profit and the for-profit education sectors. Federal support for higher education was expanded in order to compensate for this increasing costs, which lead to an increase in both the average and the maximum awards for Pell grants (Figure 2b). These were part, for example, of the College Cost Reduction and Access Act of 2007 and of the American Recovery and Reinvestment Act of 2009.[3]

The size of individual grants primarily depends on a student's family earnings. The largest share of Pell grant disbursements are typically received by students from families with an adjusted gross income of less than $60,000.[4] The grant amounts are conditional on the student's expected family contribution (EFC), the institutional cost of attendance, the student's enrollment status, and whether or not they attend a full academic year or less.[5] A full-time student is eligible for the following Pell Grant award if the maximum Pell Grant ($Pell^{MAX}$) higher than the EFC:

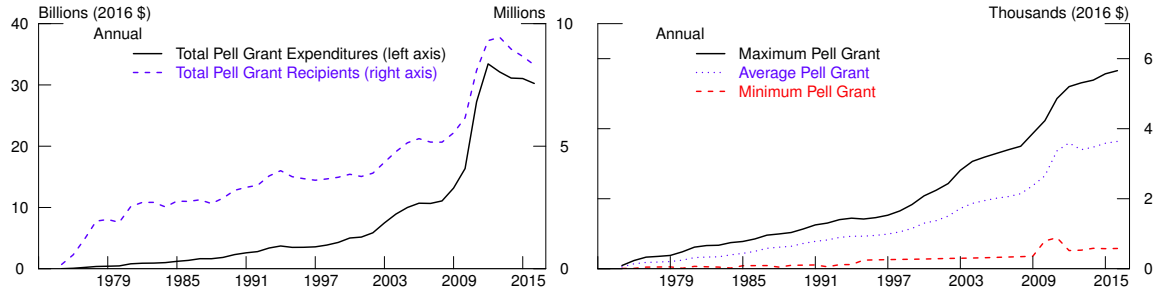
$$Pell_{i,t} = max\left\{(Pell_t^{MAX} - EFC_{i,t}), Pell_t^{MIN}\right\}, \tag{1}$$

[3] A full summary of legislative changes is found in Appendix A.

[4] For example, 96.6% of Pell Grant recipients in 2011-12 had an income of $65,995 or less (see Delisle, 2017).

[5] Financial need is determined by the Department of Education using a standard formula established by Congress to evaluate the to determine the EFC.The formula relies on the student's income (and assets for independent students), the parents' income and assets (for dependent students), the family's household size, and the number of family members (excluding parents) attending post-secondary education.

Figure 2. Evolution of the Federal Pell Grant Program



(a) Aggregate Awards (b) Individual Awards

Notes: Left figure plots the evolution of the dollar-value of Pell grant awards (left axis, solid) and the number of Pell Grant recipients (right-axis, dashed). Right figure plots the minimum (dashed), average (dotted) and maximum (solid) value of an individual Pell grant. Data is obtained from the Title IV Program Volume Reports by the Department of Education.

where $Pell^{MIN}$ is the minimum Pell Grant.[6] Once the grant amount is determined, the institution at which the student is enrolled either credits the grant funds to the student's account, pays the student directly by check, or combines these methods. Grant recipients can enroll at various types of institutions, ranging from 4-year colleges to those specialized in occupational training. Currently, about 5,000 post-secondary institutions participate in the program and more than 40 percent of all undergraduates are relying on this type of aid. The majority of grant recipients are enrolled at public 2-year schools and a significant share is enrolled at for-profit institutions. Pell grants do not typically cover the entire cost of attendance and, as result most recipients supplement this type of aid with funds from other sources, such as federal and/or private student loans, personal savings, 529 plan savings, and other sources.

2.2. Data

To estimate the short-run economic effects of the Pell Grant Program we analyze a sample of 367 metropolitan areas with data from 1990 to 2015.[7] Data on personal income is obtained from the Bureau of Economic Analysis (BEA). We retrieve detailed employment data at the sector level by MSA from the BLS. We combine annual data from Delta Cost with quarterly Pell Grant information retrieved from the Title IV Program Volume reports published by the Department of Education.[8] The data allows us to control for a set of institutional level characteristics, such as the number of undergraduate students and the average tuition fee, a dummy on whether the institution is for-profit, and a variable on whether the institution primarily offers 2 or 4 year degrees. Both datasets cover nearly the universe of American higher education institutions. We aggregate the data to the

[6] Awards are rounded to the nearest $100. Part-time students awards are scaled by a factor of 0.5; scale factor is used for all determinants in Eq. (1). Part-year students receive a prorated Pell Grant.

[7] This is less than the universe of 382 MSAs, as those that never receive Pell grants were excluded, as well as MSAs that receive more than 5% of Pell total Pell grants.

[8] Delta Cost Project is an independent, nonprofit organization, which put together it's namesake data set, which is based on data from the Integrated Postsecondary Education Data Systems (IPEDS).

Table 1: Summary Statistics

	Mean	SD	Obs.	Min.	Max.	Source
Depend Variable						
Δ Personal Income (Biannual)	0.077	0.046	9355	-0.393	0.697	BEA
Pell grants						
Growth in Expenditure - Metro	0.024	0.066	9355	-0.722	1.143	Delta Cost
Growth in Expenditure - National	0.175	0.311	9355	-0.210	1.235	Delta Cost
Control Variables						
Students (log)	9.606	1.271	9355	1.386	13.78	Delta Cost
Students (% of Population)	6.508	5.672	9355	0.004	112.5	Delta Cost
Students (log change)	0.033	0.164	9355	-4.222	4.425	Delta Cost
Tuition fee (log)	8.542	0.868	9355	4.605	10.77	Delta Cost
For Profit (%)	18.95	20.172	9355	0	100	Delta Cost
Black (% of Population)	11.011	14.686	9355	0.076	52.67	Census
Hispanic (% of Population)	11.109	27.405	9355	0.277	95.75	Census
Bachelors Degree (% of Pop.)	9.868	8.531	9355	3.200	139.5	Census
Credit Card Utilization Rate	27.363	6.257	6110	8.004	65.02	CCP (post 1999)
Age (Median)	46.574	4.79	6110	27.50	63.00	CCP (post 1999)
Equifax Risk Score (Median)	700.8	34.43	6110	583.9	787.9	CCP (post 1999)
Mortgage Delinq. (%)	5.527	4.807	6110	-7.601	64.4	CCP (post 1999)
Total Debt (% of Income)	86.096	31.956	6110	11.247	299.2	CCP (post 1999)
Student Debt (% of Income)	5.035	3.961	6110	0.127	67.25	CCP (post 1999)

Notes: Summary statistics for the merged sample. Data from 1990 to 2015 covering 376 metropolitan areas. CCP stands for Federal Reserve Bank of New York/Equifax Consumer Credit Panel.

metropolitan area level.[9] Financial control variables are obtained from a 10% sample of a dataset that covers 5% of the universe of Equifax data in the Federal Reserve Bank of New York's Consumer Credit Panel (CCP).[10] We use this dataset to control for student and overall debt, median Equifax Risk Score, mortgage delinquency and credit card utilization. Data is available for the post-1999 period at quarterly frequency, which we annualize by taking averages. Demographic control variables for race and education levels are retrieved from the Census Bureau. Summary statistics are provided in Table 1.

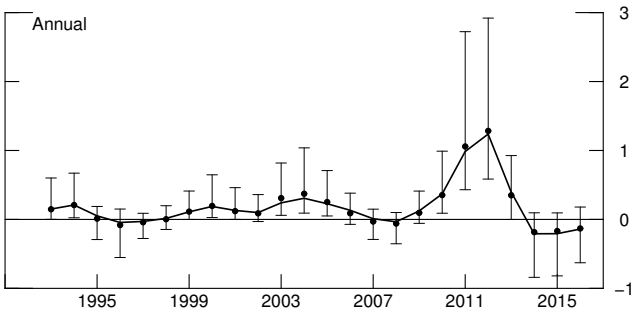
We use Delta Cost as our primary source for Pell grant data because it covers the period between 1987 and 2015, while official data from the Department of Education (DoEd) on the federal funding programs is available only from 2000. One issue with Delta Cost data is that a small fraction of observations is adjusted or imputed.[11] To validate the Delta Cost data we compare the MSA-level Delta Cost data with the available DoEd data aggregated at the same level. This comparison reveals 16 areas where Pell grants from Delta Cost differ erratically from the DoEd data, which we address in two ways on a case-by-case basis. First, for the cases when one year of data were missing or one MSA-year observation was considered suspicious, we used linear interpolation based on the Delta

[9] We allocate between 80% and 87% of all Pell grants in a given year to the MSAs. The remaining is distributed to rural areas. This share has been increasing over time.

[10] We used a 10% sample of the CCP in order to increase our geographical coverage. For more information on the CCP, see Lee and der Klaauw (2010).

[11] For more information, see the documentation posted on their website: https://www.deltacostproject.org/delta-cost-project-database.

Figure 3. Regional Variation: Changes to National and Local Pell Grant to Income Ratio



Notes: Line presents national percentage point change of Pell Grant to GDP ratio. Confidence intervals capture 90th to 10th percentile of percentage point change MSA-level Pell Grant to Income Ratio, while squares present the median change.

Cost data. Second, for the cases when multiple MSA-year observations were either missing or were questionable, we applied the growth rate observed in the DoEd data to Delta Cost data. From our sample of 367 MSAs we correct the path of Pell grants for 9 using interpolation and 10 using the DoEd growth rate. Data for the remaining 348 MSAs was not subject to this adjustment.

2.3. Strategy

While the generosity and conditionality of Pell grants are determined at the national level, there is significant variation in the extent to which sub-national areas benefit from an increase in national-level Pell grant awards. This variation is driven by the fact that areas differ in the number of eligible students that are enrolled in post-secondary education. A city with a large number of universities benefits more from an increase than a city without universities, while a city where a small fraction of its student population is eligible (e.g. because of the level of family income) benefits less than a city where a greater fraction is eligible, even if both cities inhibit a similar number of students overall. The regional variation in Pell grant disbursements is illustrated in Figure 3. The solid line plots the biannual growth rate of Pell grant disbursements at the national level, which is highly correlated with the median growth of disbursements at the local level, marked by squares.[12] The figure's confidence intervals, which plot the 90th and 10th percentile of the growth in Pell Grants, show that there is considerable regional variation, and that this variation is particularly high in the last 10 years of the sample.

We use this variation to estimate the effect of an increase in the generosity of the Pell Grant Program on income growth. To perform this analysis at the national level is complicated, because Pell grants increase in response to economic fluctuations. Enrolment in university is counter-cyclical, tending to increase when economic performance is poor, for example, causing an endogenously negative relationship between growth and the size of the Pell Grant Program. In fact, the 2009 in-

[12] The correlation coefficient between the median metropolitan-level growth rate and the national growth rate is 0.99.

crease in the level of individual Pell grants as part of the American Recovery and Reinvestment Act was expressly in response to poor economic performance during the Global Financial Crisis. We overcome this national-level limitation by analysing the effect of an increase in generosity of the Pell Grant Program at a the city (Metropolitan Statistical Area–MSA). Metropolitan areas are the appropriate level of analysis because a vast majority of U.S. college students resides locally where their school is located.[13] Additionally, there is more variation in spending across metropolitan areas than at other levels commonly used in the estimation of multipliers, like at the state level.[14]

To obtain a causal estimate of the effect of Pell grants on a metropolitan area's economic growth, we must still address the possibility of endogeneity in changes to local Pell-grant awards. Increases in Pell grant awards at the level of a metropolitan area may respond, for example, to an increase in local college enrolment that is driven by a deterioration of local economic conditions. This puts a downward bias on the estimates. To solve this, we exploit two characteristics of Pell grants: the program has become substantially more generous due to nation-wide legislative changes, and there is strong heterogeneity in the extent to which the additional grants were awarded across metropolitan areas. Following Nakamura and Steinsson (2014)'s state-level approach for defense spending, we use these characteristics by instrumenting metropolitan changes in Pell Grant spending by changes in national spending, with separate coefficients for each area.

We estimate the effect of an increase in Pell grant disbursements along:

$$\frac{Y_{m,t} - Y_{m,t-2}}{Y_{m,t-2}} = \beta \cdot \frac{E_{m,t} - E_{m,t-2}}{Y_{m,t-2}} + \phi_m + \psi_t + \gamma' X_{m,t} + \mu_{m,t}, \tag{2}$$

where $Y_{m,t}$ is the macroeconomic variable of interest observed in metropolitan area m in year t, $E_{m,t}$ is the total transfer of Pell grants to students enrolled at schools in metropolitan area m, X is a vector of control variables that includes an area-specific time trend, while ϕ_m and ψ_t, respectively, denote fixed effects for metropolitan areas and years. All variables are in per capita terms. Our dependent variables for Y is personal income, which is a measure that correlates highly with GDP.[15] Biannual changes in variables are considered to mitigate the noise associated with differences between calendar years and academic years (for which Pell grants are assigned), and to account for the fact that a one-year shock to spending tends to precipitate in the second year.[16]

To address the endogeneity concern that changes to local Pell grant disbursements are endogenous to local economic growth, we instrument local Pell grant disbursements with changes in national-level generosity, multiplied with a dummy for each metropolitan area's in order to cap-

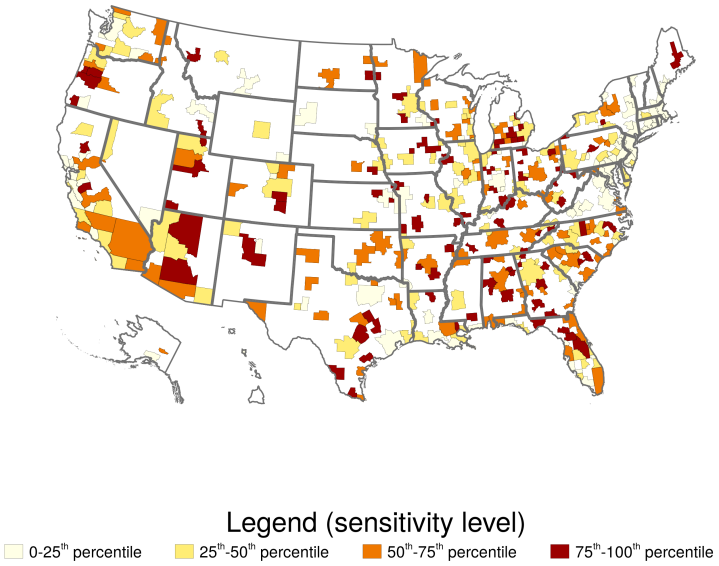
[13] Also, according to the 2015 Digest of Education Statistics Table 309.10 covering student residence and migration, 82 percent of first-time degree-seeking undergraduate students attend college within their state of residence.

[14] Over the complete sample, the ratio of Pell grant spending to GDP is 0.16% across MSAs with a standard deviation of 0.17%, while that ratio is 0.12% at the state level with a standard deviation of just 0.08%.

[15] MSA-level GDP is only available after 2001 while our other variables start in 1990. For years in which both variables are available, their correlation coefficient equals 0.997.

[16] Robustness checks using alternative horizons are provided in the Appendix.

Figure 4. Local Sensitivity to National Changes in Supply of Pell grants



Notes: Sensitivity level refers to coefficient φ_m from equation (3) for the metropolitan area. Grey areas fall outside metropolitan areas or, in rare cases, are areas that never receive Pell grants.

ture differential regional sensitivity to changes in Pell grants at the national level. The first-stage equation reads:

$$\frac{E_{m,t} - E_{m,t-2}}{Y_{m,t-2}} = \sum_{i \in M} \mathbb{1}_{i=m} \cdot \varphi_m \cdot \frac{E_{N,t} - E_{N,t-2}}{Y_{N,t-2}} + \zeta_m + \eta_t + \tau' X_{m,t} + \varepsilon_{m,t}, \tag{3}$$

where subscripts N identify national values of the variables and $\mathbb{1}$ denotes the indicator function which equals one if an observation belongs to MSA m. Coefficients φ_m capture the sensitivity of changes to MSA-level Pell grants to changes in national-level grants, which gives cross-sectional variation to the otherwise constant within-period national changes in Pell grant disbursements. The geographical distribution of φ_m across metropolitan areas is mapped in Figure 4.[17] Dark areas attain the largest increase in spending when national spending increases, while light areas attain the smallest increase in spending. The figure shows that the distribution of sensitivity does not exhibit clustering, and areas with high and low sensitivity are frequently neighbors.

There is substantial variation in the estimated coefficients φ_m. In metropolitan areas with the lowest sensitivity to national spending there is a modest decline in Pell grant spending as national spending increases. The 10^{th} percentile of φ_m is -0.38 while the coefficient reads 1.8 at the 90^{th} percentile. This means that a one percentage point increase in the Pell grant to GDP ratio leads to a 1.8 percentage point increase in the Pell Grant to income ratio in that MSA. The interquartile range is -0.10 to 0.89. Table 2 presents mean values for a number of covariates for MSAs with sensitivity

[17] The coefficients are estimated while controlling for changes in state spending, the percentage of inhabitants that is a student, and demographic controls. This set of controls is the largest set of controls that is available for the full sample. A discussion is provided in Section 3.1.

Table 2: Mean Values of Observables for MSAs with Low or High Sensitivity to National Spending

	Low Sensitivity		High Sensitivity	
Variable	Mean	St. Dev.	Mean	St. Dev.
Outcome Variables				
Δ Income per capita	.079	.05	.078	.044
Δ Employment rate	.005	.031	.006	.03
Education Variables				
Ratio undergr. students to pop.	.039	.021	.088	.069
For profit (% students)	.065	.146	.036	.077
Tuition (average, log)	8.28	.892	8.11	.724
Undegraduate students (log)	9.36	1.57	9.75	1.03
Demographic Controls				
Ratio black to pop.	.093	.089	.114	.119
Ratio hisp. to pop.	.091	.11	.095	.165
Ratio college degree to pop.	.097	.029	.087	.024
Financial Controls				
Credit Card util. rate	.268	.058	.285	.065
Age (median)	46.46	4.67	45.5	4.55
Equifax Risk Score (median)	708.905	31.778	690.48	34.828
Mortgage Del. 30 day	.056	.051	.057	.048
Total debt to income	.903	.332	.842	.315
Student debt to income	.042	.035	.048	.037

Notes: Table presents the average and standard deviation of select variables across MSAs with below (left) or above (right)-average sensitivity of local to national Pell grant disbursements. Data from 1990 to 2015 for outcome, education and demographic variables. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015.

levels below (left columns) or above (right column) the median sensitivity φ_m. Results show that there are no meaningful differences between the average growth rate of per capita income rates of both groups. The metropolitan areas are also similar in terms of age, credit scores, credit card utilization and mortgage delinquency rates, as well as racial composition. The share of the population with a Bachelor's degree is slightly greater in areas with low sensitivity of local to national spending, while debt-to-income ratios and the fraction of schools operating for profit are higher. The largest difference between both groups of metropolitan areas is in the ratio of undergraduate students to the population. In areas with above median sensitivity to national Pell grants, 8.8% of the inhabitants are enrolled in an undergraduate degree. In areas with below median sensitivity only 3.9% of population is enrolled in an undergraduate degree. We control for these differences in our main analysis, and always include MSA fixed effects to control for any time-invariant differences across states with low or high φ_m.

Our estimates of the multiplier of the Federal Pell Grant Program correspond to coefficient β in equation (2). This coefficient measures the *relative* increase in metropolitan area m's income when it achieves a relative increase in Pell grants as an increase in Pell grants of 1% of local income. The estimate has a causal interpretation under the assumption that national changes to the Pell Grant Program are orthogonal to the *relative* economic performance of metropolitan areas. This

is because we exploit two sources of variation for changes in local-level Pell disbursements: (1) the national-level change, to which the identification restriction corresponds, and (2) the average local-level Pell grant sensitivity to national changes. Any endogeneity in the latter, for example because low-growth cities have more students that qualify for Pell grants, is controlled for through the inclusion of metropolitan area fixed effects in the regression. We additionally control for the share of students in a metropolitan area's population. This assures that differences in local Pell grant spending are not driven by changes in a city's student population. Students usually have below-average income, such that not controlling for changes in student population could cause a negative bias on multiplier estimates.

3. Results

We now proceed with the main estimation exercise. Section 3.1 presents results for the first stage and shows that national trends are a relevant instrument for local changes in Pell grant disbursements. It also explains the sequence of control variables that we add in the main estimation. Section 3.2 presents the estimation of the multiplier of Pell grants along equation (2), as well as a number of robustness checks.

3.1. First Stage and Control Variables

We first assess whether changes in nation-wide generosity of the Pell Grant program are valid instruments for local grant receipts by testing the instrument relevance condition. We do so by testing the significance of the relationship between changes in local Pell grant disbursement and the fitted value from the interaction of the estimated φ_m (see eq. 3) and changes in national Pell grant disbursements:

$$\sum_{i \in M} \mathbb{1}_{i=m} \cdot \varphi_m \cdot \frac{E_{N,t} - E_{N,t-2}}{Y_{N,t-2}}$$

Results in Table 3 present the F-statistic for this term.[18] Each column relies on a different set of control variables, which match the sequence of control variables that are used in the main multiplier estimation presented in Section 3.2. All estimations control for MSA-level fixed effects, year fixed effects, a linear MSA time trend, and a control for changes in state appropriations for higher education. An MSA time trend is included because it increases stability of the estimated multipliers over the sample in the second stage. State appropriations are included because they interact with Pell grants. During the 2009 recession, for example, state appropriations fell by 29 cents for every dollar increase in federal research funds (Dinerstein et al. 2014). Some states even reduce appropriations proportionally to increases in Pell grants. This has a negative effect on economic

[18] Note that the degree to which national changes predict local changes naturally differs across cities, as this is the source of variation on which the identification of our multipliers for Pell grants relies.

Table 3: First Stage: Effect of National Spending on Local Spending

	Full Sample				Post 1999		
Income	I	II	III	IV	V	VI	VII
F-Statistic	26.39	26.21	26.40	26.40	25.31	25.43	25.43
P-Value	0	0	0	0	0	0	0
Controls							
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes
Financial Controls						Yes	Yes
Observations	9355	9355	9355	8,997	6110	6110	6110
No. MSAs	367	367	367	367	365	365	365

Notes: MSA controls: number of undergraduate students (log), change in undergraduate students (log) last 2 years, average tuition fee (log), for-profit penetration, percentage of population black, percentage Hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

activity and not controlling for appropriations would therefore lead to an underestimation of the ceteris paribus effect of Pell grants on short-term economic growth.[19]

The first four columns include control variables that are available for the entire 1990-2015 sample. Column I presents the F-statistic of the fitted value for Pell grants from the specification with the basic set of controls, which is highly significant. The next columns additionally control for the fraction of the population that are undergraduate students; MSA controls including average tuition and the percentage of schools that is for-profit, demographic controls consisting of the percentage of the population that is black, Hispanic, and the fraction that at least have a Bachelor's degree; and the lag of biannual growth. F-statistics are highly significant and similar in all specifications. The last three columns of Table 3 are based on estimations for a shorter, post-1999 sample. This is the sample for which we have control variables on the financial position of households in the MSA. These controls, which we obtain from Equifax, include the median Equifax Risk Score, average age, the average ratio of total debt to income, credit card utilization rates and 30-day mortgage delinquency rates. These controls are likely to affect local growth and are therefore relevant, but they reduce the sample to 11 years.

Table 4: Effect of Pell Grants on Local Income Per Capita

Income	Full Sample				Post 1999			Full Sample
	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Multiplier	2.269*	2.441**	2.366**	2.144*	2.904**	2.617**	2.490**	0.906
	(1.190)	(1.207)	(1.172)	(1.258)	(1.244)	(1.144)	(1.226)	(0.890)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,355	9,355	9,355	8,997	6,110	6,110	6,110	8,641
No. MSAs	366	366	366	366	364	364	364	366

Notes: Dependent variable is biannual growth of per capita income. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. State spending is instrumented exploiting the state-level sensitivity to national trends in state appropriation, analogous to the instruments for Pell grants. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last 2 years, average tuition fee (log), for-profit penetration, percentage of population black, percentage Hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

3.2. Multiplier Estimates

The results for the main estimation of the multiplier of Pell grants are presented in Table 4. Multipliers represent the estimated coefficient β from equation (2). The columns are ordered as in Table 3. All columns include fixed effects for metropolitan areas and years, as well as an area-specific time trend and changes to state appropriations. Standard errors are clustered to correct for within-panel correlation and heteroskedasticity. The first column shows that the estimated multiplier is 2.27 in the base specification, which means that when local spending increases by 1 percent of the MSA's income, the MSA's income increases by 2.27 percent. Column II adds a control for the share of the population that are undergraduate students which raises the estimate to 2.44.

Column III presents the preferred specification, which includes Delta Cost control variables for tuition, the level and change (in log) of the number of students, the percentage of for-profit schools in the area, and controls for race and education levels. By adding controls for the change in number of student, our results are not affected by changes in the *number* of students receiving Pell grants in

[19] Reductions in state appropriations tend to have negative effects on students. Webber (2017) shows that for every $1000 per student state budget cut, the average student pays $257 more in tuition and fees. Webber (2017) also shows that this trend has increased over time. State appropriations for higher education are also shown to have an impact on enrollment and borrowing. Goodman and Volz (2019) find that changes in appropriations induce students to substitute between public and for-profit colleges and have corresponding effects on student borrowing.

a metropolitan area. Instead, the estimates capture the effect of having a higher *share* of students that receive Pell grants. The estimated multiplier is 2.37. That is within the range of 1.3 to 2.5% estimated for military expenditure based on state-level data by Nakamura and Steinsson (2014). It is higher than the median (1.9) and the average (2.1) of multipliers found in previous studies that rely on geographic cross-sectional variation in other forms of fiscal spending, as surveyed by Chodorow-Reich (2019). Column IV adds a lagged dependent variable, which somewhat lowers the estimated multiplier to 2.14, close to the average in the studies summarized by Chodorow-Reich.[20]

Columns V to VII are on the shorter post-1999 sample for which we have financial controls from the Federal Reserve Bank of New York/Equifax Consumer Credit Panel. In Column V we reproduce our preferred specification (III) for the shorter sample, and find a multiplier of 2.9. In Column VI we add the financial control variables which reduces the multiplier to 2.6, still exceeding the estimates in Column III. The higher multiplier may be explained by the fact that the Great Recession occurred in the second half of the sample; in Section 4 we show that Pell grants generally have a larger effect on local economic activity during recessions. In Column VII we add lagged growth as in specification (IV), which modestly reduces the multiplier to 2.5.

Our primary dependent variable is the change in local personal income. Largely for reasons of data availability, a part of the fiscal multiplier literature instead studies how spending affects employment. We also estimate the effect of Pell grant disbursements on local employment, but find smaller effects. Table 5 repeats the analysis of Table 4 using the biannual changes in the employment rate as the dependent variable. Most estimates of the fiscal multiplier on employment are positive, with the preferred estimate around 0.75, but quite far from being statistically significant. For comparison, the same specification for military expenditure at the state level in Nakamura and Steinsson (2014) gives an employment rate multiplier of 1.3. Our estimate implies that the cost of creating a job through Pell grants is around $40,000.[21]

Pell grants have a larger short-run effect on income than the literature usually finds for other fiscal expenditures, while their effect on employment is smaller. The wedge between the effect of Pell grants on income and employment can be explained by the fact that the direct effect of Pell grants does not work through employment. The grants are a transfer and cause a one-for-one increase in personal income as measured by the BEA. Other forms of government spending, such as infrastructural investments or defense spending, usually cause a direct increase in employment (e.g. the hiring of construction workers or military personnel). Pell grants are a cash transfer, so the effect on employment works through the consumer spending by students that receive grants.[22] While this can create additional employment as a second round effect, the effect is more uncertain and falls short of those forms of spending that directly affect employment (in line with our—

[20] Our preferred specification does not include a lagged dependent variable because both the Akaike and Bayesian Information Criterion suggest it should be omitted.

[21] This number is found from equation (2) using the change in employment rates as the dependent variable. The effect of Pell grants on employment count is given by $\partial L_t / \partial E_t = \widehat{\beta} \cdot L_{t-2} / Y_{t-2}$. Inserting average per capita personal income in the sample ($29.700) and $\widehat{\beta} = 0.745$ gives 0.25 jobs per $10,000.

[22] We provide some evidence on the mechanism in the next section.

Table 5: Effect of Pell Grants on Employment Rate

Employment	Full Sample				Post 1999			Full Sample
	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Multiplier	0.746	0.694	0.745	0.534	0.753	0.417	0.002	-0.208
	(0.911)	(0.923)	(0.893)	(0.914)	(0.943)	(0.909)	(0.925)	(0.680)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,354	9,354	9,354	8,995	6,109	6,109	6,107	9,355
No. MSAs	366	366	366	366	364	364	364	366

Notes: Dependent variable is biannual growth of employment. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

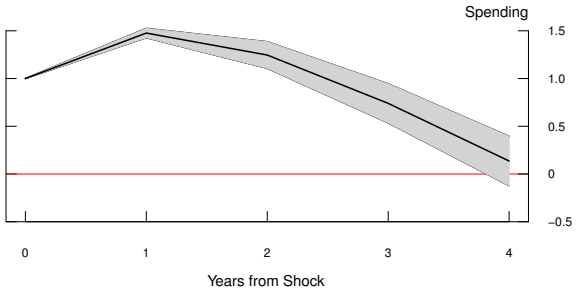
insignificant—point estimate of 0.75 on employment). This is also in line with previous evidence from Feyrer and Sacerdote (2011) that transfers for education have modest effects on employment.

Our results so far have studied the effect of biannual changes in spending on biannual changes in local income. This is preferred over a one year horizon as Pell grants are measured by academic year, while output is measured by calendar year. Biannual changes therefore capture a larger portion of actual changes to local Pell grants. Multiplier estimates over different horizons are provided in Appendix B. Tables A1 and A2 respectively calculate one-year and 4-year multipliers of Pell grants to local income. One-year multipliers are positive and around 1 for the full sample and around 2 for the post-1999 sample, but generally not significant. Conversely, we find very large multipliers over 4-year horizons: estimates range from 4.7 to 5.5, well beyond usual estimates. To understand the latter, consider the path of Pell grants at the MSA level after a one-time increase along the following local projection:

$$\frac{E_{m,t+h} - E_{m,t-1}}{Y_{m,t-1}} = \alpha_h \frac{E_{m,t} - E_{m,t-1}}{Y_{m,t-1}} + \phi_{m,h} + \psi_{t,h} + \varepsilon_{m,t+h}, \tag{4}$$

for $h = 0,1,2,3,4$. The impulse response is plotted in Figure 5. A Pell grant shock at time *0* is slightly amplified in the first year: one year after a one-percentage point shock in the Pell Grant to income ratio, the ratio has increased by 1.5 percentage points. The impulse response function suggests that

Figure 5. Effect of Contemporaneous Spending Shock over Time



Notes: y-axis plots coefficients α_h. Shaded area identifies 95% confidence interval. Estimates obtained using 2SLS instrumenting the first argument of (4) with national values interacted with MSA dummy variables.

the effect of increased Pell grants is significant for three years. This pattern is in line with the 2 to 4 year duration of undergraduate programs at U.S. (community) colleges.

Figure 5 implies that an increase in Pell grants wears off after around four years. If economic activity responds more persistently to the initial increase, the cumulative increase in output vastly exceeds the cumulative increase in Pell grants (which is negligible). This leads to large estimates for the multiplier over a 4-year horizon. We conclude that our baseline biannual approach is appropriate for the analysis of the effects of education expenditures on economic activity.

4. When Are Pell Grants Most Effective?

We next assess under what conditions the effect of an increase in Pell grant disbursements on local economic activity is the largest. To do so, we look at how the effect of Pell grants depends on the state of the economy when disbursements are increased, and whether the effect of grants depends on the type of institution that students attend.

4.1. Multipliers in Recessions and Expansions

Our first estimation compares the multiplier of Pell grants during episodes when the economy is in expansion to when it is in recession. Recent evidence suggests that fiscal spending generally has a greater effect on output when the economy is in recession.[23] If this holds for Pell grants, they could form a particularly effective tool to stabilize macroeconomic activity. We estimate the following equation to test this:

$$\begin{aligned}\frac{Y_{m,t}-Y_{m,t-2}}{Y_{m,t-2}} &= F(z_{m,t-1})\left[\beta_R \frac{E_{m,t}-E_{m,t-2}}{Y_{m,t-2}}\right] + [1-F(z_{m,t-1})]\left[\beta_E \frac{E_{m,t}-E_{m,t-2}}{Y_{m,t-2}}\right] \\ &\quad +\phi_m + \psi_t + \gamma' X_{m,t} + \mu_{m,t}, \end{aligned} \tag{5}$$

[23] Examples include Auerbach and Gorodnichenko (2012), Corsetti et al. (2012), Ilzetzki et al. (2013), Blanchard and Leigh (2013), Jordà and Taylor (2016), and Berge et al. (2020). Ramey and Zubairy (2018) do not find state-dependence in a historical sample with news shocks about defense spending.

where β_R and β_E respectively capture the multiplier in recessions and expansions, while $F(z_{m,t})$ is a continuous function that strictly decreases with lagged biannual growth z_{t_1}.

This equation is also known as a smooth transition model, which we borrow from the literature on the state-dependent effect of fiscal and monetary policy on economic activity.[24] The specification assigns weight to observations based on whether the economy is in recession or expansion. If last year's growth was relatively high, the observation weighs towards β_E while it weights more towards β_R. Following Tenreyro and Thwaites (2016), $F(z_{m,t})$ is a logistic function:

$$F(z_t) = \frac{\exp\left(\theta \frac{[z_{m,t}-\mu_m]}{\sigma_m}\right)}{1+\exp\left(\theta \frac{[z_{m,t}-\mu_m]}{\sigma_m}\right)}, \tag{6}$$

where μ_m determines the fraction of the sample in which the metropolitan area is in recession, σ_m gives the standard deviation of biannual growth in while θ determines how stark the demarcation between recessions and expansions are (e.g., for a lower θ, the weight of observations is more equally split between β_E and β_R). μ_m is calibrated such that each area is in recession 20% of the sample, which matches the percent of quarters that the economy is in recession at the national level according to the NBER. We calibrate θ to 3 in line with Tenreyro and Thwaites (2016).

Results are presented in Table 6. Recession multipliers represent β_R in equation (5) while expansion multipliers represent β_E. The recession (expansion) should be interpreted as the 2-year effect of a relative increase in Pell grants on relative income growth if growth is initially at its *lowest* (highest) level in the dataset. The actual multiplier of an increase in Pell grant disbursements depends on how close growth is to either of these levels. The estimations of columns I to V are estimated with two-stage least squares regressions. Pell grant disbursements at the MSA level are instrumented with disbursements at the national level, multiplied by $F(z_{m,t-1})$ for the first term and $1-F(z_{m,t-1})$ for the second term. Column I contains the base specification that controls for metropolitan and year fixed effects as well as an area-specific time trend. Column II adds control for the share of students in the population while column III adds the other non-financial control variables. Column IV repeats the regression in column III on the post-1999 sample, while column VI adds the financial control variables. Columns with lagged dependent variables are omitted as they are correlated with the assignment function ($F(z_{m,t-1})$). Estimates for the multiplier during recessions vary from 2.9 to 3.2 (3.8 when controlling for financial variables), while estimates during expansions lie between 1.4 to 1.7 (2.7 for the post-1999 sample). Only multipliers in recession are statistically significant.

The difference between the multiplier when the economy is in expansion or recession rate ranges from a modest 0.5 to an economically relevant 2.4, although the difference is not significant at the conventional levels. While our estimates suggest that the effect is noisy, the large estimates

[24] Similar specifications are used by Auerbach and Gorodnichenko (2012), Ramey and Zubairy (2018), Tenreyro and Thwaites (2016), and De Ridder and Pfajfar (2017).

Table 6: State-Dependence of Education Spending Multiplier

	Full Sample			Post 1999		Full Sample
Income	I	II	III	IV	V	VI
	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Recession Multiplier	2.889***	3.092***	3.165**	3.153**	3.784**	2.056
	(1.473)	(1.492)	(1.490)	(1.567)	(1.524)	(1.325)
Expansion Multiplier	1.609	1.728	1.539	2.701	1.416	0.131
	(1.866)	(1.880)	(1.820)	(1.984)	(1.863)	(1.359)
Difference	-1.280	-1.364	-1.626	-0.452	-2.367	-1.925
	(2.370)	(2.376)	(2.351)	(2.538)	(2.503)	(2.010)
Controls						
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes
Financial Controls					Yes	
Observations	8,997	8,997	8,997	6,109	6,109	8,641
No. MSAs	366	366	366	364	364	366

Notes: Dependent variable is biannual growth of per capita income. Multipliers follow from Smooth Transition estimates. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last 2 years, average tuition fee (log), for-profit penetration, percentage of population black, percentage Hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

of the recession multiplier suggest that Pell grants are particularly effective when growth is low and that they could therefore be a tool for countercyclical fiscal policy.

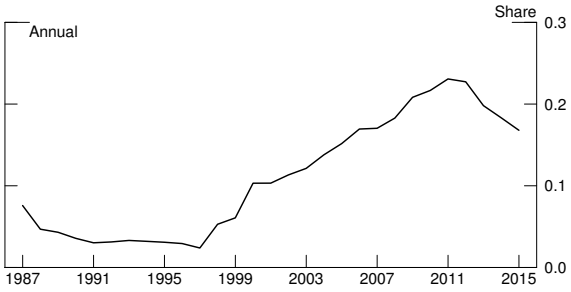
4.2. Institutions: For-Profit vs Non-Profit

We next assess whether multipliers depend on the type of institutions that the beneficiary attends. The previous sections have shown that Pell grants have substantial multipliers, especially during recessions. One objection to using Pell grants for countercyclical policy may be, however, that 15–20% of grants is spent at for-profit colleges (Figure 6).[25] If for-profit colleges have market power, they may be able to charge higher tuition fees in response to higher generosity of Pell grants. Pell grants can therefore operate as an implicit subsidy. As public companies own a large fraction of for-profit colleges, not all of these subsidies will be spent within the college's metropolitan area.[26]

[25] The reduction after 2013 is the result of "Gainful Employment" regulation. This regulation restricts federal student aid at several for-profit institutions (see, for example, Cellini et al., 2016).

[26] Examples of publicly listed companies that own for-profit colleges are Grand Canyon University (LOPE), Adtalem (ATGE, previously DeVry), American Public University System (APEI) and Bridgepoint Education Inc. (BPI).

Figure 6. Percentage of Pell grants Awarded to For-Profit Schools



Notes: Figure plots the fraction of national-level Pell grants that is awarded to students who are enrolled at for-profit institutions. Data is obtained from Delta Cost.

To test whether for-profit schools indeed respond differently to a rise in Pell grants we compare multipliers at for-profit and non-profit institutions. We first assess how both types of institutions change their tuition fees. We use school-level micro data on enrollment, expenditures and revenue sources from Delta Cost to perform this analysis.[27] We define a school's tuition fee as the amount of tuition received directly from students, net of any grants or (institutional) student aid, divided by the number of full-time equivalent students. The estimation equation reads:

$$\frac{\tau_{i,t}-\tau_{i,t-2}}{\tau_{i,t-2}} = \Gamma \frac{Pell_{i,t}-Pell_{i,t-2}}{\tau_{i,t-2}} + \phi_i + \psi_t + \mu_{i,t}, \tag{7}$$

where τ_{it} is the average tuition rate at school i during academic year t, while $Pell$ denotes the amount of Pell grants received per full-time equivalent student. We look at biannual changes to match the horizon over which we estimate the multiplier.

The estimation of (7) is subject to endogeneity because an increase in demand for schooling may increase both tuition fees and the number of Pell grants a school receives. To address this, we instrument changes in school-level Pell Grant with the interaction between a school dummy and national changes in Pell grants analogous to our first-stage approach at the MSA level described in equation (3). In combination with the year and MSA fixed effects in (7), this enables a causal estimate of Γ if the federal government does not change the national generosity of Pell grants in response to an individual school's tuition fees.

Results are presented in Table 7. When Pell grants increase as a percentage of the total tuition revenue, both non-profit and for-profit schools increase their average tuition fees, but the response of the for-profit schools is much higher than in the case of non-profit schools. Non-profit schools increase their tuition fees by about 0.08% when Pell grants share in the total tuition increase by 1 percentage point. For-profit schools, on the other hand, increase their average tuition fees by 1.3 to 1.6%. That means that for-profit schools raise tuition fees more than proportionally when the grants increase. This confirms that Pell grants implicitly subsidize for-profit schools and do not increase the purchasing power of the students that are awarded a grant.

[27] Relevant summary statistics are provided in Appendix Table A10.

Table 7: Effect of Pell grants on Tuition Fees

	For-Profit		Non-Profit	
Δ Tuition	(I)	(II)	(III)	(IV)
Δ Pell grants (% Tuition)	1.558***	1.258**	0.0795***	0.0861***
	(0.537)	(0.504)	(0.030)	(0.023)
School F.E.	Yes	Yes	Yes	Yes
School Time-Trend	No	Yes	No	Yes
Year F.E.	Yes	Yes	Yes	Yes
Observations	16,408	16,408	75,873	75,873
No. Schools	1,574	1,574	3,580	3,580

Notes: Dependent variable is biannual growth in per-capita tuition received from students. 2SLS regressions use national spending interacted with school-dummies to instrument school-level grants. Standard errors clustered by school and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. Both regressions control for school and year fixed effects. Columns I and II contain results from the estimation of (7) on the sample of for-profit schools, while columns III and IV conduct the estimation on the sample of non-profit schools.

Because for-profit schools prevent students from gaining purchasing power when Pell grants disbursements increase, grants may have a smaller effect on economic activity. To test this, we compare the multiplier of Pell grants that are awarded to for-profit schools to the multiplier of Pell grants that are awarded to non-profit schools. Because these may be correlated at the MSA level, we estimate both multipliers jointly along:

$$\frac{Y_{m,t}-Y_{m,t-2}}{Y_{m,t-2}} = \beta^{FP}\frac{E^{FP}_{m,t}-E^{FP}_{m,t-2}}{Y_{m,t-2}} + \beta^{NP}\frac{E^{NP}_{m,t}-E^{NP}_{m,t-2}}{Y_{m,t-2}} + \phi_m + \psi_t + \gamma' X_{m,t} + \mu_{m,t}, \tag{8}$$

where $E^{FP}_{m,t}$ denotes the total amount of Pell grants awarded to for-profit schools in metropolitan area m in year t, while $E^{NP}_{m,t}$ denotes the amount awarded to non-profit schools. The first-stage equation is augmented to include both the national trends in non-profit and for-profit awards.

Results are presented in Table 8. Control variables follow the same sequence as in Table 4. The for-profit multiplier of Pell grants estimates the multiplier effects of grants awarded to private for-profit schools, while the non-profit multiplier estimates the effects of Pell grants at other schools. By including both estimates in the same specification we control for the correlation between awards at both types of schools. As we can see in Table 8, the multipliers are considerably higher for non-profit schools than for for-profit schools where in most cases the difference between the multipliers is higher then 1.5, although is not statistically significant at conventional levels due to high standard errors. The multiplier for non-profit schools ranges from 3.6 to 4.1, while for for-profit schools from 1.6 to 3.4. Multiplier initiated from grants to for-profit schools are—except in Column III—significant only for the post-1999 sample. This implies that there are notable difference in the policy transmission of the education spending depending on profit orientation of recipient schools. Multipliers in for-profit education sector are considerably smaller.

Table 8: Effect of Pell Grants on Local Income Per Capita: For-Profit vs Non-Profit

	Full Sample				Post 1999			Full Sample
Income	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Non-Profit Mult.	3.682***	3.815***	3.576***	4.093***	4.006***	3.600***	4.008***	1.109
	(1.374)	(1.388)	(1.368)	(1.463)	(1.547)	(1.366)	(1.474)	(0.991)
For-Profit Mult.	1.614	1.925	2.625**	2.272	2.842**	3.363**	2.460**	0.0131
	(1.294)	(1.337)	(1.162)	(1.440)	(1.130)	(1.591)	(1.176)	(2.088)
Difference	2.068	1.890	0.951	1.821	1.165	0.237	1.548	1.090
	(1.666)	(1.685)	(1.537)	(1.799)	(1.607)	(1.917)	(1.617)	(2.238)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,348	9,348	9,348	9,348	6,103	6,103	6,103	9,348
No. MSAs	366	366	366	366	364	364	364	366

Notes: Dependent variable is biannual growth of per capita income. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last 2 years, average tuition fee (log), for-profit penetration, percentage of population black, percentage Hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

To understand the lower effect of for-profit Pell grant disbursements, we look at how educational expenditures respond when Pell grants increase. Pell grants can have a positive effect on growth because consumer spending increases or because schools spend additional income productively. The tuition hike at for-profit institutions signals that the transmission through consumer spending will be low, which could explain the difference in multipliers in Table 8. To see how expenditures by colleges respond to a change in Pell grants, Table 9 estimates the effect on overall college expenditures.[28] The dependent variable is the biannual change in overall expenditure as a percentage of aggregate personal income in the MSA, analogous to equation (2). Increases in Pell grants generosity do not significantly increase overall expenditures at both for-profit and non-profit institutions. While multipliers for non-profit sector are positive, and in some cases close to being significant, the multipliers at for-profit sector are virtually zero.[29]

[28] Tables A3 and A4 in Appendix B conduct the estimation separately for education-related expenditures and other expenditures.

[29] We also find no evidence of an increase in employment in the education sector. Results are available on request.

Table 9: Effect of Education Spending on College Expenditures: For-Profit vs Non-Profit

	Full Sample				Post 1999			Full Sample
Overall Expenditures	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Non-Profit Multiplier	0.426	0.421	0.423	0.417	0.261	0.225	0.324	0.500*
	(0.275)	(0.278)	(0.280)	(0.293)	(0.281)	(0.290)	(0.269)	(0.274)
For-Profit Multiplier	0.024	0.007	0.025	-0.021	0.010	0.039	-0.015	0.113
	(0.117)	(0.118)	(0.124)	(0.102)	(0.110)	(0.119)	(0.100)	(0.130)
Difference	0.775	0.784	0.772	0.867	0.631	0.531	0.675	0.381
	(0.437)	(0.437)	(0.434)	(0.437)	(0.426)	(0.409)	(0.407)	(0.493)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,348	9,348	9,348	8,987	6,103	6,103	6,099	9,349
No. MSAs	366	366	366	365	364	364	363	366

Notes: Dependent variable is annual growth of total expenditures as a percentage of aggregate personal income in the MSA. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Dinerstein et al. (2014) found that public universities during the Great Recession increased their educational expenditures with the increase in the maximum Pell grants that occurred during 2009/2010. Our results, however, suggest that most of the "transmission" of the increase of Pell grants do not happen through college spending, but through student spending as consumers. To confirm this hypothesis, we also check the effect on employment in educational sector and find no effect on employment in this sector.

4.3. Institutions: Two-Year vs Four-Year

An alternative characteristic that differs between colleges is whether they primarily offer 2-year or 4-year degrees. The share of the former has steadily increased over time: while only 25% of all Pell grants were disbursed to 2-year institutions in 1987, this share has increased in the 80's and 90's and has fluctuated and between 35 and 40% (Figure 7). These institutions are usually community colleges that offer post-secondary education to local students, who are likely to spend their grants

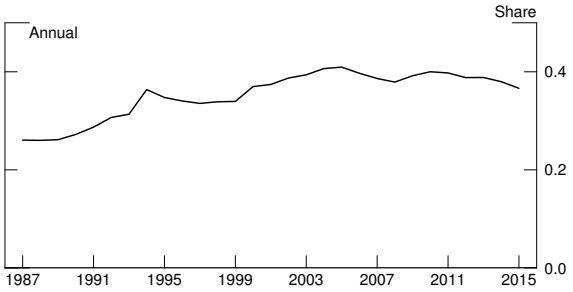
Table 10: Effect of Pell Grants on Local Income Per Capita: Two-Year vs Four-Year Schools

	Full Sample				Post 1999			Full Sample
Income	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
4-year Multiplier	1.468	1.610	1.434	1.644	2.030	1.604	1.663	1.225
	(1.307)	(1.323)	(1.269)	(1.303)	(1.393)	(1.174)	(1.302)	(1.232)
2-year Multiplier	4.072**	4.357**	4.629**	4.592*	5.810***	5.231**	5.879**	0.208
	(2.025)	(2.026)	(2.017)	(2.346)	(2.176)	(2.096)	(2.380)	(1.978)
Difference	-2.604	-2.746	-3.196	-2.948	-3.780	-3.628	-4.216	1.017
	(2.345)	(2.338)	(2.300)	(2.585)	(2.449)	(2.310)	(2.630)	(2.617)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,402	9,402	9,402	9,044	6,145	6,145	6,145	9,403
No. MSAs	367	367	367	367	365	365	365	366

Notes: Dependent variable is biannual growth of per capita income. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last 2 years, average tuition fee (log), for-profit penetration, percentage of population black, percentage Hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

in the metropolitan of their school.

Figure 7. Percentage of Pell grants Awarded at 2-year Institutions



Notes: Figure plots the fraction of national-level Pell grants that is awarded to students who are enrolled at 2-year institutions. Data is obtained from Delta Cost.

Table 11: Effect of Pell Grants on College Expenditures: Two-Year vs Four-Year

	Full Sample				Post 1999			Full Sample
Overall Expenditures	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
4-year Multiplier	0.577*	0.569*	0.569*	0.581*	0.410	0.362	0.470	0.551**
	(0.334)	(0.337)	(0.337)	(0.351)	(0.325)	(0.323)	(0.316)	(0.263)
2-year Multiplier	-0.197	-0.215	-0.203	-0.287	-0.221	-0.168	-0.206	0.171
	(0.231)	(0.233)	(0.237)	(0.238)	(0.227)	(0.212)	(0.217)	(0.462)
Difference	1.092	1.096	1.084	1.151	0.909	0.801	0.910	0.528
Error	0.509	0.508	0.504	0.523	0.452	0.441	0.451	0.509
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,402	9,402	9,402	9,040	6,145	6,145	6,141	9,403
No. MSAs	367	367	367	366	365	365	364	366

Notes: Dependent variable is annual growth of total expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

To test whether multipliers are different, we estimate equation (8) with Pell grant disbursements to two and 4-year institutions rather than for-profit and non-profit institutions. Table 10 presents the results. There is a considerable difference between the estimated multipliers across 2-year and 4-year institutions. Most estimates of the multiplier for the full sample are around 4 for the 2-year institutions and around 1.6 for 4-year institutions, while for the short sample the 2-year institutions multiplier increases to above 5 and 4-year institutions multiplier to about 1.6 to 2.0. The difference between the 4-year and 2-year institutions multipliers is significant for the post-1999 sample. The multiplier for 4-year institutions is insignificant, which is likely due to the positive correlation between the instruments for the two and 4-year Pell grants (0.26). This raises the standard errors in the estimation. The point-estimate of the multiplier in our preferred specification (III) is 1.43, 0.94 points below the average multiplier across institutions.

The analysis in this section leads us to conclude that Pell Grants for attending public 2-year institutions are likely to generate the largest positive short-run effects on economic activity. We next assess whether this is due to differences in the change in educational spending by these types

of institutions. Table 11 presents the results, which is analogous to Table 9 for profit vs non-profit. The table shows that at 4-year colleges, an increase in Pell grants leads by 1% of local personal income leads to an increase in educational spending by 0.3 to 0.6% of local personal income. In contrast, 2-year institutions do not increase their expenditures in response to the increase of Pell grants. This suggests that the positive multipliers that we estimated in Table 10 are not due to the increase of college expenditures, but likely due to a consumer spending effect. In Appendix B's Tables A5 and A6 we further look at the education and non-education expenditures and we observe that most of the increase in overall expenditures in Table 11 are due to the increase of non-education expenditures at 4-year institutions, although in the post-1999 sample this has somewhat shifted toward education expenditures.

5. Conclusion

This paper estimates the effect of the Federal Pell Grant Program on short-run economic activity. Specifically, we assess how a relative increase in Pell grant disbursements at the metropolitan area raises the area's relative income. To do so, we exploit the fact that areas differ in the degree to which their disbursements respond to changes in the national-level generosity of the Program. This gives a causal estimate of the multiplier of Pell grants, under the assumption that the national-level generosity does not respond to the relative performance of metropolitan areas.

We find an average multiplier of around 2.4 in the main specification. This implies that a 1% increase in Pell grants as a fraction of local income raises local income by 2.4%. This is higher than the average (2.1) and median (1.9) estimate of the multiplier from geographical cross-sectional data of other forms of fiscal spending found in the literature. We also find that multipliers are higher when the economy is in recession. Our results imply that having beneficial effects in the long run, educational investments can also be used for countercyclical fiscal policy.

Our findings also have implications for education policy. We find that for-profit institutions raise tuition fees in response to an increase in Pell grant disbursements and that Pell grants do not increase either education or non-education expenditures at these schools. Conversely, non-profit schools only increase tuition by a small fraction of the increase in Pell grants. This validates recent restrictions imposed on the eligibility of students at for-profit institutions for Pell grants. Finally, we show that 2-year institutions have significantly larger multipliers that 4-year institutions. Pell grants are therefore particularly effective as a tool for countercyclical policy if granted to students attending public community colleges.

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Appendix

A. Main Legislative Changes to the Pell Grant Program

First, in 1978, the Middle Income Student Assistance Act (MISAA) expanded student eligibility by limiting the rate at which parental discretionary income was assessed under the EFC formula. This act was repealed two years later, in 1980. In 1990, the Omnibus Budget Reconciliation Act eliminated student aid eligibility at high default schools. In 1992, the Higher Education Act was reauthorized and changed the definition of an independent student. In 1994, the Violent Crime Control and Law Enforcement Act eliminated Pell grants for prisoners. In 2007 Congress passed the College Cost Reduction and Access Act (CCRAA), which supplemented the grant funding and changed Pell eligibility by increasing the amount and types of income excluded from the EFC formula. A renewed set of legislative measures paired with the countercyclicality of the enrollment effect caused a significant increase in Pell Grant disburements. These legislative measures include: the Higher Education Opportunity Act (HEOA) of 2008, which authorized year-round Pell grants and limited eligibility to 18 full-time semesters or the equivalent; the American Recovery and Reinvestment Act (ARRA) of 2009, which provided additional funding to the Pell Grant program (ARRA raised the maximum Pell Grant by more than $400); the Health Care and Education Reconciliation Act of 2010, which increased the maximum Pell grant by over $600 and expanded eligibility by increasing the income threshold (from $20,000 to $30,000) for an automatic EFC of zero. Pell Grant disbursements started to decline in 2011, once the economy gained momentum and undergraduate enrollment returned to pre-crisis levels.[30] Congress eliminated the year-round Pell Grant eligibility established in 2008, when it provided supplemental funding to the program and lowered the income threshold for an automatic EFC of zero to 23,000. In 2012, the Consolidated Appropriations Act provided additional funding to the Pell Grant program and reduced Pell lifetime eligibility to 12 semesters.

[30] During economic recovery, fewer individuals qualify to receive Pell grants. Enrollment decreases as people opt for employment instead of education.

B. Additional Tables

Table A1: Effect of Pell Grants on Local Income Per Capita for 1 Year Horizon

	Full Sample				Post 1999			Full Sample
Income	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Multiplier	1.043	1.126	1.084	1.077	2.115*	1.952*	2.093*	0.418
	(1.067)	(1.083)	(1.077)	(1.049)	(1.128)	(1.083)	(1.083)	(0.765)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,354	9,354	9,354	9,354	6,109	6,109	6,109	9,355
No. MSAs	367	367	367	367	365	365	365	367

Notes: Dependent variable is annual growth of per capita income. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A2: Effect of Pell Grant on Local Income Per Capita for 4 Year Horizon

	Full Sample				Post 1999			Full Sample
Income	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Multiplier	5.048***	5.498***	4.974***	0.838	5.346***	4.773***	0.898	0.641
	(1.627)	(1.642)	(1.545)	(1.231)	(1.678)	(1.533)	(1.112)	(1.281)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	8,993	8,993	8,993	7,552	6,105	6,105	6,105	8,994
No. MSAs	366	366	366	366	364	364	364	366

Notes: Dependent variable is 4-year growth of per capita income. Multiplier equals coefficient β in Equation 2 with 4-year Pell Grant changes. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A3: Effect of Pell Grant on Non-Education Expenditures by Colleges

Non-education exp.	Full Sample				Post 1999			Full Sample
	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Non-Profit Multiplier	0.167	0.172	0.171	0.180	0.0449	0.0335	0.0837	0.122
	(0.132)	(0.132)	(0.134)	(0.119)	(0.167)	(0.159)	(0.142)	(0.131)
For-Profit Multiplier	-0.00440	0.00690	0.0181	-0.0161	0.0251	0.0287	0.0107	0.00887
	(0.0713)	(0.0718)	(0.0738)	(0.0578)	(0.0755)	(0.0702)	(0.0610)	(0.0562)
Difference	0.171	0.165	0.153	0.196	0.0198	0.00487	0.0730	0.113
Error	0.153	0.152	0.153	0.138	0.187	0.178	0.161	0.144
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,297	9,297	9,297	8,927	6,097	6,097	6,085	9,298
No. MSAs	363	363	363	361	363	363	361	363

Notes: Dependent variable is biannual growth of non-educational expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A4: Effect of Pell Grants on Education Expenditures by Colleges

Education exp.	Full Sample				Post 1999			Full Sample
	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Non-Profit Multiplier	0.259	0.249	0.253	0.240	0.216	0.192	0.241	0.381
	(0.216)	(0.218)	(0.221)	(0.240)	(0.194)	(0.205)	(0.192)	(0.282)
For-Profit Multiplier	0.0280	0.000107	0.00987	-0.00899	-0.0154	0.0101	-0.0302	0.108
	(0.0760)	(0.0798)	(0.0826)	(0.0771)	(0.0617)	(0.0745)	(0.0669)	(0.106)
Difference	0.232	0.249	0.243	0.249	0.231	0.182	0.272	0.273
Error	0.238	0.237	0.238	0.253	0.203	0.223	0.203	0.301
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,297	9,297	9,297	8,927	6,097	6,097	6,085	9,298
No. MSAs	363	363	363	361	363	363	361	363

Notes: Dependent variable is biannual growth of educational expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A5: Effect of Pell Grants on Non-Education Expenditures by Colleges

	Full Sample				Post 1999			Full Sample
Non-education exp.	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
4-year Multiplier	0.371**	0.378**	0.373**	0.366**	0.222	0.208	0.256*	0.310**
	(0.161)	(0.160)	(0.159)	(0.160)	(0.162)	(0.150)	(0.151)	(0.128)
2-year Multiplier	-0.219*	-0.206	-0.199	-0.218	-0.176	-0.175*	-0.196*	-0.290**
	(0.131)	(0.130)	(0.134)	(0.140)	(0.116)	(0.102)	(0.114)	(0.132)
Difference	0.590	0.584	0.572	0.585	0.398	0.383	0.452	0.600
Error	0.225	0.224	0.224	0.232	0.217	0.202	0.220	0.185
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,351	9,351	9,351	8,980	6,139	6,139	6,127	9,352
No. MSAs	364	364	364	362	364	364	362	364

Notes: Dependent variable is biannual growth of non-educational expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A6: Effect of Pell Grants on Education Expenditures by Colleges: 2 Year Horizon

	Full Sample				Post 1999			Full Sample
Education exp.	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
4-year Multiplier	0.485	0.476	0.478	0.472	0.455*	0.425	0.447*	0.362*
	(0.303)	(0.307)	(0.307)	(0.331)	(0.263)	(0.266)	(0.266)	(0.207)
2-year Multiplier	-0.0178	-0.0373	-0.0307	-0.0905	-0.0565	0.00725	-0.0161	0.439
	(0.172)	(0.173)	(0.176)	(0.176)	(0.161)	(0.165)	(0.167)	(0.497)
Difference	0.503	0.513	0.509	0.563	0.512	0.418	0.463	-0.0767
Error	0.343	0.342	0.339	0.354	0.306	0.300	0.300	0.481
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
State Spending	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,351	9,351	9,351	8,980	6,139	6,139	6,127	9,352
No. MSAs	364	364	364	362	364	364	362	364

Notes: Dependent variable is biannual growth of educational expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A7: Effect of Pell Grants on Overall Expenditures by Colleges

	Full Sample				Post 1999			Full Sample
All exp.	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Multiplier	0.206	0.191	0.198	0.227	0.166	0.171	0.197	0.333
	(0.184)	(0.189)	(0.192)	(0.200)	(0.163)	(0.164)	(0.160)	(0.239)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	9,303	9,303	9,303	8,933	6,103	6,103	6,091	9,304
No. MSAs	366	366	366	365	364	364	363	366

Notes: Dependent variable is biannual growth of total expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A8: Effect of Pell Grants Spending on Non-Education Expenditures by Colleges

	Full Sample				Post 1999			Full Sample
Non-education exp.	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Multiplier	0.100	0.107	0.111	0.155	0.0462	0.0387	0.0788	0.0471
	(0.0984)	(0.0992)	(0.101)	(0.0952)	(0.122)	(0.120)	(0.107)	(0.0843)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	8,595	8,595	8,595	7,868	6,103	6,103	6,091	8,596
No. MSAs	363	363	363	361	363	363	361	363

Notes: Dependent variable is biannual growth of non-educational expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A9: Effect of Pell Grants on Education Expenditures by Colleges

Education exp.	Full Sample				Post 1999			Full Sample
	I	II	III	IV	V	VI	VII	VIII
	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	2SLS	OLS
Multiplier	0.183	0.170	0.179	0.225	0.166	0.171	0.196	0.307
	(0.180)	(0.184)	(0.187)	(0.204)	(0.163)	(0.163)	(0.160)	(0.246)
Controls								
MSA F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year F.E.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Trend	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
% Student		Yes	Yes	Yes	Yes	Yes	Yes	Yes
MSA Controls			Yes	Yes	Yes	Yes	Yes	Yes
Lagged Growth				Yes			Yes	
Financial Controls						Yes	Yes	
Observations	8,595	8,595	8,595	7,868	6,103	6,103	6,091	8,596
No. MSAs	363	363	363	361	363	363	361	363

Notes: Dependent variable is biannual growth of educational expenditures. Multiplier equals coefficient β in Equation 2. 2SLS regressions use national spending interacted with MSA-dummies to instrument local spending. Standard errors clustered by MSA and given in parentheses. *, **, and *** denote significance at the 10, 5, and 1% level, respectively. MSA controls: number of undergraduate students (log), change in undergraduate students (log) last year, average tuition fee (log), for-profit penetration, percentage of population black, percentage hispanic, percentage with at least a bachelors degree. Data on financial controls is from Federal Reserve Bank of New York/Equifax Consumer Credit Panel and is available from 1999 to 2015. It includes median Equifax Risk Score, age, debt-to-income ratio, credit card utilization and 30-day mortgage delinquency rate. We exclude MSA-years receiving more than 5% of Total Pell grants in a given year.

Table A10: Aggregated School-Level Summary Statistics from Delta Cost

Variable	Obs.	Mean	St. Dev.	Min	Max	Source
Pell Grant Disbursements	10,729	26,868,982	82,315,079	0	1,645,212,928	DeltaCost
Pell Grants: For Profit	10,725	4,397,998	30,588,941	0	1,299,494,912	DeltaCost
Avg. Tuition Fee	10,451	6,711	5,273	0	47,480	DeltaCost
School (count)	10,758	14.4	56.5	1	1,096	DeltaCost
For-Profit School (count)	10,758	3.22	8.08	0	127	DeltaCost
Total Undergraduates	10,758	38,409	120,232	0	2,372,351	DeltaCost
Total Enrollment	10,758	44,709	137,400	0	2,638,180	DeltaCost
State Appropriation	10,758	135,386,046	411,576,994	0	8,576,051,452	DeltaCost
School Revenue	10,758	836,372,660	2641825108	-3,420,080,033	49,300,000,000	DeltaCost
School Spending	10,758	252,154,297	738,396,323	0	13,900,000,000	DeltaCost
Education Spending (frac.)	10,613	0.859	0.15	0.223	1	DeltaCost