The Effect of Price Shocks on Undocumented Students' College Attainment and Completion[*]

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Abstract

We examine the effect of a price shock caused by the temporary removal of in-state tuition benefits on the attainment of undocumented immigrants enrolled in a large urban college system using a difference-in-differences identification strategy. The 113 percent one-semester tuition increase led to an 8 percent decrease in reenrollment and a similarly-sized reduction in credit accumulation. For students who had been enrolled at least a year prior to the policy change, the price hike caused them to leave college sooner but did not increase their probability of dropping out. Conversely, students who entered college the semester prior to the policy change experienced lasting reductions in attainment, including a 22 percent decrease in degree receipt compared to students with more college experience at the time of the price shock. Our results suggest that public subsidies that lower college prices can increase degree completion among resource-constrained students who have made the decision to enroll in college, with larger benefits accruing to those who are early in their college careers. *Keywords: educational attainment; higher education; undocumented immigrants; tuition subsidy. JEL: I21, I22, H75, J15*

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1 Introduction

In the absence of federal policy governing access to higher education for the nation's 11 million undocumented immigrants, many states have chosen to invest in their integration by extending eligibility for in-state higher education tuition benefits. Previous research suggests that such subsidies affect undocumented students' college entry decisions, yet little is known about whether these public expenditures increase college completion and degree receipt. This same information gap exists in research on the effects of college prices for the general student population; while many studies demonstrate that changes in price affect college enrollment (e.g., Deming and Dynarski, 2010), only a handful of papers investigate price effects on persistence and degree receipt. Despite the growth in college enrollment, college completion rates have declined, particularly among low-income students (Bound, Lovenheim and Turner, 2010; Bailey and Dynarski, 2011), underscoring the importance of research on the long-run effects of public and institutional investments aimed at lowering higher education costs.

In this paper, we estimate the effect of a one-semester price increase on undocumented students' reenrollment, credits, grades, and degree receipt. We identify these effects using the unanticipated elimination and subsequent restoration of the in-state tuition subsidy for undocumented students enrolled in New York City's public university system, the City University of New York (CUNY). Midway through the fall of 2001, CUNY reversed its long-standing policy of charging in-state tuition rates to undocumented students from New York. As a result, undocumented students were exposed to a significant increase in tuition for the following semester, with students enrolled in one of CUNY's "senior" colleges (institutions that offer both bachelor's and associate degrees) facing a 113 percent price increase.[1] The price hike was reversed after a single semester, which renders our variation much like public, private, and institutional policies that change tuition prices and financial aid offerings from year to year.[2]

To identify the effect of the price shock on short-run attainment, we use a generalized difference-in-differences identification strategy that compares changes in undocumented students' outcomes three semesters before and after the tuition hike to differences in the outcomes of documented noncitizens, a group unaffected by the policy change. The price hike led to an immediate 8 percent reduction in reen-

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[1]Though postsecondary institutions are typically classified as "four-year" or "two-year" schools, we use the CUNY System's label of "senior" college (as opposed to "four-year" college) because approximately 40 percent of CUNY's senior college students start out in an associate's degree program and these students face the same tuition charges as senior college students enrolled in bachelor's degree programs. Thus, the magnitude of the price change is specific to the institution, not the degree. We elaborate on this point in Section 2. Undocumented students in CUNY's community colleges also faced a price increase of roughly 23 percent in spring 2002. We find no evidence of statistically significant responses to this modest price hike among undocumented community college students. However, given the size of the tuition shock and the small number of undocumented students enrolled in CUNY community colleges, our estimates are imprecise and prevent us from drawing meaningful conclusions. Results pertaining to community college students are available upon request.

[2]Although mid-year tuition increases are relatively uncommon, there are several recent examples of such decisions, including Northern Iowa and Iowa State (announced September 2015, $100 in magnitude) and four University of Maryland System institutions (announced January 2015 and immediately effective, 2 percent in magnitude).

rollment and a similar decrease in credit accumulation. We find no evidence that the price shock led to an increase in transfers, either within or outside of the CUNY System. However, the effect differed substantially for students who had just enrolled when prices increased and those who were further along in their schooling. Among students who entered college the semester before the policy change, the price shock primarily caused students to exit who would have otherwise persisted for the three subsequent semesters. Conversely, we show that the more experienced students who left school when prices increased would have dropped out in the following three semesters even in the absence of a price increase. In other words, the price shock appears to have sped up the timing of exit for the more experienced students, but not their overall probability of exit.

We take advantage of these heterogeneous short-run effects across entry cohorts to provide evidence on the effect of the price shock on long-run outcomes. While undocumented students in all entry cohorts were exposed to the price hike, our analysis of the effects of the policy change on short-run outcomes shows that students in the 1999 cohort did not experience lasting reductions in enrollment or credit accumulation. Therefore, we use this earlier entry cohorts as a comparison group for students in later entry cohorts to evaluate the longer-run impact of the price hike on credit accumulation and degree receipt eight years after entry, again using differences in documented noncitizens' outcomes across entry cohorts to generate a counterfactual. Consistent with the short-run reenrollment analysis, we find that undocumented students exposed to the price shock earlier in their college careers experienced the largest decrease in long-run attainment. Relative to students who entered college in 1999, those who entered in the semester prior to the price shock experienced a 22 percent reduction in degree receipt, while students with at least one year of enrollment prior to the shock saw a 6 percent reduction in degree completion. These findings could be attributed to more experienced students having better information about their probability of long-run success and/or the ability to recognize that tuition changes can be temporary. As a result, price shocks close to college entry are more likely to induce dropout among students who would have ultimately been successful than price shocks affecting more experienced students.

Our findings directly contribute to research examining the effect of state, local, and institutional policies aimed at making college more accessible to undocumented students. Undocumented youth who migrate to the US as children are a centerpiece of federal immigration reform proposals and recent higher education policies in many states. Although federal efforts to pass legislation extending legal status and other federal benefits to this population have been unsuccessful, 20 states now provide in-state tuition benefits to undocumented youth who received their secondary schooling in the state. These subsidies represent a substantial reduction in postsecondary costs given that out-of-state tuition rates are typically more than twice the in-state rates (Hemelt and Marcotte, 2011).

Several existing studies use national survey data and a difference-in-differences framework to estimate

the effects of in-state tuition subsidies on undocumented students' college enrollment decisions. Kaushal (2008), Flores (2010*b*), Chin and Juhn (2011), Amuedo-Dorantes and Sparber (2014), and Darolia and Potochnick (2015) estimate the average effects of in-state tuition across all states with such policies, while Flores (2010*a*) and Dickson and Pender (2013) focus on the impact of Texas' in-state tuition subsidy. All prior studies proxy for undocumented status with Mexican (or Hispanic) students who are not citizens and, with the exception of Dickson and Pender (2013) and Amuedo-Dorantes and Sparber (2014), use data from the Current Population Survey (CPS) or the American Community Survey (ACS). All but Chin and Juhn (2011) find positive impacts of eligibility for the in-state tuition subsidy on college enrollment. Dickson and Pender (2013) and Darolia and Potochnick (2015) show that resident tuition rates primarily increased noncitizens' college-going at two-year and less selective institutions. Kaushal (2008) further estimates the effects of resident tuition policies on Mexican noncitizens' probability of holding an associates degree or higher, with results that range from zero to small positive effects depending upon the subsample.

Our study builds on this prior work by estimating the effect of such subsidies on enrolled students' retention, credit accumulation, grades, and ultimate degree receipt. Though we are unable to estimate the cumulative effect of resident tuition policies on college enrollment and degree completion, our analysis builds on these earlier studies by providing causal estimates of the effects of tuition changes on attainment among students past the enrollment decision. We are also the first to use administrative data that includes measures of students' documentation status. We provide additional analyses that show substantial differences in findings when noncitizen Hispanic status is used as a proxy for undocumented status, suggesting some caution in interpreting results from studies that rely on this proxy measure.

Our findings are clearly best generalized to the undocumented college population, but our setting also provides a unique opportunity to understand better the effect of postsecondary prices on the human capital acquisition of low-income students in the general population. Research reviewed by Deming and Dynarski (2010) points to significant increases in college-going among students who experience a policy-driven price decrease. However, there is far less evidence on the impact of price changes on students' attainment after they have already spent time in college. Although gaps in college entry by family income have shrunk in recent years, low-income students' graduation rates remain low (Bailey and Dynarski, 2011), suggesting that the effects of financial need on attainment persist beyond the enrollment margin. A handful of studies suggest that increases in need-based grants can boost the attainment of enrolled students when such increases are not offset by reductions in other aid (Bettinger, 2004; Angrist et al., 2014; Goldrick-Rab et al., 2015; Marx and Turner, 2015).[3]

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[3]Goldrick-Rab et al. (2015) find that eligibility for an annual $3,500 Wisconsin Scholars Grant increased four-year bachelor's degree completion by 5 percentage-points (21 percent). Illustrating the importance of accounting for loan crowd-out, Marx and Turner (2015) estimate that Pell Grant aid does not increase persistence or attainment in a setting where additional grant aid

A related body of research explores the role of monetary incentives tied to other supports (such as mentors) or requirements (such as a minimum course load or grade point average) on enrolled students' effort and degree completion (Dynarski, 2008; Angrist, Lang and Oreopoulos, 2009; Scott-Clayton, 2011; Patel and Rudd, 2012; Angrist, Oreopoulos and Williams, 2014; Barrow et al., 2014). Most interventions that condition financial support on grades and/or provide additional supports have been shown to produce positive impacts on enrolled students' attainment.[4] Our study focuses exclusively on the estimation of tuition price effects that are not tied to performance or bundled with other services. Given that undocumented students lack access to public grant and loan programs, we are also able to generate pure price elasticities that are less likely to be contaminated by offsetting endogenous responses on the part of students or institutions (e.g. Turner, 2014; Marx and Turner, 2015). Finally, ours is the first study to provide evidence that students early in their college careers are more vulnerable to price shocks than students with more college experience.

2 The CUNY System and Undocumented Students

As an established immigrant gateway, New York is home to approximately three million foreign-born residents, an estimated 625,000 of whom are undocumented (American Community Survey, 2010; Passel and Cohn, 2010). In fall 2013, approximately 8,300 undocumented students were enrolled in New York state colleges, with 80 percent residing in New York City and attending one of the CUNY System schools (DiNapoli and Bleiwas, 2014).[5]

In the period we examine, the CUNY System included 11 senior colleges and 6 community colleges. We classify CUNY schools as senior or community colleges instead of using the standard labels of two- or four-year institutions because four of the 11 senior CUNY colleges offer both associate's and bachelor's degree

reduces aid from federal loans. In contrast, Bettinger (2004) provides evidence that Pell Grant aid increases Ohio public college students' persistence rates between the first to the second year of college, with an additional $1,000 in Pell Grant aid estimated to increase reenrollment by 3 to 4 percentage-points. However, these estimates are not robust to controlling for institution fixed-effects. Castleman and Long (2016) estimate the impact of state need-based grant aid on Florida high school graduates' college enrollment and attainment and impacts on both initial enrollment and degree receipt. However, the positive effect of grant eligibility on enrollment makes it is difficult to determine whether grant aid eligibility increased attainment above and beyond its impacts on college attendance. Addressing concerns of both selection into college and crowd-out of federal and institutional grant aid, Angrist et al. (2014) examine the impact of a need- and merit-based scholarship in Nebraska. They find substantial impacts on the persistence of nonwhite students, but estimate that overall, at least 80 percent of funds were spent on students whose behavior was not affected by the grant.

[4]Dynarski (2008) estimates positive impacts of state merit-based aid on persistence and graduation with larger effects among female students. Scott-Clayton (2011) studies West Virginia's PROMISE scholarship and finds positive impacts only during years in which aid was tied to performance. Results from the Student Achievement and Retention Project, an experimental study that randomly-assigned students in a Canadian university to receive financial aid (tied to grades), support services, or both, suggests higher levels of merit aid coupled with support services increased female (but not male) students' grade point average and persistence(Angrist, Lang and Oreopoulos, 2009). However, a follow-up study that involved stronger incentives found smaller impacts on attainment (Angrist, Oreopoulos and Williams, 2014). Finally, a series of papers examine the impact of randomly assigned student incentives and find evidence of small, but significant impacts on attainment (e.g., Patel and Rudd, 2012; Barrow et al., 2014).

[5]An additional 18 percent of undocumented students were enrolled in a State University of New York (SUNY) institution in one of the five counties surrounding New York City, and the remaining 2 percent attended a SUNY institution elsewhere in the state.

programs.[6] Additionally, CUNY senior college students who are enrolled in an associate degree program face the same tuition rates as those in bachelor's degree programs. In 2001, nominal in-state tuition for a full-time senior college student was $3,200 per year, while the nominal out-of-state rate faced for full-time senior college students was $6,800.[7]

Our identification strategy takes advantage of two unanticipated shocks to undocumented senior college students' eligibility for in-state tuition. In 1989, long before any state considered granting in-state tuition to undocumented students, New York City Mayor Edward Koch issued an executive order that extended in-state prices to CUNY students who lacked documentation but who could demonstrate that they graduated from a New York high school or received a GED from the state (Rincón, 2008). Yet in the fall of 2001, shortly after the terrorist attacks of September 11, the CUNY Chancellor overturned this policy and announced that starting in the spring 2002 semester, CUNY would charge undocumented students who had previously qualified for the in-state subsidy out-of-state tuition rates.[8] Although no changes to the new pricing policy were anticipated at the beginning of the spring 2002 semester, Governor George Pataki announced his support for legislation offering in-state tuition to undocumented students with ties to New York State in April 2002.[9] In the summer of 2002, the state legislature passed a law that restored in-state tuition benefits for eligible undocumented students. Thus, for the spring 2002 semester only, tuition rates for undocumented students at senior colleges more than doubled (from $133 to $283 per credit). With a full-course load of 12 credits, this represented a price increase of $1,800 for the semester.

2.1 Characteristics and outcomes of undocumented students

The Pew Hispanic Center estimates that there are approximately 1.7 million undocumented immigrants under the age of 31 who migrated to the US at or before they were 16 (Passel and Lopez, 2012). The proposed *Development, Relief, and Education for Alien Minors* (DREAM) Act would have provided eligible youth with a pathway to permanent residency status and access to federal benefits, such as aid for college.[10] Congress voted against the DREAM Act in 2001, 2007 and 2010.

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[6]This practice is not unique to the CUNY System. According Integrated Postsecondary Education Data System (IPEDS) data, in 2013, 60 percent of public institutions categorized as "four-year" schools also offered certificate and/or associate degree programs.

[7]Both in-state and out-of-state tuition rates remained constant (in nominal terms) between fall 1999 and spring 2003. In-state rates increased to $4,000 per year for senior college students in fall 2003. Out-of-state rates increased to $8,640 per year for senior college students in fall 2003.

[8]See, for instance, Karen W. Arenson's 2001 *New York Times* article, "CUNY raises tuition rates for foreigners here illegally." Downloaded on 2/2/2014 from http://www.nytimes.com/2001/11/03/nyregion/cuny-raises-tuition-rates-for-foreigners-here-illegally.html.

[9]See Joyce Purnick's *New York Times* article, "Metro Matters; Tuition, Out of State And Beyond," (downloaded 1/5/2015 from http://www.nytimes.com/2002/02/18/nyregion/metro-matters-tuition-out-of-state-and-beyond.html) and Sara Hebel's May 2002 *Chronicle of Higher Education* article, "N.Y. Governor Backs Plan to Help Some Illegal Immigrants."

[10]In addition to removing the threat of deportation and the opportunity for legal employment, the bill encourages college enrollment by offering a pathway to legalization for students who obtain a college degree.

In an effort to jump-start reforms targeting undocumented youth, in 2012, the Obama administration announced the *Deferred Action for Childhood Arrivals* (DACA) program - an executive order that shields eligible undocumented immigrants from deportation and provides them with temporary work authorization. President Obama attempted to expand the DACA program to other undocumented residents in November 2014; however, 26 states challenged these actions in federal court and successfully obtained an injunction to suspend the orders in *Texas v. United States*, 787 F.3d. 733, 743 (5th Cir. 2015).[11] In the meantime, several states, Boards of Regents, and individual institutions have opted to extend in-state tuition benefits to undocumented college students enrolled in public institutions. As of 2016, most of the top immigrant-receiving states (including California, New York, Texas, Florida, New Jersey, and Illinois) have granted this subsidy to eligible undocumented youth.

Despite the ample policy attention given to undocumented college students, there are few large-scale analyses of their outcomes because federally-sponsored surveys and other administrative data sources are prohibited from asking respondents to state their immigration status. Several qualitative studies of undocumented college students identified through non-probabilistic sampling methods find that students who lack documentation face substantial barriers to college success (Abrego, 2006; Contreras, 2009; Perez, 2009; Gonzales, 2011; Muñoz and Maldonado, 2012). Most undocumented students come from families with limited financial resources and parents who are themselves undocumented and unable to provide guidance and support in navigating US institutions. Thus, undocumented students face many of the same hurdles encountered by other low-income, first generation, college students. Their lack of documentation poses greater challenges to normal college pursuits, such as obtaining driver's licenses, places to live, student identification cards, and employment both on and off campus (Contreras, 2009; Muñoz and Maldonado, 2012).

At the same time, these studies suggest that undocumented youth demonstrate a high level of ambition and resilience. Consistent with this anecdotal evidence, Conger and Chellman (2013) show that undocumented CUNY students' academic outcomes resemble those of other noncitizen immigrant groups (namely permanent residents and visa holders), all of whom earn higher grade point averages (GPAs) and complete more credits than citizens. These findings align with research on immigrant students in the K-12 education system, which find that younger immigrants are positively-selected and outperform native-born students with observably similar race and class profiles (e.g., Kao and Tienda, 1995; Schwartz and Stiefel, 2006).

Undocumented youth should be highly responsive to tuition shocks. Following the news that tuition will increase in the next semester, we predict that some undocumented students will exit college, reduce their credit-load, and/or devote less time to their school work. These negative effects may continue in later

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[11]In 2016, the US Supreme Court affirmed the lower courts ruling through a split decision in *United States v. Texas*, 579 U.S. (2016), which puts the case back in district court.

semesters even when the in-state rates are restored if students face costs associated with switching between working and attending college or expect to face other tuition increases in the future.[12]

3   Data and Sample

Our analyses rely on administrative data from the CUNY System, which includes information on first-time, degree seeking students' demographic characteristics and academic outcomes. The CUNY data have also been matched with data from the National Student Clearinghouse (NSC), which provides information on whether students transfer to and obtain degrees from non-CUNY postsecondary institutions in the US. Crucially, CUNY also records students' citizenship and immigration status for the purpose of tuition determination. Upon enrollment, students are asked to identify themselves as US citizens, permanent residents, student or temporary visa holders, asylees or refugees, or undocumented.[13] Students must submit documentation to validate their self-reported status and those who either report that they are undocumented or who fail to provide documentation (e.g., current visa, temporary authorizations to live and work in the US) are recorded as undocumented. To qualify for in-state tuition, undocumented students are required to submit a notarized affidavit stating that they plan to legalize their status as soon as they are eligible. These students also must demonstrate that they received their secondary schooling in the state of New York, either from a New York high school or GED program.

Our main sample consists of the 9,795 noncitizen students who obtained a high school diploma or GED from New York State and entered a senior college between fall 1999 and fall 2001.[14] The characteristics of these students and the corresponding set of 25,999 citizens who earned a high school degree or GED from New York State and entered a senior college between fall 1999 and fall 2001 are displayed in the first three

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[12]While some students can also choose to lower their consumption, two-thirds of students enrolled in the CUNY System already live with their parents or guardians making reductions in housing consumption less of an option for lowering the cost of attendance. See CUNY's "2012 Student Experience Survey," available at: http://cuny.edu/about/administration/offices/ira/ir/surveys/student/SES2012FinalReport.pdf for further details (accessed 23 September 2014).

[13]A US citizen is an individual who either was born in the US or obtained citizenship through the process of naturalization. Permanent residents (also known as a green card holders) are defined by the US Citizenship and Immigration Services as "any person not a citizen of the United States who is residing the in the U.S. under legally recognized and lawfully recorded permanent residence as an immigrant" (see the US Citizenship and Immigration Services Glossary, available at: http://www.uscis.gov/tools/glossary). Visa holders are individuals who reside in the US temporarily for a specific purpose, typically to work or attend school. Finally, an undocumented immigrant is one who does not have legal authority to live or work in the US. This status is achieved either by entering the country illegally, or by violating the terms of a legal visa. US citizens and permanent residents are eligible for all forms of aid and loans from governmental and private sources. Most visa holders are ineligible for these sources of aid, with the exception of Cuban and Haitian entrants.

[14]Among the 45,317 degree seeking senior college students who entered CUNY during this period, we drop 3,038 (7 percent) with missing citizenship or documentation information and an additional 282 (less than 1 percent) with a missing age at entry. Of the remaining 41,997 students, 29,499 are citizens, 11,480 are documented noncitizens, and the remaining 1,018 are undocumented. Restricting our sample to students who earned their high school diploma or GED in New York State excludes 142 undocumented students (14 percent) and 2,561 documented noncitizens (22 percent). We impose this restriction to ensure that undocumented students in our sample were eligible for in-state tuition prior to Fall 2001 and to increase the comparability of documented and undocumented noncitizens. Among citizens, 3,500 (12 percent) are excluded due to this restriction. Unfortunately, data from earlier entry cohorts are not available.

columns of Table 1. Of the 35,794 students in these entry cohorts, 27 percent are noncitizens and 9 percent of the noncitizens are undocumented.[15]

The final three columns of Table 1 display *p*-values from tests of the equality of the characteristics of citizen versus noncitizen students, undocumented versus documented noncitizens, and all three groups, respectively. Compared to noncitizens, CUNY students with US citizenship significantly differ on nearly all observable background characteristics, though most differences are small in magnitude. Importantly, there are far fewer differences in the characteristics of undocumented and documented noncitizens. Undocumented students are more likely to be black or Hispanic and, correspondingly, less likely to be white or Asian than their documented classmates. Undocumented students are also less likely to require remediation or enroll in selective CUNY institutions than documented noncitizens.[16]

Table 1 also highlights one of the unique features of our study location. New York City is the largest city in the US and contains a diverse student population (of both natives and immigrants). Undocumented youth living in New York City come from all over the world, not just from Latin and South America as is common in other regions. Thus, the responses of CUNY undocumented students to tuition shocks may not resemble the responses of other undocumented students across the nation. We address concerns over the generalizability of our estimates in Section 5.4 by examining whether the impact of the tuition increase varies by Hispanic ethnicity.

Finally, Table 1 illustrates the differences in attainment outcomes across citizenship and documentation groups. We measure cumulative credits earned within CUNY institutions (both community and senior colleges) and degree receipt (within CUNY and non-CUNY schools) 8 years after college entry. Less than half of the students in any given group earn a degree within eight years of entry and degree receipt outside of the CUNY system is rare, especially for undocumented students. Citizens fare worse than both groups of noncitizens students in their attainment outcomes, while documented and undocumented students have fairly similar rates of attainment.

4   Empirical Framework

Our data and setting provide several advantages for estimating effects of price shocks on undocumented students' outcomes. First, the decision to eliminate the in-state tuition subsidy for undocumented students appears to have been made in reaction to 9/11 and not to any patterns observed among undocumented or

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[15]The majority of documented noncitizens (93 percent) are permanent residents.

[16]We classify institutions' selectivity using the Barron's Guide, which places the following colleges in each rank: "Very Competitive" includes Baruch; "Competitive" includes Brooklyn, City, Hunter, John Jay, and Queens; Less "Competitive" includes Lehman; "Noncompetitive" includes City Tech, Medgar Evers, New York City College of Technology, Staten Island, and York.

documented noncitizens before fall 2001 (Rincón, 2008). Thus, there is no reason to expect undocumented students were experiencing changes in any relevant drivers of attainment, such as financial need, courses, institutions, or grades, relative to their documented counterparts.

Second, undocumented students are ineligible for most federal, state, and private grants and loans.[17] In addition, no exceptions to the elimination of the in-state tuition subsidy appear to have been granted, or additional supports made available, rendering all previously-eligible undocumented students subject to the same price increase. These circumstances means that our estimates will more closely measure the theoretical effects of price shocks on postsecondary attainment than studies that examine the effect of a specific subsidy (e.g., Pell Grants) on the outcomes of students who have access to other potentially offsetting resources (e.g., federal loans).

Third, most surveys do not request that respondents state their immigration status or provide documentation to validate their responses. Thus, studies that rely on federal data sources, such as the ACS or the CPS, code both undocumented students and other noncitizen immigrants (namely, permanent residents and those with legal visas) as treatment group members, leading to measurement error in students' exposure to changes in tuition prices. Our data set provides a more accurate measure of undocumented status, thereby reducing measurement error and allowing us to difference out non-price impacts on attainment by using documented noncitizens as the control group.[18]

To estimate the short-run effects of the price shock on reenrollment and credit accumulation, we focus on the three semesters surrounding the policy change and the semester of the price shock: fall 2000 through fall 2003 (with spring 2002 at the center of the series).[19] We estimate generalized difference-in-differences models, allowing for persistent effects of the policy change after in-state rates were restored:

$$Y_{isct} = \beta_1 Treat_t \times Undoc_i + \beta_2 Post_t \times Undoc_i + \boldsymbol{\gamma} \mathbf{X_i} + \delta_{sc} + \delta_t + \tau \times \delta_c + \epsilon_{isct} \tag{1}$$

In equation (1), Y_{isct} is one of several attainment outcomes in semester t for student i who initially entered college s as a member of entry cohort c. $Undoc_i$ is set to one if the student is undocumented and $\mathbf{X_i}$ is a vector of student covariates measured in the first semester of college including indicators for documentation status (permanent resident, student visa holder, or asylee/refugee), initial degree program (associate versus bachelor's degree), high school GPA, high school type (NYC public, NYC private, GED, or other New York state school), need for remedial courses, disability, age, gender, race/ethnicity (Black, Hispanic, White,

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[17]Undocumented students do not qualify for federal student aid or the need-based New York State Tuition Assistance Program.

[18]For instance, our identification strategy can account for the removal of the subsidy leading all noncitizens to feel unwelcome in the CUNY System. In other settings, such "chilling effects" have been shown to alter documented noncitizens' behavior (Watson, 2014).

[19]In Section 5.2, we show that our results are robust to larger and smaller windows.

or other), and single parent status. We include semester and college by entry cohort fixed effects, δ_t and δ_{sc}, respectively, and cohort-specific linear trends $\tau \times \delta_c$, where $\tau = t - c$ represents semesters since entry. Finally, under the identifying assumption that the outcomes of undocumented and documented noncitizen students would have followed similar trends in the absence of the price increase, ϵ_{isct} represents a random error component. Student-semester observations are dropped following receipt of any degree.[20] Standard errors are clustered at the college by entry cohort level.

The coefficient on the interaction between the indicator for the semester of the price increase ($Treat_t$) and undocumented status, β_1, represents the change in attainment during the semester of the tuition hike on the outcomes of undocumented students relative to documented noncitizens. Additionally, β_2 represents the average change in outcomes for undocumented students in the three semesters after the tuition hike (compared to the semesters before the increase) relative to the same change for documented noncitizens.[21] Estimation of β_2 allows for a test of the persistence of the effect of the one-semester price shock, which could occur if some students found it too costly to return to school after leaving or because the price hike increased their uncertainty about future price increases.

The main identifying assumption underlying our research design is that, in the absence of the policy change, the outcomes of documented noncitizen and undocumented students in the spring 2002 and the following semesters would have followed similar trends. A possible violation of this assumption would be if underlying trends in the outcome variables are correlated with the policy change. Examination of the pre-policy trends in attainment, discussed in the following section, suggests that prior to the tuition increase, outcomes of documented and undocumented noncitizens followed similar paths.

In this case, an additional potential violation comes from the terrorist attacks of September 11, 2001. These attacks had a major impact on New York City residents and institutions and may have uniquely influenced the schooling decisions of immigrants. For instance, Kaushal, Kaestner and Reimers (2007) provide evidence that 9/11 had a negative effect on the employment and wages of New York City's Arab and Muslim residents. If undocumented students felt disproportionately impacted by the climate caused by 9/11, perhaps reducing their schooling investments due to a decrease in morale or increased fear of deportation, then observed changes in spring 2002 could be attributed to the terrorist attack and not to the change in the tuition policy. Though we are unable to directly examine the academic response to 9/11, we can test whether the policy change led to reductions in attainment among documented noncitizens relative to US citizens. Documented noncitizens at CUNY were not subject to the new tuition policy, but they were exposed to the post-9/11 environment and may have felt a similar level of hostility and reduction in attachment to

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[20]Less than 1 percent of student by semester observations are dropped due to this restriction (e.g., Table 1).

[21]Main effects for $Treat_t$ and $Post_t$ are subsumed by the vector of semester fixed effects while the main effect for $Undoc_i$ is included in $\mathbf{X_i}$.

US institutions. As discussed in the following section, trends before and after 9/11 reveal no evidence that documented noncitizens' enrollment or attainment differed from that of US citizens.

5   The Effect of the Price Shock on Attainment

To illustrate our identification strategy and preview our main results, we plot average reenrollment (Figure 1), credits attempted (Figure 2), and credits earned (Figure 3) of citizens, documented noncitizens, and undocumented students over the seven semesters surrounding the policy change.[22] In each figure, the solid black line represents the average outcomes of undocumented students, the dashed dark gray line represents the average outcomes of documented noncitizens, and the solid light gray line represents the average outcomes of citizens. Differences between the black and dashed gray lines before and after the policy change will approximate our difference-in-differences estimates.

Prior to spring 2002, both documented and undocumented noncitizens were more likely to reenroll relative to US citizens (Figure 1). The decline in mean reenrollment for all groups reflects the increased likelihood of exits over time. Reenrollment rates for documented noncitizen and undocumented senior college students are quite similar prior to spring 2002, while in spring of 2002, the increase in tuition for undocumented students corresponds with a substantial drop in reenrollment. Following spring 2002, reenrollment continues to decline monotonically for all three groups. Relative to documented noncitizens and citizens, decreases in undocumented students' reenrollment slow slightly after in-state tuition rates were restored.

Figures 2 and 3 display trends in credits attempted and credits earned, respectively. Since we do not condition on enrollment, changes in credits attempted and earned reflect a combination of intensive (e.g., course load reductions or less effort devoted to courses) and extensive margin (e.g., exit) responses. Documented and undocumented noncitizens attempt and earn more credits than citizens in all semesters, and trends in credits attempted and earned are similar for documented and undocumented noncitizens before spring 2002. In the semester of the price shock, undocumented students' attempt and earn fewer credits relative to documented noncitizens, suggesting that the policy change reduced both credits attempted and earned. Following spring 2002, undocumented students' credit accumulation rebounds slightly, but remains lower (relative to documented students' attainment) than in the pre-spring 2002 semesters.

The pre- and post-policy trends of US citizens and documented noncitizens reveal no substantial differences between these two groups. The absence of a difference indicates that documented noncitizens appear not to have reacted to the tuition hike (via a chilling effect) or to the terrorist attacks of 9/11. Although the

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[22]Reenrollment represents the unconditional probability of enrollment in a given semester. Note that we use the term "reenrollment" as opposed to "enrollment" as the latter is typically used to refer to the decision to enter college. We also do not use the term "persistence" because we focus here on reenrollment that is not conditional on the previous semester. Senior college students who transfer to a CUNY community college are considered to have reenrolled within the CUNY system.

absence of a reaction to 9/11 among documented noncitizens (relative to citizens) does not entirely rule out 9/11 as an explanation for undocumented students' attainment decreases, it suggests that 9/11 is unlikely to be the major cause of the academic responses we observe.

5.1 Effects on reenrollment, credits attempted, and credits earned

We first examine effects of the price shock on reenrollment, exits from, and returns to CUNY institutions, where reenrollment is the unconditional probability of enrollment in a given semester, exit is the probability of not enrolling in semester t conditional on having been enrolled in semester $t-1$, and return represents the probability of enrollment in semester t conditional on not having been enrolled in semester $t-1$. Table 2 reports the coefficients and standard errors on the interaction of undocumented status and indicators for the semester of the price increase (spring 2002) and semesters following the price increase (post-spring 2002) from estimation of Equation (1) for all senior college students (Column 1) and separately for those who enrolled initially as bachelor's degree seekers (Column 2) and associate degree seekers (Column 3). The results in the first column of Panel A shows that the price shock led to an approximately 7 percentage-point decrease in undocumented senior college students' reenrollment (an 8 percent drop relative to fall 2001). The price shock resulted in smaller effects on students' reenrollment in the semesters after the tuition hike was reversed, leading to a 3 percentage-point (3 percent) decrease. We obtain similar results when we examine renrollment in CUNY and non-CUNY institutions using matched NSC data (see Appendix Table A.1).

The test of equality of the estimated parameters on the interaction of undocumented and spring 2002 and the interaction of undocumented and post-spring 2002 reveal that the two are statistically distinguishable at conventional levels. The difference between the immediate (spring 2002) and medium-run (post-spring 2002) effects suggests that either some students induced to leave in spring 2002 did not return even when the in-state rates were restored or that approximately half of the students who exited would have left in the following semesters even in the absence of the policy change.

We distinguish between these explanations with two additional analyses. We first examine whether the policy change affected the hazard of exit, defined as the probability of exit in semester t conditional on semester $t-1$ enrollment (Panel B). Consistent with the estimates displayed in Panel A, undocumented students experienced a 7 percentage-point increase in their exit hazard in spring 2002 (a 61 percent increase relative to fall 2001). We observe no differences in exit rates after the spring 2002 semester, consistent with the expectation that students who remained enrolled in the semester of the tuition hike would be unlikely to disproportionately leave school once the subsidy was reinstated. We then examine effects on reentry among students who "stopped-out" of college for at least one semester (Panel C). Undocumented students who left

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CUNY prior to spring 2002 were 8 percentage-points (33 percent) less likely to return to college in the semester of the price shock. Furthermore, even when in-state tuition rates were restored, the probability of reentry remained negative (albeit insignificant) among undocumented students who had previously left school. The persistent reduction in reenrollment after in-state rates were restored suggests that approximately half of the students induced to leave in the spring of 2002 would have left college in the following semesters even if tuition rates had remained the same. Columns (2) and (3) provide results for bachelor's and associate degree seeking students. Responses to the price shock are statistically indistinguishable for these two groups except in the case of the estimated post-2002 impact on reenrollment, with only bachelor's degree seeking students experiencing significant reductions after in-state rates were restored ($p = 0.09$).

Table 3 examines whether the price hike at CUNY's senior colleges caused students to transfer to CUNY community colleges or to postsecondary institutions outside of the CUNY System. For students already enrolled in the CUNY System, especially those in associate degree programs, CUNY community colleges represent a cheaper and relatively accessible alternative to the senior colleges. Yet Panel A of Table 3 shows that the price hike at senior colleges had no effect on students' hazard of transferring to a CUNY community college. We might also expect to observe senior college students transferring to non-CUNY institutions for lower prices. Such transfers are unlikely because CUNY institutions are often the least expensive option for students seeking a postsecondary credential in the New York metropolitan area; in 2002, CUNY senior colleges' out-of-state tuition rates were approximately $5,000 lower than the tuition rates charged at other postsecondary institutions in the New York area.[23] Correspondingly, Panel B of Table 3 shows no effect of the price shocks on undocumented students' hazard of transferring to a non-CUNY institution. These results hold for both associate and bachelor's degree-seeking students, the latter of which might be more expected to transfer given that CUNY offers fewer bachelor's degree than associate degree programs.[24] These results are consistent with our previous finding that the estimated effects of the price hike on reenrollment are the same whether or not we include enrollment within non-CUNY institutions.

Undocumented students also attempted and earned fewer credits within CUNY institutions in spring 2002 (Table 4). We do not condition on enrollment when estimating impacts on credits attempted and earned, therefore, our point estimates represent the combined impact of the price increase on intensive (e.g., course-taking) and extensive margin (e.g., reenrollment) responses. Undocumented students attempted 0.9 fewer

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[23] Authors' calculations based on data from the Integrated Postsecondary Education Data System. In 2002, the average out-of-state tuition for full-time enrollment at a CUNY senior college was $6,800 while the average tuition at nearby Title IV eligible institutions was $11,432. Of the 45 nonreligious higher education institutions in the New York City metropolitan area, only 3 charged out-of-state tuition rates that were lower than the CUNY senior college out-of-state rate (St. Paul's School of Nursing-Staten Island, Institute of Design and Construction in Brooklyn, and American Academy McAllister Institute of Funeral Service in Manhattan) and only none cost less than CUNY community colleges' out-of-state rate.

[24] We explored testing for heterogeneous responses to the price shock by college major and college selectivity, but separating the sample into just three major categories generated imprecise estimates and we lack variation in selectivity among our senior colleges with 4 of the 6 ranked as "competitive" by the *Barron's Guide*.

credits in spring 2002 (a 10 percent decrease relative to fall 2001) and earned 0.8 (9 percent) fewer credits. Undocumented students continued to earn fewer credits even after in-state tuition rates were restored. The similarities between effects on credits attempted and earned, as well as the trends shown in Figures 2 and 3, suggest that observed decreases in credit accumulation are largely driven by decreases in credits attempted, rather than declines in course pass rates. Thus, we focus on estimating effects on credits earned in the remaining analyses. Estimated impacts on credits attempted are quite similar (available upon request). Columns (2) and (3) show that the impact of the price increase did not differ by initial degree program; none of the differences in effects by degree program are statistically significant.

5.2   Robustness tests

To relax the assumption of constant post-Spring 2002 effects imposed by equation (1), we estimate a modified version of our main specification that allows for time-varying differences between documented and undocumented noncitizens' outcomes before and following the price shock:

$$Y_{isct} = \sum_{j=-3}^{-1} \beta_j \mathbf{1}\left[sem = j\right]_t \times Undoc_i + \sum_{j=0}^{3} \beta_j \mathbf{1}\left[sem = j\right]_t \times Undoc_i + \boldsymbol{\gamma}\mathbf{X_i} + \delta_{sc} + \delta_t + \tau \times \delta_c + \epsilon_{isct} \quad (2)$$

The terms $\mathbf{1}\left[sem = j\right]$ indicate the semester outcome Y is observed falls before the price shock ($t < 0$), at the same time as the price shock ($t = 0$), or following the price shock ($t > 0$). In Figures 4 and 5, we graph the estimated β_j terms and the corresponding 95 percent confidence intervals when Y_{isct} represents reenrollment within CUNY institutions and credits earned, respectively. Fall 2001 (the semester immediately prior to the price shock, $t = -1$) serves as the omitted category. This event study framework allows us to test for differences in the trends in documented and undocumented students' outcomes prior to the price shock. We can also test how the impact of the price shock changes in each semester after spring 2002.

Differences in reenrollment rates between documented and undocumented students are not statistically significant before the price shock (Figure 4).[25] However, undocumented students were more than 5 percentage-points less likely to reenroll in spring 2002 and around 3 percentage-points less likely to reenroll in fall 2002. After fall 2002, impacts on undocumented students' reenrollment remain negative but are no longer statistically significant at the 5 percent level. Likewise, trends in credits earned for documented and undocumented students prior to the price shock are also not statistically distinguishable (Figure 5). Although the drop in credits earned by undocumented students relative to their documented counterparts is largest in spring 2002, statistically significant differences in credit accumulation persist for at least two

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[25]Appendix Figure A.1 shows that estimated impacts on reenroll within CUNY and non-CUNY institutions using data from the NSC by semesters since the policy change are quite similar.

semesters following the restoration of in-state rates.[26]

Table 5 displays estimated effects on reenrollment and credits earned from three robustness tests. Column (1) includes estimates from models that include student fixed effects. Column (2) includes estimates from models that use a larger window around the policy change (4 semesters) and Column (3) includes estimates from models that use a smaller window (2 semesters).

Including student fixed effects will account for student-specific time-invariant characteristics. If students' time-invariant unobservable characteristics are correlated with both their attainment and exposure to the policy change, our main estimates will suffer from omitted variables bias. Conversely, our fixed effects models use students' own pre-treatment outcomes as a counterfactual for their outcome in the absence of the policy change. In this case, documented noncitizens only allow us to identify cohort by school and semester fixed effects, since these students experience no change in their exposure to the tuition increase. The disadvantage of including student fixed effects is that attenuation bias due to classical measurement error in the "treatment" variables will be exacerbated, biasing our estimates towards zero. Even if documentation status contains minimal measurement error, our treatment variable will contain measurement error by construction. This is because not all students are still enrolled in spring 2002, but we treat all students as being affected by the price increase. The second and third robustness tests vary the size of the window around the policy change that we use to define our sample to show that our results are not driven by the three semester window we use in our main specification.

The estimated effects of the policy change are robust to these alternative specifications. Across all four specifications (the original and the alternatives discussed above), the price increase led to a 7 to 8 percent decrease in reenrollment in spring 2002, and a 2 to 3 percent continued reduction after the subsidy was restored. Correspondingly, the price increase caused an 8 to 9 percent decrease in credits earned in spring 2002, and a 5 to 6 percent decrease post-spring 2002.

5.3   Disentangling extensive and intensive margin responses to the price shock

To understand better how much of the reduction in credits earned due to the price shock was driven by decreases in reenrollment, we estimate a set of models that condition on enrollment. First, we examine the effect of the price increase on credits earned by enrolled students (Table 6, Panel A). The price increase led to an insignificant 0.2 (2 percent) decrease in credits earned by undocumented students during spring 2002. This point estimate is less than 20 percent of the size of the estimated impact when we do not condition on reenrollment, suggesting that the price increase primarily reduced attainment by inducing students to leave

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[26]Appendix Figures A.2 and A.3 show corresponding estimates by initial degree program. Patterns are similar for students initially entering into bachelor's and associate degree programs.

school. In the semesters after spring 2002, enrolled students earned 0.3 (3 percent) fewer credits.

The reductions in attainment that persist after in-state tuition rates were restored to undocumented students could stem from several channels. First, affected undocumented students could respond to the price increase by increasing their non-school work investments (and lowering their course loads). Alternatively, undocumented students who reenroll following the price increase could be negatively selected, and thus, would have earned fewer credits even in the absence of the policy change. We find no effect of the price shock on enrolled students' GPA (Table 6, Panel B).[27] Our 95 percent confidence intervals rule out impacts larger than a -0.13 point decrease and a 0.05 point increase in enrolled students' GPAs in spring 2002.

The estimated effects on credits earned and GPA capture both the effect of the policy change on attainment and effects driven through selection into the sample of enrolled students. We explore selection into reenrollment in the semester of the price hike by comparing undocumented students who exited in spring 2002 to those who exited in earlier semesters, with documented noncitizens again serving as a counterfactual. We focus on cumulative credits earned and cumulative GPA in the semester before exit. As shown in Table 7, relative to documented noncitizens, undocumented students who left college in spring 2002 had earned significantly more credits than those who left college prior to the price shock.

To disentangle the potential effect of differential selection from lasting impacts of the price shock on credit accumulation and course grades, we reestimate the credits earned and GPA models with student fixed-effects. By including a student fixed effect in equation (1), our results will represent within-student variation in outcomes in spring 2002 and later semesters and exclude any contamination due to differential selection into persistence following the price shock. As shown in Appendix Table A.2, estimated effects on credits earned and GPA from student fixed-effects models are very similar to those displayed in Table 6, suggesting that the price shock had no substantial effect on enrolled students' credits or grades.

5.4 Heterogeneity by gender and race/ethnicity

Prior research suggests female bachelor's degree seeking students may be more sensitive to tuition supports than their male counterparts (e.g., Dynarski, 2008; Angrist, Lang and Oreopoulos, 2009). To determine whether the price increase had larger effects on female undocumented students' attainment, we estimate equation (1) separately for male and female students. We find no evidence of heterogeneous impacts of the price change on students' outcomes by gender (Table 8).

We also test for differences in the effect of the price increase on Hispanic versus non-Hispanic students. Undocumented students in New York City are less likely to be Hispanic than undocumented students else-

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[27]We lose a small number of student by semester observations with a missing GPA. We find no relationship between the probability of having a missing GPA in a semester in which the student is classified as being enrolled and the interaction between undocumented status and spring 2002 or post-spring 2002 (available upon request).

where in the US, therefore, this exercise helps us assess how generalizable our results are to undocumented students outside of the CUNY System. We estimate equation (1) separately for Hispanic and non-Hispanic students; results are displayed in Table 9.[28] The price hike had statistically significant negative effects on both Hispanic and non-Hispanic undocumented students' reenrollment and earned credits. Undocumented Hispanic students generally experienced larger reductions in reenrollment and credits earned and the difference in the effect of the price increase on credit accumulation between Hispanic and non-Hispanic students is statistically significant ($p = 0.025$).

Given that prior studies on undocumented immigrants' responses to resident tuition rates tend to restrict the sample to Hispanics and proxy for undocumented status with non-citizenship, we conducted additional analyses to determine how use of such a proxy would have biased our results. We reestimate our main specification, coding all noncitizen Hispanics as treatment group members, and using Hispanic citizens as a control group. We find substantial differences in the results obtained from using the proper measure of undocumented status compared to estimates obtained from using the proxy measure. Most of the estimated effects of the price shock on reenrollment and credits earned are positive with 95 percent confidence intervals that include zero (see Appendix Table A.4). These results suggest that the conventional approach of using Hispanic noncitizens to proxy for undocumented individuals may lead to biased results, particularly in contexts like New York City where the share of Hispanic noncitizens who are undocumented is relatively low (approximately 10 percent). We are unable to comment on the implications of using this proxy measure in areas where most Hispanic noncitizens are undocumented.

5.5 Heterogeneity by entry cohort

Finally, we test for heterogeneous impacts of the price increase by entry cohort, separately examining students who entered a CUNY institution in 1999, 2000, and 2001.[29] Earlier entrants were able to gain more experience and likely faced less uncertainty over whether they ultimately would be successful in college when the policy change was announced. As shown in Table 10, we find evidence of heterogeneous responses by the length of time since entry at the time of the tuition increase.

For undocumented students who entered college in 1999 or 2000, the price shock led to a 3 to 7 percentage-point (5 to 9 percent) reenrollment decline in spring 2002. However, students in these entry cohorts - who potentially had been enrolled for at least a year when the tuition increase hit - experienced no lasting declines in reenrollment after spring 2002. In other words, all of the students in the 1999 and 2000 entry cohorts

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[28]In Appendix Table A.3, we display results from models that separate non-Hispanic students into three additional categories: Black, Asian, and White. Though the magnitudes of estimated effects differ slightly, p-values from tests of the equality of the estimated parameters across the four equations suggest no differences in impacts by race/ethnicity.

[29]We group students by academic rather than calendar year. Thus, students entering a CUNY institution in spring 2000 are classified as entering college in 1999 and students who enter in spring 2001 are classified as 2000 entrants.

induced to leave school due to the policy change would have left in the following three semesters even if prices had not changed. For 2001 entrants, the immediate effect of the price shock on reenrollment - an 8 percentage-point (8 percent) decrease - was not statistically distinguishable from that experienced by earlier cohorts ($p = 0.132$). However, 2001 entrants also experienced lasting declines in reenrollment, with the probability of reenrollment falling by 7 percentage-points (7 percent) in semesters after spring 2002. Taken with the estimated effect on reenrollment in the semester of the price increase, this implies that close to 90 percent of the students induced to leave school in the 2001 cohort would have remained in school for several more semesters had they not been exposed to the tuition increase. We can reject the equality of post-spring 2002 effects across entry cohorts with $p = 0.013$.[30] Our results are robust to limiting the sample to fall entrants (Appendix Table A.6) or examining enrollment within CUNY and non-CUNY institutions using matched NSC data (Appendix Table A.7). Finally, we find similar patterns across entry cohorts when examining impacts on credit accumulation within CUNY institutions, with some evidence of lasting effects on credit accumulation among the 2000 entry cohort (Panel B).

6   Longer-Run Outcomes and Degree Receipt

In the previous section, we show that undocumented students belonging to the 1999 entry cohort did not experience persistent declines in attainment after in-state tuition rates were restored. Conversely, undocumented students who entered college in 2001 experienced lasting reductions in both reenrollment and credit accumulation, while 2000 entrants experienced persistent reductions in credit accumulation (but not reenrollment) after in-state rates were restored.

We build upon these short-run patterns to examine effects of the tuition hike on long-run attainment, including cumulative credits earned and degree receipt eight years after entry. To do so, we compare differences in the outcomes of undocumented students who entered college in 1999 relative to those who entered in 2000 and 2001, again using differences in documented noncitizens outcomes across entry cohorts to generate a counterfactual:

$$Y_{isc} = \alpha_{2000} Undoc_i \times \mathbf{1}\left[cohort = 2000\right] + \alpha_{2001} Undoc_i \times \mathbf{1}\left[cohort = 2001\right] + \boldsymbol{\eta}\mathbf{X_i} + \psi_{sc} + \nu_{isc} \qquad (3)$$

Here, Y_{ics} represents cumulative credits earned or the probability of degree receipt (any degree, associate degree, and bachelor's degree) eight years after entry for student i who initially enrolled in college s as a

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[30]In Appendix Table A.5, we present results from models in which we estimate effects of the price shock separately by entry cohort and initial degree program. We find similar patterns in effects across cohorts by degree program and only two of the 12 pairwise comparisons between associate and bachelor's degree seeking students are significant at the 10 percent level.

member of cohort c.[31] We examine degree receipt both within and outside of the CUNY system, using the matched NSC data to generate the latter measures. The interaction between $Undoc_i$ and indicators for belonging to the 2000 or 2001 entry cohort represents the treatment we are interested in estimating, with corresponding coefficients α_{2000} and α_{2001}. The vector $\mathbf{X_i}$ includes the same set of controls as in our main equation. We also control for school by cohort fixed effects, ψ_{sc}. Each observation represents a unique student and standard errors are clustered at the school by cohort level.

Our key identifying assumption is that there are no unobservable differences between students entering college in 1999 and those entering in 2000 and 2001 that vary with documentation status and affect long-run attainment. Although this assumption is fundamentally untestable, we test whether there are differences in observable characteristics along these dimensions by regressing students' predetermined characteristics on interactions between undocumented status and an indicator for belonging to the 2000 entry cohort or 2001 entry cohort, documentation status, and college by entry cohort fixed effects. As shown in Appendix Table A.8, we find no evidence of statistically significant changes in the observable characteristics of students by entry cohort that vary by undocumented status and entry and cannot reject the hypothesis that the estimates are jointly insignificant ($p = 0.731$ for the 2000 cohort and $p = 0.274$ for the 2001 cohort). Finally, this approach relies on the assumption that undocumented students who entered a senior college in 1999 were only affected by the price shock in the short-run. If some students in this entry cohort also experienced declines in long-run attainment, our estimates provide a lower bound of the true impacts of the price shock on long-run outcomes.

Table 11 provides estimates from equation (3) for three samples: all senior college students (Panel A), students who initially entered college in a bachelor's degree program (Panel B), and students who initially entered an associate degree program (Panel C). Column 1 of Table 11 shows that only undocumented students from the fall 2001 entry cohort experienced significant reductions in long-run credit accumulation. Relative to undocumented students who entered college in 1999, 2001 entrants earned 7 fewer credits (a 9 percent decrease). Effects are large in magnitude for bachelor's degree seeking students relative to associate degree seeking students (an 8 versus 6 credit reduction), but similar in percentage terms (both represent a 10 percent reduction relative to the 1999 cohort mean).

The second through fourth columns present estimated effects on degree receipt within the CUNY System eight years after entry. Column 2 contains estimated effects of the price shock on receipt of any CUNY credential (including certificates), while Columns 3 and 4 focus on receipt of associate of arts or science (AA/AS) and bachelor of arts or science (BA/BS) degrees, respectively. Again, only undocumented students who entered college in fall 2001 experienced a reduction in CUNY degree receipt over the long-run. However,

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[31]Certificates are included in our measure of any degree receipt.

these impacts are substantial and include a 10 percentage-point (22 percent) reduction in receipt of any degree and a marginally significant 9 percentage-point (22 percent) reduction in bachelor's degree receipt. Effects on bachelor's degree receipt are driven by bachelor's degree seeking students, who experienced a 12 percentage-point (23 percent) reduction, while associate degree seeking students were 12 percentage-points (46 percent) less likely to earn an associate degree within eight years of entry. Again, these effects are interpreted as the long-run effect of a price hike on students by the length of time they had been enrolled before the price hike occurred.

Columns five through seven provide the results on degree attainment in non-CUNY institutions. All estimates are near zero and statistically insignificant, which is consistent with our earlier findings that the price shock did not induce students to transfer to schools outside of the CUNY System. We can, therefore, interpret our results for CUNY as the effect of the price hike on overall attainment, not just attainment in the CUNY System.[32]

7 Conclusions

Our results suggest that CUNY's decision to eliminate temporarily the in-state tuition subsidy reduced undocumented students' short- and long-run attainment. Given that senior college students faced an 113 percent increase in tuition during the semester of the price hike, our estimates imply a price elasticity of reenrollment equal to -0.07. This result is very similar to the -0.10 price elasticity of reenrollment implied by the estimates from Angrist et al. (2014). While we find no substantial differences in effects by initial degree program, gender, or Hispanic ethnicity, we find that the timing of the price shock matters a great deal for long-run attainment. The price hike did not affect the long-run degree completion of students with more years of college attendance, but it did cause them to leave school earlier than they might have otherwise planned. Relative to these more experienced students, those who had only completed one semester prior to the price shock experienced a 9 percent reduction in credit accumulation and a 22 percent decrease in degree receipt eight years after entry. The latter effect implies a price elasticity of degree receipt equal to -0.19 (under the assumption that students viewed the initial price hike as permanent).

Prior research suggests that in-state tuition subsidies induce undocumented students to enter college. Our paper demonstrates that this public investment also increases undocumented students' likelihood of persisting further in college and, for some students, their probability of degree completion. The full return on this investment is difficult to calculate in the current policy regime. On the benefits side, a major question concerns the labor market returns to a year of college or a college degree for undocumented youth

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[32]Appendix Table A.9, which displays estimated effects on degree receipt from any institution, confirms that the reduction in attainment for students in the 2001 entry cohort is driven by changes in degree receipt from CUNY System schools.

who currently have no permanent legal authority to live and work in the US. Even students who are enrolled in the DACA program have only temporary authorization to work and it is unclear whether this program will become permanent legislation. While returns to a year of college have been estimated at roughly 10 percent for an average student (e.g., Kane and Rouse 1995; Card, 1999) with additional boosts in returns for degree completion, undocumented college graduates may experience smaller private returns.

The benefits of increasing the college persistence and attainment of undocumented immigrants are likely to accrue in non-market realms (Lochner, 2011). For instance, undocumented youth who obtain college credentials may be more civically engaged, clearly not as voters, but as consumers and participants in the informal civic and political context (e.g., Dee 2004; Milligan, Moretti and Oreopoulos 2004). In addition, assuming these undocumented youth are not deported, many are likely to have children who will be US citizens and who will benefit from having parents with some college education (e.g., Currie and Moretti 2003). In sum, the subsidy is likely to be welfare-enhancing, yet the most substantial private benefits are uncertain given these students' lack of access to formal labor markets.

Though our findings are most generalizable to undocumented students, they also suggest that unanticipated increases in tuition and reductions in financial aid can have large effects on low-income students beyond the college entry margin. Our paper shows that a one-time price hike had lasting effects, particularly for students who had just begun their college careers and for whom the uncertainty in the returns to their college investment was greatest. The fact that the shock was only temporary suggests that these results provide a lower bound of the effects of permanent price increases on college degree attainment.

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Figures and Tables

Figure 1: Trends in Reenrollment by Citizenship and Documentation
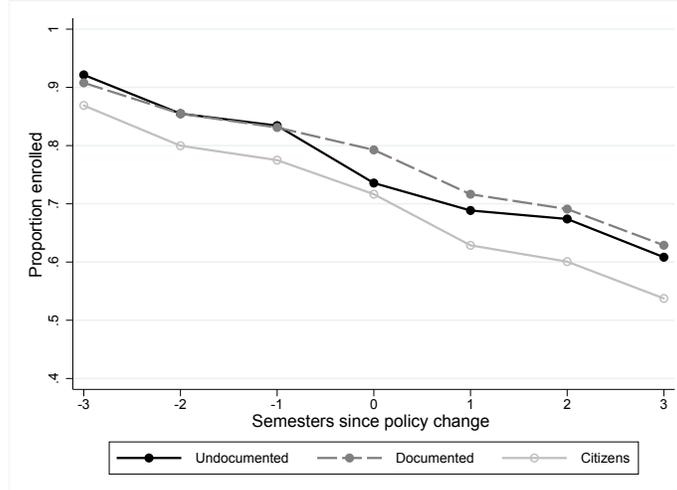
Source: CUNY administrative data. *Notes:* Sample includes first-time CUNY undergraduate degree seeking students belonging to the fall 1999 through fall 2001 entering cohorts who earned a high school diploma or GED from New York State and initially entered a senior college (Baruch, Brooklyn, City, Hunter, John Jay, Queens, Lehman, City College of Technology, Staten Island, or York College). Each line represents the share of students in the specified group who were enrolled in the specified semester. Spring 2002 is represented by "0". See text for definitions of documented and undocumented noncitizens. Student by semester observations following degree receipt are dropped.

Figure 2: Trends in Credits Attempted by Citizenship and Documentation
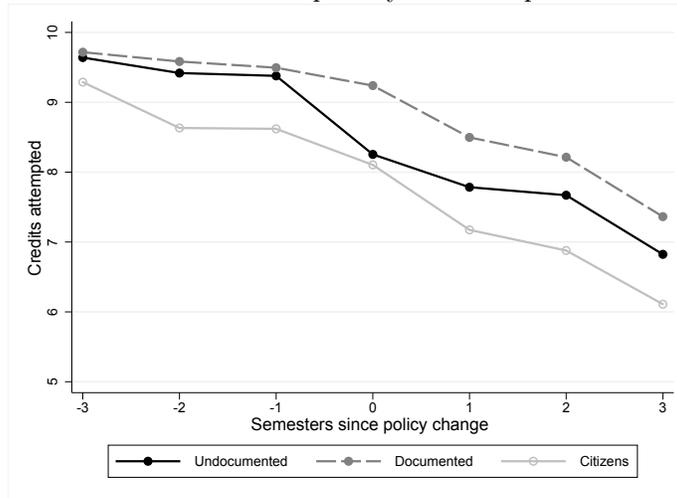
Source: CUNY administrative data. *Notes:* See Figure 1 notes for sample definition. Each line represents average credits attempted by students in the specified group and semester.

Figure 3: Trends in Credits Earned by Citizenship and Documentation
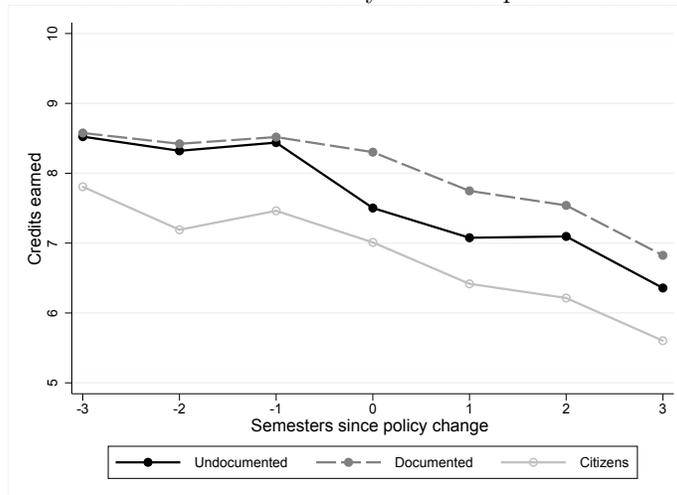
Source: CUNY administrative data. *Notes:* See Figure 1 notes for sample definition. Each line represents average credits earned by students in the specified group and semester.

Figure 4: Effects of the Price Shock on Reenrollment by Semester
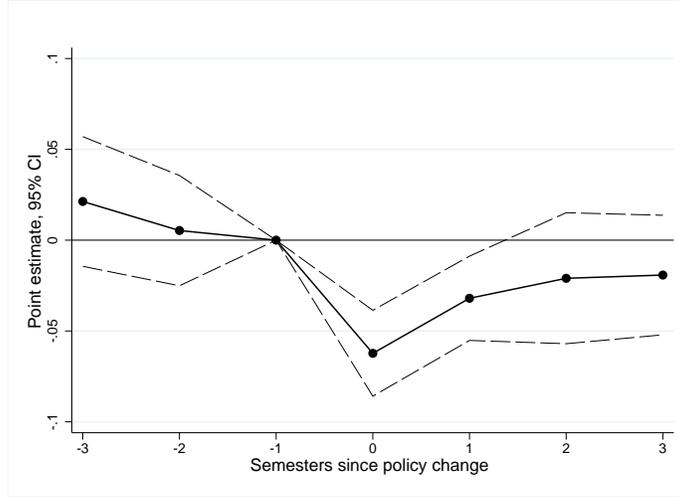
Source: CUNY administrative data. *Notes:* Sample includes first-time CUNY noncitizen undergraduate degree seeking students who belonged to the fall 1999 through fall 2001 entering cohorts and earned a high school diploma or GED from New York State who initially enrolled in a senior college. Each marker represents the estimated β_j coefficients from equation (2). Spring 2002 is represented by "0". The thin dashed line represents the corresponding 95 percent confidence interval. See text for definitions of documented and undocumented noncitizens. Student by semester observations following degree receipt are dropped.

Figure 5: Effects of the Price Shock on Credits Earned by Semester
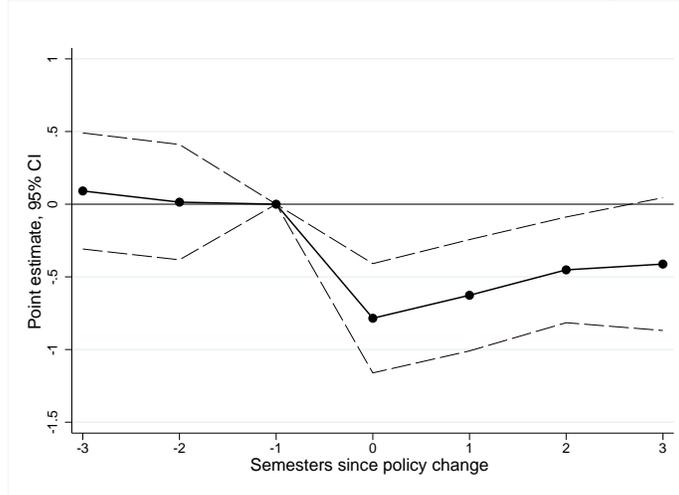
Source: CUNY administrative data. *Notes:* See Figure (4) notes for sample definition and specification.

Table 1: Characteristics of Students by Citizenship and Documentation Status at Entry

| | (1) Citizens | Noncitizens | | Tests of equality (*p*-value) | | |
		(2) Documented	(3) Undocumented	Citizen vs. noncitizens	Documented vs. undoc.	All three groups
Age	19	19	19	0.010	0.834	0.035
Female	0.58	0.57	0.58	0.504	0.616	0.705
Race/ethnicity:						
Asian/Pacific Islander	0.10	0.30	0.26	<0.001	0.003	<0.001
Black	0.28	0.26	0.33	0.007	<0.001	<0.001
Hispanic	0.29	0.21	0.25	<0.001	0.002	<0.001
White	0.33	0.23	0.16	<0.001	<0.001	<0.001
Single parent	0.02	0.01	0.01	0.127	0.634	0.282
Disabled	0.03	0.01	0.02	<0.001	0.292	<0.001
Foreign-born	0.08	1	1			
Need any remediation	0.33	0.42	0.38	<0.001	0.038	<0.001
High school type:						
NYC public	0.69	0.86	0.85	<0.001	0.179	<0.001
NYC private	0.18	0.05	0.04	<0.001	0.446	<0.001
GED	0.06	0.07	0.06	0.673	0.741	0.866
High school GPA (0-100)	78	80	80	<0.001	0.061	<0.001
Missing high school GPA	0.02	0.02	0.02	<0.001	0.662	<0.001
Bachelor's degree program	0.61	0.63	0.62	0.002	0.402	0.006
Initial institution selectivity:						
Very competitive	0.09	0.13	0.10	<0.001	0.028	<0.001
Competitive	0.48	0.45	0.47	<0.001	0.204	<0.001
Less/noncompetitive	0.43	0.42	0.42	0.126	0.844	0.303
CUNY attainment:						
Cumulative credits earned	67	78	76	<0.001	0.337	<0.001
Any degree receipt	0.43	0.51	0.49	<0.001	0.351	<0.001
AA/AS degree	0.10	0.10	0.11	0.013	0.438	0.034
BA/BS degree	0.36	0.44	0.42	<0.001	0.384	<0.001
Non-CUNY attainment:						
Any degree receipt	0.10	0.09	0.06	0.004	<0.001	<0.001
AA/AS degree	0.02	0.02	0.02	0.087	0.625	0.207
BA/BS degree	0.07	0.06	0.04	0.001	0.006	<0.001
Observations	26,000	8,922	876			

Source: CUNY and NSC administrative data. *Note*s: Sample includes first-time CUNY undergraduate degree seeking students belonging to the fall 1999 through fall 2001 entering cohorts who earned a high school diploma or GED from New York State and initially entered a senior college (Baruch, Brooklyn, City, Hunter, John Jay, Queens, Lehman, City College of Technology, Staten Island, or York College). High school GPA refers to the CUNY college admissions average, which is a standardized measure of students' high school grade point averages on a scale of 0 to 100. College competitiveness level according to the Barron's Profile of American Colleges. Attainment outcomes as of 8 years after college entry.

Table 2: Effects of the Price Shock on Reenrollment, Exits, and Returns

	(1) All	(2) Bachelor's degree seeking	(3) Associate degree seeking
A. Reenrollment			
Undocumented × spring 2002	-0.065	-0.071	-0.054
	(0.012)**	(0.014)**	(0.020)*
Undocumented × post-spring 2002	-0.029	-0.042	0.001
	(0.013)*	(0.015)**	(0.022)
Test of equality (*p*-value)	0.005	0.007	0.070
Fall 2001 undocumented mean	0.83	0.88	0.77
Impact in % change: spring 2002	-8%	-8%	-7%
Impact in % change: post-spring 2002	-3%	-5%	0.1%
Observations	61,481	38,674	22,807
B. Pr(*exit$_t$/enrolled$_{t-1}$*)			
Undocumented × spring 2002	0.067	0.069	0.063
	(0.013)**	(0.014)**	(0.025)*
Undocumented × post-spring 2002	0.010	0.012	0.002
	(0.010)	(0.011)	(0.020)
Test of equality (*p*-value)	<0.001	<0.001	0.067
Fall 2001 undocumented mean	0.11	0.09	0.13
Impact in % change: spring 2002	61%	77%	48%
Impact in % change: post-spring 2002	9%	13%	2%
Observations	50,185	33,405	16,780
C. Pr(*return$_t$/not enrolled$_{t-1}$*)			
Undocumented × spring 2002	-0.080	-0.156	-0.023
	(0.041)+	(0.073)*	(0.051)
Undocumented × post-spring 2002	-0.032	-0.100	0.016
	(0.037)	(0.064)	(0.050)
Test of equality (*p*-value)	0.132	0.369	0.149
Fall 2001 undocumented mean	0.24	0.33	0.18
Impact in % change: spring 2002	-33%	-47%	-13%
Impact in % change: post-spring 2002	-13%	-30%	9%
Observations	11,296	5,269	6,027

Source: CUNY administrative data. *Notes*: Sample includes first-time CUNY noncitizen undergraduate degree seeking students belonging to the fall 1999 through fall 2001 entering cohorts who earned a high school diploma or GED from New York State and initially enrolled in a senior college. Each column within a panel contains estimates from separate regressions. Reenrollment measures the unconditional probability of enrollment in a given semester. Panel B sample is limited to students who were enrolled in the prior semester. Panel C sample is limited to students who were not enrolled in the prior semester. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. Reported coefficients are interactions between an indicator for whether a student is an undocumented noncitizen at college entry and spring 2002 and interactions between undocumented status and post-spring 2002. All regressions also include controls for age at entry, high school GPA (set to zero if missing), an indicator for whether a student's high school GPA is missing, indicators for race/ethnicity (Black, Hispanic, or White), documentation status, and gender, indicators for whether the student was a single parent, needed remediation, or was disabled at entry, semester fixed effects, institution by cohort fixed effects, and cohort-specific linear time trends. Column (1) regressions also control for initial degree program (associate versus bachelor's degree). Student by semester observations are dropped following degree receipt.

Table 3: Effects of the Price Shock on the Hazard of Transfer

	(1) All	(2) Bachelor's degree seeking	(3) Associate degree seeking
A. Transfers to CUNY community colleges			
Undocumented × spring 2002	0.002	0.007	-0.008
	(0.004)	(0.005)	(0.007)
Undocumented × post-spring 2002	-0.004	-0.001	-0.008
	(0.004)	(0.004)	(0.007)
Test of equality (*p*- value)	0.348	0.110	0.993
Fall 2001 undocumented mean	0.01	0.004	0.01
Observations	59,541	37,896	21,645
B. Transfers to non-CUNY institutions			
Undocumented × spring 2002	0.003	0.006	-0.002
	(0.004)	(0.004)	(0.006)
Undocumented × post-spring 2002	-0.005	-0.006	-0.003
	(0.003)	(0.004)	(0.004)
Test of equality (*p*- value)	0.066	0.025	0.966
Fall 2001 undocumented mean	0.01	0.01	0.02
Observations	59,182	37,247	21,935

Source: CUNY and National Student Clearinghouse administrative data. *Notes*: Sample includes first-time CUNY noncitizen undergraduate degree seeking students who earned a high school diploma or GED from New York State belonging to the fall 1999 through fall 2001 entering cohorts who initially enrolled in a senior college. Each column within a panel contains estimates from separate regressions. Sample is limited to students who had not yet transferred by $t - 1$. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. Reported coefficients are interactions between an indicator for whether a student is an undocumented noncitizen at college entry and spring 2002 and interactions between undocumented status and post-spring 2002. See Table 2 for additional control variables. Student by semester observations are dropped following degree receipt.

Table 4: Effects of the Price Shock on Credits Attempted and Earned

	(1) All	(2) Bachelor's degree seeking	(3) Associate degree seeking
A. Credits attempted			
Undocumented × spring 2002	-0.913	-0.912	-0.914
	(0.176)**	(0.226)**	(0.299)**
Undocumented × post-spring 2002	-0.547	-0.494	-0.637
	(0.180)**	(0.213)*	(0.346)+
Test of equality (*p*-value)	0.033	0.048	0.273
Fall 2001 undocumented mean	9.4	10.5	7.5
Impact in % change: spring 2002	-10%	-9%	-12%
Impact in % change: post-spring 2002	-6%	-5%	-8%
Observations	61,481	38,674	22,807
B. Credits earned			
Undocumented × spring 2002	-0.763	-0.862	-0.603
	(0.159)**	(0.228)**	(0.221)*
Undocumented × post-spring 2002	-0.511	-0.469	-0.586
	(0.156)**	(0.180)*	(0.297)+
Test of equality (*p*-value)	0.165	0.077	0.950
Fall 2001 undocumented mean	8.4	9.6	6.6
Impact in % change: spring 2002	-9%	-9%	-9%
Impact in % change: post-spring 2002	-6%	-5%	-9%
Observations	61,481	38,674	22,807

Source: CUNY administrative data. *Note*s: See Table 2 notes for sample definition. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for additional controls and specification. Student by semester observations are dropped following degree receipt.

Table 5: Robustness of Effects on Reenrollment and Credits Earned

	(1) Student fixed effects	(2) Larger window (+/- 4 semesters)	(3) Smaller window (+/- 2 semesters)
A. Reenrollment			
Undocumented × spring 2002	-0.058	-0.064	-0.060
	(0.013)**	(0.012)**	(0.011)**
Undocumented × post-spring 2002	-0.019	-0.024	-0.024
	(0.015)	(0.014)+	(0.014)+
Test of equality (*p*-value)	0.007	0.006	0.006
Fall 2001 undocumented mean	0.83	0.83	0.83
Impact in % change: spring 2002	-7%	-8%	-7%
Impact in % change: post-spring 2002	-2%	-3%	-3%
Observations	61,481	73,768	45,777
B. Credits earned			
Undocumented × spring 2002	-0.673	-0.738	-0.737
	(0.170)**	(0.166)**	(0.165)**
Undocumented × post-spring 2002	-0.378	-0.412	-0.497
	(0.187)*	(0.156)*	(0.161)**
Test of equality (*p*-value)	0.141	0.082	0.212
Fall 2001 undocumented mean	8.4	8.4	8.4
Impact in % change: spring 2002	-8%	-9%	-9%
Impact in % change: post-spring 2002	-5%	-5%	-6%
Observations	61,481	73,768	45,777

Source: CUNY administrative data. *Note*s: Sample includes first-time CUNY noncitizen undergraduate degree seeking students who earned a high school diploma or GED from New York State belonging to the fall 1999 through fall 2001 entering cohorts. Column (2) sample includes student by semester observations from four semesters before and after the policy change while column (3) sample excludes student by semester observations more than two semesters before/after the policy change. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** $p<0.01$, * $p<0.05$, + $p<0.1$. Column (1) specification includes student fixed effects and excludes time-invariant student characteristics. See Table 2 notes for specification and additional control variables included in columns (2) and (3) models. Student by semester observations are dropped following degree receipt.

Table 6: Effects of the Price Shock on Attainment of Enrolled Students

	(1) All	(2) Bachelor's degree seeking	(3) Associate degree seeking
*A. Credits earned	enrolled*			
Undocumented × spring 2002	-0.175	-0.148	-0.284
	(0.172)	(0.234)	(0.226)
Undocumented × post-spring 2002	-0.322	-0.093	-0.916
	(0.174)+	(0.153)	(0.352)*
Test of equality (*p*- value)	0.473	0.834	0.022
Fall 2001 undocumented mean	10.3	11	8.8
Impact in % change: spring 2002	-2%	-1%	-3%
Impact in % change: post-spring 2002	-3%	-1%	-10%
Observations	45,866	31,275	14,591
*B. GPA	enrolled*			
Undocumented × spring 2002	-0.041	-0.064	0.014
	(0.045)	(0.059)	(0.054)
Undocumented × post-spring 2002	-0.025	-0.039	0.012
	(0.032)	(0.042)	(0.038)
Test of equality (*p*- value)	0.624	0.547	0.959
Fall 2001 undocumented mean	2.57	2.68	2.36
Impact in % change: spring 2002	-2%	-2%	1%
Impact in % change: post-spring 2002	-1%	-1%	1%
Observations	45,817	31,242	14,575

Source: CUNY administrative data. *Note*s: Sample includes enrolled first-time CUNY noncitizen undergraduate degree seeking students who earned a high school diploma or GED from New York State belonging to the fall 1999 through fall 2001 entering cohorts who initially enrolled in a senior college. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for additional controls and specification. Student by semester observations are dropped following degree receipt.

Table 7: Selection into Exit in Spring 2002

	(1) Cumulative GPA	(2) Cumulative credits earned
Undocumented × spring 2002	0.208	2.493
	(0.145)	(1.180)*
Fall 2001 undocumented mean	1.99	18
Impact in % change: spring 2002	10%	14%
Observations	4,291	4,291

Source: CUNY administrative data. *Note*s: Sample includes first-time CUNY noncitizen undergraduate degree seeking senior college students who earned a high school diploma or GED from New York State belonging to the Fall 1999 through Fall 2001 entering cohorts and exited from college in semester *t*. Dependent variable is cumulative GPA or cumulative credits earned at the time of exit. Each column contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for additional control variables and specification. Student by semester observations are dropped following degree receipt.

Table 8: Heterogeneity in Effects by Gender

	(1) Female	(2) Male	Test of equality (*p*- value)
A. Reenrollment			
Undocumented × spring 2002	-0.073 (0.016)**	-0.054 (0.018)**	0.447
Undocumented × post-spring 2002	-0.035 (0.016)*	-0.020 (0.019)	0.515
Fall 2001 undocumented mean	0.84	0.83	
Observations	35,290	26,191	
B. Credits earned			
Undocumented × spring 2002	-0.881 (0.209)**	-0.591 (0.280)*	0.422
Undocumented × post-spring 2002	-0.548 (0.172)**	-0.457 (0.262)+	0.757
Fall 2001 undocumented mean	8.9	7.9	
Observations	35,290	26,191	

Source: CUNY administrative data. *Note*s: See Table 2 notes for sample description. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for specification and additional control variables. Student by semester observations are dropped following degree receipt.

Table 9: Heterogeneity in Effects by Hispanic Ethnicity

	(1) Hispanic	(2) Non-hispanic	Test of equality (*p*- value)
A. Reenrollment			
Undocumented × spring 2002	-0.083 (0.024)**	-0.058 (0.015)**	0.414
Undocumented × post-spring 2002	0.002 (0.031)	-0.037 (0.015)*	0.280
Fall 2001 undocumented mean	0.83	0.84	
Observations	13,189	48,292	
B. Credits earned			
Undocumented × spring 2002	-1.384 (0.318)**	-0.541 (0.189)**	0.025
Undocumented × post-spring 2002	-0.583 (0.346)+	-0.482 (0.176)**	0.799
Fall 2001 undocumented mean	8.1	8.6	
Observations	13,189	48,292	

Source: CUNY administrative data. *Note*s: See Table 2 notes for sample description. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for specification and additional control variables. Students who earn degrees prior to exit are excluded.

Table 10: Heterogeneity in the Effects by Entry Year

	(1) 1999	(2) 2000	(3) 2001	Test of eq. (*p*- value)
A. Reenrollment				
Undocumented × spring 2002	-0.033	-0.073	-0.084	0.132
	(0.020)	(0.020)**	(0.018)**	
Undocumented × post-spring 2002	-0.002	-0.009	-0.073	0.013
	(0.022)	(0.022)	(0.018)**	
Test of equality (*p*- value)	0.119	0.011	0.549	
Fall 2001 undocumented mean	0.68	0.79	1.00	
Impact in % change: spring 2002	-5%	-9%	-8%	
Impact in % change: post-spring 2002	-0.3%	-1%	-7%	
Observations	21,586	24,539	15,356	
B. Credits earned				
Undocumented × spring 2002	-0.452	-0.937	-0.928	0.224
	(0.216)*	(0.216)**	(0.354)*	
Undocumented × post-spring 2002	0.181	-0.546	-1.072	<0.001
	(0.271)	(0.283)+	(0.155)**	
Test of equality (*p*- value):	0.071	0.19	0.642	
Fall 2001 undocumented mean	7.0	8.0	10.0	
Impact in % change: spring 2002	-6%	-12%	-9%	
Impact in % change: post-spring 2002	3%	-7%	-11%	
Observations	21,586	24,539	15,356	

Source: CUNY administrative data. *Note*s: See Table 2 notes for sample description. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for specification and additional control variables. Student by semester observations are dropped following degree receipt.

Table 11: Effects of the Price Shock on Cumulative Credits Earned and Degree Receipt

	1. Cumulative credits earned	Degree receipt - CUNY:			Degree receipt - non-CUNY:		
		2. Any	3. AA/AS	4. BA/BS	5. Any	6. AA/AS	7. BA/BS
A. All students							
Undocumented × 2000 entrant	-2.37	-0.030	-0.001	-0.020	-0.0002	-0.003	0.015
	(3.69)	(0.047)	(0.026)	(0.041)	(0.015)	(0.011)	(0.012)
Undocumented × 2001 entrant	-7.01	-0.104	-0.042	-0.086	0.001	-0.0002	0.008
	(3.08)*	(0.047)*	(0.028)	(0.043)+	(0.022)	(0.013)	(0.016)
Undocumented mean (1999)	73.9	0.48	0.13	0.4	0.05	0.02	0.03
Observations	9,798	9,798	9,798	9,798	9,798	9,798	9,798
B. Bachelor's degree seeking							
Undocumented × 2000 entrant	-5.07	-0.017	0.011	-0.026	0.001	-0.011	0.015
	(4.78)	(0.062)	(0.018)	(0.063)	(0.024)	(0.019)	(0.018)
Undocumented × 2001 entrant	-8.28	-0.099	0.009	-0.119	-0.013	-0.010	-0.007
	(4.47)+	(0.064)	(0.016)	(0.064)+	(0.027)	(0.020)	(0.022)
Undocumented mean (1999)	84.4	0.55	0.04	0.52	0.06	0.02	0.04
Observations	6,190	6,190	6,190	6,190	6,190	6,190	6,190
C. Associate degree seeking							
Undocumented × 2000 entrant	2.24	-0.045	-0.003	-0.018	-0.008	0.007	0.008
	(4.67)	(0.052)	(0.044)	(0.040)	(0.021)	(0.011)	(0.016)
Undocumented × 2001 entrant	-5.78	-0.109	-0.119	-0.038	0.023	0.011	0.030
	(3.69)	(0.050)*	(0.044)*	(0.030)	(0.026)	(0.017)	(0.017)+
Undocumented mean (1999)	58.8	0.39	0.26	0.22	0.04	0.01	0.01
Observations	3,608	3,608	3,608	3,608	3,608	3,608	3,608

Source: CUNY and NSC administrative data. *Note*s: See Table 2 notes for sample description. Each column within a panel contains estimates from separate regressions. Reported coefficients are interactions between an indicator for whether a student is an undocumented noncitizen and whether the student belonged to either the 2000 or 2001 entry cohort. Clustered standard errors (institution by cohort) in parentheses; ** $p<0.01$, * $p<0.05$, + $p<0.1$. Regressions include controls for age at entry, high school GPA (set to zero if missing), an indicator for whether a student's high school GPA is missing, indicators for race/ethnicity (Black, Hispanic, or White), documentation, and gender, indicators for whether the student was a single parent, needed remediation, or was disabled at entry, and institution by cohort fixed effects.

Appendix A   Additional Figures and Tables

Figure A.1: Effects of the Price Shock on Reenrollment by Semester: CUNY and Non-CUNY Institutions
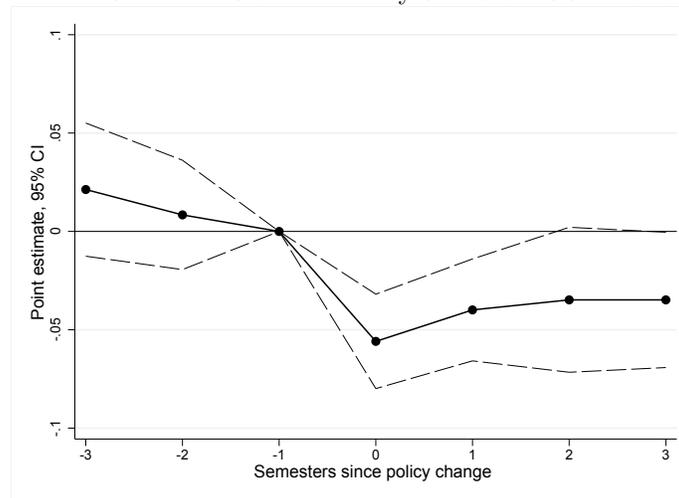
Source: CUNY and NSC administrative data. *Notes:* See Figure 4 notes for sample definition and specification. Dependent variable is enrollment in any CUNY or non-CUNY institution. Spring 2002 is represented by "0". The thin dashed line represents the corresponding 95 percent confidence interval. Student by semester observations following degree receipt are dropped.

Figure A.2: Effects of the Price Shock on Reenrollment by Semester by Initial Degree
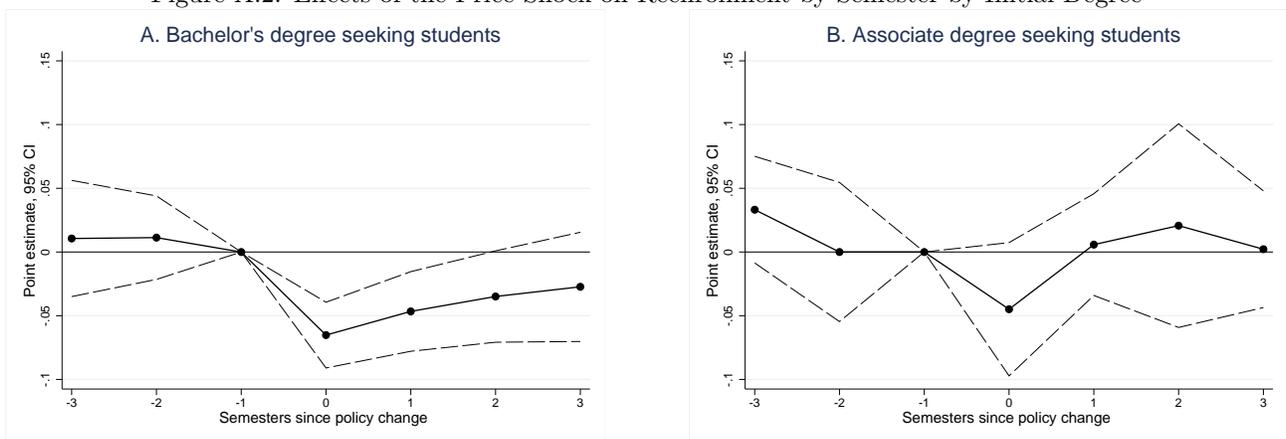
Source: CUNY administrative data. *Notes:* See Figure 4 notes for sample definition and specification. Spring 2002 is represented by "0". The thin dashed line represents the corresponding 95 percent confidence interval. Student by semester observations following degree receipt are dropped.

Figure A.3: Effects of the Price Shock on Credits Earned by Semester by Initial Degree
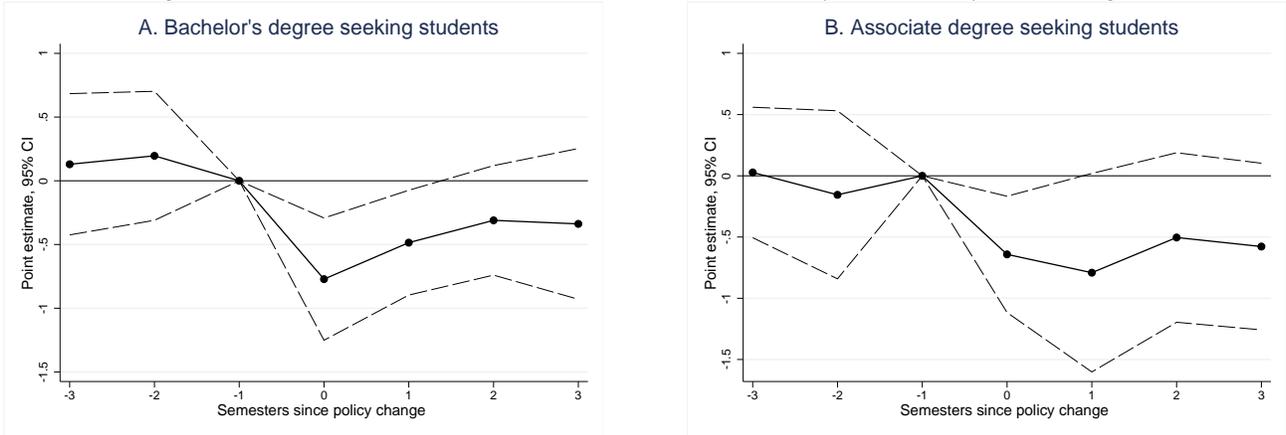
A. Bachelor's degree seeking students

B. Associate degree seeking students

Source: CUNY administrative data. *Notes:*See Figure 4 notes for sample definition and specification. Spring 2002 is represented by "0". The thin dashed line represents the corresponding 95 percent confidence interval. See text for definitions of documented and undocumented noncitizens. Student by semester observations following degree receipt are dropped.

Table A.1: Effects of Price Shock on Reenrollment: CUNY and non-CUNY Institutions

	(1) All	(2) Bachelor's degree seeking	(3) Associate degree seeking
Undocumented × spring 2002	-0.064	-0.071	-0.051
	(0.012)**	(0.015)**	(0.019)*
Undocumented × post-spring 2002	-0.045	-0.063	-0.009
	(0.012)**	(0.015)**	(0.019)
Test of equality (*p*- value)	0.117	0.614	0.015
Fall 2001 undocumented mean	0.85	0.89	0.79
Impact in % change: spring 2002	-8%	-8%	-6%
Impact in % change: post-spring 2002	-5%	-7%	-1%
Observations	61,481	38,674	22,807

Source: CUNY and National Student Clearinghouse administrative data. *Notes*: See Table 2 notes for sample definition and specification. Each column includes estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. Student by semester observations are dropped following degree receipt.

Table A.2: Effects of Price Shock on Attainment of Enrolled Undocumented Students: Student Fixed-Effects Models

	(1) All	(2) Bachelor's degree seeking	(3) Associate degree seeking
A. Credits earned / enrolled			
Undocumented × spring 2002	-0.223	-0.220	-0.286
	(0.178)	(0.235)	(0.243)
Undocumented × post-spring 2002	-0.295	-0.157	-0.712
	(0.194)	(0.176)	(0.417)
Test of equality (*p*-value)	0.747	0.823	0.164
Fall 2001 undocumented mean	10.3	11.0	8.8
Impact in % change: spring 2002	-2%	-2%	-3%
Impact in % change: post-spring 2002	-3%	-1%	-8%
Observations	45,866	31,275	14,591
B. GPA / enrolled			
Undocumented × spring 2002	-0.018	-0.044	0.040
	(0.041)	(0.050)	(0.059)
Undocumented × post-spring 2002	0.010	-0.014	0.071
	(0.034)	(0.042)	(0.044)
Test of equality (*p*-value)	0.347	0.404	0.54
Fall 2001 undocumented mean	2.57	2.68	2.36
Impact in % change: spring 2002	-1%	-2%	2%
Impact in % change: post-spring 2002	0.4%	-1%	3%
Observations	45,817	31,242	14,575

Source: CUNY administrative data. *Notes*: Sample includes first-time CUNY noncitizen undergraduate degree seeking students who earned a high school diploma or GED from New York State belonging to the Fall 1999 through Fall 2001 entering cohorts and were enrolled in semester t. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for specification. All regressions include student fixed-effects. Student by semester observations are dropped following degree receipt.

Table A.3: Heterogeneity in Effects by Race/Ethnicity

	(1) Asian	(2) Black	(3) Hispanic	(4) White	Test of equality (p- value)
A. Reenrollment					
Undocumented × spring 2002	-0.064	-0.055	-0.083	-0.037	0.757
	(0.021)**	(0.023)*	(0.024)**	(0.032)	
Undocumented × post-spring 2002	-0.005	-0.026	0.002	-0.057	0.438
	(0.020)	(0.023)	(0.031)	(0.029)+	
Fall 2001 undocumented mean	0.88	0.77	0.83	0.91	
Observations	18,194	16,605	13,189	13,455	
B. Credits earned					
Undocumented × spring 2002	-0.407	-0.604	-1.384	-0.439	0.102
	(0.306)	(0.284)*	(0.318)**	(0.392)	
Undocumented × post-spring 2002	-0.650	-0.238	-0.583	-0.418	0.837
	(0.302)*	(0.305)	(0.346)+	(0.357)	
Fall 2001 undocumented mean	9.3	7.6	8.1	9.6	
Observations	18,194	16,605	13,189	13,455	

Source: CUNY administrative data. *Note*s: See Table 2 notes for sample definition. Students classified as Native American are excluded due to their small group size. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. Brackets contain *p*-values from test of equality of treatment variables by race/ethnicity. Student by semester observations are dropped following degree receipt.

Table A.4: The Effect of the Price Shock on Attainment of Hispanic Noncitizens

	(1) All	(2) Bachelor's degree seeking	(3) Associate's degree seeking
A. Reenrollment			
Noncitizen × spring 2002	0.010	0.002	0.024
	(0.008)	(0.009)	(0.017)
Noncitizen × post-spring 2002	0.030	0.036	0.023
	(0.013)*	(0.016)*	(0.020)
Test of equality (*p*-value)	0.137	0.026	0.974
Fall 2001 undocumented mean	0.81	0.85	0.76
Impact in % change: spring 2002	1%	0.2%	3%
Impact in % change: post-spring 2002	4%	4%	3%
Observations	60,529	37,376	23,153
B. Credits attempted			
Noncitizen × spring 2002	0.136	-0.002	0.359
	(0.130)	(0.172)	(0.173)+
Noncitizen × post-spring 2002	0.516	0.434	0.644
	(0.199)*	(0.255)+	(0.274)*
Test of equality (*p*-value)	0.011	0.017	0.251
Fall 2001 undocumented mean	8.8	10.0	7.0
Impact in % change: spring 2002	2%	-0.02%	5%
Impact in % change: post-spring 2002	6%	4%	9%
Observations	60,529	37,376	23,153
C. Credits earned			
Noncitizen × spring 2002	0.108	0.001	0.280
	(0.110)	(0.165)	(0.110)*
Noncitizen × post-spring 2002	0.217	0.148	0.328
	(0.161)	(0.199)	(0.238)
Test of equality (*p*-value)	0.376	0.333	0.797
Fall 2001 undocumented mean	7.7	8.9	5.9
Impact in % change: spring 2002	1%	0.01%	5%
Impact in % change: post-spring 2002	3%	2%	6%
Observations	60,529	37,376	23,153

Source: CUNY administrative data. *Notes:* Sample includes first-time CUNY Hispanic undergraduate degree seeking students belonging to the fall 1999 through fall 2001 entering cohorts who earned a high school diploma or GED from New York State and initially enrolled in a senior college. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** $p<0.01$, * $p<0.05$, + $p<0.1$. Reported coefficients are interactions between an indicator for whether a student is a noncitizen at college entry and spring 2002 and interactions between noncitizen status and post-spring 2002. All regressions also include controls for age at entry, high school GPA (set to zero if missing), an indicator for whether a student's high school GPA is missing, indicators for citizenship, gender, whether the student was a single parent, needed remediation, or was disabled at entry, semester fixed effects, institution by cohort fixed effects, and cohort-specific linear time trends. Column (1) regressions also control for initial degree program (associate versus bachelor's degree). Student by semester observations are dropped following degree receipt.

Table A.5: Heterogeneity in Effects by Entry Year and Degree Program

	Bachelor's degree seeking			Associate degree seeking			Test of eq. (*p*-value)		
	(1) 1999	(2) 2000	(3) 2001	(4) 1999	(5) 2000	(6) 2001	1999	2000	2001
A. Reenrollment									
Undocumented × spring 2002	-0.062	-0.068	-0.081	0.007	-0.071	-0.084	0.103	0.918	0.930
	(0.029)*	(0.023)**	(0.019)**	(0.030)	(0.028)*	(0.044)			
Undocumented × post-spring 2002	-0.028	-0.020	-0.075	0.033	0.025	-0.053	0.072	0.214	0.559
	(0.032)	(0.022)	(0.021)**	(0.023)	(0.030)	(0.037)			
Test of equality (*p*-value)	0.274	0.108	0.798	0.224	0.031	0.240			
Fall 2001 undocumented mean	0.79	0.81	1	0.52	0.75	1			
Observations	12,365	15,914	10,395	9,221	8,625	4,961			
B. Credits earned									
Undocumented × spring 2002	-0.690	-0.946	-0.973	-0.100	-0.956	-0.912	0.162	0.983	0.915
	(0.333)+	(0.304)**	(0.513)+	(0.278)	(0.338)*	(0.282)*			
Undocumented × post-spring 2002	0.216	-0.550	-0.907	0.151	-0.539	-1.482	0.892	0.989	0.056
	(0.386)	(0.286)+	(0.148)**	(0.316)	(0.592)	(0.307)*			
Test of equality (*p*-value):	0.069	0.170	0.872	0.359	0.448	0.296			
Fall 2001 undocumented mean	8.4	8.7	11.3	4.9	7.1	7.6			
Observations	12,365	15,914	10,395	9,221	8,625	4,961			

Source: CUNY administrative data. *Notes*: See Table 2 notes for sample definition and specification. Each numbered column within a panel contains estimates from separate regressions; *p*-values from tests of equality of coefficients across degree programs for a given entry cohort displayed in the last three columns. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. Student by semester observations are dropped following degree receipt.

Table A.6: Heterogeneity in Effects by Entry Year: Fall Entrants Only

	(1) 1999	(2) 2000	(3) 2001	Test of eq. (*p*- value)
A. Reenrollment				
Undocumented × spring 2002	-0.039	-0.070	-0.084	0.215
	(0.020)+	(0.021)**	(0.018)**	
Undocumented × post-spring 2002	-0.021	-0.023	-0.073	0.086
	(0.021)	(0.024)	(0.018)**	
Test of equality (*p*- value)	0.380	0.077	0.549	
Fall 2001 undocumented mean	0.70	0.78	1	
Impact in % change: spring 2002	-6%	-9%	-8%	
Impact in % change: post-spring 2002	-3%	-3%	-7%	
Observations	18,303	22,080	15,356	
B. Credits earned				
Undocumented × spring 2002	-0.426	-0.910	-0.928	0.193
	(0.202)+	(0.230)**	(0.354)*	
Undocumented × post-spring 2002	0.038	-0.535	-1.072	<0.001
	(0.248)	(0.315)	(0.155)**	
Test of equality (*p*- value):	0.171	0.264	0.642	
Fall 2001 undocumented mean	7.3	8.3	10	
Impact in % change: spring 2002	-6%	-11%	-9%	
Impact in % change: post-spring 2002	1%	-6%	-11%	
Observations	18,303	22,080	15,356	

Source: CUNY administrative data. *Note*s: Sample includes first-time CUNY noncitizen undergraduate degree seeking senior college students who earned a high school diploma or GED from New York State belonging to the Fall 1999 through Fall 2001 entering cohorts. Students entering in spring semesters are excluded. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. See Table 2 notes for additional covariates and specification. Student by semester observations are dropped following degree receipt.

Table A.7: Heterogeneity in Effects on Reenrollment by Entry Year: CUNY and non-CUNY Institutions

	(1) 1999	(2) 2000	(3) 2001	Test of eq. (*p*- value)
Undocumented × spring 2002	-0.033	-0.080	-0.081	0.152
	(0.021)	(0.020)**	(0.017)**	
Undocumented × post-spring 2002	-0.012	-0.030	-0.096	<0.001
	(0.021)	(0.017)+	(0.014)**	
Test of equality (*p*- value)	0.290	0.018	0.397	
Fall 2001 undocumented mean	0.71	0.81	1	
Impact in % change: spring 2002	-5%	-10%	-8%	
Impact in % change: post-spring 2002	-2%	-4%	-10%	
Observations	21,586	24,539	15,356	

Source: CUNY and NSC administrative data. *Note*s: See Table 2 notes for sample definition and specification. Each column within a panel contains estimates from separate regressions. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1. Student by semester observations are dropped following degree receipt.

Table A.8: Changes in Observed Characteristics by Entry Cohort and Documentation

Dependent variable:	Undocumented × 2000 entrant	Undocumented × 2001 entrant
Age	0.035	0.328
	(0.196)	(0.250)
Female	0.025	0.061
	(0.049)	(0.041)
Black	0.001	0.025
	(0.042)	(0.046)
Hispanic	0.045	0.019
	(0.035)	(0.037)
White	-0.031	-0.043
	(0.047)	(0.048)
Single parent	-0.006	0.003
	(0.005)	(0.010)
Needs remediation	-0.023	-0.028
	(0.039)	(0.037)
Disabled	-0.018	-0.026
	(0.019)	(0.018)
High school GPA	0.843	0.657
	(0.828)	(0.681)
Missing HS GPA	-0.005	-0.004
	(0.009)	(0.007)
NYC public high school	0.019	0.036
	(0.035)	(0.028)
GED	-0.026	-0.000
	(0.018)	(0.014)
Test of joint sig. (*p*- val.)	0.731	0.274
Observations		9,798

Source: CUNY administrative data. *Notes*: See Table 2 notes for sample description. Each cell displays the estimated coefficient on the interaction between undocumented status and an indicator for belonging to the 2000 entry cohort or 2001 entry cohort. Regressions also include controls for documentation status, initial degree program, and college by entry cohort fixed effects. Clustered standard errors (institution by cohort) in parentheses; ** p<0.01, * p<0.05, + p<0.1.

Table A.9: Effects of the Price Shock on Degree Receipt from Any Institution

	(1) Any degree	(2) AA/AS degree	(3) BA/BS degree
A. All students			
Undocumented × 2000 entrant	-0.025	-0.007	-0.002
	(0.043)	(0.028)	(0.040)
Undocumented × 2001 entrant	-0.101	-0.044	-0.079
	(0.050)*	(0.029)	(0.046)+
Undocumented mean (1999)	0.53	0.15	0.42
Observations	9,798	9,798	9,798
B. Bachelor's degree-seeking			
Undocumented × 2000 entrant	-0.001	-0.001	-0.003
	(0.059)	(0.025)	(0.061)
Undocumented × 2001 entrant	-0.099	-0.001	-0.119
	(0.068)	(0.025)	(0.068)+
Undocumented mean (1999)	0.59	0.06	0.55
Observations	6,190	6,190	6,190
C. Associate degree-seeking			
Undocumented × 2000 entrant	-0.058	0.002	-0.012
	(0.051)	(0.044)	(0.047)
Undocumented × 2001 entrant	-0.100	-0.110	-0.022
	(0.055)+	(0.053)*	(0.030)
Undocumented mean (1999)	0.43	0.27	0.23
Observations	3,608	3,608	3,608

Source: CUNY and NSC administrative data. *Notes*: See Table 2 notes for sample description. Each column within a panel contains estimates from separate regressions. Reported coefficients are interactions between an indicator for whether a student is an undocumented noncitizen and whether the student belonged to either the 2000 or 2001 entry cohort. Clustered standard errors (institution by cohort) in parentheses; ** $p<0.01$, * $p<0.05$, + $p<0.1$. Regressions include controls for age at entry, high school GPA (set to zero if missing), an indicator for whether a student's high school GPA is missing, indicators for race/ethnicity (Black, Hispanic, or White), documentation, and gender, indicators for whether the student was a single parent, needed remediation, or was disabled at entry, and institution by cohort fixed effects.